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Chemical characterization of the Tucana II and Tucana III dwarf galaxies using SkyMapper photometry

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Ultra-faint dwarf galaxies are some of the oldest systems (~13 Gyr) in the Milky Way halo. By extension, the study of the metal content (or "metallicity") of their stars can place strong constraints on models of early chemical enrichment. However, spectroscopy, the primary observational technique to study the chemical content of stars, only permits the chemical characterization of at best ~10-20 stars per system due to the faintness of these stars and associated prohibitively long observing times.

Here we present the first metallicity analysis of the Tucana II and Tucana III ultra-faint dwarf galaxies based on deep SkyMapper photometry. This new technique uses narrow-band 'v' filter images that enable discriminating metallicities solely based on photometry rather than spectroscopy. This way, we can retrieve information on the metallicities of more stars, 1-2 magnitudes fainter than is permitted by spectroscopy. We have thus characterized the metal content of stars out to several half-light radii of each dwarf galaxy and have found multiple new members. Some members are even bright enough for chemical characterization based on high-resolution spectroscopy. We have indeed obtained high-resolution spectra for two newly identified bright members of Tucana II that were identified using our SkyMapper photometry, demonstrating the validity of our photometric metallicities and broader approach.

Implications of this photometry work are that we are now able to produce substantially more complete metallicity distributions of these dwarf galaxies. This is crucial for modeling their evolution and to test models of early metal mixing and element formation. In turn, this will improve our understanding of early chemical evolution and galaxy formation.

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