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Notice for the PhD Viva Voce Examination

Mr Akhil Krishna R, Registration Number: 2071205, PhD Scholar at the Department of Physics and Electronics, School of Sciences, CHRIST (Deemed to be University) will defend his PhD thesis at the public viva-voce examination on Thursday, 05 June 2025 at 2.30 pm in Room No. 044, Ground Floor, R & D Block, CHRIST (Deemed to be University), Bengaluru - 560029, Karnataka, India.

- Title of the Thesis** : **Tracing the Evolution of Polar Ring Galaxies through Multi-Wavelength Observations and Cosmological Simulations**
- Discipline** : **Physics**
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The members of the Research Advisory Committee of the Scholar, the faculty members of the Department and the School, interested experts and research scholars of all the branches of research are cordially invited to attend this open viva-voce examination.

Place: Bengaluru
Date: 02 June 2025


Registrar (Academics)

ABSTRACT

Polar Ring Galaxies (PRGs) are lenticular galaxies characterized by a ring of gas and stars orbiting in a nearly polar or orthogonal plane with respect to the central host galaxy. This study combines multiwavelength observations and cosmological simulations to explore the role of PRGs in the evolutionary transition from late-type galaxies (LTGs) to early-type galaxies (ETGs). It highlights the contributions of both young and old stellar populations to their formation and evolution. The study investigates the young stellar populations within PRGs, revealing distinct evolutionary trajectories characterised by star formation activities in their ring components. Using the multiwavelength UV to MIR data, we studied the resolved-scale stellar populations in the ring and host components. We suggest that PRGs undergo various evolutionary stages, and the three galaxies are excellent examples for understanding the evolutionary pathway of PRGs as NGC 3718 is in the initial stage, followed by NGC 2685 (intermediate stage), and finally, NGC 4262 will be in the final stage of the evolution of PRGs.

Furthermore, we studied the Globular Clusters System (GCS) of NGC 4262, using deep optical observations from the CFHT. The spatial and azimuthal distributions of GCs reveal strong evidence of previous interactions within the host galaxy. The results suggest past interactions within NGC 4262 and a shift from dissipative to dissipationless mechanisms in its GCS evolutionary history, potentially influenced by recent accretion events. We compared PRGs with spiral, elliptical, lenticular, and other ring-type galaxies based on different galaxy properties. we found PRGs in a transitional zone between spiral and elliptical galaxies with NGC 4262 transitioning towards an elliptical. This study also highlights the distinct colour differences between bluer ring components and host galaxies, indicating active star formation in PRGs compared to other ring-type galaxies. We extended our study using simulated data from the TNG50 cosmological hydrodynamical simulation in the IllustrisTNG project. Identifying PRGs and analyzing their kinematic maps confirmed dynamically decoupled components, validating their classification. Our study highlighted the role of viewing angles in detecting polar rings, emphasizing challenges in observational studies. Using TNG-processed data on PRGs and their GCS, we found similar results to NGC 4262. The azimuthal and polar GC distributions of PRGs differ from those of elliptical and lenticular galaxies, bridging observations and models and deepening our understanding of PRG evolution. In conclusion, this thesis provides a framework for PRG evolution, highlighting their role in galaxy transformation and offering insights into their structural, stellar properties, and broader impact on galaxy evolution. Consequently, this work concludes that PRGs serve as a key transitional link between LTGs and ETGs, with the observed PRGs being in an intermediate evolutionary stage, ultimately evolving into ETGs. Future work will explore a broader range of PRGs to deepen insights into their evolution.

Keywords: *galaxies: evolution – galaxies: peculiar – galaxies: photometry – galaxies: star formation – galaxies: structure – galaxies: star clusters: general – globular clusters*

Publications:

1. **Akhil, K. R.**, Kartha, S. S., Ujjwal, K., and Blesson, Mathew., Robin, T., Shankar, Ray., Ashish D., “Connecting the dots: Tracing the evolutionary pathway of Polar Ring Galaxies in the cases of NGC 3718, NGC 2685, and NGC 4262,” Publications of the Astronomical Society of Australia, (Under Revision).
2. **Akhil, K. R.**, Kartha, S. S., and Mathew, B., “Beyond the rings: Polar ring galaxy NGC 4262 and its globular cluster system,” MNRAS, vol. 530, no. 3, OUP, pp. 2907–2918, 2024. doi:10.1093/mnras/stae1061.
3. **Akhil, K. R.**, Kartha, S. S., Mathew, B., Ujjwal, K., Ezhikode, S. H., and Robin, T., “DES J024008.08-551047.5: A new member of the polar ring galaxy family,” A&A, vol. 681, Art. no. A35, 2024. doi:10.1051/0004-6361/202347357