Faint Features in the Outskirts of the Isolated Galaxy CIG96

P. Ramírez Moreta[1], L.Verdes-Montenegro[1], S.Leon[2], J.Blasco-Herrera[1], M.Fernández-Lorenzo[1], M.Yun[3], AMIGA Team[1]

1 Instituto de Astrofísica de Andalucía IAA-CSIC (Spain); **2** European Southern Observatory/Joint ALMA Observatory (Chile); **3** U.Massachusetts (Amherst, MA, USA)

AMIGA's isolated galaxies

AMIGA is developing a multi-wavelength study using the **C**atalogue of **I**solated **G**alaxies (CIG[1]). Extremely strict isolation criteria[2,3] define it as an **ideal laboratory** to study galaxy evolution.

Despite CIG galaxies show the **lowest asymmetry level in the HI integrated profile** when compared to other samples, some cases reach up to 50%[4].
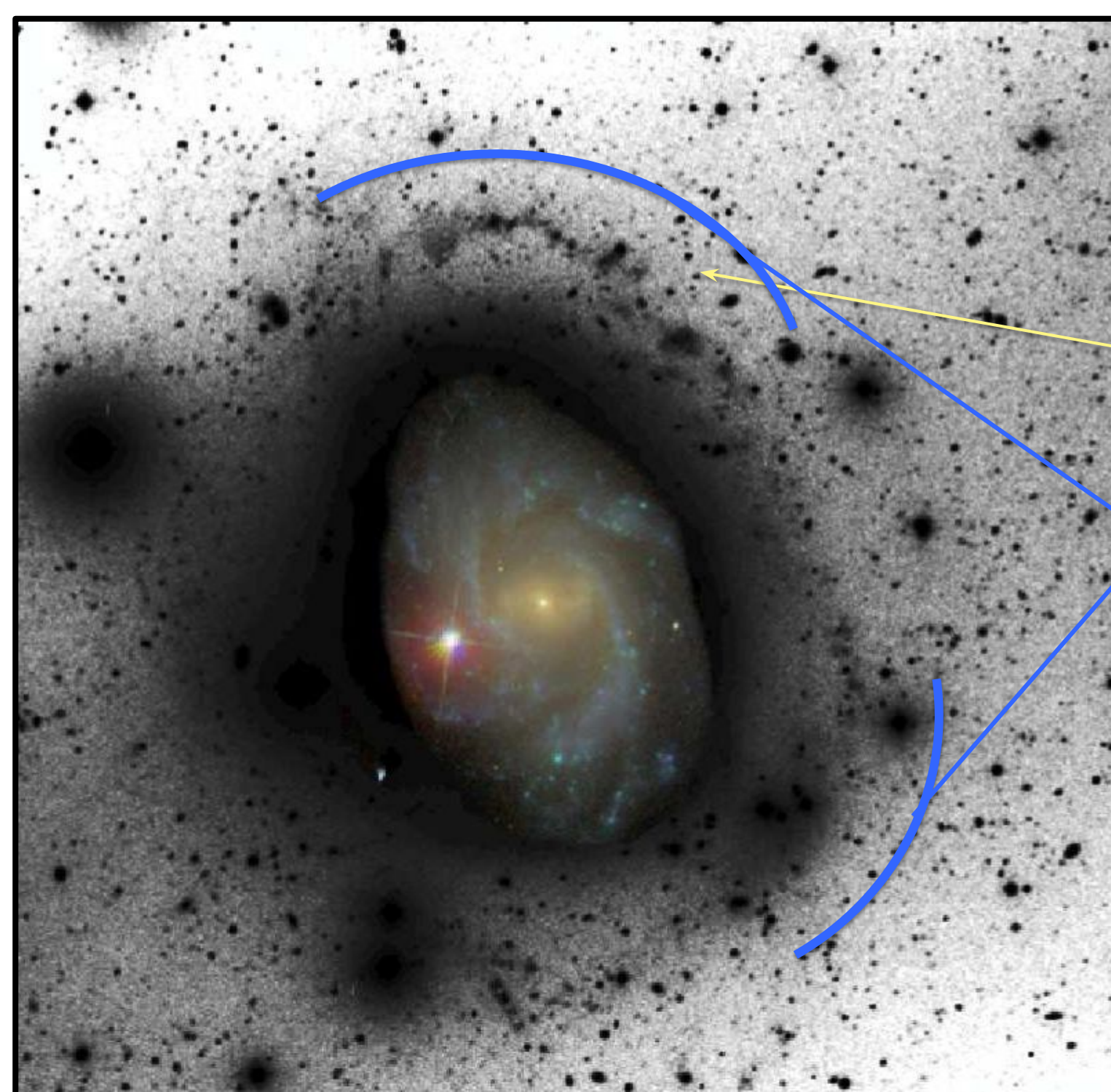
CIG96 has a 16% asymmetry level:

HI integrated flux of CIG96
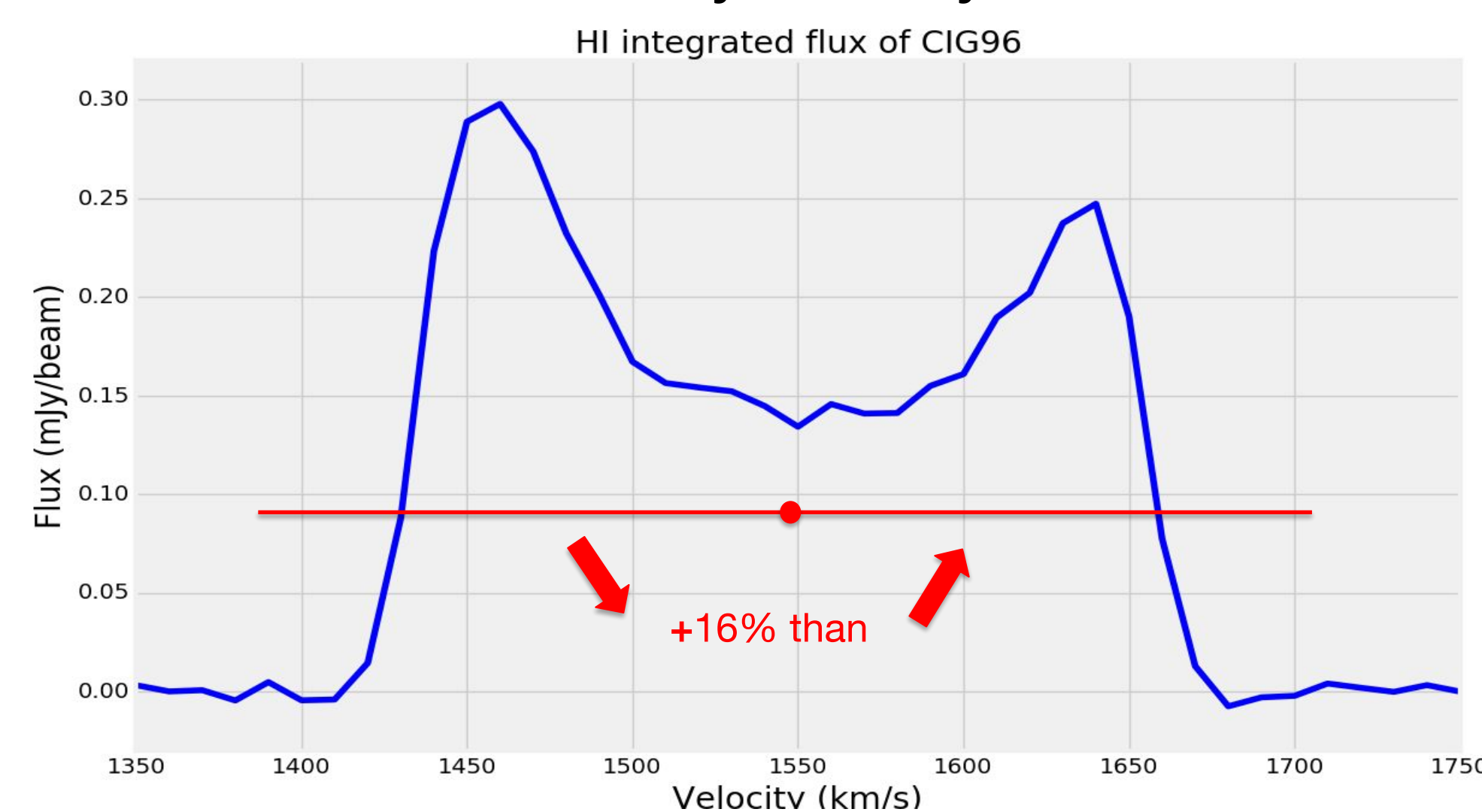
Free of major mergers for at least 3Gyr[5], the nature of these asymmetries is not known yet.

Minor mergers?
Internal processes?
Primordial gas accretion?…   **OPEN QUESTION!**

Asymmetries: external ring in the outskirts of CIG96

Deep optical data[8]
CAFOS (CAHA 2.2m): **ToS = 3.8h** (*R* filter)

CIG96 to scale

Deep optical (*b&w*) over SDSS (*color*)

XUV ring with SF regions.[6]

Faint ring-shaped outer structure.

$$\mu_R = 26.9 \text{ mag/arcsec}^2$$

External (>> R_{25}) faint halo substructures may live several Gyr[7] → relics of old events may define the current galaxy morphology.

Outskirts of CIG96: faint HI column density

Deep HI interferometric data[8]
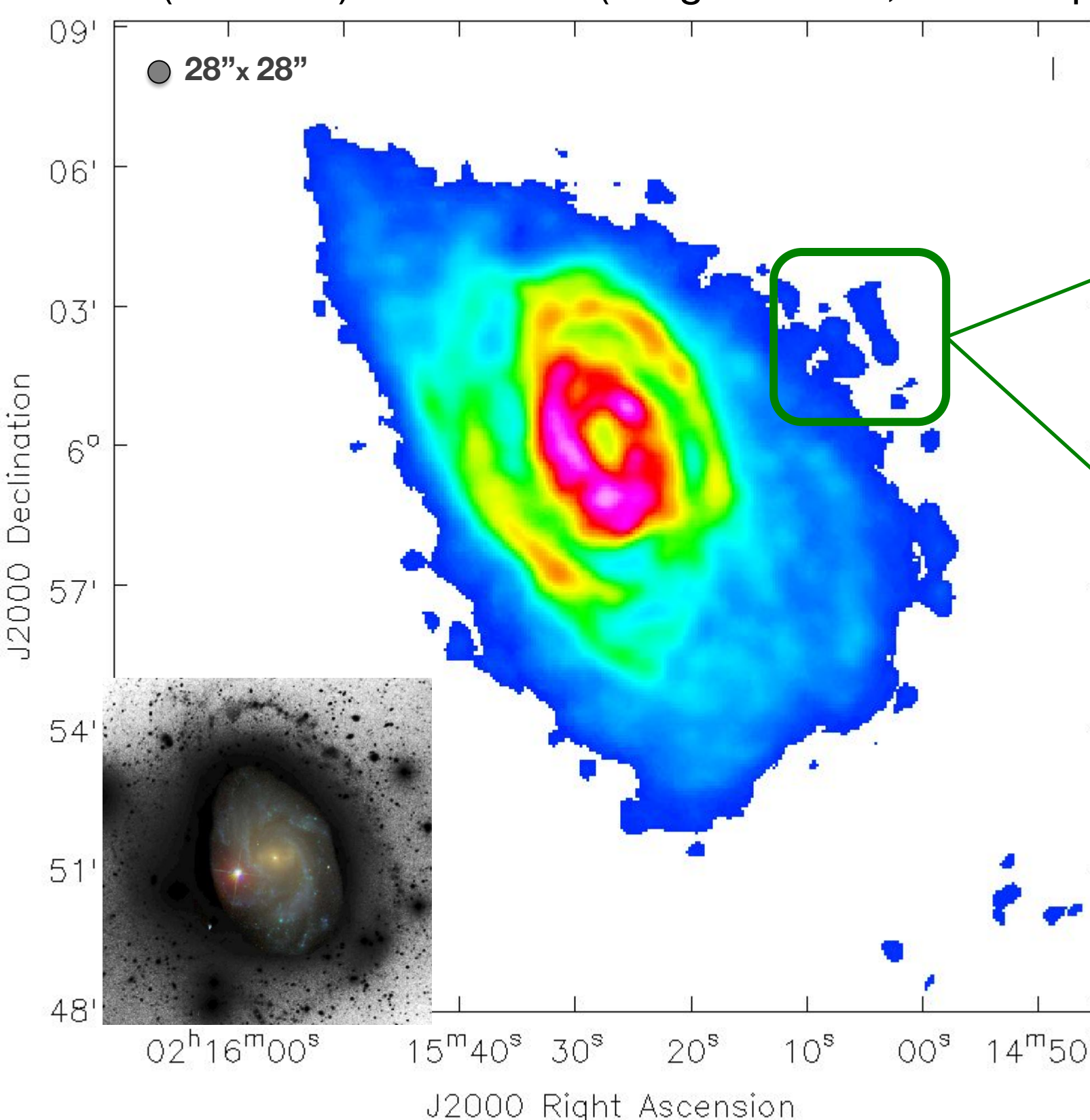HI datacube (EVLA & VLA, C&D conf.): **ToS =19h** (L band) $N_{HI}^{5\sigma} = 1.8 \times 10^{19}$ cm-2

WF = Wavelet Filtering (Ricker/sombrero function)

5σ detection limits and 3.5σ 0th moment:

HI mass	HI column density
$M_{HI}^{WF} = 1.2 \times 10^6$ M$_\bullet$	$N_{HI}^{WF} = 8.9 \times 10^{18}$ cm^{-2}

CIG96 (NGC864) 0th moment (integrated flux, 3.5σ + optical to scale)

CIG96 channels map[WF]
(3.5σ, 4σ, 5σ contours)
σ = 0.13 mJy/beam

Green area: HI structures spread over 7 channels (10 km/s/channel), suggesting an oblique trajectory[9] for the interaction.

Position–velocity profile (minor axis):

5σ detections
ΔVel ~ 70 km/s
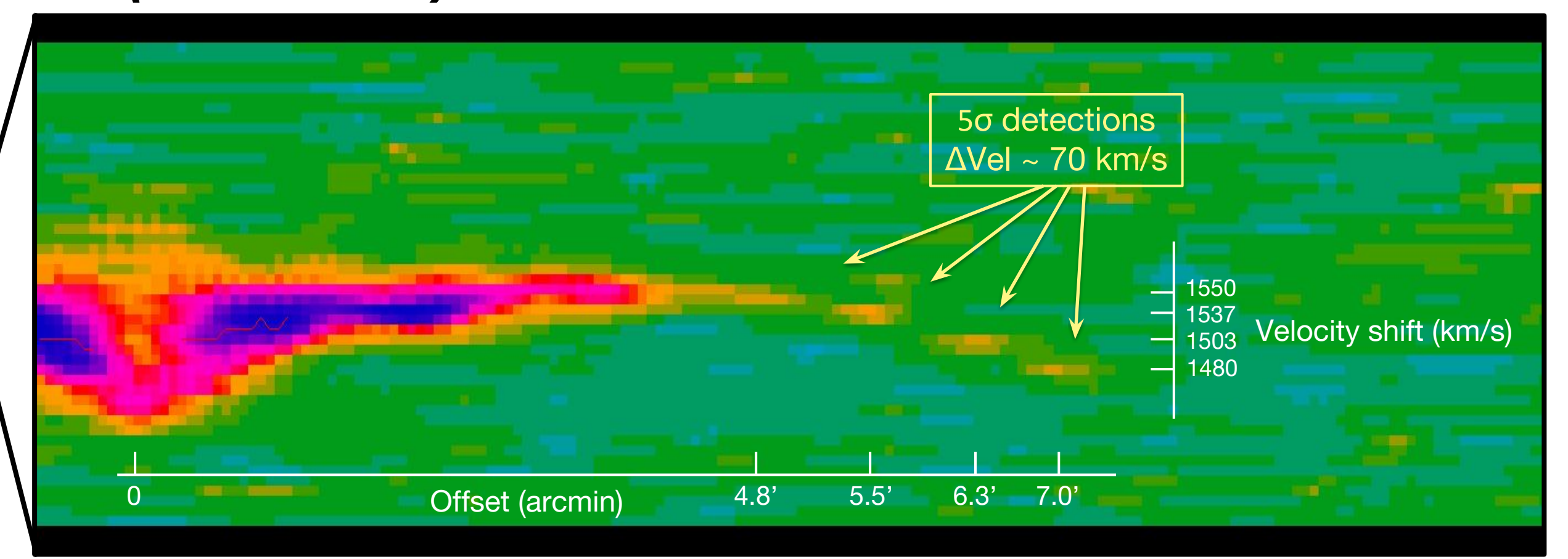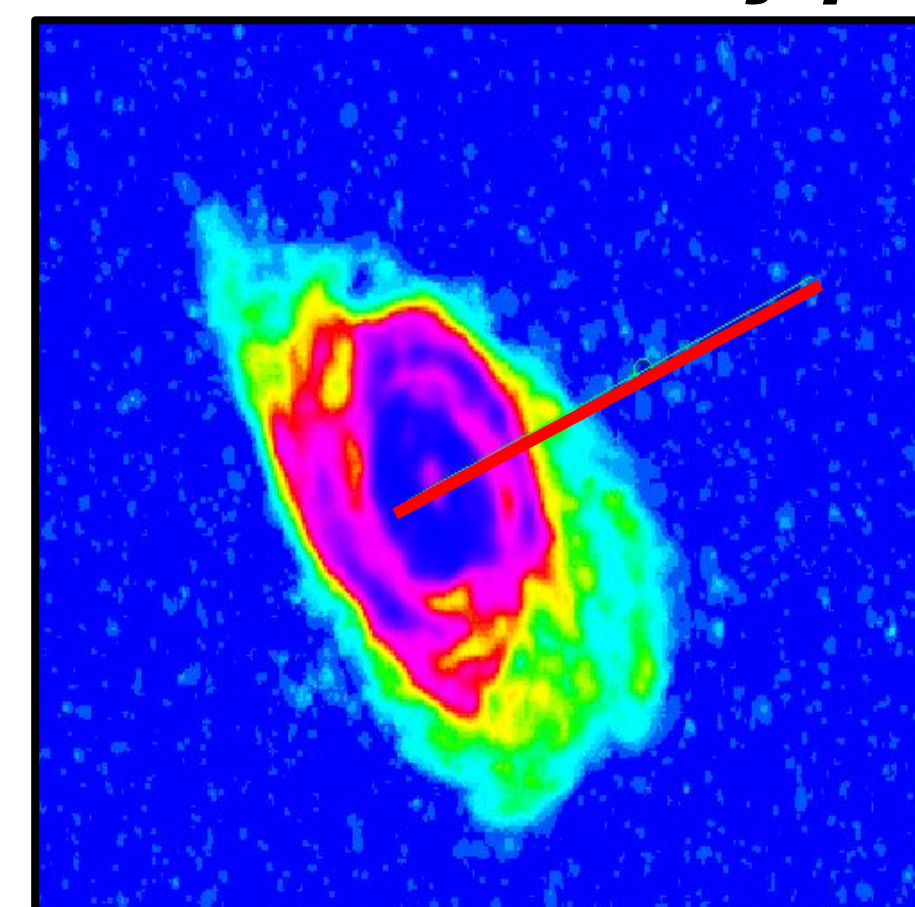
Ongoing work (Ramírez-Moreta et al. *in prep.*)

The faint optical surface brightness and HI column here presented have unveiled a number of faint structures in the outskirts of CIG96 as well as in other isolated galaxies. Neither the optical nor the interferometric data have shown any clear signs of companions that would explain such asymmetries.

Comparisons with galaxy evolutionary models with different kinds of interactions may help to figure out whether possible minor mergers might have been the source of such features. Other phenomena such as galactic fountain or cosmic gas accretion cannot be ruled out either. A classification scheme defining features' morphology and nature will be proposed in future works and Ph.D. thesis.

References

1 Karachentseva 1973
2 Verley et al. 2007
3 Argudo-Fernández et al. 2013
4 Espada et al. 2011b
5 Verdes-Montenegro et al. 2005
6 Espada et al. 2011[a]
7 Peñarrubia et al. 2005
8 Ramírez-Moreta et al. (in prep.)
9 Espada et al. 2005

Author & Research Group

☺ **Pablo Ramírez Moreta**
📍 Ph.D. student at IAA (Spain)
@ prm@iaa.es

AMIGA — Analysis of the Interstellar Medium of Isolated GALaxies