Exploring Ultra luminous X-ray Sources with JWST

Jeena K
Department of Physics
Providence Women's College
Kozhikode, Kerala

Need of Multi wavelength study of ulxs

- **Non nuclear point sources like extra galactic sources**
- **X-ray studies-**

  Chandra - better positioning accuracy.

  XMM-Newton, NuStar -good S/N for spectral and timing analysis..

- **Multiwavelength studies -**

  Broad understanding of emission mechanisms

  Nature of compact object

  Environment of ULXs

  Variability studies and accretion physics

- **Role of JWST**

  Better resolution of compared to other images…..

JWST observations and analysis

- **Case study - NGC 1672 – spiral galaxy , 16.3Mpc**
- **JWST observations**

  proposal iD – 2107

  NIRCam – F200W, F300M, F360M
- **Downloaded the uncal files**
- **Image reduction for the 3 filters done using the stage1 , stage 2 & stage 3 pipelines**

The First Glimpse of ULXs Through the Near-Infrared Images Captured by the James Webb Space Telescope

Sinan Allak*
Space Science and Solar Energy Research and Application Center (UZAYMER), University of Çukurova, 01330, Adana, Turkey

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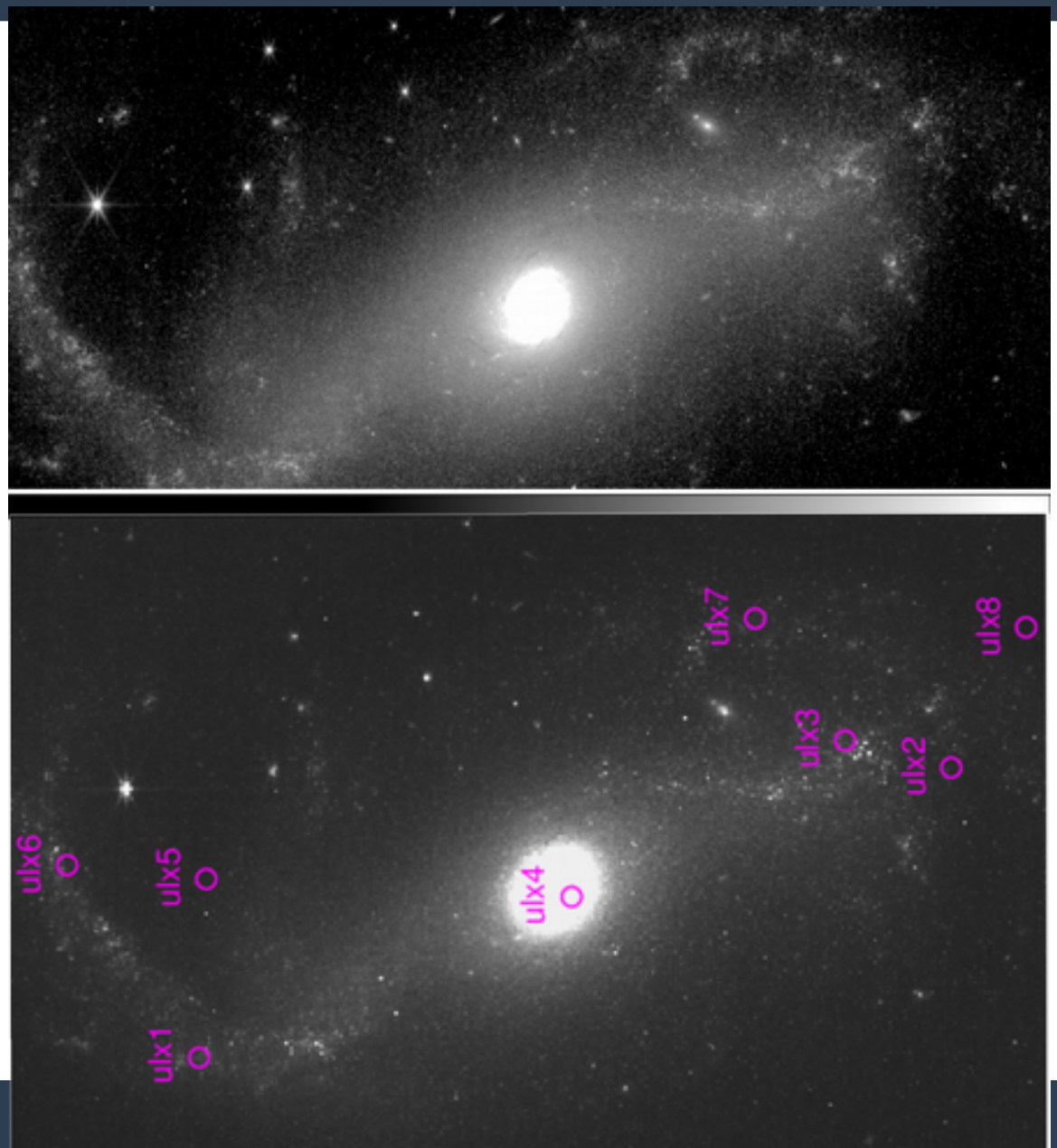
ABSTRACT

This work presents the first results of near-infrared (NIR) counterparts of ultraluminous X-ray sources (ULXs) in the case of NGC 1672 by using *James Webb Space Telescope* (*JWST*) observations. Through advanced astrometry, unique counterparts were identified for four of the eight ULXs (ULX-1, ULX-4, ULX5, and ULX-8) located in NGC 1672, while multiple counterparts were identified for the remaining ULXs. The NIR observations show clues of warm dust or circumbinary disk around ULX-5 and ULX-8. In the case of ULX-5, optical SED is a well-fitted blackbody with 4300 K while NIR excess is well-fitted by a blackbody with a temperature of 1600 K. The optical-NIR photometric results show that the possible donor star of ULX-5 may be a K-M type RSG (red supergiant) whose optical emission is affected by the presence of a circumbinary disk or warm dust. Additionally, the counterpart of ULX-4 could be an AGN (active galactic nuclei) or star cluster due to its high K-band magnitude. Thanks to the good enough resolution of the *JWST* images, in past studies, most of the point-like and/or bright NIR counterparts of ULXs in distant galaxies observed appear to be likely blended sources, so most likely, many of them do not have the red color that an RSG could have. The significant improvement in sensitivity and resolution supplied by *JWST* will lead to a new perspective on the ambiguous nature of ULXs donors and environments necessitating a significant reassessment of earlier infrared studies of ULXs.

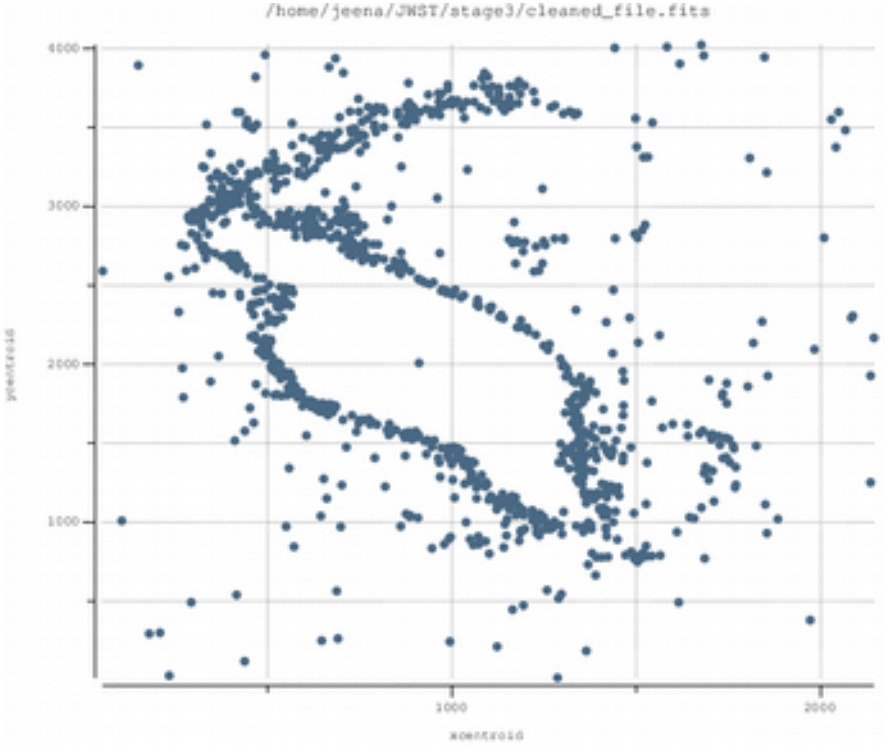
Key words: galaxies: individual: NGC 1672 - X-rays: binaries, (ULXs) -stars: general: (Counterparts of ULXs, Red supergiants), -circumstellar matter: Circumbinary disk/dust -space vehicles: instruments: JWST

NIRCam image –F200w

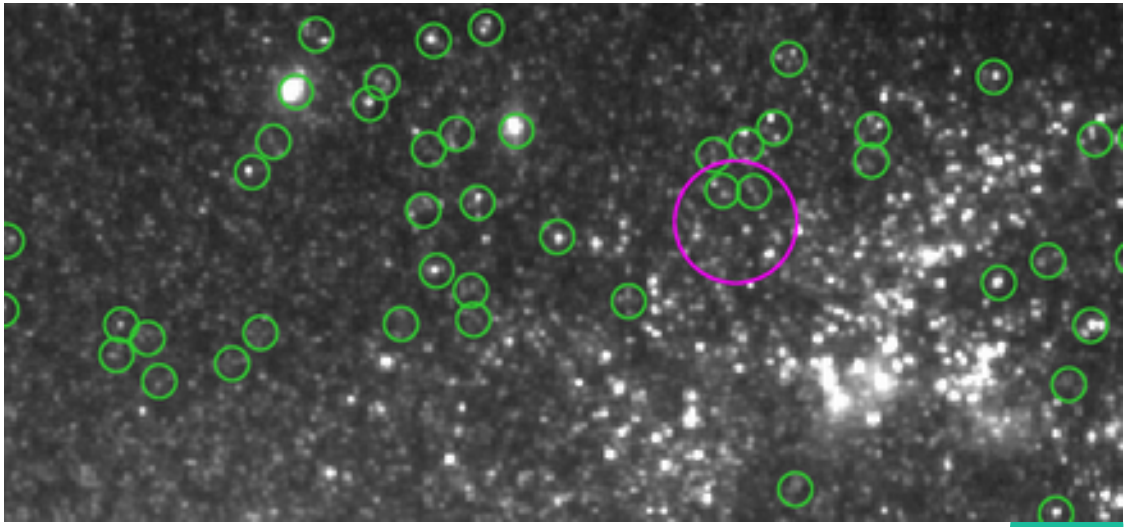


Source number ...	*JWST* R.A. (hh:mm:ss.sss)	*JWST* Decl. (° : ′ : ″)
ULX-1	4:45:52.854	-59:14:56.20
ULX-2	4:45:31.632	-59:14:54.70
ULX-3	4:45:33.995	-59:14:42.06
ULX-4	4:45:42.181	-59:14:52.23
ULX-5	4:45:51.024	-59:14:22.96
ULX-6	4:45:54.325	-59:14:10.47
ULX-7	4:45:35.089	-59:14:12.63
ULX-8	4:45:28.489	-59:14:33.46

IR counter parts



- **Photutils package – used for detecting point sources and performing photometry.**
- **Identified NIR counter parts for some ulxs.**



Moving Forward

- Astrometry- Matching X-ray positions to NIR using reference stars/ catalogues.
- Combine JWST with X-ray missions for multi wavelenth studies.

Thank you