

## 20 years keeping an eye on R Aquarii

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The R Aquarii nebula taken with the Nordic Optical Telescope (NOT) at the Observatory of Roque de los Muchachos (ORM) in La Palma. Colours indicate different ionization stages of the same chemical element, oxygen. Credit: R. Corradi - Daniel López.

An international team of researchers, including scientists from the Instituto de Astrofísica de Canarias, has published a detailed study of the evolution of the nebula surrounding the symbiotic star R Aquarii. The

study involved observations from telescopes at the Roque de los Muchachos Observatory, La Palma, and Chile taken over the course of more than two decades.

In astronomical terms, at 600 light years away, the nebula around R Aquarii is relatively close. The symbiotic star is made up of a red giant and a white dwarf that have interacted over centuries to form the magnificent surrounding nebula from material ejected from the system.

This system, known as R Aquarii for its apparent location in the large zodiacal constellation of Aquarius, is an important example of the effects of the gravitational interactions that occur between nearby [stars](#). In the later stages of their evolution, when stars like the sun grow to giant dimensions, lowering the surface gravity and allowing prodigious amounts of matter to escape, the gravitational pull of a nearby star can become the dominant cause of their evolution and destiny. As shown by R Aquarii, matter lost by one star can be sculpted into complex, albeit symmetric, nebulae, and in the process, highly collimated outflows, called jets, can form. Jets are a common phenomenon in the universe, and are found around binary stars and black holes, as well as in the centres of the largest and most powerful galaxies.

R Aquarii is the closest-known stellar jet, allowing these complex physical processes to be studied in unprecedented detail. Given its proximity, it has been possible to follow the evolution of the nebula and its jet in real time by patiently obtaining sequence of images over many years. The study recently published in the journal *Astronomy & Astrophysics* used telescopes at the Roque de los Muchachos Observatory (Garafía, La Palma) and Chile over the course of more than 20 years.

"While the large hourglass nebula expands in a regular way, the jet shows an extremely complex behaviour," says Tiina Liimets, the first author of the article and Ph.D. student at the University of Tartu's Tartu

Observatory (Estonia). The observations reveal the jets to be composed of multiple knots of material, which at first glance don't seem to be flowing linearly away from the centre.

"Instead they seem to be moving in apparently random directions, merging together and breaking apart, appearing and disappearing from view," says David Jones, researcher at the Instituto de Astrofísica de Canarias and co-author of the work.

"This indicates that at the observed scales other external factors dominate the apparent evolution of the jet and its curvature, including the changes in the illumination from the central stars," adds Romano Corradi, director of the Gran Telescopio the Canarias, who obtained the first images for the study more than 25 years ago.

"We will continue to follow the [evolution](#) of R Aquarii over coming decades, taking advantage of the next generation of telescopes and instruments, which will provide important information on this spectacular system and about the common processes that regulate the formation of all [astrophysical jets](#)," says Liimets.

**More information:** T. Liimets et al, New insights into the outflows from R Aquarii, *Astronomy & Astrophysics* (2018). [DOI: 10.1051/0004-6361/201732073](#)

Provided by Instituto de Astrofísica de Canarias

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