Extragalactic HI Science: ongoing activities towards the SKA

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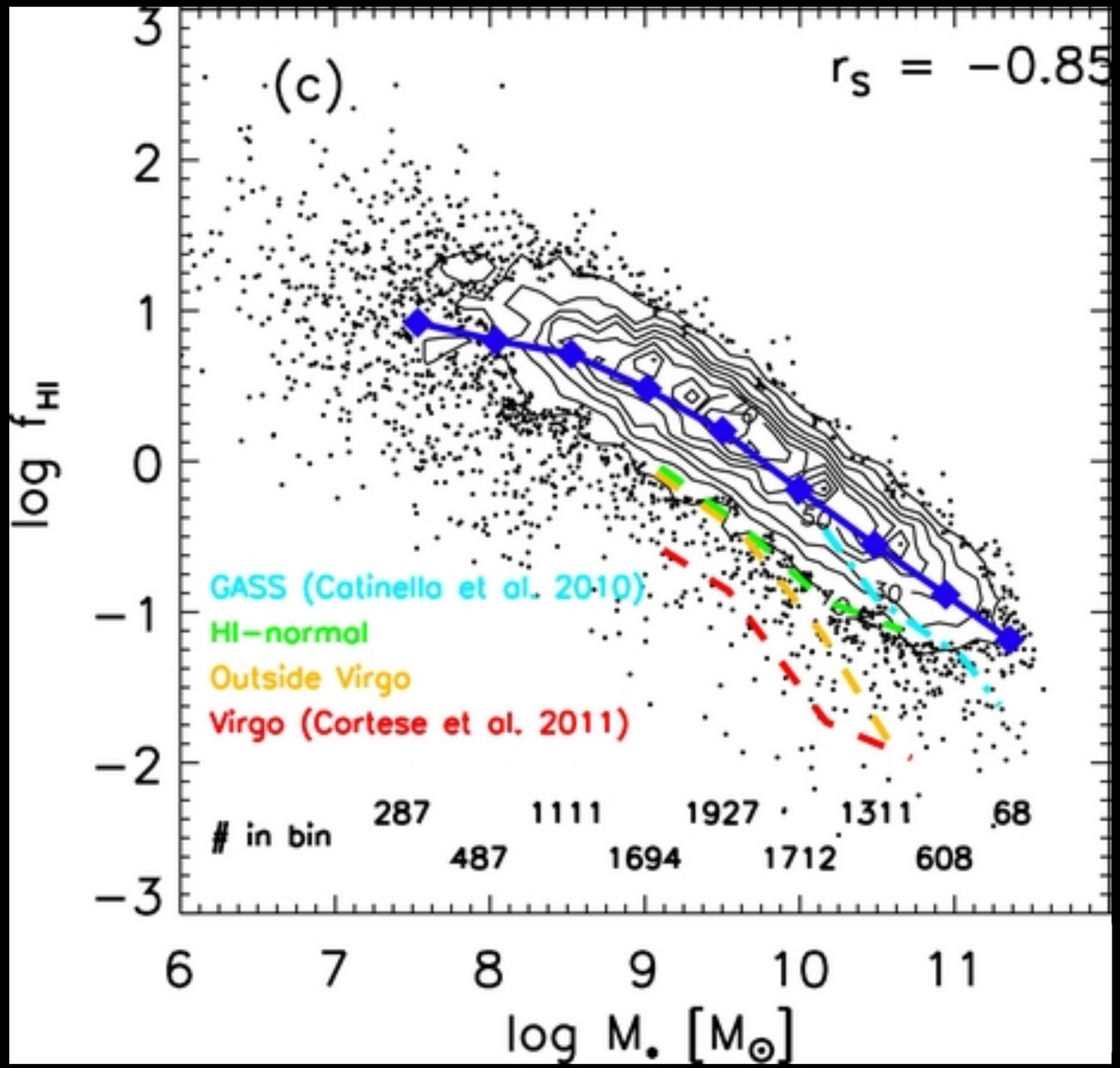
Where from?

Wide area single-dish surveys

	HIPASS	*ALFALFA*
area	3π	2/3 π
resolution	15 arcmin, 18 km/s	4 arcmin, 10 km/s
noise (20 km/s)	13 mJy/beam	1.5 mJy/beam
nr detections	5,000	30,000
redshift range	0 - 0.04	0 - 0.06
	Barnes et al. (2001)	Haynes et al. (2018)

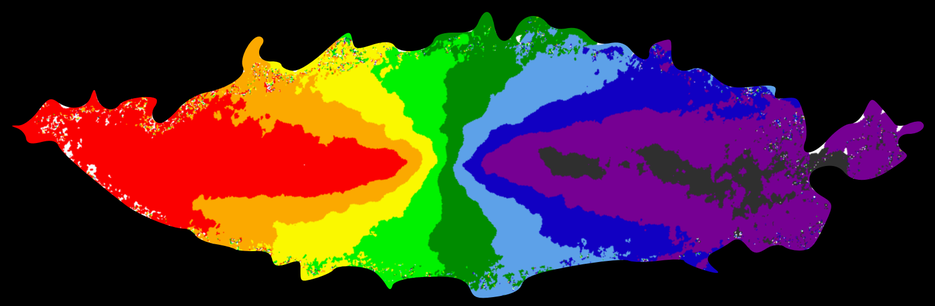
Global scaling relations



Hunag et al. (2012)

Pointed interferometric observations

~ 1000 resolved galaxies
detailed morphology
kinematics, rotation curves
$z \sim 0$



Kenney et al. (2004)

…, Broeils & Rhee (1997), UMa (Verheijen & Sancisi 2001), WHISP (Swaters et al. 2002, Noordermeer et al. 2005), THINGS (Walter et al. 2008), FIGGS (Begum et al. 2008), Cvn (Kovac et al. 2009), VIVA (Chung et al. 2009), HALOGAS (Heald et al. 2011), LITTLE THINGS (Hunter et al. 2012), Voids Survey (Kreckel et al. 2012), Atlas3D (Serra et al. 2012), Bluedisk (Wang et al. 2013), DiscMass (Martinsson et al. 2016), LVHIS (Koribalski et al. 2018), …

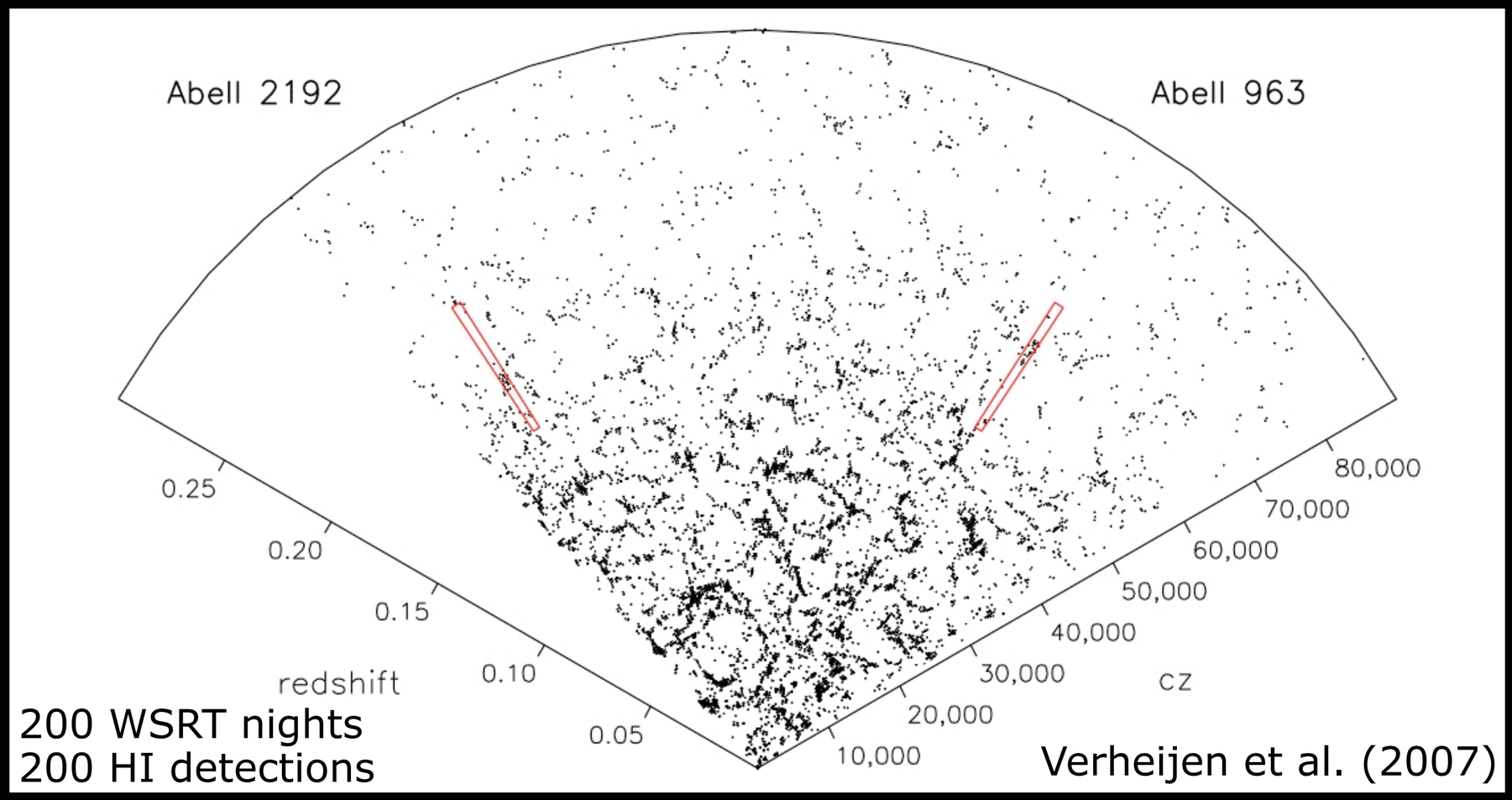
Where from?

~10^4 unresolved galaxies at z < 0.05

~10^3 resolved galaxies at z ~ 0

Where from?

~10⁴ unresolved galaxies at z < 0.05
~10³ resolved galaxies at z ~ 0



200 WSRT nights
200 HI detections

Verheijen et al. (2007)

Where from?

~10^4 unresolved galaxies at z < 0.05

~10^3 resolved galaxies at z ~ 0

Where to?

~10^6 unresolved galaxies at z < 1.5

~10^4 resolved galaxies at z < 0.1

HI surveys wedding cake

wider area

more sensitive, higher z

LADUMA (MeerKAT)

CHILES (VLA)

MHONGOOSE (MeerKAT)

FORNAX (MeerKAT)

MIGHTEE-HI (MeerKAT)

DINGO (ASKAP)

APERTIF - M

MALS (MeerKAT)

WALLABY (ASKAP)

APERTIF - S

WALLABY

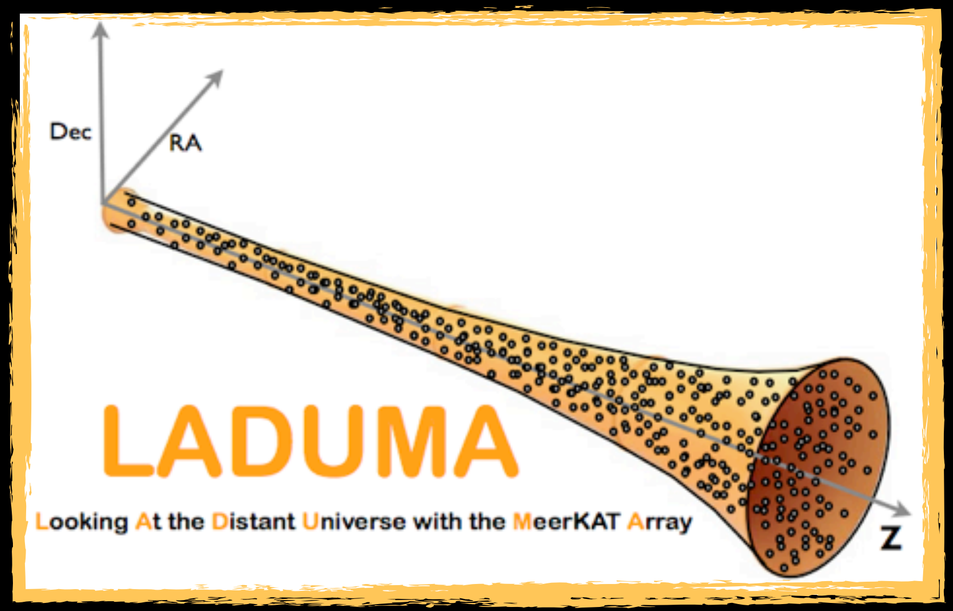
P.I.’s Koribalski & Staveley-Smith

ASKAP

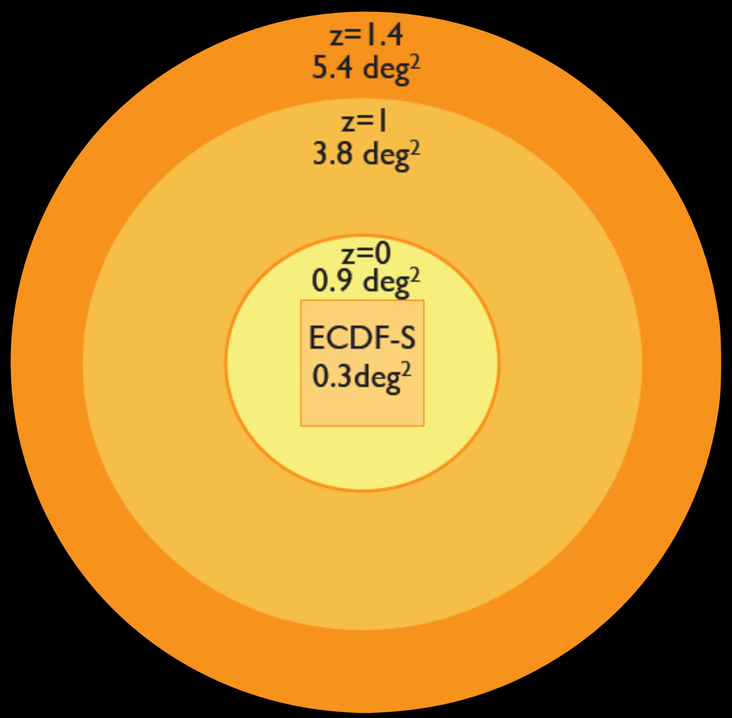
other wide-area surveys at
low *z* with APERTIF

	WALLABY	*ALFALFA*
area	3π	2/3 π
resolution	0.5 arcmin, 4 km/s	4 arcmin, 10 km/s
noise (20 km/s)	0.7 mJy/beam	1.5 mJy/beam
nr detections	500,000	30,000
redshift range	0 - 0.26	0 - 0.06

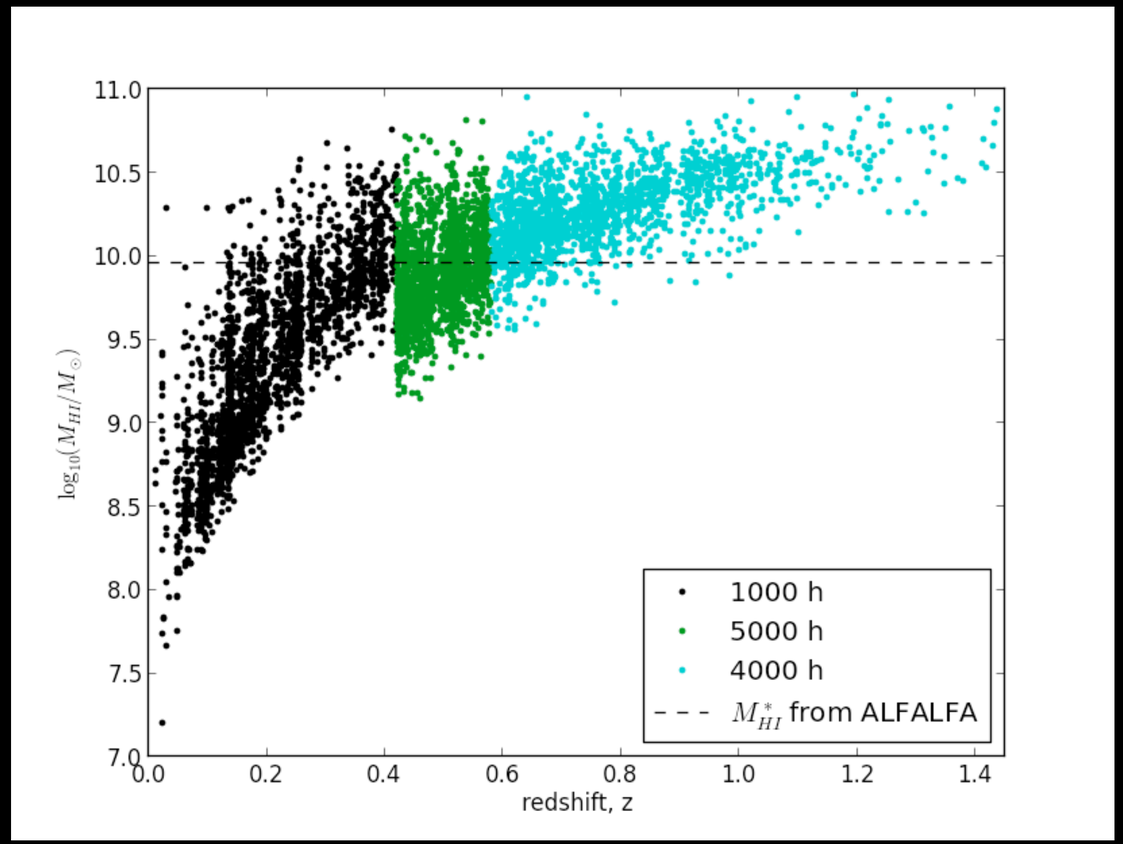
see Dane Klenier’s talk



P.I.’s Baker, Blyth, Holwerda
MeerKAT
L-band & UHF



from S. Blyth’s talk at PHISCC 2014



MeerKAT Fornax Survey

P.I. Serra

Area~2×1 Mpc^2

N(HI)~10^{19} cm^{-2} @ 1 kpc

N(HI)~10^{18} cm^{-2} @ 10 kpc

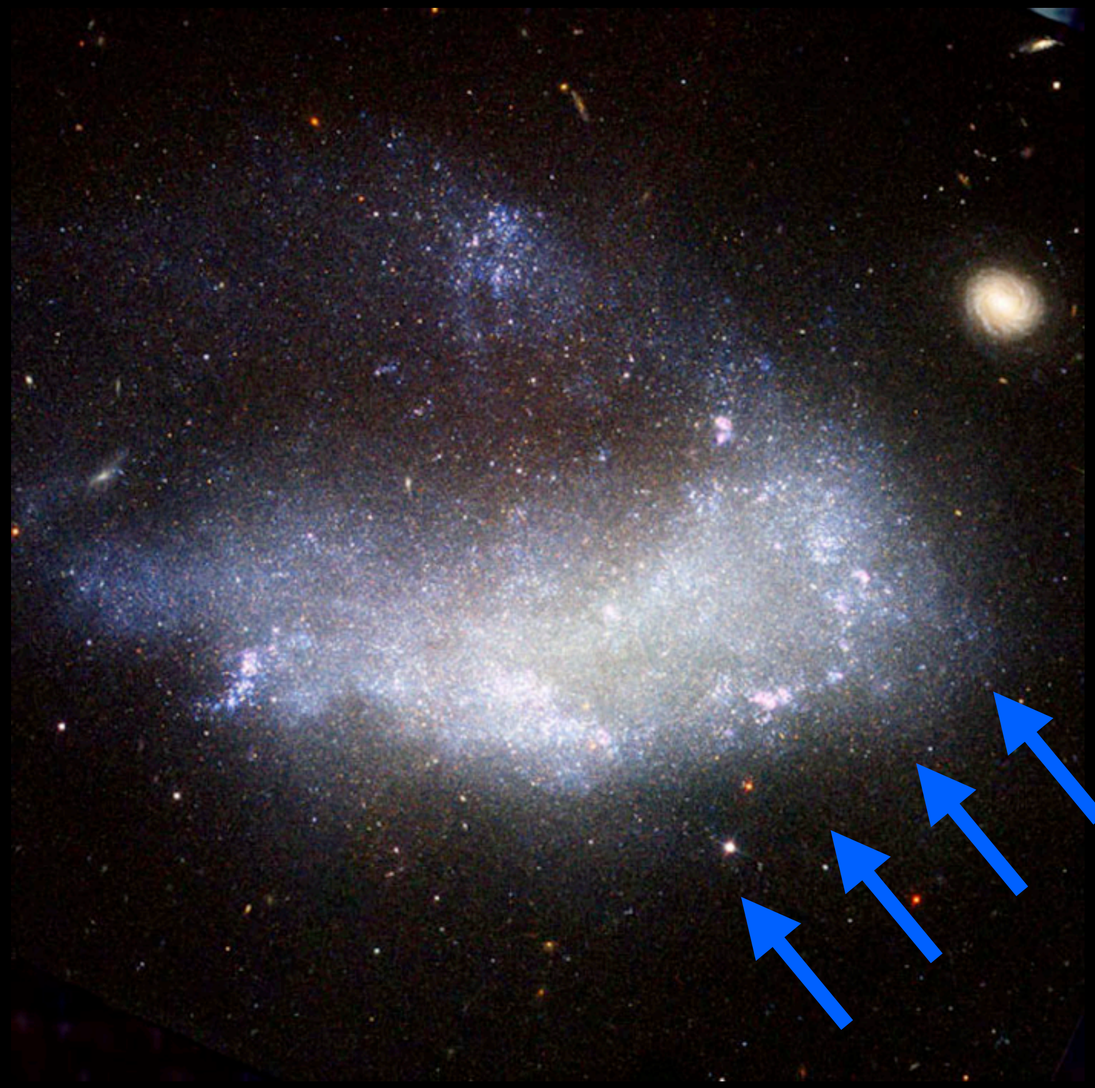
M(HI)~$5×10^5$ $M_\odot$

E. de Blok (ASTRON, Kapteyn, UCT)
G. Bryan (Columbia)
R.-J. Dettmar (Bochum)
B. Frank (SARAO)
F. Govoni (INAF - Cagliari)
G. Józsa (SARAO, Rhodes)
D. Kleiner (INAF - Cagliari)
R. Kraan-Korteweg (UCT)
A. Loni (INAF - Cagliari, UniCa)
F. Maccagni (INAF - Cagliari)
D. Molnar (INAF - Cagliari)
M. Murgia (INAF - Cagliari)
T. Oosterloo (ASTRON, Kapteyn)
R. Peletier (Kapteyn)
R. Pizzo (ASTRON)
M. Ramatsoku (INAF - Cagliari)
M. Smith (Cardiff)
S. Trager (Kapteyn)
J. van Gorkom (Columbia)
M. Verheijen (Kapteyn)

Image credit: ESO. Acknowledgement: Aniello Grado and Luca Limatola.

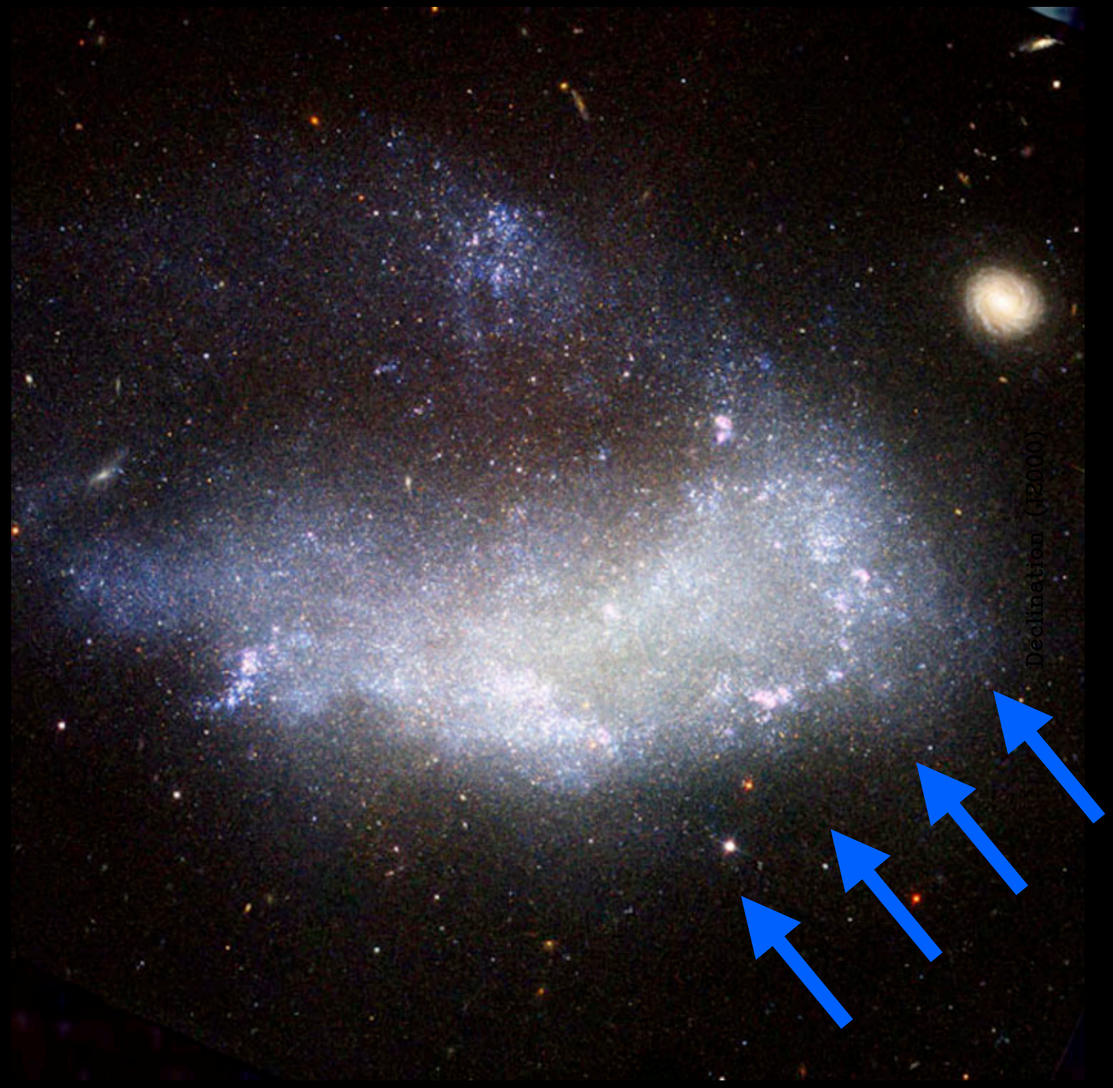
see Filippo Maccagni's talk

NGC 1427A (ATCA)



Hilker+ 97,05; Chaname+ 00;
Gregg+ 03; Mora+ 15

NGC 1427A (ATCA)



Hilker+ 97,05; Chaname+ 00;
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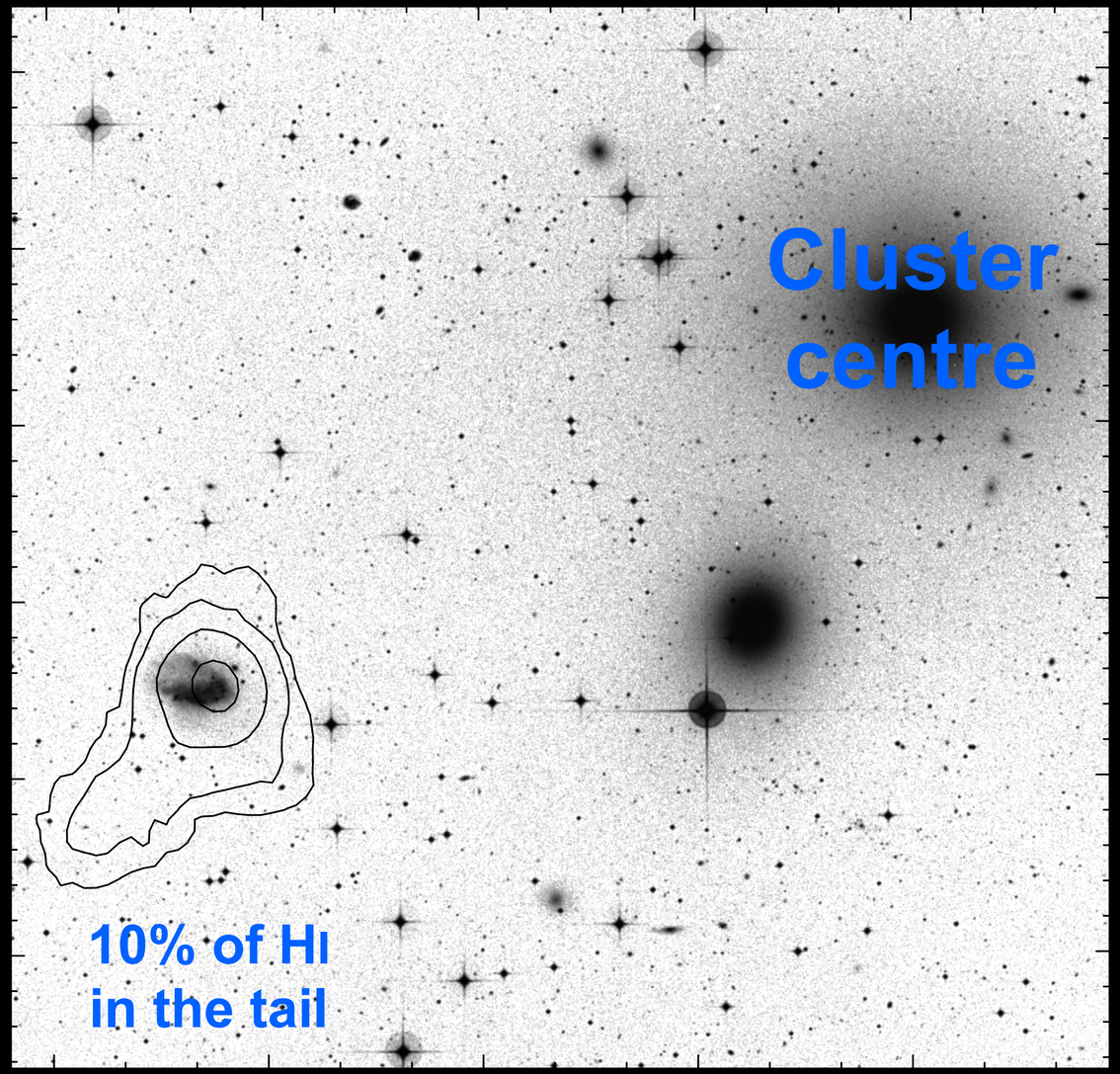
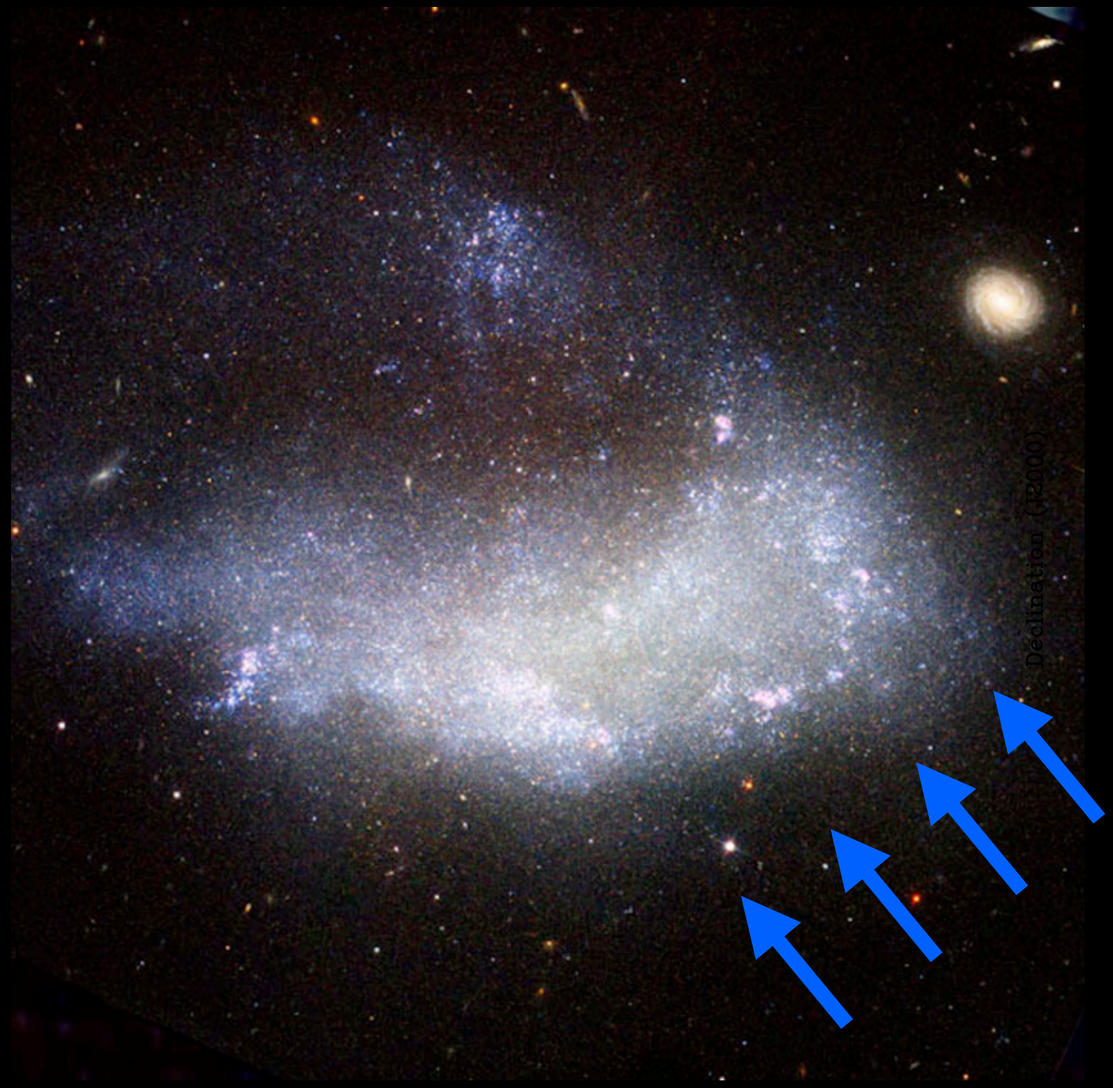


Lee-Waddell et al. (2018)

NGC 1427A (ATCA)



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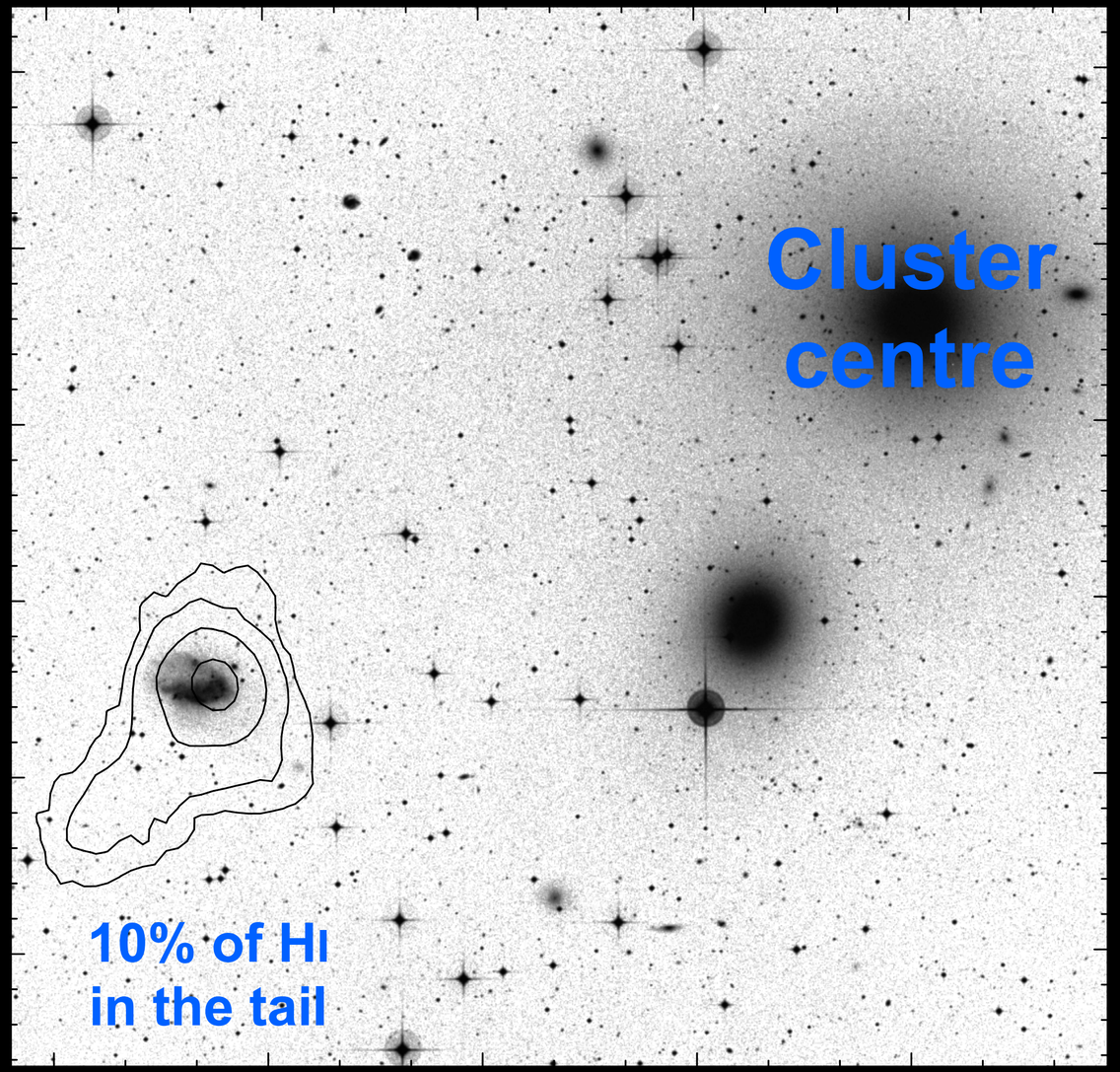


Lee-Waddell et al. (2018)

Also using deep FDS VST images by Peletier (Kapteyn) and Iodice (Capodimonte)

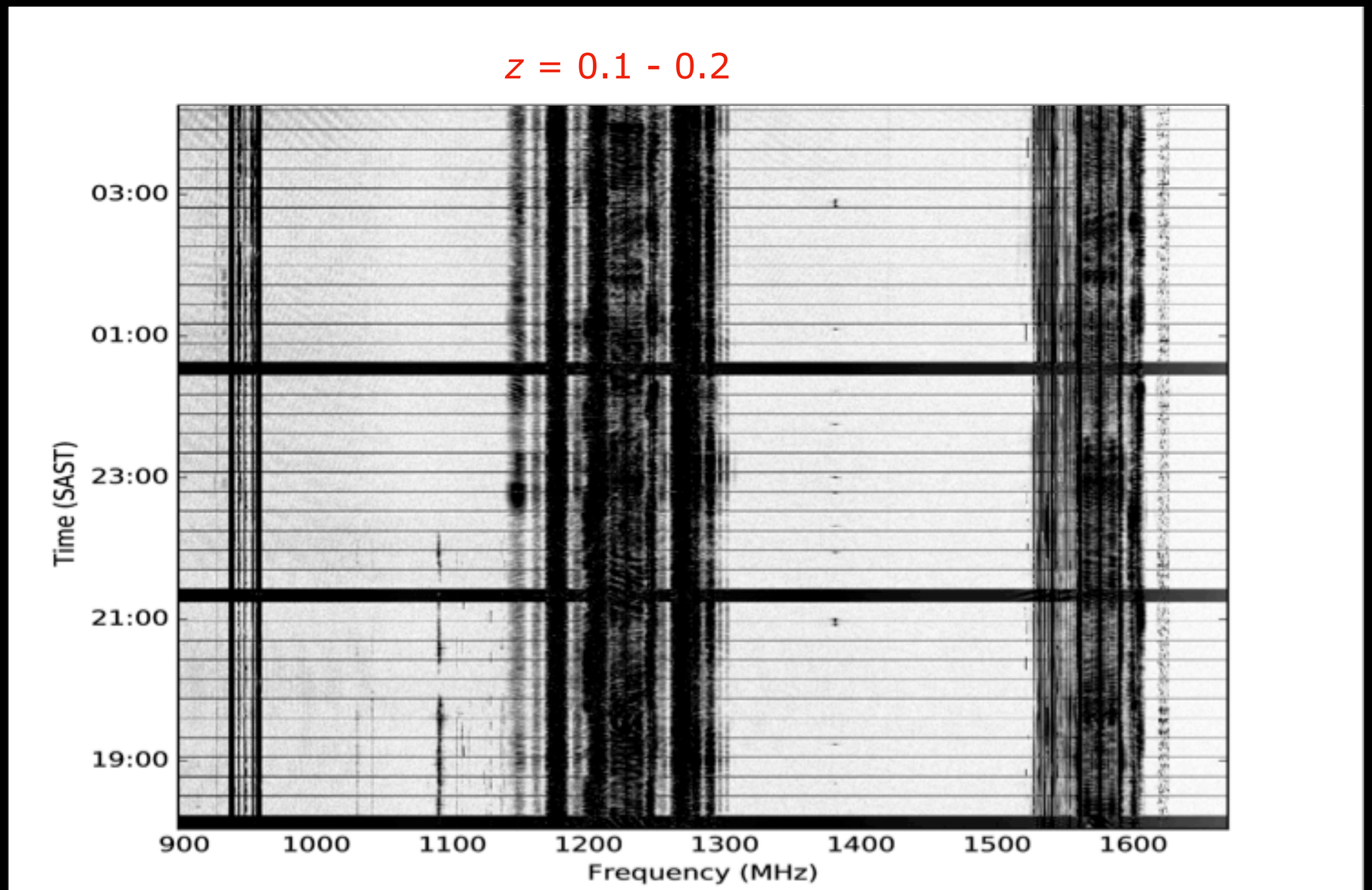
Won’t be easy

Huge data volumes

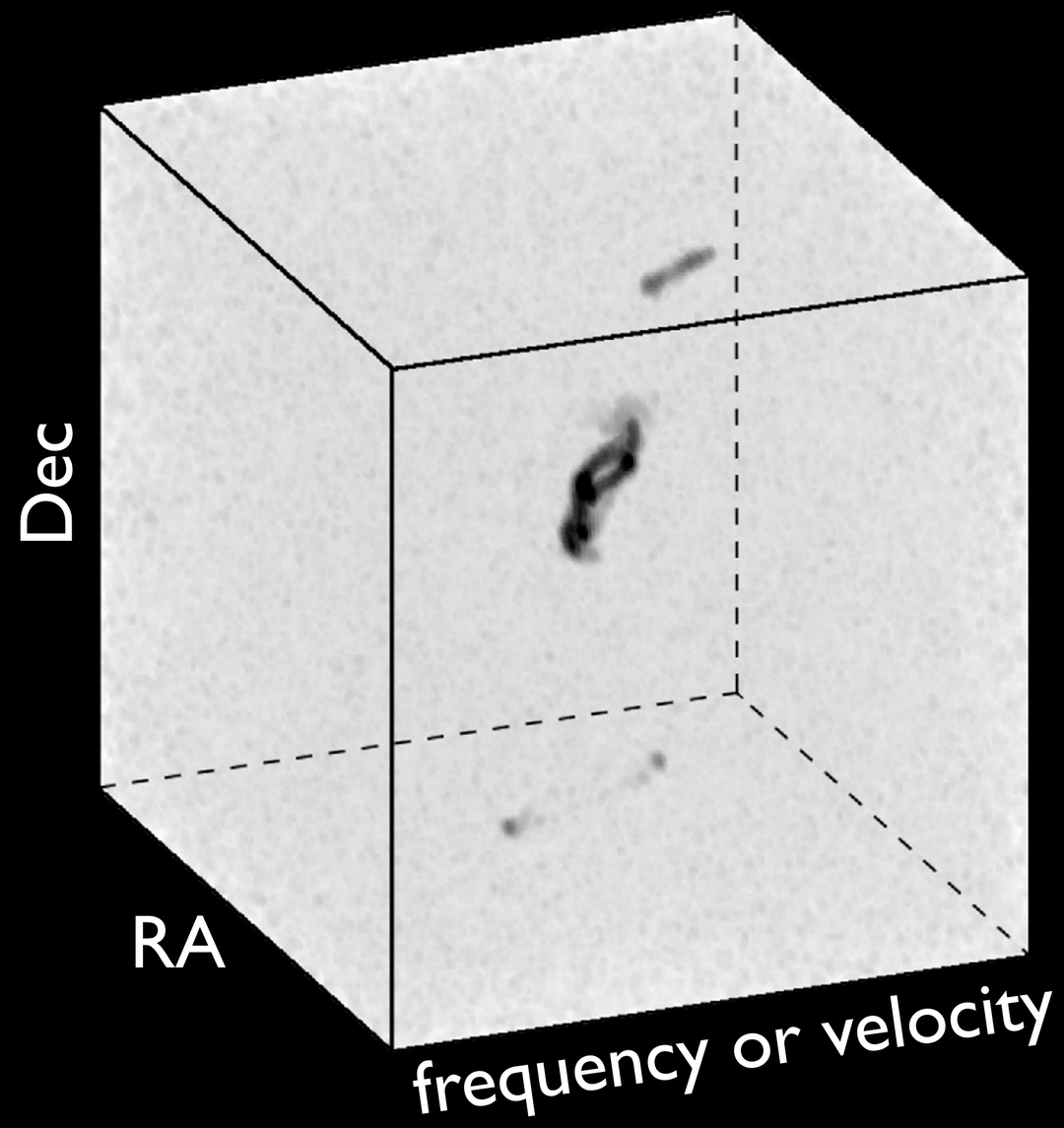
ASKAP won’t store full-resolution visibilities

MeerKAT will but for just ~1 year

Radio Frequency Interference



Source finding



$\times 10^7$!!!

Image credit: N. Giese

Coordinated effort of the extragalactic HI community

PHISCC* meetings

2009 Bunkerbay - *Australia*
2010 Arniston - *South Africa*
2011 Perth - *Australia*
2011 Kloster Seeon - *Germany*
2012 Cape Town - *South Africa*
2013 Sydney - *Australia*
2014 ASTRON - *the Netherlands*
2015 Rutgers University - *U.S.*
2016 Cape Town - *South Africa*
2017 Pune - *India*
2018 Pingtang - *China*
2019 Perth - *Australia*

(*) Pathfinders HI Science Coordination Committee

Sessions at next PHISCC

- Reference Fields (Adams)
- Database & products for public release (Staveley-Smith)
- RFI flagging and mitigation (Moss)
- Data quality assessment (Adams)
- New lessons in high/deep dynamic range imaging (Smirnov)
- Visualisation (Taylor)
- Source finding (Westmeier)
- Source parameterisation (Oh)
- SKA HI-SWG (Verdes-Montenegro)

SoFiA

Source Finding Application

Tobias Westmeier, Lars Flöer, Nadine Giese, Russell Jurek, Bärbel Koribalski, Martin Meyer, Attila Popping, Paolo Serra, Lister Staveley-Smith, Thijs van der Hulst, Benjiamin Winkel

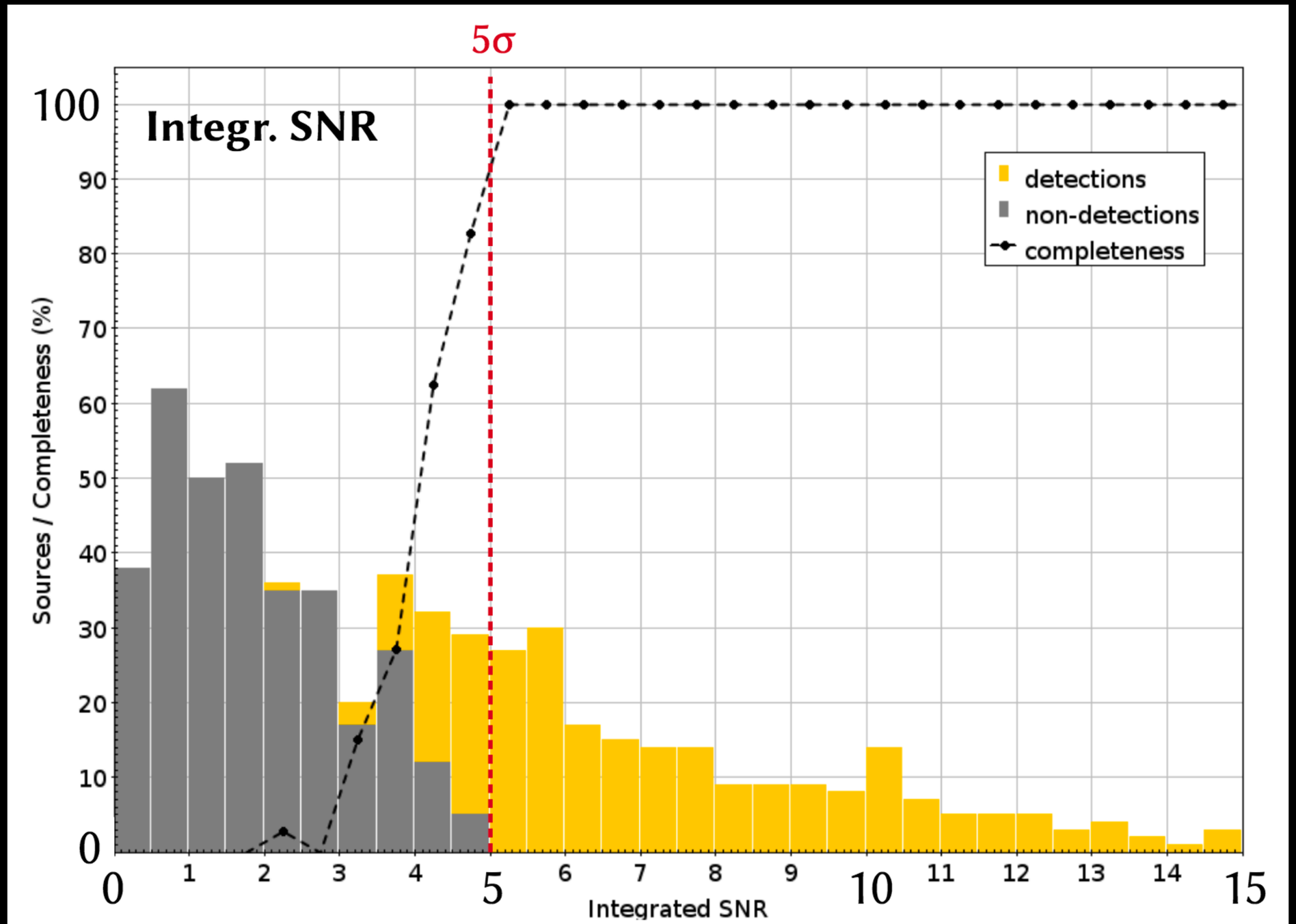
References

https://github.com/SoFiA-Admin/SoFiA

Serra et al. 2015, MNRAS, 448, 1922

Other papers on source finding and parameterisation resulting from WALLABY/PHISCC coordination: Floer & Winkel (2012), Jurek (2012), Popping et al. (2012), Serra, Jurek & Floer (2012), Westmeier, Popping & Serra (2012), Westmeier et al. (2014), Kamphuis et al. (2015), Oh et al. (2018)

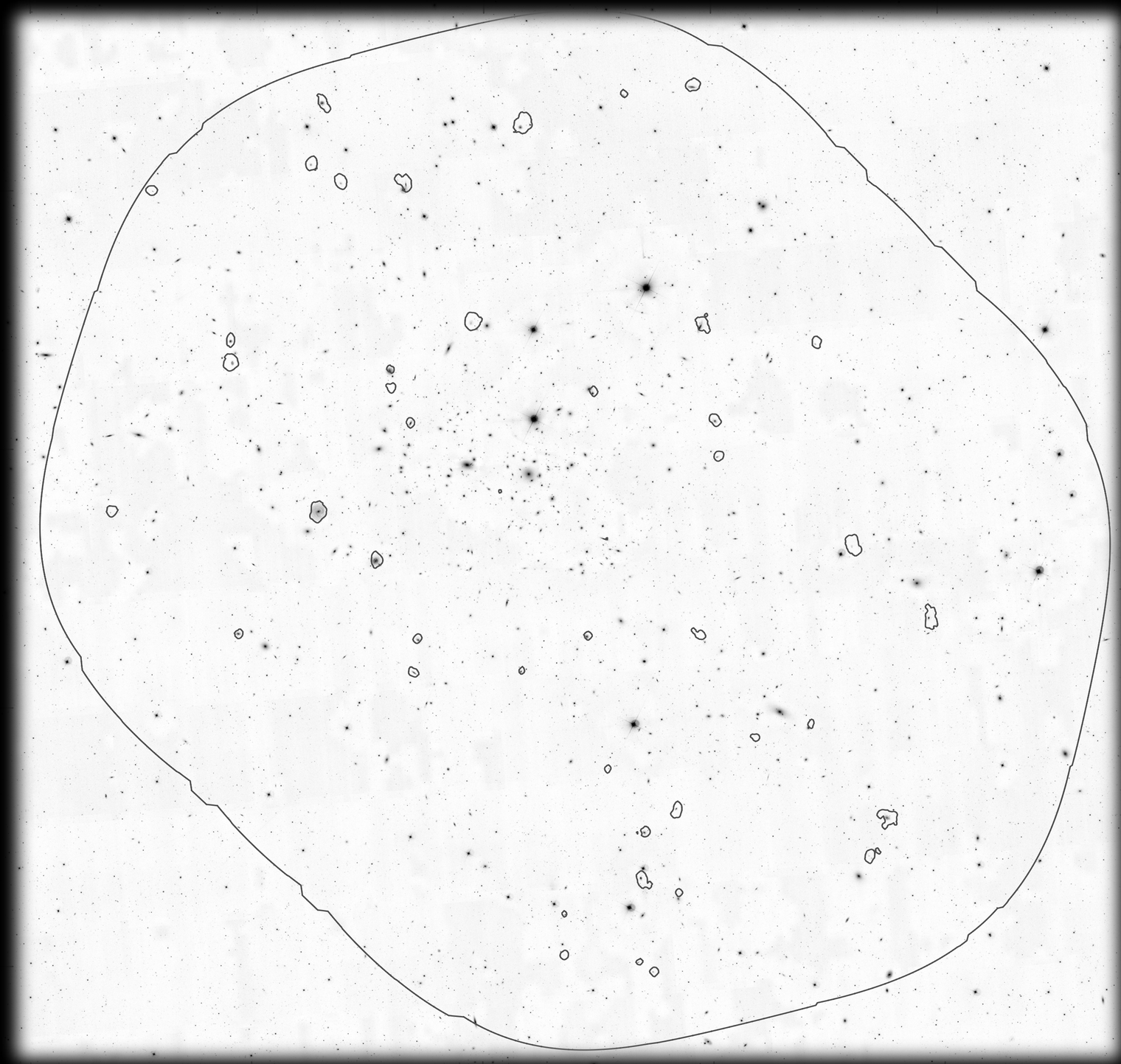
SoFiA completeness and reliability



Slide from Westmeier talk at PHISCC 2018

HI projects on the way to the SKA pathfinders

Quenching galaxies in dense environments
SFR - $M_\star$ - M_{HI} scaling



Coma @ WSRT

D. Molnar
Cagliari

+ Serra (Cagliari),
Poggianti (Padova) et al.

~50 HI detections

+ multi-wavelength imaging/spectroscopy to obtain Mstar and SFR

(e.g., Hunt et al. 2019)

GASP - GAs Stripping Phenomena in galaxies

P.I. B. Poggianti (Padova)

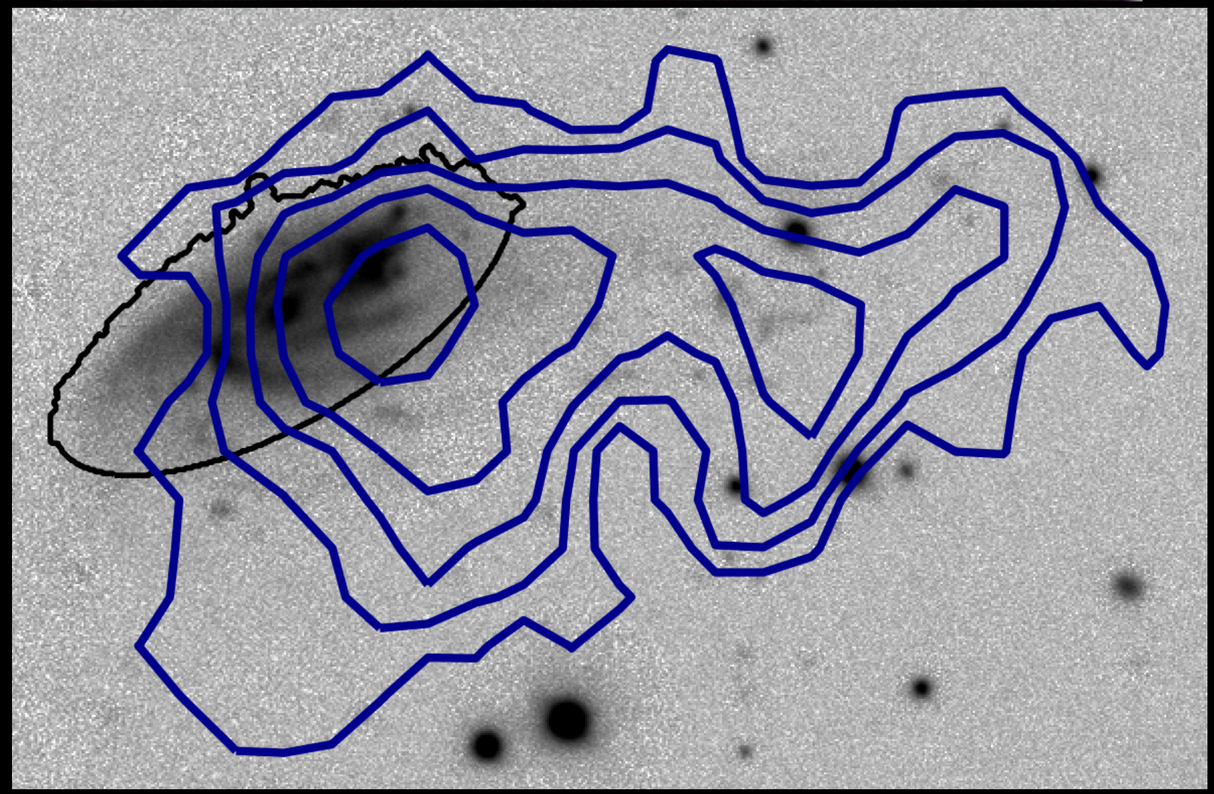
Includes several collaborators in Padova and Cagliari

~100 stripped galaxies observed with MUSE

13 papers published in 2017-2018

additional observations with

APEX, ALMA, VLA, UVIT



Poggianti et al. (2017)

Ramatsoku et al. (in prep.)

ESKAPE HI

Empowering the SKA as a Probe of galaxy Evolution with HI

P.I. L. Hunt (Arcetri)

+ 62 coIs: IASF-Milano, OA Brera, OAS Bologna, OA Capodimonte, OA Roma, OA Padova, OA Trieste, 4 universities (Firenze, Milano, Padova, Trieste)

€400k PRIN-SKA 2016

GOAL: *Build up all that is needed for an effective scientific exploitation of SKA for our understanding of the role of HI in driving galaxy evolution up to redshift ~ 2*

WP1: local HI benchmark

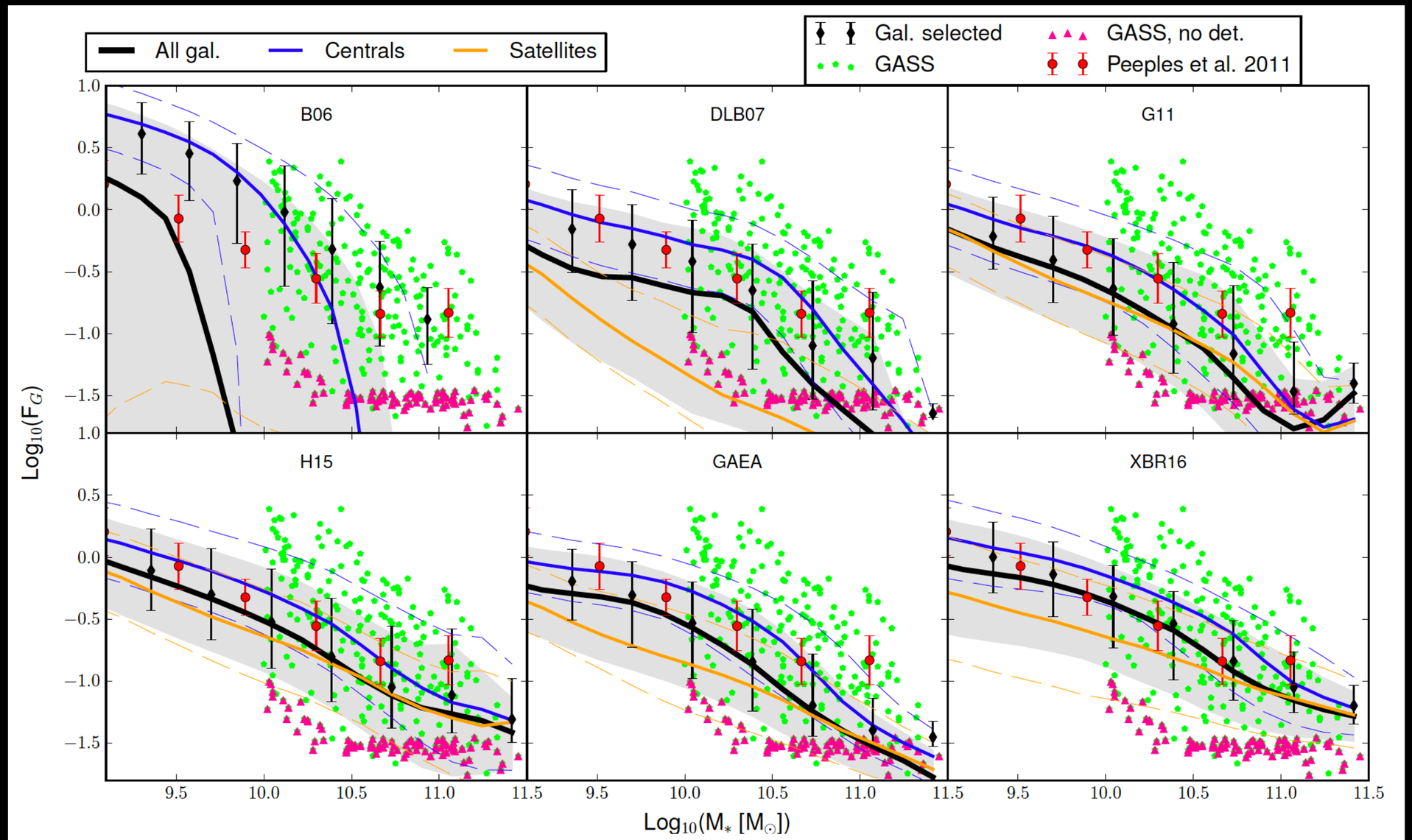
- Global scaling relations
- Resolved studies of environmental effects and feedback (GASP, MAGNUM)

WP2: multi wavelength data for SKA target fields

- High-z surveys including optical, IR, CO, dust (VIPERS, VUDS, VVDS, COSMOS, KiDS, LEGA-C, PEP, H-ATLAS, HerMES, WEAVE-StePS)
- Hydrodynamical simulations

HI content of galaxies in semi-analytic models

Zoldan, De Lucia, Xie, Fontanot, Hirschman (Trieste)



Zoldan et al. (2018)

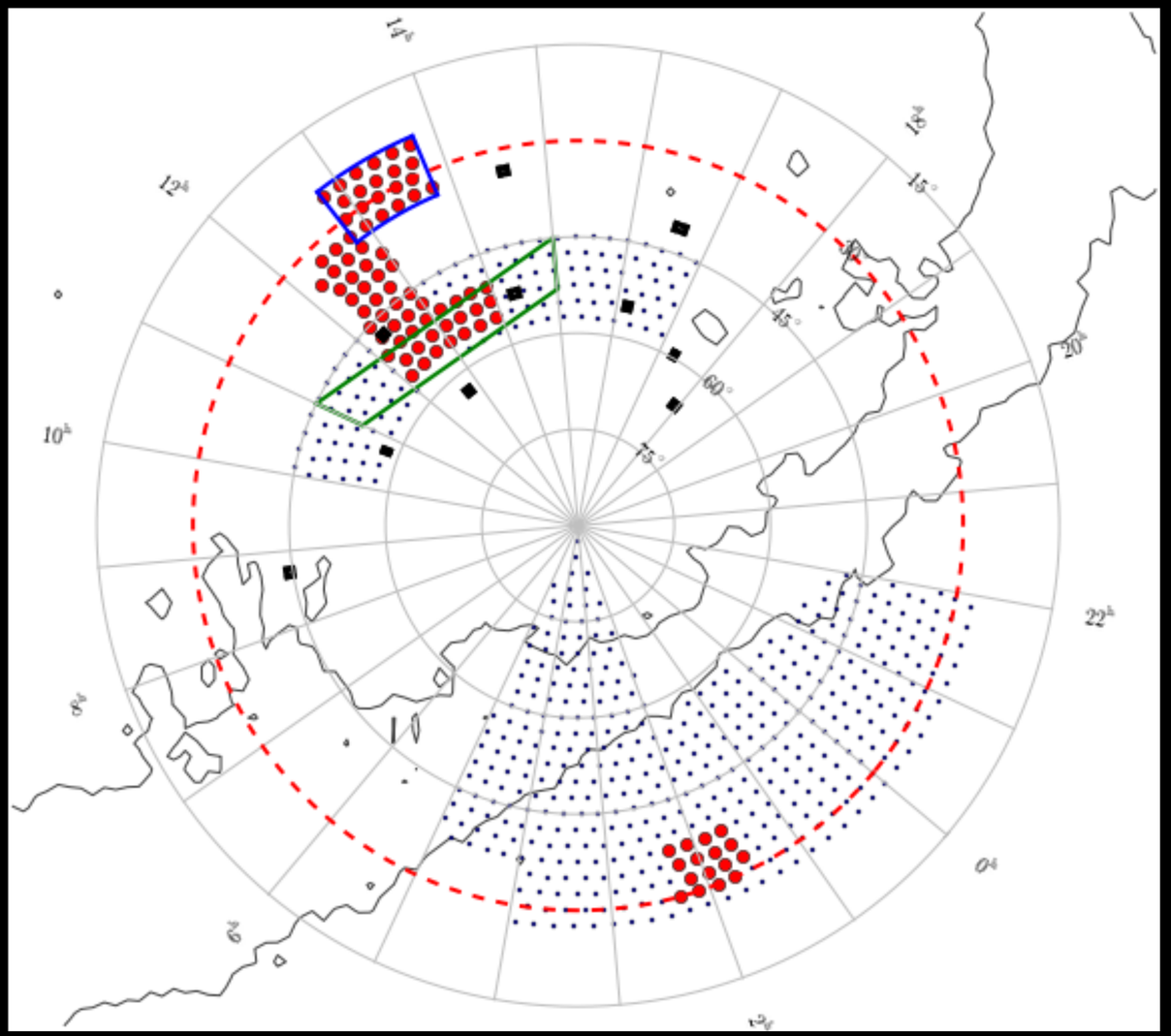
see Anna Zoldan's talk

WEAVE - APERTIF Survey

P.I. J. Falcon-Barroso (IAC)

includes Cagliari, Arcetri

IFU follow-up of a sample selected based on HI mass and HI morphology from APERTIF

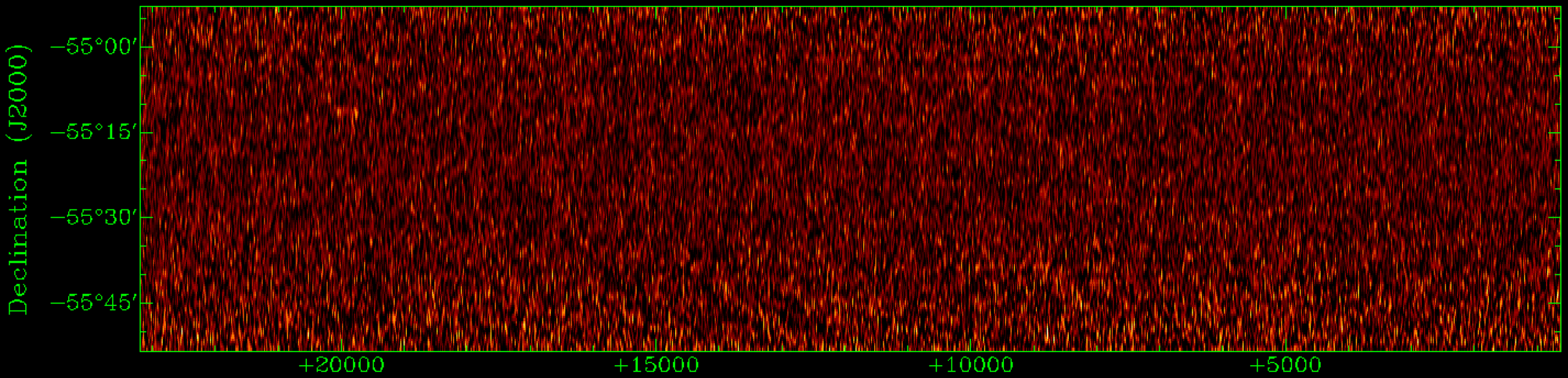


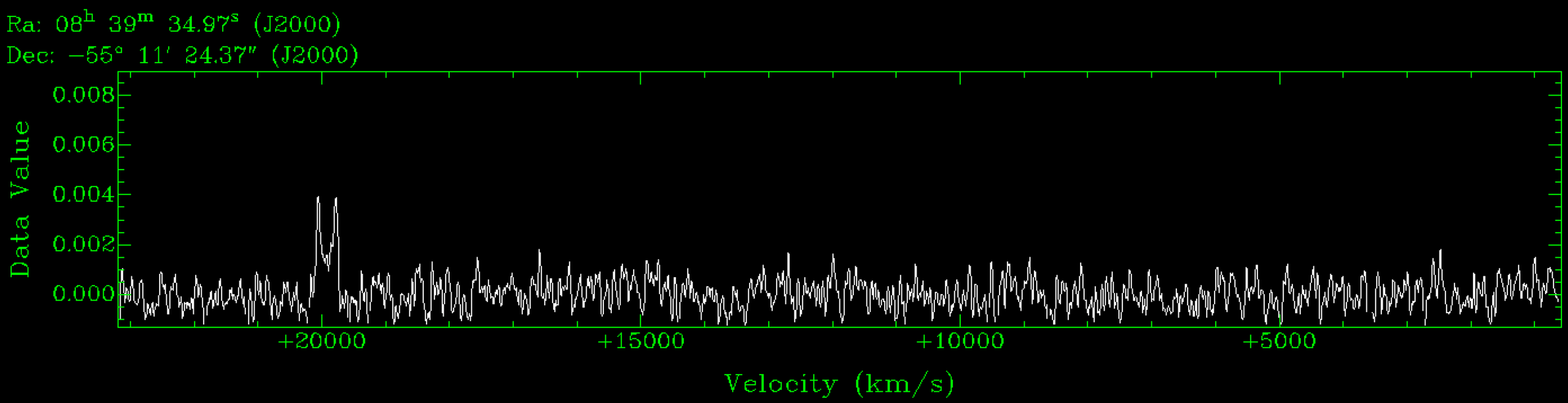
APERTIF

APERture Tile In Focus

Mapping the Vela supercluster behind the ZoA with MeerKAT

P.I. R. Kraan-Kraan-Korteweg (UCT) – includes Ramatsoku, Serra (Cagliari)





Great improvement in extragalactic HI science with SKA Pathfinders

The extragalactic Italian community interested in HI science is large and is active in projects leading to SKA Pathfinder science

This project has received funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (grant agreement no. 679627; project name FORNAX).