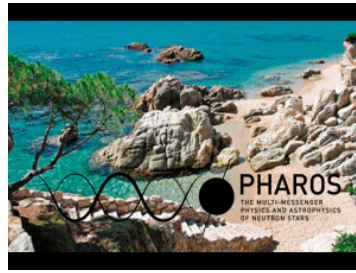


## PHAROS Conference 2019: the multi-messenger physics and astrophysics of neutron stars



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### **Simultaneous Radio and X-ray Mode-changing: Three Pulsars – Three Puzzles!**

Recent simultaneous radio (LOFAR, Lovell & GMRT) and X-ray observations (ESA's XMM-Newton) of three old and relatively nearby pulsars (B0943+10, B1822-09, B0823+26) have led to puzzling results. All three are known at radio frequencies to switch intermittently and suddenly between B ('Bright') and Q ('Quiet') modes with differing strengths and modulation patterns. In each case the X-ray response has been found to be different. In two of the pulsars the X-ray and radio emissions clearly change mode synchronously, while in another no change was detected. The combination of thermal surface emission and non-thermal X-rays (and their switch) was also different in each case. These groundbreaking results clearly indicate that mode-changing is a powerful pan-magnetosphere phenomenon and provide major clues towards understanding its true nature.

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