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PRESS RELEASE

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THE MAGELLANIC GROUP AND ITS SEVEN DWARF GALAXIES

Astronomers at the University of Zurich have proposed a new theory for the formation of dwarf galaxies. In a paper published in «The Astrophysical Journal», Elena D'Onghia and George Lake solve several outstanding problems by comparing observed dwarfs to supercomputer simulations of their formation (Astrophysical Journal Letters, Volume 686, Nr. 2, p. L61).

The properties of dwarf galaxies have presented many challenges. «Ten years ago, my team at the University of Washington found that our cosmological model predicts 30-50 times as many small objects as we see. If the numbers had been nearly equal, that would have been an easy success for the model. If there were none, we might figure out a way to keep any from forming» says lead author George Lake «but at the risk of confusing fairy tales, having 30-50 times fewer dwarfs than predicted presents a ‹Goldilock's problem›. How do we keep most of them from forming, but not all?»

The main theory to prevent the formation of luminous dwarfs has been that events in the early Universe remove the gas that might have formed stars. The first of these events is the global heating and reionization of the Universe that happens within a billion years after the big bang. In this theory, the small fraction of dwarfs that form quickly enough escape destruction. «While this is an interesting idea, it doesn't explain why most of the dwarfs have stars that form much later than this» says Lake.

There is also the odd grouping of dwarfs. «Like those of the *correct* fairy tale, the dwarfs that we have are ‹friendly›, they group together both within our galaxy and in nearby associations» continues co-author Elena D'Onghia. «One might even think they've seen the movie as seven of them are associated with The Magellanic Clouds, the largest satellites of the Milky Way that are easily seen if you are lucky enough to view the sky from the Southern Hemisphere».

In the past, other researchers have noticed that as galaxies form hierarchically in the Universe, that many of the pieces come in as groups of small objects. «The critical element of these groups of dwarfs isn't that they are a club, but rather they have a ‹dwarf leader› or ‹parent›. When events in the early Universe expels the gas in the smallest object, the dwarf leader shepherds this gas and allows its small companions to recapture it at later times» says D'Onghia.

Lake and D'Onghia have put all these puzzle pieces together to propose that the Magellanic Clouds were the largest members of a group of dwarf galaxies that entered the Milky Way dark halo not long ago. Seven of the eleven brightest satellite galaxies of our Milky Way were part of this group.

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New simulations performed at the University of Zurich show that it is typical for dwarf galaxies to form in groups and enter large galaxies at late times. The group is then disrupted by tidal forces, spreading the small population of luminous dwarfs around the Milky Way making the satellite galaxies we observe today.

New measurements by scientists at Harvard University including Nitya Kallivayalil and Gurtina Besla indicate that the Magellanic Clouds are moving faster than previously believed and may have entered the Milky Way recently. «The scenario proposed by D'Onghia and Lake fits in well with these observational determinations and may account for many facets of the satellite population of the Milky Way», according to Lars Hernquist of Harvard University.

As well as wrapping up several problems in galaxy formation, their theory makes clear predictions that will be tested rapidly. One such prediction is that isolated dwarf and satellite galaxies will be found to have companions. Since their theory was first circulated, the dwarf galaxy Leo IV was found to have another little Leo V companion in July. The existence of nearby dwarf associations also supports this new theory.

Lake and D'Onghia are located in the Institute of Theoretical Physics at the University of Zurich. This Institute is known for the pioneering work in relativity and cosmology. Most recently, they have been leaders in predicting the distribution and properties of dark matter in the Universe.

Figure Caption:
A Magellanic group sized object falling into a galaxy with the size of the Milky Way.

FURTHER INFORMATION
Astrophysical Journal Letters paper: http://xxx.lanl.gov/abs/0809.3787

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