ON THE ORIGIN OF KEPLER'S SUPERNOVA REMNANT

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Aim of my poster is to show that Kepler's supernova progenitor was a massive star, rather than an old population object, as commonly accepted. The star was subject to strong mass loss, and the present remnant is due to the interaction of the blast wave with dense circumstellar matter

Speculations on the nature of this remnant must account both for the density of the emitting gas (>1 cm^{-3} from X-ray data; $\simeq 10^3$ cm^{-3} from optical spectroscopy) and the velocities of optical knots (only a few hundred km/s, without evidence of expansion, but with an appreciable common motion, 350 km/s for a distance of 5 kpc). The knots cannot be ejecta, as they are not expanding; the interstellar nature can also be ruled out: gas is much denser and clumpier than expected at z=600 pc (the density should be only $3 \cdot 10^{-3}$ cm^{-3}), and no systemic motion should be measured. A circumstellar origin looks more natural: the average knots velocity reflects then that of the progenitor. If the star started from the galactic plane, a purely ballistic consideration gives an age of 3 million years.

The wind of a runaway star can be deflected by the interstellar flow As in a comet, a bow shock forms in the direction of the motion; there matter stagnates and, due to instabilities, is likely to clump. If the blast wave is crossing now the bow shock, a brighter limb should appear on that side: this is actually observed. The size of the bow shock gives $\dot{M} \cdot w$; $\dot{M}/w$ comes from the assumption that the blast wave is in Sedov phase (supported by the broad X-ray radial profile on the side opposite to the bow shock); then mass loss ($\dot{M} \simeq 5 \cdot 10^{-5}$ $M_\odot$/yr) and wind speed ($w \simeq 10$ km/s) are derived. A lower limit of 10 $M_\odot$ can be put to the mass lost in a wind

An alternative distance estimate is obtained by fitting the pattern of optical knots, in the assumption that they are confined to the intersection of the blast wave with the bow shock: I found a distance of 6 kpc

Candidates for the progenitor are massive, runaway stars: I suggest Wolf-Rayet (WR) runaway. Such stars can be associated with ring nebulae. These nebulae are very clumpy, show a brighter limb, possibly in the direction of the star motion, and expand at a few tens of km/s: they probably formed during a red supergiant phase. WR runaway stars are suspected to have a neutron star companion. If a neutron star is left also after the WR explosion, one expects to find two neutron stars in eccentric orbits, exactly as for the binary pulsars PSR1913+16 and PSR2303+46.

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