



# X-RAY ASTRONOMY 2019

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## Search for multiwavelength emission from the binary millisecond pulsar J1836-2354A

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We present a multi-wavelength search for X-ray, optical and gamma-ray emission from the radio milli-second pulsar J1836-2354A (M22A, hereafter) hosted in the Galactic globular cluster M22 (NGC 6656), at 3.2 kpc far from Earth. In the last two decades, the cluster was observed with the X-ray satellites XMM-Newton, Chandra and Swift. Thanks to the  $\sim 85$  ks of exposure time, the 2014 Chandra observation allowed us to better constrain the position and the spectral parameters of the X-ray source. The radio and X-ray position are found being consistent within 1 sigma error box. The X-ray luminosity is  $2-3 \times 10^{30}$  erg/s, in the 0.5-8 keV range, which makes M22A one of the faintest milli-second pulsar. The X-ray spectrum is consistent with a power-law of photon index  $\sim 1.5$ , which favour as possible origin of the X-ray emission an intrabinary shock between the pulsar wind and the matter ablated from the companion star.

We also searched for optical and gamma-ray counterparts, using data from the Hubble Space Telescope and Fermi-LAT catalogues, respectively. No optical counterpart is found down to  $V=25.9$  and  $I=24.7$ , which suggests a companion star not more massive than  $0.1-0.2 M_{\odot}$ . The low X-ray luminosity and the upper limit on the mass of the companion allow us to speculate whether M22A is a black widow or rather a redback.

Finally, from the inspection of the latest 8-year Fermi-LAT catalogue, we found a gamma-ray source (4FGL J1836.8-2354), associated with the cluster. However, its 95% error ellipse does not encompass the radio/X-ray position of M22A, though it is very close.

Further deep studies on these type of sources will be possible thanks to the new generation of X-ray satellites, as for example ATHENA, which will be able to achieve highly significative detections of very faint X-ray milli-second pulsars, thanks to its high spectral capabilities and to the reduced instrumental background level. This will enable the scientific community to retrieve more information about the temporal and spectral features of these sources and eventually to discriminate between the different emission scenarios.

### Topic

Compact and diffuse sources in galaxies and in the Galactic Center

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