Soumen Mondal

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Astrophysics & Cosmology
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Guidance of Students/Post-Docs/Scientists

a) Ph.D. Students

1. Supriyo Ghosh; Studies on Cool and Evolved stars; Awarded
2. Anindita Mondal; Multi-wavelength studies of Novae; Awarded; Soumen Mondal (Co-supervisor), Ramkrishna Das (Supervisor)
3. Samrat Ghosh; Understanding the Atmosphere of Brown Dwarfs and Low Mass Stars; Under progress
4. Dhrimadri Khata; Understanding of Physical Properties of M-dwarfs : Optical and Near-IR Spectroscopic Studies; Under progress; Soumen Mondal (Supervisor), Ramkrishna Das (Co-supervisor)
5. Alik Panja; A Multiwavelength Study of Galactic Star-forming Regions; Under progress
6. Siddhartha Biswas; Studies of Pre-main Sequence stars in the Galactic Star-forrmation processes; Under progress
7. Diya Ram; Understanding of Active M dwarfs; Under progress
8. Rajib Kumbhakar; Studies of Galactic Very Low-mass Stars
9. Gaurav Patel; Studies of Galactic HII regions; Under progress

b) Post-Docs

1. Arka Chatterjee; Research on Compact Objects and AGNs

c) External Project Students / Summer Training

1. Lopamudra Roy; Spectroscopy techniques for understanding of Milk Adulteration; Technical Reserach Center, SNBNCBS
2. Supratim Sen; Spectroscopy techniques for understanding of Milk Adulteration in NIR wavelengths; Technical Reserach Center, SNBNCBS
3. Pallabi Saha; Understanding Galactic Low Mass Stars: M-Dwarfs; Department of Physics, Diamond Harbour Women's University
4. Swagata Mukhopadhyay; Multi Wavelength Study Of Star Forming Region; Department of Physics, Diamond Harbour Women's University
5. Sipra Sinha; Mira Variable - A Pulsating M-Giants; Department of Physics, Diamond Harbour Women's University
6. Simantini Maiti; Estimation of Fundamental Parameter of Stellar Sources; Department of Physics, Diamond Harbour Women's University

Teaching

1. Autumn semester; Basic Laboratory -I (PHY 191); Integrated PhD; 05 students; with 1 (Prof. Samir K. Pal) co-teacher
2. Spring semester; Astrophysics and Astronomy (PHY 403); Integrated PhD; 13 students; with 1 (Dr. Ramkrishna Das) co-teachers
3. Spring semester; Astrophysics and Astronomy (PHY 510); PhD; 04 students; with 1 (Dr. Ramkrishna Das) co-teachers

4. Autumn semester; Observational Techniques in Astronomy; PhD; 05 students; with 1 (Dr. Ramkrishna Das) co-teachers

Publications

a) In journals

1. Alik Panja, Wen Ping Chen, Somnath Dutta, Yan Sun, Yu Gao, and **Soumen Mondal**, *Sustaining Star Formation in the Galactic Star Cluster M 36?*, The Astrophysical Journal, 910, 80, 2021
2. Samrat Ghosh, **Soumen Mondal**, Somnath Dutta, Ramkrishna Das, Santosh Joshi, Sneh Lata, Dhrimadri Khata, Alik Panja, *Fast photometric variability of very low mass stars in IC 348: detection of superflare in an M dwarf*, Monthly Notices of the Royal Astronomical Society, 500, 5106 – 5116, 2021
3. upriyo Ghosh, **Soumen Mondal**, Ramkrishna Das and Somnath Dutta, *Spectroscopic and Photometric Monitoring of a Poorly Known Highly Luminous OH/IR Star: IRAS 18278+0931*, The Astronomical Journal, 161, 198, 2021
4. Rahul Bandyopadhyay, Ramkrishna Das, **Soumen Mondal**, Samrat Ghosh, *Morphology and ionization characteristics of planetary nebulae PB 1 and PC 19*, Monthly Notices of the Royal Astronomical Society, 496, 814-831, 2020

Talks / Seminars Delivered in reputed conference / institutions

1. Invited talk on "Understanding of Pre-main Sequence Stars in Galactic Star-Forming Regions" in the HCT20 Science Meeting; Sep 29, 2020; Indian Institute of Astrophysics, Bangalore (online); 20 mins

Administrative duties

1. (i). Head of the Department of Astrophysics and Cosmology, S. N. Bose National Centre of Basic Sciences (ii). Nodal Officer of Technical Research Centre (TRC), S. N. Bose National Centre of Basic Sciences (iii). Internal committee member in Board of Studies (BoS); Students' Curriculum & Research Evaluation Committee (SCREC); Project and Patent cell; Member in Library Committee; Land-acquisition committee for the Astronomical Observatory, Advisory committee member of Computer cell, etc.

Extramural Projects (DST, CSIR, DAE, UNDP, etc.)

1. Technical Research Centre (TRC), SNBNCBS; DST; January 2016 - June 2021; PI

Scientific collaborations with other national / international institutions (based on joint publications)

1. Prof. Wen-Ping Chen, National Central University, Taiwan; Sl. No. 1; International
2. Prof. Yu Gao, Purple Mountain Observatory and Department of Astronomy, Xiamen University, Republic of China; Sl. No. 1; International
3. Dr. Somanth Dutta, Institute of Astronomy and Astrophysics, Academia Sinica, Taipei, Taiwan; Sl. No. 1,2,3; International
4. Dr. Yan Sun, Purple Mountain Observatory, Nanjing 210033, People's Republic of China; Sl. No. 1; International
5. Dr. Santosh Joshi, Aryabhatta Research Institute of Observational Sciences(ARIES), Nainital-263 002, India; Sl. No. 3; National
6. Dr. Sneh Lata, Aryabhatta Research Institute of Observational Sciences(ARIES), Nainital-263 002, India; Sl. No. 3; National

Areas of Research

(IMulti-wavelength studies on Galactic star-forming regions; (ii) Spectroscopic studies of Low-mass M-dwarfs, M giants and AGB stars; (iii) Photometric variability studies of Brown dwarfs and Very Low Mass stars; (iv) Extra-solar Planets; (v) Astronomical Instrumentation

1. **Fast photometric variability of very low mass stars in star-forming region IC 348: detection of superflare in an M dwarf**

The optical *I*-band photometric variability down to ≅19 mag of a young (~2–3 Myr) star-forming region IC 348 in the Perseus molecular cloud is studied here. We aim to explore the fast rotation (in the time-scales of hours) in

very low-mass stars including brown dwarfs (BDs). From a sample of 177 light curves using our new *I*-band observations, we detect new photometric variability in 22 young M dwarfs including 6 BDs, which are bonafide members in IC 348 and well characterized in the spectral type of M dwarfs. Out of 22 variables, 11 M dwarfs including one BD show hour-scale periodic variability in the period range 3.5–11 h , and rest are aperiodic in nature. Interestingly, an optical flare is detected in a young M2.75 dwarf in one night data on 2016 December 20. From the flare light curve, we estimate the emitted flared energy of 1.48 × 10^{35} erg. The observed flared energy with an uncertainty of tens of percent is close to the superflare range (~10^{34} erg), which is rarely observed in active M dwarfs **(Samrat Ghosh et al., MNRAS, 2021).**

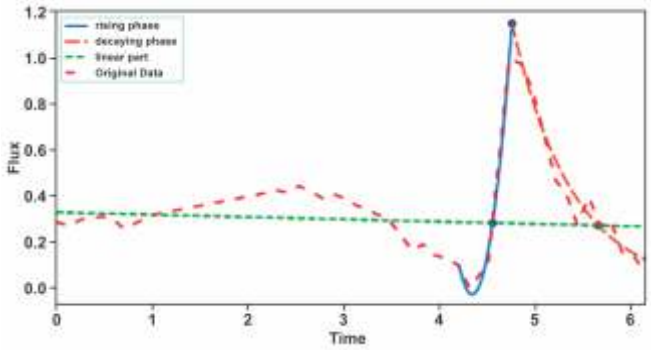

Figure 1. *A flare event in M2.75 dwarf (ID233) is observed in 2016 December 20. The light curve is fitted in three parts for three different regions: constant phase (before flare), rising phase, and decaying phase. Three blue triangles are indicating flare start, peak, and ending time in our calculation.*

2. Sustaining Star Formation in the Galactic Star Cluster M 36?

A comprehensive characterization of the Galactic open cluster M 36 is presented here. Some 200 member candidates have been identified on the basis of proper motion and parallax measured by the Gaia DR2. With an estimated age of ~15 Myr, M 36 is free of nebulosity. To the southwest of the cluster, we discover a highly obscured (A_V up to ~23 mag), compact dense cloud, within which three young stellar objects in their infancy (ages less than 0.2 Myr) are identified. If the physical association between M 36 and the young stellar population can be unambiguously established, this manifests a convincing example of prolonged star

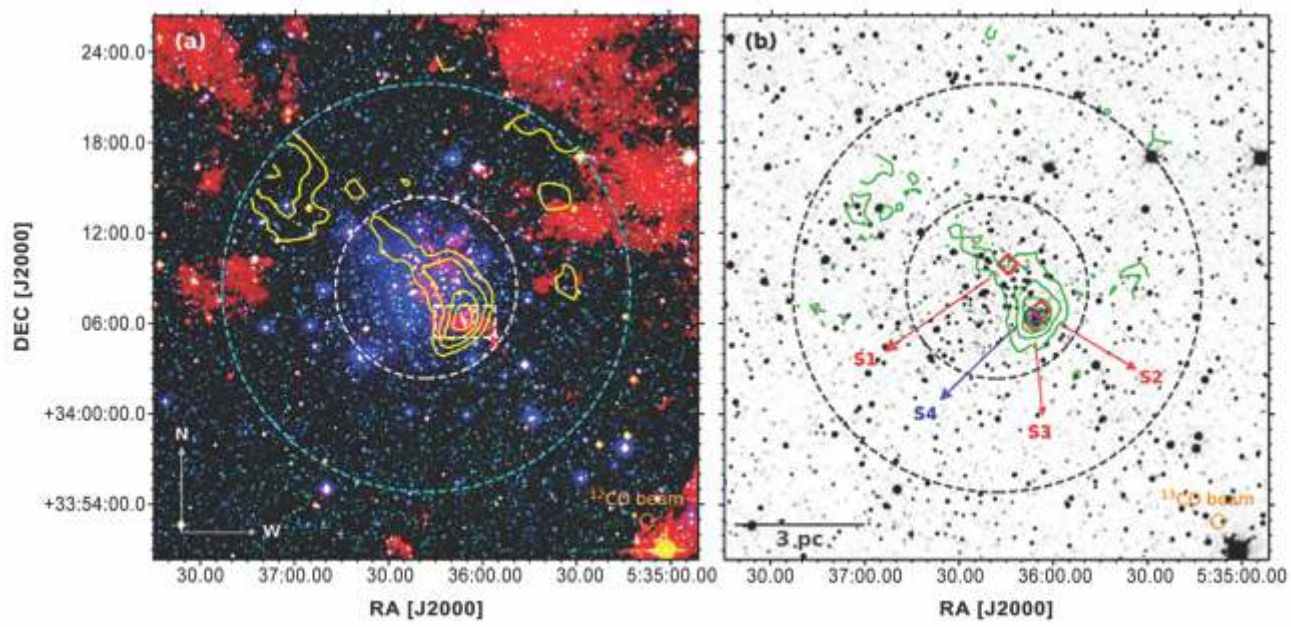

Figure 2. *(a) Color composite image of M 36 using optical and infrared data, taken from DSS2 B 0.44 Mm (blue), 2MASS K 2.2 Mm (green), and WISE W3 12 Mm (red) for a region of M 36 . The ^{12}CO (J = 1–0) distribution is traced by the yellow contours. The high-extinction complex is depicted by the white rectangle. (b) The corresponding WISE 4.6 Mm image is presented, with the green contours representing the ^{13}CO (J = 1–0) integrated intensity. The four YSOs (S1-4) are indicated*

formation activity spanning up to tens of Myr in molecular clouds **(Alik Panja et al., APJ, 2021).**

Plan of Future Work Including Project

1. A. Scientific programs in the observational Astronomy : (i) Spectrophotometric studies of late M-type stars (dwarfs and giants) and Miras: Spectrophotometric studies of low-to-intermediate mass stars represent a vital test of theoretical models of stellar evolution, structure, and atmospheres. Optical/Near-IR spectrophotometric studies of these 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: Multi-wavelength studies of such regions provide a census of Young Stellar Objects, their fundamental parameters. To provide comprehensive observations and in-depth study of the physical properties of Very Low Mass (VLM) objects and brown dwarfs, we are studying these objects using the National telescope facilities. (iii). 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. B. Establishment of S. N. Bose Centre Telescope project at Panchet Hill, Purulia: A new Astronomical observing facility is planned at Panchet hill, West Bengal. This project envisages establishing a 1.5-meter telescope, first in the eastern part of the country. We got recently the approval for 2 hectares of land at Panchet hill-top, Purulia for this Observatory site from the Forest department of Govt. Of India and state Govt. Of West Bengal. Scientific motivations for our telescope program encompass forefront problems in Astronomy and Astrophysics ranging from Extra-solar planets to Black-hole astrophysics.

Any other Relevant Information including social impact of research

1. Advanced manpower generation (Human resource development) through training of Ph.D./Integrated Ph.D. students for National needs in educational sectors as well as a need for National/ International mega projects (like TMT, LIGO, etc.).
2. A spectroscopic-based low-cost instrument "Mil-Q-Way" is being developed under the Technical Research Centre (TRC), SNBNCBS for the detection of adulteration of milk. A prototype instrument is already developed at the Centre, which is under trial run. Such a project is intended for societal benefit and valuable Knowledge resource for the food sector and security.