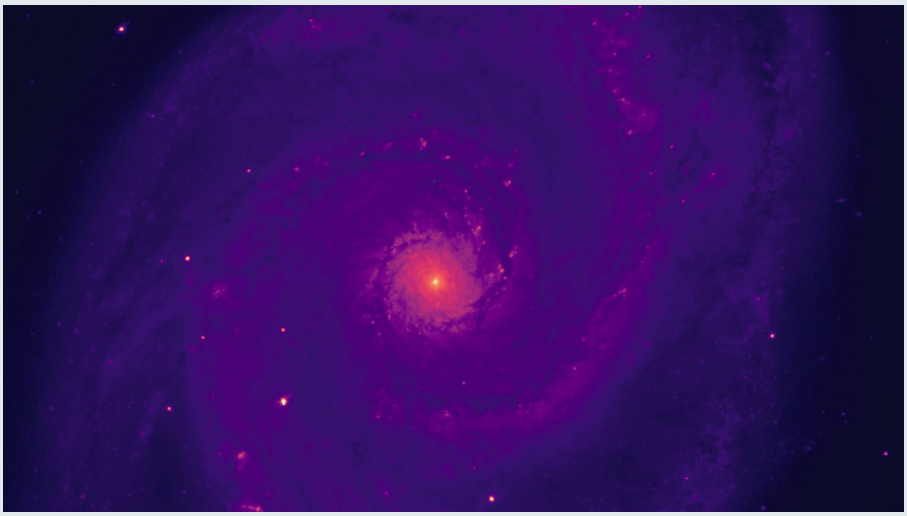
INSTRUMENTATION

DESIgner specs

The Dark Energy Spectroscopic Instrument (DESI) is an ambitious fibre-fed optical spectrograph that is currently under construction at the Lawrence Berkeley National Laboratory in the United States. Once completed — planned for the end of 2019 — it will sit atop the 4 m Mayall Telescope on Kitt Peak, and engage in a survey of 35 million galaxies to measure the 3D distribution of visible matter in the Universe. The image shown here of the Whirlpool galaxy (M51) is a result of the commissioning phase of DESI, which tests the part of the instrument's optics named the corrector: six silica lenses housed at the prime focus of the telescope.

When complete, DESI will consist of a ~1 m diameter focal plane that houses 5,000 robotically adjustable fibres, which feed into ten visible and very near-infrared (360–980 nm) spectrographs. The focal plane will sit above the corrector, which will allow the fibres to gather light from an 8 square degree field of view — orders of magnitude larger than MUSE, another state-of-the-art optical spectrograph, for instance. During commissioning, a stand-in instrument is taking the place of the focal-plane component; this replacement is the same weight as the final DESI focal plane will be, but it is composed of five CCD sensors rather than 5,000 optical fibres. The image of M51 (taken with an r-band filter) is a product of the first night's commissioning, and shows that the lenses can focus light from the telescope as planned.



Credit: DESI Collaboration

Although the Whirlpool galaxy makes for a pleasant subject for a 'first light' image, when fully operational DESI will be searching for galaxies out to a redshift of $z \approx 3.5$ (that will thus appear much smaller on the sky). Rather than produce a single image, as here, DESI will generate spectra for multiple objects at once, from which a precise redshift can be determined. This will allow the distribution of galaxies in the Universe to be mapped. A key science goal of the DESI astronomers will be to understand the large-scale structure of the Universe, particularly looking for the clustering of matter produced by baryon acoustic oscillations. The DESI survey is the successor to the Baryon Oscillation Spectroscopic Survey (BOSS), and will cover an order of magnitude more volume, and observe an order of magnitude more galaxies. The survey area will overlap marginally with both the Stage III Dark Energy Survey and the Stage IV Large Synoptic Survey Telescope imaging surveys, enabling complementary observations. ❐

Paul Woods

Published online: 9 May 2019
https://doi.org/10.1038/s41550-019-0775-2