PSR J 0538+2817 as the remnant of the first supernova explosion in a massive binary

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It is generally accepted that the radio pulsar PSR J 0538+2817 is associated with the supernova remnant (SNR) S 147. The only problem for the association is the obvious discrepancy (Kramer et al. 2003) between the kinematic age of the system of ~ 30 kyr (estimated from the angular offset of the pulsar from the geometric center of the SNR and pulsar's proper motion) and the characteristic age of the pulsar of ~ 600 kyr. To reconcile these ages one can assume that the pulsar was born with a spin period close to the present one (Kramer et al. 2003; Romani & Ng 2003). We propose an alternative explanation of the age discrepancy based on the fact that PSR J 0538+2817 could be the stellar remnant of the first supernova explosion in a massive binary system and therefore could be as old as indicated by its characteristic age. Our proposal implies that S 147 is the diffuse remnant of the second supernova explosion (that disrupted the binary system) and that a much younger second neutron star (not necessarily manifesting itself as a radio pulsar) should be associated with S 147. We use the existing observational data on the system PSR J 0538+2817/SNR S 147 to suggest that the progenitor of the supernova that formed S 147 was a Wolf-Rayet star (so that the supernova explosion occurred within a wind bubble surrounded by a massive shell) and to constrain the parameters of the binary system. We also restrict the magnitude and direction of the kick velocity received by the young neutron star at birth and find that the kick vector should not strongly deviate from the orbital plane of the binary system.