Contribution Title

Name of First Author and Name of Second Author

Abstract

Name of First Author
Name, Address of Institute, e-mail: name@email.address

Name of Second Author
Name, Address of Institute e-mail: name@email.address

1 Introduction

2 LMXB and accretion onto NS

3 Properties of AMXP

4 Observational overview of AMXP

4.1 SAX J1808.4-3658

4.2 IGR J1749.8-2921

4.3 MAXI J0911-655

4.4 IGR J17062-6143

4.5 IGR J16597-3704

4.6 IGR J17379-3747

4.7 IGR J17591-2342

The source IGR J17591−2342 was discovered by *IBIS/ISGRI* on board the *INTEGRAL* satellite on August 10, 2018. Trigger by the discovery of the source, *Swift*, *NuSTAR* and *NICER* begin to observe the source leading to the detection of coherent X-ray pulsations at ~527 Hz [**?**]. The NS spin frequency showed a clear drift compatible with the Doppler shift induced by the binary orbital motion with period close to 8.8 hours, very similar to the intermittent AMXP SAX J1748.9−2021 (Altamirano2008a, Sanna2016a) and the eclipsing AMXP SWIFT J1749.4−2807 (Markwardt2010aa,Altamirano2011a, Ferrigno2011a).

The mass function $f(m_2, m_1, i) \sim 1.5 \times 10^{-2}$ $M_\odot$ of IGR J17591−2342 implies a minimum companion mass of $M_c = 0.37$ $M_\odot$ (for a 1.4 $M_\odot$ NS and binary inclination $i = 90°$). Since neither total eclipses nor dips have been observed in the X-ray light curves, the binary inclination can be limited to values lower than 60 degrees (Frank02), implying a lower limit on the companion star mass $M_c \gtrsim 0.42$ $M_\odot$ (for a 1.4 $M_\odot$ NS), which increases up to $M_c \gtrsim 0.52$ $M_\odot$ if we consider a 2 $M_\odot$ NS.

A comparison between mass-radius relation of the donor star obtained from the Roche-lobe overflow condition (see e.g. Sanna:2018ac) and numerically simulated mass-radius relations for zero-age main-sequence stars (ZAMS) (Tout1996aa), as well as isochrones for stars of 8 (red diamonds) and 12 Gyr (Girardi2000aa), suggest that the companion star is compatible with either a ZAMS with mass $\sim$ 1.1 $M_\odot$ (corresponding to an inclination angle of $i \sim 24$ degrees) or an old main-sequence star with mass 0.85−0.92 $M_\odot$ (i ranging between 28 and 30 degrees) for a stellar age between 8 and 12 Gyr. It should be noted, however, that the a priori probability of observing a binary system with inclination $i \leq 30$ degrees is of the order of 13%. Nonetheless, it should not be excluded the possibility of a bloated donor star with the limitation that its thermal timescale ($GM_c^2/R_c L_c$) should be much longer than the evolutionary timescale ($M_c/\dot{M}_c$).

Phase-coherent timing analysis of the *NICER* observations performed between August 15 and August 24, revealed a spin-up frequency derivative of $(2.0\pm1.6)\times10^{-13}$ Hz/s. This values is compatible with the maximum spin-up derivative estimated under the assumption of accretion of matter leaving the accretion disc with angular momentum equal to that at the co-rotation radius, and mass accretion rate of $\dot{M} \simeq 5.2 \times 10^{-10}$ $M_\odot$/yr (for an NS radius and mass of 1.4 $M_\odot$ and 10 km) obtained for a broad-band (0.1–100 keV) absorbed flux of $\sim 7 \times 10^{-10}$ erg/s/cm^2 and a source distance of 8.5 kpc (assumed near the Galactic centre, see, e.g, Kerr1986aa).

The NS dipolar magnetic field can be roughly constrained by assuming the condition of spin equilibrium for accreting X-ray pulsars:

$$B = 0.63\,\zeta^{-7/6}\left(\frac{P_{\rm spin}}{2{\rm ms}}\right)^{7/6}\left(\frac{M}{1.4M_\odot}\right)^{1/3}\left(\frac{\dot{M}}{10^{-10}M_\odot/{\rm yr}}\right)^{1/2}10^8{\rm G}, \tag{1}$$

where ζ represents a model-dependent dimensionless factor (between 0.1–1) corresponding to the ratio between the magnetospheric radius and the Alfvén radius (Ghosh79a,Wang96), $P_{\rm spin}$ is the pulsar spin period in ms, and M is the NS mass. Assuming a 1.4 $M_\odot$ NS and the value of $\dot{M}$ reported above, we obtain a range for the dipolar magnetic field of $1.4\times10^8 < B < 8\times10^9$ G, consistent with the average magnetic field of known AMXPs (Mukherjee2015).

Finally, the broad-band energy spectrum (0.5-80 keV) of IGR J17591−2342, obtained combining almost simultaneous *Swift*, *NuSTAR* and *INTEGRAL* observations, is well described by an absorbed soft black-body-like component ($kT \sim 0.8$ keV) with a relatively small emitting area that is compatible with emission from the neutron star surface (or part of it) plus a Comptonised component ($\Gamma \sim 1.8$) with a seed photon temperature compatible with the soft thermal component. The spectral properties of the source are consistent with those of other AMXPs observed in the hard state (Falanga05a,Gierlinski2005a, Papitto09, Papitto2013a,Sanna2017a,Sanna2017b). Marginal evidence of a weak emission line compatible with the iron K-α transition are present, in accordance with other AMXPs in the same accretion state (Papitto09,Papitto2013a, Sanna2017a, Sanna2017b).

5 Spectral properties

6 Secular evolution of spin and orbital parameters

7 Open questions

8