THE UNIVERSITY of EDINBURGH

# *News Release*

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## Smallest galaxies in Universe lend insights into dark matter

Scientists have created a new method to measure the amount of dark matter at the centre of tiny dwarf galaxies.

Dark matter makes up most of the mass of the Universe, yet it remains elusive. Depending on its properties, it can be densely concentrated at the centres of galaxies, or more smoothly distributed over larger scales.

Researchers realised that studying the behaviour of clusters of stars within a galaxy could enable them to derive details about dark matter.

The tightest constraints on dark matter come from the very smallest galaxies in the Universe, known as dwarf galaxies.

The smallest of these contain just a few thousand or tens of thousands of stars – so-called ultra-faint dwarfs.

Such tiny galaxies, found orbiting close to the Milky Way, are made up almost entirely of dark matter.

By comparing the distribution of dark matter in galaxies with detailed models, researchers can test ideas for what might constitute dark matter.

If the distribution of dark matter in these galaxies could be mapped out, it could provide new information about its nature.

However, being devoid of gas and containing very few stars, until recently there was no viable method for making this measurement.

Researchers from the Universities of Edinburgh and Surrey developed a new method to calculate the inner dark matter density of dwarf galaxies - even those with no gas and very few stars.

The key to the method lies in gravitationally bound collections of stars within galaxies, known as star clusters, which orbit close to the centre of the dwarf.

Unlike galaxies, star clusters are so dense that their stars gravitationally scatter from one another, causing them to slowly expand.

The research team realised that the rate of this expansion depends on the gravitational field in which the star cluster orbits and, therefore, on the distribution of dark matter in the host galaxy.

The team used a large suite of computer simulations to show how the structure of star clusters is sensitive to whether dark matter is densely packed at the centre of galaxies, or smoothly distributed.

Scientists then applied their method to the recently discovered ultra-faint dwarf galaxy, Eridanus II, finding much less dark matter in its centre than many theoretical models would have predicted.

Their study was published in Monthly Notices of the Royal Astronomical Society (MNRAS) and funded by the European Research Council.

Dr Jorge Peñarrubia, from the University of Edinburgh's School of Physics and Astronomy, who took part in the study, said: "These findings lend a fascinating insight into the distribution of dark matter in the most dark matter-dominated galaxies in the Universe, and there is great potential for what this new method might uncover in the future."

Dr Filippo Contenta, from the University of Surrey, who led the study, said: "We have developed a new tool to uncover the nature of dark matter and already the results are exciting. Eridanus II, one of the smallest galaxies known, has less dark matter in its centre than expected. If similar results are found for a larger sample of galaxies, this could have wide-ranging implications for the nature of dark matter."

For further information, please contact:
Catriona Kelly, Press & PR office: 0131 651 4401; 07791 355940; Catriona.Kelly@ed.ac.uk