

Netherlands Institute for Radio Astronomy

Searching for gas-bearing dark matter halos in the Local Group

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Take-away Message

- Ultra-compact high velocity clouds are good candidates to represent gas bearing dark matter halos with minimal stellar content
- AGC198606 is an excellent candidate to represent such an object
 - Rotational velocity of ~14 km/s

The Small Scale Crisis Dark Matter

- Mismatch between simulations and observations Known Milky Way Satellites at the low mass end
 - abundance
 - internal structure/ kinematics
 - which halos host galaxies?
- Discovery of ultra-faint dwarfs has fueled new understanding





2.0

log w (km s⁻¹)

Morphological Segregation

- Morphological segregation within Local Group
- Leo T
 - Most distant UFD found in SDSS (d=420 kpc)
 - $M_{HI} = 3 \times 10^5 M_{sun}$
- Detect more systems via HI?
 - ALFALFA is sensitive to $10^5 M_{sun}$ out to 1.5 Mpc



High Velocity Clouds

- High velocity clouds: clouds of HI with no stars at velocities inconsistent with Galactic rotation
- "Dark" galaxies in LG?
 - Blitz et al. 1999 and
 Braun and Burton 1999
 with compact HVCs
 - ~1 deg in size
 - $M_{HI} \sim 10^7 M_{sun}, R_{HI} \sim 10 \text{ kpc}$ at 1 Mpc
- NO direct distance information



Background

Ultra-compact HVCs as as an and a stream and Local Group Galaxies

- Ultra-compact high velocity clouds
 - Selected for size & isolation (& no OC)
 - 59 in α.40

-G Galaxies?

- At 1 Mpc: M_{HI} ~ 10⁵ M_{sun} & R_{HI}~1-2 kpc
- Overcome previous objections: sizes and masses match constraints
- Consistent with models of gas in low mass DM halos (Faerman+ 2013)
- Kinematics and spatial distribution consistent with LG hypothesis
- NO direct distance information



Adams+ 2013



Understanding the UCHVC Population

 Deep optical searches are showing most systems don't host (easily) observable stellar counterparts (e.g., Bellazzini+ 2014, Sand+ 2015, Janesh+ in prep.)

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- What stellar population could be there?
- Turn to HI for an alternate view
 - No distance info but kinematic info

AGC198606: A gas-bearing dark matter minihalo?



- Smooth HI morphology
 Velocity gradient of ~25 km/s across ~20'
 vrot ~ 14 km/s

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Friend of Leo T

The Nature of AGC198606

- No obvious optical counterpart in deep WIYN imaging
 - Detailed search is ongoing (Janesh+ in prep)
- Galactic halo HI cloud
 - HI morphology doesn't match
- Gas-bearing dark matter halo
 - d=420 kpc (Leo T)
 - More HI mass than Leo T but more extended
 - d=150 kpc (Faerman+ 2013)
 - Less HI mass than Leo T but within hot corona of MW



Adams+, 2015

WSRT HI Imaging



WSRT HI Imaging

- 12 systems observed, 2 good candidates
 - Interestingly, both are at low cz
 - AGC198606:
 - 25 km/s across 20' -> v_{rot}~14 km/s
 - AGC249525
 - 14 km/s across 11' -> v_{rot}~12 km/s
- ALPHA-6 (initial Apertif roll-out) is well-suited for this work: good column density sensitivity

Take-away Message

- Ultra-compact high velocity clouds are good candidates to represent gas bearing dark matter halos with minimal stellar content
 - But which ones?
- AGC198606 is an excellent candidate to represent such an object
 - And now AGC249525
- ALPHA-6 will be a good instrument for finding more of these

AGC198606: What is it?

	AGC198606 (w/ Leo T)	AGC198606 (Faerman 2013)	AGC198606 (Galactic halo)	Leo T	Leo P
dist	420 kpc	150 kpc	10 kpc	420 kpc	1.72 Мрс
Μ	6.2x10	7.9x10	350 M	2.8x10	9.3x10
r	1400 рс	500рс	34 рс	300 рс	500 рс
Μ	1.5x10	5.3x10	-	3.3x10	2.6x10
Μ	-	-	-	1.2x10	5.7x10

Friend of Leo T