The X-ray binary 2S0114+650=LSI+65 010:A slow pulsar or tidally-induced pulsations?

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The X-ray source 2S0114+650$=$LSI$+$65 010 is a binary system containing a B-type primary and a low mass companion believed to be a neutron star. The system has three reported periodicities: the orbital period, P$_{orb}\sim$11.6 days, X-ray flaring with P$_{flare}\sim$2.7 hours and a ``superorbital'' X-ray periodicity P$_{super}=$30.7 days. The objective of this paper is to show that the puzzling periodicities in the system may be explained in the context of scenarios in which tidal interactions drive oscillations in the B-supergiant star. We calculate the solution of the equations of motion for one layer of small surface elements distributed along the equator of the star, as they respond to the forces due to gas pressure, centrifugal, coriolis, viscous forces, and the gravitational forces of both stars, which provides variability timescales that can be compared with those observed for 2S0114$+$650. In addition, we use observational data obtained at the Observatorio Astron\'omico Nacional en San Pedro M\'artir (OAN/SPM) between 1993-2004 to determine which periodicities may be present in the optical region. The models for circular orbits predict ``superorbital'' periods while the eccentric orbit models predict strong variations on orbital timescales, associated with periastron passage. Both also predict oscillations on timescales of $\sim$2 hrs. We suggest that the tidal oscillations lead to a structured stellar wind which, when fed to the neutron star, produces the X-ray modulations.The connection between the stellar oscillations and the modulation of the mass ejection may lie in the shear energy dissipation generated by the tangential motions that are produced by the tidal effects, particularly in the tidal bulge region. From an observational standpoint, we find indications for variability in the He I 5875 \AA\ line on $\sim$2 hrs timescale and, possibly, the ``superorbital'' timescale. However, the line profile variability exceeds that which is predicted by the tidal interaction model and can be understood in terms of variable emission that is superposed on the photospheric absorption. This emission appears to be associated with the B-supergiant's stellar wind rather than the vicinity of the companion.

The model calculations lead us to conclude that the B-supergiant may be the origin of the periodicities observed in the X-ray data, through a combination of a localized structured wind that is fed to the collapsed object and, possibly, by production of X-ray emission on its own surface. This scenario weakens the case for 2S0114+650 containing a magnetar descendent.

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