Ramkrishna Das

Associate Professor
Astrophysics & Cosmology
ramkrishna.das@bose.res.in

Guidance of Students/Post-Docs/Scientists

a) Ph.D. Students

1. Anindita Mondal; Multi-wavelength Study of Novae; Awarded; Dr Soumen Mondal, SNBNCBS (Co-supervisor)
2. Ayan Bhattacharjee; Accretion flow around Black Hole and Neutron star; Thesis submitted; Prof Sandip K Chakrabarti (Supervisor)
3. Anubhab Banerjee; Nature of transient, variable and persistent X-Ray emissions from accretion around Black Holes in compact X-Ray Binaries; Thesis submitted; Prof Sandip K Chakrabarti (Supervisor)
4. Dhrimadri Khata; Understanding Physical Properties of M-dwarfs: Optical and Near-IR Spectroscopic Studies; Under progress; Dr Soumen Mondal (Supervisor)
5. Prantik Nandi; Active Galactic Nucleus; Under progress; Prof Sandip K Chakrabarti (Supervisor)
6. Rahul Bandyopadhyay; Study of Planetary Nebuale; Under progress
7. Ruchi Pandey; Properties of Novae; Under progress
8. Gesesew Reta Habti; Study of Novae; Under progress
9. Subhajit Kar; Massive stars; Under progress

Teaching

1. Autumn semester; PHY 403; Integrated PhD; 14 students; with 1 (Dr Soumen Mondal) co-teacher
2. Autumn semester; PHY 510; PhD; 4 students; with 1 (Dr Soumen Mondal) co-teacher
3. Spring semester; PHY 391; Integrated PhD; 8 students; with 3 (Dr Manik Pradhan, Dr Tirupathaia Setti, and Dr Rajib Mitra) co-teachers

Publications

a) In journals

1. 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
2. Dhrimadri Khata, Soumen Mondal, **Ramkrishna Das**, Supriyo Ghosh, Samrat Ghosh, *Understanding the physical properties of young M dwarfs: NIR spectroscopic studies*, Monthly Notices of the Royal Astronomical Society, 493, 4533-4550, 2020
3. 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

b) Conference proceedings / Reports / Monographs / Books

1. Ramkrishna Das, "Elemental abundances in novae", Journal of Astrophysics and Astronomy, Volume 42, Issue 2, article id. 13, 2021

Administrative duties

1. Liason Office & Chairman, Reservation Cell of the Centre
2. Member of Seminar and Colloquium Programme (SCOLP)
3. Member of Newsletter Committee
4. Member, Conference, Workshop and Extension Programme (CWEP)
5. Member, Committee to facilitate and initiate the process of land acquisition and construction activities at the proposed site for setting up of astronomical observatory and installation of telescope
6. Member, Committee for Selection of Integrated PhD students
7. Member, Committee for Selection of Junior Research Fellow, Department of Astrophysics & Cosmology

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

1. Butterfly Galaxies: Study and Search of the Winged Radio Galaxies to Solve the Mystery of Wing Formation and the Nature of Jets; Submitted to SERB; Co-PI

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

1. Dr Santosh Joshi, ARIES, Nainital; Sl. No. 3; National
2. Dr Sneh Lata, ARIES, Nainital; Sl. No. 3; National

Areas of Research

Novae, Planetary Nebulae, Massive Stars, Modeling of spectra

1. We have studied two compact planetary nebulae (PNe), PB1 and PC 19 using the optical spectra observed at 2 m Himalayan Chandra Telescope (HCT) and archival/literature data. We have used the morpho-kinematic code to construct 3D morphologies of the PNe (Figure 1) and the photoionization code to model the observed spectra (Figure 2). The 3D model of PB 1 consists of an elongated shell surrounded by a bipolar halo and that of PC 19 consists of an open lobed bipolar structure and a spiral filamentary pair. We analyze the ionization structure of the PNe by deriving several plasma parameters and by photoionization modelling. We estimate the elemental abundances of the elements, He, C, N, O, Ne, S, Ar, and Cl, from our analysis. We find He, C, and N abundances to be significantly higher in case of PB 1. From photoionization modeling we estimate different physical parameters of the central stars and the central star, namely effective temperature, luminosity, gravity, hydrogen density profiles, radii, etc., and distances to the PNe as ~4.3 kpc for PB 1 and as ~5.6 kpc for PC 19. Progenitor masses are estimated from theoretical evolutionary

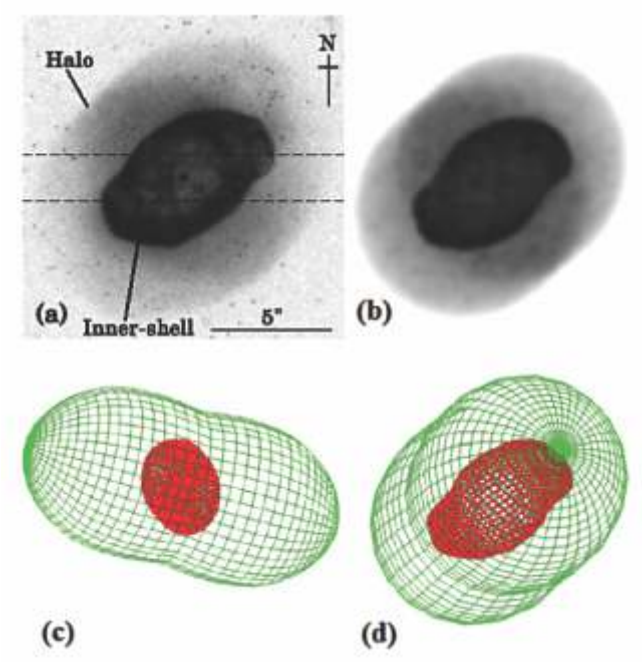

Figure 1: (a) HST HA image of PB 1, used for the 3D reconstruction. The position and width of the slit used for HCT spectroscopic observation is marked with dotted line on the image. (b) The rendered grey-scale 2D model image for comparison with the observed image. (c) The side view and (d) the sky view from the Earth of the constructed 3D model of PB 1.

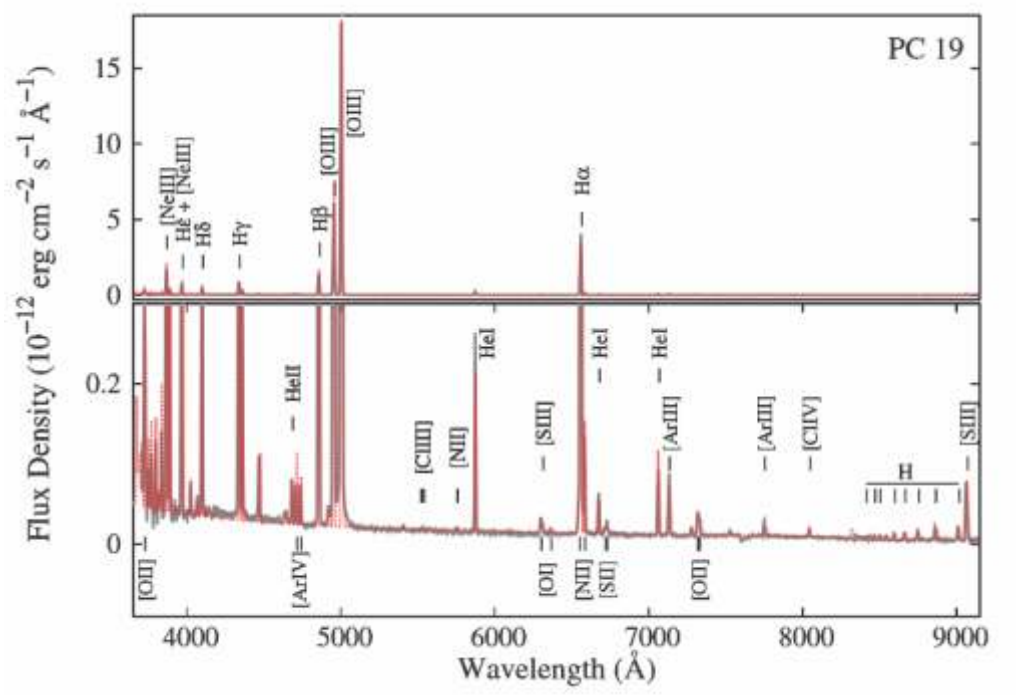

Figure 2: The observed optical spectrum (grey solid line) and the modelled spectrum (red dashed line) are shown for PC 19. Prominent emission lines are marked. Fluxes are in absolute scale. The vertically zoomed spectrum (lower panel) shows the fit of the weaker lines and the continuum.

trajectories and are found to be ~1.67 and ~2.38 M for PB 1 and PC 19, respectively.

2. We have observed medium resolution (~ 1200) near-infrared H- and K-band spectra (1.50-1.80 m and 1.95-2.45 m, respectively) of 53 M-type dwarf stars (M0V-M7V) using the TIFR Near-Infrared Spectrometer and Imager instrument on the 2-m Himalayan Chandra Telescope. Using interferometrically measured effective temperature (T_{eff}), radius and luminosity of nearby bright calibrator stars, we have created new empirical relationships among those fundamental parameters and spectral indices. The equivalent widths of H-band spectral features like Mg (1.57 m), Al (1.67 m) and Mg (1.71 m), and the H_2O-H index are found to be good indicators of T_{eff}, radius and luminosity and we establish linear functions using these features relating to those stellar parameters. The root-mean-squared error of our best fits are 102 K, 0.027 Rsun and 0.12 dex respectively. Using spectral-type standards along with known parallaxes, we calibrate both H- and K-band H_2O indices as a tracer of spectral type and absolute K_s magnitude, and estimate metallicities, mass etc. of M-dwarfs using the K-band calibration relationships.

3. We have modeled the optical and near-Infrared spectra of the dust forming nova V1280 Scorpii to understand how the physical and chemical parameters change from the pre-dust phase to the post-dust phase. From the best-fit model, we estimate the values of different parameters, e.g. temperature, luminosity, density, elemental abundances etc. Dust condensation conditions are achieved with high enough density and low enough temperature. We find a mixture of small amorphous carbon dust and large astrophysical silicate dust. Our model yields a very high

abundances of a few elements, e.g. carbon, nitrogen, oxygen etc. relative to solar in the ejecta, during the pre-dust phase, which decrease in the post-dust phase. (submitted to ApJ, paper under review).

Plan of Future Work Including Project

1. We are reducing and analyzing the observed data. We are planning to observe more object using the available facilities.
2. We are modeling the observed spectra to understand the physics inside the objects.
3. We are in a process to establish S N Bose Centre's Astronomical Observatory at Purulia. We are preparing the the proposal and planning to submit it at the earliest.

Any other Relevant Information including social impact of research

1. i. Progress in the basic sciences is required to solve the problems and understand the world around us. ii. Solving the basic scientific questions improves and enriches the basic knowledge. iii. Development of human resource, through teaching and supervising PhD students, helps to build the Nation. iv. Generates manpower for worldwide astronomical projects.