Astronomers find the first galaxy whose ultraviolet luminosity is comparable to that of a quasar

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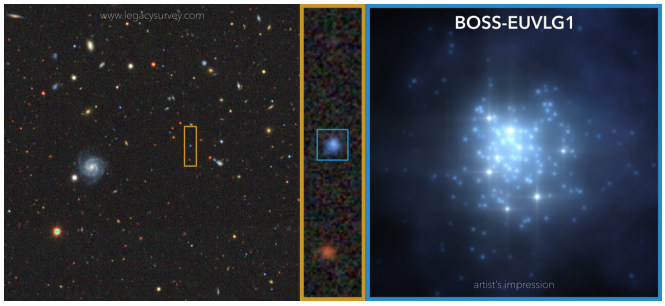

Left and centre: Image of the region of the sky containing BOSS-EUVLG1, which stands out due to its blue colour. Credit: DESI Legacy Imaging Surveys. Right: Artist's drawing of the burst of star formation in BOSS-EUVLG1, which contains a large number of young massive stars, and hardly any dust. Credit: Gabriel Pérez Díaz, SMM (IAC).

Using observations made with the Gran Telescopio Canarias (GTC), at the Roque de los Muchachos Observatory (Garafía, La Palma, Canary Islands), and with the ATACAMA Large Millimeter/submillimetre Array (ALMA), in Chile, astronomers have found the first galaxy whose ultraviolet luminosity is comparable to that of a quasar. The discovery was recently published in the journal *Monthly Notices of the Royal Astronomical Society Letters*.

The galaxy, called BOSS-EUVLG1, has a red-shift of 2.47. This is a measure of the reddening of the light coming from the galaxy, and can be used to find its distance: the further away the galaxy, the greater the value. For BOSS-EUVLG1, the value of 2.47 means that the galaxy has been observed when the universe was some 2000 million years old, around 20% of its present age.

The large values of redshift and luminosity of BOSS-EUVLG1 caused it to be classified previously in the BOSS (Baryon Oscillation Spectroscopic Survey) project as a quasar. However, from the observations made with the OSIRIS and EMIR instruments on the GTC, and with the millimeter-wave telescope ALMA, the researchers have shown that it is not a quasar, but in fact a galaxy with extreme, exceptional properties.

The study revealed that the high luminosity of BOSS-EUVLG1 in the ultraviolet and in Lyman-alpha emission is due to the large number of young, massive stars in the galaxy. This high luminosity, well above the range for other galaxies, gave rise to its initial identification as a quasar. However, in quasars, the high luminosity is due to the activity around the supermassive black holes in their nuclei and not to star formation.

"BOSS-EUVLG1 seems to be dominated by a burst of formation of young, very massive stars, with hardly any dust, and with a very low metallicity," explains Rui Marques Chaves, a researcher at the CAB, formerly a doctoral student at the Instituto de Astrofísica de Canarias and the University of La Laguna (ULL), and first author of the article.

The rate of star formation in this galaxy is very high, around 1000 solar masses per year, which is about 1000 times higher than that in the Milky Way, although the galaxy is 30 times smaller. "This rate of star formation is comparable only to the most luminous infrared galaxies known, but the absence of dust in BOSS-EUVLG1 allows its ultraviolet and visible emission to reach us with hardly any attenuation," explains Ismael Pérez Fournon, an IAC researcher and a co-author of the article.

The results of the study suggest that BOSS-EUVLG1 is an example of the initial phases of the formation of massive galaxies. In spite of its high

luminosity and star formation rate, its low metallicity shows that the galaxy has hardly had time to enrich its interstellar medium with dust and newly formed metals. Nevertheless, says IAC doctoral student and co-author Camilo E. Jiménez Ángel, "the galaxy will evolve toward a dustier phase, similar to the infrared galaxies. Also, its high luminosity in the UV will last only a few hundred million years, a very short period in the evolution of a galaxy."

"This would explain why other galaxies similar to BOSS-EUVLG1 have not been discovered," says Claudio Dalla Vecchia, a researcher at the IAC, and a co-author of the article.

BOSS-EUVLG1 was discovered via the analysis of a half-million spectra of galaxies and quasars in the BOSS project of the Sloan Digital Sky Survey (SDSS) and observations with large telescopes such as the GTC and ALMA.

More information: The discovery of the most UV-Ly-alfa luminous star-forming galaxy: a young, dust- and metal-poor starburst with QSO-like luminosities. Arxiv: arxiv.org/abs/2009.02177v1

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