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Detailed SiO proper motion analysis: slow net expansion and a small correlation with the magnetic field

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A detailed analysis of 23 epochs (covering two stellar cycles) of monitoring R Cas SiO J=1-0 v=1 masers showed 184 maser features (an average of 20% per epoch) could be matched over between 3 and 13 epochs. The largest number of matches occur in the early part of each cycle, following the maser brightness trends, which are roughly as predicted. The proper motions can be tangential, radial, intermediate or change direction, but overall the net direction is expansion corresponding to ~0.4(0.1) km/s. This would take ~67 year to cross the SiO maser shell, giving a mass loss rate similar to other estimates in the literature. A small proportion of feature pairs in successive epochs have significant polarization and polarization angles consistent to within pi/8 rad. A small excess of this subsample have proper motion vectors within 22.5 deg of parallel to the inferred magnetic field direction (2sigma significance) but this is in radial expansion for less than half of these. The magnetic field strength provides a force comparable to the kinetic and thermal energy densities and could influence their directions, but it does not appear to be driving the majority of motions of gas clumps. The SiO masers typically emanate from a shell within 2-5 optical stellar radii, which is also the region where the radio photosphere becomes optically thick at 1.3 - 6 cm wavelength, and where molecular or dust emission can be traced by IR interferometry. Recent advances in techniques and e-MERLIN K-band observations will allow improved coordination between maser and continuum/IR observations in the investigation of how exactly mass is lost from stars.

NB to be presented by Assaf if able to attend, otherwise Richards. Thank-you.