

IIA Theoretical Astrophysics Group Mini Workshop on Cosmology and Galaxies

Date: 28 November, 2011

Venue: Auditorium, IIA

Program

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|---------------|-----------------------|---|
| 9:30 - 9:35 | Opening remarks | |
| Session 1 | Session chair : | Bhanu Das |
| 9:35 - 10:05 | Changbom Park | <i>Constraining the Dark Energy Using the Large-Scale Structure Topology</i> |
| 10:05 - 10:35 | Ravi Subrahmanyan | <i>Cosmic Dawn in redshifted 21-cm</i> |
| 10:35 - 11:05 | Tarun Deep Saini | <i>Constraining distance-redshift relation using BBO/DECIGO observations of gravitational radiation from merging binaries</i> |
| Coffee break | 11:00 - 11:30 | |
| Session 2 | Session chair : | Tushar Prabhu |
| 11.30 - 12.00 | Biman Nath | <i>Galactic wind and the intergalactic medium</i> |
| 12.00 - 12.30 | Chanda J. Jog | <i>Prolate-shaped dark matter halo in the outer Galaxy as deduced from flaring HI gas</i> |
| 12.30 - 13.00 | Prateek Sharma | <i>Hot Gas in Massive Dark Matter Halos</i> |
| Lunch break | 13:00 - 14:30 | |
| Session 3 | Session chair : | Ravi Subrahmanyan |
| 14.30 - 14.50 | Sivarani Tirupathi | <i>Origin of carbon in the Early Galaxy</i> |
| 14.50 - 15.10 | Mousumi Das | <i>AGN Activity and Black Hole Masses in Low Luminosity Galaxies</i> |
| 15.10 - 15.30 | Amit Shukla | <i>Multiwavelength study of TeV Blazar Mrk421 during giant flare</i> |
| Coffee break | 15:30 - 16:00 | |
| Session 4 | Session chair : | Changbom Park |
| 16.00 - 16.30 | Shiv Sethi | <i>Heavy charged lepton as dark matter in the universe?</i> |
| 16.30 - 17.00 | Rajesh Gopal | <i>Primordial magnetic fields and collapse of baryonic region</i> |
| 17.00 - 17.30 | Pravabati Chingangbam | <i>Residual foreground contamination in the CMB</i> |

Abstracts

1. Changbom Park

Title : Constraining the Dark Energy Using the Large-Scale Structure Topology

Abstract : We propose to use the topology of large-scale structure (LSS) of the universe as a cosmic ruler to constrain the cosmological parameters governing the expansion of the universe, and the dark energy equation of state in particular. The statistical properties of pattern of LSS is scale-dependent, and is conserved in comoving space. This allows one to use LSS as a cosmic ruler. The LSS topology as measured by the genus is relatively insensitive to non-linear systematic effects such as gravitational evolution, galaxy biasing, and redshift-space distortion, and thus is an optimal statistics to be used to measure the cosmological parameters using this method.

2. Ravi Subrahmanyam

Title : Cosmic Dawn in redshifted 21-cm

Abstract : I will review the redshifted 21-cm signatures from cosmological re-ionization and summarize the efforts at RRI towards detecting these. The experimental efforts towards detecting all-sky spectral signatures include single element and zero-spacing interferometer systems being developed at Gauribidanur observatory. Separately, we are part of the EoR collaboration working towards imaging the 21-cm signatures with the Murchison Widefield Array: we are developing algorithms for distinguishing re-ionization signatures in the presence of orders of magnitude higher foregrounds. This talk will be on behalf of the members of the RRI astro group, engineers, post-docs, and students involved in the efforts.

3. Tarun Deep Saini

Title : Constraining distance-redshift relation using BBO/DECIGO observations of gravitational radiation from merging binaries

Abstract : The expansion history of the Universe is encoded in the distance-redshift relationship. If measured to a high precision this relationship can help constrain the various components that constitute our Universe; in particular the most mysterious of all: the dark energy component. By observing mergers of compact objects, future gravity wave experiments would measure the luminosity distance to a large number of sources to a high precision but not their redshifts. Given the directional sensitivity of these experiments, a fraction of such sources (gold plated GP) can be identified optically as single objects in the direction of the source. In this talk I will show that if an approximate distance-redshift relation is known then it is possible to statistically resolve sources with multiple galaxies in the beam. I will discuss the feasibility of using gold plated sources to iteratively resolve the unresolved sources, obtain the self-calibrated best possible distance-redshift relation. I will also discuss the effect of contamination from false identifications and how to minimize it.

4. Biman Nath

Title : Galactic wind and the intergalactic medium

Abstract : Outflows from galaxies enrich the intergalactic medium and play a crucial role in the evolution of galaxies. I will discuss the physics of these outflows and compare the results of theoretical models with observations.

5. Chanda J. Jog

Title : Prolate-shaped dark matter halo in the outer Galaxy as deduced from flaring HI gas

Abstract : The visible galactic disk in a spiral galaxy is believed to be embedded in a dominant dark matter halo, however the physical properties of the halo such as its shape are not well-understood. We show that the dark matter halo of our Galaxy is prolate in shape, with the vertical-to-planar axis ratio steadily increasing to 1.8 at 24 kpc. This is obtained by modeling the observed steeply flaring HI gas in the outer Galactic disk, where the gas is supported by pressure against the net gravitational field of the disk and the halo. The prolate shape agrees with the trend seen in simulations of galaxy formation. This shape has important implications for galactic dynamics: for example, it can support long-lived warps thus explaining why these are so common.

6. Prateek Sharma

Title : Hot Gas in Massive Dark Matter Halos

Abstract : Multiwavelength observations have shown that the gas in cluster cores is not cooling as expected. The observations of radio jets/bubbles and X-ray cavities show that the AGN at the cluster center can provide significant mechanical energy to offset radiative cooling. I will describe idealized numerical simulations of X-ray gas in clusters and groups and show that local thermal instability plays a crucial role in determining the hot gas properties. Our model provides hints for solving several puzzles such as the X-ray luminosity-temperature relation and provides a unified picture of the state of the hot gas in clusters, groups, and galaxies.

7. Sivarani Tirupathi

Title : Origin of carbon in the Early Galaxy

Abstract : In recent years, with the massive spectroscopic surveys it is possible to get homogeneous chemical abundances for large number of stars. This allow us to probe the chemical/kinematical history of the Galaxy. Here, we present recent results on increased carbon abundances seen in low metallicity stars in our Galaxy. We determine carbon abundances for 300,000 stars in the SDSS sample. For a subset of 30,000 stars with well understood target selection, kinematic analysis done, in order to probe the origin of carbon in connection to the early Galaxy formation. Similar high carbon abundances have also been reported at high redshifts (Kobayashi et al. 2011, Matsuoka et al. 2011). Carbon rich stars which show no signature of AGB pollution (CEMP-no stars especially seen below $[Fe/H] = -3.0$), have abundance pattern similar to high redshift faint supernovae.

8. Mousumi Das

Title : AGN Activity and Black Hole Masses in Low Luminosity Galaxies

Abstract : Low Luminosity spiral galaxies are generally dark matter dominated systems that are gas rich but poor in star formation. They are thus thought to be poorly evolved systems that show little nuclear activity. Recent results however indicate that a significant fraction of these galaxies have AGN and the associated black hole masses are relatively low compared to bright galaxies. In this talk we will present radio and optical observations of the nuclear activity of a distinct class of low luminosity galaxies - the Giant Low Surface Brightness (GLSB) galaxies. We will present GMRT radio observations and HCT optical spectroscopy of the nuclei of these galaxies and discuss the implications of our results.

9. Amit Shukla

Title : Multiwavelength study of TeV Blazar Mrk421 during giant flare

Abstract : We present results of a multiwavelength study of nearby ($z=0.03$) TeV blazar Mrk421 during its high state of activity in February - April, 2010, which has shown flaring behavior in X-ray and gamma ray bands in February 2010. One of the brightest flaring episodes of this source was observed by various experiments on 17 February, 2010. HAGAR observations during 13 - 19 February, 2010, in the energies above 250 GeV show an enhancement in the flux level, with a maximum flux of ~ 7 Crab units having been detected on 17 February, 2010. We present the spectral energy distributions during this flaring episode and investigate the correlation of the variability in X-ray and γ -ray bands.

10. Shiv Sethi

Title : Heavy charged lepton as dark matter in the universe?

11. Rajesh Gopal

Title : Primordial magnetic fields and collapse of baryonic region

12. Pravabati Chingangbam

Title : Residual foreground contamination in the CMB

Abstract : Searches for non-Gaussian deviation of the CMB temperature anisotropy field have typically revealed deviation roughly of the order of one-percent. It is usually assumed the data has been cleaned of all contaminants and that this deviation has primordial origin. We study the possibility that there is residual foreground contamination from our galaxy and point sources in the sky, using WMAP 7 years data, which can lead to the observed non-Gaussianity. We calculate correlations between the cleaned CMB signal and the so-called 'peak' field, which is the foreground field from which long wavelength correlations have been subtracted. We find that there is significant positive correlation of the cleaned CMB and the peak field, clearly indicating there that there is residual contamination. Further, we find that a significant portion of the correlation comes from pixels which have positive values above three sigma. We conclude that there are several point sources which have not been properly identified in WMAP 7 years data and this can lead to incorrect estimation of primordial non-Gaussianity.

Participants

1. Arunima Banerjee, *IISc, Bangalore*
2. Pravabati Chingambam, *IIA, Bangalore*
3. Bhanu Das, *IIA, Bangalore*
4. Mousumi Das, *IIA, Bangalore*
5. Jonathan Freundlich, *IAP, Paris*
6. Abhijit Ghosh, *CQUEST, Seoul*
7. Rajesh Gopal, *IIA, Bangalore*
8. K. Hariharan, *IIA, Bangalore*
9. P.K. Joby, *IIA, Bangalore*
10. Chanda Jog, *IISc, Bangalore*
11. Poonam Mehta, *DU, Delhi*
12. Vinod Krishan, *IIA, Bangalore*
13. A. Satya Narayan, *IIA, Bangalore*
14. Biman Nath, *RRI, Bangalore*
15. Changbom Park, *KIAS, Seoul*
16. Tushar Prabhu, *IIA, Bangalore*
17. S.P. Rajaguru, *IIA, Bangalore*
18. Swati Routh, *IIA, Bangalore*
19. Tarun Deep Saini, *IISc, Bangalore*
20. Shiv Sethi, *RRI, Bangalore*
21. Prateek Sharma, *IISc, Bangalore*
22. Prajval Shastri, *IIA, Bangalore*
23. Amit Shukla, *IIA, Bangalore*
24. Prasanna Srinivasa, *IIA, Bangalore*
25. Subham Srivastava, *IIA, Bangalore*
26. C. S. Stalin, *IIA, Bangalore*

27. Ravi Subrahmanyam, *RRI, Bangalore*
28. Firoza Sutaria, *IIA, Bangalore*
29. Sivarani Tirupathi, *IIA, Bangalore*
30. Sudhir Vempati, *IISc, Bangalore*