National Centre for Radio Astrophysics
TIFR, Pune

Annual Report

April 1, 2003 – March 31, 2004

Academic

Sun and Solar System

To supplement the long, simultaneous stretches of Jupiter observations with Chandra and HST. Jupiter was observed with GMRT at 610 and 244 MHz (dual mode) simultaneously with Chandra and HST. Initial results were presented in INCUSRI–2003 held in NPL, Delhi during 25 – 28 November, 2003. *[C. H. Ishwara-Chandra with Anil Bhardwaj, N. Udaya Shankar, Girish K. Beeharry, Ronald F. Elsner and G. Randall Gladstone].*

The first observations of a solar flare with GMRT, at 1060 MHz were made on November 17, 2001. This was associated with a prominence and the initiation of a fast partial halo Coronal Mass Ejection event. Subramanian et al. (2003) found evidence for reconnection above the prominence, while Kundu et al. (2003) found that the filament eruption shows a gradual onset and then a rapid acceleration phase, which they found to be tied close to the impulsive phase of the flare. *[S. Ananthakrishnan and P.K. Manoharan with P. Subramanian (IUCAA, Pune), P. Janardhan (PRL, Ahmedabad), M.R. Kundu (University of Maryland, USA), White, Garaimov].*

We analyzed 15 coronal mass ejections using Ooty IPS and SOHO LASCO data to study their evolution in the inner heliosphere. The additional data points on the speed of the CME at distances $>50\ R_{/}$ obtained from the IPS measurements have provided a better understanding of the propagation of CMEs. The results on the radial dependence of CME speed have been used to empirically predict the arrival of CME at 1 AU. Arrival times of a set of 32 LASCO CMEs have been compared with the predictions and a good agreement has been seen. The results on the CME

travel time confirm that the IPS technique detects the sheath between the shock and the CME. *[P.K. Manoharan].*

We studied 91 interplanetary (IP) shocks associated with coronal mass ejections (CMEs) originating within about ±30° in longitude and latitude from the center of the Sun during 1997 – 2002. These CMEs cover a wide range of initial speeds of about 120 to 2400 kms^{-1} and they also include a special population of 25 interacting CMEs. This study provides the characteristics of propagation effects of more number of high-speed CMEs ($V_{CME} > 1500$ kms^{-1}) than the data used in earlier studies. The results on comparison of IP shock speed and transit time at 1 AU suggest that the shock transit time is not controlled by its final speed, but is primarily determined by the initial speed of the CME and effects encountered by it during the propagation. It is found that the CME interaction tends to slow the shock and associated CME. The deviations of shock arrival times from the empirical model are large for slow ($V_{CME} < 300$ kms^{-1}) and fast ($V_{CME} > 800$ kms^{-1}) CMEs. Results show that the slow and fast CMEs experience stronger effective acceleration. *[P.K. Manoharan* with *N. Gopalswamy (GSFC, NASA, USA), S. Yashiro (Catholic University of America, USA), A. Lara (UNAM, Mexico) and R.A. Howard (NRL, USA)]*

Galactic Astronomy

Imaging the distribution of Acetaldehyde toward the Galactic Center: Giant Meterwave Radio Telescope images of the 1065 MHz emission from the $1_{10} \rightarrow 1_{11}$ rotational transition of acetaldehyde in the molecular cloud complex Sgr B2 were obtained.. Our observations are unique in that they have a high spatial resolution ($\sim 4''$), while still being sensitive to large-scale emission. Most complex organic molecules in this cloud (e.g. acetone, methyl formate, acetic acid) are concentrated in a very small core, ~ 0.1 pc across. In contrast, acetaldehyde is found to be spread

over a region at least 100 times larger in extent. The line emission is confined to regions with radio continuum emission and correlates well (in both position and velocity) with formaldehyde absorption towards this continuum; this is consistent with earlier single dish results suggesting that it is likely to be weakly mased. Our observations also suggest that grain mantle destruction by shocks plays an important role in the observed gas phase abundance of acetaldehyde in Sgr B2. *[Jayaram N Chengalur* with *Nissim Kanekar, Netherlands Foundation for Research in Astronomy, The Netherlands].*

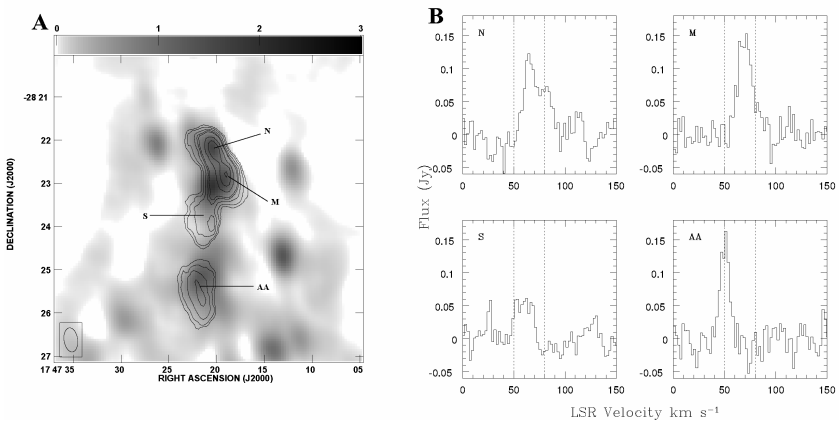


Figure 1: [A] Integrated Acetaldehyde emission towards SGR B2 (contours) overlaid on the 1065~MHz continuum emission (greyscale). [B] Acetaldehyde emission spectra towards the four regions marked in panel [A] The dotted lines are at LSR velocities of 50 kms and 80 kms.

New observations of the Galactic Centre (GC) region have been carried out at 1010 MHz with the GMRT. The compact object Sgr A*, which coincides with the position of the 2.6×10^6 $M_{/}$ black hole candidate at the GC, is found to have a flux density of 0.6 ± 0.12 Jy. This result, when compared with their earlier measurements of its flux density at 580 and 620 MHz (0.5 ± 0.1 Jy) establishes the following: (i) Its spectral index between 580 and 1010 MHz is consistent with its higher radio frequency spectral index (slightly inverted and is about 0.17). This indicates that there is no low-frequency turnover of its emission at frequencies above 0.6 GHz. (ii) Although Sgr A* is located along the same line of sight as the HII region

Sgr A West, the emission from it undergoes no absorption by Sgr A West, which indicates that Sgr A* is located in front. These results along with the findings based on their earlier 580 an 620 MHz observations have been published as Roy & Rao 2004, MNRAS, 349, L25. *[Subhashis Roy and A. Pramesh Rao].*

Magnetic field can play an important role in the central region of a galaxy. However, except the central 200 pc region of our Galaxy, the magnetic field in the rest of the inner 5 kpc region is not observationally constrained. Therefore, in the last few years, observations have been carried out to constrain the line-of-sight magnetic field of the central 2 kpc region ($354° \leq l \leq 6$, $-1.8° \leq b \leq 1.8°$) by estimating the Faraday Rotation Measure (RM) towards a large number (65) of suspected background extragalactic sources. Out of 65 sources, 60 were inferred to be extragalactic, which increases the number of known extragalactic sources seen through the region by an order of magnitude. Out of 65 sources observed, polarised emission were detected from 42 sources. The Faraday rotation measures (RM) towards most of these sources are found to be positive and large (~ 500 rad m^{-2}). Based on the typical electron density in the region, the line of sight component of this magnetic field is estimated to be 0.7 μG. This large scale magnetic field around the GC is consistent with a bisymmetric spiral configuration of magnetic fields in the Galaxy. The outer scale of the RM fluctuation is about 30 pc. With certain assumptions, the probability of encountering the ionised material responsible for the Faraday rotation and scattering in the central 2 kpc of the Galaxy is estimated to be 0.02, which indicates that the plasma is arranged in the form of dense clumps, with sizes ~ 35 pc and electron density ~ 20 cm^{-3}. These are likely to be the ionised outer envelope of HII regions. The estimated upper limit on the line of sight magnetic field in the central 300 pc of the Galaxy is 60 μG, thereby suggesting the milliGauss magnetic field estimated near the NTFs are

localised and does not pervade the central 300 pc of the Galaxy. *[Subhashis Roy and A. Pramesh Rao with Ravi Subrahmanyan (ATCA)].*

Radio Recombination Lines

We have analyzed GMRT and VLA radio recombination line data towards a group of Galactic HII regions near $l = 24.8°$ and $b = 0.1°$. We detect hydrogen lines near 20 cm and 49 cm due to transitions between levels near $n = 166$ and $n = 220$ from the largest HII region. We have modelled the physical conditions which can give rise to these lines and find that the line emission near 20 cm arises both in the HII region (~ 7000 K) and the associated ionized tenuous envelope whereas that at 49 cm arises only in the envelope. Although the observed line strengths can be explained by a cool (~ 100–400 K) photo-dissociated region, the large observed line widths rule this out. *[N.G. Kantharia* with *W. M. Goss, A.D. Roshi, Raman Research Institute, Bangalore, N. Mohan, F. Viallefond)].*

High-resolution radio observations of a sample of 65 radio sources at low Galactic latitudes have been presented. The sources were all observed at 5 GHz with the VLA A-array. MERLIN observations at 5 GHz of the ultracompact HII region G34.26 + 0.15 and one of the extragalactic sources, B1857–000, have also been presented, as well as GMRT observations of HI in the direction of three sources, B1801–203, B1802–196 and B1938+229. These observations were made with the objectives of (i) finding compact components suitable for studying the effects of interstellar scattering at lower frequencies, (ii) identifying high surface-brightness lobes of background radio sources to probe the Galactic magnetic field on different scales via polarization observations, and (iii) searching for young supernova remnants. The nature of the sources found to have shell or shell-like structure and exhibiting both thermal and non-thermal spectra have been discussed. Of the remaining sources, B1749–281 is coincident within the

positional errors of a known pulsar, not detected earlier at 5 GHz. The rest are likely to be background extragalactic objects. *[D.J. Saikia and S. Roy with Peter Thomasson, Alan Pedlar and Tom Muxlow, Jodrell Bank Observatory, England].*

X-ray binaries are the brightest X-ray sources in the sky, and exhibit a wide variety of phenomena like rapid variability and outbursts. A small fraction of the X-ray binaries also show strong radio emission. The basic phenomena of radio emission from X-ray binaries are similar to that of quasars, both in morphology and physics; hence these are known as microquasars. We have observed the microquasar GRS1915+105 at low radio frequencies, viz, 610 and 235 MHz in June 2003. Preliminary analysis shows that GRS1915+105 is brighter at these frequencies than expected from naive application of synchrotron self-absorption model for compact jets *[Ishwara-Chandra and Pramesh Rao with Mamta Pandey, R.K. Manchanda, Phillippe Durouchoux].*

Gamma Ray Bursts

We have observed the GRB030329, shortly (within two days) after the burst, and then nearly once a month for about a year. The GRB was detected with GMRT with a flux density of 0.25 mJy at 1280 MHz within a day of the burst. The flux density at this frequency increased steadily for a few months and decayed slowly. Two GCN circulars were sent based initial observations. Subsequently GRB030329 was also observed at 610 MHz, and the flux density at this frequency was found consistent with the model. *[A. Pramesh Rao, C. H. Ishwara-Chandra, D. Bhattacharya (Raman Research Institute) and L. Resmi]*

Pulsars

The discovery of the first pulsar with the GMRT: During February 2003, I was involved in phased array pulsar mode observations with the GMRT of a selected list of 16 globular clusters in our Galaxy, with the primary aim of searching for as yet undiscovered pulsars in these dense and massive stellar condensates. In November 2003, analysis of the data from the globular cluster NGC1851 revealed the presence of a new 4.99-millisecond period pulsar. Follow-up observations at the GMRT in December 2003 confirmed the discovery of this pulsar. This is the first pulsar discovered in the cluster NGC1851, and **the first new pulsar discovery using the GMRT.** Furthermore, the follow-up observations showed that this is a binary pulsar, and that too in a very unusual binary orbit. Our data are best fit by an orbital period of 18.785 days and an orbital eccentricity of **0.889** — the highest known for any pulsar binary system. Our initial estimates put the minimum mass of the companion as 0.9 of the Sun's mass. The parameters of this system have significant implications for theories of formation of binary pulsar systems. Using simultaneous recording of the interferometric data, we were able to make a radio map of the globular cluster and pin-point the location of the pulsar as being fairly close (within 0.1 arcminute) to the centre of the cluster. The reports of the discovery of this pulsar and our preliminary estimates of its parameters have been accepted for publication (Freire, Gupta, Ransom & Ishwar-Chandra, ApJL, 2004). We are currently in the process of long-term timing observations of this new binary system which will allow better determination of the parameters of the pulsar and binary orbit. *[Yashwant Gupta and C. H. Ishwar-Chandra with P. C. Freire (NAIC, Arecibo), S. Ransom (McGill University, Canada)].*

Multi-frequency observations (MFO) of pulsars: Simultaneous multi-frequency multi-observatory pulsar observations are powerful tools for

studying the pulsar emission mechanism. New results were obtained from an ongoing program of analysis of MFO data taken with the GMRT, Jodrell Bank and Effelsberg telescopes. In this work, we presented the results from flux density measurements of individual pulses simultaneously observed at four different frequencies for pulsars B0329+54 and B1133+16. Flux density spectra of individual pulses were computed, for the first time for any pulsar. *[Yashwant Gupta* with *M. Kramer (University of Manchester, UK), A. Karastergiou and S. Johnston (University of Sydney, Australia), N.D.Ramesh Bhat (Arecibo Observatory, USA) & A.G. Lyne (University of Manchester, UK)].*

Frequency dependence of interstellar pulse broadening of pulsar signals: Final results were obtained from the study of interstellar pulse broadening of pulsar signals carried out using the GMRT during 2002-2003. This project was carried out with the aim of understanding the frequency dependence of the scatter broadening time scale, for a selected set of medium dispersion measure (DM) pulsars. Multi-frequency observations were carried out with the GMRT at 243, 325 and 610 MHz. The results show that the frequency dependence of the scattering is consistent with the Kolmogorov spectrum of electron density fluctuations in the interstellar medium, as is found to be true for the low DM pulsars. This implies that the anomalous frequency dependence seen for the pulsars with high DMs is likely to be due to special scattering conditions along lines-of-sight probing the regions of the inner Galaxy. These results have been submitted for publication. *[Yahswant Gupta, O. Loehmer (MPIfR, Bonn), D. Mitra (MPIfR, Bonn & NCRA, Pune), M. Kramer (University of Manchester, UK) and A. Ahuja (IUCAA, Pune)].*

Study of subpulse drifting in wide profile pulsars (pulsars for which emission occurs for a wide longitude range) may help to interpret the nature

of the emission process in radio pulsars and understand the location and distribution of the emission regions in pulsar magnetosphere. We studied the pulsar PSR B0826-34. This is a wide profile pulsar which shows an interesting drift behaviour. Recent study of this pulsar has been done by Gupta et al. (2004). The GMRT observations of PSR B0826-34 were made at the frequencies 610 MHz, 1060 MHz. With frequency there is a remarkable evolution of the pulse profile for this pulsar. From our data we could make out this trend of change of average profiles. We have analyzed the 610 MHz data and have seen 6 to 7drift bands in the main pulse region (region I hereafter), as seen in 318 MHz. In addition to that we have seen 2 to 3 drift bands in the inter pulse region (region2 hereafter). In 1060 MHz the inter pulse dominates over the main pulse and we have observed 5 to 6 drift bands for region I and 4 to 5 drift bands for region II respectively. In this pulsar we see curved drift bands, indicating reversals of the drift direction. There are many interesting aspects of this pulsar which need to be studied in detail.

Parkes high Galactic latitude multibeam search: This is a survey with Parkes radio telescope using the 20 cm multi–beam receiver, to search for new and exotic millisecond pulsars in a region around the southern Galactic plane between longitudes 220° and 260° and latitudes $|b| < 60°$. The observations for the survey were completed in December 2002 and the data analysis has recently been completed. A total of 17 new pulsars have been discovered in this survey, including the first ever Double pulsar PSR J0737–3039A and PSR J0737–3039B. The detections in this survey are consistent with the expected number. Four of the new pulsars, are in binary systems and one is a young pulsar. The timing measurements of these pulsars are continuing at present. *[B.C. Joshi with M. Burgay, A. G. Lyne, R. N. Manchester, A. Possenti, F. Camilo, N. D'Amico, M. Kramer, M. McLaughlin, D. Lorimer].*

The two pulsars in the binary system J0737–3039 were discovered in the above survey. A 22-ms pulsar was discovered in April 2003. in a 2.4 hour binary system with another neutron star as companion. The system is the most relativistic binary system known and the relativistic advance of the periastron was soon measured. The estimated time of its merger (85 Myr) and shorter life-span implied an increase in the double neutron star merger rate by at least a factor of 10, significantly improving the chances of the detection of gravitational waves by earth based detectors such as LIGO. These findings were published in Nature by Burgay et al. in December, 2003.

Later, re-analysis of PSR J0737–3039A data revealed occasional strong pulsations at a period of 2.8 s. The second pulsar had the same dispersion measure as PSR J0737–3039A and an opposite Doppler variation of the period, confirming that this system is a **double pulsar** system — the **first** such system found to-date. The second pulsar is visible for two brief periods of 10 minute each and this pattern of visibility is essentially identical at all observing frequencies. Careful analysis of data also revealed a short eclipse of PSR J0737–3039A of about 20 s. The timing solutions for the two pulsars and the eclipse confirm the edge-on viewing geometry of the system. The mass of the two neutron stars were measured with unprecedented accuracy to be 1.33 $M_{\odot}$ and 1.25 $M_{\odot}$, the latter being the smallest known mass for a neutron star. These results were published in Science by Lyne et al. in January 2004.

The edge on nature of the orbit together with highly relativistic motion of the binary companions provides a unique opportunity for testing theories of gravity. The system is one of the most over-constrained for such tests with the knowledge of neutron star masses independent of theory of gravity and measurements of four Post Keplerian parameters. The system

will also provide an independent radiative test once the orbital decay due to gravitational radiation is measured. The radiation of PSR J0737–3039A passes through the magnetosphere of the slower pulsar, allowing a probe of the pulsar magnetosphere.

The Parkes High-latitude pulsar survey collaboration continues to monitor the system using various instruments across the world to study the above aspects of the system. The pulsar was observed using Chandra telescope and X-ray emission from the system was detected. The system is being observed using Parkes and Jodrell Bank radio telescope. Two observations of the pulsar at low frequency were carried out using Giant Meterwave Radio Telescope simultaneously with Parkes telescope this year obtaining the eclipse profile at low frequency which is shown in the Figure. The data were examined for drift modulation from the two pulsars and no drifting was detected. Further follow up observations of the system are proposed. *[B.C. Joshi with M. Burgay , A. G. Lyne, M. Kramer, R. N. Manchester, A. Possenti, N. D'Amico, F. Camilo, M. McLaughlin, D. Lorimer, J. Reynolds, J. Sarkissian].*

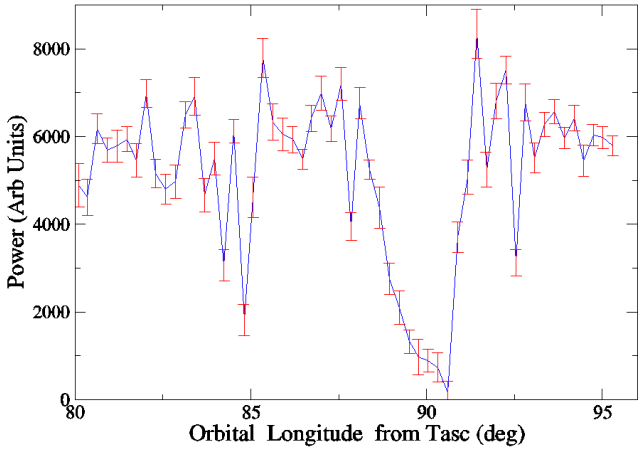


Fig: The short eclipse of PSR J0737–3039A by its companion J0737–3039B in the Double Pulsar system as observed at 344 MHz using GMRT in the phased array mode. The plot shows the average pulse power as a function of orbital longitude from the ascending node.

Extragalactic Astronomy

Variation of Fundamental Constants

A new technique to estimate variations in the fundamental constants using observations of the 18cm OH absorption lines was devised. In conjunction with observations of one additional transition (for example, an HCO^+ line), it is possible to simultaneously measure changes in α, g_p and $y \equiv m_e/m_p$. We used existing observations of these line redshifts in conjunction with GMRT observations of the OH 18 cm main lines in a gravitational lens at $z \sim 0.68$ to constrain changes in the above three parameters over the redshift range $0 < z < 0.68$. *[Jayaram N. Chengalur* with *Nissim Kanekar]*

Nearby Galaxies

GMRT observations at three frequencies (326, 615 and 1281 MHz) of the radio lobe spiral galaxy, NGC 3079 have been presented. These observations are consistent with previous data obtained at other telescopes and reveal the structure of the nuclear radio lobes in exquisite detail. In addition, new features are observed, some with HI counterparts, showing broad scale radio continuum emission and extensions. The galaxy is surrounded by a radio halo that is at least 4.8 kpc in height. Two giant radio extensions/loops are seen on either side of the galaxy out to $\sim$11 kpc from the major axis, only slightly offset from the direction of the smaller nuclear radio lobes. If these are associated with the nuclear outflow, then the galaxy has experienced episodic nuclear activity. Emission along the southern major axis suggests motion through a local IGM (not yet detected) and it may be that NGC 3079 is itself creating this local intergalactic gas via outflows. We also present maps of the minimum energy parameters for this galaxy, including cosmic ray energy density, electron diffusion length,

magnetic field strength, particle lifetime, and power. *[D.J. Saikia with Judith A. Irwin, Queen's University, Kingston].*

Synthesis maps of HI of the edge-on starburst NGC 5433 and its environment have been obtained with the VLA in its C and D configurations. The observations and spectral model residuals of the main disc emission in NGC 5433 reveal 3 extraplanar features. We associate 2 of these features with coherent extraplanar extensions across multiple spectral channels in our data, including a complete loop in position-velocity space. Interpreting the latter as an expanding shell we derive a corresponding input energy of 2×10^{54} ergs, comparable to that for the largest supershells found in the Galaxy and those in other edge-on systems. NGC 5433 is in a richer environment than previously thought. We confirm that KUG 1359+326 is a physical companion to NGC 5433 and find two new faint companions, both with Minnesota Automated Plate Scanner identifications, that we label SIS–1 and SIS–2. Including the more distant IC 4357, NGC 5433 is the dominant member of a group of at least 5 galaxies, spanning over 750 kpc in a filamentary structure. A variety of evidence suggests that interactions are occurring in this group. While a number of underlying mechanisms are consistent with the morphology of the high-latitude features in NGC 5433, we argue that environmental effects may play a role in their generation *[D.J. Saikia with Kristine Spekkens, Cornell University, USA and Judith Irwin, Queen's University, Canada].*

A multi-frequency radio continuum as well as HI study of the superwind galaxy NGC1482 with both the GMRT and the VLA has been made. This galaxy has a remarkable hourglass-shaped optical emission line outflow as well as bi-polar soft X–rays bubbles on opposite sides of the galactic disk. The low-frequency, lower-resolution radio observations show a smooth structure, while the high-frequency, high-resolution radio images of the central starburst region which is at the base of the superwind bi-cone

shows one prominent peak of emission and more extended emission. A comparison with images at different wavelengths shows that the peak of infrared emission is the only feature which is coincident with the prominent radio peak, and possibly defines the centre of the galaxy. The HI observations with the GMRT show two blobs of emission on opposite sides of the central region. These two blobs are located at $\sim$2 kpc from the centre with the western blob being red shifted by $\sim$100 km s^{-1} relative to the optical systemic velocity of 1916 km s^{-1} while the eastern one is blue shifted by $\sim$300 km s^{-1}. In addition, these observations also reveal a multi-component HI–absorption profile against the central region of the radio source. The approaching side is blue shifted by 227 km s^{-1} while the receding side is red shifted by 26 km s^{-1} relative to the optical heliocentric systemic velocity. The deepest absorption feature appears blue shifted by 76 km s^{-1}. These observations suggest that the HI gas clouds could be in the form of a ring with the different clouds moving outwards with different velocities due to the nuclear starburst, in addition to rotating about the centre. The energy from the starburst appears adequate to drive the HI clouds outwards *[Ananda Hota and D.J. Saikia]*.

The barred spiral galaxy NGC6764 with an active nucleus and a starburst in the nuclear region and a multi-phase superwind, has been studied in radio continuum as well as HI using both the GMRT and the VLA. The HI emission appears depleted in the nuclear region, possibly due to ionization by the central starburst. HI emission is seen in both ends of the stellar-bar, close to the regions of enhanced Hα emission. The high resolution 8 and 5 GHz VLA A-array images shows somewhat conical-shaped regions of radio-emitting plasma along the major axis on both sides of the nucleus while the 1.4 GHz VLA A-array image also shows radio-emitting bubbles along the minor axis of this galaxy. Hα emitting gas with

filamentary structures and X-ray emitting hot gas appear to be related to the radio bubbles *[Ananda Hota and D.J. Saikia]*.

We have analysed GMRT data at 1280, 610, 325 and 240 MHz towards a few members of the small group of galaxies Ho 124. A bridge of emission connecting NGC 2820, NGC 2820A and NGC 2814 is detected at 325 MHz. Combining this with earlier observations by others, we find that the bridge has a very steep spectral index α of 1.8 ($S \propto \nu^{-\alpha}$) compared to the individual galaxies ($\alpha \leq 0.8$). *[N.G. Kantharia, S. Ananthakrishnan, R. Nityananda]*.

Young radio sources

Compact Steep Spectrum (CSS) sources are a subclass of FRII radio sources having both linear sizes of less than 20 kpc and steep high frequency radio spectra. Observational evidence implies that these objects are young, and asymmetrically distributed gas is found close to their nuclei. Previous investigations have shown a high incidence of HI absorption from within their host galaxies against the CSS continuum emission. Implied HI column densities are of the order of 10^{20} cm^{-2}. A few CSSs have also been detected in CO and these objects offer the potential for investigating atomic and molecular gas at intermediate and high redshifts. In a search for HI absorption and OH emission or absorption against a sample of CSS and larger sources using both the GMRT and the the Arecibo 305-m telescope, there has been one new detection of a complex multi-component HI absorption system towards the radio source 3C258, and new or improved upper limits for the other sources. The astrophysical implications of the results are being explored. *[Neeraj Gupta and D.J. Saikia with Tapasi Ghosh and Chris Salter, NAIC, Arecibo, and S. Jeyakumar, Raman Research Institute]*.

Giant radio sources

Low-frequency GMRT observations at 333 and 617 MHz of the most-distant giant quasar J1432+158, which is at a redshift of 1.005, have been presented. The radio source has a total angular extent of 168 arcsec, corresponding to a projected linear size of 1.35 Mpc. This makes it presently the largest single object observed beyond a redshift of one. The objectives of the GMRT observations were to investigate the possibility of detecting a bridge of emission at low frequencies, which may be suppressed due to inverse-Compton losses against the cosmic microwave background radiation. We detect a jet-like structure connecting the core to the western hotspot, while the eastern hotspot is found to be largely tail-less with no significant bridge emission. The estimated life-time for the radiating electrons in the tail of the western lobe appears smaller than the travel time of the radiating particles from the hotspot, suggesting either in-situ acceleration or dissipation of energy by the jet at this location. The pressure of the intergalactic medium at $z \sim 1$ estimated from the minimum energy density calculations appears to be marginally lower than the value extrapolated from nearby giant radio galaxies. *[C. Konar and D.J. Saikia with Ashok K. Singal, Physical Research Laboratory, Ahmedabad].*

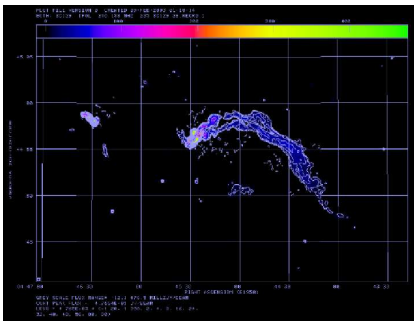
Multi-frequency observations with the GMRT and the VLA of a sample of seventeen largely giant radio sources (GRSs) have been presented. These observations have either helped clarify the radio structures or provided new information at a different frequency. The broad line radio galaxy, J0313+413, has an asymmetric, curved radio jet and a variable radio core, consistent with a moderate angle of inclination to the line of sight. We attempt to identify steep spectrum radio cores (SSCs), which may be a sign of recurrent activity, and find four candidates. If confirmed, this would indicate a trend for SSCs to occur preferentially in GRSs. From the structure and integrated spectra of the sources, we suggest that the lobes of

emission in J0139+399 and J0200+408 may be due to an earlier cycle of nuclear activity. We find that inverse-Compton losses with the cosmic microwave background radiation dominate over synchrotron radiative losses in the lobes of all the sources, consistent with earlier studies. We also show that the prominence of the bridge emission decreases with redshift, possibly due to inverse-Compton losses. This could affect the appearance and identification of GRSs at large redshifts. *[C. Konar, D.J. Saikia, C.H. Ishwara-Chandra and V.K. Kulkarni].*

Head–Tail Radio Sources

Head-tail radio sources, which are almost always associated with clusters of galaxies, are characterised by a highly elongated radio structure with the associated optical (usually giant elliptical) galaxy at one end. A classical example of this class is 3C 129 which, along with its companion 3C 129.1 (a wide-angle-tail), is a member of the X-ray cluster 4U 0446+44 (z=0.021) that happens to lie in the galactic plane. A variety of models have been proposed to explain the morphology and spectral index distribution of the head-tail sources and 3C 129. The main result is that the radio spectrum has been found to steepen with distance ($S_\nu \propto \nu^\alpha$, where S_ν and α are the flux density at frequency ν and the spectral index respectively) along the tail of 3C 129, and has been interpreted in terms of ageing of electron population. In our recent paper we presented results for 3C 129 and describe the morphological and spectral properties. The radio map of it using GMRT is presented alongside. We have studied in detail the morphology of the source and the distribution of spectral index over the object. We find large-scale spectral steepening along the jet away from the core. Using synchrotron spectral ageing theory, we infer the age (time since particle acceleration) of electrons at various locations along the jet and ascribe an age of $\sim$200 Myr to 3C 129. We also found that the "Crosspiece" has a spectral index of ~ -1, similar to the jet, which is not consistent with the suggestion

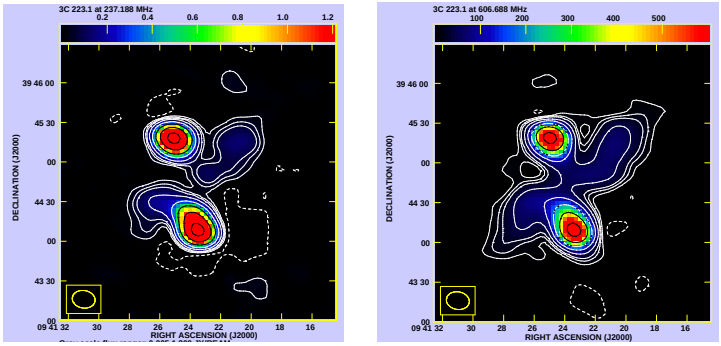
by Lane et al. (2002) that it could be a radio relic. *[Dharam Vir Lal and A. Pramesh Rao].*



X–shaped radio sources

A class of radio sources, "winged" or "X-type" are characterised by two low-surface-brightness lobes (the "wings") oriented at an angle to the "active", or high-surface-brightness radio lobes, giving the total source an 'X' shape; both sets of lobes pass symmetrically through the centre of the associated elliptical galaxy. The existence of such sources was recognized almost three decades ago. Many authors have attempted to explain the unusual structure in X-shaped sources; first attempt suggested that the jet direction processes due to a realignment caused by the accretion of gas with respect to the central BH axis. All the models known currently, can be grouped into the following four formation scenarios: (A) backflow from the active lobes into the wings, (B) slow, conical precession of the jet axis, (C) reorientation of the jet axis during which the flow continues, and (D) as model (C), but with the jet turned off or at greatly reduced power during the change of direction. Another recent model identifies the winged or X-type radio sources to be the candidates where super-massive BH are produced by galactic mergers. We have mapped the sample of such X-shaped sources with the GMRT with an aim to study radio morphology and spectral index gradients in the X–shaped sources. The radio map of X-shaped source, 3C 223.1 at 240 and 610 MHz using GMRT is shown

alongside. These observations provide for the first time high sensitivity radio images of them. *[Dharam Vir Lal, A. Pramesh Rao]*



Radio Galaxies and Quasars

High spectral resolution Australia Telescope Compact Array HI 21cm observations were obtained towards two extragalactic radio sources. The two lines of sight were selected on the basis of the simplicity of their absorption profiles and the strength of the background sources; the high velocity resolution of the spectra then enabled us to estimate the kinetic temperatures of the absorbing gas by fitting multiple Gaussians to the absorption profiles. Four separate components were detected toward the two sources, with estimated kinetic temperatures of $T_k = 3127 \pm 300$ K, 3694 ± 1595 K, 3500 ± 1354 K and 2165 ± 608 K respectively. All four components were thus found to have temperatures in the thermally unstable range $500 < T_k < 5000$ K; this suggests that thermal equilibrium has not been reached throughout the WNM. *[Jayaram N. Chengalur* with *Nissim Kanekar, NFRA, The Netherlands, Ravi Subrahmanyan, Australia National Telescope Facility, Australia* and *Vicky Safouris].*

GMRT HI data from the redshifted system 0902+34 in the 325 MHz band was analysed. A deep narrow component is detected but no broad component, reported earlier by others, is detected. No emission feature, reported by others, is detected to the north of the above object. Thus, only

a narrow HI feature is associated with the system. *[N.G. Kantharia, P. Chandra, G. Swarup, V. K. Kulkarni].*

New results were obtained on the radio dichotomy of QSOs, which continues to be a much debated issue. Many of these studies make use of the Palomar-Green Bright QSO sample, which is now known to suffer from major incompleteness. As an alternative to this a new, more complete large-sky area survey for bright QSOs has been carried out using the ESO telescopes. From this Hamberg-ESO survey, a well defined subset of 196 bright QSOs (covering 2715 sq. deg effective area of the sky) was observed with VLA at 5 GHz in the BnC configuration. In this study, no evidence was found for radio dichotomy of QSOs *[Gopal-Krishna* with *L. Wisotzki and C.S. Stalin].*

A Z-symmetric distortion was detected in the rare class of radio galaxies whose X-shaped radio lobes are suspected to result from the coalescence of two super-massive black holes (SMBH) situated at the nuclei of two large galaxies prior to their merger. This results in the spin-flip of the radio jet producing SMBH, accompanied by the emission of gravitational radiation. The newly found Z-symmetry of the older radio lobe pair is a tracer of the orbital rotation of the infalling SMBH, prior to the merger. This finding goes to support the SMBH merger model for the X-shaped radio galaxies and, at the same time, considerably diminishes the appeal of the otherwise attractive alternative model that invokes a diversion of the back flowing plasma in the radio lobes *[Gopal-Krishna* with *P. Biermann* and *P.J. Wiita, Georgia State University, USA].*

It was argued that the maximum attainable brightness temperature of the superluminal radio knots of quasars may be considerably suppressed due to the low energy cut-off in the relativistic electron population, which is found to occur near 0.1 GeV in some well known particle acceleration

models. This could explain the faster superluminal motion found in the VLBI surveys at higher frequencies, as well the apparent inability of most radio cores to even attain the brightness temperatures consistent with the equipartition condition. This mechanism may also play a significant role in causing X-ray variability of the kiloparsec-scale relativistic jets, and influence their detectability at higher redshifts, in spite of a much stronger cosmic microwave background *[Gopal-Krishna* with *P. Biermann* and *P.J. Wiita, GSU].*

A theoretical framework has been proposed for quasar jets, incorporating a pair plasma flow convecting Poynting flux. Conditions for the formation, stable propagation and termination of such ExB drift jets are examined and it is inferred that they are likely to be extremely relativistic mono-energetic pair-plasma jets. Observational evidence and some observational implications of this model are pointed out in the context of AGN and the evolved/young stellar systems in our galaxy *[Gopal-Krishna* with *W. Kundt].*

GMRT observations have been made for several high redshift galaxies and quasars ($z \sim 0.3$ to 5) for searching for associated absorption by neutral hydrogen (HI) with the objective of studying the properties of cold gas likely to be present in their surroundings. Properties of absorption line from surrounding neutral hydrogen gas in a radio galaxy at $z = 3.1$ observed with GMRT have been described. Data for 9 objects observed are being analyzed. *[S.K. Sirothia with G. Swarup, Poonam Chandra with Morganti].*

Dwarf Galaxies

Kinematics of Faint Dwarf Galaxies: Deep, high velocity resolution GMRT HI 21cm synthesis images of two faint dwarf galaxies DDO210 and GR8 were obtained. For both galaxies, the velocity field is quite regular. DD0210's velocity field is consistent with rotational motion and the derived

rotation curve has a peak rotation velocity of only ~ 8 km sec^{-1}, comparable to the random motions in the HI gas. After correcting for the dynamical support provided by random motion (the "asymmetric drift" correction), we find the corrected peak rotation velocity of ~ 16.0 km sec^{-1}. Mass modeling shows that the kinematics of DDO210 can be well fit with either a modified isothermal or an NFW halo (although in the case of an NFW halo the fit parameters are differ considerably from those expected from numerical simulations). For GR8 we find that neither pure rotation, nor pure radial motion alone can fit the observed velocity field; however a combination of radial and circular motions can provide a reasonable fit. The most natural interpretation is that the neutral ISM, in addition to rotating about the center, is also expanding outwards, as a result of energy input from the ongoing star formation in the galaxy. Support for this interpretation comes from the fact that the pressure in the HII regions in the galaxy is known to be substantially (~ 55 times) more than the average pressure in the gas disk. Several theoretical models also predict expulsion of the ISM in dwarf galaxies due to energy input from star formation. *[Ayesha Begum* and *Jayaram N. Chengalur]*

We obtained high velocity resolution (~ 1.6 kms^{-1}) GMRT HI 21 cm synthesis images of a sample of very faint ($M_B \leq -14$) dwarf irregular galaxies, as well as optical broad band images for some of our sample galaxies. We found that, despite being faint, all our sample galaxies showed large scale systematic gradients, as apposed to the earlier studies which found the velocity field of such faint galaxies to be chaotic. For some of our sample galaxies, the velocity fields are consistent with rigid body rotation. We derived rotation curves for the galaxies and fit mass models to them. We found acceptable fits using isothermal halos while NFW halos provided a poor fit to the data. Finally, we compiled from literature a sample of galaxies with HI synthesis observations and I band magnitudes. From this

sample we found, in agreement with earlier studies (which used single dish HI data), that dwarf galaxies tend to lie below the I band Tully-Fisher relation defined by brighter galaxies. *[Ayesha Begum and J.N. Chengalur]*

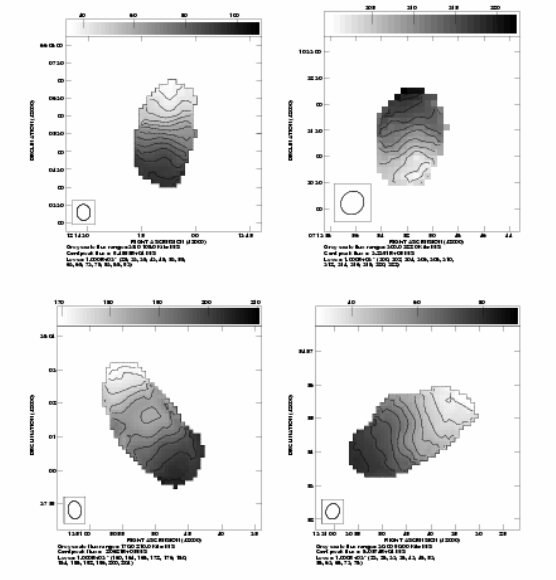


Figure 2: Velocity field of some faint dwarf irregular galaxies observed in HI emission with the GMRT

Instrumentation and Facilities

Ooty Radio Telescope

The 12-beam system of the ORT has been refurbished with improved IF and DC amplifiers. A new 12-beam data acquisition system has been written and being regularly used for observations. This new software also supports the display of four selected beams of the ORT on the monitor of the computer.

A modern, general purpose digital backend is being built for the ORT in collaboration with the Raman Research Institute, Bangalore. In this system, the IF signals reaching the receiver room from each of the 22 modules of ORT will be directly digitised and the entire processing (currently being done in analog systems) will be replaced by a

reconfigurable system based on high density field programmable gate arrays (FPGA) and a DSP-based controller. The system can be reconfigured in a variety of ways including those necessary to support the ongoing observational programmes. It is expected that the digitally formed beams will have a higher sensitivity compared to the existing system both due to the broader bandwidth and the possibility of complex correlators between north and south modules. In addition, it will be possible to carry out a variety of new types of spectral line observations including the incoherent addition of power spectra of signals reaching individual modules for in a very sensitive search for deuterium lines.

At present, new analog systems to tap the module outputs at PA-1 level and provide suitable amplifiers and filters have been built and tested. A choice of two filters has been provided for each module — one with a 12 MHz bandwidth and the other a narrow band filter with 800 kHz bandwidth. The digital systems have been designed at RRI and most of the PCBs required for the systems have been fabricated and being tested in Bangalore.

Giant Metrewave Radio Telescope

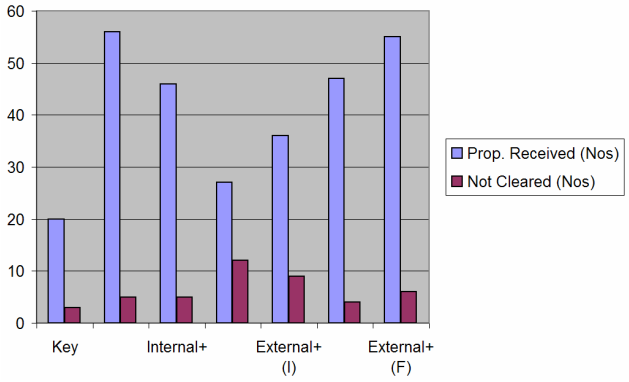
GTAC Activities

From the beginning of 2002, the GMRT has run as a full fledged international observational facility for radio astronomy below 1.4 GHz, in five cycles. Each cycle, approximately six months, consisted of ~40 proposals referred and allotted time by an independent GMRT Time Allocation Committee (GTAC). To allow for such extensive routine operation, teams of engineering staff were on rota duty at the GCC (GMRT Control Centre) and were able to maintain availability of 27 or more antennas for most of the time, through preventive maintenance, build up of

spares, close monitoring and rapid replacement. Approximately, thirty six hours are used for a weekly maintenance shutdown, and in addition two one-month shutdowns were needed for work on the correlators and other systems. The statistics from the five cycles are show below.

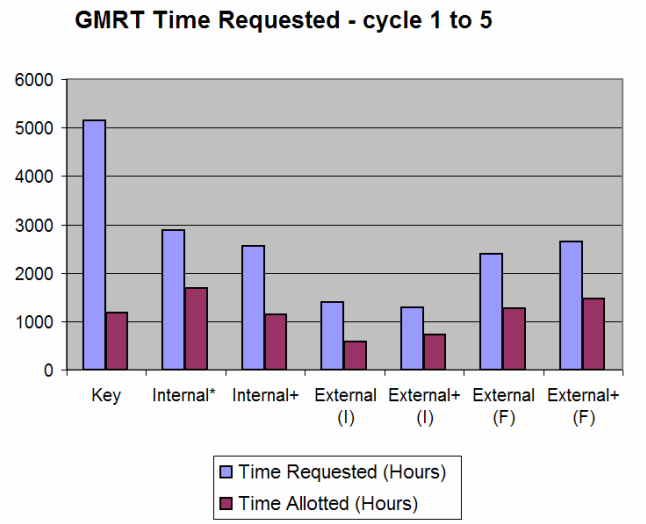
Categories	Prop. Received	Time Requested	Time Allotted	Not Cleared
	(Nos)	(Hours)	(Hours)	(Nos)
Key	20	5145	1175	3
Internal*	56	2891	1691	5
Internal+	46	2561	1142	5
External (I)	27	1396	589	12
External+ (I)	36	1294	722	9
External (F)	47	2400	1274	4
External+ (F)	55	2643	1474	6
Total	**287**	**18330**	**8067**	**44**

GMRT Proposals received - cycle 1 to 5

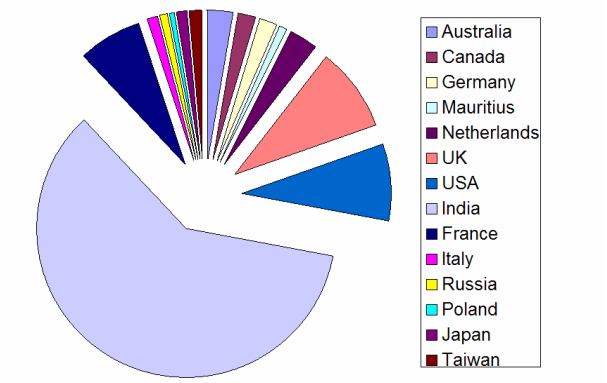


Categories

Key:	Key proposals
Internal:	PI and Co-PIs from TIFR
Internal+:	PI from TIFR, Co-PI non-TIFR
External (I):	PI & Co-PIs not from TIFR, but from other Indian Inst.
External+ (I):	PI non-TIFR, with atleast one Co-PI from TIFR
External (F):	PI & Co-PIs from abroad.
External+ (F):	PI from abroad, with atleast one Co-PI from TIFR
Key Projects:	Disk Galaxies, Clusters of Galaxies, Gal Plane, DLA



Countrywise distribution of GMRT proposals : Cycle 1 to 5



Country	No. of proposals
Australia	8
Canada	5
Germany	6
Mauritius	2
Netherlands	9
UK	26
USA	23
India	169
France	20
Italy	3
Russia	2
Poland	2
Japan	3
Taiwan	4
Total 1 to 5	**282**

Instrumentation and upgrade

Low loss flexible foam cables with 10 times better phase stability with respect to temperature were installed in all the GMRT antennas and performance tested. With this the gain limitation problem of the receiver at the high frequency bands got solved because of the 9 dB improvement at the highest operating sub-band. *[A. Praveen Kumar, H.S. Kale, Anil Raut].*

L-band feed and Front-end, with reliable interconnections and packaging were installed and tested in 17 antennas. *[A. Praveen Kumar, Anil Raut].*

Wideband high dynamic range low noise amplifier was designed as a common amplifier for all the frequencies and several units with repeatable performance were tested in GMRT antennas. *[A.Praveen Kumar].*

High dynamic range 150 MHz front-end units were designed incorporating notches at several frequencies where interference levels were very high *[B. Ajit Kumar, A. Praveen Kumar].*

Four units were produced and their performances evaluated for repeatability and reliability. *[Anil Raut, A. Praveen Kumar, Sandeep Chakravarthy].*

Library

About 600 books were added both at NCRA and GMRT Observatory libraries. NCRA and GMRT Observatory libraries have separate web pages.

Library initiated Digital library project in 2002. In the first phase scanning of all technical reports (about 2000 pages) available in the library were completed. Now all the technical reports are available in full text format. http://www.ncra.tifr.res.in/~library/technical/reports.html

In the next phase library initiated scanning of all astronomical slides available in the library. There are about 600 slides available in the library. All these slides are available online for the NCRA users.

http://www.ncra.tifr.res.in/~library/images/index.html

Library has also completed compiling a list of papers published using Ooty Radio Telescope. This list is now compiled and is made available through library web page.

http://www.ncra.tifr.res.in/~library/ootypub/maintable1.html

National and International Involvement (Professional and Academic)

S. Ananthakrishnan

Member, Site Evaluation and Selection Committee, Square Kilometer Array, the Netherlands

Member, International Engineering Management Team, Square Kilometer Array, the Netherlands.

Jayaram N. Chengalur

Member SOC, IAU25 JD 21, "Astrochemsitry of external galaxies", Sydney Australia.

Gopal Krishna

Coordinator, GMRT Time Allocation Committee (GTAC).

Member, SOC for Joint Discussion Group 18 on 'Quasars, cores & Jets' IAU General Assembly, August 2003, Sydney, Australia.

Member, Physical Sciences Research Committee of CSIR.

R. Nityananda

Editor, Journal of Astronomy and Astrophysics.

Co-ordinator, Astronomy Sector, Indo-Japan Cooperative Science Programme of Department of Science and Technology, Government of India.

Member, Academic Programme Advisory Committee, S.N. Bose National Centre for Basic Sciences, Kolkata.

Member, Joint National Committee for Pure and Applied Physics (IUPAP) and Astronomy (IAU), INSA.

D.J. Saikia

Associate Editor, Bulletin of the Astronomical Society of India.

Member, review committee for IUCAA associates in Astrophysics.

Member, Advisory Committee for the Centre for Space Physics, Kolkata.

T.L. Venkatasubramani

Member, Radio Astronomy Frequency Committee for the Asia Pacific (RAFCAP)

Member, Review Panel of National Frequency Allocation Planning 2002

Member, National Working Groups for World Radio Communication Conference — 2007

Visits

S. Ananthakrishnan

Visited as Distinguished Visiting Fellow, ATNF, Sydney, Australia
June 15 – August 3, 2003.

IAU 2003, Sydney
July 12 – 23, 2003.

SKA meeting, Geraldton, Australia
July 26 – August 3.

SKA meeting, Cape Town, South Africa
January 9–19, 2004.

Sunita Barve

Special Librariaes Association's annual conference
Los Angeles in U. S. A.
June 7 – 14 June, 2002 in

Sterrenkundig Instituut Anton Pannekoek, Amsterdam, The Netherlands
June 15 –30, 2002.

Institut dAstrophysique in Paris, France
June 25 – 26, 2002.

Library and Information Science in Astronomy (LISA IV) conference IV
Prague, Czechoslovakia Republic
July 2 – 5, 2002.

Strahoviensis in Prague, Czechoslovakia
July 4, 2002.

Sharing of E-journals through consortia in Indian libraries
roundtable meeting, Indian Institute of Astrophysics, Bangalore
November 28 – 29, 2002.

Forging collaborative partnerships: consortium of libraries of DAE institutions and FORSA libraries meet
TIFR, Mumbai
July 28–30, 2003

Humbolt Bibliothek Reinickendorf library Berlin, Germany
August 1–9, 2003.

69th International Federation of Library Associations and Institutions (IFLA) annual conference, Berlin
1–9 August 2003.

Ayesha Begum

IAU General Assembly Meeting
Sydney, Australia
July 21–25, 2003

Australian Telescope National Facility (ATNF)
Sydney, Australia
July 27–30, 2003

University of Melbourne
Melbourne, Australia
August 1–5, 2003

Bhaswati Bhattacharya

Supernovae and their connections to gamma-ray bursts and pulsars
TIFR, Mumbai, India
January 19 – January 23, 2004

Gopal Krishna

Max-Planck-Institut f. Radioastronomie, Bonn,
May-July, 2003

Max-Planck-Institut f. Radioastronomie, Bonn
October – December, 2003

Institute d' Astrophysique, Paris, France
March, 2004

Yashwant Gupta

Radiocommunication Conference 2003,
International Telecommunication Union
Geneva, Switzerland, June 9 – July 4, 2003

Department of Physics, The American College, Madurai
September 22 – 26, 2003

National Conference on Radio Science in India (INCURSI-2003)
National Physical Laboratory, New Delhi
November 27 – 29, 2003.

C.H. Ishwara-Chandra

International Space Science Institute, Bern, Switzerland
Search for radio emissions from extrasolar planets, lead by Dr. Daniel Winterhalter of JPL, NASA, March 8 – 12, 2004.

CE Saclay DSM, DAPNIA, Service d'Astrophysique, France
March 15 – 18, 2004

25th General Assembly of the International Astronomical Union and the IAU Symposium 128 "Young Neutron Stars and their Environments"
Sydney, Australia
July 14–17, 2003.

Bhal Chandra Joshi

25th General Assembly of International Astronomical Union
Sydney, Australia
July 13 – July 26, 2003

IAU Symposium 218, "Young Neutron Stars and their Environments"
Sydney, Australia
July 14 - July 17, 2003

Baseband Systems and Coherent Dedispersion
Sydney, Australia
July 18, 2003

Supernovae and their connections to gamma-ray bursts and pulsars
TIFR, Mumbai, India
January 19 – January 23, 2004

P.K. Manoharan

Goddard Space Flight Center, NASA, USA
April 1 to 11 November 2003

R. Nityananda

Visited as Distinguished Visiting Fellow, ATNF, Sydney, Australia
July 23– August 14, 2003.

IAU 2003, Sydney
July 12 – 23, 2003.

SKA meeting, Geraldton, Australia
July 26 – August 3, 2003.

University of Melbourne
August 3, 2003

A. Praveenkumar

Search Conference, Technical Teacher's Training Institute,
Cusrow Wadia College of Engineering & Technology, Bhopal
June 5, 2003.

T.L. Venkatasubramani

Technical laboratories, ASTRON, The Netherlands
May 25 – June 7, 2003

WRC-2003 as a Delegate of the Govt. of India,
Geneva, Switzerland
June 8–28, 2003

Awards and Distinctions

S. Ananthakrishnan

Elected, Fellow of Indian National Science Academy, 2004.

Sunita Barve

Special Library Association's (SLA, USA) International Membership
Librarian Award for the year 2002–2003.

Invited Talks (Speaker, Title, Occasion, Place, Date)

S. Ananthakrishnan

The making of the Giant Metrewave Radio Telescope
ATNF, Sydney
June 25, 2003

GMRT — Instrumentation & Systems
ATNF, Sydney
June 26, 2003

GMRT for users
ATNF, Sydney
June 27, 2003.

Sun and Space weather
ATNF, Sydney
June 30, 2003

GMRT — An introduction
73rd Annual session of the National Academy of Sciences, Allahabad
PRL, Ahmedabad
October 10 – 12, 2003.

Proposed 1 Billion Dollar 'Square Kilometer Array'
National Conference on Radio Science
November 27–29, 2003, NPL, New Delhi

Ayesha Begum

Dark matter distribution in faint dwarf galaxies
SNAG Talk, Indian Institute of Astrophysics, Bangalore, India
May 28, 2003.

HI in faint dwarf irregular galaxies
University of Melbourne, Melbourne, Australia
August 4, 2003.

Kinematics of extremely faint dwarf galaxies
IAU General Assembly meeting, Sydney, Australia
July 23, 2003.

A study of faint dwarf irregular galaxies
GS75, NCRA, Pune
March 23, 2004.

Jayaram N. Chengalur

High resolution spectroscopy with the Giant Meterwave Radio Telescope
IAU JD 20: Frontiers of high resolution spectroscopy, Sydney, Australia,
24 July, 2004.

Constraing the variation of fundamental constants using 18cm oh lines
Free Meson Seminar, TIFR Mumbai
18 March, 2004.

Gopal Krishna

Radio dichotomy of quasars
Astrophysikalisches Institut, Potsdam, Germany
November 2003

Yashwant Gupta

Radio pulse observations of neutron stars: A review
Young Neutron Stars and their Environments, 25th General Assembly and IAU Symposium 128, Sydney, Australia
July 14–17, 2003

Radio Astronomy with the GMRT
National Conference on Radio Science in India (INCURSI-2003)
National Physical Laboratory, New Delhi
November 27 – 29, 2003.

Single Pulse Studies of Pulsars with the GMRT
Supernovae and their connections to Gamma-ray bursts and Pulsars, TIFR, Mumbai
January 19 – 23, 2004.

The Discovery of the First Pulsar with the GMRT
Supernovae and their connections to Gamma-ray bursts and Pulsars, TIFR, Mumbai
January 19 – 23, 2004.

C.H. Ishwara-Chandra

Radio Astronomy
IEEE Student's chapter, Kamala Nehru Engineering College, Nagpur
August 24, 2003.

Bhal Chandra Joshi

Cluster Benchmarking
Baseband Systems and Coherent Dedispersion
Sydney, Australia
July 18, 2003

Pulsar Instrumentation at GMRT
Baseband Systems and Coherent Dedispersion
Sydney, Australia
July 18, 2003

Giant pulses in millisecond pulsars
Supernovae and their connections to gamma-ray bursts and pulsars
TIFR, Mumbai
January 23, 2004

R. Nityananda

Radio Astronomy and the GMRT
Inaugural talk at the National Camp, Indian Astronomy Olympiad, Nehru Science Centre, Mumbai
May 10 – 24, 2004.

Gravity and Light
ATNF Sydney
August 12, 2003

Gravity and Light
University of Melbourne
August 14, 2003.

Conference Organised by the School / Deptt. / Group

School on Synthesis Imaging, NCRA–TIFR, Pune, June 2–22, 2003.

A school on synthesis imaging in Radio Astronomy was organized at NCRA from 2nd to 22nd June 2003. The primary target audience was research scholars and postdocs working in astronomy or closely related fields. There were about 20 participants from across the country. Topics covered in the school included random signals, fourier transforms, elementary digital signal processing, single dish telescopes, aperture synthesis,imaging and deconvolution, calibration and sensitivity of interferometers, wide field imaging and polarimetry. In addition all students did a project involving taking and analyzing GMRT data. *[Jayaram N. Chengalur]*

Digital Libraries
Nov 30 – Dec 1, 2003

2-day workshop on "Building digital libraries using greenstone digital library software", Bioinformatics Centre, Pune, November 30 –December 1, 2003. *[Sunita Barve].*

Library Web-page
Feb 22, 2004

1-day workshop on "Creating web page of the library using Microsoft FrontPage", Department of Library and Information Science, University of Pune, February 22, 2004. *[Sunita Barve].*

GS-75, GMRT Observatory, Khodad and NCRA Campus, Pune
March 22-23, 2004.

A lively 2 day workshop was organized in connection with the 75th birthday of Prof. Govind Swarup, during March 22–23, 2004. On March 22, the workshop had a technical session at GMRT Observatory, in which there were 50 participants from India; Dr. W. Baan, Director of Westerbork Observatory, Netherland also attended the workshop. There were 11 invited talks on different technical aspects ranging from new prototype antenna construction and a new Cluster Array and a new Satellite astronomy facility to different GMRT upgrades.

On the second day there were 9 presentations at NCRA auditorium which covered a wide range of scientific topics such as Dwarf Galaxies, Supernovae, interstellar clouds, Pulsars, gravitational lens, X-shaped radio sources, galaxy evolution and galactic centre. Prof. Swarup gave his comments on the whole meeting.

Many speakers and letters from abroad commented on the sterling contribution made by Prof. Govind Swarup to the Indian astronomy and technology growth over the past more than 40 years.

Non DAE Research Projects (Investigators, Title, Funding Agency, Duration)

Publications

a) In Journals

R. Nityananda
Phase Space and the Optics–Mechanics Analogy
Physics Education, 223 (2003)

V. Balasubramanian, P. Janardhan, S. Srinivasan, and **S. Ananthakrishnan**
Interplanetary scintillation observations of the solar wind disappearance event of May 1999
Journal of Geophysical Research, **108**, 1121, (2003).

Ayesha Begum and **Jayaram N. Chengalur**
Kinematics of two dwarf galaxies in the NGC 6946 group
A&A, astro-ph/0406211 (2004).

Ayesha Begum and **Jayaram N. Chengalur**
Kinematics of the dwarf irregular galaxy GR8
A&A, **409**, 879 (2003).

Ayesha Begum and **Jayaram N. Chengalur**
Kinematics of the faintest gas rich galaxy in the Local Group: DDO210
A&A, **413**, 525 (2004).

P.K. Manoharan and M.R. Kundu
Coronal Structure of a Flaring Region and Associated Coronal Mass Ejection,
Astrophysical Journal, **592**, 597, (2003).

N. Gopalswamy, **P.K. Manoharan** and S. Yashiro
Comment on "Coronal mass ejections, interplanetary ejecta and geomagnetic storms by H.V. Cane et. al.",
Geophysical Research Letters, **30**, 2232, (2003).

Jayaram N.Chengalur and Nissim Kanekar
Widespread acetaldehyde near the Galactic Centre
A&A (Let), **403**, 43, (2003).

Ayesha Begum and **Jayaram N. Chengalur**
Kinematics of the dwarf irregular galaxy GR8
A&A, **409**, 879, (2003)

Nissim Kanekar, **Jayaram N. Chengalur**, A. G. de Bruyn and D. Narasimha
Detection of OH and wide HI absorption towards B0218+357
MNRAS (Let), **345**, 7, (2003).

Jayaram N. Chengalur and Nissim Kanekar
Constraining the variation of fundamental constants using 18cm OH lines
Phy. Rev. Let., **91**, 241302, (2003).

Nissim Kanekar, Ravi Subrahmanyan, **Jayaram N. Chengalur** and Vicky Safouris
The temperature of the warm neutral medium in the Milky Way
MNRAS (Let), **346**, 57, (2003).

Ayesha Begum and **Jayaram N. Chengalur**
Kinematics of the faintest gas rich galaxy in the Local Group: DDO210
A&A, 413, 525, (2004).

Gopal-Krishna, P.L. Biermann and P.J. Wiita
The Origin of X-shaped Radio Galaxies: Clues from the Z-Symmetric Secondary Lobes
Astrophys. J. Letters, **594**, L103, (2003)

Gopal-Krishna and P.J. Wiita
Did radio galaxies play a role in the evolution of the universe?
Invited talk at the 22nd meeting of the Astronomical Society of India
Bull. Astr. Soc. India, **31**, 215, (2003)

Gopal-Krishna, A.R. Dhakulkar, P.J. Wiita, and S. Dhurde
Radio Emission and the Optical Isophotal Twist of Radio-Loud Ellipticals
Astron. Astrophys., **410**, 139, (2003)

Gopal-Krishna, P.L. Biermann, & P.J. Wiita
Brightness Suppresion of Relativistic Radio Jets of Quasars: The Role of the Lower Electron Energy Cut-off
Astrophys. J. Letters, **603**, L9, (2004)

R. Sagar, C.S. Stalin, **Gopal-Krishna**, & P.J. Wiita
Intranight Optical Variability of Blazars
Mon. Not. Royal Astron.Soc., **348**, 176, (2004)

C.S. Stalin, **Gopal-Krishna**, R. Sagar, & P.J. Wiita
Intranight Optical Variability of Radio Quiet and Radio Lobe Dominated Quasars
Mon. Not. Royal Astron. Soc., **350**, 175, (2004)

C. H. Ishwara-Chandra, K. S. Dwarakanath and K. R. Anantharamaiah
GMRT Detection of HI 21 cm-line Absorption in the high redshift red quasar 3C 190
JA&A, **24**, 37, (2003)

S.V. Vadawale, A.R. Rao, S. Naik, J.S. Yadav, **C.H. Ishwara-Chandra**, **A. Pramesh Rao** and G. G. Pooley
On the origin of various types of radio emission in GRS 1915+105.
ApJ, **597**, 1023, (2003).

S.Q. Park, J.M. Miller, J.E. McClintock, R.A. Remillard, J.A. Orosz, C.R. Shrader, R.W. Hunstead, D.Campbell--Wilson, **C. H. Ishwara-Chandra**, **A. Pramesh Rao**, M. P. Rupen
Spectral and Timing Evolution of the Black Hole X-ray Nova 4U 1543–47 During its 2002 Outburst.
ApJ, in press, (2004).

P.C. Freire, Y. Gupta, S. M. Ransom, **C. H. Ishwara-Chandra**, V.M. Kaspi
A Millisecond pulsar in a very eccentric system
ApJL, **606**, 53, (2004).

Neeraj Gupta, R. Srianand, P. Petitjean and C. Ledoux
Outflowing material in the zem = 4.92 BAL QSO SDSS J160501.21–011220.0
A&A, **406**, 65, astro-ph/0305124 (2003)

Judith A. Irwin and **D.J. Saikia**
Giant Metrewave Radio Telescope observations of NGC 3079
MNRAS, **346**, 977, astro-ph/0309373 (2003)

D.J. Saikia and **Neeraj Gupta**
Polarization asymmetry in CSS sources: evidence of AGN fuel?
A&A, **405**, 499, astro-ph/0304532 (2003)

Ashok K. Singal, **C. Konar** and **D.J. Saikia**
J1432+158: the most distant giant quasar
MNRAS, **347**, 79P, astro-ph/0312296 (2004)

Subhashish Roy and **A. Pramesh Rao**
Sgr A* at low radio frequencies: Giant Metrewave Radio Telescope observations
MNRAS, **349**, L 25, (2004).

M. Kramer, A. Karastergiou, **Y. Gupta,** S. Johnston, N.D.R. Bhat, and A.G. Lyne,
Simultaneous Single-pulse Observations of Radio Pulsars. IV. Flux Density Spectra of Individual Pulses
A&A, **407**, 655 (2003).

Dharam Vir Lal and **A. Pramesh Rao**
Low frequency observations of a head-tail radio source.
Bull. Astron. Soc. India, **31**, 427, (2003)

Dharam Vir Lal and **A. Pramesh Rao**
3C 129: The GMRT observations
A&A, **420**, 491, (2004)

Dharam Vir Lal, P. Shastri and D.C. Gabuzda
Milliarcsec-scale radio structure of a matched sample of Seyfert 1 and Seyfert 2 galaxies
Accepted for publication in *A&A*.

V. Balasubramanian, P. Janardhan, S. Srinivasan and **S. Ananthakrishnan**
IPS Observations of the Solar wind Disappearance Event of May 1999
JGR, **108**, A 3, 1121 (2003).

S. Ananthakrishnan, N.G. Kantharia and **R. Nityananda**
Extra-Planar Radio Emission from Edge-on Disk Galaxies
Bull. Astron. Soc. of India, **31**, 421 (2003).

Prasad Subramanian, **S. Ananthakrishnan**, P. Janardhan, M.R. Kundu, S.M. White and V.I. Garaimov
Giant Meterwave Radio Telescope Observations of an M2.8 Flare: Insights into the initiation of a Flare-Coronal Mass Ejection Event
Solar Physics, **218**, 247, (2003).

M.R. Kundu, S.M. White, V.I. Garaimov, **P.K. Manoharan**, P. Subramanian, **S. Ananthakrishnan** and P.Janardhan
Radio Observations of Rapid acceleration in a Slow Filament Eruption/Fast Coronal Mass Ejection Event
Ap. J, **607**, 530, (2004).

A. Pramesh Rao, C.H. Ishwara-Chandra and D. Bhattacharya.
GRB 030329: radio observations at GMRT
GCN, **2073**, 1, (2003)

A. Pramesh Rao, C.H. Ishwara-Chandra and D.Bhattacharya
GRB 030329: Further radio observations at GMRT
GCN, **2268**, 1, (2003).

G. Swarup
Search for HI Reionization Epoch in the Early Universe
Bull. Astron. Soc. India, **31**, 451 (2003).

B.C. Joshi, M. Kramer and A.G. Lyne
Next generation software based instruments for pulsar astronomy
BASI, **31**, 237, (2003)

M. Kramer, J.F. Bell, R.N. Manchester, A.G. Lyne, F. Camilo, I.H. Stairs, N. D'Amico, V.M. Kaspi, G. Hobbs, D.J. Morris, Crawford, A. Possenti, **B.C. Joshi,** M. McLaughlin, D. Lorimer, A. Faulkner,
The Parkes Multibeam Pulsar Survey — III. Young pulsars and the discovery and timing of 200 pulsars
MNRAS, **342**, 1299, (2003)

M. Burgay, N. D'Amico, A. Possenti, R.N. Manchester, A.G. Lyne, **B.C. Joshi,** M.A. McLaughlin, M. Kramer, J.M. Sarkissian, F. Camilo, V. Kalogera, C. Kim, D. Lorimer,
An increased estimate of the merger rate of double neutron stars from observations of a highly relativistic system
Nature, **426**, 531, (2003)

V. Kalogera, C. Kim, D. Lorimer, M. Burgay, N. D'Amico, A. Possenti, R.N. Manchester, A.G. Lyne, **B.C. Joshi,** M.A. McLaughlin, M. Kramer, J.M. Sarkissian, F. Camilo,
The Cosmic Coalescence Rates for Double Neutron Star Binaries
ApJ, **601**, L179, (2004)

A.G. Lyne, M. Burgay, M. Kramer, A. Possenti, R.N. Manchester, F. Camilo, M.A. McLaughlin, D.R. Lorimer, N. D'Amico, **B.C. Joshi**, J. Reynolds, P. Freire,
A Double-Pulsar System: A Rare Laboratory for Relativistic Gravity and Plasma Physics,
Science, **303**, 1153, (2004)

X-Ray Emission from the Double Pulsar System J0737–3039
M.A. McLaughlin, F. Camilo, M. Burgay, N. D'Amico, **B.C. Joshi**, M. Kramer, D.R. Lorimer, A.G. Lyne, R.N. Manchester, A. Possenti,
ApJ, **605**, L41, (2004)

b) In Proceedings

Ayesha Begum and **Jayaram N. Chengalur**
Kinematics of Extremely Faint Dwarf Galaxies
IAU Symp. 220, Dark Matter in Galaxies, 2004.

Jayaram N. Chengalur and Nissim Kanekar
Spin Temperature in High Redshift Dlas
to appear in proceedings of *IAU JD15* (2003).

Jayaram N. Chengalur
High Resolution Spectroscopy with the GMRT
to appear in proceedings of *IAU JD20* (2003).

Ayesha Begum and **Jayaram N. Chengalur**
Kinematics of Extremely Faint Dwarf Galaxies
to appear in proceedings of *IAU SS220*.

Gopal-Krishna and P.J. Wiita
Radio Galaxies and the Magnetization of the Intergalactic Medium
Invited talk at the Workshop: Radio Astronomy at the Fringe,
T. Zensus, M. Cohen & E. Ros (eds.), *ASP Conf. Series*, **300**, 293, (2003)

Gopal-Krishna, P.J. Wiita and M.A. Osterman
Radio Galaxies and the Star Formation History of the Universe
S. Collin, F. Combes & I. Shlosman (eds.), *ASP Conf. Series*, 298, (2003)

Sunita Barve and **Gopal-Krishna**
Analysis of the Publication Patterns of Radio Astronomers from India
During 1990-2001
Proc. of LISA Conf. IV: B. G. Corbin, E. P. Bryson & M. Wolf (eds.),
(U.S. Naval Observatory), 298, (2003)

Gopal-Krishna, P.J. Wiita & M.A. Osterman
Radio Galaxies and the Star Formation History of the Universe
in Active Galactic Nuclei: from Central Engine to Host Galaxy, S.
Collin, F. Combes and I. Shlosman (eds.), *ASP Conference Series*, **290**,
319, (2003).

S. Ananthakrishnan, N.G. Kantharia, R. Nityananda
Proceedings of the XXI Astronomical Society of India, Thiruvananthapuram, (Bulletin of the Astronomical Society of India) Conference Series, **31**, 421, (2003).

D. J. Saikia, N. G. Kantharia, A. Hota, B. Phookun, A. Pedlar, K. Kohno
Active Galactic Nuclei: from Central Engine to Host Galaxy
ASP Conference Series, **290**, 543, (2003).

A. Chuprikov, **C.H. Ishwara-Chandra**, S. Likhachev, I. Guirin, G.S. Tsarevsky
GMRT low frequency observations of microquasar candidates.
Poster paper, JENAM, (2003)

A. Bhardwaj, **C.H. Ishwara-Chandra**, N. Udaya Shankar, R. F. Elsner, G.R. Gladstone, G.K. Beeharry
First GMRT Observations of Jupiter's Radio Emissions
Invited talk, *INCURSI*, (2003)

G. Sankarasubramanian and **S. Sureshkumar**
A Quasi-Analog Beam-forming Technique for Antenna Arrays
INCURSI
PJ5, 150, (2003)

Ananda Hota and **D.J. Saikia**
Radio study of a superwind galaxy: NGC1482
Proc. of the 22nd meeting of the ASI, *BASI*, **31**, 425 (2003)

Judith A. Irwin and **D.J. Saikia**
GMRT observations of NGC 3079
J. R. Astron. Soc. Can., **97**, 214 (2003)

Chiranjib Konar, **D.J. Saikia**, **C.H. Ishwara-Chandra** and **V.K. Kulkarni**
A study of giant radio galaxies
Proc. of the 22nd meeting of the ASI, *BASI*, **31**, 437 (2003)

D.J. Saikia and **Neeraj Gupta**
Polarization asymmetry in CSS sources: evidenc of AGN fuel?
Proc. of the 22nd meeting of the ASI, *BASI*, **31**, 441 (2003)

C.J. Salter, S. Jeyakumar, **D.J. Saikia**, T. Ghosh, and J. Stutzki
HI absorption towards compact steep spectrum radio sources
AAS Meeting N0. 202, Abstract 42.10 (2003)

S. J. Pandharpure, T. L. Venkatasubramani, J. Ponsanby
INCURSI-2003, (2003)

Y. Gupta
Radio Pulse Observations of Neutron Stars: A Review
Young Neutron Stars and their Environment,
Proc. IAU 218 (2003).

J. Kijak, **Y. Gupta**, K. Krzeszowski, and W. Lewandowski
Flux Monitoring at 5 GHZ and the ISM
Young Neutron Stars and their Environment,
Proc. IAU 218 (2003).

A. Karastergiou, S. Johnston, M. Kramer, N.D.R. Bhat, **Y. Gupta**
Single Pulses Observed Over a Broad Frequency Range
Young Neutron Stars and their Environment,
Proc. IAU 218 (2003).

S. Ananthakrishnan and **A. Pramesh Rao**
The Giant Metrewave Radio Telescope
Multicolour Universe, Proc. of TIFR Int'l conf. eds. R.K.Manchanda and B.Paul, 233, (2002).

S. Ananthakrishnan and M. Kojima
Remote Sensing of the Inner Heliosphere
Commission 49: Interplanetary Plasma and the Heliosphere — IAU Highlights, Reports on Astronomy, XXVA, 1001–1003, (2003)

B.C. Joshi, A.G. Lyne, M. Kramer, D.R. Lorimer,C. Jordan, A. Holloway, T. Ikin, I.H. Stairs,

Coherent On-line Baseband Receiver for Astronomy
Radio Pulsars, ASP Conference Proceedings Series, Eds. Bailes Matthew, Nice J. David and E. Stephen Thorsett. San Francisco: 302, 321, (2003)

B.C. Joshi, M. Kramer, A.G. Lyne, M.A. McLaughlin, I.H. Stairs,
Giant Pulses in Millisecond Pulsars
Young Neutron Stars and Their Environments, IAU Symp. 218, Eds. Fernando Camilo and Bryan M. Gaensler. San Francisco : p.319, (2004)

c) In Books

P.K. Manoharan
The Solar Wind,
Lectures on Solar Physics, (eds. H.M. Antia et al.),
Springer-Verlag Heidelberg, **619**, 299, (2003).

R. Nityananda
Wave Optics
Physics Text Book for Class XII
NCERT, New Delhi

d) Books/Book Reviews

Low Frequency Radio Astronomy,
Eds.: Jayaram N. Chengalur, Yashwant Gupta & K. S. Dwarakanath,
Jointly published by NCRA–TIFR Pune and RRI Bangalore.

Jayaram N. Chengalur
Diving in Einstein's dumpster, review of (The extravagant universe by R. P. Kirshner)
Current Science, **85**, 520, (2003).

e) Technical Reports/Internal Reports

Nimisha G. Kantharia and **A. Pramesh Rao**
GMRT Antenna Primary Beams Gain Correction Factors (240, 325, 610 MHz), June 2003.

Nimisha G. Kantharia, A. Adoni and **A. Pramesh Rao**
Computer Clocks at GMRT — A, July 2003.

Nimisha G. Kantharia, M.R.Sankaraman and **A.Pramesh Rao**
Wideband Radio Frequency Interference in the 233 MHz band (Technical memo), July 2003.

A. Praveen Kumar and **Anil Raut**
Improvement Of GMRT Receiver for Better Dynamic Range, November 2003.

G. Sankarasubramanian and **S. Sureshkumar**
Beam-former & Data processing system for the Mexican IPS Array *MxA/TR/2k3-02*, June,2003, 16pp.

G. Sankarasubramanian and **S. Sureshkumar**
Beam-forming Schemes for the Mexican IPS Array *MxA/TR/2k3-01*, 12, (2003).

T.L. Venkatasubramani
Input from TIFR to the 7th meeting of National Preparatory Committee for ITU WRC-2003
April 17, 2003

T.L. Venkatasubramani
Final input from TIFR to WRC-2003
May 20, 2003

T.L. Venkatasubramani
Protection of the Radio Astronomy Service in the band 608614 MHz from unwanted missions of HEO BSS Systems operating in the band 620-790 MHz
May 11, 2003

T.L. Venkatasubramani

On the protection of the Radio Astronomy Service in the band 406.1–410 MHz from EESS (active) Synthetic Aperture Radars in the band 432-438 MHz (re: Agenda Item 1.38 of WRC-2003)
Input document to the 23rd Meeting of SFCG in San Diego, California, USA. August 13, 2003

T.L. Venkatasubramani

Input from TIFR for the Special Meeting of SACFA on Aug 19, 2003 on Agenda Item 1: Debriefing for WRC-2003: Items related to Radio Astronomy.
August 18, 2003

L. Pommier and T.L. Venkatasubramani

Data Acquisition of Measurement Instruments, general Purpose Interface Bus
Internal Technical Report
October 31, 2003

L. Pommier, and T. L. Venkatasubramani

The 30-t-01 data acquisition system: General presentation, last modifications and tests Internal Technical Report
November 11, 2003

T. L. Venkatasubramani

Effect of CDMA-type cellular system on GMRT
Internal Technical Report
January 2004

L. Pommier, T. L. Venkatasubramani

Interface between a PC Parallel port and GPIB Devices
Internal Technical report
February 2004

T. L. Venkatasubramani

GMRT Receiver upgrade

GS75, Khodad
March 2004

Lectures / Lecture Courses Given Elsewhere

Sunita Barve

Information access in developing countries with special reference to Astronomy libraries in India
SLA conference, Los Angeles, U. S. A.
June 7 – 14, June 2002.

Special Libraries Association: Various awards available for the developing country Librarians
Pune Librarians Network Forum, IUCAA, Pune
November 29, 2002.

International Federation of Libraries Associations and Institutions (IFLA): Conference Report
Pune Librarians Networking Forum
September 2003.

Introduction to digital library, electronic library and virtual library
Institute of Armament Technology, Pune
November 10, 2003.

Digital Libraries
Course in IT for Librarians, UGC-Academic Staff College of Goa University in collaboration with Library, Goa University
May 3–4, 2004.

Jayaram N. Chengalur

Galaxies: Structure & Dynamics, 3 lectures
IUCAA-Osmania University workshop
Osmania University, Hyderabad

Yashwant Gupta

Radio Astronomy (3 lectures)
Introductory School on Astronomy and Astrophysics, Department of Physics, The American College, Madurai
September 22 – 26, 2003.

Ananda Hota

Radio-Eyes on a Superwind Galaxy: NGC1482
Raman Memorial Conference 2004, University of Pune, Pune
February 2004.

Dharam Vir Lal

Spectral structure of X-shaped radio sources
GS-75, NCRA Pune
March 23, 2004

P.K. Manoharan

Astronomy researches and facilities at NCRA–TIFR
Lady Doak College, Madurai
March 26, 2004.

R. Nityananda

Why Study Radio Waves?
Institute of Physics, Bhubneswar
January 28, 2004.

Radio Astronomy ?? (Five talks at the)
School on Radio Interferometry and Aperture Synthesis
June 9–13, 2003.

Galaxy and Galactic Dynamics
3 lectures at the VSR Programme, IUCAA–NCRA
May 13 – July 5, 2004.

Optics for Astronomers
2 lectures at the VSRP Programme IUCAA–NCRA
May 13 – July 5, 2004.

Subhashis Roy

Observing the Galactic Centre region
GS75, NCRA Pune
March 23, 2004.

D.J. Saikia

The Radio Universe
Dibrugarh University, Assam
July 2003.

The search for black holes
Crescent Academy, Jorhat, Assam
July 2003.

Galaxies: the building blocks of the Universe
Exploratory, Pune
February 2004.

Outflows in galaxies
Physical Research Laboratory, Ahmedabad
March 2004.

G. Swarup

Exploration of the Radio Universe using GMRT
DRDO Laboratory (ERDL), Hyderabad
July 2003

T.L. Venkatasubramani

Current status of GMRT
ASTRON, Dwingeloo
June 5, 2004

Lectures at NCRA

Bhaswati Mookerjea
KOSMA,University of Cologne, Germany
Observational studies of Photon Dominated Regions
15/3/04

Iain Brown, Jodrell Bank Observatory
INTEGRAL and MINE Observations of microquasars

Ralph Spencer, Jodrell Bank Observatory
Optical fibres in high bandwidth radio astronomy

D.J.Pisano, CSIRO Australia Telescope National Facility
Searching for Galaxy Formation in Groups
27/2/04

S.P.Gupta, Physical Research Laboratory,Ahemedad
Effect of meteoric particles on lower ionosphere with special reference to Leonid meteor storm
16/2/04

Amrit Ahuja, IUCAA,Pune
Tracking Pulsar Dispersion Measures with GMRT Multi-frequency Observations
13/2/04

Jose Coppens, Nijmegen University,The Netherlands
Probing Pulsar Emission Regions using Multi-frequency Observations
13/2/04

Igor D.Karachentsev, Special Astrophysical Observatory, Russian Academy of Sciences Russia
A Catalog of Neighboring Galaxies
September 2, 2004

Peter Thomasson, Jodrell Bank Observatory
MERLIN, new results and developments
June 2, 2004

John R.Dickal, Astronomy Department,University of Illinois at Urbana-Champaign
A 4.8 and 8.6 Ghz survey of the Large Magellanic Cloud
27/1/04

Robert Williams, Distinguished Research Scholor, and former Director Space Telescope Science Institute, Baltimore
The Universe of Hubble Space Telescope
16/1/04

Ramesh Narayan, Harvard University
Hot gas clusters of galaxies
15/1/04

Jeremiah P.Ostriker, Cambridge University ,Princeton University
What is dark matter? Evidence from low mass galaxies Evidence from low mass galaxies, gravitational lenses and substructure
13/1/04

B.C.Joshi, NCRA-TIFR,Pune
Discovery of a highly relativistic Double Neutron Star binary systems
February 1, 2004

Nimesh Patel, Harvard Smithsonian Centre for Astrophysics, USA
Intial science results from the Submillimeter Array
19/12/03

Kartik Sheth, Caltech
Bars do NOT disappear at $z > 0.7$: NICMOS Deep Field Observations
28/11/03

Nissim Kanekar, Kepteyn Astronomical Institute, Netherlands
Molecules at Low Frequencies
21/11/03

Carlos De Breuck, Institute d'Astrophysique de Paris
Multi-Wavelength Studio of High Redshift Radio Galaxies
23/10/03

Dipanjan Mitra, MPIfR,Bonn
Large Scale Galactic Magnetic Field Towards the Perseus Arm: Using Pulsars as Probes
20/10/03

Anish Roshi, Raman Research Institute, Banglore
Are UCH11 Regions Pressure Confined?
17/10/03

Steve Rawlings, Oxford University
Large-scale structure from present and future radio surveys
October 10, 2003

Anibran Chatterjee, Interdisciplinary school of scientific Computing, University of Pune
Location of Radio Frequency Interference using GMRT
June 10, 2003

Emma Ryan-Weber, University of Melbourne
Intergalactic H11 Regions Discovered Near HI-rich Galaxies
22/6/03

J.Daves, Cardiff University,U.K.
Dwarf Galaxies Confront Cold Dark Matter
31/7/03

Informal Discussion Group

J.N. Chengalur, NCRA-TIFR, Pune
Dust Lanes And Holes In Late Type Galaxies
May 3, 2004

A. N. Ramprakash, IUCAA, Pune
Model Of The Imagine Degradation Due To Wind Buffeting On An Extremely Large Telescope
May 3, 2004

Ayesha Begum, NCRA-TIFR, Pune
Does fine constant structure vary with time?
May 12, 2003

Pavan Chakraborty, IUCAA,Pune
Knowing wild 2, the largest of STARDUST
May 12, 2003

Ranjan Gupta, IUCAA,Pune
Irregular Particles In The Hale-Bopp Comet As Inferred From Mid-IR ISO Spectra
21/11/2003

Yashwant Gupta, NCRA-TIFR,Pune
The Brightsest Pulses In The Universe: Nanosecond Radio Bursts From The Crab
21/11/03

Tarun Souradeep, IUCAA, Pune
A Cosmic Infra-red Cut Off
July 11, 2003

J.N.Chengalur, NCRA-TIFR,Pune
Inner Structure of LCDM Halos
July 11, 2003

D.J. Saika, NCRA-TIFR, Pune
Renewed activity in Active Galactic Nuclei
October 10, 2003

Parampreet Singh, IUCAA, Pune
Some Cosmological applications of Loop Quantum Gravity
October 10, 2003

Ananda Hota, NCRA-TIFR, Pune
A Superwind-ULIRG: Arp 220
25/4/03

Anand Sankar sengupta
IUCAA, Pune
Association between Gamma Ray Bursts (GRBs) and Gravitational Wave bursts (GWBs)
25/4/03

Joydeep Bagchi, IUCCA,Pune
A star in a 15.2 year orbit around the supermassive black hole at the centre of the Milky Way
April 4, 2003

Gopal Krishna, NCRA-TIFR,Pune
High frequency Peakers
April 4, 2003

C.H. Ishwara Chandra, NCRA-TIFR,Pune
Inverse Compton X-rays from the radio galaxy 3C 219
21/3/03

Tarun Souradeep, IUCAA,Pune
Cosmic Microwave Background anisotropy results from WMAP
21/3/03

Sanjeev Dhurandhar, IUCAA,Pune
Time dely Interferometry for LISA
July 3, 2003

A.Pramesh Rao, NCRA-TIFR,Pune
1830-211-the Ooty lens revisited
July 3, 2003

Parampreet Singh, IUCAA,Pune
The Pre Big Bang scenario in String Cosmology
21/2/03

G.Swarup, NCRA-TIFR,Pune
Search for the Reionization Epoch
21/2/03

Harvinder K.Jassal, IUCAA,Pune
Tests of inflation: Next generation
July 2, 2003

R. Nityananda, NCRA-TIFR,Pune
Quantum Interferometric Optical Lithography: Exploiting
Entanglement to Beat the Diffraction Limit
July 2, 2003

Dharam Vir Lal, NCRA-TIFR,Pune
Chandra Detection of a Type 11Quasar at z =3.288
31/1/03

M.Sami, IUCAA,Pune
Cosmology with Rolling Tachyon
31/1/03

Bhal Chandra Joshi, NCRA-TIFR,Pune
Twinkle twinkle neutron star
17/1/03

Prasad Subramanian, IUCAA,Pune
Coronal Mass Ejections (CMEs) from the Sun:Energy budgets
17/1/03

Vasant Kulkarni, NCRA-TIFR,Pune
Parsec-scale Radio Structure and Broad Optical Emission Lines in a complete sample of 3CR Lobe-Dominated Quasars
22/11/02

Jayant Narlikar, IUCAA,Pune
The Case for Non- Velocity Redshifts in Galaxies
22/11/02

Naresh Dadhich, IUCAA,Pune
Homogeneous Collapse On The Brane
August 11, 2002

D.J.Saikia, NCRA-TIFR,Pune
Radio-FIR correlations
August 11, 2002

D.V. Ahluwalia, IUCAA,Pune
Quantum Tower of Pisa
25/10/02

V. Sahni
IUCAA,Pune
Braneworld Cosmology25/10/02

Ayesha Begum, NCRA-TIFR,Pune
Faint stars in the Ursa minor dwarf spheroidal galaxy:implication for the low-mass stellar intial mass function at high redshift
November 10, 2002

Rajaram Nityananda, NCRA-TIFR,Pune
The strange world of negative refractive index
November 10, 2002

N.G. Kantharia, NCRA-TIFR,Pune
The Large-scale Bipolar Wind in the Galactic Centre
27/9/02

Rajesh Nayak, IUCAA,Pune
Sensitivity of the Laser interferometer Gravitational Wave Observatory to a Stochastic background, and its dependence on the detector orientations

S. Ananthakrishnan, NCRA-TIFR,Pune
Coronal Mass Injection or Solar Flare – Which comes first
13/9/02

J.V. Sheth, IUCAA,Pune
Hot bubbles from active galactic nuclei as a heat source in cooling-flow clusters
13/9/02

Tirthankar Roy choudhury, IUCAA,Pune
Constraints on reionization from thermal history of the IGM
23/8/02

C.H.Ishwara Chandra, NCRA-TIFR,Pune
Observational Evidence for disk -jet connection in AGN
23/8/02

Tarun Souradeep & Kandaswamy Subramanian, IUCAA,Pune
Recent surprise from CMB anisotropy data
September 8, 2002

A.Pramesh Rao, NCRA-TIFR,Pune
Pulsar SNR Association- Case of the Duck
26/7/02

R.Srianand, IUCAA,Pune
Oxygen Abundance in the Low Density IGM
26/7/02

Ajit K. Kembhavi, IUCAA,Pune
Chandra Observations of X-ray jets
December 7, 2002

Dharam Vir Lal, NCRA-TIFR,Pune
3C129 at 90 cm: Evidence for a Radio Relic?
December 7, 2002

Gopal Krishna, NCRA-TIFR,Pune
A Large-scale jet and FR 1 source in a spiral galaxy
October 5, 2002

S.Sridhar, IUCAA,Pune
Starts and singularities: stellar phenomena near a Massive black hole
October 5, 2002

Jayaram Chengalur, NCRA-TIFR,Pune
The Milky Way's satellite population in a CDM Universe
26/4/02

Prasad Subramanian, IUCAA,Pune
X-ray / Gamma ray flares from hadronic jets in AGN
26/4/02

Ranjeev Mishra, IUCAA,Pune
Ultra-Luminious X-ray Sources: A new kind of black holes systems
December 4, 2002

Subhashis Roy, NCRA-TIFR,Pune
Detection of X-ray emission and flaring from the supermassive black hole at the Galactic Centre
December 4, 2002

Student Seminar

Dipti Sharma, Pune University, Pune
Deconvolution and Calibration
August 7, 2003

Premalatha, N.G.M.College,Poolachi
Episodic Activity in Radio Galaxies
August 7, 2003

Kamaljit, Aabasaheb Garware College,Pune
Self-Calibtation Techniques in Radio Astronomy
August 7, 2003

Palani M, Velammal Engg. College, Chennai
Pulsar Research Technique
August 7, 2003

T.Nithyanandan, IIT, Chennai
MNLS deconvolution
August 7, 2003

Udayakant Pandey, VNIT,Nagpur
Polarimetrric Observation of Pulsars using GMRT
August 7, 2003

Kamal Saharia, Tezpur University, Tezpur
Microquasars

Janusz, Institute of Astronomy University of Zielona Gora, Poland
Understanding How Pulsars Work: The Ruderman-Sutherland Pulsar Model Revisited
July 7, 2003

Pilippe Durouchoux, Service d' Astrophysique CEA. Saclay, France
INTERAGAL: 7 Months After
23/6/03

Govind Swarup, NCRA-TIFR,Pune
Radio Astronomy and the Early Universe
19/6/03

K.S.Dwarakanath, Raman Research Institute, Banglore
Large Velocity Disperson HI towards the Galactic Centre Existence and Origin
19/6/03

Poonam Chandra, TIFR,MUMBAI
A study of circumstellar interaction of young extragalactic supernovae

Sanjay Bhatnagar, NCRA-TIFR,Pune
Relaxing simpifying assumptions in current data analysis algorithms
28/5/03

Ananda Hota, NCRA-TIFR,Pune
Radio study of superwind galaxies
21/5/03

Ayesha Begum, NCRA-TIFR,Pune
Kinematics of the faint dwarf galaxies
21/5/03

Neeraj Gupta, NCRA-TIFR,Pune
Probing central regions of CSS objects using Polarization and HIV observations
21/5/03

Graduate Courses

Jayaram N. Chengalur

Introduction to Astronomy and Astrophysics

Gopal Krishna

Extragalactic Astronomy II

R. Nityananda

Electro-dynamics and Radiative Processes I

Ph.D. Theses / M.Sc. Theses

Subhashis Roy

A study of the Galactic Centre Environment
Pune University, March 25, 2004
Guide: D.J. Saikia

VSRP Projects / Training of College Students

K. Prabhu, M.Sc.(Physics), Government Arts College, Ooty
Geo-magnetic storms caused by transient mass ejections from the sun.
Guide: P.K. Manoharan.

N. Jagadeesh Kumar, M.Sc.(Physics), Government Arts College, Ooty
Interstellar scattering of pulsar signal
Guide: P.K. Manoharan.

K. Murugadass, M.Sc.(Physics), Government Arts College, Ooty
Study of solar radio bursts and analysis of Ooty measurements
Guide: P.K. Manoharan.

A. Sumathi, M.Sc.(Phy), Mother Teresa Women's University, Kodaikanal
A study of large intensity pulses from PSR0950+08'
Guide: P.K. Manoharan.

I. Vanitha Mary, M.Sc. (Phy), Mother Teresa Women's University, Kodaikanal
Observational aspects of active galaxy and quasars
Guide: P.K. Manoharan.

P.M. Annlet Sofia, M.Sc.(Physics), Mother Teresa Women's University, Kodaikanal
A study of Jupiter and its observations at 327 MHz
Guide: P.K. Manoharan.

M. Renuga Devi, M.Sc.(Physics), Mother Teresa Women's University, Kodaikanal
Long term variations and large-scale structure of the solar wind
Guide: P.K. Manoharan.

Samir Dhurde, M.Sc. Physics, University of Pune, Pune
Empirical determination of magnetic field in different components of radio galaxies
Guide: Gopal Krishna.

Kamal Saharia (VSRP Student):
Microquasars, June – July 2003
Guide: C.H. Ishwara-Chandra.

D. Premalatha, N.G.M. College, Coimbatore
Episodic activity in radio galaxies
Guides: D.J. Saikia and C. Konar

M. Reena, Government Arts College, Ooty, her M.Sc.(Physics) final year project on `Man made radio frequency interference
Guide: D. Nandagopal.

M. Dorathy Ruba, M.Sc.(Physics), Government Arts College, Ooty
Printed Circuit board and its characteristics
Guide: D. Nandagopal.

L. Jennifeer Beena, M.Sc.(Physics), Government Arts College, Ooty
Study of solar radio bursts and analysis of Ooty measurements
Guide: D. Nandagopal.

About 100 students from various engineering and science colleges all Tamil Nadu have been given implant training at RAC, Ooty.

Yogesh Karandikar, BE Project
Detection of Jovian radio emission at 20.1 MHz
Guide: S. Ananthakrishnan and T.L. Veknatasubramani

VSRP Project
Estimation of Emission measure and Temperature of an HII region in the presence of non-thermal emission
Guide: Subhashis Roy.

Ramachandra Dabade, VNIT, Nagpur
Sophisticated software package for acquisition and analysis of pulsar data from different back-ends
Guide: Yashwant Gupta.

Varsha C. Hedau and Anand D. Kulkarni, Govt. College of Engg., Pune
Signal processing applications in the GMRT pulsar receiver control software
Guide: Yashwant Gupta.

Anirban Chatterjee, M.Sc. Computer Science, Pune University
Guide: G. Swarup

Sachin Pathak and Vishal Kale, Engineering College, Lonare
Location of sources of Radio Frequency Interference using the GMRT Array
Guide: G. Swarup

Uday Kant Pandey, National Institute of Technology, Nagpur:
Polarimetric Observations of Pulsars using GMRT
Guide: Bhal Chandra Joshi

M. Palani, Velammal Engineering College, Chennai:
Pulsar Search Techniques
Guide: Bhal Chandra Joshi

Popular Science Articles / Lectures

A. Pramesh Rao and S. Ananthakrishnan
Giant Metrewave Radio Telescope
Khagol Newsletter, Vol --, Jan 11, (2004)

Yashwant Gupta

The Giant Metrewave Radio Telescope
Lady Doak College Campus, Madurai
September 23, 2003.

The Giant Metrewave Radio Telescope
The American College, Madurai
September 26, 2003.

P.K. Manoharan

How does our Sun shine?
Rotary Club, Ooty,
January 19, 2004.

New discoveries in astronomy
Tamil Nadu Science Forum, Bethlehem Teacher Training Institute, Ooty,
February 28, 2004.

Radio & TV Programmes

Any other information