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Notice for the PhD Viva Voce Examination

Mr Prajwel P J (Registration Number: 1740078), PhD Scholar at the School of Sciences, CHRIST (Deemed to be University), Bangalore will defend his PhD thesis at the public viva-voce examination on Tuesday, 11 March 2025 at 10.30 am in Room No. 044, Ground Floor, R & D Block, CHRIST (Deemed to be University), Bengaluru - 560029, Karnataka, India.

Title of the Thesis	:	Study of the Effect of AGN Activity on Star Formation in Nearby Galaxies Using UVIT
Discipline	:	Physics
External Examiner - I (Outside Karnataka)	:	Dr Alok C Gupta Professor Aryabhata Research Institute of Observational Science Nainital - 263002 Uttarakhand
External Examiner - II (Within Karnataka)	:	Dr Stalin C S Professor Indian Institute of Astrophysics Koramangala Bengaluru - 560034 Karnataka
Supervisor	:	Dr Blesson Mathew Associate Professor Department of Physics and Electronics School of Sciences CHRIST (Deemed to be University) Bengaluru - 560029 Karnataka
Co-Supervisor	:	Dr P Sreekumar Professor Manipal Centre for Natural Sciences Manipal Academy of Higher Education Manipal 576104, Karnataka

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: 06 March 2025


Registrar (Academics)

ABSTRACT

The study of star formation is an important aspect of understanding the galaxy evolution in the Universe. While many processes can affect star formation in galaxies, we have explored the effect of active galactic nuclei (AGN). AGN are compact regions located at the centres of some galaxies with luminosities unexplained by stellar populations, and they can even outshine the host galaxy. Galaxies that host AGN are called active galaxies. The source of AGN energy production is now universally accepted to be accretion onto the supermassive black holes found in the central region of galaxies. The star formation rate in an active galaxy can be regulated due to the copious amounts of energy released by AGN to the gaseous components of the galaxy (AGN feedback). AGN feedback, in the form of radiative and mechanical modes, can suppress/trigger star formation by heating/compressing the gas. There is a scarcity of high spatial resolution studies exploring the influence of AGN on star formation activity in nearby galaxies.

In this work, we studied a sample of three nearby galaxies—Cen A, NGC 3982, and NGC 628 (all within < 16 Mpc)—and evaluated the role of AGN in regulating star formation. For this purpose, we used ultraviolet observations from UVIT and GALEX, supplemented with multiwavelength information, to derive a meaningful picture of the star formation activity in these galaxies. The excellent imaging capability of UVIT onboard AstroSat space observatory is evident in the high-resolution images and the derived science presented in this contribution. Centaurus A is the nearest active galaxy known, and we studied the mechanical mode of AGN feedback in this galaxy using UVIT observations augmented by multiwavelength data. An edge-on galaxy with a jet approximately perpendicular to the galaxy disk, Centaurus A has ongoing star formation within and outside the galaxy disk. We studied the Northern Star-forming Region of Centaurus A and identified 352 ultraviolet sources likely associated with the galaxy. The ultraviolet sources were classified into star-forming and diffuse categories. The identified star-forming sources are predominantly aligned with the Centaurus A jet, suggesting that the jet may have played a role in triggering star formation in the Northern Star-forming Region. In this region, we observed age differences between star-forming sources located closer (in projection) to the galaxy and those situated relatively farther away.

We also identified the probable trajectory of past jet activity in Centaurus A and discovered new star-forming sources where jet activity likely induced star formation. NGC 3982 is a nearby galaxy that hosts a Seyfert-type AGN, and we studied the radiative mode of AGN feedback in this galaxy by combining ultraviolet imaging with optical integral field unit data. Our study of NGC 3982 reveals suppression of star formation in the galaxy's central region due to negative AGN feedback. Since AGN can suppress star formation in the central regions of their host galaxies, we investigated the suppression of central star formation in NGC 628 to search for signs of recent AGN activity. UVIT and JWST imaging data were used to probe the spatial distribution of recent star formation, while MUSE data was used to look for the signatures of AGN activity. We found that nebulae inside the star formation cavity region are excited by a strong ionising source. In light of the absence of star formation in this region, it is likely that this strong ionising source is an AGN that was active until recently. Our analysis provides insights into AGN's influence on star formation in nearby galaxies. The proximity of the galaxies studied provides a detailed understanding of AGN feedback. The cases of NGC 3982 and NGC 628 add to the few existing observations of ring-like star formation caused by AGN feedback in galaxies.

Keywords: *ultraviolet: galaxies – galaxies: star formation – galaxies: jets*

Publications:

1. Joseph, P., George, K., & Paul, K. T. (2022). Active galactic nucleus feedback in NGC 3982. *Astronomy & Astrophysics*, 667, A88.
2. Joseph, P., Sreekumar, P., Stalin, C. S., Paul, K. T., Mondal, C., George, K., & Mathew, B. (2022). UVIT view of Centaurus A: a detailed study on positive AGN feedback. *Monthly Notices of the Royal Astronomical Society*, 516(2), 2300-2313.