Dynamics of H II regions around exiled O stars

Jonathan Mackey^1, Norbert Langer^1, Vasilii V. Gvaramadze^{2,3}

1 - Argelander-Institut fuer Astronomie, Auf dem Huegel 71, 53121 Bonn, Germany
2 - Sternberg Astronomical Institute, Lomonosov Moscow State University, Universitetskij Pr. 13, Moscow 119992, Russia.
3 - Isaac Newton Institute of Chile, Moscow Branch, Universitetskij Pr. 13, Moscow 119992, Russia.

At least 25 per cent of massive stars are ejected from their parent cluster, becoming runaways or exiles, travelling with often-supersonic space velocities through the interstellar medium (ISM). Their overpressurised H II regions impart kinetic energy and momentum to the ISM, compress and/or evaporate dense clouds, and can constrain properties of both the star and the ISM. Here we present one-, two-, and (the first) three-dimensional simulations of the H II region around a massive star moving supersonically through a uniform, magnetised ISM, with properties appropriate for the nearby O star Zeta Oph. The H II region leaves an expanding overdense shell behind the star and, inside this, an underdense wake that should be filled with hot gas from the shocked stellar wind. The gas column density in the shell is strongly influenced by the ISM magnetic field strength and orientation. H-alpha emission maps show the H II region remains roughly circular, although the star is displaced somewhat from the centre of emission. For our model parameters, the kinetic energy feedback from the H II region is comparable to the mechanical luminosity of the stellar wind, and the momentum feedback rate is >100X larger than that from the wind and about 10X larger than the total momentum input rate available from radiation pressure. Compared to the star's eventual supernova explosion, the kinetic energy feedback from the H II region over the star's main sequence lifetime is >100X less, but the momentum feedback is up to 4X larger. H II region dynamics are found to have only a small effect on the ISM conditions that a bow shock close to the star would encounter.

Reference: MNRAS in press, arXiv:1308.5192
Status: Manuscript has been accepted

Weblink: http://adsabs.harvard.edu/abs/2013MNRAS.tmp.2269M

Comments:

Email: jmackey@astro.uni-bonn.de