UNIVERSITEIT GENT

FACULTEIT WETENSCHAPPEN

The missing ISM mass problem in NGC 205

Ilse De Looze[1], Maarten Baes[1], Jacopo Fritz[1], Tara J. Parkin[2], Christine D. Wilson[2] and VNGS/HELGA consortia

Abstract: NGC 205 is a low-metallicity ($Z \approx 0.3 Z_\odot$), early-type dwarf satellite of M31. In the past, NGC 205 had a tidal encounter with M31 and a recent episode of star formation (500 Myr ago). Observations of these young stars predict a more massive ISM in NGC 205 than currently observed through HI, CO(1-0) and dust (< 160 µm) observations. Here, we revise the missing ISM mass problem based on JCMT CO(3-2) and Herschel dust continuum, [CII] and [OI] spectroscopic observations.

Fig 1: NGC 205 , dwarf satellite of Andromeda.

1. Theoretical gas predictions

Total Burst mass = mass of young stars

$1.4 \times 10^6 M_\odot \leq M_\star \leq 5.3 \times 10^7 M_\odot$

↓ assume star formation efficiency (SFE) ≈ 10 %

$= M_g$ (left-over) + M_g (mass loss by p.n.)

$= M_g$ (current) $\geq 1.3 \times 10^7 M_\odot$

2. Previous observations

Gas: HI + CO(1-0)
$M_g \approx 1.5 \times 10^6 M_\odot$

Dust (Spitzer obs.):
$M_g \approx 3\text{-}6 \times 10^6 M_\odot$

→ **inconsistent with predicted M_g**

= **MISSING ISM MASS PROBLEM**

BUT : - Low Z → [CII] better tracer of H_2?
- CO observations only cover northern part
- Cold dust at λ ≥ 160 µm?

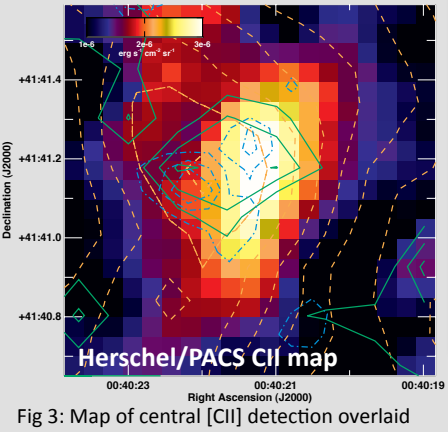


Fig 3: Map of central [CII] detection overlaid with HI, CO(3-2), MIPS 24µm emission contours (dashed, solid, dashed-dotted, respectively).

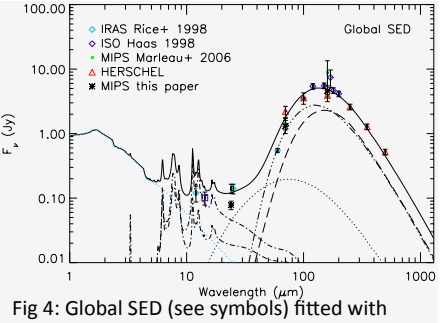


Fig 4: Global SED (see symbols) fitted with DustEm dust model (silicate+am.carb. grains).

3. New observations

Gas: JCMT CO(3-2) + Herschel [CII]+[OI]
Dust: Herschel → combining data from
- Very Nearby Galaxy Survey (PI: C. Wilson)
- Herschel Exploitation of Local Galaxy Andromeda (HELGA, PI: J. Fritz)

↓

Gas: M_g (CO(3-2)) << M_g (CO(1-0))
[CII] weak detection: $M_g \approx 1.5 \times 10^4 M_\odot$
[OI]: no detection

Dust: $M_d \approx 1\text{-}2 \times 10^4 M_\odot$ @ $T_d \approx 18\text{-}21$ K
→ $M_g \approx 4\text{-}7 \times 10^6 M_\odot$ (GDR ≈ 400)

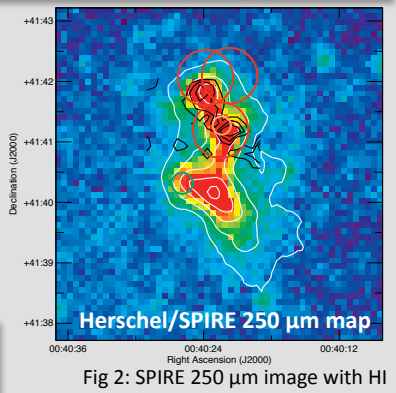
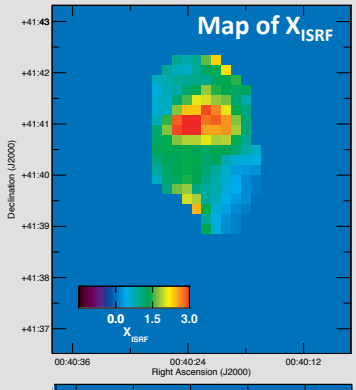


Fig 2: SPIRE 250 µm image with HI (white), CO(3-2)(black) contours and CO(1-0) pointings (red+green).



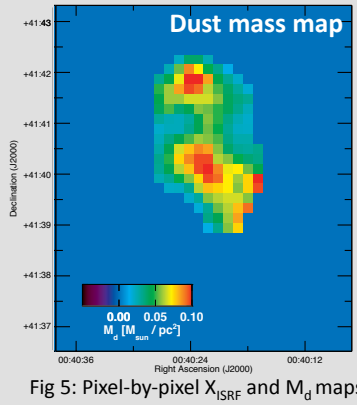


Fig 5: Pixel-by-pixel X_{ISRF} and M_d maps.

RESULTS

- From Herschel/JCMT observations, we reject the presence of a massive (cold) ISM in NGC 205.
→ this confirms the missing ISM mass problem: M_g (predictions) >> M_g (observed)
- Non-standard conditions (top-heavy IMF, increased SFE) incapable of solving discrepancy.
- Part of ISM reservoir seems expelled from the galaxy, either due to supernovae or tidal influence.

[1] Sterrenkundig Observatorium, Universiteit Gent, Krijgslaan 281, S9, B-9000 Gent, Belgium
[2] Dept. of Physics & Astronomy, McMaster University, Hamilton, Ontario, L8S 4M1, Canada