## Young Astronomers' Meet 2009

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## 1 Preface

For over a decade now, YAM (Young Astronomers' Meet) has been instrumental in providing a platform for budding researchers in varied fields of Astronomy - to share and intercommunicate ideas from young minds across the country. The interaction with ones' peers not only ensures awareness about the diversity of Astronomy research in India, it also helps to build useful collaborations. This year we are previleged to host the annual *rendezvous* for this event . Indian Institute of Technology, Kharagpur does not require much introduction as being a leading national centre for scientific and industrial research and education. The organisers express their heartfelt thanks to the Department of Science and Technology Government of India, for providing the support and the Centre for Theoretical Studies (I.I.T Kharagpur) for making the  $12^{th}$  YAM a success. It is a special honour to celebrate YAM 2009 in the International Year of Astronomy, coinciding with the  $400^{th}$ year since the first recorded astronomical observations were made by Galileo.

Let us hope that the tradition of YAM will prevail in this very special year.

## 2 Cosmology

## 2.1 Constraining cosmology using clusters as an ensemble of cosmic rulers

Satej Khedekar, S. Majumdar Tata Institute of Fundamental Research

### TALK

Abundance and distribution of clusters of galaxies are one of the many probes of cosmological parameters since they depend on the expansion history of the Universe as well as the growth of cosmic structures. On the other hand, a measurement of the luminosity distance (like from SNe observations) or the angular diameter distance as a function of redshift, both of which depend on the expansion history, can be used as complementary probes of cosmology. We show the in near future, clusters jointly found in large yield Sunyaev-Zel'dovich and X-Ray surveys can be used as an 'ensemble of cosmic rulers', thus giving us a measurement of the angular diameter distance with redshift. This comes at no extra costs as these clusters are already found in the surveys. Thus one can add the benefit of complementarity of distance measure with that of cluster number counts to break cosmological parameter degeneracies. We do Fisher matrix estimates as well as full blown MCMC analysis to forecast cosmological constraints and show how error bars are reduced on parameters. In particular, we show that there is significant improvement on dark energy constraints. Our estimates promises another application of upcoming cluster data.

## 2.2 Cosmology Using Redshifted Neutral Hydrogen (H I) 21-cm Observations

Tapomoy Guha Sarkar Indian Institute of Technology, Kharagpur

## Talk

The redshifted 21-cm radiation from neutral hydrogen (H I) has emerged as a powerful probe of the large scale structure (LSS) of the universe. The presence of cosmological neutral hydrogen at high redshifts make it a valuable probe of epochs which cant be investigated using other methods like galaxy or quasar redshift surveys. The advantage of using H I as a tracer of the LSS is the fact that, being a line emission one can use the 21-cm radiation, to continuously probe different z - slices by suitably tuning the frequency of radio observations and thereby creating a tomographic 3 dimensional image. Though detection of the signal from individual clouds at low z is difficult, the distribution of diffused H I can be quantified through statistical measures like the power spectrum. We have used the statistical distribution of H I and other relevant fields like CMBR temperature anisotropy, to calculate various Cross-Correlation power spectra to quantify the late time evolution of the universe to understand the nature of dark energy.

## 2.3 Cosmological Scaling Solutions with Tachyon: Modified Gravity model

Chandrachani Ningombam Devi, A. A. Sen Centre for Theoretical Physics, Jamia Millia Islamia

Talk

I will review about the scaling solutions in modified gravity models where the universe is sourced by a background matter fluid together with a tachyon type scalar field.Then,I will describe a general prescription to calculate the scaling potential in such models.I will discuss considering some specific examples of the modifications.

## 2.4 SZ/X-ray observations of clusters and the interplay between clusterphysics and cosmology

Anya Choudhury, S. Majumdar Tata Institute of Fundamental Research

Talk

I will talk about the physical processes known to occur in different types of galaxy clusters that have been observed and about how their statistical behaviour embodied in cluster scaling relations is used in cosmology.

## 2.5 The Local Dimension: a method to quantify the Cosmic Web

Prakash Sarkar, S. Bharadwaj Indian Institute of Technology, Kharagpur

TALK

It is now well accepted that the galaxies are distributed in filaments, sheets and clusters all of which form an interconnected network known as the Cosmic Web. It is a big challenge to quantify the shapes of the interconnected structural elements that form this network. Tools like the Minkowski functionals which use global properties, though well suited for an isolated object like a single sheet or filament, are not suited for an interconnected network of such objects. We consider the Local Dimension D, defined through  $N(R) = AR^{D}$ , where N(R) is the galaxy number count within a sphere of comoving radius R centered on a particular galaxy, as a tool to locally quantify the shape in the neighbourhood of different galaxies along the Cosmic Web. We expect  $D \sim 1.2$  and 3 for a galaxy located in a filament, sheet and cluster respectively. Using LCDM N-body simulations we find that it is possible to determine D through a power law fit to N(R) across the lengthscales 2 to 10 Mpc for  $\sim 33\%$  of the galaxies. We have visually identified the filaments and sheets corresponding to many of the galaxies with  $D \sim 1$  and 2 respectively. In several other situations the structure responsible for the Dvalue could not be visually identified, either due to its being tenuous or due to other dominating structures in the vicinity. We also show that the global distribution of the D values can be used to visualize and interpret how the different structural elements are woven into the Cosmic Web.

## 2.6 Simulating Matched Filter Search for Ionized Bubbles in EoR

Suman Majumdar, K. K. Datta, S. Bharadwaj, T. R. Choudhury Inidian Institute of Technology, Kharagpur

#### Talk

Extending the formalism of Datta, Bharadwaj & Choudhury (2007) for detecting ionized bubbles in redshifted 21 cm maps using a matched-filtering technique, we use different simulations to analyze the impact of H I fluctuations outside the bubble on the detectability of the bubble. In the first three kinds of simulations there is a spherical bubble of comoving radius  $R_b$ , the one that we are trying to detect, located at the center, and the neutral hydrogen (H I) outside the bubble traces the underlying dark matter distribution. We consider three different possible scenarios of reionization, i.e., (i) there is a single bubble (SB) in the field of view (FoV) and the hydrogen neutral fraction is constant outside this bubble (ii) patchy reionization with many small ionized bubbles in the FoV (PR1) and (iii) many spherical ionized bubbles of the same radius  $R_b$  (PR2). The centers of the extra bubbles trace the dark matter distribution. The fourth kind of simulation uses more realistic maps based on semi-numeric modelling (SM) of ionized regions. We make predictions for the currently functioning GMRT and a forthcoming instrument, the MWA at a redshift of 6 (corresponding to a observed frequency 203 MHz) for 1000 hrs observations. We find that for both the SB and PR1 scenarios the fluctuating IGM restricts bubble detection to size  $R_b \leq 6$  Mpc and  $R_b \leq 12$  Mpc for the GMRT and the MWA respectively, however large be the integration time. These results are well explained by analytical predictions. In the PR2 scenario, we find that bubble detection is almost impossible for neutral fraction  $x_{\rm HI} < 0.6$  because of large uncertainty due to the H I fluctuations. Applying the matched-filter technique to the SM scenario, we find that it works well even when the targeted ionized bubble is non-spherical due to surrounding bubbles and inhomogeneous recombination. We find that determining the size and positions of the bubbles is not limited by the H I fluctuations in the SB and PR1 scenario but limited by the instrument's angular resolution instead, and this can be done more precisely for larger bubble. We also find that for bubble detection the GMRT configuration is somewhat superior to the proposed MWA.

# 2.7 Cosmological Model Comparison using Bayesian Approach

Noble P Abraham, M. V. John, K. Indulekha Mahatma Gandhi University, Kottayam

#### Poster

Applications of Bayesian theorem in Cosmology and Astrophysics has grown vigorously as datasets of large sizes and complexities became available. Bayesian method has proven to have an edge over the widely used traditional statistical tools. In this poster we present Bayesian model comparison technique to discriminate some Friedmann Models with the aid of recent releases of supernova data.

## **3** Cosmic Microwave Background Radiation

## 3.1 CMB Polarization and Temperature Power Spectra Estimation using Linear Combination of WMAP 5-year Maps

P. K. Samal, R. Saha, S. Prunet, P. Jain, T. Souradeep Indian Institute of Technology, Kanpur

#### TALK

We estimate CMB polarization and temperature power spectrum using WMAP 5-year foreground contaminated maps. The power spectrum estimation method does not utilize the diffuse foreground templates nor the detector noise model. The method essentially consists of two steps, (i) removal of diffuse foregrounds contamination by making linear combination of individual maps and (ii) cross-correlation of foreground cleaned maps to minimize detector noise bias. For temperature power spectrum we also estimate and subtract residual unresolved point source contamination in the cross-power spectrum by using WMAP's point source model. Our TT, TEand EE power spectra are in good agreement with the published results of the WMAP science team. We perform detailed numerical simulations to test for bias in our procedure. We find that the bias is relatively small for the TTand TE power spectrum. A negative bias at low l in TT power septrum has been pointed in an earlier publication. We find that the negative bias corrected quadrupole power  $(l(l+1)C_l/(2\pi))$  is 532 /micro  $K^2$ , approximately 2.5 times the WMAP's result  $(313.4 / micro K^2)$ .

## 4 Dark Matter & Dark Energy

## 4.1 Dark Matter In Our Galaxy

Soumini Chaudhury, P. Bhattacharjee Saha Institute Of Nuclear Physics

Talk

The work discusses the coupling of Dark Matter and Visible Matter in Milky Way and it's effects on Dark Matter Detection.

# 4.2 A k-essence Model Of Inflation, Dark Matter & Dark Energy

Nilok Bose, A. S. Majumdar

S. N. Bose National Centre for Basic Sciences

### TALK

We first show that using a purely kinetic k-essence model the late time energy density of the universe cannot be expressed exactly as the sum of a cosmological constant and a dark matter term. We then present a k-essence model in which the Lagrangian contains a potential for the scalar field as well as a non-canonical kinetic term. We show that such a model reproduces the basic features of inflation in the early universe, and also gives rise to dark matter and dark energy at appropriate subsequent stages. Observational constraints on this model are also obtained.

## 5 Radio Astronomy and Interstellar Medium

## 5.1 A Study of ISM of Dwarf Galaxies Using H I Power Spectrum Analysis

Prasun Dutta, A. Begum, S. Bharadwaj, J. N. Chengalur Indian Institute of Technology, Kharagpur

#### TALK

We estimate the power spectrum of H I intensity fluctuations for a sample of 8 galaxies (7 dwarf and one spiral). The power spectrum can be fitted to a power law  $P_{\rm HI}(U) = AU^{\alpha}$  for 6 of these galaxies, indicating turbulence is operational. The estimated best fit value for the slope ranges from  $\sim$ -1.5 (AND IV, NGC 628, UGC 4459 and GR 8) to  $\sim -2.6$  (DDO 210 and NGC 3741). We interpret this bi-modality as being due to having effectively 2D turbulence on length scales much larger than the scale height of the galaxy disk and 3D otherwise. This allows us to use the estimated slope to set bounds for the scale heights of the face on galaxies in our sample. We also find that the power law slope remains constant as we increase the channel thickness for all these galaxies, suggesting that the fluctuations in H I intensity are due to density fluctuations and not velocity fluctuations, or that the slope of the velocity structure function is  $\sim 0$ . Finally, for the four galaxies with "2D turbulence" we find that the slope  $\alpha$  correlates with the star formation rate per unit area, with larger star formation rates leading to steeper power laws. Given our small sample size this result needs to be confirmed with a larger sample.

## 5.2 The Intrinsic Axial Ratio of H I Disks in Dwarf Galaxies

Sambit Roychowdhury, J. N. Chengalur, A. Begum, Igor D National Centre for Radio Astrophysics

## Talk

A consistent dynamical model of galaxy structure should be able to reproduce the observed distribution of axial ratios. This in turn has implications for galaxy formation and evolution models. In kinematical studies, the mean intrinsic axial ratio is routinely used to determine the inclination angle of disk galaxies. There are hence a variety of reasons to try and determine the intrinsic axial ratio distribution of galaxies. Although there have been a number of such studies for large galaxies, there have been relatively few that focused on dwarfs. Differences in the intrinsic axial ratios of spirals and dwarfs are expected, since there are clear structural differences between these two classes of galaxies. The dominant rotation in spiral disks produces a largely axi-symmetric object that undergoes highly efficient star formation in contrast to the more weakly rotating, more disordered motion of dwarfs that is likely to produce a diffuse, triaxial object. We analyze the data from 44 extremely faint dwarf galaxies selected from the GMRT based FIGGS survey. From the distribution of observed axial ratios of the H I disks in these galaxies, we try to constrain the intrinsic shapes of the H I disks.

# 5.3 21 cm signal and foreground contribution : GMRT observation at 610 MHz

Abhik Ghosh, S. Ali, S. Bharadwaj, J. N. Chengalur Indian Institute of Technology, Kharagpur

TALK

For future redshifted 21 cm observation the biggest challenge will be the foreground subtraction. We have calculated fiducial values of parameters for different foregrounds contribution at 610 MHz. We use GMRT observations at 610 MHz to characterize the statistical properties of the background radiation across a frequency band of 16 MHz with 125.0 kHz resolution. The statistic we use is the visibility correlation function, or equivalently the angular power spectrum  $C_l$ . We find that even fairly simple minded calibration allows one to estimate the visibility correlation function at a given frequency  $V_2(U, 0)$ . We have determined the observed value  $V_2(U, \Delta\nu)$  of the visibility correlation estimator  $\hat{V}_2(U, \Delta\nu)$ :

$$\hat{V}_2(U,\Delta\nu) = \overline{V(\mathbf{U},\nu_i)V^*(\mathbf{U}+\Delta\mathbf{U},\nu_i+\Delta\nu)}$$

We expect the real part of the estimator to provide an estimate of the foreground. On the other hand, the visibility correlation between different frequencies  $\kappa(U, \Delta \nu)$ , seems to be much more sensitive. Though our before source subtracted data almost matches with the theoretical prediction (variation of less than 10%) but after source subtraction we find a rapid decline in  $\kappa(U, \Delta \nu)$ . We think a better model of source substation is needed.

## 5.4 ISM turbulence and temperature from H I observation

Nirupam Roy, L. Peedikakkandy, J. N. Chengalur National Centre for Radio Astrophysics

## TALK

We have used the millennium Arecibo 21 cm absorption survey data to examine the nature of the turbulence in the diffuse neutral ISM from direct observation of non-thermal line widths at different scales. The non-thermal H I line widths are found to have a power-law dependence on the length scale. The power law index is consistent with what one would expect from a turbulent medium with a Kolmogorov scaling. This analysis has helped us to derive the "true" temperature distribution of the ISM. Instead of directly using the observed line widths, we have used the estimate of the non-thermal contribution to the line widths and corrected the H I kinetic temperature. The distribution of this corrected H I temperature shows that the estimated WNM fraction in the ISM is smaller than the fraction determined from earlier analysis. However, a significant fraction of the gas is found to be in the thermally unstable phase. But the Arecibo data are affected by emissionrelated issues like non-uniformity of H I clouds across the beam, stemming from stray radiation, self-absorption and the spectral baseline stability. This has prompted us to carry out a a deep H I absorption survey using GMRT and WSRT to critically re-examine whether a significant fraction of WNM has temperatures in the unstable phase. Preliminary results from this survey will also be reported.

## 5.5 H I Emission From Galaxy NGC2805

Alka Mishra, N. G. Kantharia, D. C. Srivastava

D.D.U.Gorakhpur University,Gorakhpur

#### Poster

Galaxies in a group can undergo the changes in their morphology and star formation rate (SFR) due to interaction with other galaxies and the intragroup medium. Tidally interacting galaxies display morphological features like bridges, tails, and rings detected at various wavelengths.Galaxies interacting with the intragroup medium display disturbed morphological features such as a sharp boundary and displaced gas disk with respect to the stellar disk.In this paper we present H I 21cm spectral line Giant Metrewave Radio telescope (GMRT)observation of the poor group Holmberg 124.Holmberg 124 is a group of four late type galaxies; NGC2805,NGC2814, NGC2820 and Mrk108. We present the column density distribution & velocity field of the group ,in particular,the almost face on spiral galaxy NGC2805. All the members of this group exhibit distorted morphology & kinematics.The H I distribution of NGC2805 is asymmetric.

## 5.6 Studies of Few Wolf-Rayet Galaxies in Radio-Continuum

Shweta Srivastava, N. G. Kantharia , D. C. Srivastava

D.D.U. Gorakhpur University, Gorakhpur

#### Poster

Galaxies containing the signatures of Wolf Rayet stars such as a broad He II  $\lambda$  4646 emission feature in their optical spectra are known as Wolf-Rayet galaxies. WR galaxies span a range in morphological types such as irregulars & spirals & dwarfs to Milky way like galaxies. The presence of WR stars provides a powerful constraint on the recent star formation in a galaxy. Some of these galaxies have been observed in radio continuum at frequencies > 1 GHz which reveal a variety of spectral energy distribution ranging from power law to flat spectra. Their is no single combination of physical mechanisms that can explain all the observed spectra as it appears from a small subset which has been observed at lower frequencies. However a large sample is required to corroborate these results. Our aim to observe a larger sample at the low GMRT frequencies which will help discriminate between the various physical models. Presently we have observed few WR galaxies at 610, 240 and 150 MHz using the GMRT. Since these are compact objects, we only resolve them at 610 MHz. In this poster paper we present the integrated spectra of these galaxies and the preliminary results from our study.

## 6 Steller Astronomy

## 6.1 Kinematics of the Young Stellar Objects associated with the CometaryGlobules in the Gum Nebula

Rumpa Choudhury, H. C. Bhatt

Indian Institute of Astrophysics

## TALK

An analysis of proper motion measurements of the Young Stellar Objects (YSOs) associated with the Cometary Globules (CGs) in the Gum Nebula is presented. While earlier studies based on the radial velocity measurements of the CGs suggested expansion of the system of the CGs, the observed proper motion of the YSOs show no evidence for expansion. In particular the kinematics of two YSOs embedded in CGs is inconsistent with the supernova explosion of the companion of  $\zeta$  pup about 1.5 Myr ago as the cause of the expansion of the CG system. YSOs associated with the CGs share the average proper motions of the member stars of the Vela OB2 association. A few YSOs that have relatively large proper motions are found to show relatively low infrared excesses.

## 6.2 Study of pulsating variable stars in eclipsing binary system

Chhavi Pandey, S. K. Tiwari, B. B. Sanwal, U. S. Chaubey Aryabhatta research Institute of Observational Sciences

### TALK

The Algol-type binaries are a class of close binary star systems in which the component of an earlier spectral type ((B)A-F spec. type) is a main sequence star while the component of a later spectral type is a subgiant. In such a binary system, the serendipitous arrangement of the pulsating star as one of the components, form a particular class of stars known as oEA (oscillating EA) stars. The oEA stars are very attractive candidates for asteroseismological investigations to study various astrophysical processes.

We will present our new UBVRI photometric observational results of Algol-like eclipsing binary system with Delta-Scuti pulsating star as one of the components. The observations are taken from 104-cm Sampurnand telescope at ARIES, Nainital.

## 6.3 Li-rich K Giants: Survey and Detailed Analysis

Bharat Kumar Yerra

Indian Institute of Astrophysics

TALK

Li-rich K giants are rare. The systematic survey has been initiated to search Li-rich K giants along the Red Giant Branch. Lithium abundances have been determined from low resolution (R 3500) spectra for half of the sample giants (1000) in our ongoing survey, selected from Hipparcos Catalog. Four of these giants possess surface Lithium abundance approaching the cosmic value of interstellar medium, and four more giants have Li contents far in excess of standard prediction. Observations and reductions of the high resolution spectra for new Li-rich giants are done. The preliminary results from the detailed analysis of various stellar parameters: Temperature, Gravity, Metallicity, Elemental abundances and rotation are discussed briefly, and infrared excess from broad band colors.

## 6.4 Infra-red studies of classical novae

Ashish Raj

Physical Research Laboratory

TALK

Nova(e) refers to a binary system consisting of a white dwarf accompanied by a main sequence star. Explosions occur on white dwarf companion after sufficient mass has been accumulated. Novae outbursts are usually modelled as thermonuclear runaways. They belong to a general category called "Cataclysmic Variable", and are usually divided into a number of subcategories, including classical novae, dwarf novae, and recurrent novae. They can change by 10-12 magnitudes in a few hours after the eruption, and typically have absolute magnitude of -7. From the spectra and photometric results we can calculate several parameters like the distance, temperature, abundance of elements. Few novae form dust depending on the favorable physical and chemical conditions. As an example results of V5579 Sgr 2008 will be discussed.

## 7 Solar Astronomy and Planetary Physics

## 7.1 On the statistical detection of propagating waves in polar coronal holes

G. R. Gupta, E. O'Shea, D. Banerjee, M. Popescu, J. G. Doyle

Indian Institute of Astrophysics

#### TALK

Waves are important for the heating of the solar corona and the acceleration of the solar wind. In this talk I will present new results on the detection of long period oscillations in polar coronal hole regions on the disk. Our observations indicate the presence of compressional waves with periods of 25 min. Using Fourier techniques, we measured the phase delays between intensity as well as velocity oscillations in the two chosen lines. From this we are able to measure the travel time of the propagating oscillations and, hence, the propagation speeds of the waves producing the oscillations. We found that there is a difference in the nature of the propagation in bright (network) and dark (internetwork) regions with the latter sometimes showing evidence for downwardly propagating waves that is not seen in the former. As, in all cases, the measured propagation speeds are subsonic, we concluded that the detected waves are slow magneto-acoustic in nature.

## 7.2 Study of distribution and asymmetry of solar filaments during solar cycle 23

N. C. Joshi, N. Singh, S. Pande, B. Pande, K. Pandey D.S.B. Campus, Kumaun University, Nainital

#### Talk

In this study we have presented the comparison between SC 20, 21, 22, and 23 and it shows that the N-S and E-W asymmetry do not show any systematic behavior and has no relation with solar cycle maximum and minimum. The results of the study of spatial distribution and asymmetry of solar active prominences (SAP) for the period 1996-2006 (solar cycle 23) have also been presented. The period of investigation includes ascending, maximum, and descending phase of solar cycle 23. The north-south (N-S) latitudinal distribution shows that the SAP events are most prolific in the 21-30 slice in the northern and southern hemispheres and east-west (E-W) longitudinal distribution study shows that the SAP events are most prolific in the 81-90 slice in the eastern and western hemispheres. It has been found that the prominence activity during this cycle is low compared to previous solar cycles. It also indicates that during the rising phase the activity lies in both north and south hemispheres simultaneously. However the activity dominates the southern hemisphere after 1999 and remained there in the successive years. Our statistical study shows that the N-S asymmetry is more significant then the E-W asymmetry. Key words: Sun: activity Sun: Prominences and filaments Sun: North-south and east-west asymmetry.

# 7.3 Correlative study of Solar Activity with all India rainfall during 1963-2006

Neeraj Singh Bankoti, N. C. Joshi, B. Pande, K. Pandey D.S.B.Campus, Kumaun University, Nainital, Uttarakhand

TALK

We use 44 years (1963-2006) data for correlative study of sunspot and solar active prominences (SAP) with the occurrence of all India rainfall. We compute the correlation and significance of correlation coefficients for the seasonal months JanFeb (JF), Mar-May (MAM), Jun-Sep (JJAS) and Oct Dec (OND) and also the annual data.Our study shows that all India rainfall is negatively correlated with the sunspot activity. SAP is positively correlated with seasonal rainfall for seasonal months (JF) and negatively correlated for(OND) with high significance. For Seasonal months (MAM) rainfall is negatively correlated with low significance and positively correlated for (JJAS) with moderate significance. The annual rainfall is negatively correlated with SAP having high significance. Key words: Solar Activity- Solar Active Prominences- Indian rainfall.

## 7.4 Investigation of the Origin of Particle acceleration in Solar flare events

Pankaj Tomar, W. Uddin Aryabhatta research Institute of observational sciences (ARIES)

Poster

We analyzed some particle events associated with solar flares and coronal mass ejections. we try to investigate the origin of the particle events in the context of multi-wavelength ground based and space based data. We have discussed our results in the light of existing theories and models of particle acceleration.

## 8 General Relativity

# 8.1 Violation of energy conditions of traversable wormholes in 2 + 1 dimensions

Sanjit Das, S. Kar

Indian Institute of Technology, Kharagpur

### TALK

One of the necessary requirements for traversable wormhole is violation of average null energy condition. This brings the notion of *exotic matter*. In this paper we restrict our attention to static, spherically symmetric wormhole. We have briefly described the idea of energy condition violation in 2 + 1 dimensions. Here we have recapitulated the idea of volume integral quantifier(VIQ)in 3 + 1 dimensions. Later we generalize this idea to 2 + 1 dimensions and constructed some examples. Here we have pointed out the fact that , if we make judicious choice of some parameters then volume integral can be made arbitrarily small.

## 8.2 Generalized Particle Dynamics: Modifying the Motion of Particles and Branes

Sudipta Das, S. Ghosh, Jan-W V. Holten, S. Pal Indian Statistical Institute,Kolkata

## Talk

We construct a generalized dynamics for particles moving in a symmetric spacetime, i.e. a space-time admitting one or more Killing vectors. The generalization implies that the effective mass of particles becomes dynamical. We apply this generalized dynamics to the motion of test particles in a static, spherically symmetric metric. A significant consequence of the new framework is to generate an effective negative pressure on a cosmological surface whose expansion is manifest by the particle trajectory via embedding geometry [5, 7, 15, 16]. This formalism thus may give rise to a source for dark energy in modeling the late accelerating universe.

## 8.3 Geodesics and geodesic deviation in warped spacetimes with a time dependent extra dimension

Suman Ghosh, S. Kar, H. Nandan Indian Institute of Technology Kharagpur

## Talk

We investigate geodesic motion and geodesic deviation in warped spacetimes with a cosmological on-brane line element and a time dependent extra dimension. The geodesic equations can be reduced to a first order autonomus dynamical system. Using analytical methods, we arrive at some useful conclusions regarding the solution space of this system for the various cases under consideration. Subsequently, making physically acceptable choices for the three functions a(t) (cosmological scale factor), b(t) (scale of extra dimension) and  $f(\sigma)$  (warp factor), we are able to solve for the null and timelike geodesic trajectories (analytically in a few cases, otherwise numerically) as well as the geodesic deviation vector. We provide pictorial representations of the nature of the trajectories as well as the deviation vector components and make an attempt towards understanding their behaviour with reference to the geometric properties of spacetime background. Finally, we compare our results with situations where there is no warping or where the extra dimensional scale does not vary with time. It is evident from our analysis that the nature (growing or decaying) of the warp factor qualitatively affects the nature of the solutions, whereas the extra dimensional scale variations yield only quantitative differences.

## 9 High Energy Physics

## 9.1 Implication of very rapid variability of VHE gamma ray flare from blazar Mrk501 on several blazars jet models

Amit Shukla

Indian Institute of Astrophysics

### TALK

The composition of the blazar jets, whether these jets are leptonic or hadronic (are they "heavy"; i.e., are they primarily electron-proton jets, or are they "light"; i.e., are they electron-positron jets?) is a matter of debate in last few years and the current field of research. The question is especially pertinent in context of TeV blazars, which are sources of very high energy gamma rays. The recent very high energy (VHE) gamma ray (TeV) observation of some near by blazar shown the very rapid variability of minute scale. These time scales are one or two order of magnitude shorter than the shortest timescale expected at the black hole horizon by light crossing time scale argument. I will be talking about implication of this very rapid variability of VHE gamma ray flare from blazar Mrk501 on several jet models of blazars .I will also present first results of HAGAR telescope .

## 9.2 Study of Quasi-Periodic Oscillations (QPOs) in the Transient X-ray Binary

Jayashree Roy, P. C. Agrawal, B. Paul Tata Institute Of Fundamental Research

### Poster

The transient x-ray sources XTE J1817-330 was discovered by RXTE on January 26, 2006. From measurement of its position accurately a radio counterpart was detected. X-ray spectral characteristics of the source and its x-ray and radio variability suggest that it is most likely a black hole binary. RXTE made observations of this binary repeatedly with the PCA during January 27 to August 2, 2006 period. Detailed timing analysis of the data in 2-8 keV and 8-15 keV energy bands show presence of strong QPOs. QPO frequency and amplitude vary with time. Detailed characteristics of the QPOs and shift of QPO frequency with luminosity of source will be presented and implications of these results will be discussed.

## 10 Compact Objects and Accretion Phenomena

## 10.1 Nulling phenomena

Vishal Gajjar, B. C. Joshi, M. Kramer

NCRA-TIFR

#### TALK

Several pulsars show sudden cessation of pulsation which is known as Nulling. A recent study has reported numerous pulsars of this class. Among the newly discovered pulsars in Parke's multi-beam survey, many show Nulling behavior in their discovery plots. A follow-up of these pulsars promises to significantly enhance the sample of Nulling pulsars. We started with the Nulling pulsars, selected from those discovered in Parke's multi-beam survey and observed them with GMRT at low radio frequencies. With the 17 antenna phased array, GMRT is sensitive to single pulses. The results of these observations will be presented in this talk with the brief discussion on Nulling phenomena.

### 10.2 Aspects of relativistic axi-symmetric accretion in Kerrmetric

Ipsita Chakraborty, P. Barai, T. K. Das, P. J. Wiita Adamas Institute of Technology

#### TALK

We perform the critical point analysis of autonomous dynamical systems To demonstrate that the general relativistic black hole accretion flow in Kerr Metric may exhibit multi-transonicity. We then show perturbing such flow may Lead to the formation of standing shock. Such shock formation stratifies the disc structure, and we found several non-linear phenomena in shocked flow which may explain the AGN micro-variability. Origin of quasi periodic oscillation may also be analyzed as a function of the black hole spin, using our model. Our model explains how the astrophysical jets may launch from shocked accretion disc as proposed using our model. We also discuss how such accretion flow (stationary back ground metric) may induce an analogue formalism (perturbative metric) of Hawking radiation.

# 10.3 Optical flux monitoring of blazars

Ravindra Pawase, C. S. Stalin , D. K. Sahu Indian Institute of Astrophysics

#### Poster

Multiband optical monitoring of six blazars 0219+428, 0235+164, 0754+100, 0829+046, 1215+303 and 1553+111 were carried out over 8 nights using the 2m HCT of Indian Institute of Astrophysics. The aim of these observations is to study optical flux variations in blazars occuring within a night on timescales from minutes to hours. For 1553+111, quasi-simultaneous observations were done in V and R filters so as to know also its spectral variability nature. The prevalence of variability in an object is arrived at through differential lightcurves of the blazar derived relative to two or more comparison stars present on the CCD frames. Intranight optical variations with amplitude of variabily of  $\sim 3\%$  was detected in 0829+046, 0235+164 and 1215+303. The detailed results of this study will be presented.

# 11 Galactic and Extragalactic Astronomy

# 11.1 Supernovae and sites of recent star formation

Sayan Chakraborti, A. Ray

TIFR, Mumbai

TALK

We plan to discuss the correlation of supernova types and locations with sites of recent star formation. We shall present observational data as well as preliminary constrains on supernova progenitors.

### 11.2 Evolution of Cluster Galaxies over 7 GYr

Vinu V, Y. G. Wadadekar, A. K. Kembhavi

IUCAA, Pune

Talk

Observational studies of galaxy evolution aim to understand how the physical properties of galaxies evolve with time. Understanding the morphological evolution of galaxies is an mportant part of such an analysis; quantitative measurements of structural parameters of the galaxy sub-components (bulge,disk,point source etc.) facilitate such studies. Using Hubble Space Telescope data we study the morphological evolution of galaxies in cluster environments over the redshift range 0.3 < z < 0.84. We have developed software to carry out two dimensional bulge/disk decomposition in an automated way. We find that the fraction of galaxies with high bulge to disk ratio of the brightest cluster galaxies decreases with lookback time. Our quantitative results are in agreement with previous qualitative studies which use visual estimates of galaxy morphology.

# 11.3 Low frequency imaging of radio halo and relic in A2256

Ruta Kale, Dwarakanath K. S. Raman Research Institute

#### TALK

Radio halos and relics, the Mpc scale diffuse synchrotron sources associated with the intra-cluster medium (ICM), are of great interest for studying the dynamical states of galaxy clusters. Various mechanisms for reacceleration of electrons in the ICM such as diffusive shock acceleration and turbulent reacceleration have been proposed to explain the origin of radio halos and relics. Multi-frequency imaging of radio halos and relics is important to find the spectral signatures of these acceleration mechanisms. We have undertaken a study of radio halos and relics in the galaxy clusters Abell 2255, 2256 and 754 at low radio frequencies such as 150 and 610 MHz with the Giant Metrewave Radio Telescope. Here we present radio images of the halo and relic in A2256. From the nature of spectral index distribution across the halo and relic, implications to the theoretical models will be discussed.

#### 11.4 SN2008D: discovery and its consequences

Rupak Roy

A.R.I.E.S, Nainital

TALK

On thirteenth January 2008, a powerful supernova explosion was caught in act by a space-based X-ray Telescope, while monitoring another supernova located in a nearby spiral galaxy (NGC 2770). As a result, this supernova event named SN2008d, has earliest observations at X-ray and optical bands.Initially, SN2008d was supposed to be an X-ray flash, but later on it was described as an X-ray outburst of a normal Type Ib/c supernova. The SN2008d showed weak X-ray flux, early narrow optical peak followed by a broad optical peak, presence of Helium lines and absence of broad nebular emission lines like Type Ic HNe in optical spectra. These peculiar features were mainly described as a result of Shock breakout' mechanism, though alternative explanation is 'Failed gamma ray burst'. We performed photometric monitoring of this event at optical bands BVR and I over 100 days, started nearly after three days from X-ray outburst and produce one of the long time photometric coverage for this event. In light of the new data, we re-investigate this event, particularly its outburst mechanism.

#### 11.5 Reverberation mapping of the AGN H 0507+164 and SDSS J0824+299

Shivinder Singh

Indian Institute of Technology Kharagpur

#### TALK

I want to present results of the work done as part of the Summer Students Programme - 2008 of the Indian Institute of Astrophysics (IIA), Bangalore. As part of this project, spectroscopic as well as photometric monitoring observations of two Active Galactic Nuclei (AGN) H 0507+164 and SDSS J0824+299 were analysed. The observations used in this project were taken at the 2 m Himalayan Chandra Telescope (HCT) operated by IIA during the period 21 November 2007 to 26 December 2007. A total of 40 spectra (23 for H 0507+164 and 17 for SDSS J0824+299) and a set of 46 image frames in U,B,V and R filters were analysed (29 frames in H 0507+164 and 17 frames in J0824+299). These data were used to determine black hole masses in these two AGN using the method of reverberation mapping. Time lag between the continumat 5100 Å and the  $H_{\beta}$  line is found to be 1.95 and 1.0 days for H 0507+164 and SDSS J0824+299 respectively. H 0507+164 is found to have a black hole of mass  $M_{BH} = 6.9 \times 10^6 M_{\odot}$ , whereas SDSS J0824+299 is found to have a black hole of mass  $M_{BH} \sim 4.40 \times 10^4 M_{\odot}$ . H 0507+164 closely follows the already known empirically established mass-luminosity relation for AGN found from reverberation mapping observations of 36 AGN, whereas, SDSS J0824+299 do not lie on the mass-luminosity relation, which might either be due to the poor quality of data or due to insufficient temporal coverage or a combination of both. It might also be due to the narrow line seyfert 1 nature of SDSS 0824+299, thus rendering reverberation mapping of this source inapplicable.

### 11.6 Extinction Mapping Through Broad Band Photometry

Ananta Charan Pradhan

Indian Institute of Astrophysics

#### Talk

Extinction is normally measured using comparison spectra between a star of a given spectral type and another standard star unaffected by interstellar reddening. This is a time intensive job as detailed spectra must be obtained. However, there are a number of photometric observations in broad bands now available, such as GALEX which has observed much of the sky in two ultraviolet bands (NUV 1750-2750A, FUV 1350-1750A). If such observations, in conjunction with other surveys (DSS, 2MASS etc) can be used to derive the extinction, we have the potential to derive extinction maps over the entire This will have important implications for our understanding of the sky. dust distribution and its properties in our own Galaxy. We are beginning this activity with an analysis of the two band GALEX observations along with two visible bands. Our method consists of convolving Kurucz models of appropriate spectral types with extinction curves to predict the spectral colours in the different bands. We can then compare the observed fluxes with this grid to actually derive the extinction for each star. Once this is done, we can then apply statistical tests to the extinction values to determine a 3-D distribution of dust.

#### 11.7 Broad Band Optical Polarimetric Study of NGC1893

C. Eswaraiah, A. K. Pandey, B. J. Medhi, J.C. Pandey, D. K. Ojha,

C. Muthumariappan

Aryabhatta research Institute of observational sciences

#### TALK

We present new B, V, R and I multicolor linear Polarimetric observations for nearly 72 stars to study the properties of the interstellar dust particles and magnetic field strength and orientation towards NGC 1893. In this study we found that the weighted mean for percentage of polarization  $(P_{max})$  and wavelength at maximum polarization  $(\lambda_{max})$  are found to be  $2.59 \pm 0.13$  and  $0.55 \pm 0.005$  respectively. Mean value of polarization angle found by fitting with Gaussian function as 158.40 with dispersion 7.20. Weighted mean value of  $P_{max}$  is close to the value corresponds to average efficiency of polarization for the interstellar dust  $(P_{max} \sim 5E(B-V))$  with a mean color excess of 0.50 towards NGC 1893. By using the relation  $R_v = (5.6 \pm 0.3) \lambda_{max}$  ( Whittet Van Breda 1978) we measure total to selective extinction,  $R_v$  as  $(3.08 \pm 0.055)$  which well coincides with the value,  $R_{cluster} = 3.06 \pm 0.07$ derived by Saurabh et al (2007) by using the procedures given by Pandey et al. (2003). We also present the correlation between our polarimetric results with starforming scanario in NGC1893 by using previous photometric and spectroscopic studies.

# 11.8 Optical Variability of Blazar 3C279

Md Zulfikar Ali

Indiam Institute of Technology, Kharagpur

#### Poster

We selected the blazar 3C279 to search the intra day variability and short term variability. We carried out observation of our source 3C279 on the night of 25th 26th and 27th may 2008 using the 1.2m infrared cassegrain type telescope equipped with CCD detector and BVRI Johnson broad band filters at Mt. Abu observatory, Rajasthan. A large number of observation were taken in the R filter. Image processing, pre processing and aperture photometry were done using IRAF software. Out of three nights of observation IDV was found on May 27. No day to day variability of the blazar was detected. We also estimated the upper size of the emission region to be  $19 \times 10^{11}$  m.

# 11.9 Studying high redshift galaxies using population synthesis model Starburst99

Mukul Mhaskey

University of Pune

#### Poster

Studying star formation and stellar mass assembly in galaxies is important for testing galaxy formation theories. We present here the study of the star formation histories for high redshift galaxies. The presence of these massive and old galaxies at high redshifts holds important clues for understanding how the first generation of galaxies formed and how the galaxy population in general has evolved with cosmic time. We have selected galaxies dominated by a stellar population older than 100 MYr, situated at Z > 5 (Wiklind et al.) and calculated galaxy parameters like redshift, age and stellar mass using the population synthesis models. We considered the candidates that exhibited the Balmer break in their spectrum for our study. These candidates were further filtered out by identification of the most likely old and high redshift galaxies by fitting Spectral Energy Distribution from the population synthesis models. The models are used to fit the observed broad-band photometric data of the selected candidates from which information about the global galaxy parameters, such as redshift, age and stellar mass is determined. We use the stellar population synthesis models of Leithrer et al (Starburst99)

# **12** Astronomical Instrumentation

# 12.1 Operations and Automation of an All Sky Camera for a continuous record of the sky

Amit Vishwas, S. R. Trehan, P. S. Thilagam, T. P. Prabhu

NITK Surathkal

#### Talk

An All Sky Camera is a CCD based wide angle photo detector. The proposed system will be installed at the Indian Astronomical Observatory, Hanle for monitoring of the Sky conditions throughout day and night. An important aspect is the ability to dynamically automate its operations with the various camera parameters. It is specially important as the observatory is controlled over a satellite link from near Bangalore. The camera provides a more uniform and scientific way for analysis of observation conditions and archival for later analysis as required. Similar systems exist elsewhere, namely the CONCAM project, MASCOT at Paranal Observatory and the All Sky Camera at MMTO Arizona. It would also be possible to perform photometric observations on bright objects from the images captured over a long period of time. The various steps in development of the system would include Data Acquisition, Hardware Interfacing, Interface Control, Image and Data Processing, Feedback, Storage and Network Access. Such observations would greatly help the observers to plan their schedules by studying the sky conditions. Once fully developed, the system will upload and update current images of the sky from Hanle to a portal at Indian Institute of Astrophysics which would be accessible publicly over the Internet.

#### 12.2 Time delay between Solar X-ray flux and Proton flux duringProton Events of 2005-2006

Ankush Bhaskar, G. Rajaram, K.Kadam

University of Mumbai

#### Poster

The proton flux and X-ray flux from the GOES-10 satellite are examined during solar proton events of 2005-2006. When flare occur flux of photons and particles get ejected, simultaneously, since photon travel with velocity of light and particles travel slower than light, definitely photons will reach first and then particles. From the present study, it is confirmed that there is a definite time delay between the measured flux of solar X-ray of 8A0 wavelength and proton flux (10-30 MeV) during High energetic proton events. This time delay can be useful for predicting the geomagnetic storms.