

## Soumen Mondal

Associate Professor  
Astrophysics and Cosmology  
soumen.mondal@bose.res.in

Dr. Soumen Mondal received his Ph.D. degree from Physical Research Laboratory (PRL), Ahmedabad in 2004. He has post doctoral research experience at PRL for a year, and then at National Central University, Taiwan under International Taiwanese-American Occultation Survey (TAOS) program for about two and half years. He joined Aryabhata Research Institute for Observational Sciences (ARIES), Nainital as a Scientist in 2007 and worked for four years, and then moved to S N Bose National Centre for Basic Sciences in 2011 as an Assistant Professor.

### Supervision of Research / Students

#### Ph.D. Students

1. Somnath Dutta (5th yr.) - "Multi-wavelength studies on Galactic H II regions" registered at CU expected to submit thesis by August 2017.
2. Supriyo Ghosh (5th yr.) - "Study of cool and evolved stars" registered at CU, expected to submit thesis by 2017.

3. Anindita Mondal (5th year, jointly RK Das) - "Multi-wavelength studies of Novae", registered at CU, expected to submit thesis by 2017.
4. Samrat Ghosh (3rd yr.)- "A search for Photometric Variability in Young/Old Brown Dwarfs" - Thesis ongoing.
5. Dhrimadri Khata (3rd yr. jointly with RK Das) - "Understanding Physical Properties of M-Dwarfs" - Thesis ongoing.
6. Alik Panja (2nd yr.) - "Multi-wavelength studies on Galactic star-forming regions" - Thesis ongoing.

#### Projects of M.Sc./ M.Tech./ B.Tech./ Post B.Sc. students

1. Koyel De – M.Sc(Physics) – Jadavpur University -2016 Summer project.

### Teaching activities at the Centre

1. PHY-403 – Astrophysics and Astronomy Elective part (4th Sem) with SKC; PHY-511 – Astrophysics PhD course work with SKC; 3. PHY-191 – Basic Laboratory 1 optics part with AKR.

### Other Publications

1. Dutta, Somanth, Mondal, Soumen, Das, Ramkrishna et al. "A census of variable stars in the young cluster NGC 2282", 41st Cospar Assembly Abstract.

### Lectures Delivered

1. "Understanding of variability properties in very low mass stars (VLMs) and Brown dwarfs" at 1st BINA International workshop held in Nainital, 15 – 18 Nov 2016.
2. "Understanding of Rapid Rotation in Very Low Mass stars (VLMs) and Brown Dwarfs" at Star and Planet Formation: Insights and Intricacies, held at IIST, Trivandram, 5-7 Dec 2016.

### Membership of Committees

#### Internal Committee

Board of Studies (BoS); Students' Curriculum & Research Evaluation Committee (SCREC); Member in Project and Patent cell; Member in Library Committee; Land-acquisition committee for the Astronomical Observatory.

### Sponsored Projects

1. One of Activity Leader (PI) in Technical Research Centre (TRC) project of DST started from Jan 2016.

### Significant research output / development during last one year

#### General research areas and problems worked on

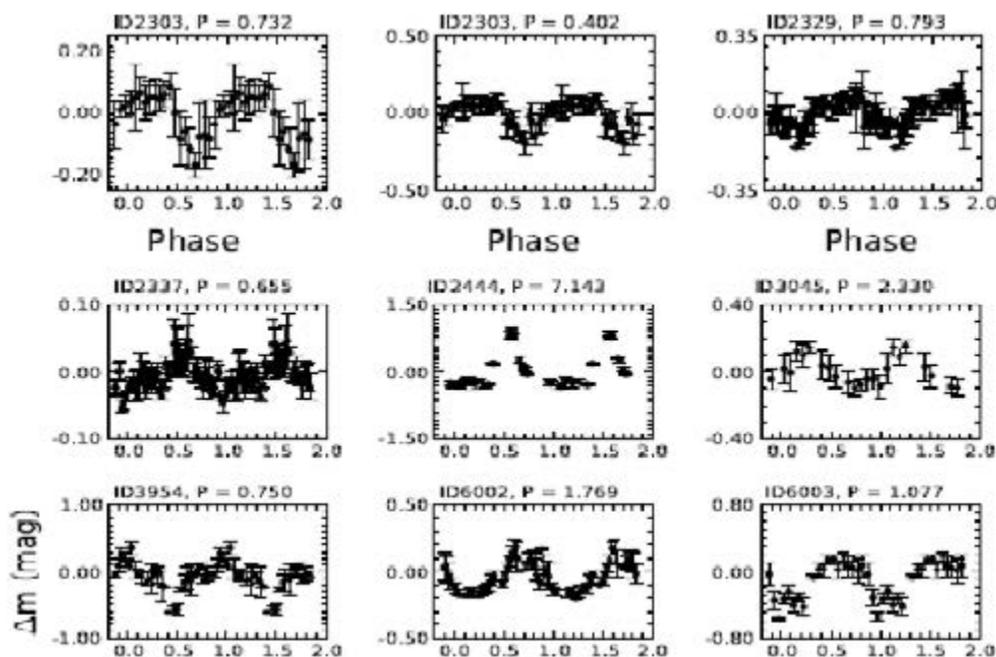
- Extra-solar planets
- Brown dwarfs and low-mass stars in star-forming regions
- M-Giants and Mira variables
- Small solar system objects
- Astronomical Instrumentation

### Interesting results obtained

#### 1. Optical Photometric Variable Stars towards Galactic Hill region NGC 2282

From CCD I-band time series photometry of a young (2-5 Myr) cluster NGC 2282 using 1.3m Devasthal Optical Telescope and 2m Himalayan Chandra Telescope (HCT) we have identified and characterized the variability of Pre-main sequence (PMS) stars. The deep I-band photometry, down to  $\sim 20.5$  mag, enables us to probe variability towards low-mass end of PMS stars. From the light curves of 1627 stars, we have identified 63 new photometric variable candidates. Their association with the region were established from H $\alpha$  emission and

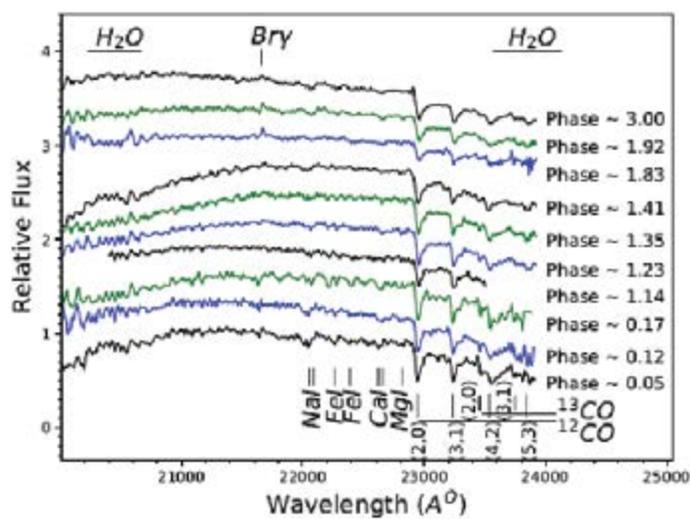
infrared excess using JHK UKIRT and mid-IR Spitzer data. Out of 63 variables, 47 are periodic variables, and show the rotation rate from 0.2 to 7 days. Period distribution shows peak around  $\sim 1.5$  days as seen in other young clusters (e.g. NGC-2264, Orion etc.), but it shows uni-modal distribution unlike others few young clusters having bi-modal distribution with slow rotators peaking at 6- 8 days. Slow rotation due to disk-locking are lacking here. To understand correlation between disk and rotation periods, we have checked infrared excess, mass and age of individual periodic member candidates, we do not have any conclusive evidence on such analyses. Below figure, the light curves of few new young variables are shown. (Dutta et al. 2015; 2017)



#### 2. Phase dependent spectroscopy of a new Mira variable and fundamental parameters of M-giants from optical/IR spectra

We have discovered a new Mira variable from MASTER Optical Transient (OT) alert on J212444.87+321738.3 (J2124+32) toward the Cygnus. We have performed long-term optical/near-IR photometric and spectroscopic observations to characterize that object. From optical light curves, we find that the object has a variability period of about 465 days with amplitude exceeding,  $I \sim 4$  mag in I-band,, which is nature of pulsating Mira

variable. The Near-IR variability amplitudes are seen in  $J \sim 2.2$ ,  $H \sim 1.9$  and  $K \sim 1.5$  mag respectively with similar optical period but have a phase lag of  $\sim 60$  days as seen in Miras. Our optical/near-IR spectra shows molecular features of TiO, VO, CO overtone and water bands, which is a signature of typical cool M-type stars. The Optical/NIR spectra indicates the likely O-rich nature. All these observations confirm that the source is a new O-rich Mira variable. Near-IR spectra of Mira variable J2124+32 is shown here taken TIRSPEC instrument on HCT telescope (Ghosh et al. 2017A; 2017b).



Proposed research activities for the coming year

### 1. **Astronomical Observing facilities of S. N. Bose Centre**

At S. N. Bose Centre, recently we have initiated to establish the World-class Astronomical observing facility at Panchet hill. This project envisages establishing initially a small one-meter-class relatively wide-field telescope. Recently, we got the approval for 2 hectares land at Panchet hill-top, Purulia (about 220 km from the Centre) for this Astronomical Observatory site from the Forest department of Govt. Of India and state Govt. of West Bengal. Our project is of relatively low-cost and will focus on a few primary science programs. Scientific motivations for our telescope encompass forefront problems in Astronomy and Astrophysics ranging from Extra-solar planets to Black-hole astrophysics.

### 2. **On-going long-term scientific programs**

#### (i). **Spectrophotometric studies of late M-type stars (dwarfs and giants) and Miras**

Spectrophotometric studies of low-to-intermediate mass stars represent vital test of theoretical models of stellar evolution, structure, and atmospheres. In stellar evolution, low-to-intermediate main-sequence stars evolve to red giant branch (RGB) through Asymptotic Giant Branch (AGB) before planetary nebulae. Optical/Near-IR spectrophotometric studies of these RGB/AGB objects are undertaken to understand their atmospheres and pulsation. Furthermore, studies of M dwarfs have been recognized as promising targets in the search for small extra-solar planets.

#### (ii) **Multi-wavelength studies of Galactic star-forming regions**

Galactic star-forming regions provide us crucial

information about star-formation process, stellar evolution and stellar structure etc. Multi-wavelength studies of such regions provide census of Young Stellar Objects, their fundamental parameters e.g., masses, ages, effective temperatures, circumstellar disks around them (if any) etc. We are studying of these regions in optical, near infrared (near-IR) and mid infrared (mid-IR) wavelengths.

#### (iii) **Photometric variability studies and characterization of very-low mass (VLM) stars and brown dwarfs**

To provide comprehensive observations and in-depth study of the physical properties of Very Low Mass (VLM) objects and brown dwarfs in galactic field as well as in young star-forming regions, we have started an observational program using the National telescope facilities.

### 3. **Astronomical Instrumentation**

With our expertise in the Optical/IR instrument design and development, we are working to establish an Astronomical Instrumentation Laboratory at the Centre for building the state-of-art backend instruments for the telescopes. We have planned one fibre-fed low-intermediate resolution spectrograph for our own telescope and other national facility telescope as a visitor instrument.

### 4. **Establishing roll-off roof observatory**

Recently, we have built a roll-off roof observatory at roof-top of the Centre to house the 8 inch Meade telescope and 14 inch Robotic telescope with Planewave optical tube assembly (OTA) on German equatorial mount from paramount ME-II. The 8 inch telescope are used to train the students, e.g., IPhD students, project students and public outreach programs. The 14 inch telescope will be used for scientific observations of bright objects and seeing measurement at the new site.