VLA-DIISC

Tracing the Baryon Cycle by Mapping the Interstellar Medium at the Karl G. Jansky VLA

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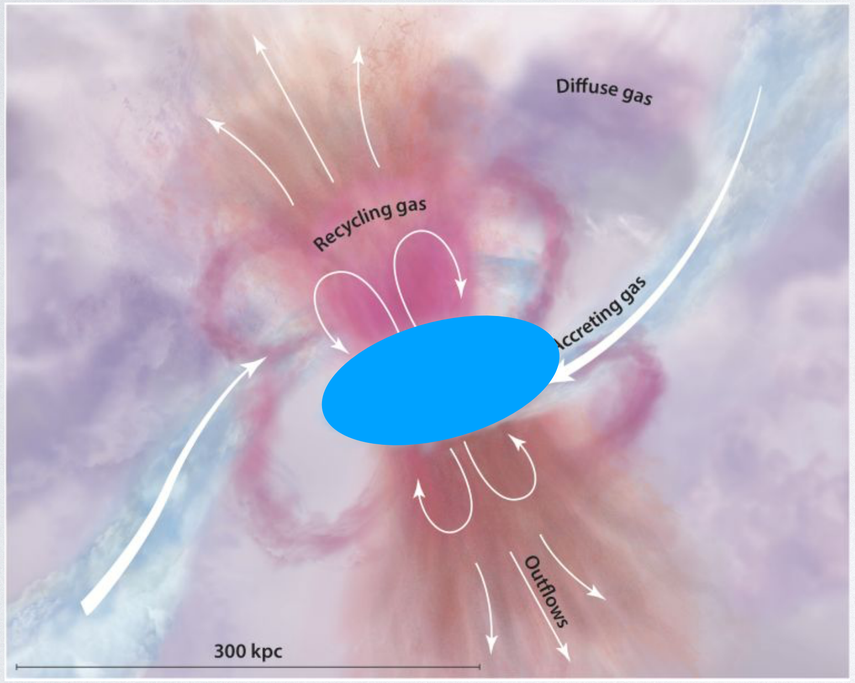
INTRODUCTION



Why HI ?

- route of the baryon cycles from CGM to molecular gas
- most sensitive tracer of the galaxy kinematics & structures at large radii
- future fuels for SF/AGN while H2 is the immediate fuel for SF
- best tracer of the tidal interaction & accretion to the galaxy

MOTIVATIONS

Why do we REVISIT local galaxies ?

- Higher angular resolution

  ALFALFA : θ~3.5 arcmin

  HIPASS : θ~15.5 arcmin

  VLA D-conf: θ ≲1 arcmin

- Higher spectral resolution

  VLA — Several galaxies were observed previously but with velocity resolution of ≳ 10 km/s

  Jansky VLA — these galaxies can be observed with better velocity resolution

SURVEY @ KARL G. JANSKY VLA

GOALS of VLA-DIISC

HI Properties

- HI distributions / structures
- HI mass / Baryonic Tully-Fisher relation
- HI deficiency / HI Asymmetry

HI Kinematics

- Kinematics of the HI disk
  (KE, velocity gradient, ···)
- Anomalous gas
  (high-velocity clouds, extrapljnar gas, ···)

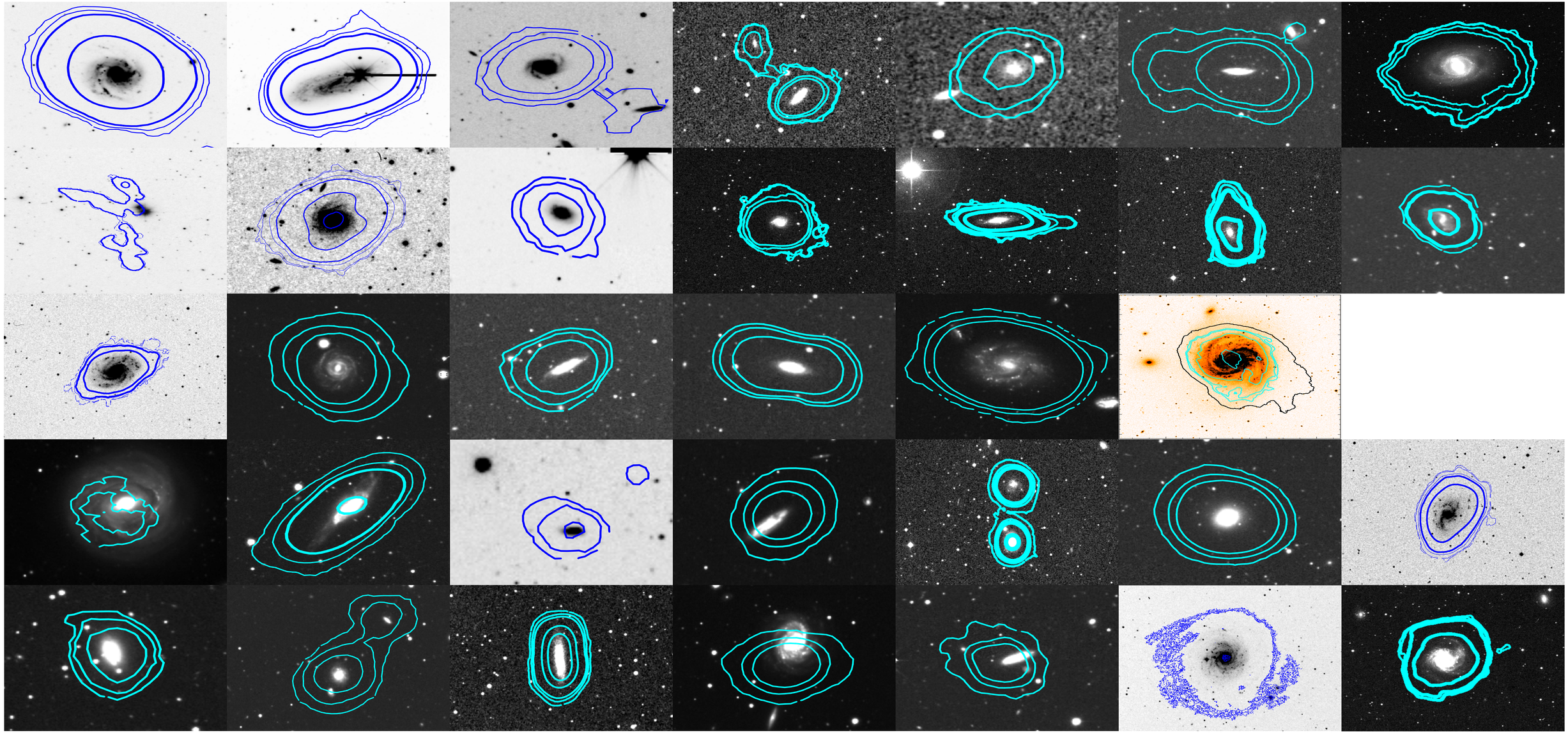
FACTSHEET

- Observation Periods: 2017~2021
- Configuration: D
  (C & B for some massive galaxies)
- Total integration time
  ~350 hours for D-configurations
- Velocity spacing : 1.65 km/s
- Velocity spacing : 1.65 km/s

Happy VLA 40th!

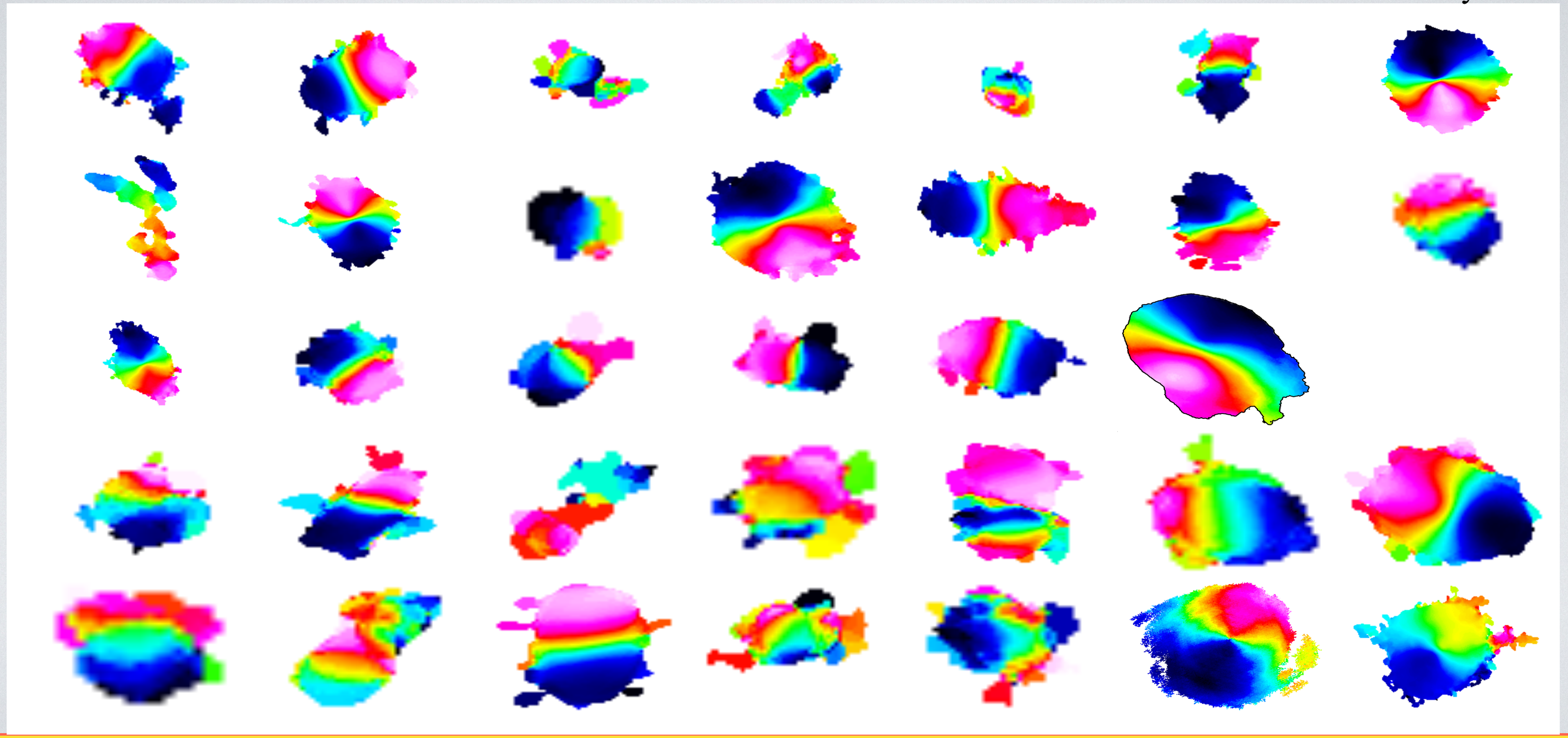
GALLERY - I

N_{HI} over optical image



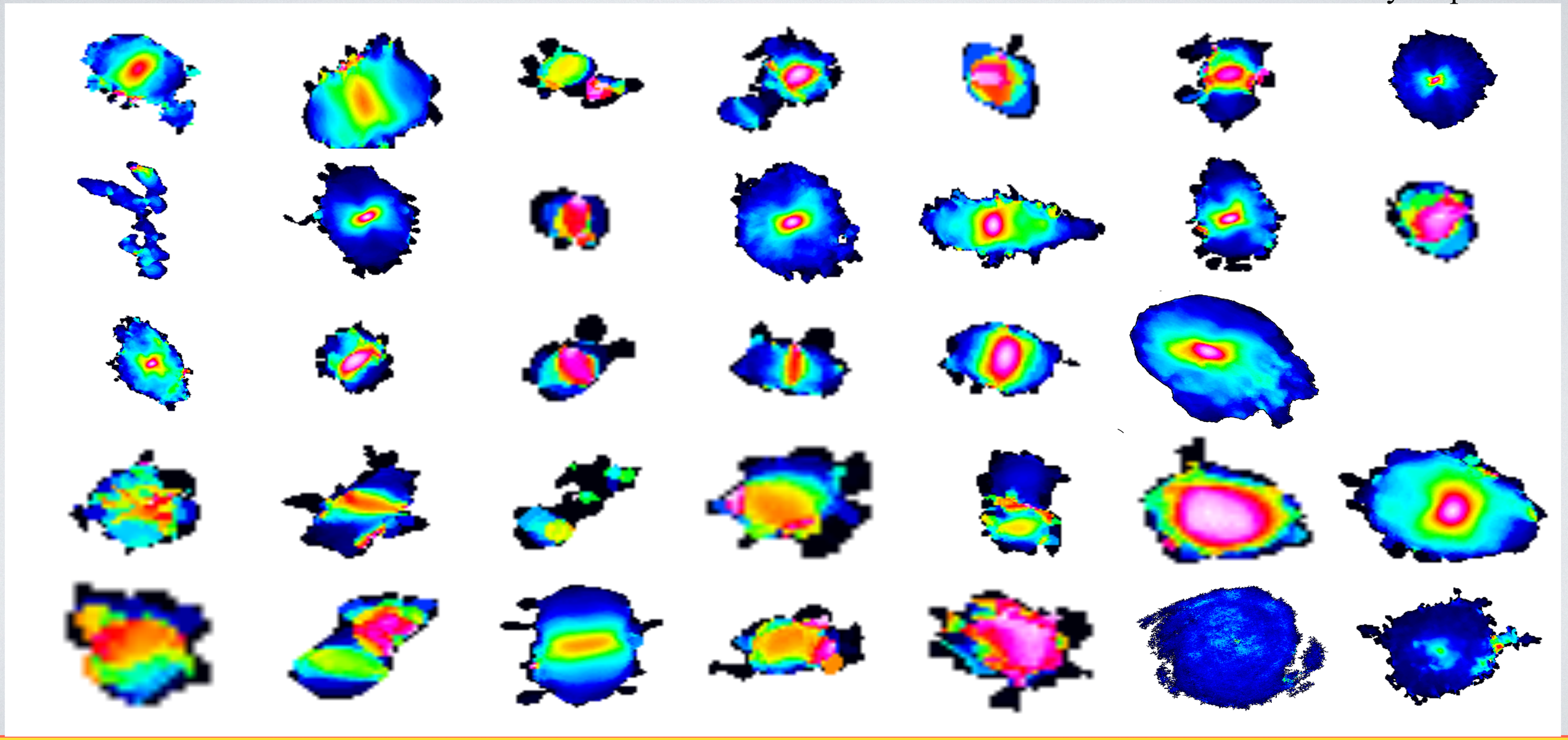
GALLERY - II

velocity field



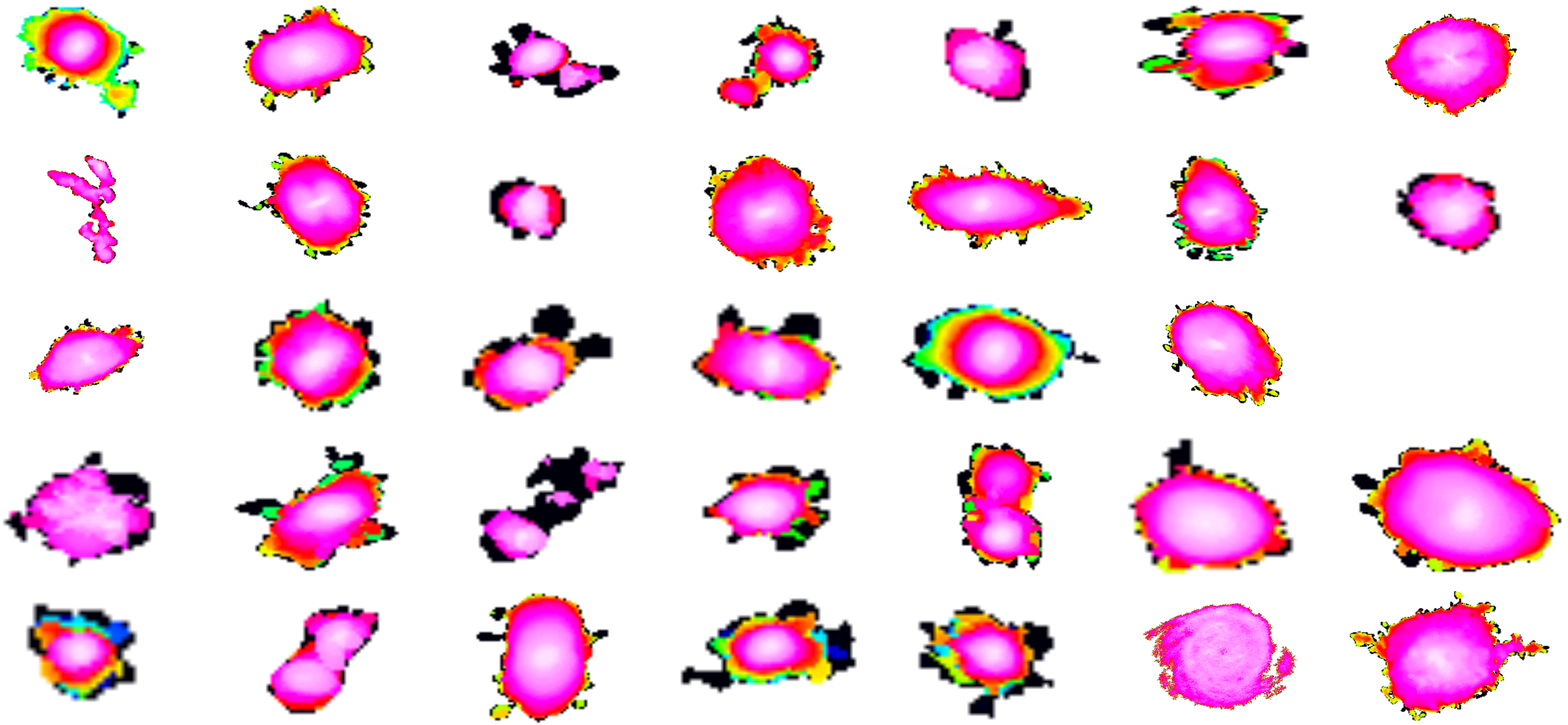
GALLERY - III

velocity dispersion

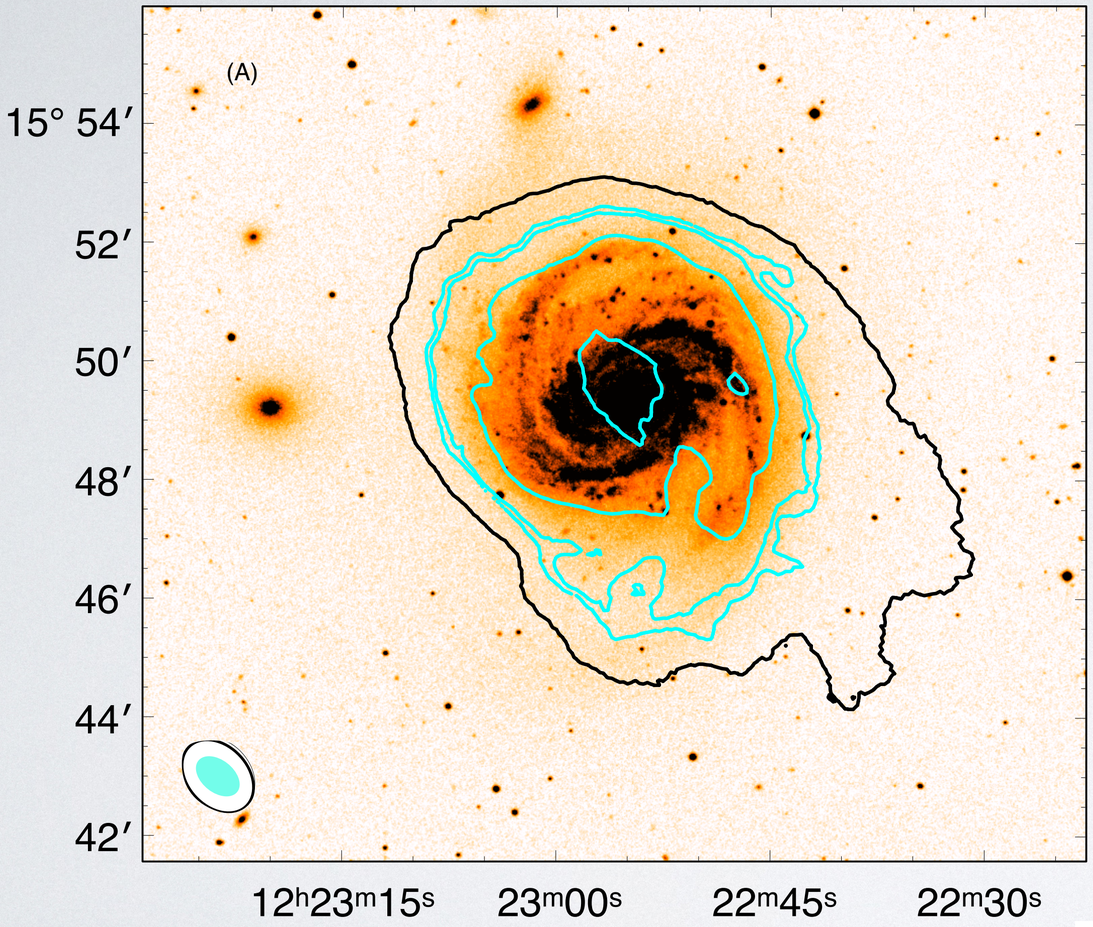


GALLERY - IV

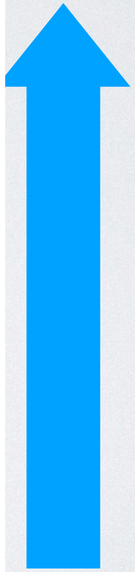
kinetic energy surface density



ISM OF M 100 (NGC 4321)



Their studies revealed many aspects of HI distribution in M100, even though those were limited by the poor spectral resolution at the VLA, e.g., velocity resolution ≳10 km/s.



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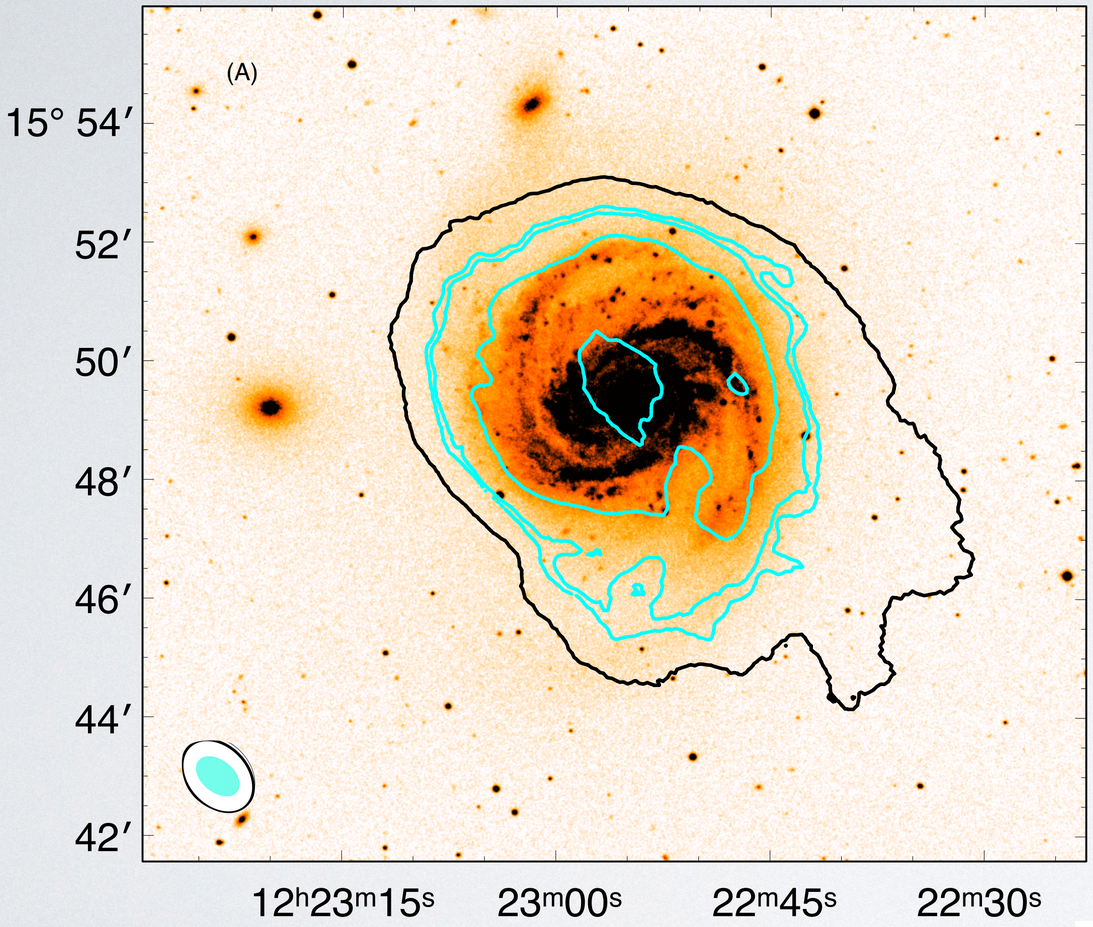
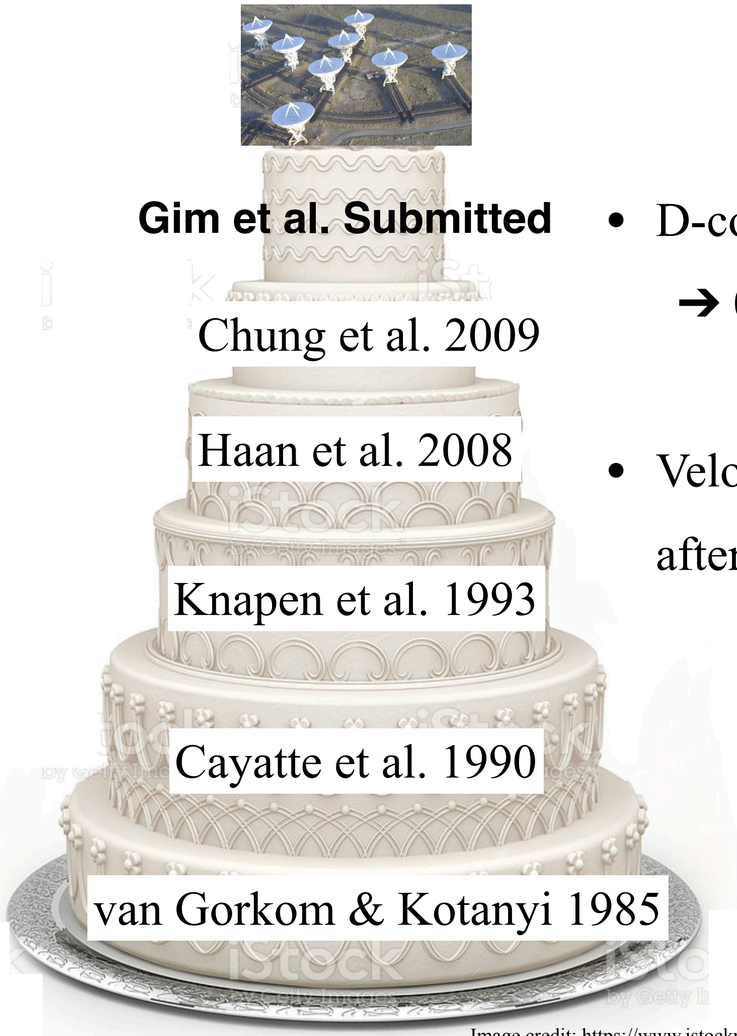
ISM OF M 100 (NGC 4321)





- D-conf.
  - ➔ θ= 44”×30" (Uniform)
    =73”×52" (Natural)
- Velocity resolution = 3.3 km/s after Hanning smoothing

Image credit: https://www.istockphoto.com/photo/traditional-wedding-cake-gm163744574-23335658
http://www.vla.nrao.edu

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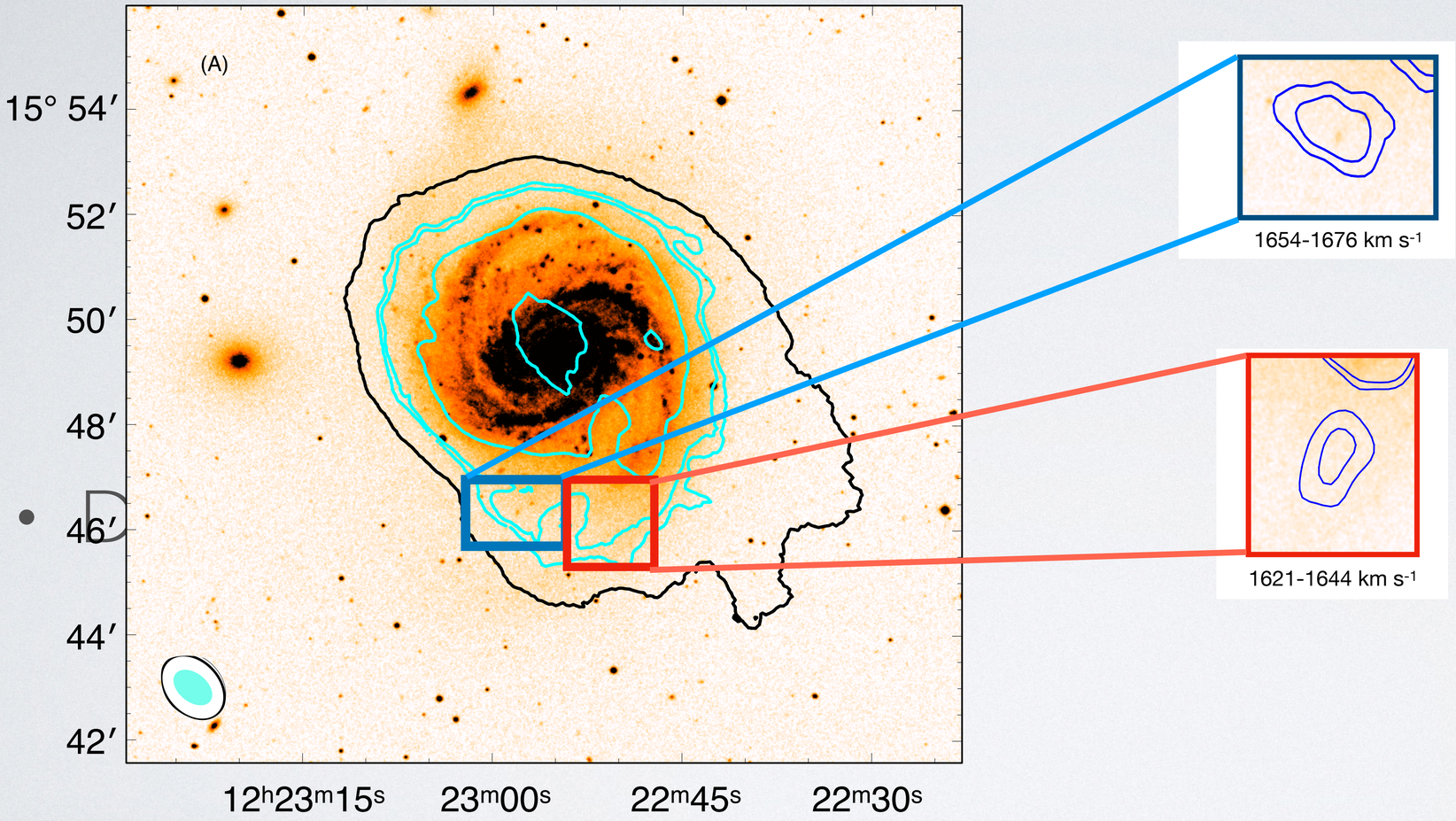
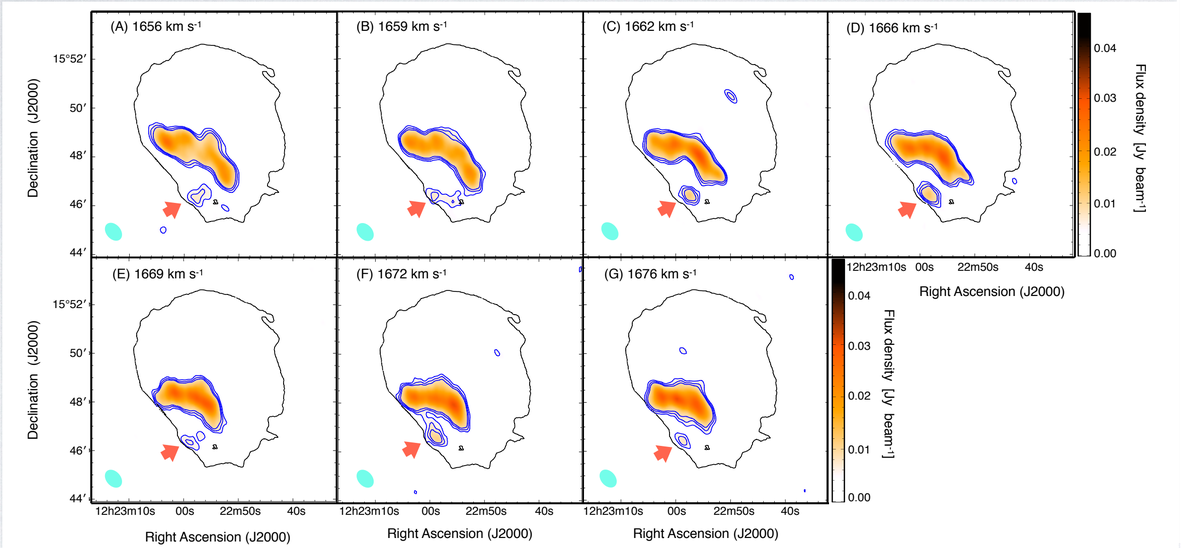
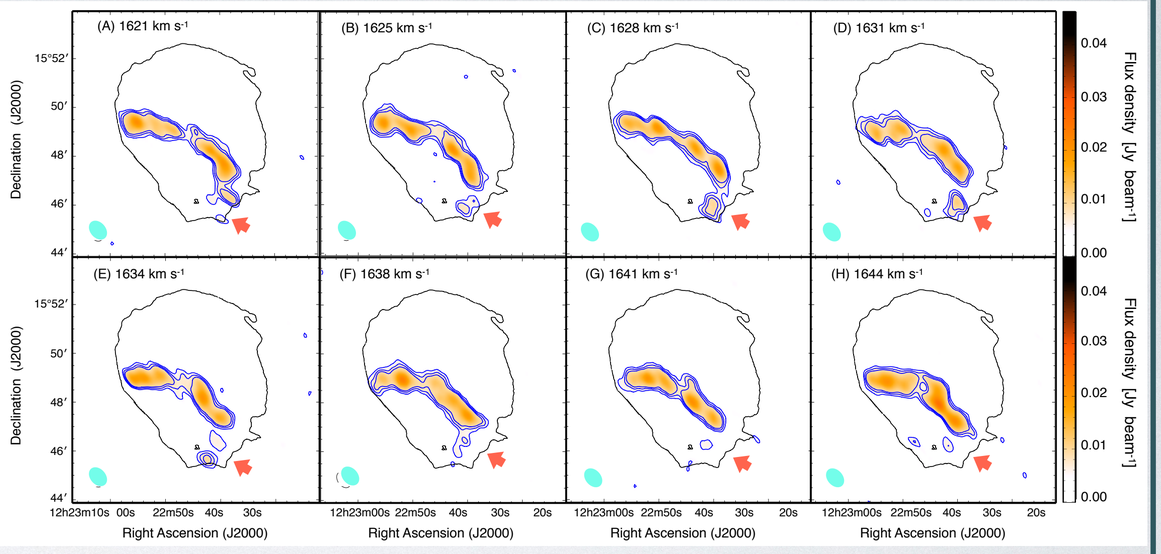
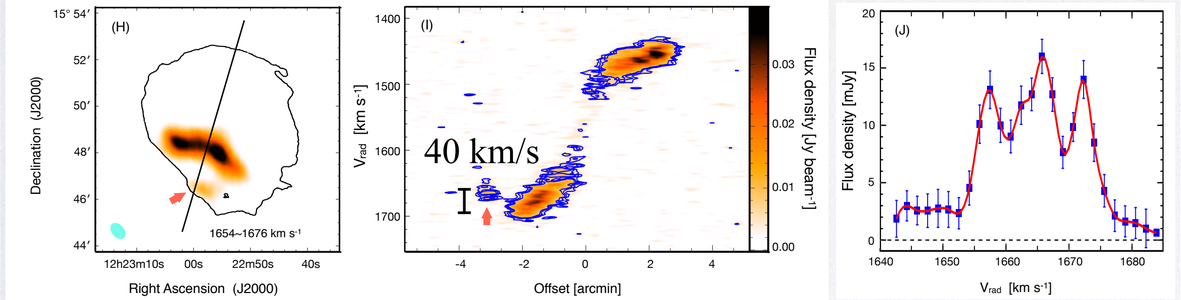
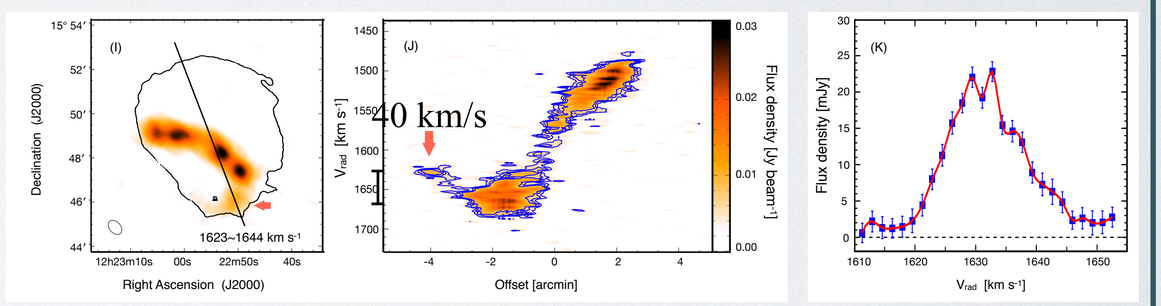
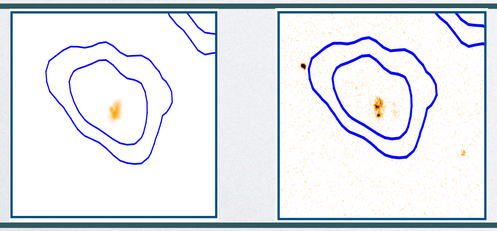
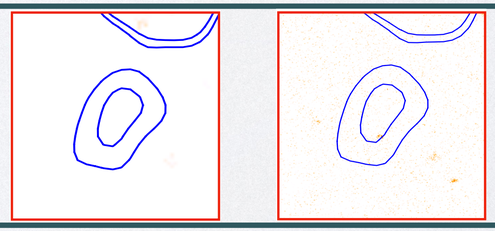
AHCS OF M 100 (NGC 4321)



Thanks to the higher spectral resolution of the Karl G. Jansky VLA, we discovered two HI clouds with anomalous kinematics from the rotating disk of M100!

AHCS OF M100 (NGC 4321)

		AHC 1	AHC 2
channel maps			
PVD	spectrum		
FUV	Hα	 SF activity $SFR_{FUV} = 7\times10^{-4}$ M⊙/yr $SFR_{H\alpha} = 5\times10^{-4}$ M⊙/yr Estimated massive stars ~ 60	 No SF activity related

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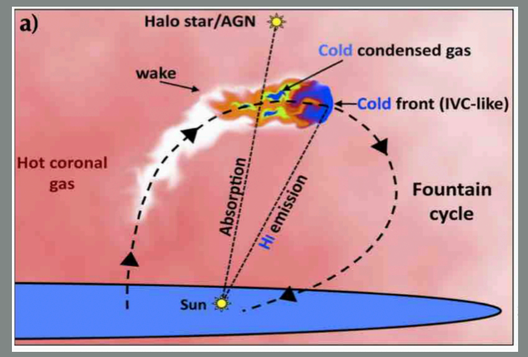
AHCS OF M100 (NGC 4321)

Scenarios for the AHC formation

Galactic fountain

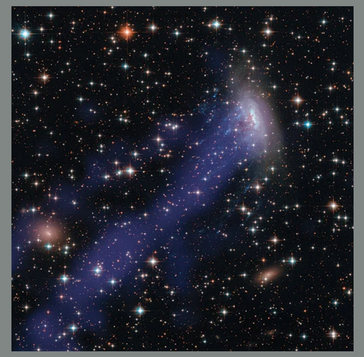


(Fraternali 17)

Star formation-driven outflow

AHC1: associated SF region

Ram-pressure



(McPartland+16)

M100 in the Virgo cluster

plausible, but M100 was classified as pre-stripping galaxy (Yoon+17)

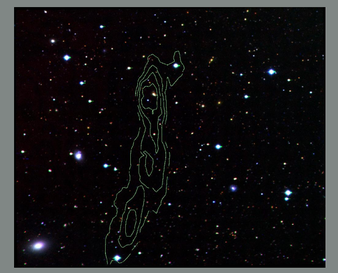
Tidal interaction

(APOD 2004-06-12)

NGC 4322 & NGC 4328 are companions of M100

plausible, but we do not see the tidal tails in our HI data

Dwarf galaxies



VIRGOHI21 (Davies+04)

'Almost dark' dwarf galaxies with little stars

HI in dwarf galaxies is not survived at the locations of AHCs

➡ Multiple mechanisms might influence the formations of AHCs in M100

SUMMARY AND FUTURE WORKS

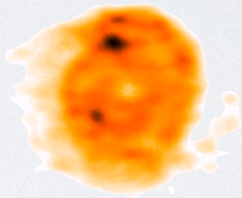
SUMMARY

- Completed D-configuration observations
- Investigating the HI properties and kinematics
- Two anomalous HI clouds in M100 were discovered with the higher spectral resolution at the Karl G. Jansky VLA

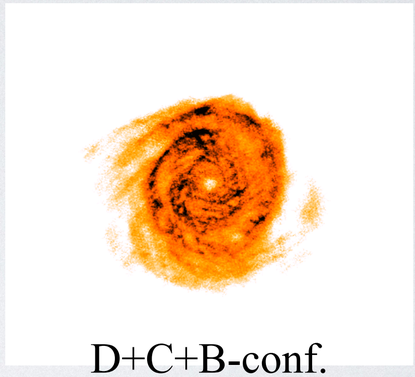
FUTURE WORKS

- Higher angular resolution data needed

  ex) NGC3344



D-conf. only



D+C+B-conf.

- xVLA-DIISC for massive galaxies (PI. Dr. Borthakur)

  Currently observed at C and B-configurations

  Stay tuned!