GOSSS catalogue clears the way for study of massive stars

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Only one in two million stars in our galactic environment is of type O, a category that includes stars with anywhere between sixteen and more than one hundred solar masses, and luminosities millions of times greater than that of the sun. Such stars end their lives in supernovae and have a decisive influence on the structure and evolution of galaxies. They are responsible, among others, for the existence of some of the elements we are composed of, but their scarcity makes them difficult to study. The GOSSS catalogue, which has just published data concerning 448 objects, constitutes a window to these stellar giants.

Stars are classified in types O, B, A, F, G, K and M (where the first are the most massive and hottest) depending on the lines of their spectra. These lines are obtained by passing the light emitted by stars through a prism, and they correspond to the different chemical elements that compose them. If the data are corrupted, however, or if different observation techniques are used, classification errors can occur. For example, in some catalogues theta1 Orionis A appears as type O, when it actually is a type B star. This is not an isolated case.

"GOSSS (Galactic O-Star Spectroscopic Survey) substantially improves on prior catalogues," says Alfredo Sota, researcher at the Institute of Astrophysics of Andalusia (IAA-CSIC) in charge of publishing the data. "It is a very ambitious project from the point of view of the number of objects and the quality of the data; it will yield a homogeneous sample, with data from both hemispheres which will be constantly updated, so it will be a very solid tool", he concludes.

The spectrum of a celestial object reveals some of its essential characteristics such as distance, age, luminosity or even rate of loss of mass—precious information in the case of O-stars whose origin and evolution still await a comprehensive theory. The GOSSS catalogue, which will cover a total of one thousand O-stars (about 2% of the total of the Milky Way), will allow us to answer key questions about these evasive objects.

Five catalogues in one

An essential characteristic of massive stars is that they almost never occur alone. They form binary, ternary or higher order systems. "A fortunate trait because it allows us to calculate the mass of each star, but also unfortunate because several stars closely huddled together look like a single object from our perspective, and because the study of such systems is technically very complex", says Jesús Maíz (IAA-CSIC), head researcher at GOSSS.

To study multiple systems, researchers of the GOSSS project have developed four parallel catalogues: OWN, IACOB, NoMaDS and CAFÉ-BEANS. The former two have been carrying out high resolution spectroscopy in the southern hemisphere and spectroscopy of different periods in the northern hemisphere, all from a GOSS subgroup, to try to find binary stars, determine their characteristics and measure their orbits. NoMaDS is an extension of IACOB to somewhat weaker stars and CAFÉ-BEANS will complete the work of OWN on a specific type of binary star in the northern hemisphere.

These catalogues are complemented by high resolution images and, together, they give us the most accurate vision of O-stars to date. The enterprise has already yielded notable results, like the finding of a massive star with the most intense magnetic field ever observed (some twenty thousand times more intense than that of the sun).

The GOSSS project, launched in 2007 and having over two hundred and fifty nights of observations, involves the Sierra Nevada Observatory (Granada), the Calar Alto Observatory (Almería), the La Palma Observatory (William Herschel telescope) and the Las Campanas Observatory (Chile).

More information: A. Sota et al. "The Galactic O-Star Spectroscopic Survey (GOSSS). II. Bright Southern Stars." The *Astrophysical Journal Supplement*. DOI: 10.1088/0067-0049/211/1/10

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