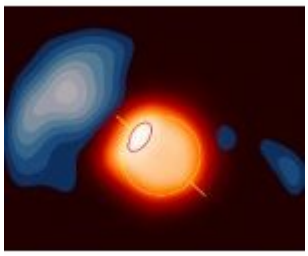
# The slow rotation of the red supergiant Betelgeuse



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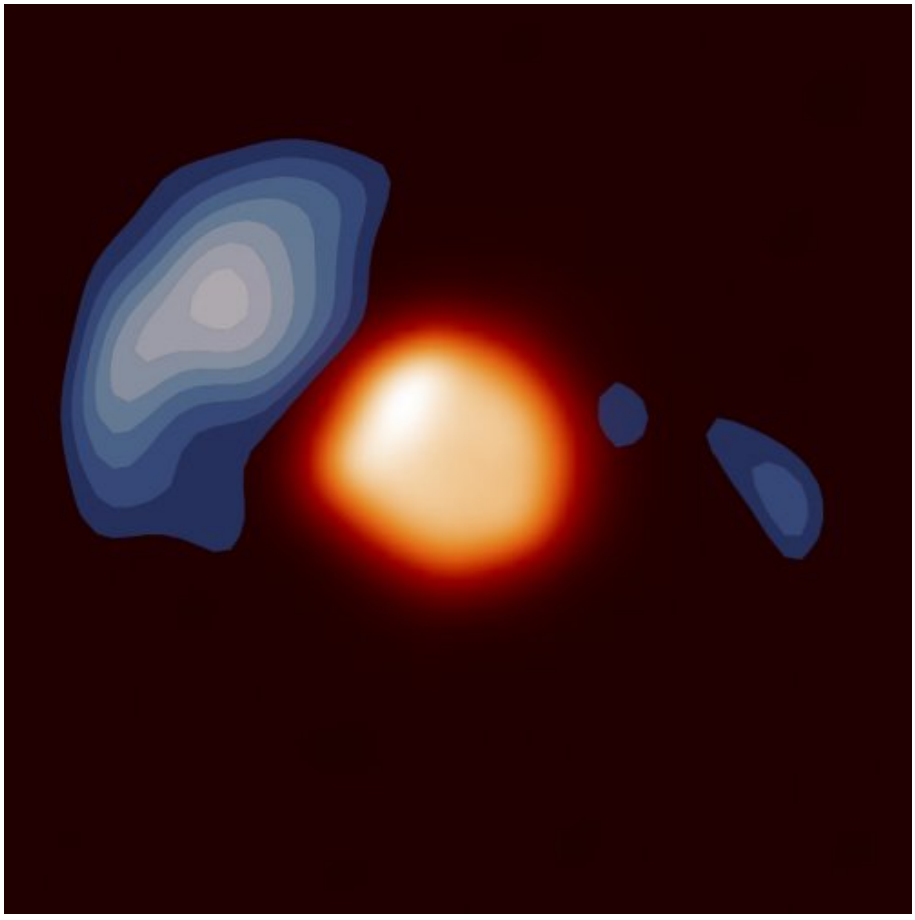
**Observatoire de Paris centre de recherche et enseignement en astronomie et astrophysique relevant du Ministère de l'Enseignement supérieur et de la Recherche.**

**The Betelgeuse star has a rotation period of about 30 years. With this discovery, published in Astronomy & Astrophysics on January 9, 2018, a scientific team under the direction of Pierre Kervella, astronomer at the Paris Observatory, opens new avenues to understand the mechanisms of loss of mass of this type of supergiant star.**

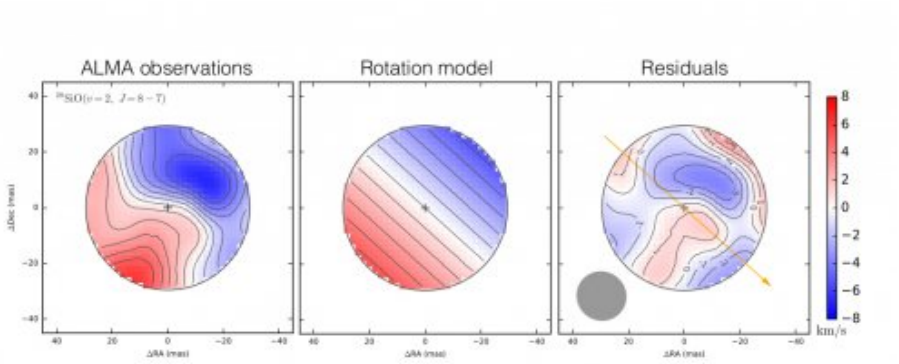


**L'environnement proche de la supergéante rouge Bételgeuse** *copyright : Pierre Kervella*

Betelgeuse is one of the largest stars known. At a distance of 700 light-years, this is an evolved massive star. Its present radius reaches 1000 times that of the Sun, for a mass of about 15 times our star's. Betelgeuse will end its existence with a supernova explosion, when its core will collapse. This spectacular event could happen within the next 10 000 to 100 000 years.

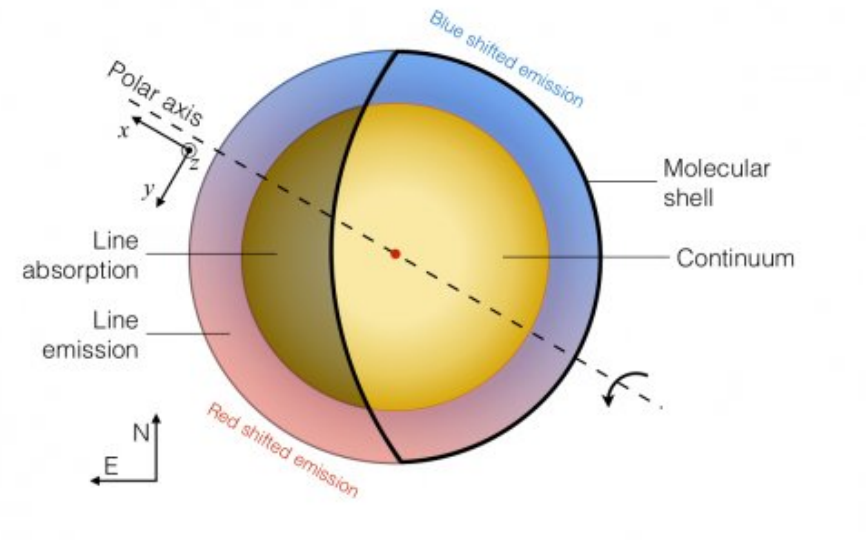
Thanks to observations obtained with the ALMA interferometer at sub-millimeter wavelengths, an international team lead by Pierre Kervella (Paris Observatory) observed the radio emission of two molecules present in the atmosphere of Betelgeuse : silicon monoxyde (SiO) and carbon monoxyde (CO). These two molecules are very abundant in the universe (including on Earth) and are also present in large quantities around the supergiant.

By measuring precisely the Doppler shift of the spectral lines emitted by the two molecules, the astronomers have observed that the north-west part of the star is coming toward us (blue shifted emission) at a velocity of 5 km/s and its south-east part is going away from us (red shifted emission) at the same speed.




**Doppler shift of the spectral lines emitted by the two molecules SiO and CO in the Betelgeuse star** *Pierre Kervella*

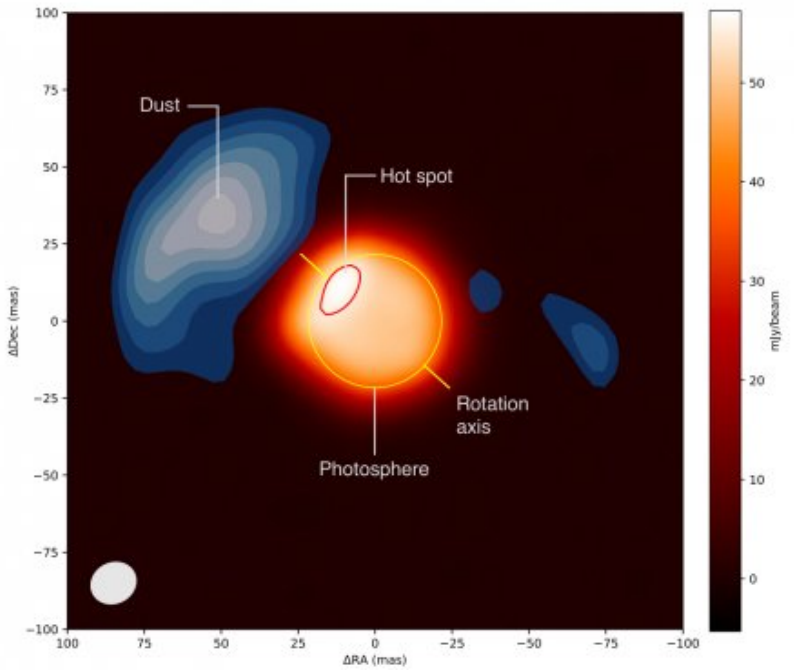
This is a characteristic consequence of the rotation of the star.




**Schematic view of the emission of the molecular gas surrounding Betelgeuse and its rotation. The molecular envelope of represented to scale. The right part of the envelope is removed to show the surface of the star, that emits thermal radiation ("continuum").** *Pierre Kervella*

Due to its very large size, and in spite of a minimum velocity of 5 km/s at its equator (five times the velocity of a rifle bullet), one rotation of Betelgeuse takes approximately 30 years. This long period is due to the considerable increase of the size of the star when it became a supergiant, that led to a slow down of its rotation.

The rotation of a star influences the way it expels its material to the surrounding space. It also increases its lifetime by mixing its interior, thus bringing more material to its core. With more fuel available to maintain nuclear fusion, a rotating star therefore lasts longer. A large and bright hot spot and a dust plume are precisely aligned with the direction of the rotation axis of Betelgeuse as measured with ALMA. This remarkable coincidence suggests that the polar cap of the star is a particularly intense mass-loss region. Further observations in the coming years will make it possible to test this hypothesis and understand the underlying mechanisms.




**Coincidence between the presence of a hot spot in the polar zone of Betelgeuse and a mass loss plume. The central image (orange colors) shows the surface of the star and the presence of a hot spot, while blue colors indicate the presence of dust created from the star's ejected material.** *Pierre Kervella*

## Composition of the team :

Pierre Kervella (Paris Observatory, France), Leen Decin (KU Leuven, Belgium), Anita M. S. Richards (University of Manchester, UK), Graham M. Harper (University of Colorado, USA), Iain McDonald (University of Manchester, UK), Eamon O'Gorman (Dublin Institute for Advanced Studies, Irlande), Miguel Montargès (KU Leuven, Belgium), Ward Homan (KU Leuven, Belgium), Keiichi Ohnaka (UCN, Chile)

## Link to the research paper :

The close circumstellar environment of Betelgeuse. V. Rotation velocity and molecular envelope properties from ALMA