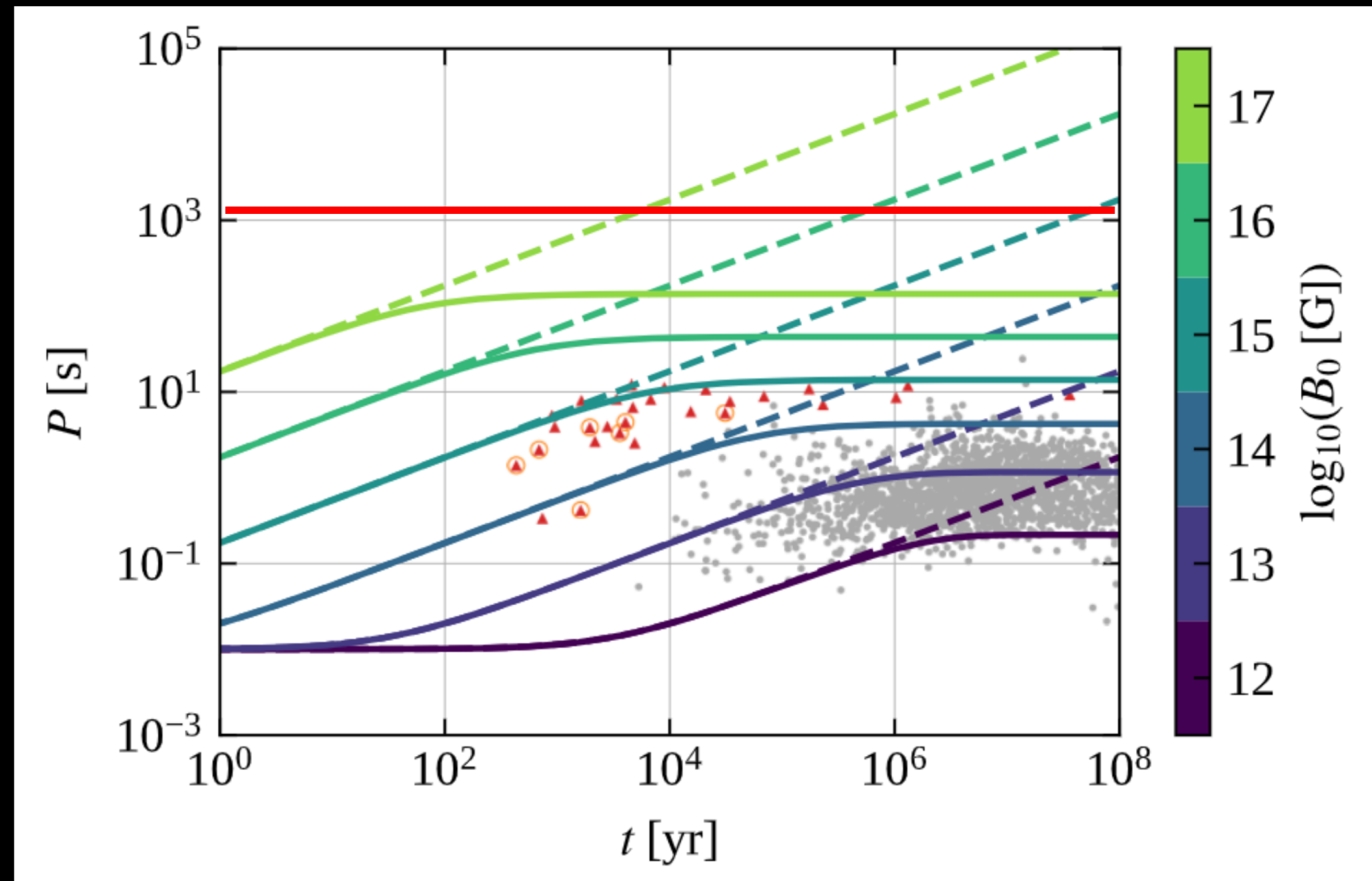
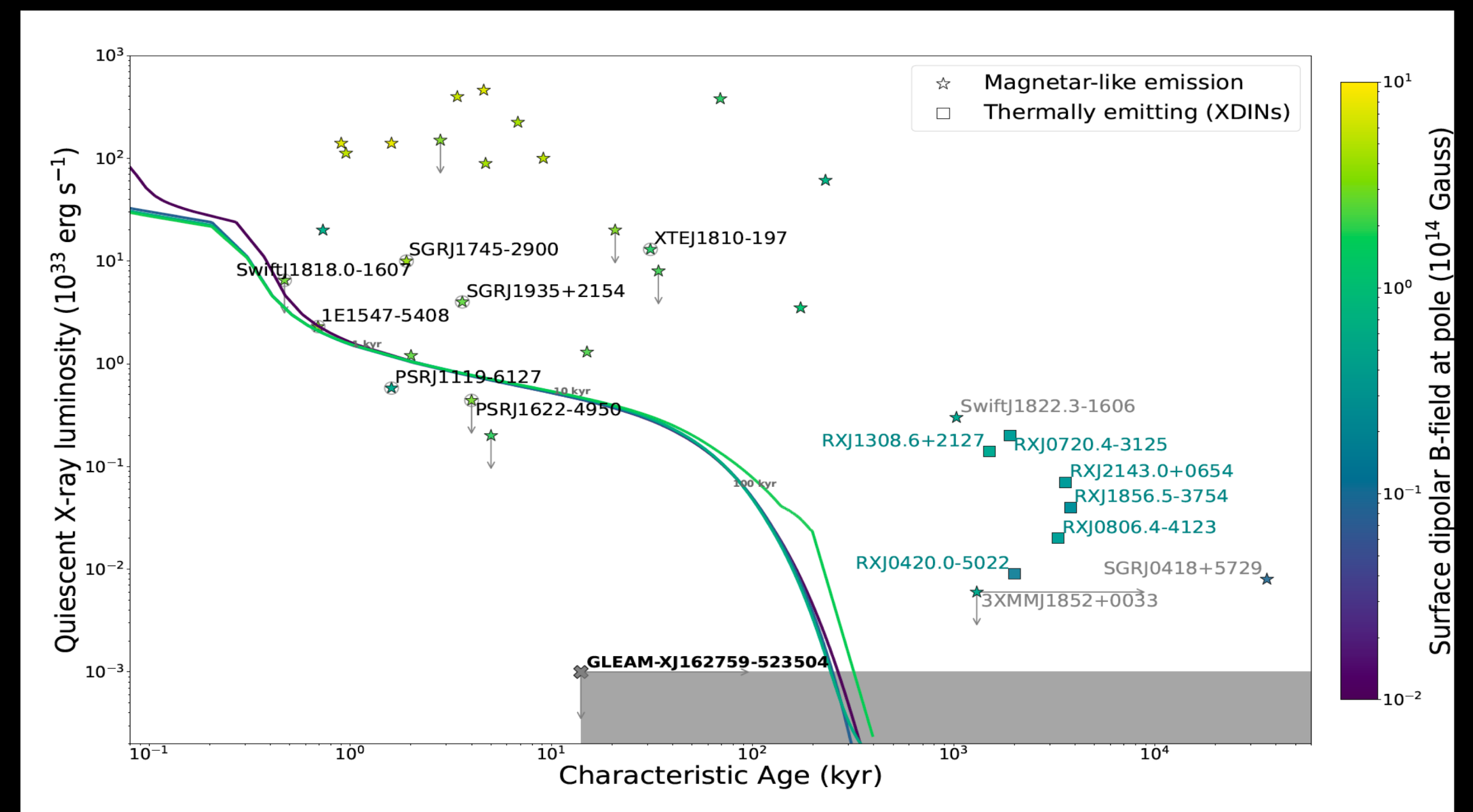
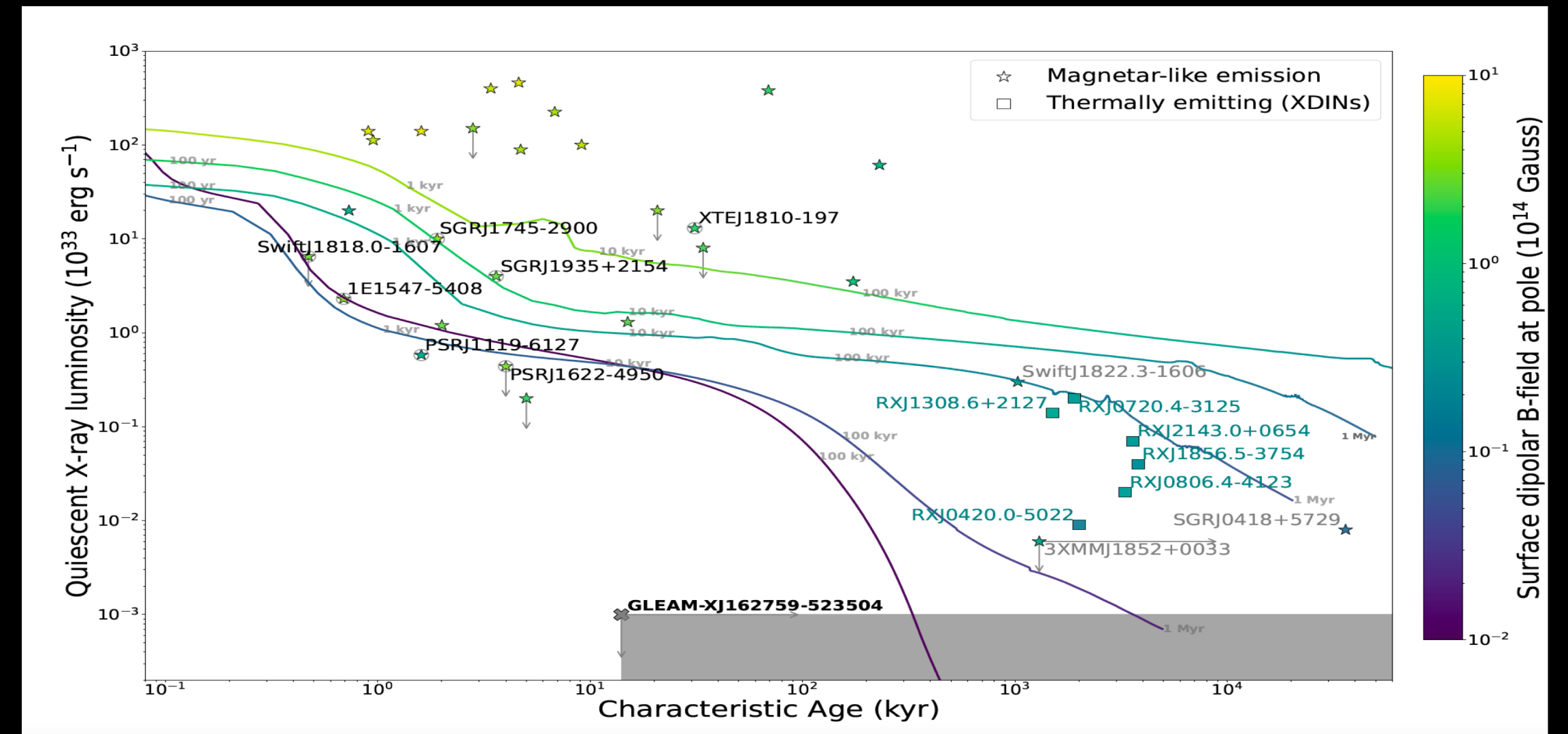


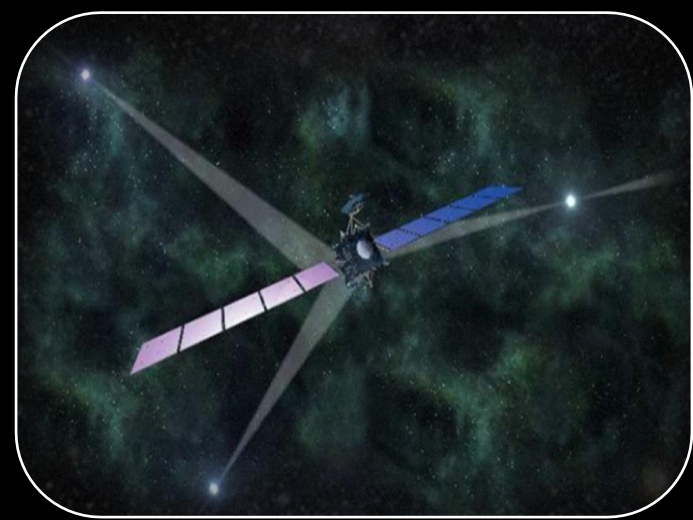
LONG PERIOD PULSARS: GLEAM-X J1627



See Ronchi's talk!

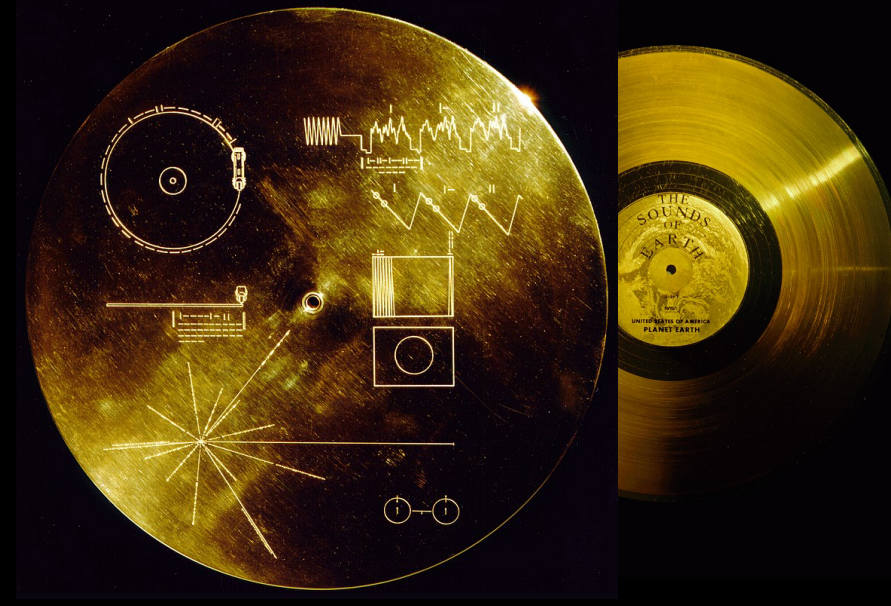
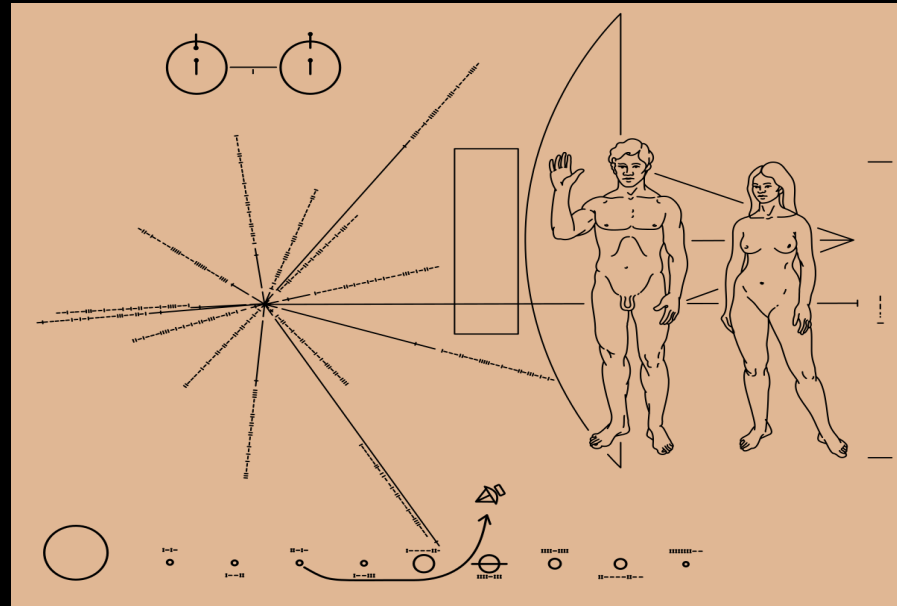


(Hurley-Walker et al. 2022, *Nature*; Caleb et al. 2022, *Nature*; Ronchi et al. 2022, *ApJ*; Rea et al. 2022 *ApJ* submitted)



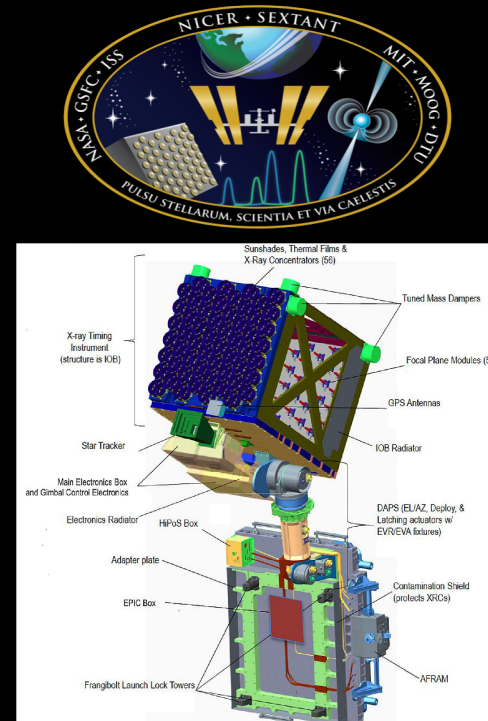
We will soon be able to travel beyond the Solar System and come back to tell the next generations.

AUTONOMOUS NAVIGATION USING X-RAY PULSARS



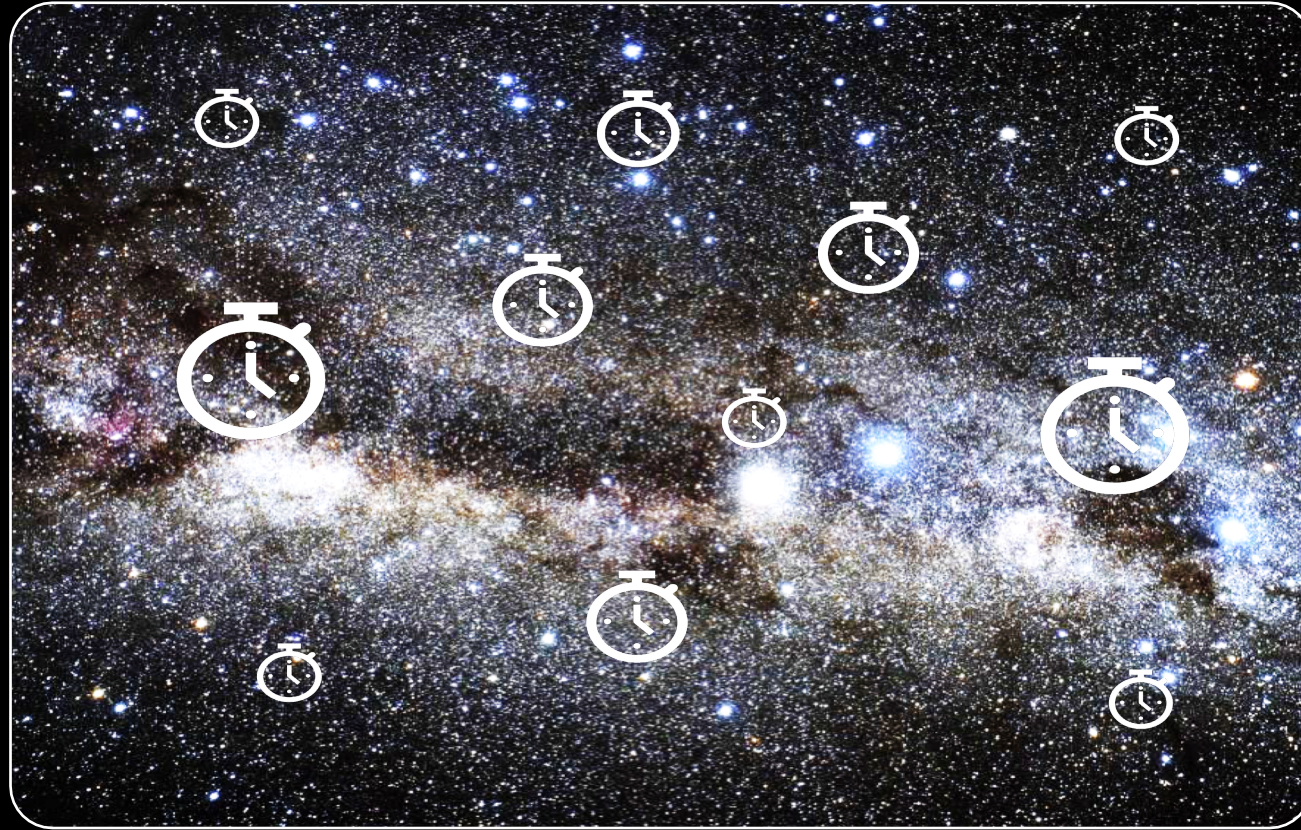
The Pioneer plaques are a pair of aluminium plaques which were placed on board the 1972 Pioneer 10, 1973 *Pioneer 11* spacecrafts, featuring a pictorial image in case either *Pioneer 10* or *11* is intercepted by extraterrestrial life.

NASA's Voyager 1, launched 35 years ago with various messages from the Earth, is on the verge of moving into interstellar space. It has a Golden Record on-board in case it will be intercepted by extraterrestrial life .



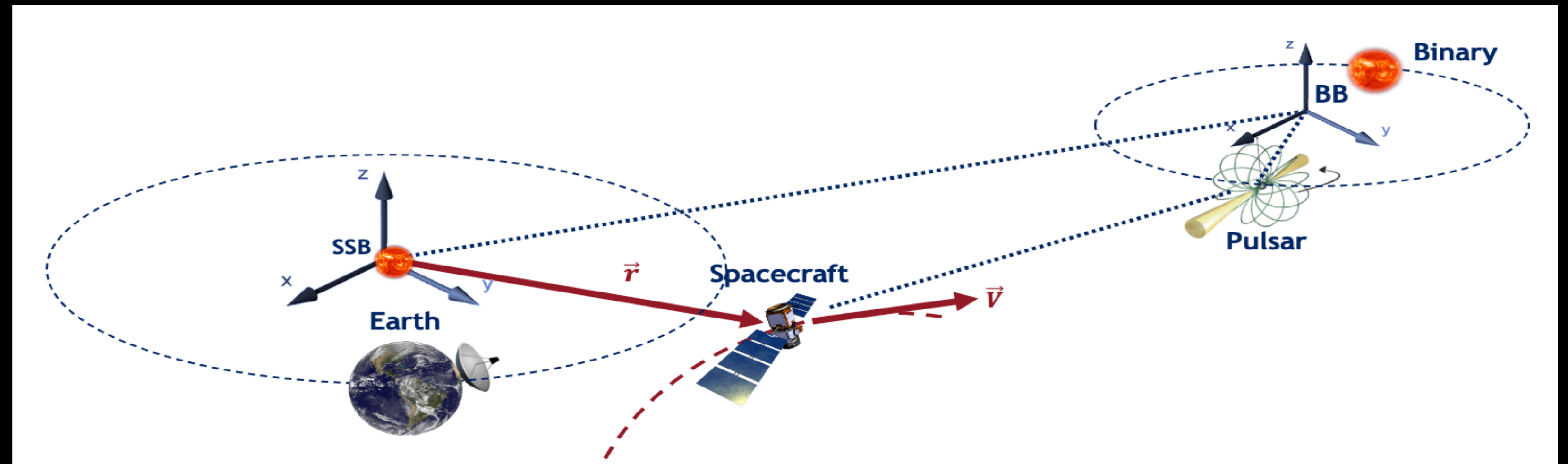
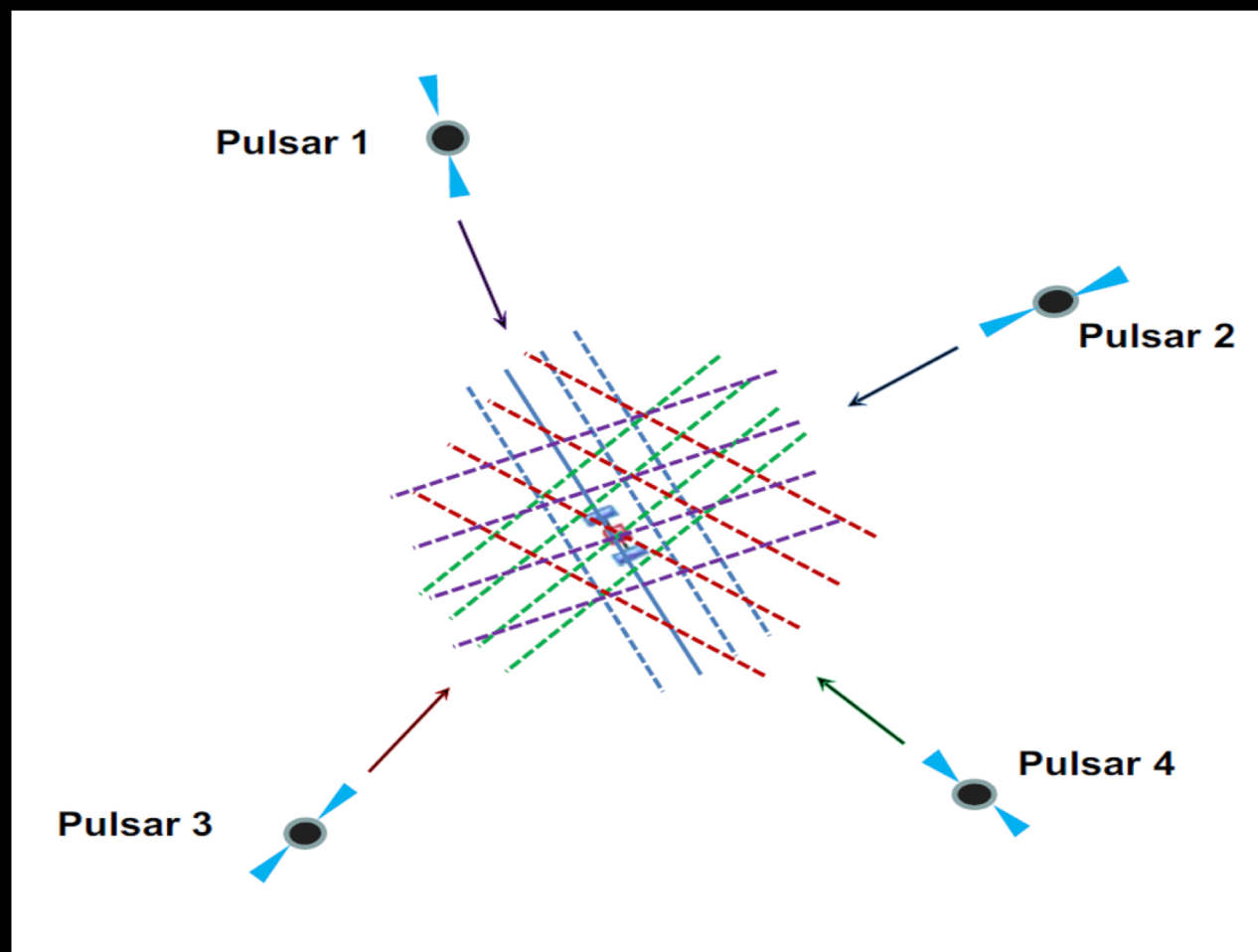
On January 2018 the first test of this pulsar GPS system has been successfully performed using the SEXTANT instrument onboard NICER, hosted by the International Space Station that orbits around Earth at slightly more than 17,500 mph. Within eight hours of starting the X-ray pulsar timing experiment, via timing 14 X-ray millisecond pulsars, the algorithm converged on a location with an error of 10 miles (16 km).

AUTONOMOUS NAVIGATION USING X-RAY PULSARS



$$t_a^{S/C} = t_e^{PSR} + \Delta t^{PSR \rightarrow S/C}$$

$$\Delta t^{PSR \rightarrow S/C} = \underbrace{\Delta t^{PSR \rightarrow BB}} + \underbrace{\Delta t^{BB \rightarrow SSB}} + \underbrace{\Delta t^{SSB \rightarrow S/C}}$$



PULSARS AS GPS: NEXT GENERATION INSTRUMENTS



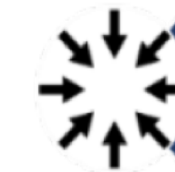
NICER/SEXTANT



esa PODIUM



Accuracy ~ 1 km



Compact

50x15x15 cm³



Lightweight

10 kg

15 W

Limited Power

15 W



in collaboration with

