CHAPTER – 1

1.0 INTRODUCTION

Information is an amorphous concept, less susceptible to a precise definition. Yet, everyone has to deal with it in many ways throughout one’s life. Indeed, information has been described as the fifth need of man ranking after air, water, food and shelter (Kemp, 1976) (190). Knowledge in general and information in particular become more meaningful when they are transferred and communicated. The concept of “Information” and “Communication” are so coexisting that they are used synonymously without much distinction in common usage and one often implies the other in many situations. Further, information is very closely related to communication. A discussion of the one brings to the fore, the other. The information explodes into power only when it is transferred and communicated. In other words, information is activated by communication (Sridhar, 1995) (366).

The Information Seeking Behaviour (ISB) involves a set of actions that an individual takes to express his/her information needs, seeks, evaluates, choose and uses his/her information. There are various ways and means to acquire variety of information for the various purposes from enumerate services. However, many of these are vary different to get due to various reasons viz knowledge explosion, social factor, population, expensiveness, complex, languages, form, format and geographical location. It is an Information Centre and Library (ICL), which provides any meaningful information from various sources. Consequently, the role of librarians / information officers and ICLs becomes vital to cope with the information on needs of their users. They develop their resources: materials, manpower, money, etc. to achieve above objectives. Hence, it is essential for them to understand the ISB of their users. Consequently, understanding the ISB of various professional groups is essential to help in planning, operation, implementation and decision making of information system and services in given work settings. Therefore user’s ISB should be taken into consideration.

ICLs are integral part of education, R&D viz research & development organization, education institution, university, etc. It not only organizes to meet the information needs of scientists, faculty, users, and staff but also supports to achieve the objectives of institute and
research needs of its users. Last few decades have witnessed the alarming changes in the higher education and research centres. Consequently, pressure has been exerted upon the traditional role of ICLs. There are three main components of information seeking behaviour (Information, seeking and behaviour), which have been expressed as acronym “ISB” to argue in this research study.

**Information** (in *Cambridge Advanced Learner’s Dictionary, 2009*) (60) has been defined, “Facts about situation, person, events, etc”. However when it is disseminated to users is known as information. Information is considered as a valuable key resource towards the development of a nation.

**Seek (ing)** (in *Cambridge Advanced Learner’s Dictionary, 2009*) (60) refers “To try to find or get something, especially something which is not a physical object”.

**Behaviour** (in *Cambridge Advanced Learner’s Dictionary, 2009*) (60) refers “Someone's behaviour is how they behave”.

Here behaviour refers to the behavioural aspect of users, while seeking refers to know/ learn the tricks methodology and techniques to get the pinpointed information. However, information refers to the professional knowledge/information that allows ICLs users to think and act in a professional manner. The main contribution of the ISB in this study is ability to view the domain from a new perspective to reflect expectations of users as well as Library and Information Science (LISc) professionals. The ISB of users of academic ICLs as well as librarians have been changed due to IT based ICL services, resources and systems, in developed and developing countries more quickly. Knowledge, skills and attitudes enhance people's ability to meet their basic needs, widen the range of options opened to them in every sphere of life. At the same time users, as well as librarians raised their level of ISB of new IT through various education programmes, professional trainings.

The last few decades’ libraries have undergone significant changes due to the application of ICT, especially academic sectors, which has exerted pressure upon the role of academic libraries and librarians. We now live in a knowledge society, one where access to information and proficiency with Information Technology (IT) are not only helpful but also become inseparable part of life. The knowledge enhances people’s ability to cope with their basic needs, widen the range of options in every walk of life. It includes not only education and trainings but also ability gain through work and experiences. The ISB of users is widely
accepted as one of the major developments in the current scenario of LISc. The techniques of seeking are depending upon the personality, matter, energy, space and time (past, and present), which differs from person to person, subject to subject. However, attitudes (integration of thought, feeling and deed), which are relatively enduring organization of beliefs around an object or situation predisposing one to respond in some preferential manner. The attitudes are integration of thought, feeling, and deed. How do scientists really discover, select and use the countless information and communications resources available to them? Studying the ISB of scientists has been one of the main concerns of librarians and information scientists at least since the Royal Society Scientific Information Conference (Royal Society, 1948) (322). As information technologies, which nowadays are major means of information service provision, develop, information services are improved and as a result information seeking activities of scientists go through changes and adjustments. This is a cycle, where research on ISB of scholars leads to better and improved information services might make the scholars alter their information seeking activities and behaviour, hence the need for continuous study of the ISB of scholars is necessary (Jamali and Nicholas, 2008) (178). Physics and astronomy, two closely associated fields, are among those that embraced the use of digital technology in their information systems and services. Physicists are renowned for having one of the, apparently, most efficient information systems (Nicholas et al, 2005) (267). Understanding the information needs, ISB, and information use of academic science users (e.g., researcher, educator, planner, decision maker, administrator and supervisor) are challenging. This task becomes more complicated, when we consider that they are likely to perform several functions, simultaneously. Consequently, their interests and needs change with time, and that technological advances continuously affect, how they find and use information (Kuruppu and Gruber, 2006) (214).

Scientists in the field of Astronomy and Astrophysics (AA) are working under many constraints, contrary to other scientists of R & D. The AA has exploded in recent years, branching into innumerable specialties. The basic goal of this study is to obtain a clear view of what, how, why, when and where to seek information by the AA users. The AA scientists seek and use information in various ways, means for different purposes in the changing scenario of IT based digital information services. However, due to various aspects
of IT as well as resources, changes in the ISB among the AA scientists have also been noticed. Knowledge about information needs and seeking behaviour to cope with the users’ needs is a crucial factor, especially in the scientific community. Consequently, they must be supported with pinpointed, proper information, at proper time. Users’ study is an area in LISc and forms a large body of literature in the discipline. Academic librarians can play a crucial role in this endeavour by providing scholarly library resources and services to fulfil the complex needs of scholars in AA and related disciplines. In order to achieve these objectives as well as responsibilities, it is essential for information officers, librarians working in Science and Technology (S&T) subjects to have a thorough knowledge, understanding of the research and teaching philosophies, activities and trends in these disciplines. It is equally important for AA information officers, librarians to have an understanding of the information needs and ISB of these scientists as well as how their needs and behaviours changes due to the dynamic and specialized nature of their respective scientific fields from time to time in the Information and Communication Technology (ICT) environment. Librarians and other information professionals have to examine the ways in which science scholars articulate their information needs, as well as how they seek and use information (Kuruppu and Gruber, 2006) (214). Hence the present study.

1.1 ASTRONOMY AND ASTROPHYSICS – GLOBAL SCENARIO

Astronomy and Astrophysics (AA) are branches of physics. Although both are different discipline, however are interrelated and interdependent. Although the study is related to LISc but it is worth here to indicate an overview of the subject and various important terminology going too used for the study frequently.

1.1.1 ASTRONOMY

Astronomy involves the observation of processes and interactions occurring in space. The “heavenly bodies” or the celestial objects are in continuous motion. This often leads to the different reactions in space. These reactions results in the formation of rays and sparks in the universe. The word astronomy means “law of stars”. Astronomy is one of the oldest sciences. Astronomers of early civilizations performed methodical observations of the night sky, and astronomical artefacts have been found from much earlier periods. However, the
invention of the telescope was required before astronomy was able to develop into a modern science. Historically, astronomy has included disciplines as diverse as astrometry, celestial navigation, observational astronomy, the making of calendars, and even astrology, but professional astronomy is nowadays often considered to be synonymous with astrophysics (Astronomy XL, 2009) (17).

1.1.2 HISTORY OF ASTRONOMY

Astronomy was invented by people even before the birth of Jesus Christ and at that time people used to observe night sky with naked eyes from tall buildings, trees and high grounds. Slowly the concept of astronomy was developed and slowly people invented telescope. In its early days, observation and prediction of movement of celestial objects were the main parts of astronomy but with the advancement of science and technology, the scope of working on astronomy has been broadened significantly. Scientists around the world now practice different types of astronomy (Astronomy XL, 2009) (17). Further details about Indian scenario have been explained in a section 1.3 of this chapter.

1.1.3 TYPES OF ASTRONOMY

Astronomy is one of the oldest sciences in the world and also one of the greatest scientific inventions by human being. Astronomy is a wonderful scientific study that let us know about the atmosphere in outer space and movement of planets and galaxies in the solar system. There are two type of astronomy. They are: observational astronomy and theoretical astronomy.

1.1.3.1 OBSERVATIONAL ASTRONOMY

Astronomy is a diverse field and there are interesting divisions within the subject. Among the different branches of astronomy, observational astronomy is one of the most significant divisions. It deals with the movement of celestial objects and the study of this field helps in the prediction of lunar and solar eclipse. The study of observational astronomy is of great relevance for astronomers and scientists. In astronomy, information is mainly received from the detection and analysis of visible light or other regions of the electromagnetic radiations. Observational astronomy may be divided according to the
observed region of the electromagnetic spectrum. Some parts of the spectrum can be observed from the Earth's surface, while other parts are only observable from either high altitudes or space (Astronomy XL, 2009) (17). Specific information on these sub fields is given below.

1.1.3.1.1 RADIO ASTRONOMY

By looking through the lens of telescope people achieved an idea about the shape and look of planets. But after a long time, scientists observed that the celestial objects in outer space emit radio waves and thus they started working on it consequently radio astronomy became an important wing of astronomical observations. Radio astronomy studies radiation with wavelengths greater than approximately one millimetre (Cox, 2000) (68). Radio astronomy is different from most other forms of observational astronomy in that the observed radio waves can be treated as waves rather than as discrete photons. Hence, it is relatively easier to measure both the amplitude and phase of radio waves, whereas this is not as easily done at shorter wavelengths (Cox, 2000) (68). The basic objective of radio astronomy is to catch the wavelength of radio waves emitted by celestial objects and studying them to acquire data about the atmosphere in outer space. By using different techniques and technologies that are similar to optical astronomy, scientists discovered that not only radio waves but also most of the celestial objects in outer space emit optical waves. The telescopes used for radio astronomy are larger in size than that used in observational astronomy for observing longer wavelengths (Astronomy, 2008) (18).

1.1.3.1.2 INFRARED ASTRONOMY

Infrared astronomy is one of the most significant branches of astronomy, which deals with detection of objects visible in infrared radiation. It is the branch of astronomy and astrophysics, which involves the study of everything that has a temperature and radiates in the infrared. It is the study of the heat energy or radiation emitted from objects in the universe and deals with the detection and analysis of infrared radiation (wavelengths longer than red light). Except at wavelengths close to visible light, infrared radiation is heavily absorbed by the atmosphere, and the atmosphere produces significant infrared emission. Consequently, infrared observatories have to be located in high, dry places or in space. The
infrared spectrum is useful for studying objects that are too cold to radiate visible light, such as planets and circumstellar disks. Longer infrared wavelengths can also penetrate clouds of dust that blocks visible light, allowing observation of young stars in molecular clouds and the cores of galaxies (Juste, 2004) (186). Some molecules radiate strongly in the infrared, and this can be used to study chemistry in space, as well as detecting water in comets (Roth, 1932) (318).

1.1.3.1.3 OPTICAL ASTRONOMY

Optical astronomy is a significant branch of astronomy that studies objects which are sensitive in the range of visible light. Most of the scientists also prefer to call this visible light astronomy. It is of immense relevance to astronomers as it enables them to measure the amount of light that is emitted from an object. Optical astronomy involves the detection of objects visible in infrared and ultraviolet wavelengths. Optical images were originally drawn by hand. In the late nineteenth century and most of the twentieth century, images were made using photographic equipment. Modern images are made using digital detectors, particularly detectors using Charge-Coupled Devices (CCDs). Although visible light itself extends from approximately 4000 Å to 7000 Å (400 nm to 700 nm) (Moore, 1997) (261) the same equipment used at these wavelengths is also used to observe some near-ultraviolet and near-infrared radiation (Astronomy, 2008) (18).

1.1.3.1.4 ULTRAVIOLET ASTRONOMY

Ultraviolet astronomy forms an important branch of astronomy that involves the study of celestial bodies by means of the ultraviolet radiation (UV) emitted from this object. It deals with those objects that emit ultraviolet range of electromagnetic radiation. Ultraviolet astronomy is one of the most useful scientific studies as it provides relevant information about processes in interstellar matter, the sun and other objects emitting UV radiation. It can be more simply said as the study of cosmic objects emitting ultraviolet radiations. The study of celestial ultraviolet emissions is done with the use of artificial satellites. The study of heavenly bodies by observing the ultraviolet radiation became easy when rockets could carry instruments in the space. Rockets, once send above the earth’s atmosphere, had the capacity to absorb most of the electromagnetic radiation of the UV
wavelengths. The main aim of ultraviolet astronomy is to study objects that are within ultraviolet wavelengths ranging from about 90 to 350 nanometres, as light of these wavelengths are absorbed by the atmosphere of the earth and observations of these wavelengths are performed from upper atmosphere or space (Astronomy, 2008) (18).

1.1.3.1.5 X-RAY ASTRONOMY

X-ray astronomy involves the study of X-ray emission from celestial objects. It is an important component of observational astronomy. X rays can penetrate the air at least for distances of few meters. Astronomers can observe x- rays emitted by cosmic sources with the help of X-ray astronomy. X-ray astronomy is the study of astronomical objects at X-ray wavelengths. Typically, objects emit X-ray radiation as synchrotron emission (produced by electrons oscillating around magnetic field lines), thermal emission from thin gases (called bremsstrahlung radiation) that is above 10^7 (10 million) Kelvin, and thermal emission from thick gases (called blackbody radiation) that are above 10^7 Kelvin (Cox, 2000) (68). Since X-rays are absorbed by the Earth's atmosphere, all X-ray observations must be done from high-altitude balloons, rockets, or spacecraft. Notable X-ray sources include X-ray binaries, pulsars, supernova remnants, elliptical galaxies, clusters of galaxies, and active galactic nuclei (Cox, 2000) (68). Detailed study and research on X-ray emission from celestial objects is the main aim of X-ray astronomy. Unlike optical, radio and infrared radiation, X-ray radiation is observed by earth's atmosphere and that is why instruments of X-ray astronomy are kept on higher altitudes. Earlier X-ray instruments were attached to balloons and sounding rockets but now X-ray detectors are kept in satellites. X-ray astronomy has now become an important part of space research (Astronomy, 2008) (18).

1.1.3.1.6 GAMMA-RAY ASTRONOMY

Astronomy is the science of studying the changes in the astronomical world or what is known to us as the “heavenly bodies”. Gamma rays are high energy photons that have no mass and are devoid of any charge. The heavenly bodies are in constant motion in space, while in motion there are a lot of interactions which leads to emission of rays. This is how gamma rays are created and this leads to a branch of astronomical study, which is known as gamma-ray astronomy. Most gamma-ray emitting sources are actually gamma-ray bursts,
objects which only produce gamma radiation for a few milliseconds to thousands of seconds before fading away. Only 10% of gamma-ray sources are non-transient sources. These steady gamma-ray emitters include pulsars, neutron stars, and black hole candidates such as active galactic nuclei (Cox, 2000) (68).

1.1.3.2 THEORETICAL ASTRONOMY

Theoretical astronomy is the study of the space, cosmos and one of the branch of sciences that let common man have a proper understanding of astronomical objects. It concentrates on the development of computer or computer aided models to implement in the study of astronomical objects and phenomena. Theoretical astronomers use a wide variety of tools which include analytical models (for example, polytropesto approximate the behaviours of a star) and computational numerical simulations. Each has some advantages. Analytical models of a process are generally better for giving insight into the heart of what is going on. Numerical models can reveal the existence of phenomena and effects that would otherwise not be seen (Roth, 1932) (318). Theoretical astronomy has been divided in sub fields are given below:

1.1.3.2.1 SOLAR ASTRONOMY

Solar astronomy is the scientific study of the solar system and the solar atmosphere. Sun is a significant part of our solar system. It contains mass of all planets, asteroids and meteoroids. Scientists are curious to understand the various processes and activity taking place in the Sun. Solar astronomy enables scientists to study various processes involving sun. Solar astronomy deals with solar atmosphere and the various activities involved in the solar system. The interior of the sun is made up of the central core, the radioactive zone and the convection zone. Photosphere, the chromospheres and the Corona constitute the solar atmosphere. Solar astronomy is the study of various zones and the structure of the sun. Solar astronomy is an important part of astronomy that deals with studying and observing activities taking place in and around the sun. Long time back ancient scientist, Copernicus explained that the sun rotates around the earth. But later Italian scientist, Galileo proved this theory to wrong and explained that it is actually the opposite. Sun is static and not only earth but all other planets rotate around the sound in a fixed orbit (Astronomy XL, 2009) (17).
1.1.3.2.2 PLANETARY SCIENCE

Planetary science is the study of planets and planetary systems. It is an interdisciplinary approach which consists of facts derived from diverse sciences. There are diverse forms of astronomy and different branches. Among the various disciplines, planetary science is an important science. It is also considered as planet logy and related to scientific study of planets. Planetary science or better known as planet logy is basically related to the planetary astronomy and is considered to be the science which deals with planets or planetary systems and also the solar system. In order to understand the planetary system one need to incorporate non-stellar objects such as asteroids, comets, moons, cosmic dust, planets, and meteoroids. The science of planets also encompasses the solar system and the sun (Astronomy XL, 2009) (17).

1.1.3.2.3 EXTRAGALACTIC ASTRONOMY

Extragalactic astronomy is a study of heavenly bodies, which are discovered outside our own galaxy (Milky Way). This branch of astronomy is the counter part of the galactic astronomy, where all the objects within our galaxy are studied. Extragalactic astronomy encompasses in its purview the study of celestial bodies which are not covered by galactic astronomy. There are more than a hundred billion galaxies in the universe, which fall under the observable horizon of our technology. Be it the elliptical galaxy, the spiral galaxy, the peculiar galaxy or the starburst galaxy, all are in constant motion and the study of these heavenly bodies gives us deep insight about the working of the universe (Astronomy XL, 2009) (17).

1.1.3.2.4 COSMOLOGY

Cosmology is the branch of theoretical astronomy that concerns with the objects and areas belonging to human settlement. It can be considered as the study of universe as a whole. Cosmology originates from the Greek word and it is the study of the universe in its totality. Cosmology could be considered the study of the universe as a whole. Observations of the large-scale structure of the universe, a branch known as physical cosmology, have provided a deep understanding of the formation and evolution of the cosmos. Fundamental
to modern cosmology is the well-accepted theory of the big bang, wherein our universe began at a single point in time, and thereafter expanded over the course of 13.7 Gyr to its present condition. The concept of the big bang can be traced back to the discovery of the microwave background radiation in 1965.

1.1.3.2.5 AMATEUR ASTRONOMY

Amateur astronomy is a section of astronomy, which deals with the understanding of theories related to celestial objects and the cosmic sources. It is done by people, who have not made it as their profession but they have taken it as a hobby. The night sky is the chief medium for these amateur astronomers to study the celestial objects and events related to them. Amateur astronomy is a subdivision of astronomy, where amateur astronomers enjoy observing celestial objects. Amateur astronomers can build their own equipment, and can hold star parties and gatherings. Collectively, amateur astronomers observe a variety of celestial objects and phenomena sometimes with equipment that they build themselves. Common targets of amateur astronomers include the moon, planets, stars, comets, meteor showers, and a variety of deep-sky objects such as star clusters, galaxies, and nebulae. One branch of amateur astronomy, amateur astrophotography, involves the taking of photos of the night sky. Many amateurs like to specialize in the observation of particular objects, types of objects, or types of events which interest them (Lodriguss, 2003) (226).

1.1.4 RELATIONSHIP OF INTERDISCIPLINARY SUBJECTS AND ASTRONOMY

The various branches of astronomy include observational astronomy and theoretical astronomy; however astronomical branches are interrelated and interdependent and are also complimented by each other. The data obtained by observation finds application in theoretical analysis. Now astronomy has become an inter discipline due to its applications in other branches of science and technology. The calculation of distances between celestial bodies, the analysis of chemical reactions and physical processes in outer space is all related to both these branches of astronomy. The analysis of data and subsequent processing through theoretical calculations involve expertise in certain fields. Chemistry, physics, mathematics and biology are the scientific fields, which are related to the study of
astronomy (Astronomy XL, 2009) (17). This in turn has lead to the formation of other various branches of astronomy based on the scientific field of specialization are given below.

1.1.4.1 ASTROBIOLOGY

One of the significant facets of natural sciences, astrobiology comes under the broader segment of theoretical astronomy. It mainly deals with the study of life outside the space or the universe. It has been coined as study of natural philosophy by the eminent celestial scientist David Grinspoon. Astrobiology is an interdisciplinary approach towards the universe and combines various aspects such as astronomy, biology and geology. It is largely based on hypothesis and scientific inquiry. Astrobiology makes profound use of physics, biology, biochemistry, philosophy and geology to speculate about the nature of life on other forms of life outside the earth. It is an evolving subject that concerns itself with the question as to whether life exists outside the universe (Astronomy XL, 2009) (17).

1.1.4.2 ASTROMETRY

Astrometry is an important branch of astronomy. It is the significant branch of science that refers to the specific and meticulous measurements and explanations of the positions and the various movements of the stars and the other celestial bodies. Astrometry is the study, which is related to calculations, measurements and explanations of the positions and movements of stars and celestial bodies (Astronomy XL, 2009) (17). Astrometry is the field of science that deals with the measurement of celestial bodies with respect to each other. The position of a particular object in space is determined through calculations. The field in astronomy in which this branch finds application includes: Galactic astronomy, stellar dynamics and celestial mechanics.

1.2 ASTROPHYSICS

Astrophysics is the branch of astronomy that deals with the physics of the universe, including the physical properties (luminosity, density, temperature, and chemical composition) of celestial objects such as galaxies, stars, planets, exo-planets, and the interstellar medium, as well as their interactions. The study of cosmology is theoretical
astrophysics at scales much larger than the size of particular gravitationally-bound objects in the universe. Because astrophysics is a very broad subject, astrophysicists typically apply many disciplines of physics, including mechanics, electromagnetism, statistical mechanics, thermodynamics, quantum mechanics, relativity, nuclear and particle physics, and atomic and molecular physics (Astrophysics, 2008) (19). Astrophysics is again divided under sub categories— theoretical astrophysics and analytical astrophysics. The study of physical cosmology is a wing of theoretical astrophysics and all observations of the cosmos and the energies involved in cosmology are included in the study of physical cosmology. Some of the major studies in astrophysics include the phenomenal gravitation theory. Gravitation, which is a natural phenomenon and a very common and familiar phenomenon, is the mass attraction that exists between two objects. Not only endowing the objects its weight, Gravitation is also responsible for keeping the earth and the other planets in their orbits around the sun, for keeping the moon in its orbit around the earth, for the formation of tides, for convection and for various other scientific observations. Modern astrophysics describes gravitation using the general theory of relativity and in this respect Newton's law of universal gravitation is an important scientific inference (Astrophysics, 2008) (19). It is the study of physical properties of the universe. It is a significant branch of science that contributes towards a better understanding of the origin, form and evolution of celestial bodies.

1.3 ASTRONOMY AND ASTROPHYSICS – INDIAN SCENARIO

Ancient Indian astrology is based upon sidereal calculations. The sidereal astronomy is based upon the stars and the sidereal period is the time that it takes the object to make one full orbit around the Sun, relative to the stars. It can be traced to the final centuries BC with the Vedanga Jyotisha attributed to Lagadha, one of the circum-Vedic texts, which describes rules for tracking the motions of the sun and the moon for the purposes of ritual. After formation of Indo-Greek kingdoms, Indian astronomy was influenced by Hellenistic astronomy (adopting the zodiacal signs or rāśis) (Astronomy, 2008) (18). Around 500 CE, Aryabhata presented a mathematical system that took the earth to spin on its axis and considered the motions of the planets with respect to the sun. He also made an accurate approximation of the earth's circumference and diameter, and also discovered how the lunar
eclipse and solar eclipse happen. He gives the radius of the planetary orbits in terms of the radius of the earth/sun orbit as essentially their periods of rotation around the sun. He was also the earliest to discover that the orbits of the planets around the sun are ellipses (Pannekoek, 1989) (286).

Brahmagupta (598-668) was the Head of the astronomical observatory at Ujjain and during his tenure, he wrote a text on astronomy, the Brahmasphutasiddhanta in 628. He was the earliest to use algebra to solve astronomical problems. He also developed methods for calculations of the motions and places of various planets, their rising and setting, conjunctions, and the calculation of eclipses. Bhaskara (1114-1185) was the Head of the astronomical observatory at Ujjain, continuing the mathematical tradition of Brahmagupta. He wrote the Siddhantasiromani, which consists of two parts: Goladhyaya (sphere) and Grahaganita (mathematics of the planets). He also calculated the time taken for the earth to orbit the sun to 9 decimal places. Other important astronomers from India include Madhava, Nilakantha Somayaji and Jyeshtadeva, who were members of the Kerala school of astronomy and mathematics from the 14th century to the 16th century. The Buddhist University of Nalanda offered formal courses in astronomical studies (Astronomy, 2008) (18).

1.4 ASTRONOMY AND ASTROPHYSICS INFORMATION CENTRES AND LIBRARIES IN INDIA

There are twelve important organizations/institutions mentioned in the Figures: 1.4.3 & 1.5.5 offering research academic activities in India. It is expected that there are more than 400 users of ICLs to seek their information in AA organizations in India. Consequently, the scope of this study is limited to AA ICLs in India. The ICL services are becoming essential to all type of users in such organizations. However, benefits that are gained by each type of users are required to be pointed out separately. Therefore, different types of users their need and their ways of seeking information have been identified and studied. Furthermore, to what extent they get information from sources other than libraries. The study has also pointed out reasons for not using to the library and to suggest further improvements. The Inter-University Centre for Astronomy and Astrophysics (IUCAA), which is a leading centre in Astronomy library in India is chosen as main sources with the following others Astronomy libraries (Sahu, 2004) (326).
During 1980s, there was tremendous growth of scientific and technical literature and AA were not exception to it. Due to proliferation of information, librarians working in astronomical institutes felt the need of coming together and join hands in sharing information held in each library. As a result, Forum for Resource Sharing in Astronomy and Astrophysics (FORSA, 2008) (109) was informally launched on July 29, 1981 during Astronomy Librarians meeting held at Raman Research Institute, Bangalore, with a mission and vision to share and exchange information and make best use of available library resources (Patil, 2004) (291, 292). In the present day context, the objectives of FORSA twenty institutional members are redefined in order to cope with changing information handling scenario (Patil, 2006) (293).

1.4.1 FORUM FOR RESOURCE SHARING IN ASTRONOMY AND ASTROPHYSICS (FORSA)

There was tremendous growth and proliferation of literature during 1970s and 1980s particularly in the field of astronomy and astrophysics. It was difficult to manage literature demand within an organization. Most of the Indian astronomy libraries were in the formative years with limited budget and resources at their disposal. In order to share and cooperate amongst the astronomy community libraries in the country, the library professionals felt the need to come together and exchange information on continuous basis. This necessitated forming the Forum for Resource Sharing in Astronomy and Astrophysics (FORSA, 2008) (109), which saw it’s on 29th July 1981 with a mission and vision to participate actively in library cooperation, information exchange and sharing resources held in each library (Patil, 2008) (294).

1.4.2 OBJECTIVES OF FORSA

Keeping in view recent developments in information handling activities, the objectives were redefined as mentioned below (Patil, 2004) (291):

- Collection Development in IT environment;
- Facilitate e - access to journals and books;
- Actively participate in resource sharing, interlibrary loan and document delivery;
- To facilitate access to each library websites;
- Database merging of libraries holdings (books/journals) and facilitate access to merged databases;
- Digitisation of archival materials of the institutes and making the same accessible through Internet;
- Participate actively in consortia formation for sharing e - journals; e - books and other databases with various publishers and academic societies;
- To come forward and support Open Access and develop Institutional Repositories.

1.4.3 FORSA MEMBERS

It is worth to give a brief over view of the members and their activities, which are directly related to information seeking behaviour of the users.

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<td>Mittal-Chandra Research Institute (BCI), Chhatnag Road, Jharu Allahabad 211 019, India Phone: +91-532-2560509 Fax: +91(256)2567 748, 2567 444 E-mail: <a href="mailto:root@asneternet.in">root@asneternet.in</a> URL: <a href="http://www.asneternet.in">http://www.asneternet.in</a></td>
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<td>Raman Research Institute (MRI), C. V. Raman Avenue, Sadashivnagar, Bangalore - 560 080, India, Phone: (80) 23810122 Fax: (80) 22610492, E-mail: <a href="mailto:root@mriren.in">root@mriren.in</a> URL: <a href="http://www.mriren.in">http://www.mriren.in</a></td>
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<td>4</td>
<td>Indian Institute of Astrophysics (IIA), II Block, Koramangala, Bangalore 560 034, INDIA, Tel. 91 (80)2552 0822 Fax. 91 (80) 2553 4022 E-mail: <a href="mailto:root@iiaernet.in">root@iiaernet.in</a> URL: <a href="http://www.iiaernet.in">http://www.iiaernet.in</a></td>
<td></td>
<td>10</td>
<td>Tata Institute of Nuclear Physics (SINP), 1/AF, Bidhan Nagar, Kolkata 700 064, India Phone:+91-33-2337-2345 Fax: +91-33-2337-2467</td>
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<tr>
<td>5</td>
<td>Inter University Centre for Astronomy and Astrophysics (IUCAA), Post Bag 4, Ganeshkhind, Pune University Campus, Pune-411 007, India Tel: +91 20 2560 4100, Fax: +91 20 2560 4699, E-mail: <a href="mailto:root@iucaaiernet.in">root@iucaaiernet.in</a> URL: <a href="http://www.iucaaiernet.in">http://www.iucaaiernet.in</a></td>
<td>IUCAAI</td>
<td>11</td>
<td>S N Bose National Centre For Basic Sciences (SNBCBS), JD Block, Sector III, Salt Lake City, Kolkata 700098, India Phone: +91-33-2335 3706 Fax: +91-33-2335 3477 E-mail: <a href="mailto:scott@bose.res.in">scott@bose.res.in</a> URL: <a href="http://www.bose.res.in">http://www.bose.res.in</a></td>
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<td>6</td>
<td>National Centre for Radio Astrophysics (NCRA-TIFR), Pune University Campus, Post Bag 1, Ganeshkhind P.O., Pune 411 007, Maharashtra, INDIA Tel. +91 20 25719000, Fax: +91 20 2592148 E-mail: <a href="mailto:root@ncratifrernet.in">root@ncratifrernet.in</a> URL: <a href="http://www.ncratifrernet.in">http://www.ncratifrernet.in</a></td>
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<td>Tata Institute of Fundamental Research (TIFR), Homi Bhabha Road, Mumbai 400 005, India Tel: +91 22 2269 2200 Fax: +91 22 2249 4610, E-mail: <a href="mailto:webmaster@tifr.res.in">webmaster@tifr.res.in</a> URL: <a href="http://www.tifr.res.in">http://www.tifr.res.in</a></td>
<td></td>
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<tr>
<td>A</td>
<td>Members of Astronomical Society of India, India</td>
<td></td>
<td>B</td>
<td>Users from Department of Physics, Astronomy and Astrophysics of various Universities/Colleges of India</td>
<td></td>
</tr>
</tbody>
</table>

Figure-1.4.3: Astronomy Information Centres and Libraries in India.
1.4.3.1 ARYABHATTA RESEARCH INSTITUTE OF OBSERVATIONAL SCIENCES (ARIES), NAINITAL

Aryabhata Research Institute of Observational Sciences (ARIES) is an autonomous institute devoted to research and development in Astronomy & Astrophysics and Atmospheric Sciences. The Institute is funded by the Department of Science and Technology (DST), Government of India for front line researches in astronomy, astrophysics and atmospheric physics and related areas. It offers challenging opportunities to motivated researchers in theory, observation and instrumentation. ARIES having around 60 academic community included faculty members, scientists, post-doctoral fellows and visitors of institute which are involved in research and development activities of ARIES in the field of astronomy and astrophysics can be classified into the following areas as aster seismology, binary stars, galactic and extra-galactic astronomy, instrumentation for astronomy, polarization, dust, solar system, star-formation, stellar evolution in galactic star forming regions, Transient objects - gamma-ray burst, supernovae, variable stars, solar physics and atmospheric science (ARIES, 2008) (16).

1.4.3.2 BOSE INSTITUTE, KOLKATA

Bose Institute is one of the few multi-disciplinary institutions in the country that has succeeded in developing a vast intellectual resource in areas ranging from astrophysics, radiation physics, and quantum mechanics to the frontline areas of contemporary biology such as bio informatics & computational biology, structure and functional dynamics of bio molecules, drug modelling, molecular genetics of microbes, development of transgenic plants etc. Based on the enduring development of scientific expertise for 85 years, the institute has scripted a programme of research for 10th five year plan that will allow it to retain the competitive edge in the 21st Century. Moreover, the steady high rate of peer reviewed publications from the institute and individual achievements of scientists in their respective area of specialization is a testimony of the excellent overall performance and thus warrants continuation of the research activities of the Institute. Bose Institute having around 50 academic staff included faculty members, scientists, post-doctoral fellows and visitors of institute (Bose Institute, 2008) (39).
1.4.3.3 HARISH-CHANDRA RESEARCH INSTITUTE (HRI), ALLAHABAD

The Harish-Chandra Research Institute (HRI) is an institution dedicated to research in mathematics, and in theoretical physics. It is located in Allahabad, India, and is funded by the Department of Atomic Energy, Government of India. Research at HRI is focused on mathematics and theoretical physics. The academic community at HRI consists of over 30 faculty members, 20 post-doctoral fellows, and 40 graduate students. The physics group at Harish-Chandra Research Institute (HRI) consists of four major sub groups, astrophysics, condensed matter physics, high energy physics and string theory. Each group conducts research in various subtopics, viz., correlated electron systems, large scale structures, microscopic systems, N-body simulations, neutrino physics, quantum chromo dynamics, quantum field theory in curved space-time, spintronics, string theory and super symmetric field theories (Harish-Chandra Research Institute, 2008) (152).

1.4.3.4 INDIAN INSTITUTE OF ASTROPHYSICS (IIA), BANGALORE

The Indian Institute of Astrophysics is a premier institute devoted to research in astronomy, astrophysics and related physics. The main campus of the institute is in Koramangala, Bangalore, whereas the Hosakote campus, near Bangalore houses the Centre for Research and Education in Science and Technology (CREST). The main observing facilities of the Institute are located at Gauribidanur, Hanle, Kavalur and Kodaikanal. IIAP having more than 300 academic community included faculty members, scientists, post-doctoral fellows and visitors of institute which are involved in research and development activities of IIAP in the field of astronomy and astrophysics can be classified into the following areas such sun, solar system research, stellar physics, galactic astronomy, high energy astrophysics, cosmology, solar terrestrial physics, instrumentation, space astronomy, stellar astronomy, galactic star forming regions, young stellar objects and sub stellar objects, peculiar and variable stars, stellar atmospheres - chemical abundances of late type stars, transient objects - novae, supernovae, gamma-ray burst sources, chemo dynamics and structure of the galaxy extragalactic astronomy and cosmology and theoretical astrophysics and physics (Indian Institute of Astrophysics, 2008) (172).
1.4.3.5 INTER-UNIVERSITY CENTRE FOR ASTRONOMY ASTROPHYSICS (IUCAA), PUNE

The Inter-University Centre for Astronomy and Astrophysics (IUCAA) is an autonomous institution set up by the University Grants Commission (UGC) of India to promote the nucleation and growth of active groups in astronomy and astrophysics at Indian universities. IUCAA aims to be a centre of excellence within the university sector for teaching, research and development in astronomy and astrophysics (IUCAA, 2008) (174). IUCAA's activities fall under two broad programmes: core academic programmes and visitor academic programmes. Core academic programmes include basic research, the PhD programme, advanced research workshops and schools, the giant metre-wave radio telescope and guest observer programmes. Visitor academic programmes include the visitor and associates programme refresher courses for teachers and helping the nucleation and growth of astronomy and astrophysics at Indian universities (IUCAA, 2008) (174). IUCAA is a centre of excellence for teaching and research, and has a beautiful campus, which includes academic facilities as well as residential and recreational areas. The centre consists of about 50 academic members, including faculty, post-doctoral fellows, and graduate students, with potential for growth in the numbers, which are involved in research and development activities of IUCAA in the field of astronomy and astrophysics can be classified into the following areas such as classical and quantum gravity, cosmic magnetic fields, cosmology and large scale structures, galactic and extragalactic astronomy, gravitational waves, high energy astrophysics, instrumentation for astronomy, interstellar medium, optical astronomy, radio astronomy, solar system and stellar physics, virtual observatory, general relativity, optical, ultraviolet, X-ray and radio astronomy, quantum gravity, including string theory (IUCAA, 2008) (174). IUCAA has a vibrant visitors programme, involving short and long-term visits of scientists from India and abroad. IUCAA has 2 m optical telescope (IGO) and a share in the Southern African Large Telescope (SALT) (IUCAA, 2008) (174).
1.4.3.6 NATIONAL CENTRE FOR RADIO ASTROPHYSICS (NCRA), PUNE

The National Centre for Radio Astrophysics (NCRA) of the Tata Institute of Fundamental Research (TIFR) is a leading centre for research in a wide range of areas in astronomy and astrophysics. NCRA also offers exciting opportunities to work in technical aspects relevant for radio astronomy such as analogue and digital electronics, signal processing, antenna design, communication and software development (NCRA, 2008) (266). NCRA has built and operates the Giant Metre wave Radio Telescope (GMRT) which is located approximately 80 km north of Pune, India and is the most powerful radio telescope operating at low radio frequencies. It is a national facility and is being used by astronomers across the world, leading to several significant discoveries. NCRA has also built and operates the Ooty Radio Telescope (ORT) which is a large cylindrical telescope located near Udhagamandalam, India. The NCRA having around 25 academic staff included faculty members, post-doctoral fellows, and research scholars (NCRA, 2008) (266).

1.4.3.7 OSMANIA UNIVERSITY, HYDERABAD

Osmania University is perhaps, the largest higher education system in the country. The department of astronomy in Osmania University has its roots in Nizamia Observatory, which was established in 1908 at Begumpet. The objective of the department of astronomy has been to impart knowledge of AA to the students at the post graduate level with a view to prepare them for higher research in the challenging fields of AA. The department acquired a 48-inch reflecting telescope under the India wheat loan educational exchange programme in 1963. Consequently, a new observatory at Japal - Rangapur village came into existence in 1966 to carry out advanced research in observational astronomy. The department was recognized by the UGC, New Delhi as a Centre for Advanced Study in Astronomy (CASA) in 1964. Department of astronomy is the only department in India which offers AA courses at master’s level and it is the only university department with an observatory with a 1.2 m telescope. The around 25 academic staffs concentrates on research in observational astronomy of binary stars, peculiar stars, pulsating stars, galactic clusters, dynamics of galaxies, binary stars, positional astronomy, radio astronomy, celestial mechanics, galactic dynamics, ionospheric research, study on problems related to colliding and interacting galaxies using analytical methods and N-body simulations. The academic staff of
department of AA of Osmania University having collaborative research programs with other leading scientific organization like Tata Institute of Fundamental Research (TIFR), Mumbai; Inter-University Centre for Astronomy and Astrophysics (IUCAA) and National MST Radar Facility at Tirupati. The modernization of the 48-inch reflector through the computer controlled operations has been undertaken and the work is in progress. With this refurbished telescope the department will enter into a new era of astronomical research (Osmania University, 2009) (280).

1.4.3.8 PHYSICAL RESEARCH LABORATORY (PRL), AHMEDABAD

Physical Research Laboratory (PRL) known as the cradle of space sciences in India. PRL was founded in 1947 by Dr. Vikram Sarabhai as a unit of the department of space, Government of India. PRL carries out fundamental research in select areas of physics, space and atmospheric sciences, AA & solar physics, and planetary and geosciences. Around 50 academic staff involve in the area of research as optical, infrared and the radio wavelength bands to understand some of the outstanding problems related to galactic and extragalactic cosmic phenomena, such as star formation, stellar evolution, interstellar medium, binary stars, pulsars, active galactic nuclei and giant radio galaxies. Solar activity and its impact on space weather are also being studied using radio techniques (PRL, 2008) (303).

1.4.3.9 RAMAN RESEARCH INSTITUTE (RRI), BANGALORE

Raman Research Institute (RRI) was founded by Nobel laureate Sir C V Raman in 1948 with funds from private sources. The main activity of the institute was basic research in selected areas of physics which were of particular interest to Prof. Raman. The institute owes its origin to action of government of Mysore in gifting to the Indian Academy of Sciences (IAS) a plot of land in Bangalore in December 1934. In the year 1956, Prof. Raman made an irrevocable gift to the Indian Academy of Sciences, of various movable and immovable properties for the use and the benefit of the Raman Research Institute. The RRI having around 40 academic staff included faculty members, post-doctoral fellows, and research scholars which are involved areas of research such as AA, Soft Condensed Matter, Theoretical Physics and Light and Matter Physics (RRI, 2008) (323).
1.4.3.10  SAHA INSTITUTE OF NUCLEAR PHYSICS (SINP), KOLKATA

Saha Institute of Nuclear Physics (SINP) institute grew out of the Palit Research Laboratory in Physics of the University Of Calcutta (CU). Professor M N Saha came back from Allahabad in 1938 to succeed Prof. D M Bose in the Palit chair of physics. In the discovery of nuclear fission by Otto Hahn and Fritz Strassman in 1939, he had seen immense potential of nuclear science for betterment of the country. Soon after laying of the foundation stone for the building by Dr Syamaprasad Mookerjee, The Institute of Nuclear Physics was founded in 1949 at Kolkata. Sometime after this the institute was renamed as Saha Institute of Nuclear Physics. The SINP having around 25 academic staffs included faculty members, post-doctoral fellows, and research scholars which are involved areas of research such as biophysical sciences, condensed matter physics, high energy physics, microelectronics, material physics and nuclear Science (SINP, 2008) (357).

1.4.3.11  S N BOSE NATIONAL CENTRE FOR BASIC SCIENCES, KOLKATA

S N Bose National Centre for Basic Sciences (SNBCBS) established in 1986 as an autonomous institution by the Department of Science and Technology (DST), Government of India. SNBCBS has research programme in the following research fields such as material sciences, chemical sciences, biological sciences, macro-molecular sciences, astrophysics, cosmology and having two units that is Advanced Materials Research Unit (AMRU) and unit for Nano science and technology. It has around 40 academic staffs which involved in above said research fields (SNBNCBS, 2008) (358).

1.4.3.12  TATA INSTITUTE OF FUNDAMENTAL RESEARCH (TIFR), MUMBAI

The Tata Institute of Fundamental Research (TIFR) was established in 1945 at the initiative of Dr. Homi Jehangir Bhabha. The institute is proud to have produced many of the finest scientists of India who have been involved in seminal research in fields ranging from mathematics, biology, chemistry, computer science, physics and science education as well as some aspects of public health. There are at present about 400 scientists in the institute working in various disciplines grouped into three major schools: the school of mathematics, the school of natural sciences and the school of technology and computer science. Scientists in the school of natural sciences work mainly in the fields of astronomy and astrophysics,
chemical sciences, condensed matter physics, high energy physics, molecular biology, nuclear and atomic physics, radio astronomy and theoretical physics. The Institute has several field stations and research facilities in different parts of the country. The National Centre for Radio Astrophysics (NCRA), A Giant Meter wave Radio Telescope (GMRT), the largest of its kind in the world, is operational at Khodad near Narayangaon, north of Pune, a large equatorially mounted cylindrical radio telescope and a high energy cosmic ray laboratory are operational at Udhagamandalam in Tamil Nadu, High energy cosmic ray and gamma ray laboratories are operated from Pachamarhi in Madhya Pradesh, The school of mathematics has a centre in Bangalore dedicated to the study of applied mathematics where mathematicians work in the fields of differential equations, harmonic analysis, numerical analysis and probability theory. TIFR runs a national balloon facility in Hyderabad which is among the best in the world and has the geographical advantage of being close to the geomagnetic equator. At Gauribidanur, TIFR scientists have built an extremely sensitive balance to study the difference between gravitational and inertial mass. A heavy ion low energy accelerator capable of accelerating particles to moderate energies for studying heavy ion atomic interactions and a nuclear magnetic resonance facility to study complex molecules are also housed in TIFR. The Institute's dental section has been actively involved in investigations pertaining to carcinogenic effects of tobacco *(TIFR, 2008)* (386).

1.5 DESIGN OF THE STUDY

The detail of the design of study (viz statement of problem, significance, objectives, hypothesis, scope and limitations) has been summarized below:

1.5.1 STATEMENT OF THE PROBLEM / RESEARCH QUESTIONS

The study was proposed to address following main questions:

- What are the networked information seeking strategies of AA scientists/ users in India?
- How can effective networked information seeking strategies are categorized to assist their use in appropriate situations of information need?
What are the important new ICT based services to be added to provide proper information to proper users at proper time in proper form and format, irrespective their geographical location and language?

What are the issue of how AA users will understand and access/adapt to the new ICT based Information Retrieval (IR)?

What are main the reason for considering this issue, in order both to understand the nature of scientist’s/user information seeking goals, and the ways in which they attempt to reach them in their interactions in IR systems?

What are the information needs and seeking behaviour of Indian AA scientists/users engaged with research and reaching in field of AA and to help AA ICLs of India to re-orient their collections, services and facilities to synchronize them with the information needs and seeking behaviour of their scientists/users?

This study is concerned with the above issue of how AA scientists/users will understand and access/adapt to the new ICT based information retrieval (IR). Consequently, it is expected that this study will also investigate the information needs and seeking behaviour of Indian astronomers, scientists, research scholars and users engaged with research in AA. Results may help AA ICLs in India to re-orient their collections, services and facilities to synchronize them with the information needs and seeking behaviour of their scientists.

1.5.2 SIGNIFICANCE (NEED) OF THE STUDY

A scientist is a consumer as well as producer of information as he/she acquires, manipulates, updates, improves and report information. Consequently adequate understanding of the information needs and ISB of users is necessary for the proper planning and improving ICL services in the given work settings. There are several studies that concentrates on the specific subjects or fields in the area. The study of ISB of users especially in developing countries has been a significant and eventful issue from last few decades. It is proposed to study ISB of users in AA ICLs; because knowledge about the information needs and seeking behaviour of users could play a vital role in meeting their information needs effectively. While scientific and technical information continues to grow exponentially, the users/scientists working in AA feels that they are not getting their pinpointed information at proper time. Consequently, the first dimension is to find out the
needs, to know behaviours (Attitudes, Skills and Knowledge) (ASK) of personnel working in AA. Significant changes have been observed in ISB including increased reliance on web based resources, fewer visit ICLs, use and availability of various resources in electronic forms: e-mails, discussion groups, bulletin boards, etc. The researcher’s interest in this subject is to find out gaps between the information needs, availabilities, and information services and also to suggest for bridging the above gaps. The researcher’s long experience working with the AA scientists has also motivated to make close insight in to their ISB due to modern information technology. Keeping the aspect in the view the researcher has proposed to carry out a contemporary problem of Library and Information Science (LISc) interest entitled “Information Seeking Behaviour of Users in Astronomy Information Centres and Libraries in India: The Impact of New Information Technology”. The importance of information of AA scientist has been felt long back; however the need to feed the information system closely related to AA is more strongly felt now, than ever before. This has been reflected in various studies (details given in the review chapter-II). In view of the above, though the importance of scientific and technical information about user’s studies has been conducted & reported, however a special category of scientist viz AA scientist is neither investigated by many nor broadly known so far. Therefore, adequate knowledge of the information needs, ISB of users in imperative for ICLs in re-orienting their collections, services and activities to synchronise them with ISB of their users. The present study is the efforts in this direction.

1.5.3 OBJECTIVES OF THE STUDY

The main objectives are:

- To examine at what extent ISB of users of AA in India has changed in the changing digital era.
- To identify types and range of electronic information resources currently used by academics/researchers in field of AA and also to determine the level and spread of their use for seeking information.
- To study the purpose of Information seeking by AA scientists.
- To determine and analyse the impact of these systems on communication and exchange of professional knowledge among scientists, users, readers, etc of AA.
• To find out the possible factors and problem faced by AA scientists, which trigger the information, need and the association of ideas, or logical consequence that leads to a particular ISB, with seeking and using information.

• Furthermore, to assess for generic use of ICT for their ISB viz various databases, search engines, strategies, catalogues, internet/intranet, particularly from journals/books and review articles, for their various purposes, etc.

1.5.4 HYPOTHESES OF THE STUDY

It is proposed to verify and test the following hypotheses:

Firstly, user’s needs are changing towards the interdisciplinary approach based on IT. It is hope that knowledge about the ISB of AA scientists/users has been changed drastically. Alternatively, there is no significant difference between the levels of users’ ISB.

Secondly, the attitudes, skills and acknowledge (ASK) of the scientists/users are oriented towards the electronic search from printed version in the changing scenario. However, printed documents will be continued and users prefer to access their information as per their convenience place, time, and type of documents and avoid going to the libraries. Alternatively, there is no significantly difference between level of ASK in utilizing the ICL resources and services is significantly higher in statistically terms than those who are not using ICL IT based services.

Finally, it is hope that AA scientists/users still seek the help of library staff to get pinpointed information and avoid garbage. There is a positive impact of IT on ISB of the AA users.

1.5.5 SCOPE AND LIMITATIONS OF THE STUDY

The researcher believes that advantages of ASK for ISB are not only in decomposing the discipline of design education and research. There are vast array of studies and view points about the study. Consequently there are some limitations too, which are

1. There are various organizations/institutions offering research academic activities in AA in India. There are twelve important organizations/institutions, offering research /academic activities in the field of Astronomy and Astrophysics (AA) in India. The Inter-University Centre for Astronomy and Astrophysics (IUCAA), which is leading centre in Astronomy library in India is chosen as main sources, which comes under a
forum called Forum for Resources sharing in Astronomy and Astrophysics (FORSA, 2008) (109) group. However, this study included following organizations (Figure- 1.5.5).

<table>
<thead>
<tr>
<th>List of FORSA Members</th>
<th>Location of FORSA Members in India</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Aryabhatta Research Institute of Observational Sciences (ARIES), Nanital</td>
<td>![Map of FORSA Members in India]</td>
</tr>
<tr>
<td>2. Bose Institute, Kolkata</td>
<td></td>
</tr>
<tr>
<td>3. Harish-Chandra Research Institute (HRD), Allahabad</td>
<td></td>
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<tr>
<td>4. Indian Institute of Astrophysics (IIA), Bangalore</td>
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<tr>
<td>5. Inter-University Centre for Astronomy and Astrophysics (IUCAA), Pune</td>
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<td>6. National Centre for Radio Astrophysics (NCRA), Pune</td>
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<tr>
<td>7. Osmania University, Hyderabad</td>
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<tr>
<td>8. Physical Research Laboratory (PRL), Ahmedabad</td>
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<td>9. Raman Research Institute (RRR), Bangalore</td>
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<td>10. S.N. Bose National Centre for Basic Sciences (SNBNCBS), Kolkata</td>
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<td>11. Saha Institute of Nuclear Physics (SNP), Kolkata</td>
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<td>12. Tata Institute of Fundamental Research (TIFR), Mumbai</td>
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</table>

Figure-1.5.5: Geographical Location of Astronomy Information Centres and Libraries in India (327).

2. Here population means all members of any well defined class of people, events or objects. The population of this study comprises all of the users from AA organizations/Institutes (FORSA Group), and randomly selected users from department of physics and astrophysics of universities and colleges of India and members of Astronomical Society of India (ASI) (Researcher had attended the 27th Meeting of the Astronomical Society of India, hosted by the Indian Institute of Astrophysics, Bangalore during February 18-20, 2009 and around 300 astronomers/scientists/users working in different astronomy organizations / institutions/ AA dept./colleges in India attended the same. Researcher had interviewed many of them and collected their feedback).

3. Changing needs and ASK for ISB of the AA users.

4. Interdisciplinary nature of AA, so as to users’ ISB.
1.6. DEFINITIONS: TERMS AND CONCEPTS USED

This being a social science oriented research, many terms and concepts do not have precise definitions. Yet an attempt is made in this section to present the meaning, scope and operational definitions of certain important terms and concepts used in this study.

1.6.1 USERS

There are various groups of users in AA ICLs. The main users taken for the study are scientists (physicists, astronomers, and astrophysicists), research scholars, post doctoral fellows, visitors, visiting associates who are engaged in research and teaching in the fields of AA, etc.

**Physicists:** Physicists explore and identify basic principles and laws governing motion and gravitation, the macroscopic and microscopic behaviour of gases, and the structure and behaviour of matter, the generation and transfer between energy, and the interaction of matter and energy.

**Astronomers:** Astronomy is sometimes considered a sub field of physics. *Astronomers* use the principles of physics and mathematics to learn about the fundamental nature of the universe, including the sun, moon, planets, stars, and galaxies.

**Astrophysicists:** Astrophysicists typically apply many disciplines of physics, including mechanics, electromagnetism, statistical mechanics, thermodynamics, quantum mechanics, relativity, nuclear and particle physics, and atomic and molecular physics.

1.6.2 USERS’ CHARACTERISTICS

In order to maximize the impact of library services and maximum use of library resources, it is essential to LIS professionals that they should know about their users properly so that they can deliver content based information services. The users’ characteristics are an important component of the communication systems/information system for better their use. The user characteristics are innumerable and could be clustered in different groups in various ways. Among the pioneering information workers, *Rosenbloom and Wolek (1967)* (317) pointed out the users characteristics factors such as
experience, seniority, educational level, professional activity and orientation, are all potentially related to information seeking behaviour. According to Line (1969) (224), the individual characteristics, which are associated with information use and needs, include the following: age, experience in research or job, background, seniority, etc? The psychological dimensions of individual characteristics include: persistence, thoroughness, orderliness, motivation, independence, breathe approach and information threshold.

1.6.3 NEED, WANT, DEMAND, USE AND REQUIREMENT

“Need” is a more abstract and difficult-to-define concept. Ford (1980) (108) and Krikelas (1983) (200) defined information need as an awareness or recognition of not knowing or existence of uncertainty. Need is what an individual ought to have, for his work, his research, his education, his recreation, etc. “Want” is what an individual would like to have, whether or not the want is actually translated into a demand on the library. Individuals may need an item they do not want, or want an item they do not need. “Demand” is what an individual asks for; more precisely, a request for an item of information which is believed to be wanted. Individuals may demand information they do not need, and certainly need or want information they do not demand. Demand is partly dependent on expectation, which in turn depends partly on existing provision of library or information-service. “Use” is what an individual actually uses. A use may be a satisfied demand, or it may be the result of browsing or a chance. Individuals can only use what is available. Use is, therefore, heavily dependent on provision and availability of library and information-service. “Requirement” is a useful bridging term; it can mean what is needed, what is wanted, or what is demanded, and can therefore be usefully employed to cover all three categories. But the term requirement is closer to the term need (Sridhar, 1987) (364).

The ISB is based term, which involves a set of action that an individual takes to express information needs, seek information, evaluate, select and ultimately uses this information to satisfy his/her needs. ISB of users, Wilson (1981) (412) presumes that as part of the search for the satisfaction of needs, an individual may engage in ISB. The interesting and most practical aspect is that needs arise out of the roles an individual fills in social life. So far as specialised information system is concerned, the most relevant of these roles is ‘work role’, that is, the set of activities, responsibilities, etc., of an individual, usually in
some organizational setting in pursuit of earnings and other satisfactions” and it is in this context that the present study emphasises work-related ISB. This study is concerned with the present as well as future ‘work-related information-needs' of the Indian astronomers.

1.6.4 FORMAL SOURCES AND INFORMAL SOURCES

Set of terms, which are often used with lesser consistency are formal, non-formal, semiformal, informal, oral, documentary, personal and inter-personal sources of information. The terms extensively used in this study are ‘formal/documentary sources' of information and ‘informal sources' of information. While the concept of ‘formal and documentary sources’ is quite clear, the ‘informal and inter-personal sources' is defined to include oral, face to face communication, e-mail/list-server, discussion forum, meeting/seminar/ conferences, discussion with librarian, etc are some non formal sources depending on their degree of inter-personal and informal nature (Sridhar, 1987) (364).

1.6.5 CONCEPT OF INFORMATION

Information is the physical representation of abstractions that can cause a change in a person’s state of knowledge. It can be a word, a printed page, a museum object, a diagram, or a whole book, article or audio-visual material. It is useful in decision-making. Information is a very familiar concept. Everyone in the society needs information. Scientists, technologists, managers, administrators, students, etc., need information. Otten (1974) (281) defined “information is an essential part of everyone's daily activities”. Debons (1974) (81) defined “information enfolds man physically and spiritually”. It is the vehicle and substance by which he deals with reality. It is essential to policy makers and scientific community. He further viewed information as a resource, one available for the acquisition of power. Information is persuasive. Information is power. It is very often considered to be synonymous with knowledge. This information is used to acquire knowledge and keep up to date about the latest developments and current trends in one’s area of activity. This is more so with the people who are engaged in research and development work. Buckland (1991) (55) has distinguished information-as-process (the communication act), information-as-knowledge (an increase or reduction in uncertainty), and information-as-thing (the objects that may impart information). In this vein, he also distinguished the actual knowledge in a
human mind (what one knows) from the artefacts of the world that represent knowledge. Most generally, information is anything that has the potential to change a person's knowledge.

1.6.6 CHARACTERISTICS OF INFORMATION

The information that is used by scientist is significantly specialized in nature according to the needs of the scientists. Scientists have to carry out research activities that have to be validated by the peers. Characteristics of information including scientific and technical information are universal particularly in physical, chemical and biological sciences.; a system of peer review and modes of communication operates in its dissemination.; peer group review ensures quality to a large measure.; peer review and speedy communication promotes healthy competition; Information becomes obsolete in fast developing disciplines and the obsolescence factor is quite high.

1.6.7 INFORMATION AND COMMUNICATION

The term “Information” is used as a noun in this study, meaning contents of a message, irrespective of its manifestations and length of exposition. A widely used definition of information is that it is a stimulus that causes change in the degree of certainty or uncertainty of the receiver. Information adds to knowledge and/or helps one in decision-making and problem-solving situations. Hence, it covers the knowledge, facts and data relating to work and the profession/discipline of the AA and programs and activities of the organization but excludes routine administrative, social and personal information. In terms of the manifestations information includes oral and written, documentary and non-documentary, statistical, pictorial, graphic, descriptive, bibliographic, and other forms from formal and informal sources.

“Communication” essentially refers to a process and a simple and generic model of communication involves a sender, message, coding, channel, decoding and a receiver. Such a single channelled, simple, linear and unidirectional communication model between two individuals is an over simplified model. But it serves the purpose of this study. Communication is more than mere contact. It is not even mere information-transfer. Being a
higher-level phenomenon, communication involves both information transfer as well as a change in the state of the receiver as well as sender of message.

1.6.8 INFORMATION NEEDS

Scientific information is used by the scientific community for different needs (Garvey et al., 1972) (121), these are: to attain professional goals: scientist seeks information to gain visibility among their peers and colleagues and to improve their scientific career: to establish a body of scientific knowledge, this is achieved through archival depositing of the scientific work and by adding their findings to the recently produced information so that it gets integrated with the scientific knowledge; to facilitate day to day work: The scientific community also require information to carry out their daily research activities, and get feedback about their work published in various channels of communication. This acts as a check to monitor the quality of information disseminated by them to their professional colleagues and peers.

The reasons mentioned above seem to be the dominant factors determining the purpose for which scientists use information. This fact is also supported by Menzel (1966) (253), who is of the view that scientists have a very strong desire to seek information channelled in their direction through the system designed to serve them. He further states that the scientists need information mainly for two reasons i.e. for specific activities connecting their professional roles as well as their personal lives. Thus due to these twin factors the scientists have very well developed and well structured information communication behaviour patterns. Hence, the information identification, location and seeking is based on the desire, determination and motivation of the scientists. These factors facilitate them to extend the frontiers of scientific knowledge, to produce and communicate scientific information and to continue to look for newer information to put to further use.

1.6.9 INFORMATION SEEKING

Information seeking is a process in which humans engage to purposefully change their state of knowledge. The process is inherently interactive as information seekers direct attention on adapt to stimuli, reflect on progress, and evaluate the efficacy of knowledge base of the information seeker. Information seeking is thus a cybernetic process in which
knowledge state is changed through inputs, purposive outputs, and feedback. Information seeking is a directed purposeful activity. It is different from information retrieval, because retrieval implies that the information has previously been stored. Searching is the behavioural manifestation of information seeking. Strategies can be formal (analytical strategies that require planning) or informal (browse strategies that proceed as cues arise during the search process) (Marchionini 1995) (240).

Kuhlthau (1991, 1993) (201, 202) focused on information search process, which emphasizes feelings, thoughts, and understanding of a situation that they need to resolve task, problem, or topic. This particular action led to the action of people as they seek the meaning of useful research in providing a framework for improving information search.

1.6.10 INFORMATION SEEKING BEHAVIOUR

The ISB refers to the series of activities that a user performs, when seeking for information. It is dependent on the reasons for seeking information and the starting knowledge of the individual. This refers to those paths or channels that are followed or used by individuals in an attempt to resolve or satisfy consciously particular information need felt by them as lacking. In other words, ISB of individuals is observed through the expressed demands or use of various channels, formal or informal, in order to resolve or satisfy their particular information needs. The information needs may be for their work, edification or recreation. Also, since the information needs, like basic human needs, may vary with the persons and their work-related situations, so is the information seeking. Information seeking is a human process that requires adaptive and reflective control over the afferent and efferent actions of the information seeker. The ISB resulted from the recognition of some needs, perceived by the user, who as a consequence makes demand upon on formal system such as libraries and information centres, or some other person in order to satisfy the perceived information need. The ISB essentially refers to locate discrete knowledge elements. It is concerned with the interactive utilization of the three basic resources namely, people, information and system. Further in order, to satisfy the information needs, the user actively undergoes the information seeking process. The attempt of the user in obtaining the needed information results from the recognition of some needs, perceived by the user.
1.6.11 STRATEGIES IN INFORMATION SEEKING

Information seeking strategies can be examined in terms of sources and methods. Sources refer to the locations while, method refers to the manner of the information is being sought. Information might be recalled from the seeker’s own memory, gathered informally from friends or colleagues, or from personal formal sources of information such as books, journals and files. The seeker may also conduct a planned investigation to identify the sought information in libraries, via electronic networks or by using a variety of information services.

1.6.12 INTERACTIVE INFORMATION SEEKING

Ranking and relevance feedback are both very useful facilities found in many retrieval systems. Internet search engines provide ranking and relevance information for searches. User satisfaction can be improved by finding information within and outside the library. Recent and emerging developments in computing, telecommunications, networking and resource sharing have made access to information anytime, anywhere possible. Users’ need studies are usually conducted by ICLs to determine the information requirements of their users.

1.6.13 COMMUNICATION PATTERNS OF SCIENTISTS

Information is generated through a number of communication channels. Information and its communication are intrinsic to the practice of science. Research, stimulated often by new information, is sustained by the continuing flow of information, and when completed, again yields new information. This, in turn, generates a fresh cycle of creation and discovery. Channels are the means by which ideas, opinions, facts and interpretations are communicated. These channels may be formal - conference papers, publication in journals, research reports, preprints, books, records, slides, audio tapes, etc., or informal – discussions, casual meetings with colleagues, correspondences, group discussions, etc. The line between formal and informal channels is difficult to draw; a reasonable approximation might be that formal channels are susceptible of use by a number of people, not necessarily at the same time, while informal channels operate on an individual interpersonal communication basis.
1.7 MODEL OF INFORMATION SEEKING BEHAVIOUR

Information related actions begin with the recognition of the need for finding information to address a situation or solve a problem, and end when the individuals resolve the situation or abandon the pursuit. Understanding how individuals satisfy their need for information may be viewed as recognizing how much effort individuals are willing to invest in finding information, in relation to the trade-offs of information quality, time constraints for achieving an objective, solving a problem, or addressing a situation. Satisfying the need for information is an integral component of the larger body of literature on information seeking and searching models. A model may be described as a framework for thinking about a problem and may evolve into a statement of relationships among theoretical propositions. Most models in the general field of ISB are of the former variety: they are statements, often in the form of diagrams, which attempt to describe information seeking activity, the causes and consequences of that activity, or relationships among stages in ISB. Rarely do such models advance to the stage of specifying relationships among theoretical propositions: rather, they are at a pre-theoretical stage, but may suggest relationships that might be fruitful to explore or test (Wilson, 1999) (417). There are various models suggested by the different workers for various groups of the users and their ISB. Consequently, it is to give a brief description to support the present study specially objectives and hypotheses. These are:


This model describes that ISB depends on the present status of the knowledge of the individual and on the information need and discuss the modes of organizational scanning in terms of these parameters as undirected viewing refers to the use of the internet to broadly scan resources without a specific topic in mind. The objective is to browse available information. The tactic is called “visioning,” an attempt to find something interesting that can be pursued further. The specific information need is thus identified after a number of resources have been browsed. In conditioned viewing, the user already has a topic in mind but would like to learn more about it. He therefore becomes more discriminating in searching and identifying useful information (4, 73 and 74).

Modes of organizational scanning

Undirected viewing → broad scanning
Conditioned viewing → Assessment of information gathered, 
Informal search → Search for more information to deepen knowledge 
Formal search → Planned procedure to obtain information about a specific issue

1.7.2  **ISB MODEL BY WILSON (1981)**

The aim of this illustrated model in **Figure-1.7.2** was to outline the various areas covered by what the writer proposed as ‘ISB’, as an alternative to the common ‘information needs’, but it is clear that the scope of the diagram is much greater and that it attempts to cover most of what is included here as ‘information behaviour’. The model suggest that ISB arises as a consequence of a need perceived by an information user, who, in order to satisfy that need, makes demands upon formal or informal information sources or services, which result in success or failure to find relevant information. If successful, the individual then makes use of the information found and may either fully or partially satisfy the perceived need or, indeed, fail to satisfy the need and have to reiterate the search process. The model also shows that part of the ISB may involve other people through information exchange and that information perceived as useful may be passed to other people, as well as being used (or instead of being used) by the person himself or herself.

![Wilson’s Model of Information Seeking Behaviour (1981)](image)

**Figure-1.7.2: Wilson’s Model of Information Seeking Behaviour (1981) (412)**

1.7.3  **ISB MODEL BY ELLIS (1989)**

**Ellis (1989)** (96) proposed a behavioural model based on the analysis of a detailed description of information-seeking activities by social scientists. In this model, the decision
of whether the information found is sufficient to meet a user’s needs is dependent upon chasing and evaluating references as well as systemically identifying content that is of interest to the user. Ellis characterizes six different types of information activities: starting, chaining, browsing, differentiating, monitoring and extracting, illustrated in Figure-1.7.3.

![Figure-1.7.3: A Stage Process Version of Ellis’s Behavioural Framework (96)](image)

1.7.4 ISB MODEL BY MARCHIONINI (1995)

Marchionini (1995) (240) described browsing modes as directed, semi-directed and undirected. In directed browsing, the searcher has a specific topic in mind and searching behaviour follows a predetermined path. In semi-directed browsing, the searcher has a vague idea about the topic and searches for information to gather information that will enable him/her to become more focused. In undirected browsing, the searcher has some interest on the topic and searches the resources to get a better view of the topic or to find another topic. Marchionini (1995) (240) observed that the determination of when to stop looking for information may depend on external functions like setting/context/situation or a search system or on internal functions like motivation, task-domain knowledge, and information-seeking ability. The detailed have been indicated in Figure – 1.7.4.
1.7.5 ISB MODEL BY DERVIN (1983, 1996)

Dervin’s Sense-Making theory has been developed over a number of years, and cannot be seen simply as a model of information-seeking behaviour. However, Sense-Making is implemented in terms of four constituent elements: a situation in time and space, which defines the context in which information problems arise; a gap, which identifies the difference between the contextual situation and the desired situation (e.g. uncertainty); an outcome, that is, the consequences of the Sense-Making process, and a bridge, that is, some means of closing the gap between situation and outcome. Dervin (1983) (83) presents these elements in terms of a triangle: situation, gap/bridge, and outcome, which have been represented as in Figure-1.7.5 and followed by updated version mentioned in Figure-1.7.6.
1.7.5 Dervin’s Sense-Making Framework (1983) (83)

1.7.5.1 Dervin’s Sense-Making Framework Modified (1996) (84)

1.7.6 ISB MODEL BY WILSON (1996)

Wilson’s 1996 (415) model shown in below said Figure-1.7.6 is a major revision of that of 1981, drawing upon research from a variety of fields other than information science, including decision making, psychology, innovation, health communication and consumer research. The basic framework of the 1981 model persists, in that the person in context remains the focus of information needs, the barriers are represented by ‘intervening variables’ and ‘ISB’ is identified. However, there are also changes: the use of the term ‘intervening variables’ serves to suggest that their impact may be supportive of information use as well as preventive; ISB is shown to consist of more types than previously, where the ‘active search’ was the focus of attention; ‘information processing and use’ is shown to be a necessary part of the feedback loop, if information needs are to be satisfied; and three relevant theoretical ideas are presented: stress/coping theory, which offers possibilities for
explaining why some needs do not invoke information-seeking behaviour; risk/reward theory, which may help to explain which sources of information may be used more than others by a given individual; and social learning theory, which embodies the concept of ‘self-efficacy’, the idea of ‘the conviction that one can successfully execute the behaviour required to produce the [desired] outcomes’. Thus, the model remains one of macro-behaviour, but its expansion and the inclusion of other theoretical models of behaviour make it a richer source of hypotheses and further research than Wilson’s earlier model (Wilson, 1999) (417).

1.7.7 ISB MODEL BY WILSON (1981, 1999)

Figure-1.7.7 shows Wilson’s 1981 (412) model, as modified in 1999 (417). He used Ellis’ list as characteristics of ISB, which he placed within the context of information need arising out of a situation (of the person’s environment, social roles and individual characteristics). That same context presents barriers, which must be overcome before information seeking takes place. This model is shown in a simplified version (which also shows the search behaviours’ defined by Ellis in Figure-1.7.3. Wilson’s model is clearly what may be described as a macro-model or a model of the gross information-seeking behaviour and it suggests how information needs arise and what may prevent (and, by implication, aid) the actual search for information. It also embodies, implicitly, a set of
hypotheses about information behaviour that are testable: for example, the proposition that information needs in different work roles will be different, or that personal traits may inhibit or assist information seeking. Thus, the model can be regarded as a source of hypotheses, which is a general function of models of this kind (Wilson, 1999) (417).

![Diagram of Wilson's 1981 Model of Information-Seeking Behaviour](image)

**Figure-1.7.7: Wilson's 1981 Model of Information-Seeking Behaviour (417)**

### 1.7.8 ISB MODEL BY WILSON (1999)

In 1999, Wilson combined the work of Ellis (1989) (96) and Kuhlthau (1991) (201), each of whom had suggested phases or stages which tend to occur within information seeking. In Figure-1.7.8, Wilson pointed to similarities between the two while emphasizing that the movement of the seeker between characteristic seeking behaviours can occur in varying sequence. Kuhlthau’s work complements that of Ellis by attaching to stages of the ‘information search process’ the associated feelings, thoughts and actions, and the appropriate information tasks. This association of feelings, thoughts and actions clearly identifies Kuhlthau’s perspective as phenomenological, rather than cognitive.

The stages of Kuhlthau’s model are: Initiation, Selection, Exploration, Formulation, Collection and Presentation. As an example, the Initiation phase of the process is said to be characterized by feelings of uncertainty, vague and general thoughts about the problem area, and is associated with seeking background information: the ‘appropriate task’ at this point is simply to ‘recognize’ a need for information. The remaining appropriate tasks are: identify, that is, fix the general topic of the search; investigate, or search for information on that
general topic; formulate, focus on a more specific area within the topic; collection, that is, gather relevant information on the focus; and complete, end the information search (Wilson, 1999) (417).

**Figure-1.7.8:** A Stage Process Version of Ellis's Behavioural Framework and Comparison with Kulthau's Stage Process Model - by Wilson 1999 (1999) (417)

1.7.9 ANOTHER ISB MODEL BY WILSON (1999)

With the next model in Figure-1.7.9, presented in 1999, Wilson (417) pointed out that information search behaviour is a subset of information seeking behaviour and that information seeking behaviour is in turn only a subset of all possible information behaviour. As such, the existence of modes of information behaviour, other than information seeking, is implied (Wilson, 1999) (417).

**Figure-1.7.9:** Wilson's 1999 Nested Model of Information Behaviour (417)
1.8 INFORMATION SEEKING BEHAVIOUR OF USERS/SCIENTISTS

The four main information needs of AA scientists are current information to keep up in a field; specific information, which is often tasks related; Retrospective information, which forms the basis of research projects; brush-up often in related or peripheral areas to the research. However, in all other cases in this literature search, IT was reported to be making a huge impact on the ISB of scientists. As expected, both the pros and cons of IT have been extensively reported in the literature. Despite such well-known barriers as network problems, user unfriendly programs and lack of access to the Web, the advantages of convenience, speed and easy access are acknowledged and drawing more and more scientists into the electronic information world. Scientists have a system of peer review of the research work they carry out. Therefore, scientists have to be careful, while using information. The authenticity and validity are of utmost importance as it may affect the research results and also the validity of the result. Information sought by scientists are specific to the discipline, hence the accuracy of the information determines its value and the value of the source. Hence, scientists prefer internationally recognised sources like database, scholarly journals and research reports. The behaviour of scientists may be studied with reference to the model given by (Ellis, 1989) (96). It has been observed that physicists, AA scientists start information seeking by personal contacts, reviews of earlier research material and forward chaining with citation indexes, browsing through abstracting service and literature searches and differentiating relevant research material from bulk of information sources, keep monitor journals, conference proceedings and abstract services for latest information. Scientists are extracting relevant information from journals, monographs, bibliographies database, e-archive and verifying the same with authentic sources and ending their information seeking to use selected information for their research and teaching works.

1.9 FACTORS AFFECTING INFORMATION SEEKING BEHAVIOUR OF USERS/SCIENTISTS

The literature searches indicate that there are many factors, which affected the ISB. The factors taken into consideration for the study are:

Whether the source is within reach - Sources that are easily accessible will be
frequent used. The information content of such sources will significantly affect the quality of research as the scientists may have to make do with obsolete data and information because the latest information is physically beyond reach.

**Cost** - The cost of scientific information is quite high. Hence, lack of funds can force a scientist to opt for low cost publications, which may not provide relevant and up to date information.

**Time** - The growth in scientific literature has made information search a cumbersome task and to provide proper information at proper time to AA scientists in the need of time. Hence, scientists may use easily available sources which may prove risky. One of the significant factors influencing the behaviour of scientists is whether the source provides the information useful and relevant to them. Scientists usually prefer scholarly journals.

**Culture** - The cultural framework of a country may affect the behaviour of scientists. Certain topics which may be considered as taboo may not be searched by scientists for fear of condemnation. Many studies have revealed that there exists a system of invisible colleges within the scientific community. The members exchange information among themselves.

**Past experiences** of scientists may influence the information seeking pattern. A valuable piece of information found in a particular source may cause the scientist to monitor the source in later searching processes also.

**Scientists**, who head a team of researchers usually keep a watch over development in the field. Such scientists are known as 'gate keeper'. These gate keeper scientists have to keep their knowledge up to date hence they regularly monitor various sources. The information available in various scientific disciplines becomes obsolete at a faster rate. The phenomenal growth in scientific literature has resulted in 'information explosion.' The outcome of this is that volume of information has itself become a barrier to access to information.

Earlier barriers like knowledge revolution, language, time, geographical location and physical format have been overcome through translation services, faster communication channels, better preservation techniques and universally compatible document formats. Consequently, librarians have to investigate the behaviours of users to improve the chances
of retrieving relevant information is the least number of retrieval attempts.

1.10 INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) FOR ISB

In the present scenario of digital information, storage and seeking, it is important to explain here about the inter relationship of ISB and ICT.

1.10.1 INFORMATION AND COMMUNICATION TECHNOLOGY

The two revolutions in computers and communications transformed the computers synonymous to Information Technology. The rapid developments in Information Technology (IT) brought revolutionary changes in information processing, storage, dissemination and distribution and became a key ingredient in bringing-up great changes in over all aspects of society. Further the advent of low cost computers and easy-to-use word processing software, computer based image processing techniques paved way for ‘digitised information’ comprising textual to multimedia data consisting of text, images along with digitised voice and video. Thus the information stored in libraries has taken a major shift from volume-limiting paper to limitless multimedia digital form.

1.10.2 USE OF ICT IN ICLs

The ease of communication along with the internet has brought a paradigm shift in information usage from the need to know basis information available, when and where you need it. Digital publishing technologies and global networking have given rise to the development of a wide variety of digital libraries. Implications of ICT in ICLs are for storage, speed, ease of use, large volume of information, interoperability, integration and advantages of web based services are for interoperability, encapsulation, availability, self-description, simplified and high scalability. Technologies used in ICLs for information capture (keyboard, scanner, digital cameras, mobiles, etc), storage (PCs, floppy disks, CDs/DVDs, pen drives, portable HDs), identification (barcode, tattle-tape, RFID, biometric, etc) and prepare databases (books, articles, reports, aggregators, publishers, etc). ICLs using different technologies as digital library software (Greenstone digital Library software, DSpace, Fedora, etc), Library automation packages (WINISIS, SOUL, Libsys, Libsuite,
Liberty, ALICE, SLIM, etc) and Open Source (KOHA, NewGenLib, etc) and Networking software as Client-server, P2P, Internet, etc.

1.10.3 NEW EMERGING TECHNOLOGIES IN ICLs

In a changing scenario of World Wide Web and emerging new technology in the field of internet, that is WEB 2.0, likewise in the field of LISc is called Library 2.0, which is explained in brief is given below:

1.10.3.1 LIBRARY 2.0

Library 2.0 is a loosely defined model for a modernized form of library service that reflects a transition within the library world in the way that services are delivered to users. The focus is on user-centred change and participation in the creation of content and community. The concept of Library 2.0 borrows from that of Business 2.0 and Web 2.0 and follows some of the same underlying philosophies. This includes online services like the use of OPAC systems and an increased flow of information from the user back to the library. With Library 2.0, library services are constantly updated and re-evaluated to best serve library users. Library 2.0 also attempts to harness the library user in the design and implementation of library services by encouraging feedback and participation. Proponents of this concept expect that the Library 2.0 model for service will ultimately replace traditional, one-directional service offerings that have characterized libraries for centuries (Library 2.0, 2008) (222). Library 2.0 is the application of interactive, collaborative and multimedia web based technologies to web based library services and collection (Maness, 2006) (236). The basic idea of Library 2.0 is to transform library service by making them more personalize, more interactive, collaborative, more web-based, driven by community needs. A very different communication environment for providing more personalized services to users is making librarians more competent (Library 2.0, 2008) (222).

1.10.3.1.1 COMPONENTS OF LIBRARY 2.0

There are many components included in concept Library 2.0 are explained below:

1.10.3.1.1.1 INSTANT MESSAGING

Instant messaging (IM) are technologies that create the possibility of real-time text-based communication between two or more participants over the internet or some form of
internal network/intranet. It is important to understand that what separates chat and instant messaging from technologies such as e-mail is the perceived synchronicity of the communication by the user. Chat happens in real-time before your eyes. Some systems allow the sending of messages to people not currently logged on (offline messages), thus removing much of the difference between Instant Messaging and e-mail (Instant Messaging, 2008) (173).

1.10.3.1.1.2 SHORT MESSAGE SERVICE

SMS is a communications protocol allowing the interchange of short text messages between mobile telephone devices. SMS text messaging is the most widely used data application on the planet, with 2.4 billion active users, or 74% of all mobile phone subscribers sending and receiving text messages on their phones. The SMS technology has facilitated the development and growth of text messaging. The connection between the phenomenon of text messaging and the underlying technology is so great that in parts of the world the term "SMS" is used as a synonym for a text message or the act of sending a text message, even when a different protocol is being used (Short Message Service, 2008) (342).

1.10.3.1.1.3 MULTIMEDIA MESSAGING SERVICE

MMS for short is a cellular telephone standard for sending messages that includes multimedia objects as images, audio, video, rich text. MMS is an extension of the SMS standard, allowing longer message lengths and using WAP to display the content. Its most popular use is sending photographs from camera-equipped handsets, although it is also popular as a method of delivering ring tones as well (Multimedia Messaging Service, 2008) (263).

1.10.3.1.1.4 WIKI - FROM THE HAWAIIAN WIKI, TO HURRY, SWIFT.

A wiki is a page or collection of web pages designed to enable anyone who accesses it to contribute or modify content, using a simplified mark-up language. Wikis are often used to create collaborative websites and to power community websites. The collaborative encyclopaedia Wikipedia is one of the best-known wikis. Wikis are used in business to provide intranet and knowledge management systems (WIKI, 2008) (410).
1.10.3.1.1.5 BLOG

A blog is a web site, usually maintained by an individual with regular entries of commentary, descriptions of events, or other material such as graphics or video. Entries are commonly displayed in reverse-chronological order. Blog can also be used as a verb, meaning to maintain or add content to a blog. Many blogs provide commentary or news on a particular subject; others function as more personal online diaries. A typical blog combines text, images, and links to other blogs, web pages, and other media related to its topic. The ability for readers to leave comments in an interactive format is an important part of many blogs (Blog, 2008) (34).

1.10.3.1.1.6 REALLY SIMPLE SYNDICATION

RSS is a family of web feed formats used to publish frequently updated works such as blog entries, news headlines, audio, and video in a standardized format. An RSS document (which is called a feed, or web feed or channel) includes full or summarized text, plus metadata such as publishing dates and authorship. Web feeds benefit publishers by letting them syndicate content automatically. They benefit readers who want to subscribe to timely updates from favoured websites or to aggregate feeds from many sites into one place. RSS feeds can be read using software called an RSS reader or feed reader or aggregator, which can be web-based or desktop-based. A standardized XML file format allows the information to be published once and viewed by many different programs. The user subscribes to a feed by entering the feed's URL into the reader or by clicking an RSS icon in a browser that initiates the subscription process. The RSS reader checks the user's subscribed feeds regularly for new work, downloads any updates that it finds, and provides a user interface to monitor and read the feeds (Really Simple Syndication, 2009) (310).

1.10.3.1.1.7 PODCAST

A podcast is a series of audio or video digital-media files which is distributed over the internet by syndicated download, through web feeds, to portable media players and personal computers. Though the same content may also be made available by direct download or streaming, a podcast is distinguished from other digital-media formats by its
ability to be syndicated, subscribed to, and downloaded automatically when new content is added (Podcasting, 2008) (300).

1.10.3.1.8 SOCIAL NETWORKING

A social network is a social structure made of nodes (which are generally individuals or organizations) that are tied by one or more specific types of interdependency, such as values, visions, ideas, financial exchange, friendship, kinship, dislike, conflict or trade. The resulting graph-based structures are often very complex. Social network analysis views social relationships in terms of nodes and ties. Nodes are the individual actors within the networks, and ties are the relationships between the actors. There can be many kinds of ties between the nodes. Research in a number of academic fields has shown that social networks operate on many levels, from families up to the level of nations, and play a critical role in determining the way problems are solved, organizations are run, and the degree to which individuals succeed in achieving their goals. In its simplest form, a social network is a map of all of the relevant ties between the nodes being studied. The network can also be used to determine the social capital of individual actors. These concepts are often displayed in a social network diagram, where nodes are the points and ties are the lines. Social Networking - perhaps you've heard of it before, but are not quite sure what it means (Social Networking, 2008) (359).

1.11 EFFECTS OF ICT ON USERS/SCIENTISTS

Due to the new formats of information resources and tools, users often prefer digital information and ICT to access and organize that information. The shift from print to digital information had an impact on libraries, information centres and other institutions directly involved in processing information as well as on the user. Users had to acquire new knowledge and skill in information searching. ICT has greatly affected the information environment on librarians and users of information and must adapt to the changing technological environment: as be able to use electronic resources and access tools; be able to respond to new user information needs and information-seeking behaviours; be able to participate in the national, regional and global infrastructure. ICT has greatly affected libraries, librarians and information seekers. The behaviour of users depends greatly on the
existing knowledge base of the searcher. This is also true of librarians who assist users in their search. In certain cases, the librarian conducts the search and also repackages the information for the user. New knowledge and new skills are required of librarians and information seekers to enable them to use the new information formats and tools in searching for and repackaging information. Librarians must be able to analyse a reference query in order to respond appropriately and determine the best resources that will provide the answer to the query. ICT is making information searching more efficient; improves research and changing professional lives; increases cooperation with colleagues; increases the ability to update research faster. ICT is a possible threat to the creative process because it could limit “thinking time” the increase use of IT in publishing tends to shift the focus onto the technology at the expense of content use of e-journals and other IT-based resources are rising but print resources and human contacts are dropping.

CONCLUSIONS

Information plays a vital role in every walk of life and AA is no exception to it. Continuous R&D is an essential activity to modernise, to complete and also to meet any eventuality or threat to a vast country like India. To maintain steady progress in AA R&D, AA users, scientists, decision, makers, etc must be provided with proper information at proper time, pin pointedly, expeditiously and exhaustively, from all possible sources. The efficiency and effectiveness of AA ICL can be seen only by using the modern means of IT. However, in order to devise more efficient and effective AA ICLs, there must be insight into the ways how the AA users seek scientific and technical information with IT in India and abroad. But the impact on special and interdisciplinary branch of science i.e. AA, have neither fully investigated nor broadly known so far. The present study is expected to fill this gap. The sufficient identification and analysis of real impact of IT on AA ICLs could be providing a base for the design and development of an ideal AA ICL in India. Use of IT must be promoted by ICLs by the government. The process of IT i.e. computer (HW &SW), communication system as internet/intranet, etc., should be brought down to the international level in all AA ICLs in India through indigenous effort.