Astronomers conduct one of the most detailed studies of a stellar halo

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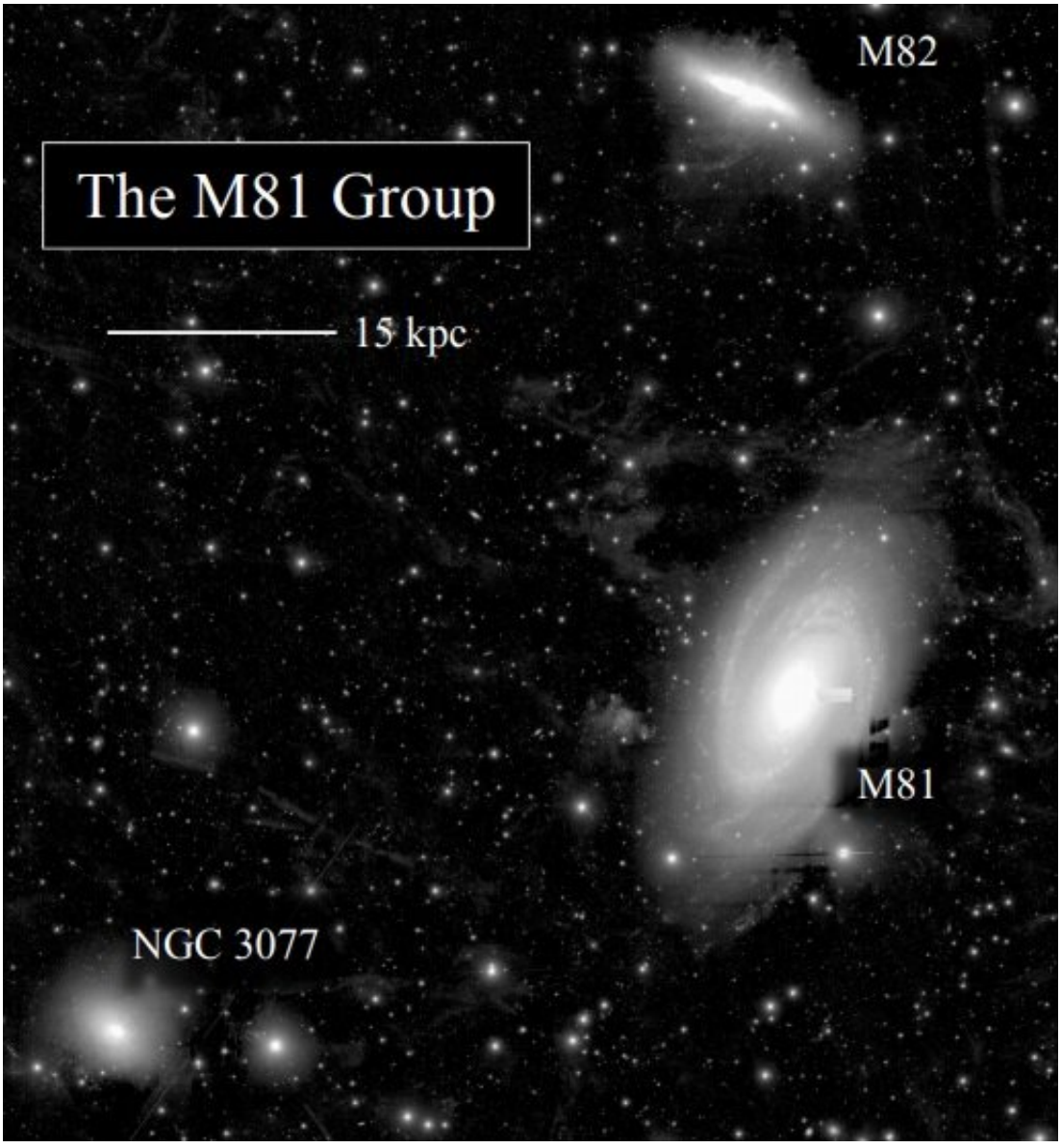

A deep, wide-field g-band mosaic of the M81 Group, taken with Subaru HSC. Credit: Smercina et al., 2019.

An international team of astronomers has used the Subaru Telescope to probe the stellar halo of the nearby Messier 81 (M81) galaxy. The observations resulted in one of the most detailed studies of a stellar halo conducted to date. The study is detailed in a paper published October 31 on arXiv.org.

Stellar haloes are spherical populations of stars and globular clusters surrounding most disk galaxies, usually containing the galaxy's oldest and most metal-poor stars. Hence, they could be crucial for better understanding the formation and evolution of galaxies. However, due to their low luminosities, stellar halos are generally difficult to observe.

Located some 12 million light years away, M81 is a spiral galaxy about half the size of the Milky Way. Discovered in 1774, the galaxy belongs to the M81 galaxy group containing also Messier 82 (M82), NGC 3077, and dozens of other galaxies. M81 is currently interacting with M82 and NGC 3077, making it the nearest ongoing significant galaxy merger.

What is baffling astronomers is that M81, like other Milky Way-mass galaxies, showcases an incredible range of stellar halo properties. The origin of such diversity is still unclear, and detailed investigation of M81's stellar halo could shed more light on this mystery.

So the astronomers led by Adam Smercina observed the halo of M81 with the Subaru Hyper Suprime-Cam (HSC) at the Subaru Telescope. The observations were conducted in 2015, and revealed M81's halo in unprecedented detail.

"In this paper, we present a Subaru Hyper Suprime-Cam (HSC) survey of the resolved stellar halo populations of the interacting M81 Group —the most detailed study of a stellar halo yet obtained outside of the

Local Group (LG)," the astronomers wrote in the paper.

The authors of the paper noted that their study provided the first complete view of the evolution of a galaxy's stellar halo throughout a merger event. In particular, they resolved the M81's halo to unprecedented V-band equivalent surface brightnesses of over 34 mag/arcsec^2, and made the first-ever global stellar-mass density map for a Milky Way-mass stellar halo beyond the Local Group.

The research found that the total past accreted stellar mass for M81 is about 1.16 billion solar masses, while M81's halo metallicity, at a radius of around 98,000 light years, was measured to be -1.2. The metallicity is in line with the galaxy's past accreted mass, relative to the stellar halo mass-metallicity relation.

The metallicity-coded map of red giant branch stars confirmed the triple interaction between M81, M82 and NGC 3077. It emphasized the stark contrast between properties of M81's halo at large radii and the metal-rich debris around the interacting satellites. The mass of tidal debris, which is currently unbound from M82 and NGC 3077, was estimated to be approximately 600 million solar masses.

"Together, these measurements allow us to piece together the saga of M81. This Milky Way analog experienced a quiet history, accreting at most a Small Magellanic Cloud-mass satellite, likely sometime early in its life. Its current mergers with M82 and NGC 3077, however, have already altered M81's stellar halo properties on a short (