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Revisiting 56 Ursae Majoris: Exit the barium star, enter the neutron-star companion

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56 Ursae Majoris is a long-period binary that was thought to contain a chemically peculiar red giant and a faint companion. The red giant was classified as a barium (Ba) star in the 70s. This classification would imply that the companion is a white dwarf, since Ba stars form when s-process rich Asymptotic Giant Branch (AGB) companions transfer mass to them. However, combining more than 50 years of radial velocity data with Hipparcos and Gaia astrometry, we measured 56UMa's orbital inclination for the first time, and we discovered that the faint companion was about 1.3 solar masses. Even if this were a white dwarf, nucleosynthesis models suggest that it would be too massive to be the progeny of an AGB star that could efficiently produce and dredge up s-process elements and then pollute a companion.

This puzzle motivated us to perform a full spectral analysis, re-investigate (and discard!) the Ba-star classification of the giant, and study the morphology of the interstellar gas in the vicinity. In my contribution, I will review the heavy metal abundance patterns obtained by different investigations, and I will discuss our findings, including the clear identification of a HI cavity around the system. The latter seems to indicate that a supernova exploded in the system several hundred thousand years ago, and that the faint companion is in fact a dormant neutron star. However, finding an evolutionary scenario that explains all these observables is not trivial, and I will discuss different possible configurations and their respective merits.

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