**Introduction**

- NGC300 ULX-1 is a ULX (ultraluminous X-ray source) pulsar originally associated with supernova impostor SN 2010da (Carpano+18a, Vasilopoulos+18a).
- "31s-pulsations were discovered during XMM-Newton/NuSTAR observations in December 2016 (Maitra+ 18).
- Monitoring with Chandra, NICER, XMM-Newton, and Swift showed that the spin period (exponentially) evolved from ~126s to ~18s over 4 years (Vasilopoulos+ 18b, Ray+ 19).
- Carpano+ 18 performed spectral fits (0.3-30 keV) with XMM-Newton and NuSTAR data from December 2016, adopting a two-component model comprising of a power law (Γ ~ 1.6) and a soft disk thermal blackbody with kT ~ 0.18 keV. They also note that the average pulse fraction in the 0.2-10 keV band of XMM-Newton data was ~55%
- Walton+ 18 analyzed the pulsed emission with the same XMM-Newton and NuSTAR data (fitting over 0.3-40 keV) and identified a potential cyclotron resonant scattering feature at ~13 keV.
- Spectral analysis of the pulsed emission by Ray+ 19 with NICER data (over two glitch epochs spanning 40 days total; 0.4-10 keV) suggests that the spectra are initially flatter (Fig. 11), and slowly evolve to softer spectra characterized by an average photon index of Γ ~ 1.5.

**Data Overview**

- Analyzed NICER observations spanning 05/2018 to 05/2019, totaling 136ks, with default NICER pipeline processing and 2018 gain calibration with 2% systematic error was assumed.
- Very short GTIs were discarded; average GTI length was ~600s.
- Data was put into 5-day bins as the trend in the hardness intensity diagram was most evident.
- Discarded 16/41 spectra due to background dominating.
- 2% systematic error was assumed.
- 4 more spectra were removed from the spectral analysis due to anomalous photon indices (Γ ≤ 1).
- 21 rebinned spectra were used for spectral fitting; with combined 180ks exposure (76% of total).

**Conclusions + Outlook**

- Our analysis looks at averaged spectra across 9 months of observations (after discarding spectra due to dominating background), while Ray+ 19 only analyzed the pulsed emission.
- When comparing our 5-day averaged light curve with Fig. 3 in Ray+ 19, the pulsed fraction is inferred to be ~60% over months of observations.
- We see similar spectral behavior with 5-day averaged spectra in the overlapping epoch (~40 days) with Ray+ 19, where the spectra are initially flatter (though our Γ is higher), then Γ stays roughly constant at Γ ~ 1.75.
- However, beyond the epoch covered by Ray+ 19, our spectral analysis with 5-day averaged spectra shows that Γ continues to rise substantially as the intensity decreases.
- Their work also supports our approach of increasing the bin size (to 5 days) as things are changing sufficiently slowly.
- In agreement with other works, an absorbed power law provides the best fit to the data among simple single emission component models.
- We note that the average spectra become softer as intensity decays, because the photon index steepens. This track the result for the pulsed component, as shown by Ray+ 19 for MJD < 58280.
- New calibration and gain for NICER will be released in 2020, so the data selection and spectral analysis will be redone.
- Comparing the work done on pulsed emission by Ray+ 19 and our work, pulsed flux dominates the source emission, so we will next analyze separately how the pulsed and non-pulsed spectra evolve.

**References**

- Carpano et al. 2018 - A&A 526, L13
- Carpano et al. 2018 - A&MN 746, L45
- Kalberla et al. 2005 - A&A 440, 775
- Ray et al. 2019 - Apl 879, 130
- Walton et al. 2018 - Apl 857, L3
- Walsh et al. 2020 - Apl 542, 914