From velocity dispersions to the dispersion of Astronomy

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Collaborators during my Phd

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Motivation

- Multi-phase ISM
- Galaxy morphology
- Velocity dispersion
Molecular gas

Detection

Structure

Blitz & Williams, 99

Image: Swiburne University
GMC scaling relations (Larson’s laws): Milky Way

Size - linewidth
Mass - linewidth
Volume density - linewidth

Solomon et al., 87
GMC scaling relations: extragalactic

Bolatto et al., 08

Hughes et al., 13
Star formation law (Schmidt-Kennicutt)

\[ \Sigma_{SFR} = A \Sigma_{HI+H_2}^N \]

\[ N \sim 1.4 \]
HI vs CO

**ATOMIC GAS**
**THINGS survey** Walter et al., 08
VLA, 21 cm line
Linear res. ~ 0.4 kpc (11 arcsec)
Spectral resolution 2.6 or 5.2 km/s

**MOLECULAR GAS**
**HERACLES survey** Leroy et al., 09
IRAM 30 m, CO: 2-1
Linear res. ~ 0.5 kpc (13 arcsec)
Spectral resolution 2.6 km/s
Single dish vs Interferometer: M51

PdBI + 30 m.

PdBI only

Combination - PdBI

Pety et al., 13

PAWS survey on M51 Schinnerer et al., 18
Single dish vs Interferometer: M51

Clumpy disk + diffuse CO component

50% of the flux IS NOT recovered by the interferometer

Pety et al., 13
### Single dish vs Interferometer

<table>
<thead>
<tr>
<th>INTERFEROMETRIC DATA</th>
<th>SINGLE DISH DATA</th>
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<tr>
<td>CARMA</td>
<td>HERACLES</td>
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<tr>
<td>CO 1 – 0</td>
<td>IRAM 30 m</td>
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<td>CO 2 – 1</td>
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<th>NGC 4736</th>
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<th>NGC 5055</th>
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Single dish vs Interferometer
Single dish vs Interferometer

![Graph showing FWHM vs R [R_25] for NGC 4736 and NGC 5055, comparing HERACLES, THINGS, and Nobeyama. Stacked sp. including all LOS.](image-url)
Moving to higher spectral resolution: M31

IRAM 30m (Nieten, 2006)
CO (1-0)
23"@2.6 km/s

CARMA survey of Andromeda (Schruba)
CO (1-0)
5.5"@2.5 km/s
Single Gaussian fit

FWHM_{SD} / FWHM_I \sim 1.50 \pm 0.37

Caldu-Primo et al., 18
SFR tracers:
- GALEX FUV
- MIPS 24 μm
- PACS 70 & 160 μm
- Hα Mayall 4m telescope
FWHM as function of SFR

![Graph showing FWHM as a function of SFR](image-url)
Compact and diffuse morphologies

Interferometric data

FWHM\textsubscript{N} = 6.8 km/s
Peak\textsubscript{N} = 0.41

FWHM\textsubscript{B} = 25.1 km/s

FWHM\textsubscript{B} is negligible

Single-dish data

FWHM\textsubscript{N} = 6.6 km/s
Peak\textsubscript{N} = 0.16

FWHM\textsubscript{B} = 13.5 km/s

FWHM\textsubscript{B} = 14.4 ± 1.5 km/s

Broad component more significant in bins of lower interferometric peak intensity
Moving to higher spectral resolution: M31
Moving to higher spectral resolution: M31