STELLAR PHYSICS

Turmoil at Antares

We are so accustomed to the incredibly detailed photos of our Sun that sometimes we forget that all stars must have equally fine structures. In fact, for a long time, images of even the closest or brightest stars haven't gone beyond the level of point sources due to technical limitations of our observational devices. This state of affairs has recently begun to change, mostly due to two instruments: the Center for High Angular Resolution Astronomy-Michigan Infra-Red Combiner (CHARA-MIRC) optical interferometer and the Very Large Telescope interferometer (VLTI). Currently, around 20 stars have been spatially resolved in some fashion, usually in the infrared part of the spectrum.

As often happens, these big achievements are presented in the news as a sort of rush towards a Guinness record: "the best-ever image of a star which is not our Sun". And the pictured image of Antares has also been recently advertised as such (with much success). However, the scientific results behind that image, presented by Keiichi Ohnaka, Gerd Weigelt and Karl-Heinz Hofmann in a recently published paper (*Nature* **548**, 310–312; 2017), are even more significant than the inherent wonder of detecting such clear structures from a point-like light source 170 parsecs away.

Credit: ESO/K. Ohnaka

Antares is one of the most recognizable stars of the sky due to its brightness and red colour — so much so that it rivals the other red dot in our sky, Mars (hence its name, 'anti-Ares', Ares being the Greek name for Mars). It is one archetype of red supergiants, a post-main sequence evolutionary state of massive stars (10–30 $M_{\odot}$). The pictured map is a reconstruction of Antares's surface from VLTI data obtained around the CO band at ~2.3 μm. The good spectral resolution ($R \approx 8,000$) allows sampling of the band at 311 wavelengths, and thanks to the unprecedented spatial resolution of 5.1 × 5.4 mas, the authors could extract a full spectrum from approximately 100 different locations on the star's surface and atmosphere. Through Doppler shift measurements at each location, the authors created a map of the line-of-sight speed together with the pictured brightness map. They detected strong upwelling and downwelling velocities even high in the atmosphere, up to 1.7 stellar radii. These motions cannot be due to simple convection, and they are probably triggered by turbulence. Such intense turbulence so high in Antares' atmosphere could also explain one of the remaining puzzles of red supergiants: how they can lose mass as quickly as observed. The mechanism behind the origin of this turbulence is still unknown. ❐

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