The origin of the puzzling hard X-ray emission of gamma Cassiopeiae

Christian Motch (1), Raimundo Lopes de Oliveira (2,3), and Myron A. Smith (4)

(1) Observatoire Astronomique, UniversitÃ© de Strasbourg, France;
(2) Universidade Federal de Sergipe, Brazil;
(3) ObservatÃ³rio Nacional, Brazil;
(4) National Optical Astronomy Observatory, USA.

Massive B and Be stars produce X-rays from shocks in high velocity winds with temperatures of a few million degrees and maximum X-ray luminosities of ~10^(31) erg/s. Surprisingly, a sub-group of early Be stars exhibits > 20 times hotter X-ray temperatures and > 10 times higher X-ray luminosities than normal. This group of Be stars, dubbed Gamma-Cas analogs, contains about 10 known objects. The origin of this bizarre behavior has been extensively debated in the past decades. Two mechanisms have been put forward, accretion of circumstellar disk matter onto an orbiting white dwarf, or magnetic field interaction between the star and the circumstellar disk (Smith & Robinson 1999). We show here that the X-ray and optical emissions of the prototype of the class, Gamma-Cas, are very well correlated on year time scales with no significant time delay. Since the expected migration time from internal disk regions that emit most of the optical flux to the orbit of the companion star is of several years, the simultaneity of the high energy and optical fluxes variations indicates that X-ray emission arises from close to the star. The systematic lack of magnetic field detection reported in recent spectro-polarimetric surveys of Be stars is consistent with the absence of strong magnetic wind braking in these fast spinning stars but put strong constraints on the possible origin of the magnetic field. We propose that in Gamma-Cas the magnetic field emerges from equatorially condensed subsurface convecting layers the thickness of which steeply increases with rotation rate and that Gamma-Cas and its analogs are the most massive and closest to critical rotation Be stars.

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Comments:

Email: christian.motch@unistra.fr