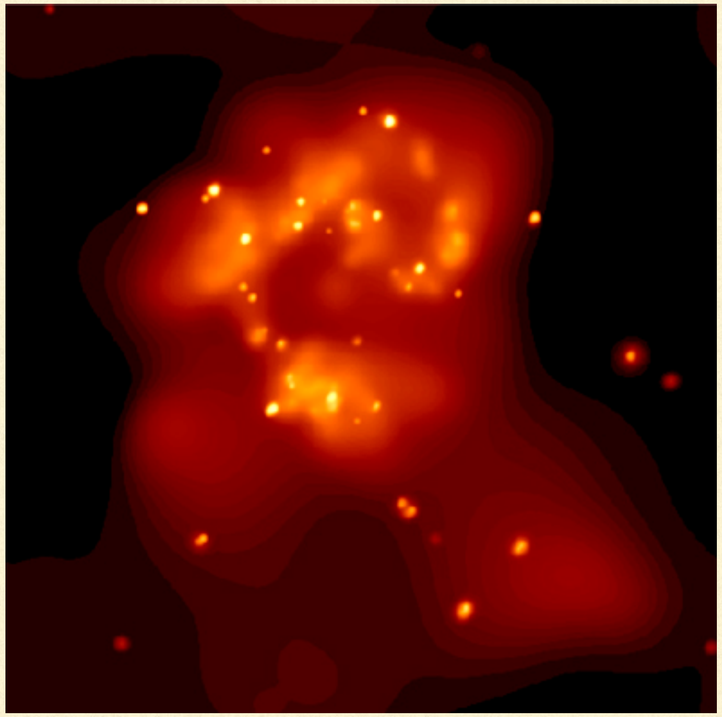
CAMK Annual Meeting 2024

Jean-Pierre Lasota



31th of January 2024

Nicolaus Copernicus Astronomical Center
of the Polish Academy of Sciences

Publications 2023

1 ☑ 2023MNRAS.526.2506L 2023/12 cited: 2

Ultraluminous X-ray sources are beamed

Lasota, Jean-Pierre; King, Andrew

2 ☐ 2023arXiv231116013L 2023/11

Problems in the astrophysics of accretion onto compact celestial bodies

Lasota, Jean-Pierre

3 ☐ 2023ATel16272....1H 2023/10

First X-ray detection of the new outburst of Swift J1753.5-0127 and continuing optical brightening

Homan, J.; Alabarta, K.; Russell, D. M. *and 16 more*

4 ☐ 2023ApJ...951...51B 2023/07 cited: 4

A New Sample of Transient Ultraluminous X-Ray Sources Serendipitously Discovered by Swift/XRT

Brightman, Murray; Hameury, Jean-Marie; Lasota, Jean-Pierre *and 11 more*

5 ☐ 2023NewAR..9601672K 2023/06 cited: 25

Ultraluminous X-ray sources

King, Andrew; Lasota, Jean-Pierre; Middleton, Matthew

6 ☐ 2023arXiv230207925L 2023/02

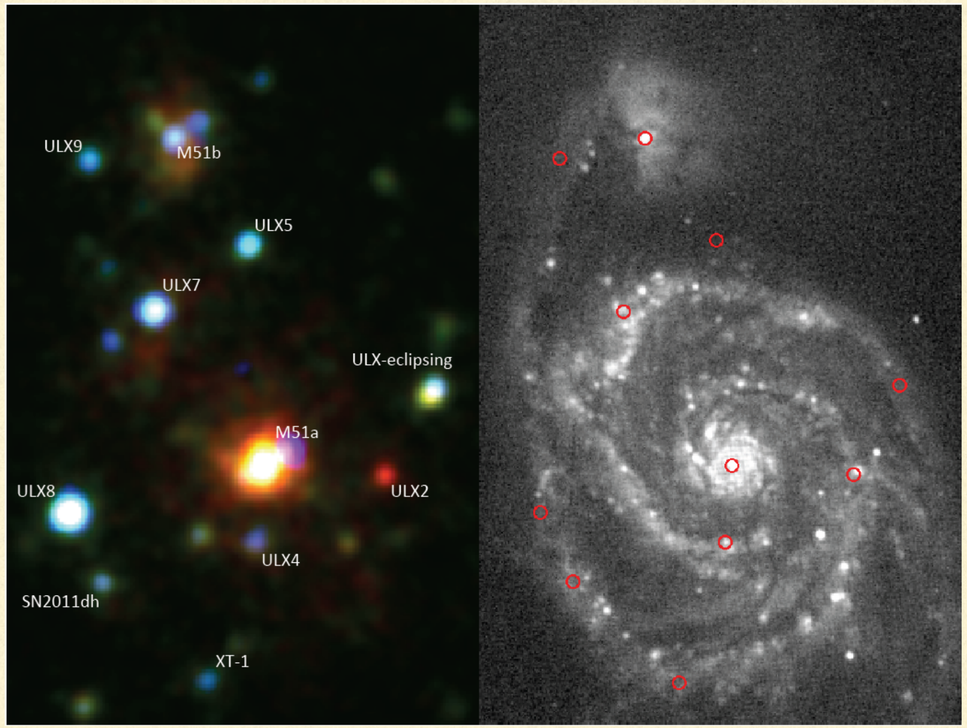
AGN Accretion Discs

Lasota, Jean-Pierre

Ultraluminous X-ray sources (ULXs):

$$L > 10^{39} \mathrm{erg\,s^{-1}} \gtrsim \mathrm{L_{Edd}}\left(10\,\mathrm{M_\odot}\right)$$

off galactic center



Pulsing ULXs (PULXs), magnetized neutron stars: L up to $10^{41}\mathrm{erg/s} \sim 1000\, L_{\mathrm{Edd}}$

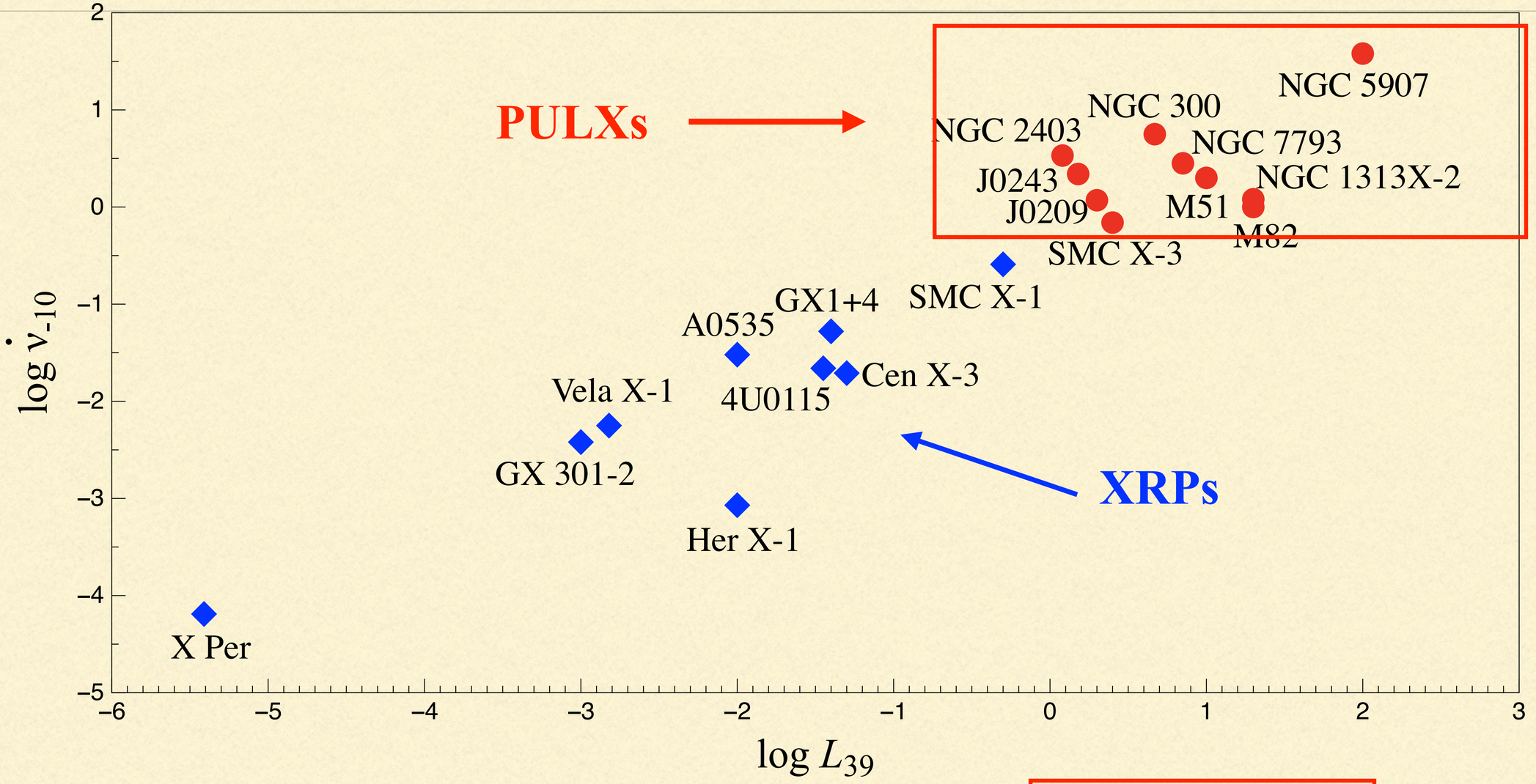
Two possibilities:

a. Beaming (luminosity is only apparently super Eddington): $L_{\mathrm{app}} \approx \frac{1}{b} L_{\mathrm{Edd}} \ln \frac{\dot{M}}{\dot{M}_{\mathrm{Edd}}}$, $b < 1$

b. Very strong magnetic field (magnetar), L_{Edd} is no longer the critical luminosity:

$$L_{\mathrm{crit}} \approx 900\, B_{14}^{4/3} L_{\mathrm{Edd}} \qquad L_{\mathrm{Edd}} < L = L_{\mathrm{app}} < L_{\mathrm{crit}}$$

I have demonstrated that b. is impossible



All PULXs have $L_X > 10^{39}\mathrm{erg/s}$ **and** $\dot{\nu} \gtrsim 10^{-10}\mathrm{s}^{-2}$

Spin-up by torque from a keplerian accretion disc

$$\dot{\nu} = \frac{\dot{J}(R_M)}{2\pi I} = \frac{\dot{M}(GMR_M)^{1/2}}{2\pi I} \propto \dot{M}^{6/7}\mu^{2/7}, \qquad R_{\rm M} \propto \dot{M}^{-2/7}\mu^{4/7}$$

gives the accretion rate

$$\dot{M} \approx 1.2 \times 10^{18} \dot{\nu}_{-10}^{7/6} \mu_{32}^{-1/3} {\rm g/s}$$

μ_{32} corresponds to 10^{14}G

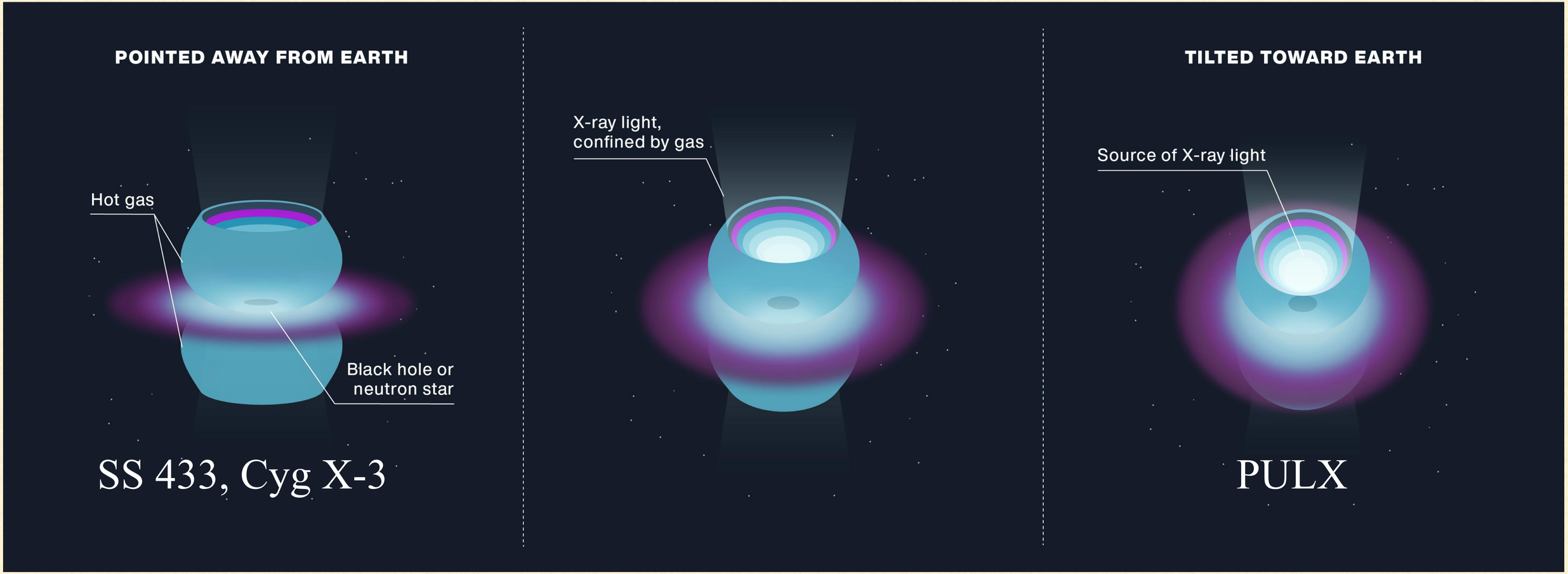
accretion subcritical

$$L_X \approx 0.1 \dot{M} c^2$$

$$L_X \approx 9 \times 10^{37} \dot{\nu}_{-10}^{7/6} \mu_{32}^{-1/3} {\rm erg/s} < {\rm L_{Edd}} \ll 10^{40} {\rm erg/s}$$

The presence of magnetars in PULXs is ruled out, because the large magnetospheric radius coupled with the high accretion rate would spin up the magnetar too quickly.

All PULXs and (at least) same ULXs are beamed



NASA/JPL-Caltech - https://photojournal.jpl.nasa.gov/jpeg/PIA24574.jpg

Outreach: the year of the anthropic principle