# HI gas kinematics of galaxy pairs in the Hydra cluster

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*+ ASKAP WALLABY SWG2*
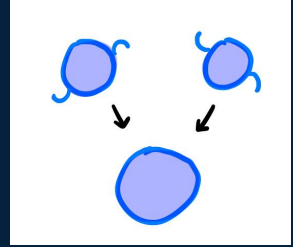
1.  **Introduction**

2.  **HI data analysis**

3.  **Correlation of physical properties**

4.  **Environmental effects + Phase-space diagram**

5.  **Summary**

**Galaxy Cluster environment / Merging galaxies**

- hot intracluster medium -> experience ram pressure stripping
- merging process -> 1) SF quenching  2) SF enhancing
- the role of mergers is critical for galaxy evolution and formation

**HI gas** is a good tracer for the study of **Environmental effects**

✓ HI is **largely distributed** from the galactic center
✓ **Easily detected** with **radio interferometry**

# *ASKAP pilot survey*

- The <u>Widefield ASKAP L-band Legacy All-sky Blind surveY (or WALLABY)</u> is a major survey that is now running on the Australian SKA Pathfinder (ASKAP).

- observe ¾ of the whole sky in the 21-cm line of HI at 30-arcsec resolution.

-  improved understanding of the processes involved in galaxy formation and evolution.

-  on the commissioning  now



▲ The Australian SKA pathfinder (ASKAP) in Western Australia

# *Hydra Cluster*

- **Resemblance with Virgo cluster**
- vel disp of cluster ~ 600 km/s
- number of bright galaxies 100~200
- But, further away than Virgo cluster (d = 55 Mpc)
  FOV of ASKAP 5.5*5.5 deg can detect up to 2.3 Rvir (~2.5 Mpc)
  -> study pre-process of galaxy cluster, get more accurate information of galaxy transformation, SF quenching

- **Resemblance with Centaurus cluster**
- considering D, cluster properties
- But, less obscured by MW



✓ ASKAP 23 well-resolved galaxies  isolated galaxy ( 18 ) , pair galaxy ( 5 )  + will be added soon (DR2)

✓ ATCA Local Volume HI survey ( < 10 Mpc)  isolated galaxy ( 42 ) , interacting  galaxy ( 19 )
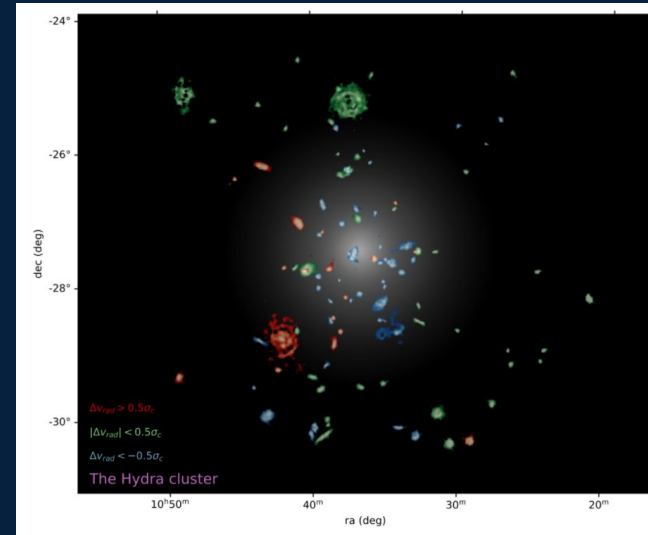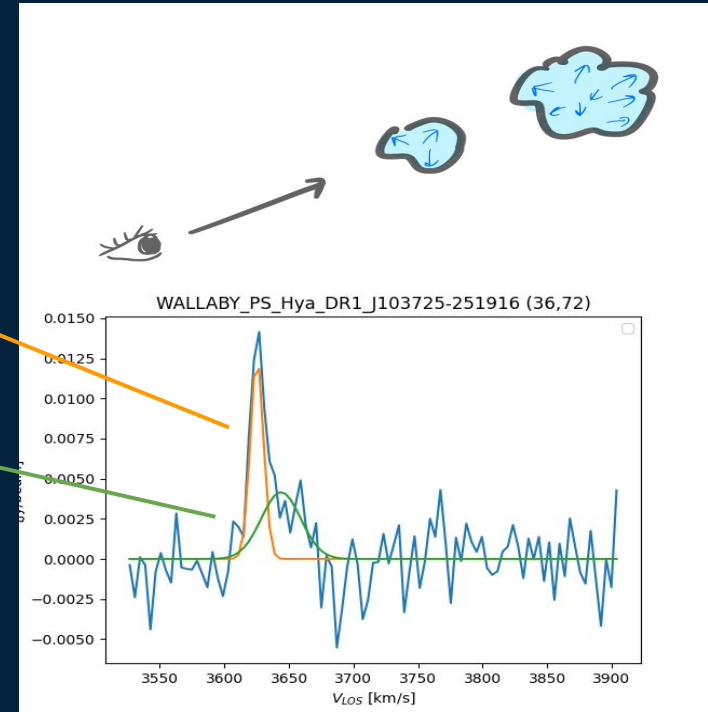
# HI Velocity Profile Decomposition

✓ **BAYGAUD - new tool**
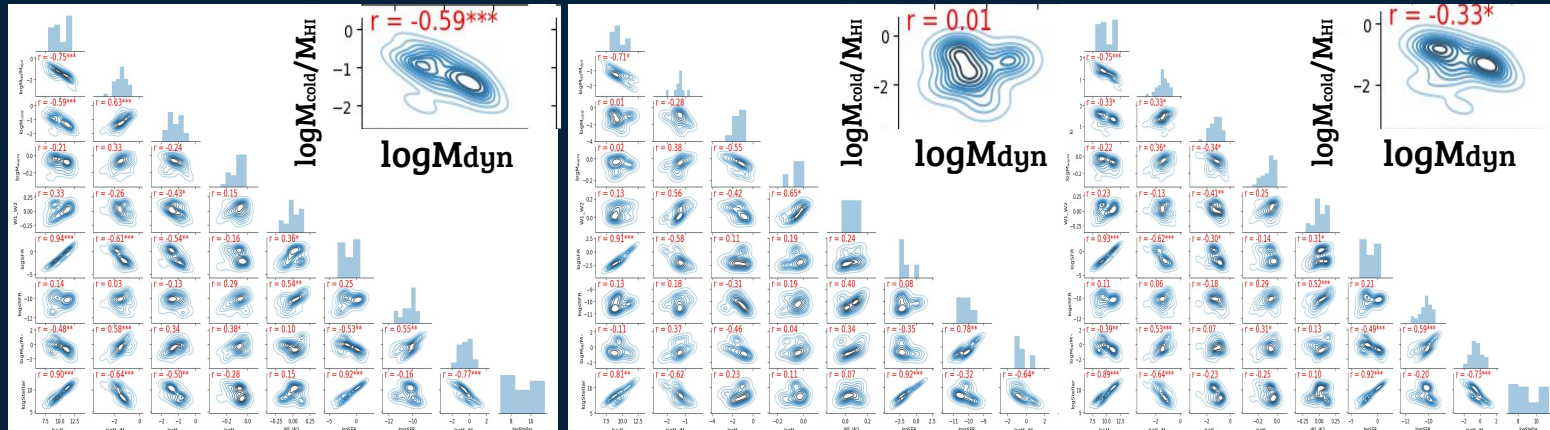✓ **Bayesian Method - gaussian fitting in velocity profile**

**components**
1) **kinematic cold (velocity dispersion 4~8 km/s)**
   **: SF reservoir candidate**

2) **kinematic warm (velocity dispersion > 8 km/s)**
   **: SF feedback**

✓ **define cold gas fraction f_cold = log10(M_cold)/(M_HI)**



WALLABY_PS_Hya_DR1_J103725-251916 (36,72)

# Correlation Plot

## M_cold/M_HI , M_warm/M_HI, M_HI/M_dyn, M_dyn, SFR, sSFR, M*, W1_W2
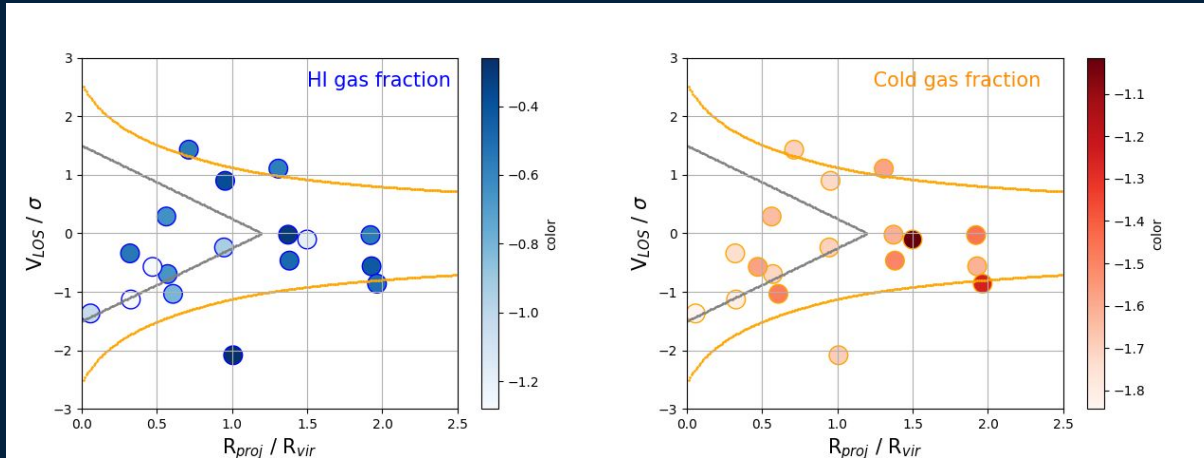


isolated galaxies (Hydra cluster, LVHIS)          interacting  galaxies          all samples

kinematically cold gas fraction shows a negative correlation with dynamical mass
but, interacting galaxies have deviations from the relation
-> interacting galaxies have more cold gas or less gas than isolated ones

# Phase-space analysis



- x-axis : **projected radius** from the galaxy center
- y-axis : **line-of-sight velocity**
- yellow line - escape velocity
- grey line - virial region
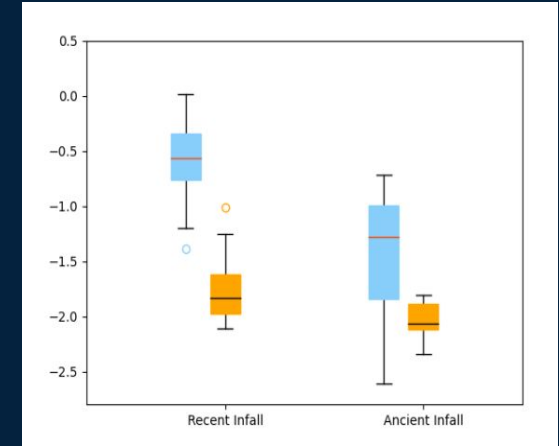
-> **Cold gas reservoir** as well as HI gas **stripped** as the galaxies settle into the galaxy cluster

# Model velocity field using 2DBAT

✓ Bayesian Method - reliable model fitting

✓ tilted ring model - PA, INC varying

✓ circular motion

- model central vel - observed central vel < 1*single_gfit_vdisp
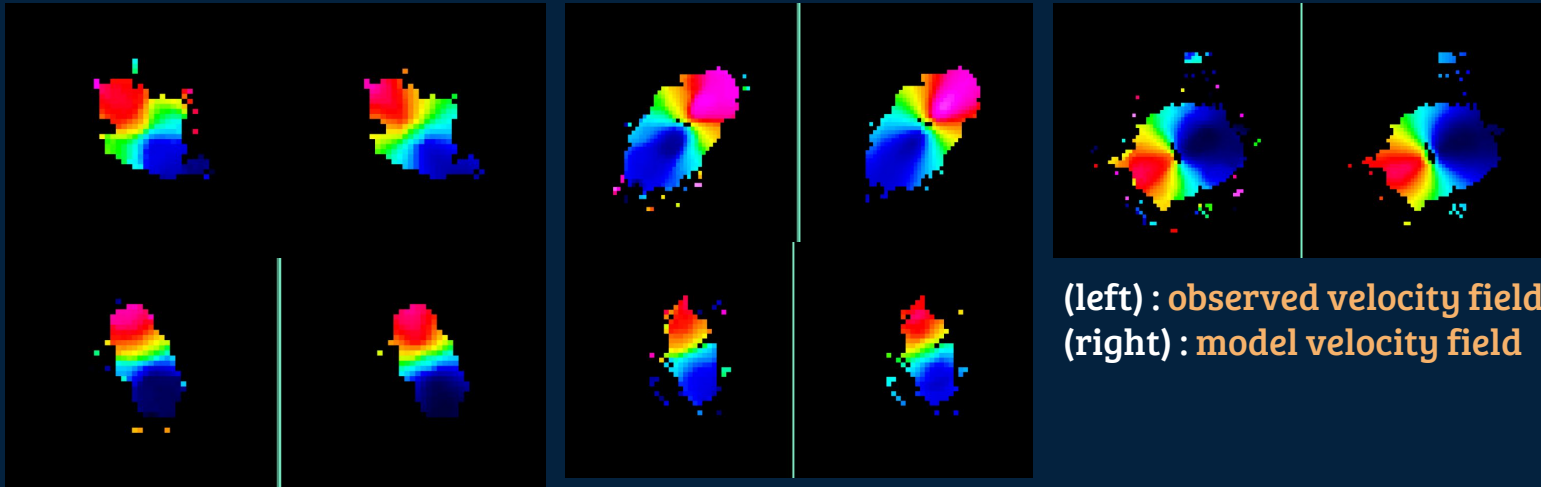


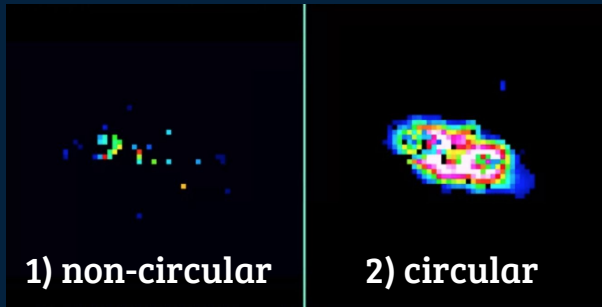(left) : observed velocity field
(right) : model velocity field

# Non-circular motion

circular : follow the circular motion in the galaxy
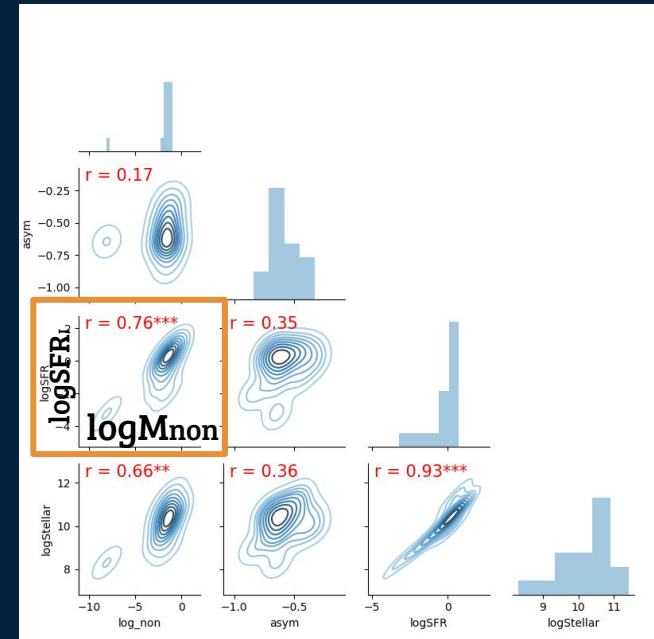non-circular : caused by hydrodynamical processes in galaxies
: Stellar feedback, dynamical interactions with neighbors

criterion : model_velocity - observed_velocity < 1*single_vdisp



1) non-circular    2) circular



We will compare non_circular motions of isolated and paired galaxies when DR2 is available

# Summary

1. **Hydra cluster** using 23 galaxies - isolated, paired galaxies

2. classify **kinematic cold (4~8 km/s)** , warm ( >8 km/s)

3. The **interacting galaxies** have either **higher or lower kinematically cold gas reservoir** than the isolated ones at a fixed dynamical mass.

4. phase-space diagram : **kinematically cold gas fraction** as well as **HI gas fraction** are **depleted** as galaxies settle into the cluster

5. non-circular motion fraction has positive correlation with SFR