Study of extreme environments with SKA and pathfinders: isolated galaxies vs compact groups

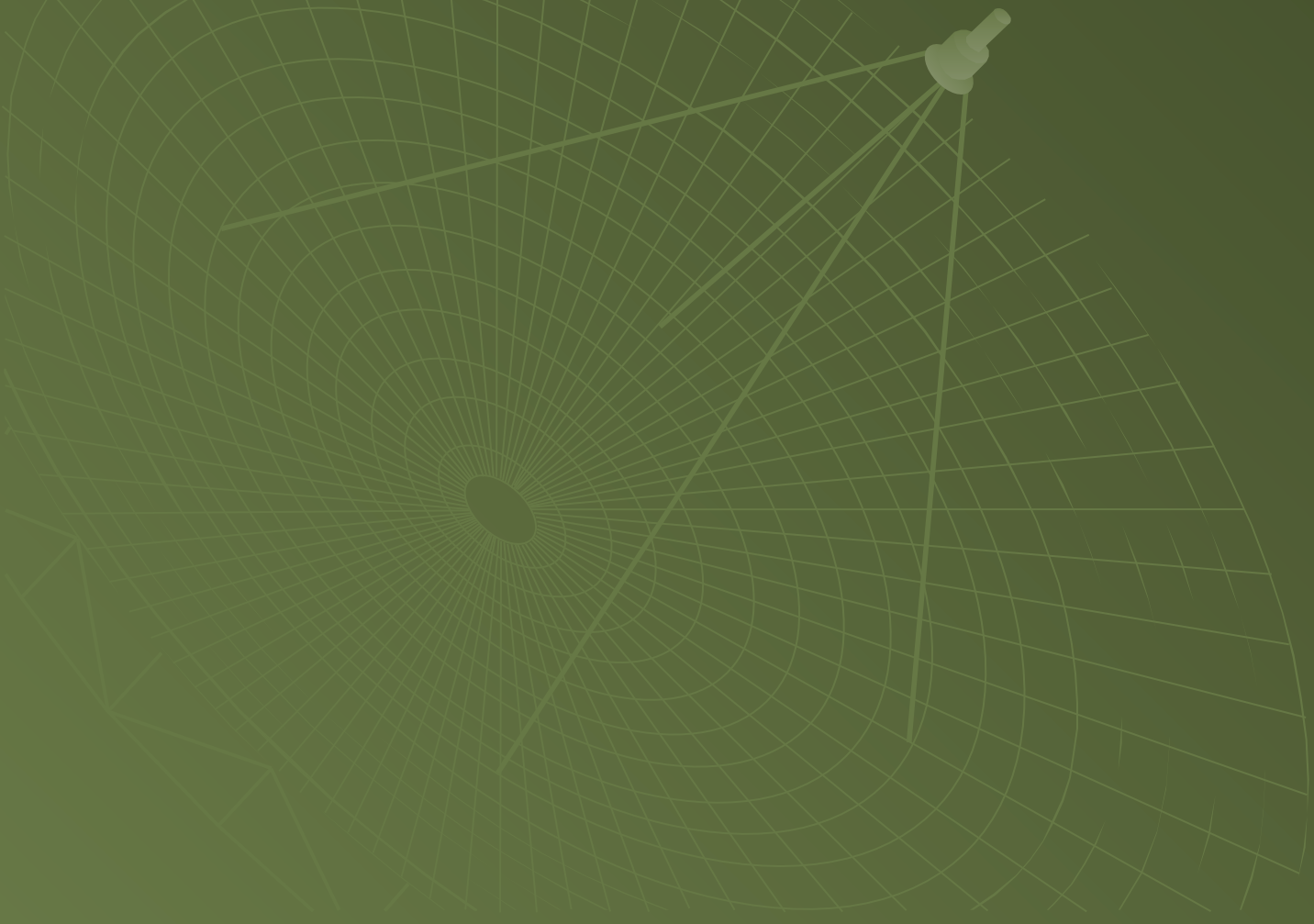
L. Verdes-Montenegro

Instituto de Astrofísica de Andalucía (IAA, CSIC)

AMIGA Project

Analysis of the interstellar Medium of Isolated GAlaxies

- Multiwavelength statistical study of ISM ~**1000 galaxies**
- Building & analysis of the sample (ISM – SF – AGN)



AMIGA Project

Analysis of the interstellar Medium of Isolated GAlaxies

Multiwavelength statistical study of ISM ~**1000 galaxies**

Building & analysis of the sample (ISM – SF – AGN)

Starts in 2003 @IAA (PI: L. Verdes-M)

Core team in Granada:

Staff: Jack Sulentic (IAA), Ute Lisenfeld (Univ. Granada)

Postdocs: Tom Scott (IAA), Antonio Portas (IAA), Simon Verley (Univ. Granada), Gilles Bergond (CAHA), Chandreyee Sengupta (CAHA-IAA), Miriam Fernández (IAA)

PhDs: Vicent Martínez, Carmen Argudo

Software development:José Enrique Ruiz del Mazo, Susana Sánchez

+ International collaboration:

ESO (Chile), Obs. Marseille, Obs. Paris, CfA, ASIAA-Taiwan, MPIfA (Bonn), UMASS, Mc Donald Obs., Arcetri, UNAM, IAC, Kapteyn Institute, ATNF

MULTIλ RESULTS

- Sb-Sc dominant population
- **LOWEST VALUES** relative to any other samples of:
  - LB of both late and early types (Sulentic et al 2006)

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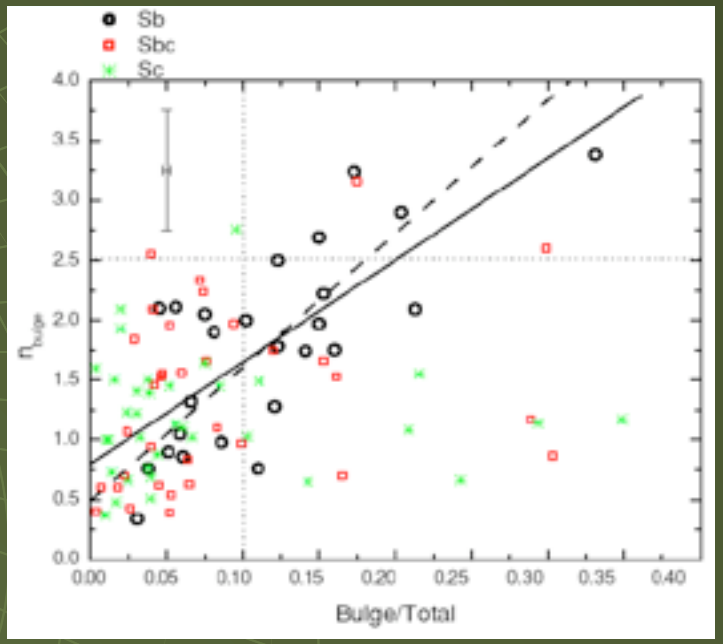
  - Sersic index of late types => **pseudobulges**
  - Optical asymmetry,

clumpiness, concentration

PhD Durbala 2009,
Durbala et al 2008, 2009



100 Sb-Sc Fourier decomposition and CAS parameter SDSS-i

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  - Sersic index of late types (= pseudobulges)
  - Optical asymmetry, clumpiness, concentration
  - LFIR (Lisenfeld et al 2007)

    · $\log(L_{FIR})$: only 2% >10.5 L_{sol}

    · Comparison with 2445 galaxies of CfA sample:

    $\langle \log(LFIR)_{CfA} \rangle = \langle \log(LFIR)_{AMIGA} \rangle + 0.26$

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PhD Sabater 2009, Sabater et al 2009, 2011

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  - Molecular gas content:

    smaller than in interacting pairs

Lisenfeld et al submitted

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Espada et al 2011

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AMIGA galaxies show different physical properties from field or loose groups

Role of nurture reduced beyond any other sample

  - Atomic gas asymmetry **Espada** et al 2011

MULTIλ RESULTS

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Limited high resolution studies of isolated galaxies to date because

- degree of isolation of nearby galaxies cannot be reliably determined

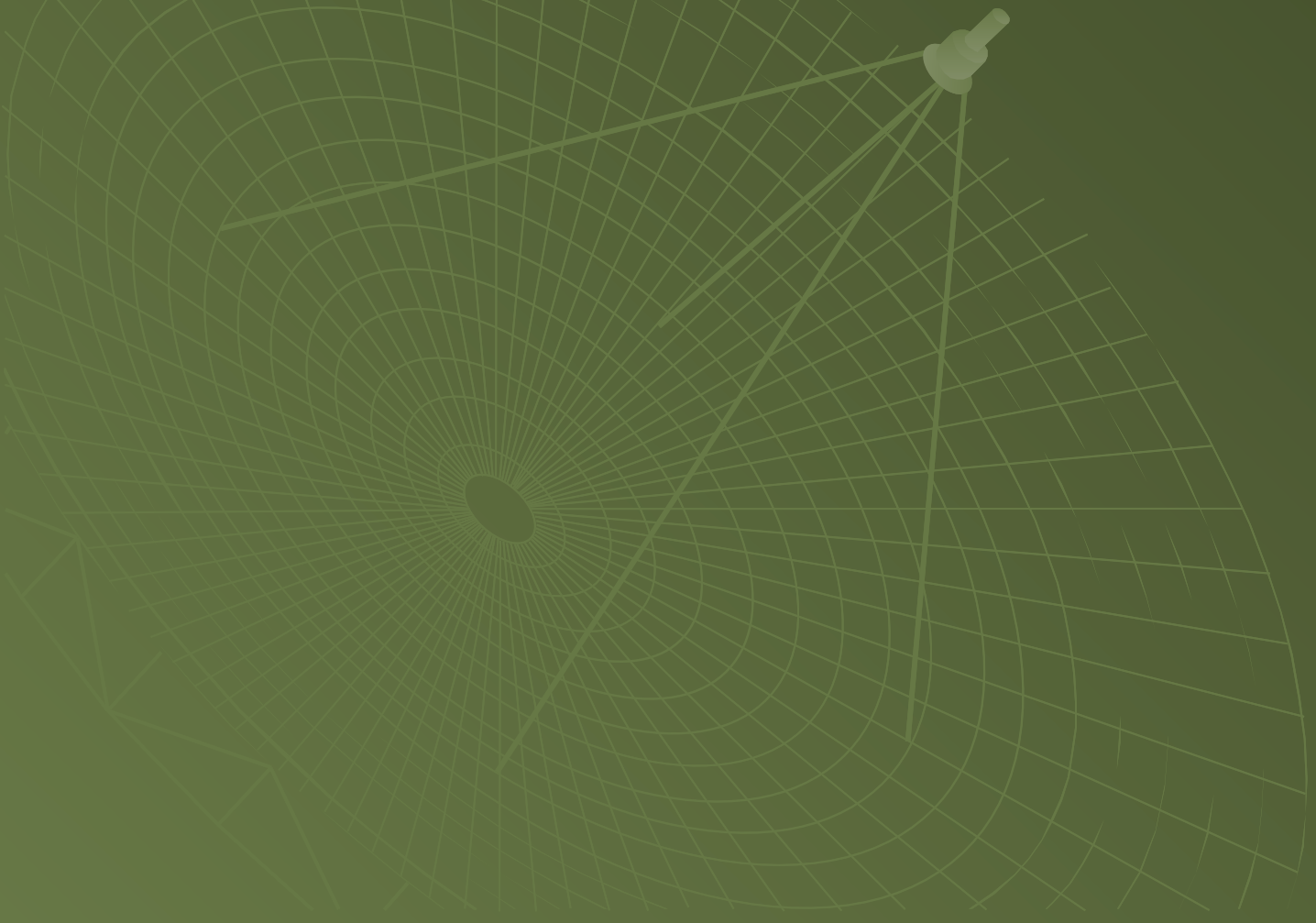
- more distant but clearly isolated galaxies, being quiescent, tend to be unusually faint at all wavelengths.

Origin of atomic gas asymmetries

- CIG < 20% vs 50% for other samples in the bibliography

Espada et al 2011

Single dish study:



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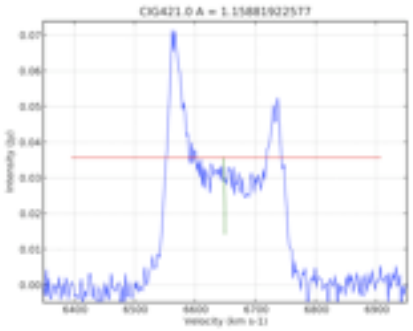
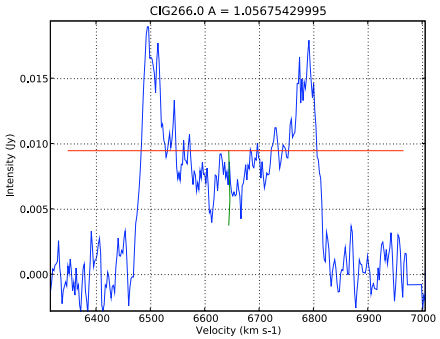
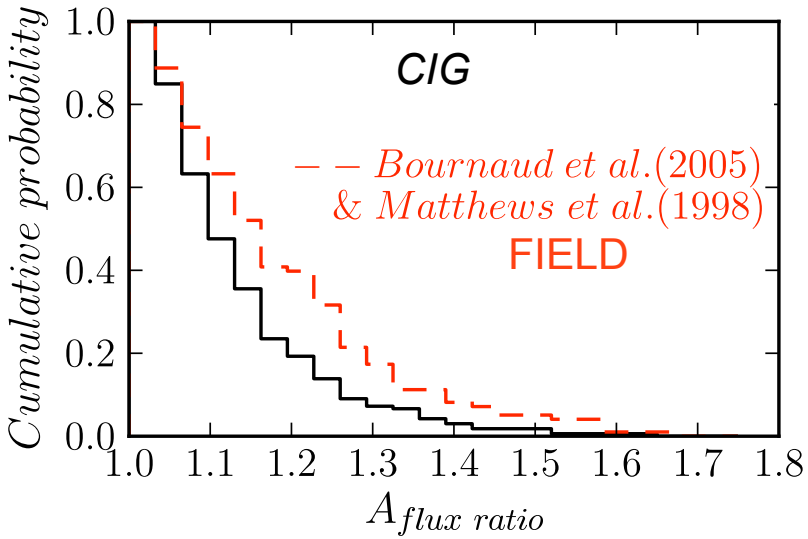


Symmetric





Origin of HI asymmetries in isolation

Interferometry (E)VLA & GMRT 25 galaxies

- Asymmetries in the velocity field
- Few HI companions (mass limit $5x10^6 M_{sol}$)
- No tidal tails

Espada et al, Sengupta et al in prep

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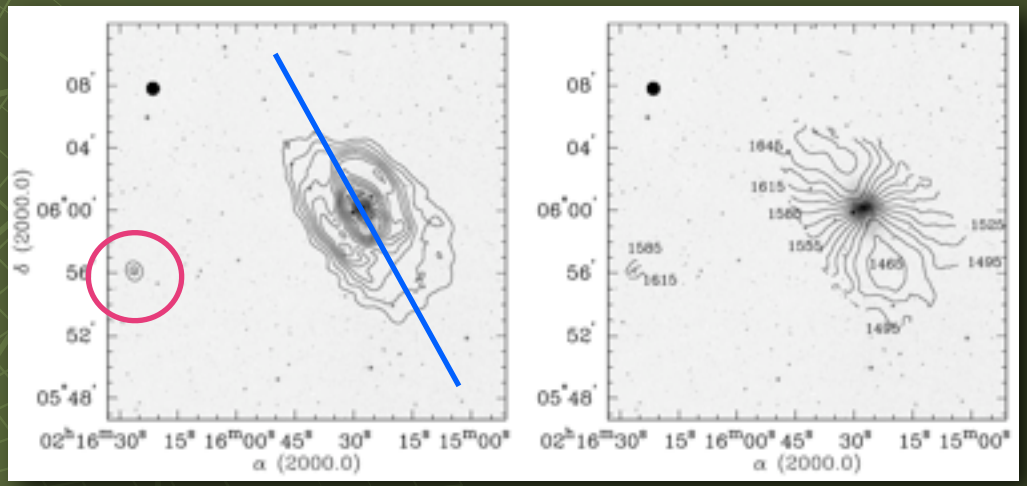
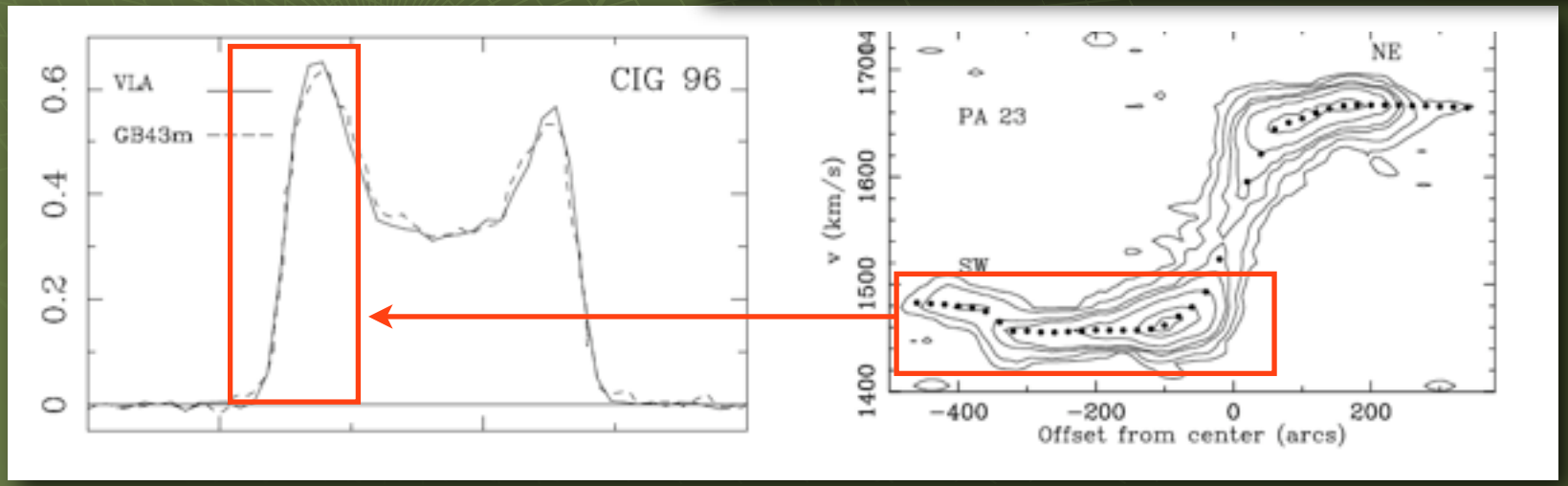
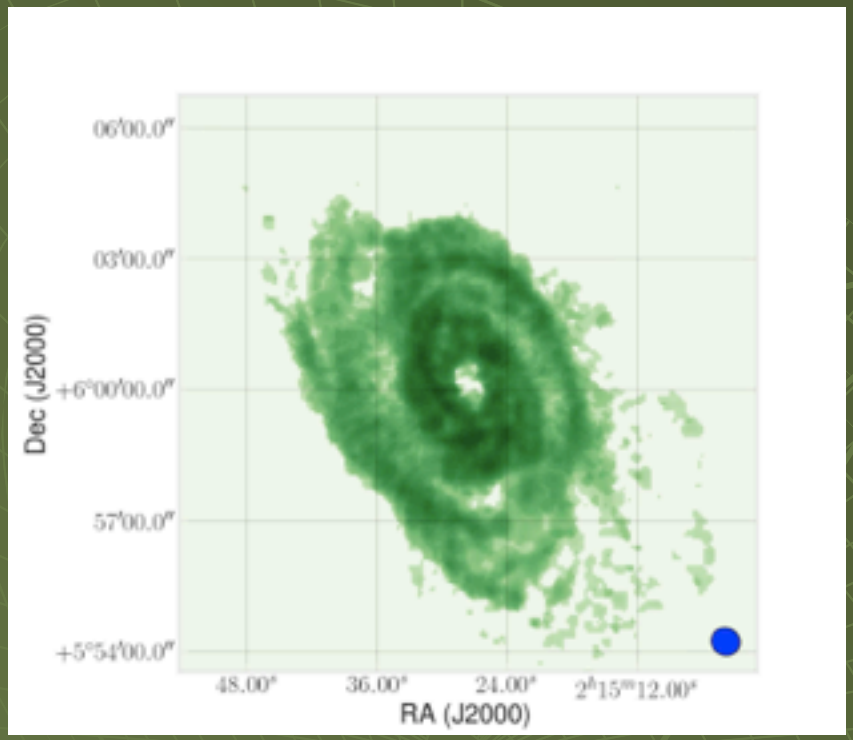


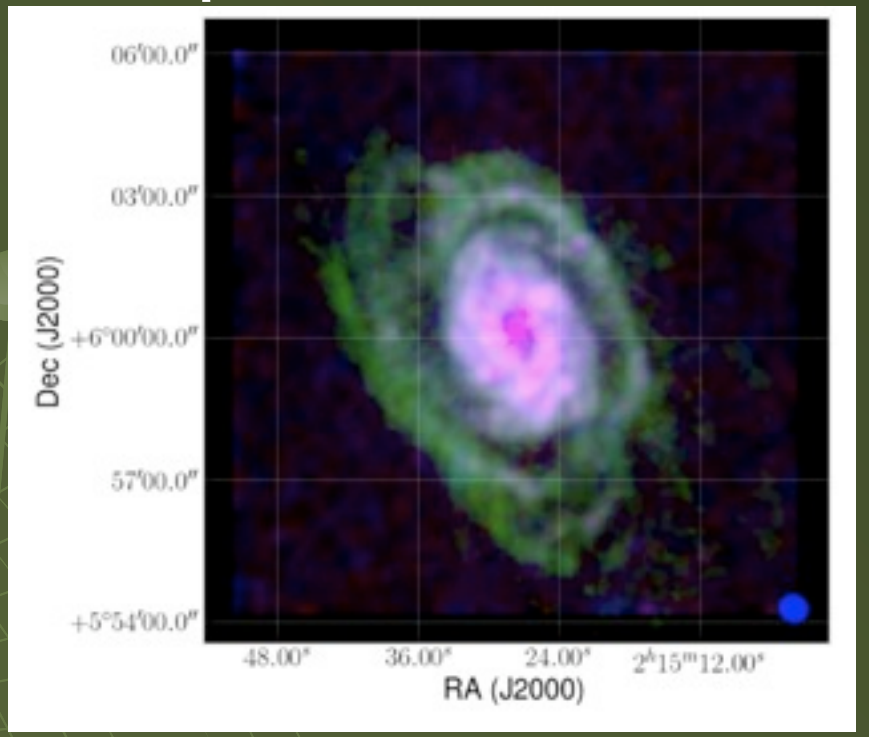


Origin of HI asymmetries in isolation

HI data VLA C+D configuration

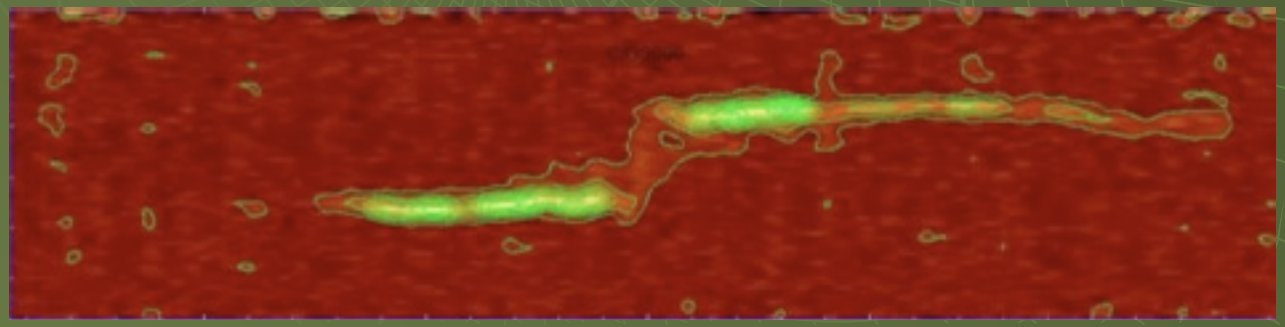


Deep GALEX Observations



Coll. Armando Gil de Paz

HI data VLA C+D configuration: N(HI) = 5 x 10^20 cm-2



Origin of HI asymmetries in isolation

How deep can we go now? **EVLA C+D**

10h C array, 20“ resolution

N(HI) = 5 x 10^19 cm-2

+3h D array smoothing (40”)

N(HI) = 3 x 10^19 cm-2

What is next?

MeerKAT (2014)

70% in core of 1 km (VLA C,D = 3, 0.6 km), 30% up to 8 km

MHONGOOSE approved Large Programme (PI. E. de Blok)

N(HI) = **1x 10^19 cm−2** at 30” resolution 200h x 30 galaxies

heavy smoothing --> **1 x 10^17 cm-2** (cosmic web)

Origin of HI asymmetries in isolation

What is next?

ASKAP (2013): ~30 deg FOV

Survey machine

WALLABY approved Large Programme (PI. B. Koribalski) **13 months**

N(HI) = **1.7x 10^19 cm−2** at 30", 75% sky z < 0.26 500.000 galaxies

DINGO (Deep Investigations of Neutral Gas Origins, PI M. Meyer

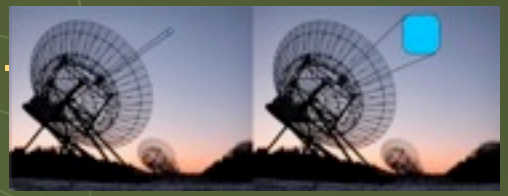
evolution of HI from z = 0 to z ~ 0.5 : HI mass function and cosmic web

N(HI) = **1 x 10^17 cm−2** at 30"

Apertif (2014): ~8 deg FOV

A medium-deep blind survey of HI in the local Universe (PI. M. Verheijen)
100h/pointing, > 5000 h

N(HI) = **2 x 10^19 cm−2** at 30", 500 deg^2 area z < 0.

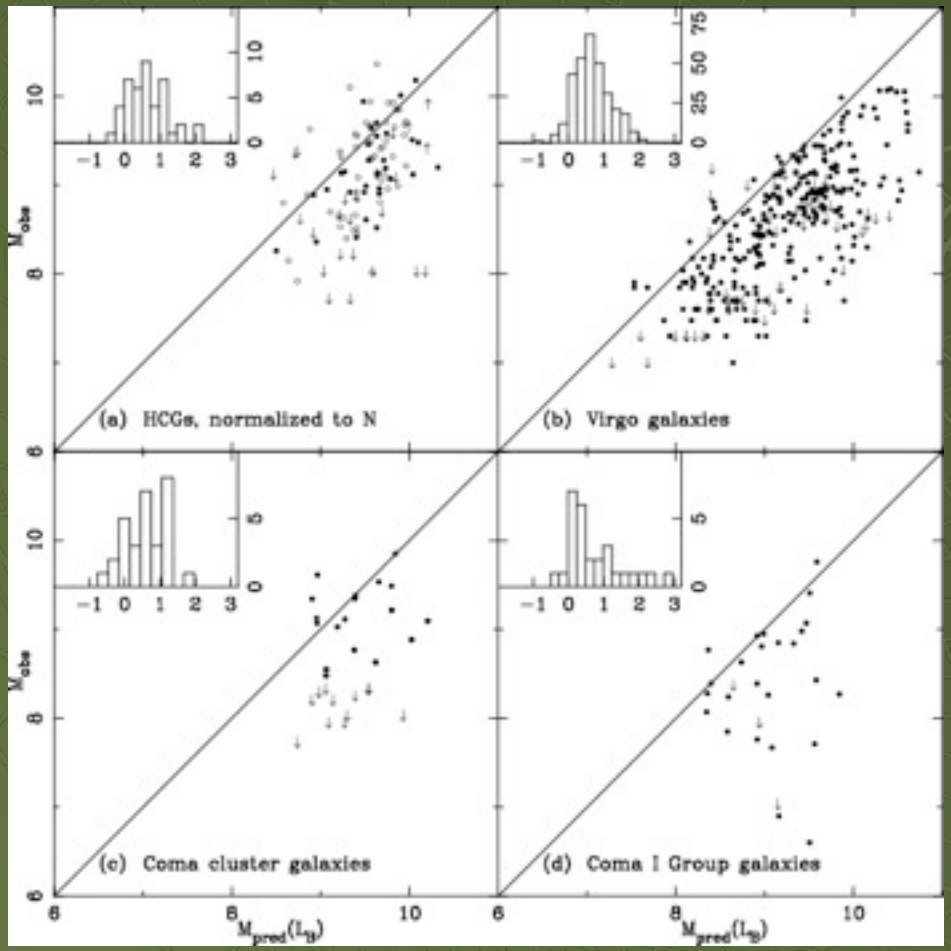


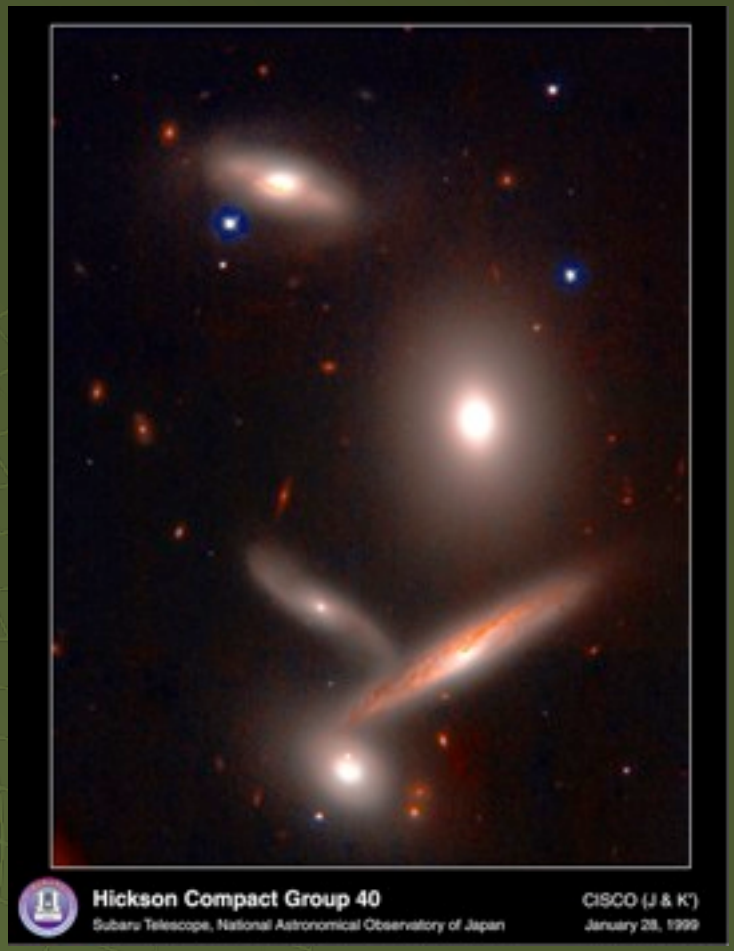
To survey a wide range of environments

Compact Groups of Galaxies

Single dish study of 72 Hickson Compact Groups (Verdes-Montenegro et al 2001)

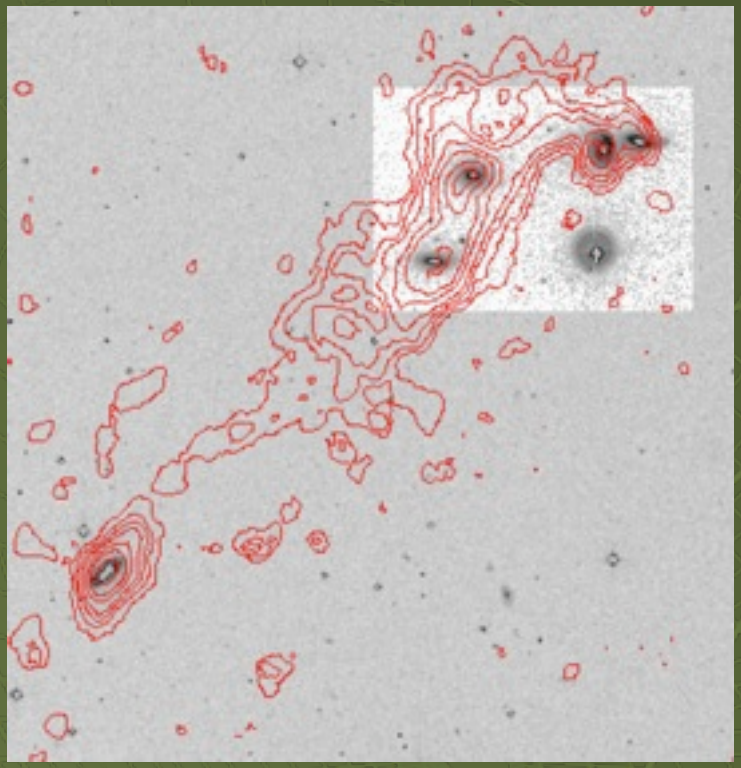
HI deficiency of groups similar to Virgo or Coma clusters





Compact groups of galaxies

VLA study of 26 Hickson Compact Groups (Verdes-Montenegro et al 2001, 2007)



Evolutionary model: amount of detected HI decreases further with evolution, by continuous tidal stripping

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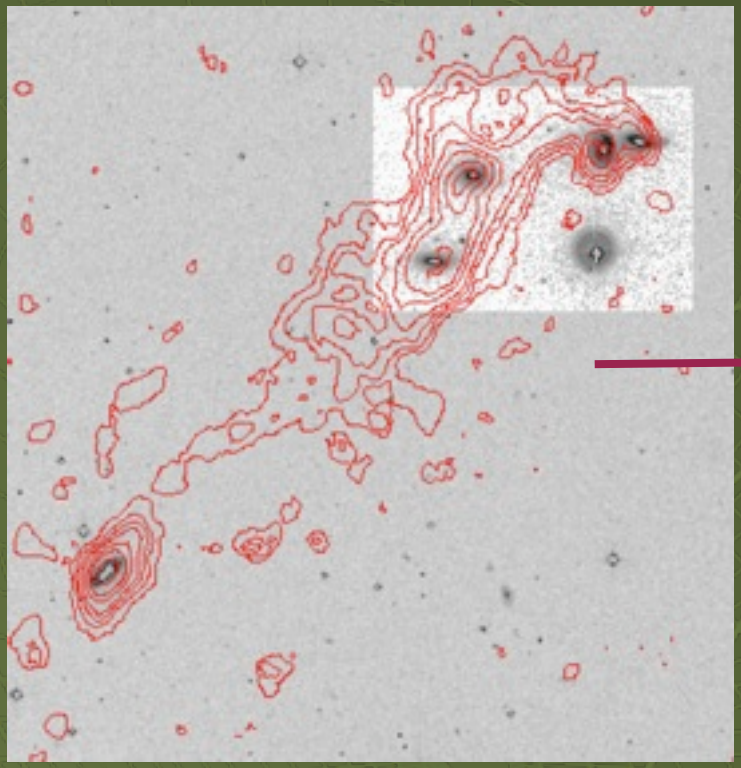

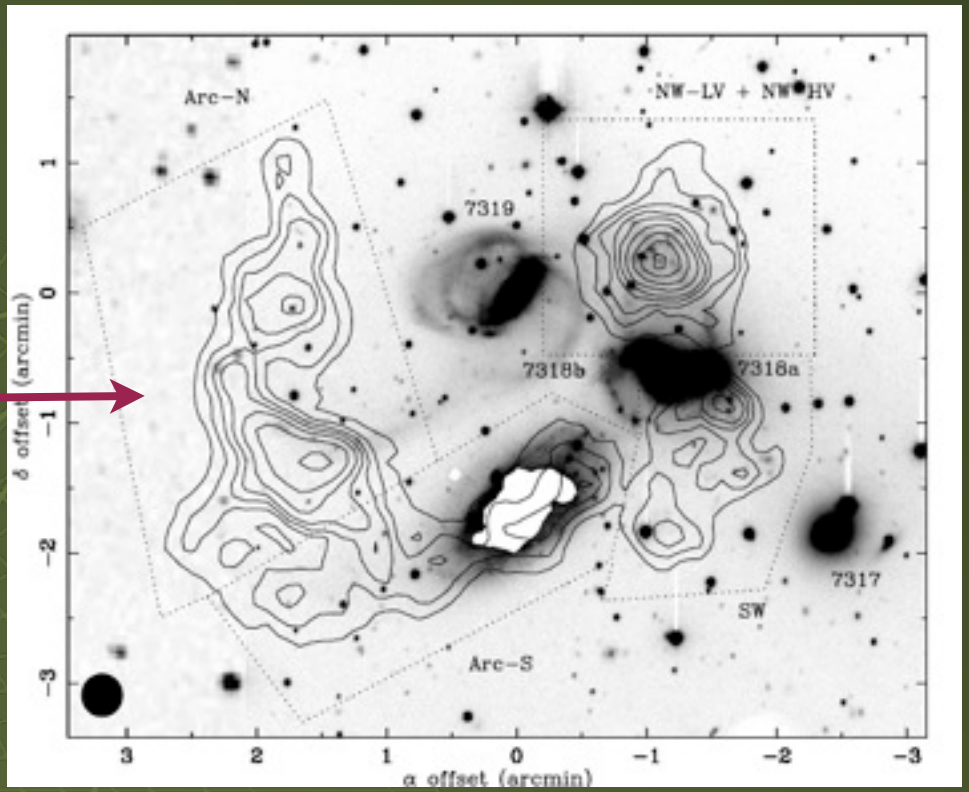

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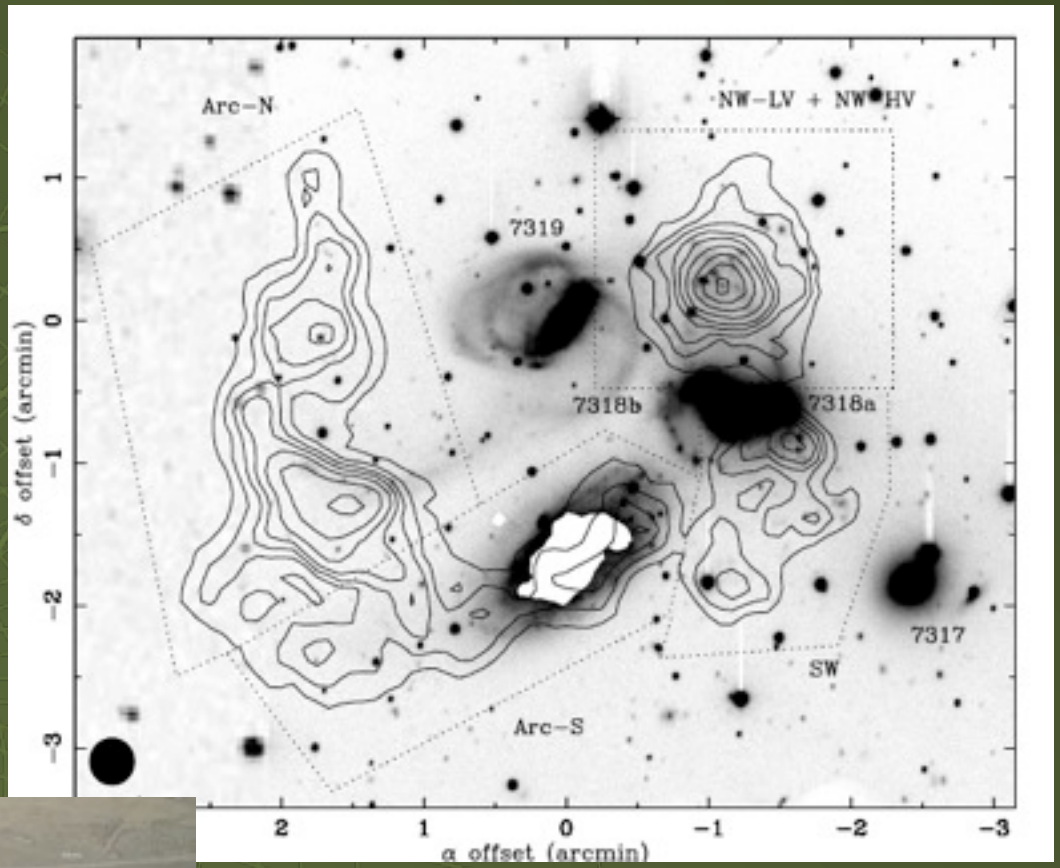
Compact groups of galaxies

What is the fate of atomic gas? Still not completely understood



N(HI) = 5 x 10^19 cm-2

VLA C+CnB+D (20”)

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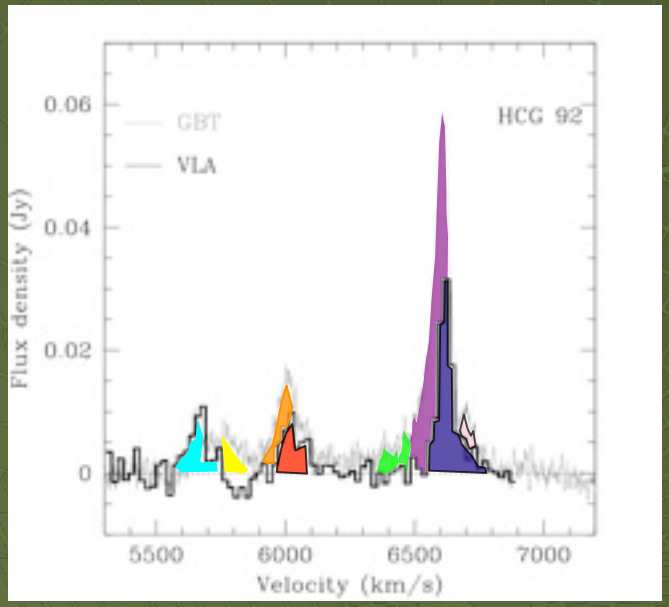
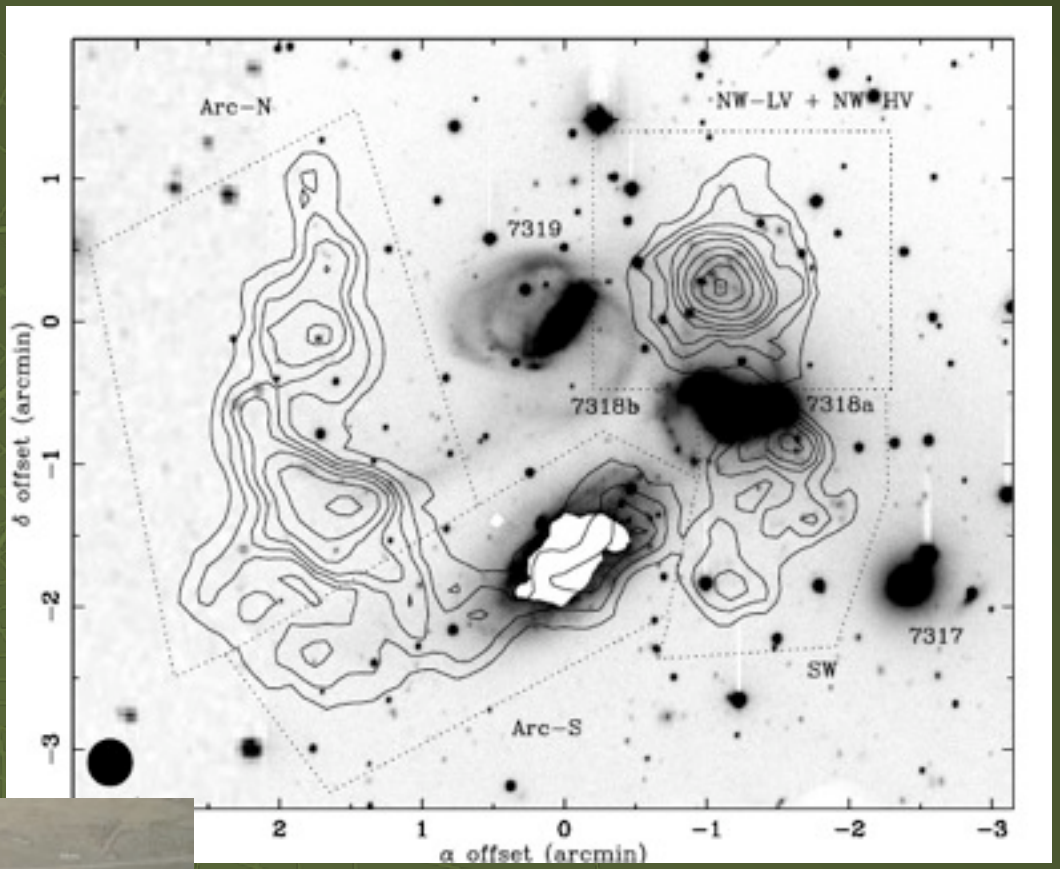
Exploitation of Single dish (GBT) vs interferometry (VLA) complementarity





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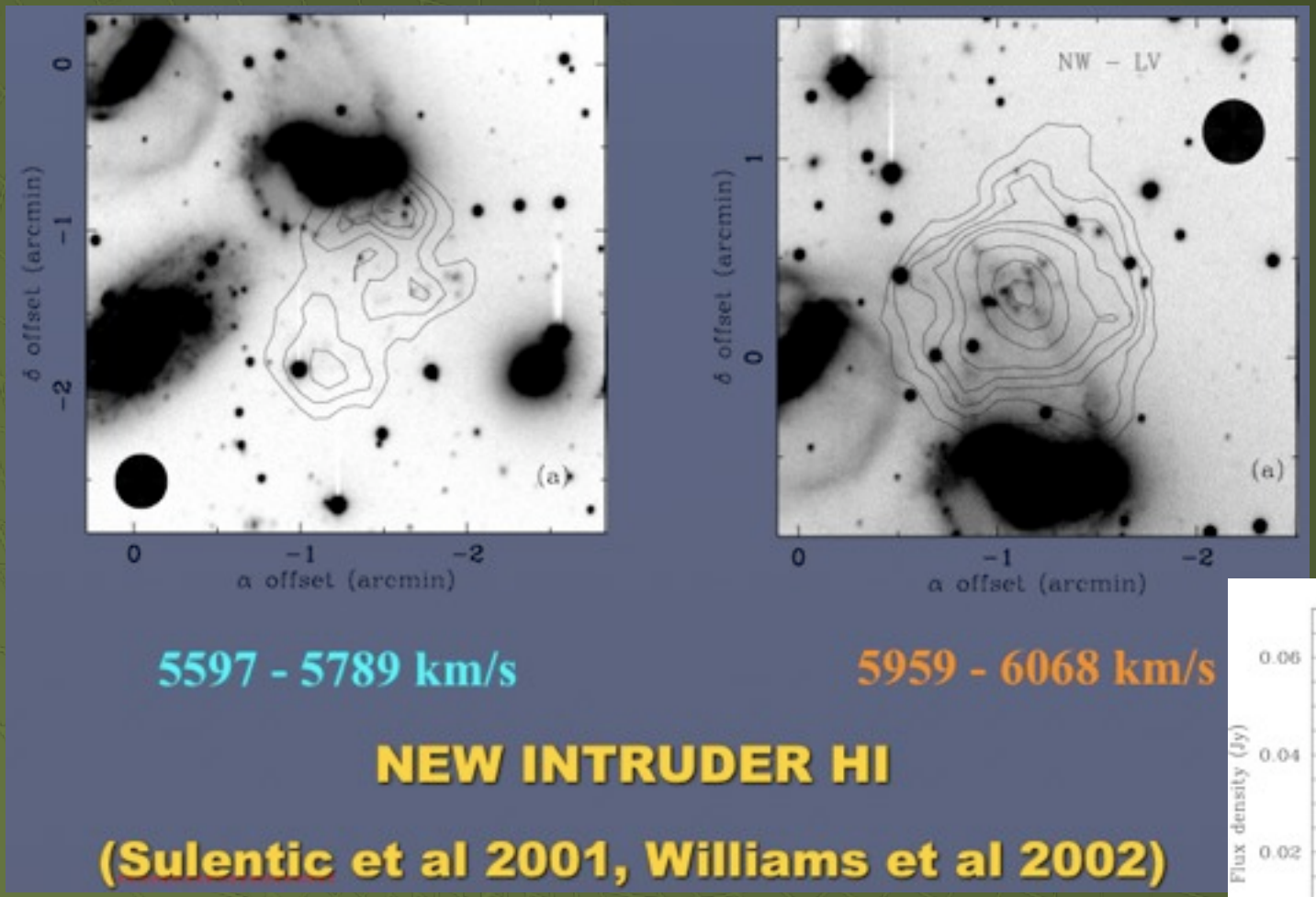

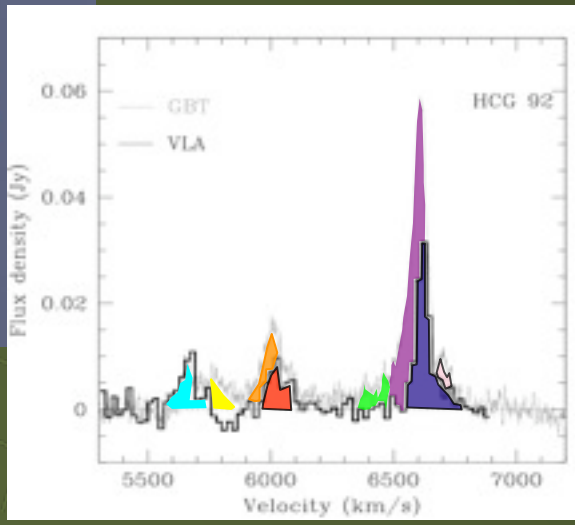

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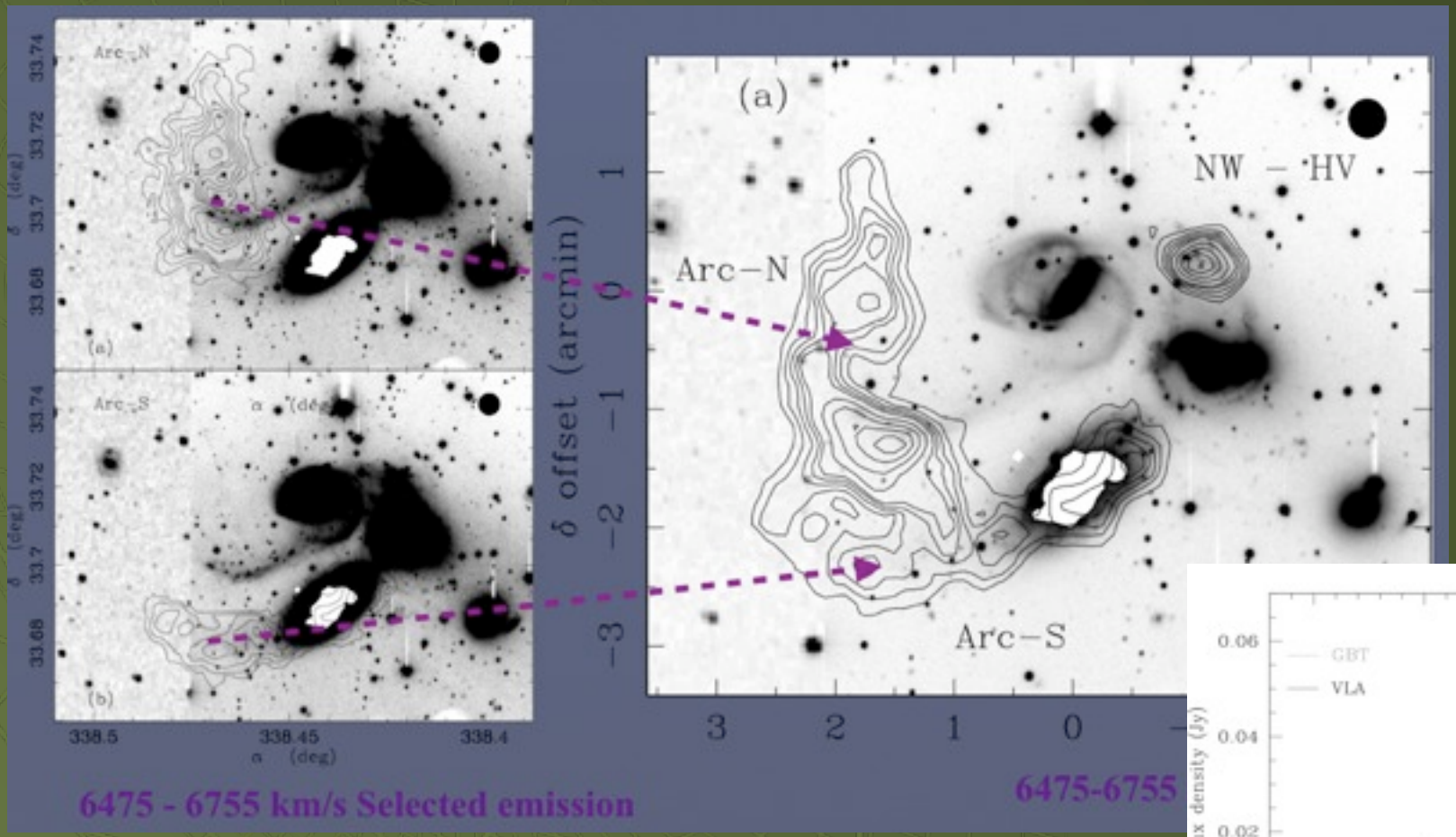

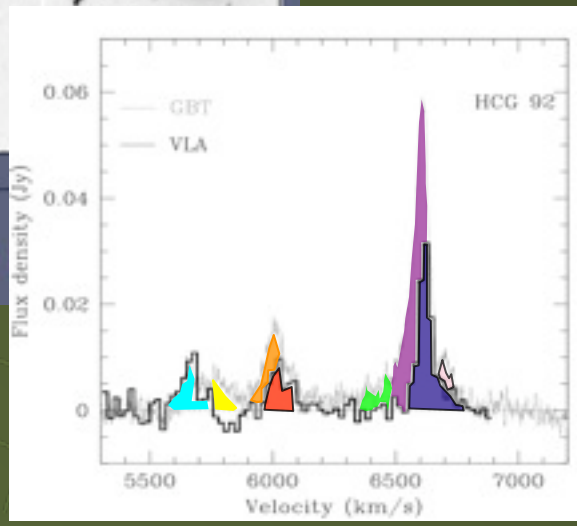

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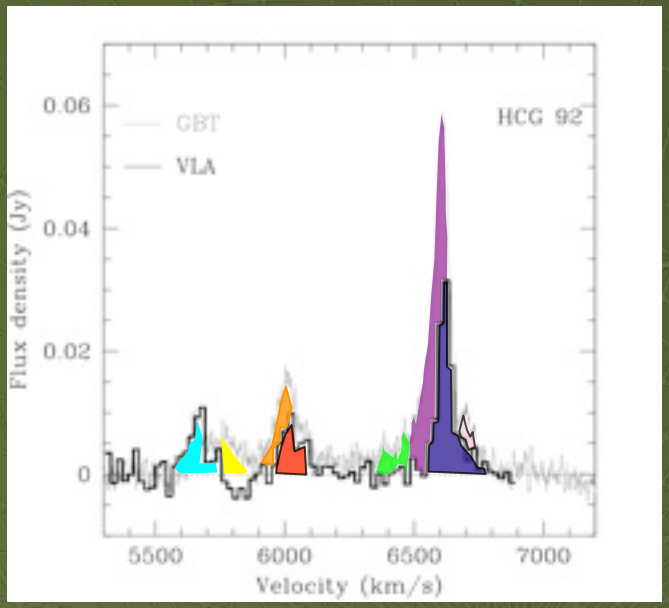

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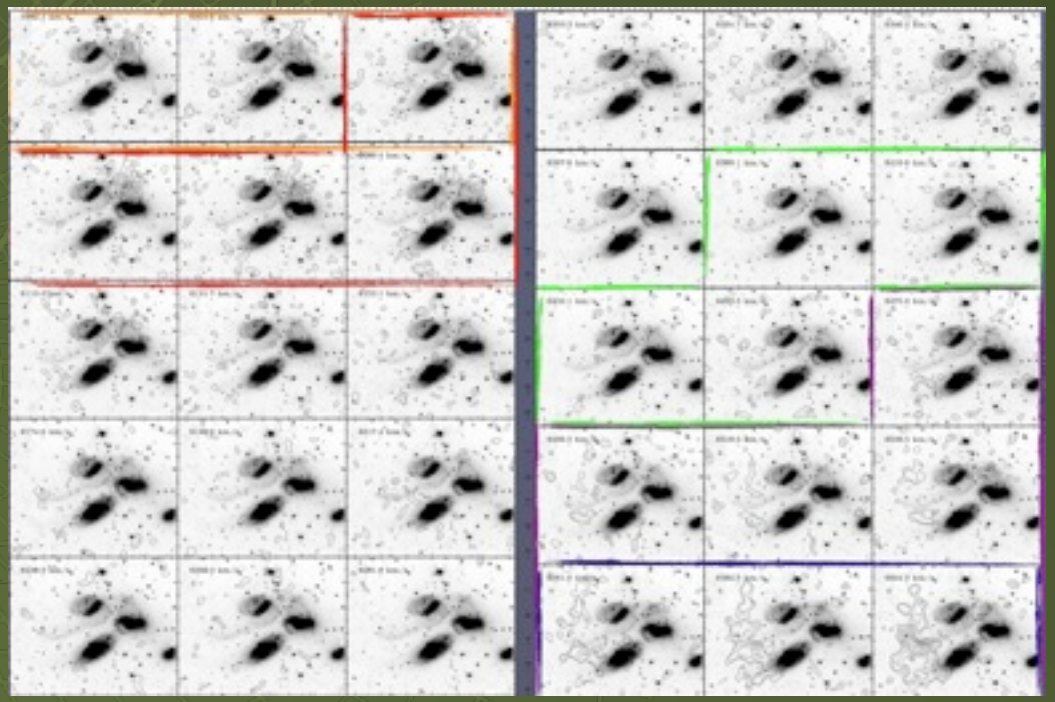

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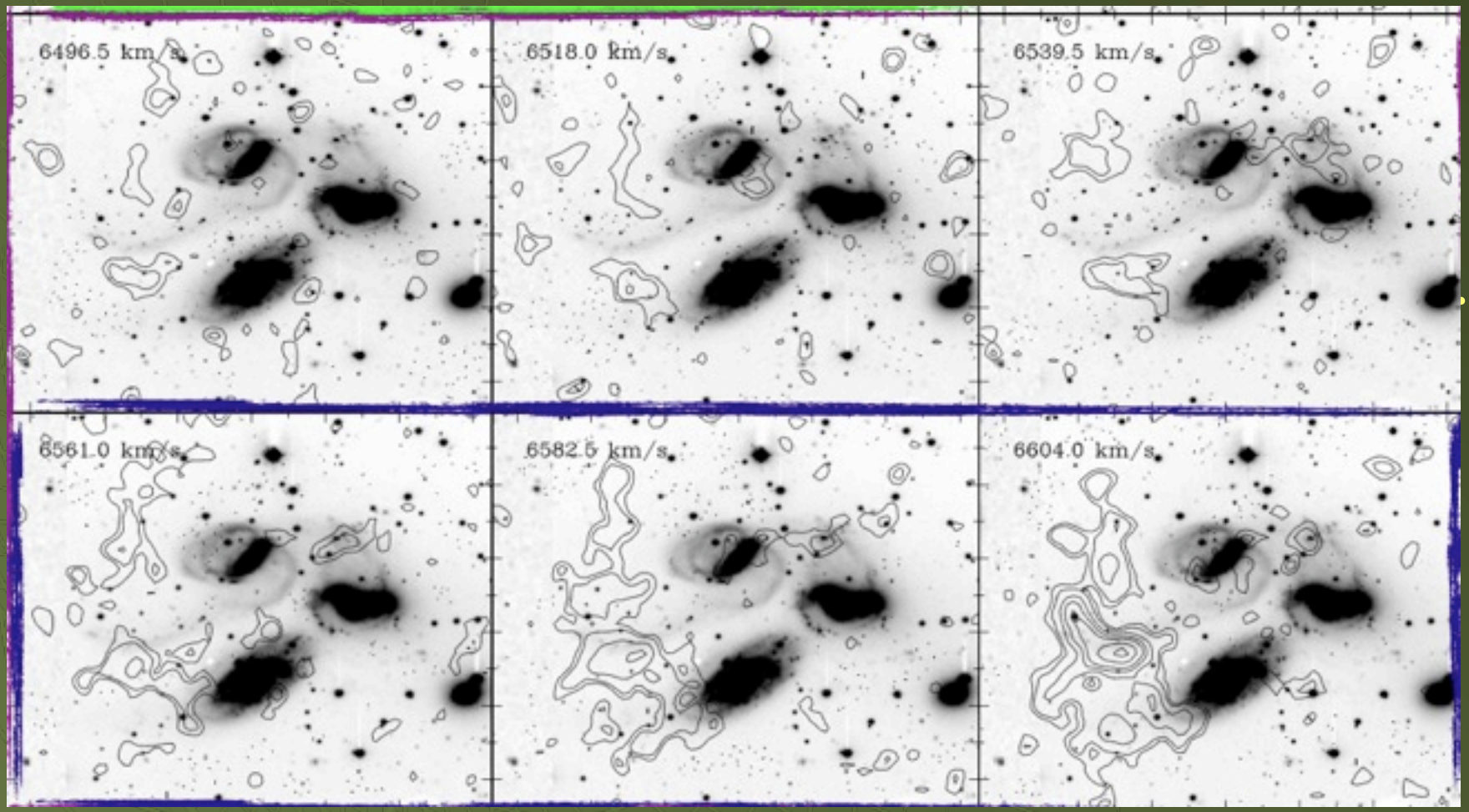

The diffuse neutral component seems associated to the presence of evolved tidal tails

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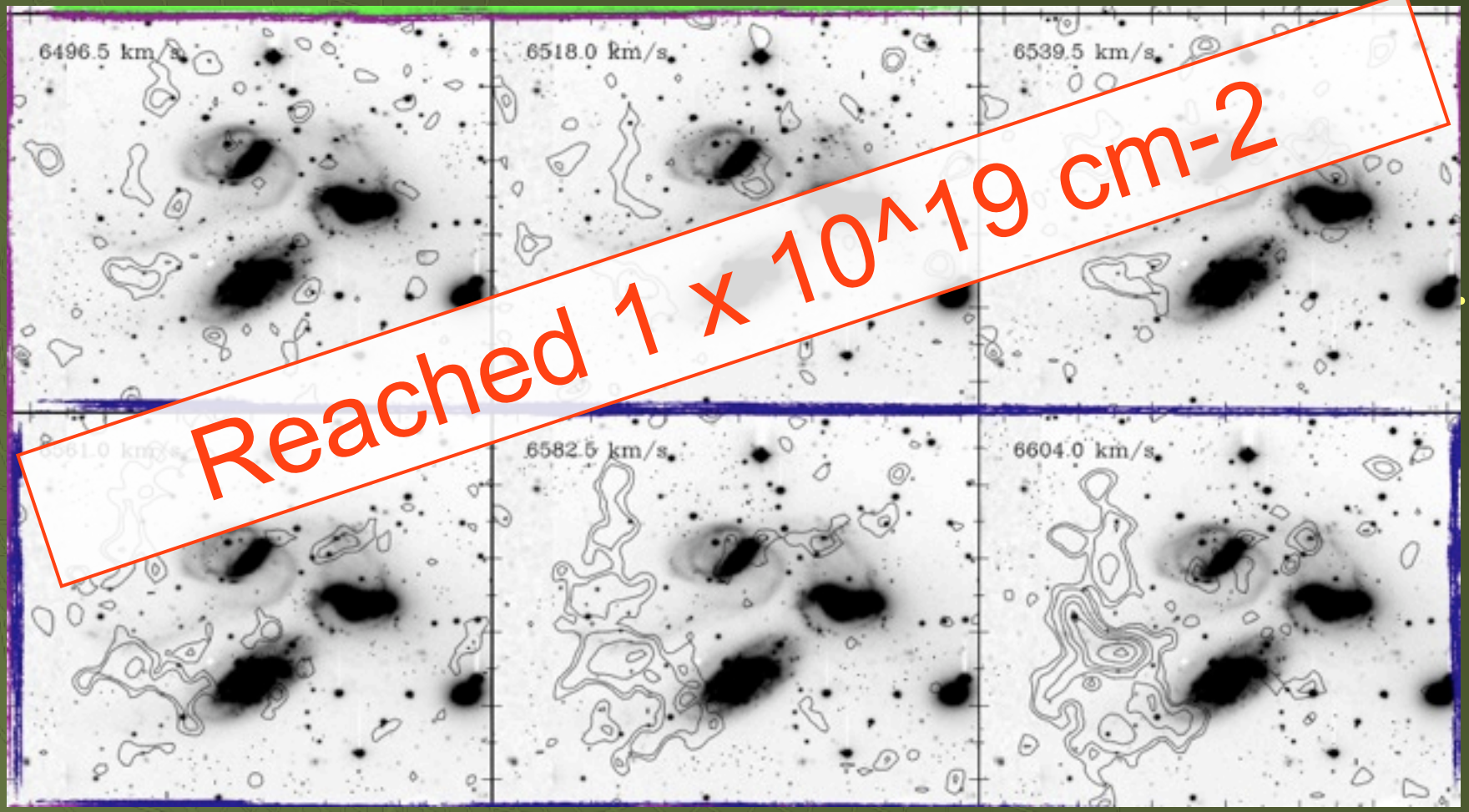

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EVLA, MeerKAT, Apertif, ASKAP

NEED TO BE SQUEEZED IN ORDER TO

APPROACH A FULL PICTURE OF THE ROLE OF ENVIRONMENT IN THE HI IN GALAXIES