

Associated H I absorption in the Grus Quartet

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PhD student

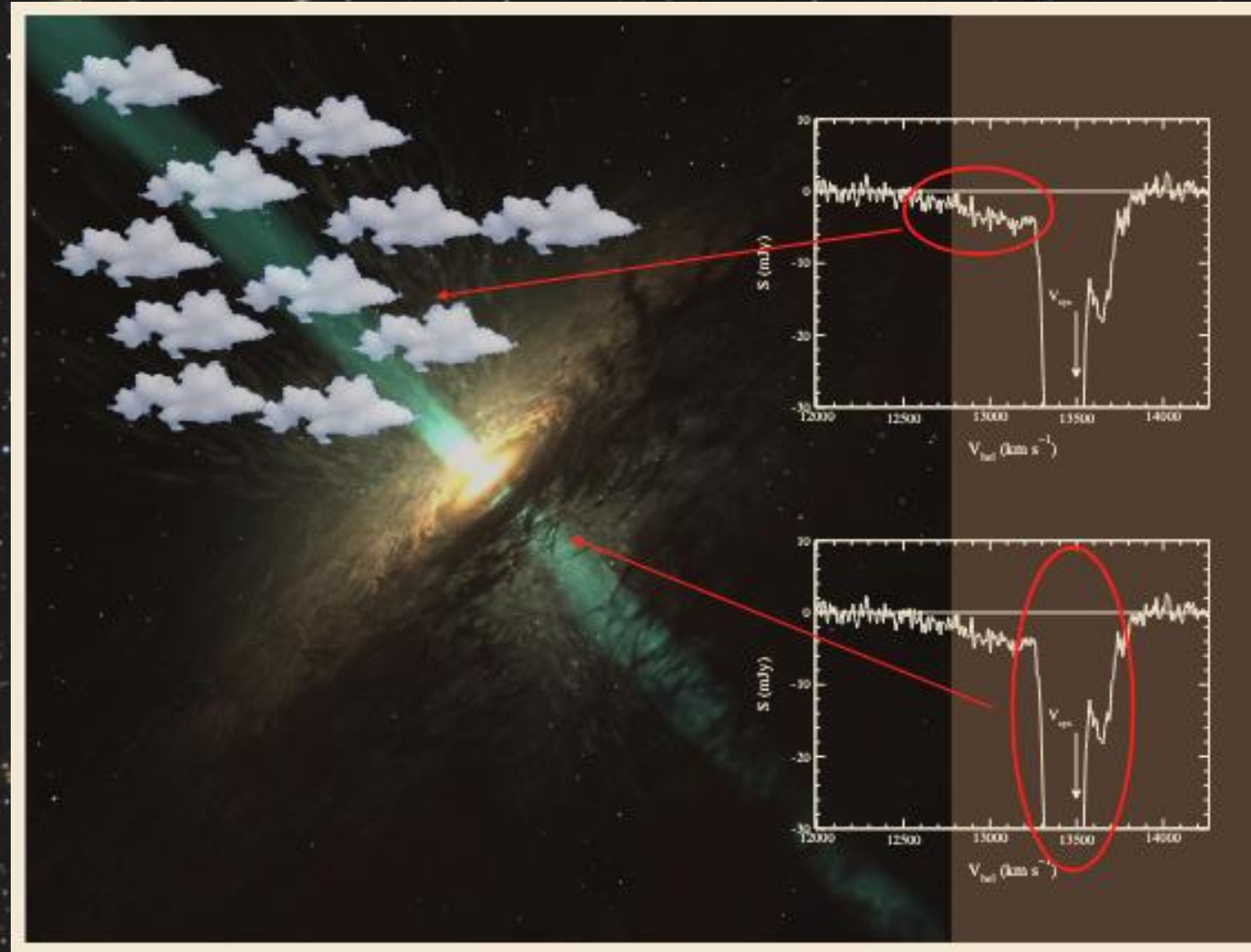
**Collaborators: Prof DJ Pisano and Dr
Moses Mogotsi**

**University of Cape Town/ South African
Astronomical Observatory**



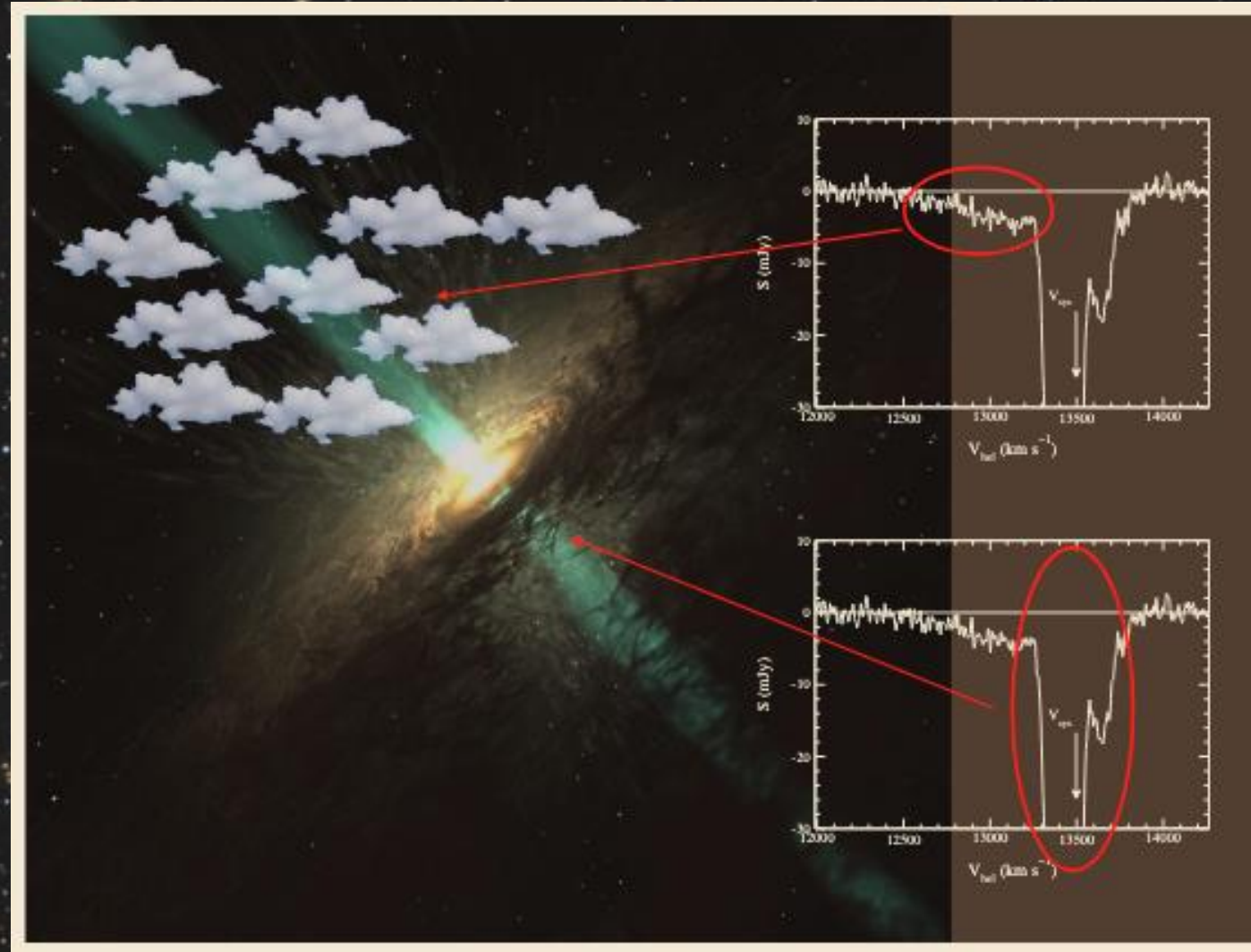
Associated and Intervening absorption

- Absorption relies on gas absorbing radiation
- Intervening absorption – gas absorbs radiation from some distant continuum source
- Associated absorption – gas and continuum source are located in same object



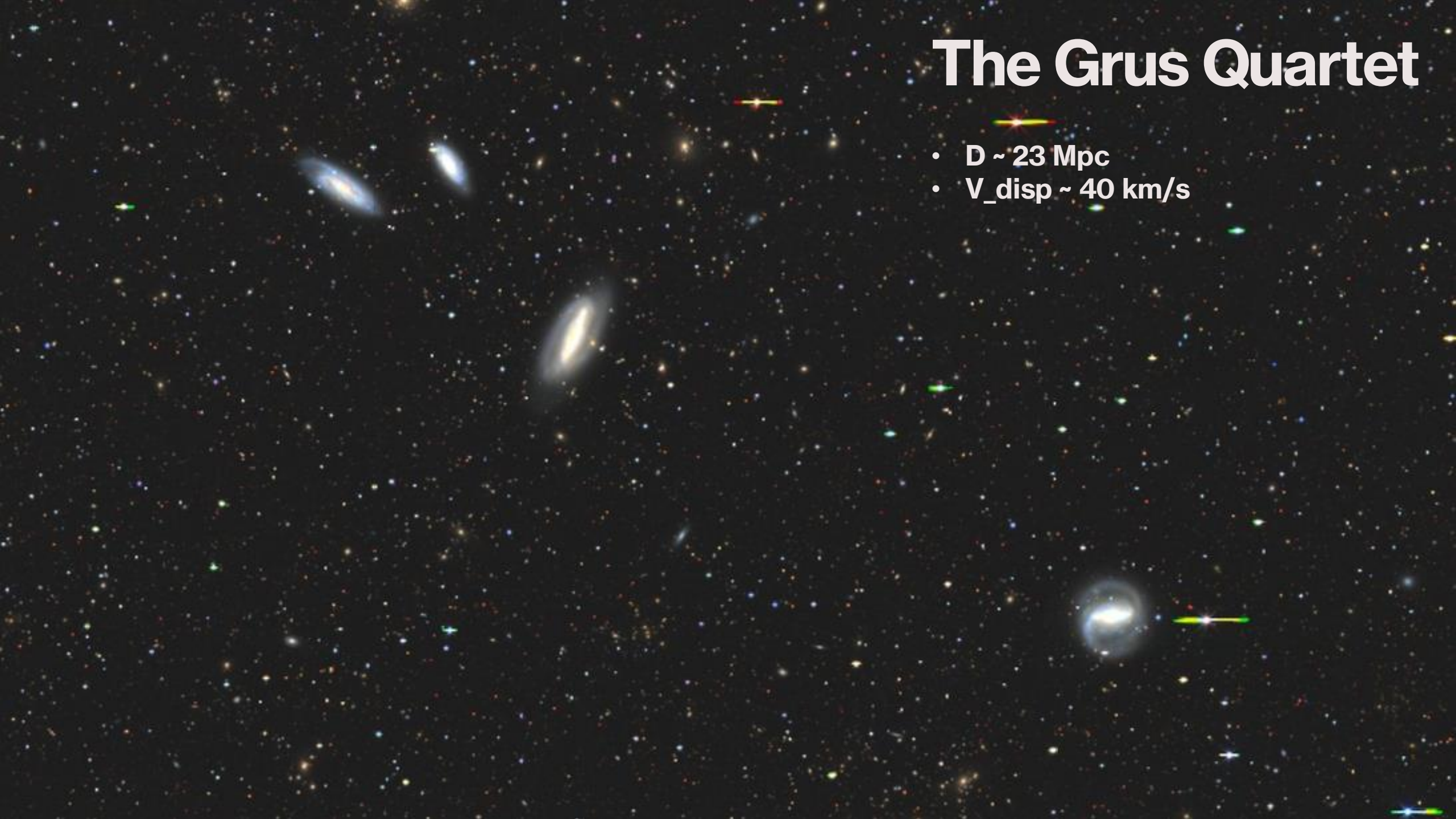
Associated and Intervening absorption

- AGN drives gas via outflows
 - HI is most massive comp
- HI absorption is particularly powerful:
 - Investigate cold gas around AGN
 - Interplay between AGN and host ISM
 - Push out to further z and higher spatial resolution



The Grus Quartet

- $D \sim 23 \text{ Mpc}$
- $V_{\text{disp}} \sim 40 \text{ km/s}$



The Grus Quartet

NGC 7590

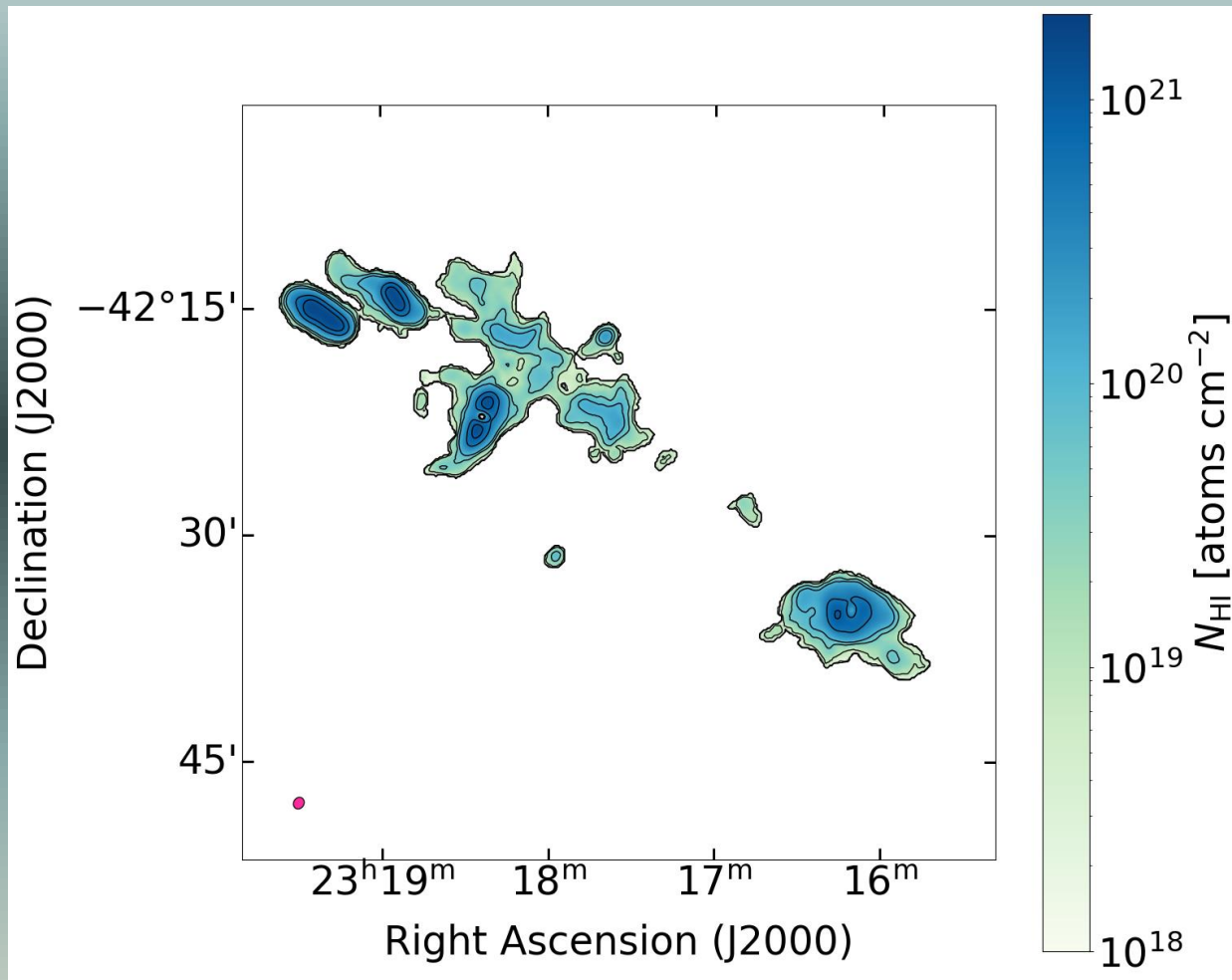
NGC 7599

NGC 7582

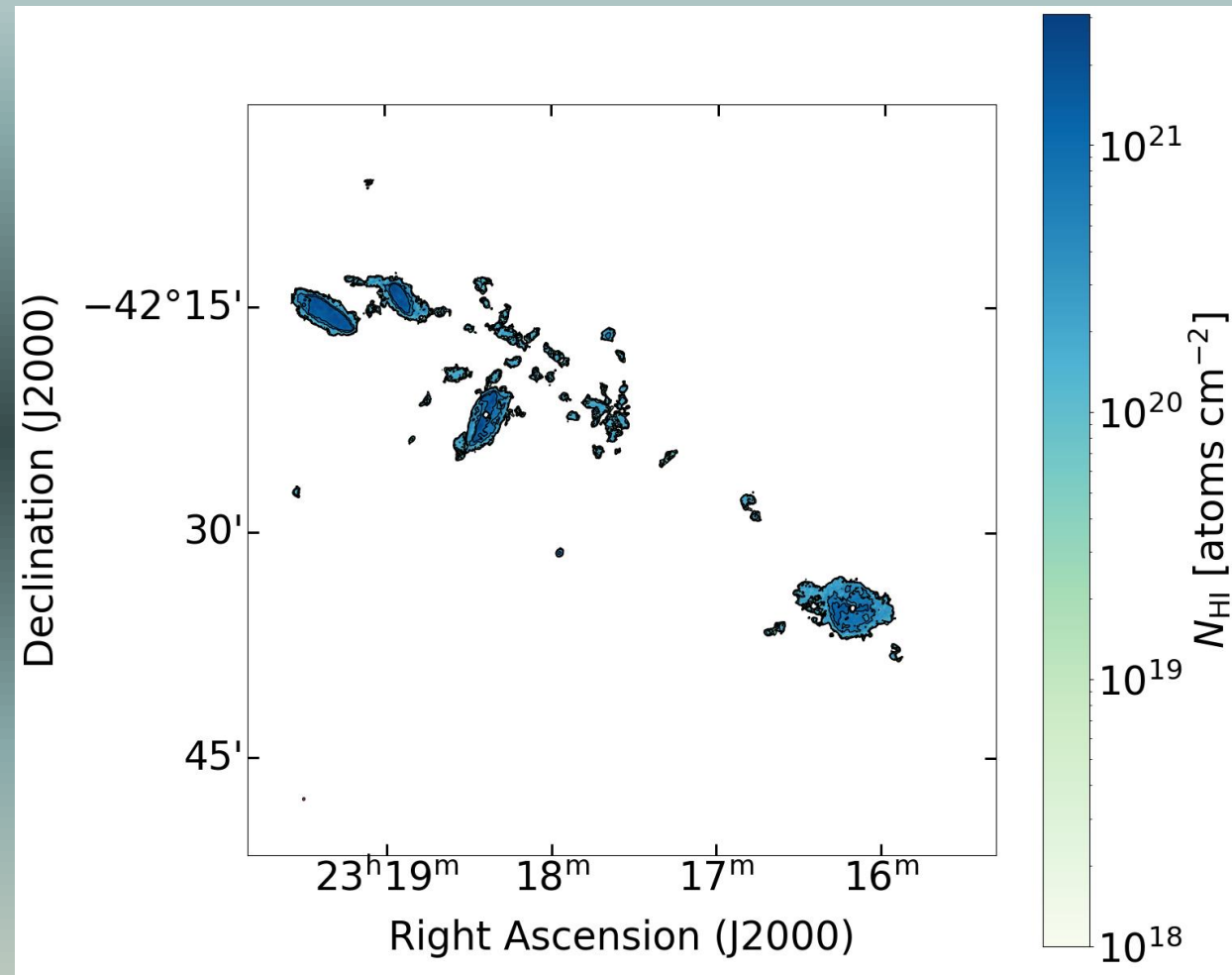
NGC 7552

- $D \sim 23 \text{ Mpc}$
- $V_{\text{disp}} \sim 40 \text{ km/s}$

MeerKAT HI data (MeerChoirs)

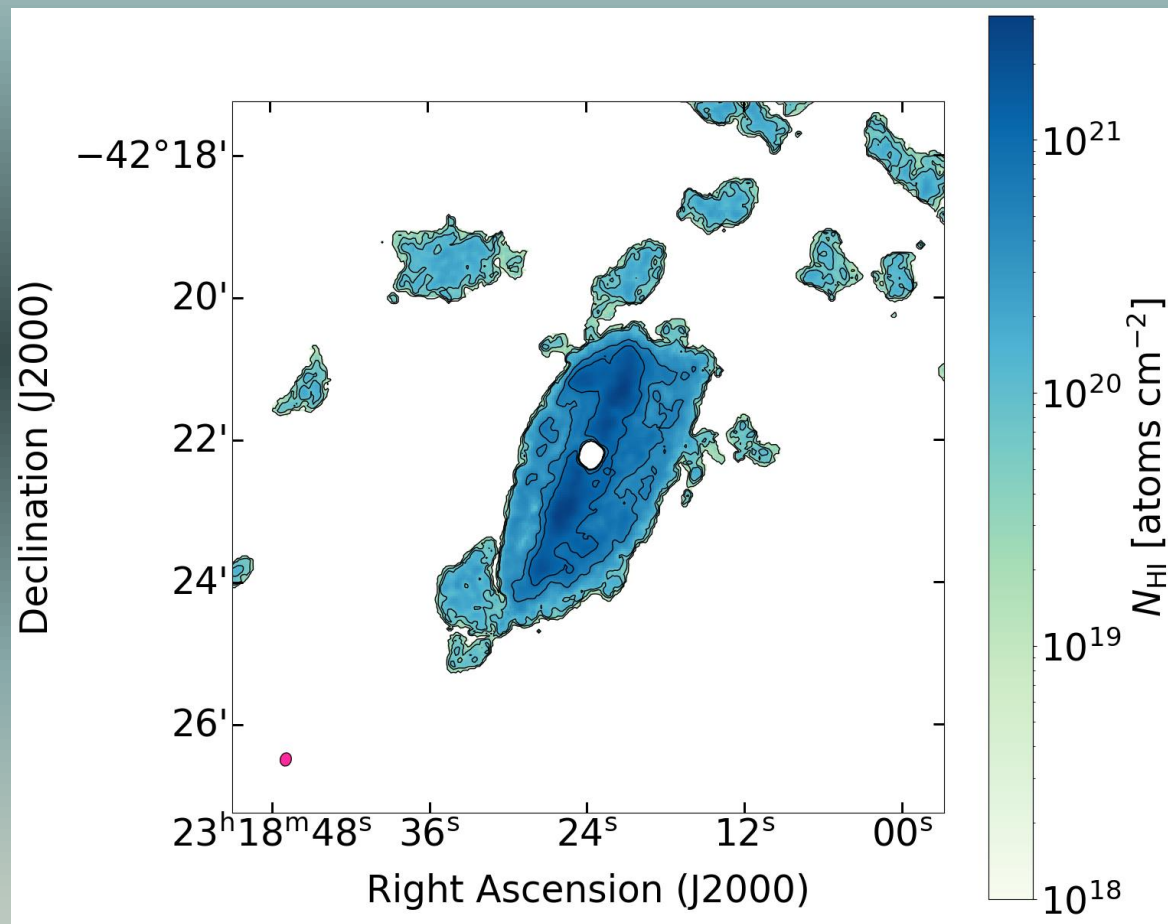


48'' x 41''

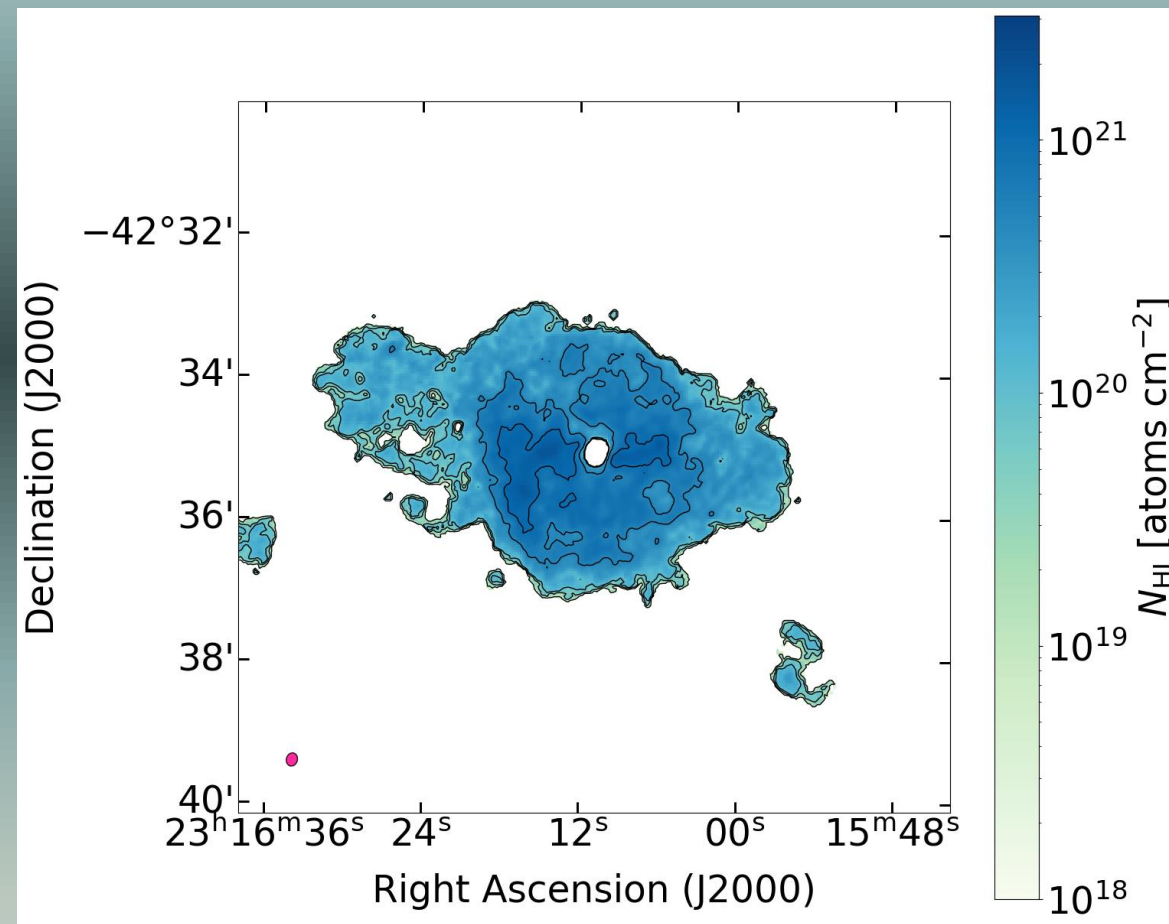


11'' x 9''

NGC 7582



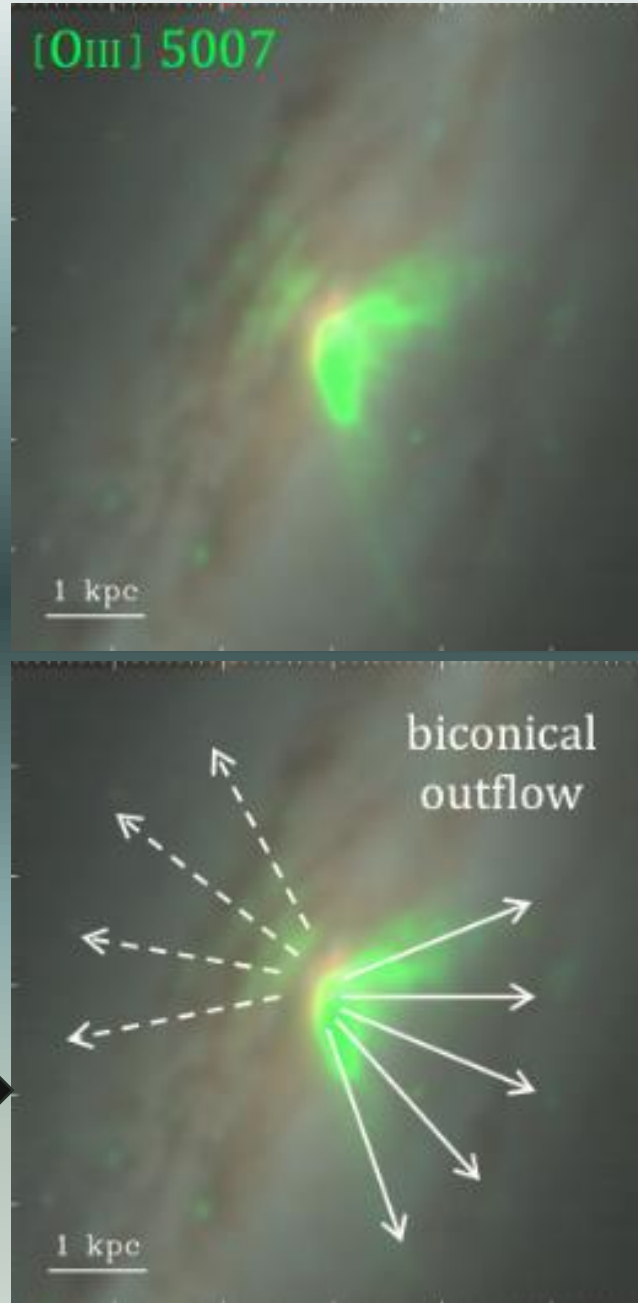
NGC 7552



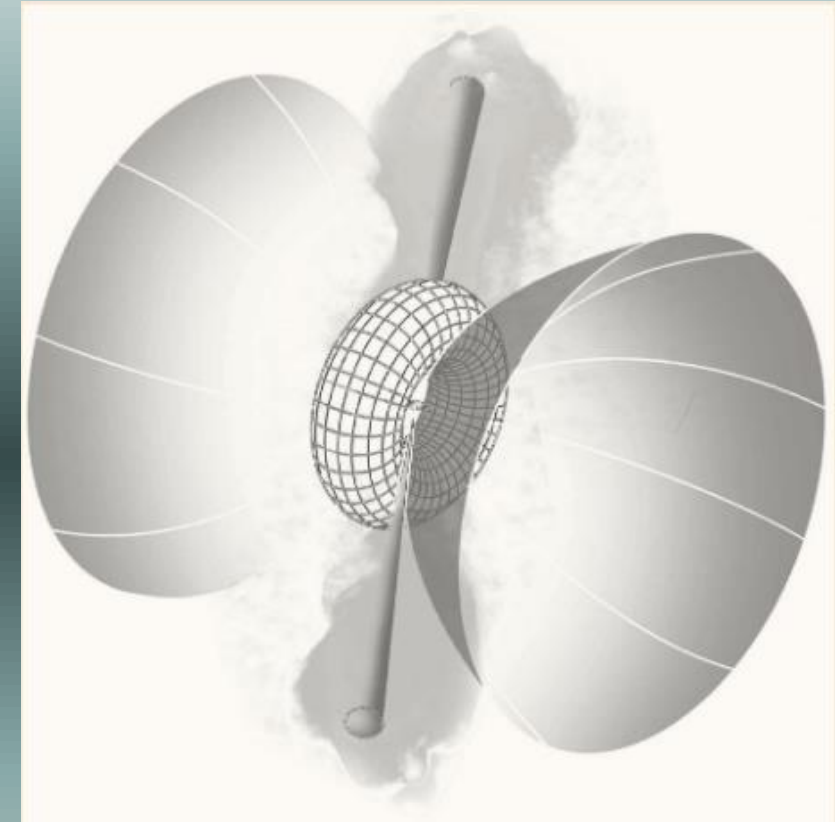
NGC 7582: State of play

- Seyfert II
- Compton-thick AGN at its centre.
- $M_{\text{BH}} = 5.5 \times 10^7 M_{\odot}$
- 200 pc circumnuclear ring
- Jet+ionization cone model

[OIII] tracing the biconical outflow



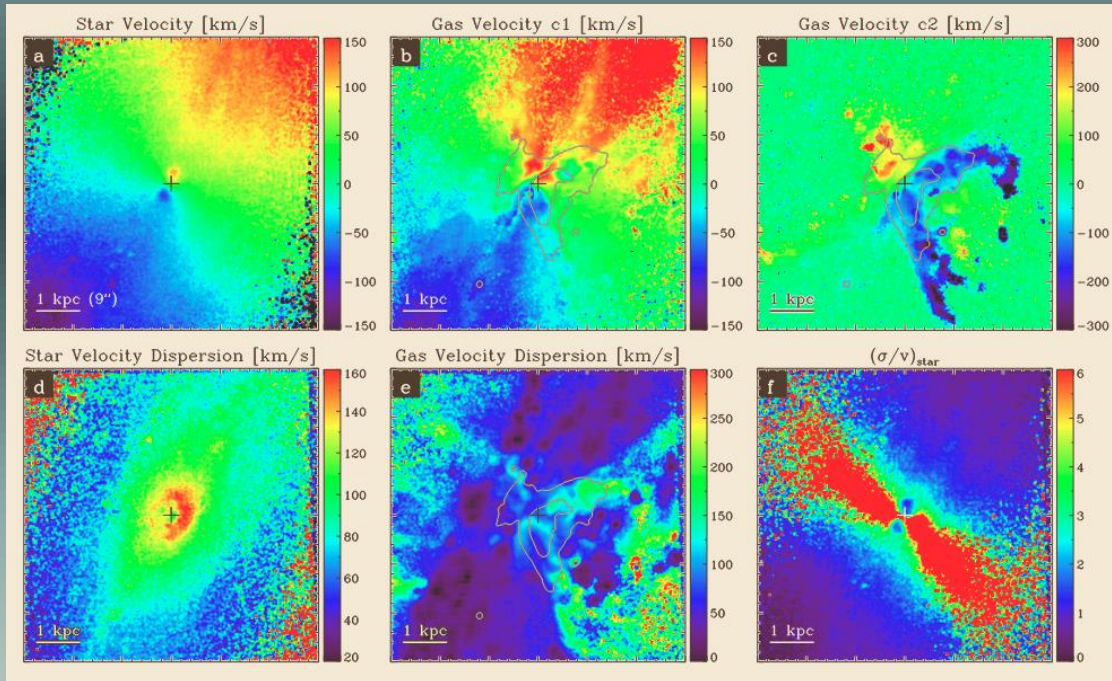
Ricci et al 2018



Jet+cone model projected onto the sky as seen by observer

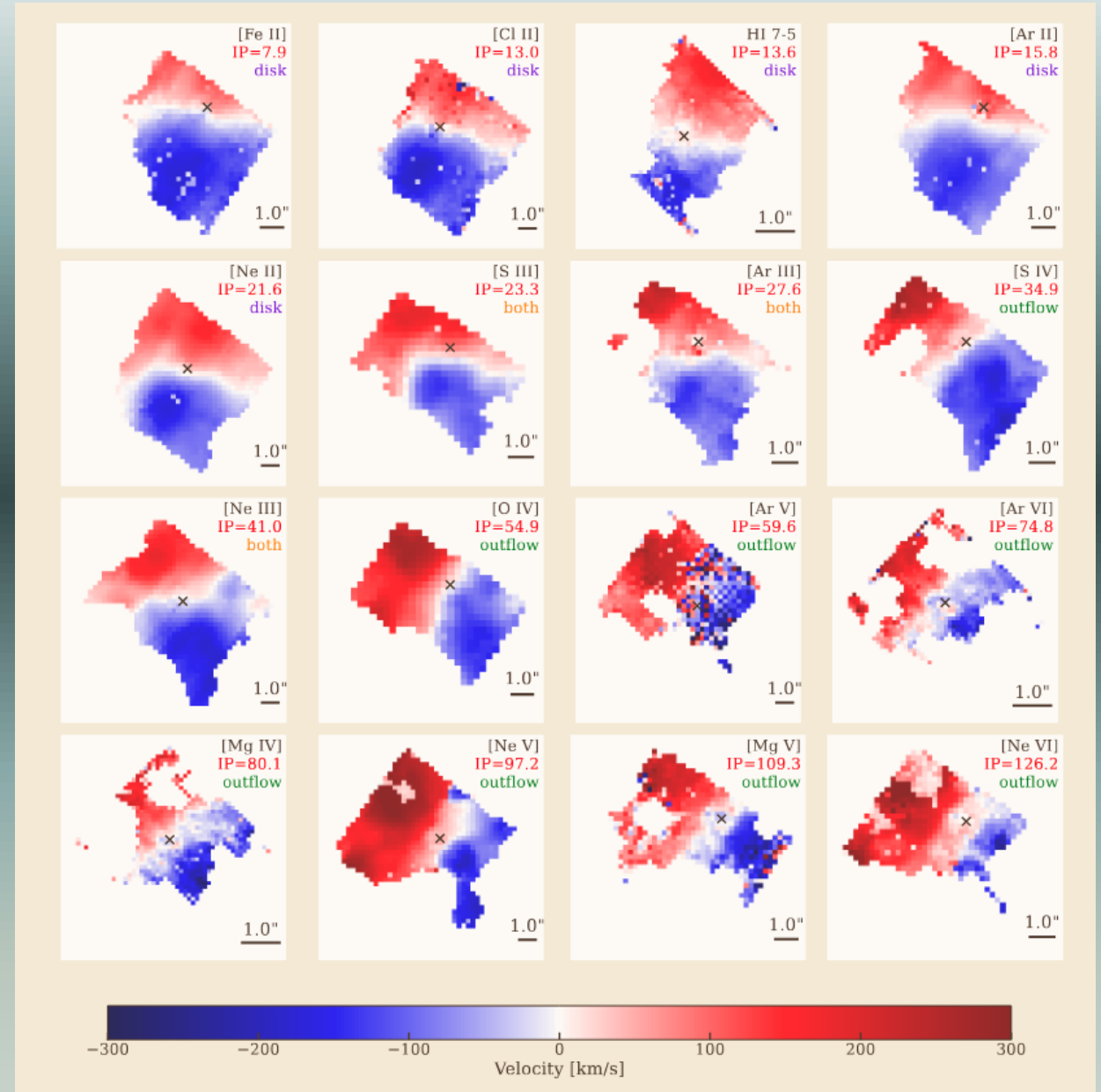
NGC 7582: State of play

- Evidence for a KDC (kinematically distinct core) rotating faster than the galaxy disk
- Central region is kinematically stratified

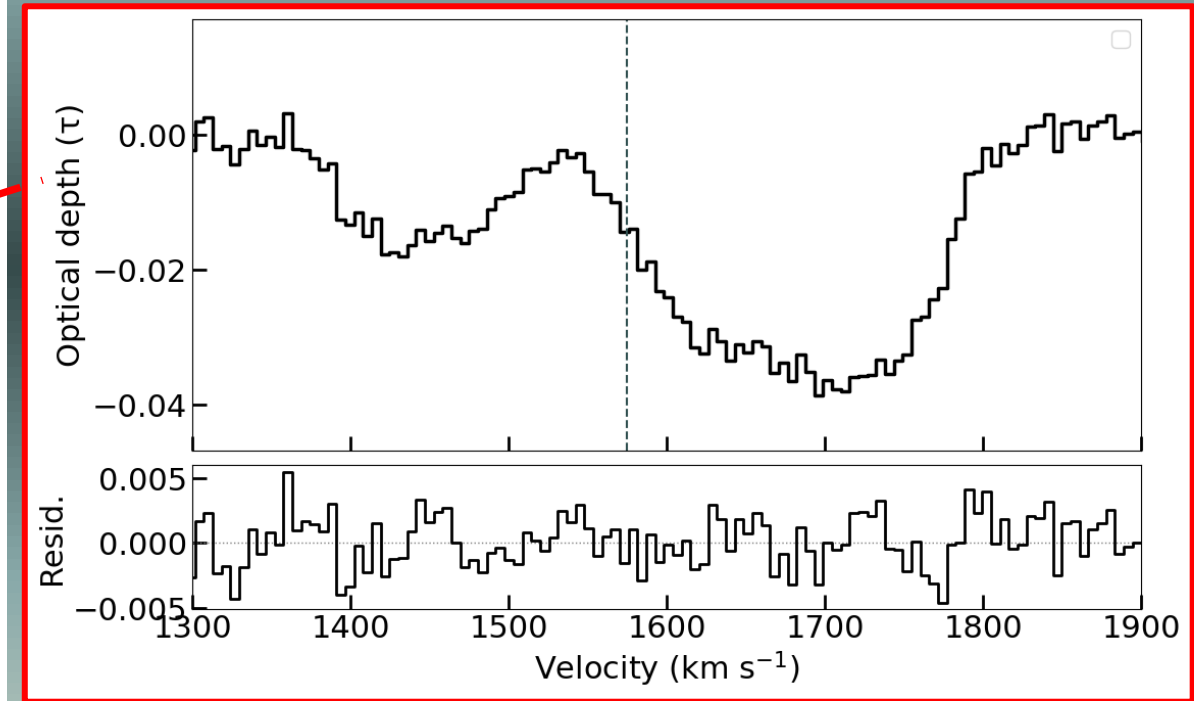
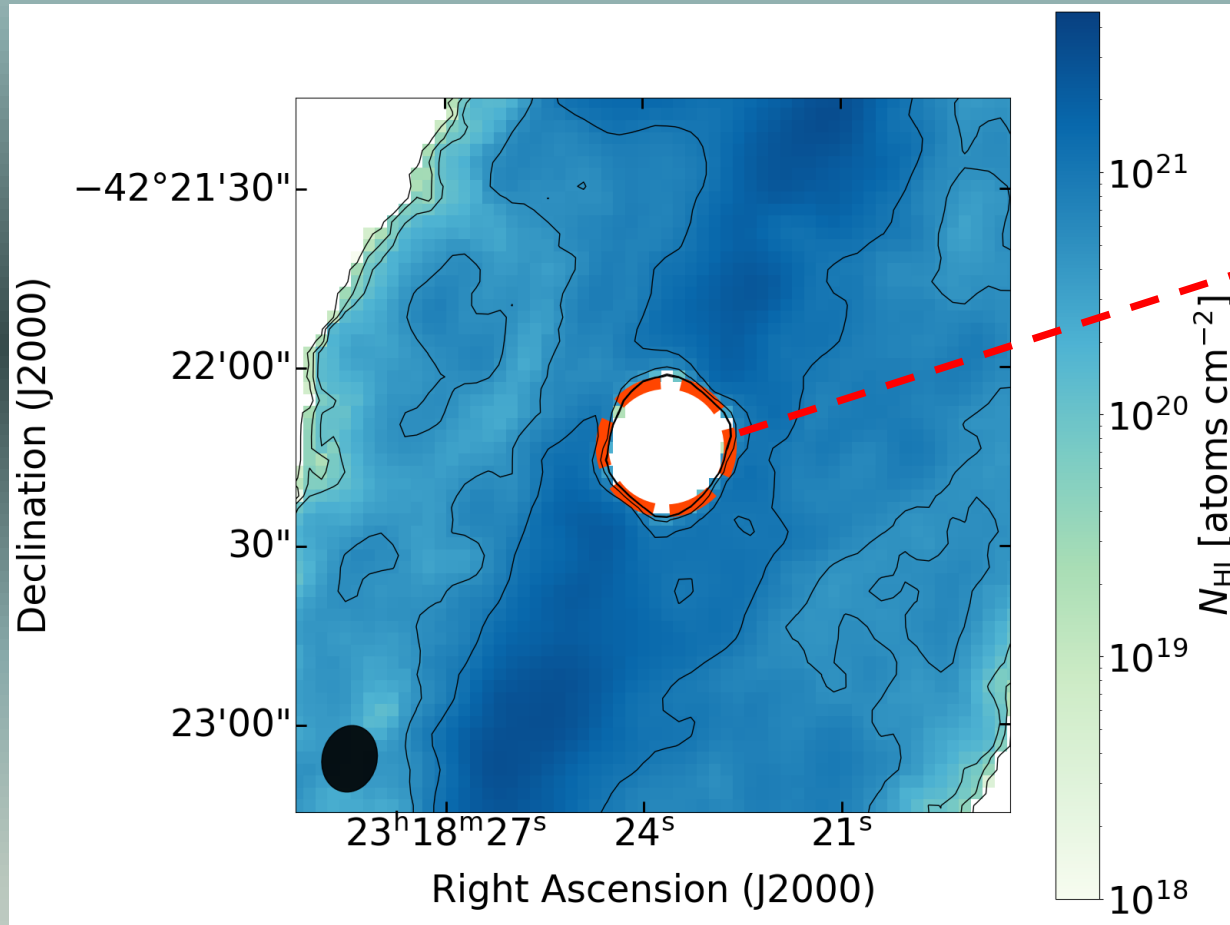


Juneau et al 2022

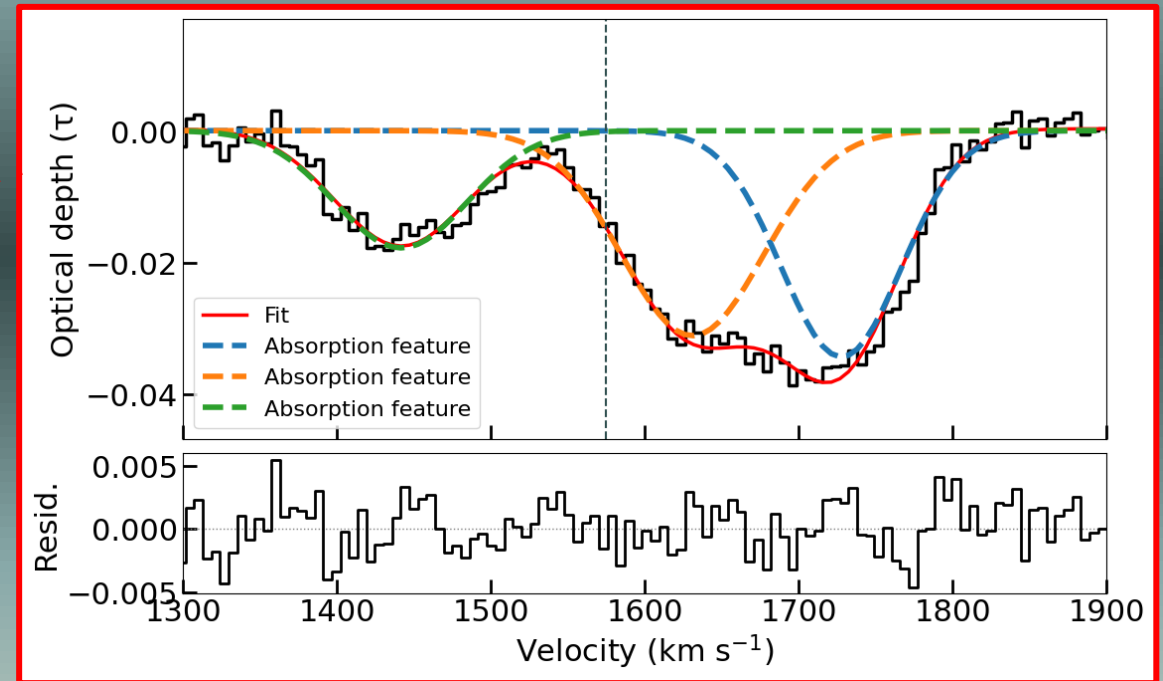
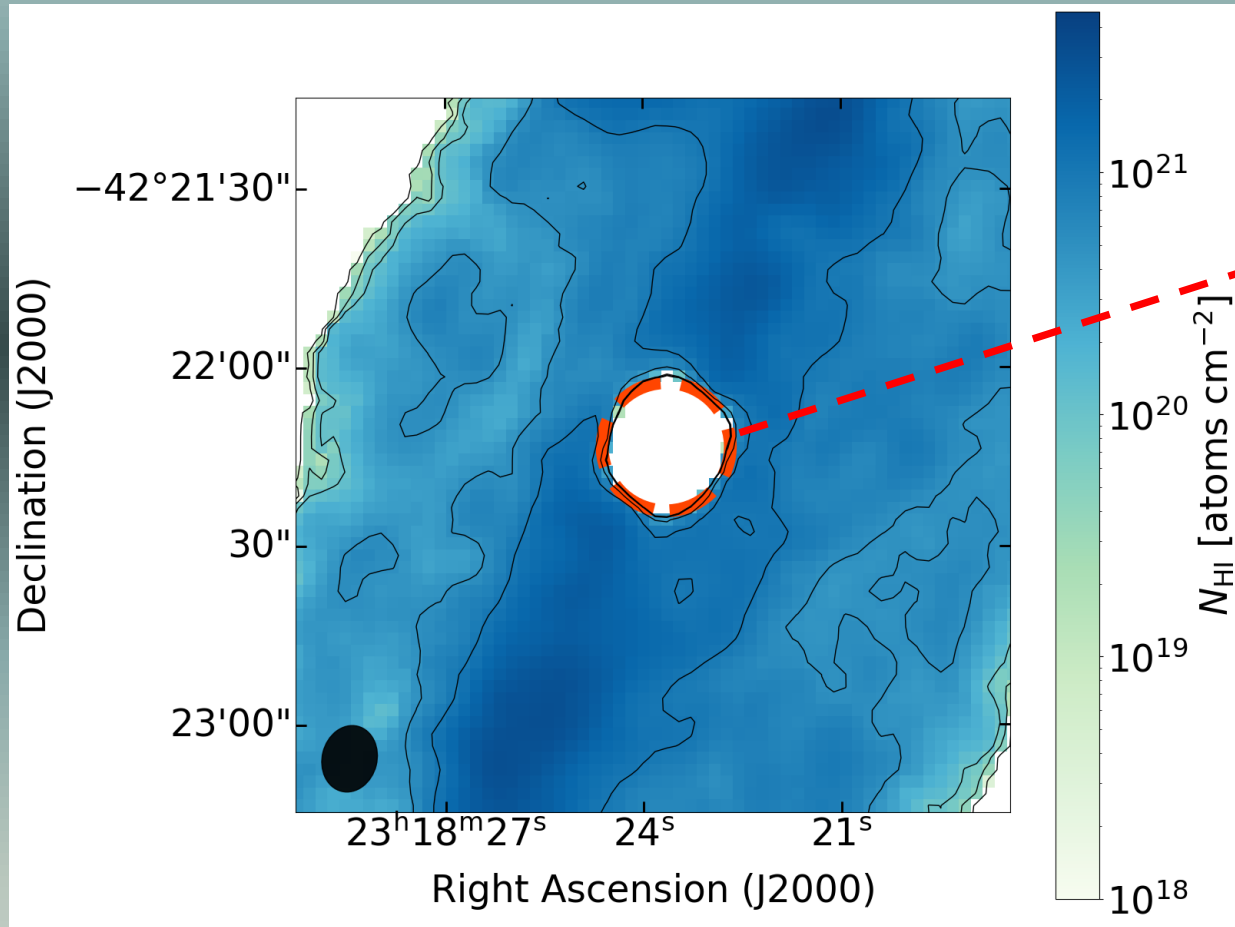
Veenema et al 2026



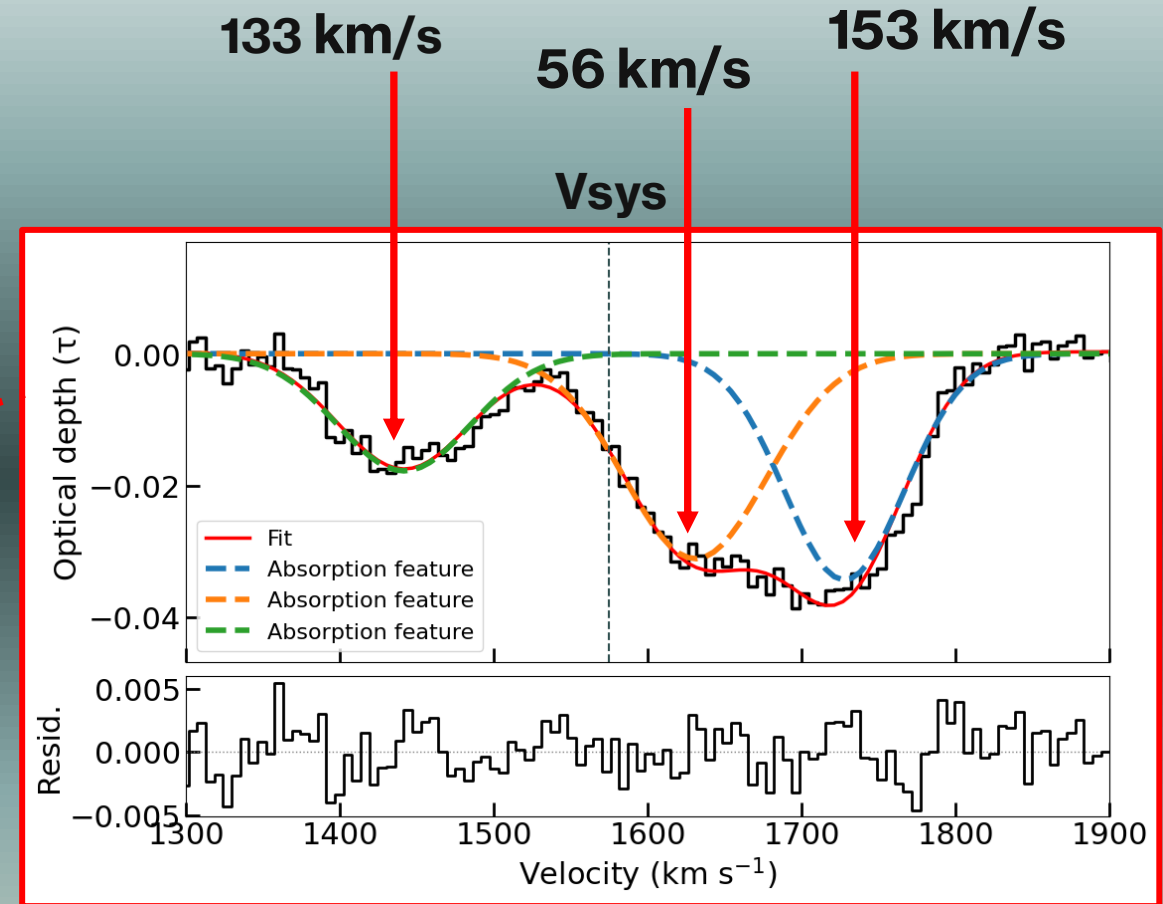
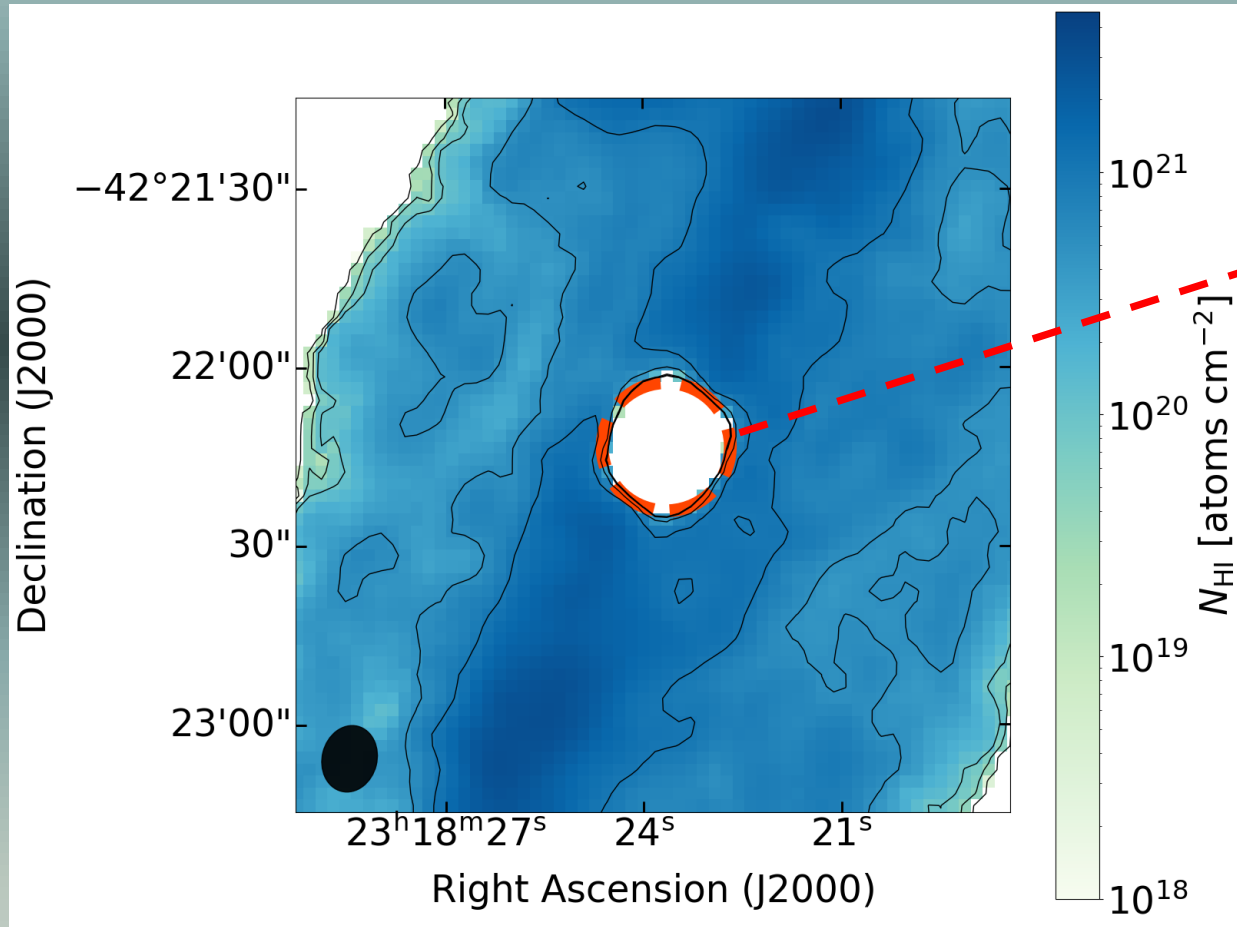
HI absorption in NGC 7582



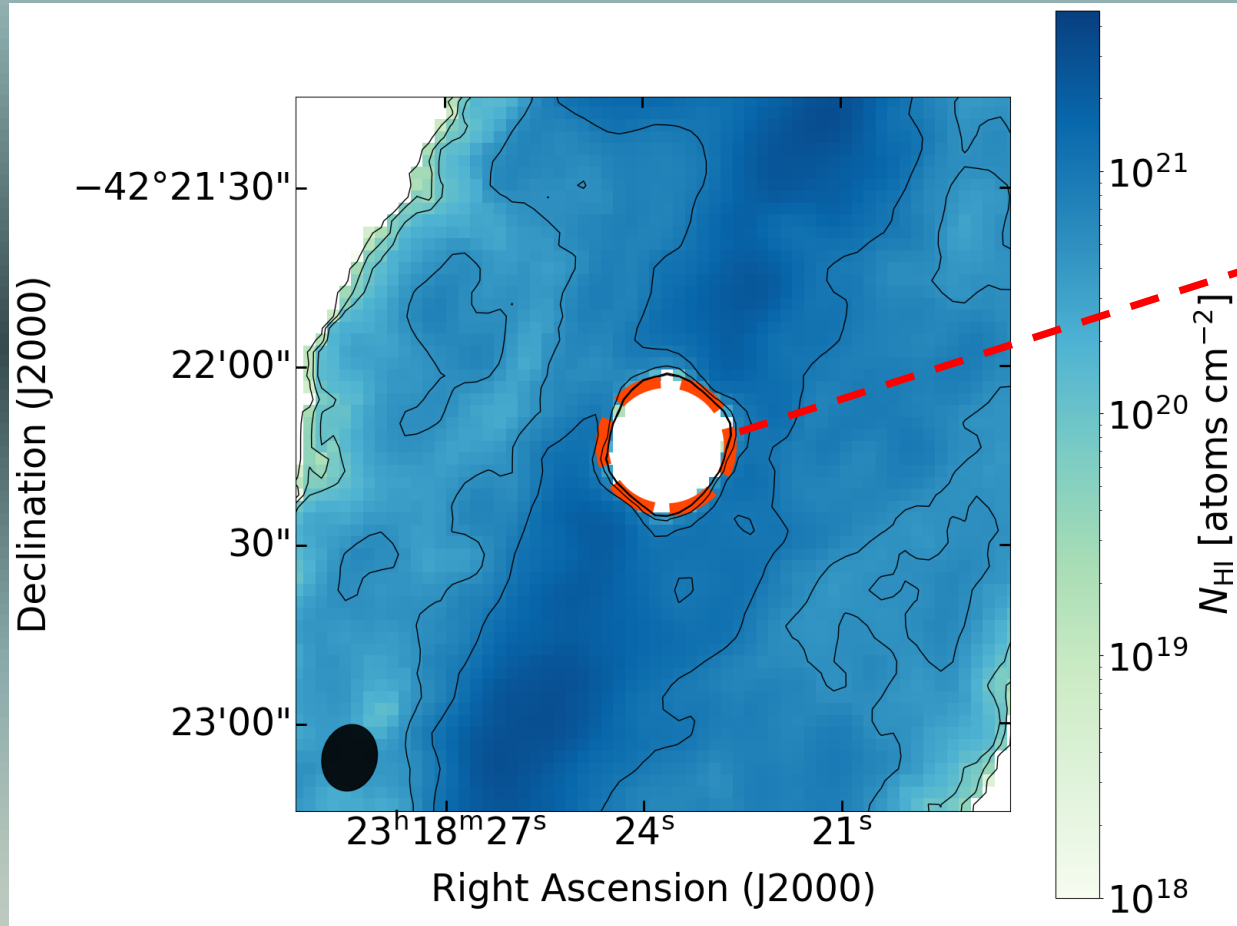
HI absorption in NGC 7582



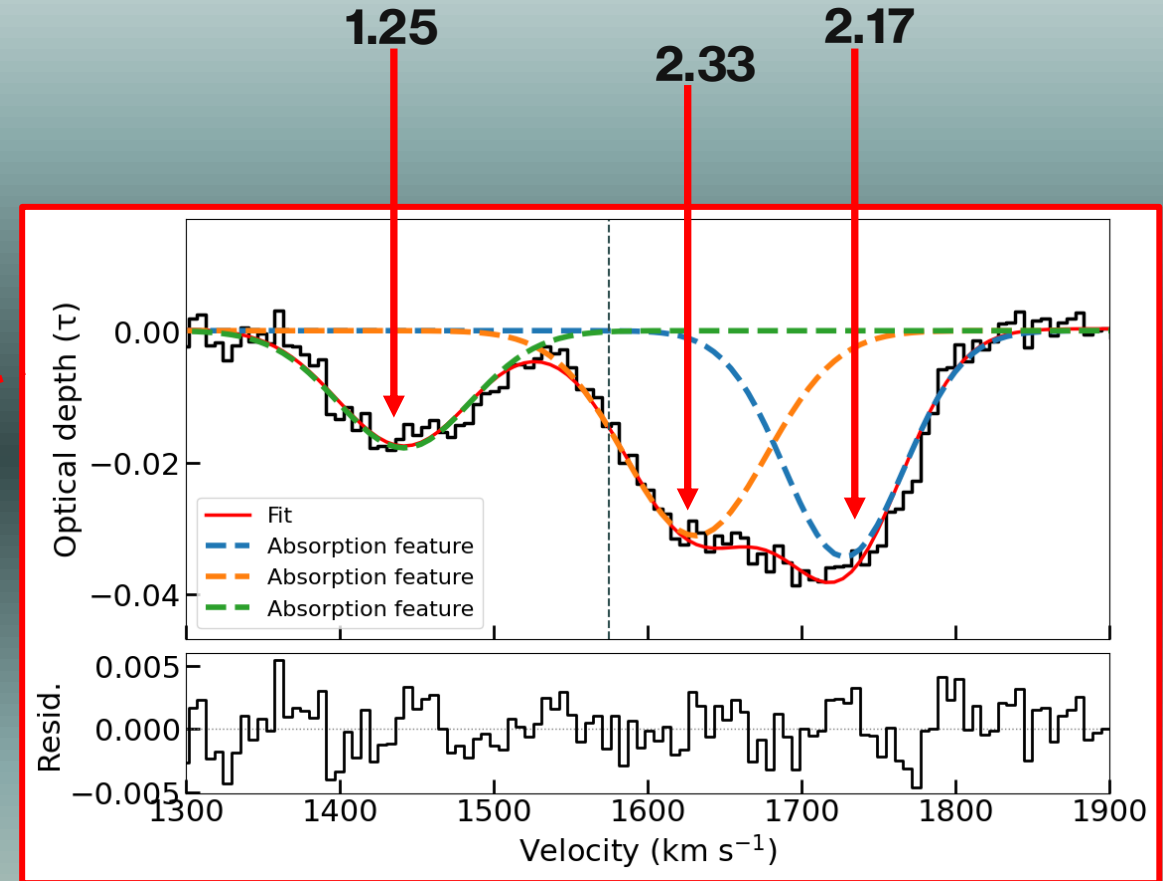
HI absorption in NGC 7582



HI absorption in NGC 7582

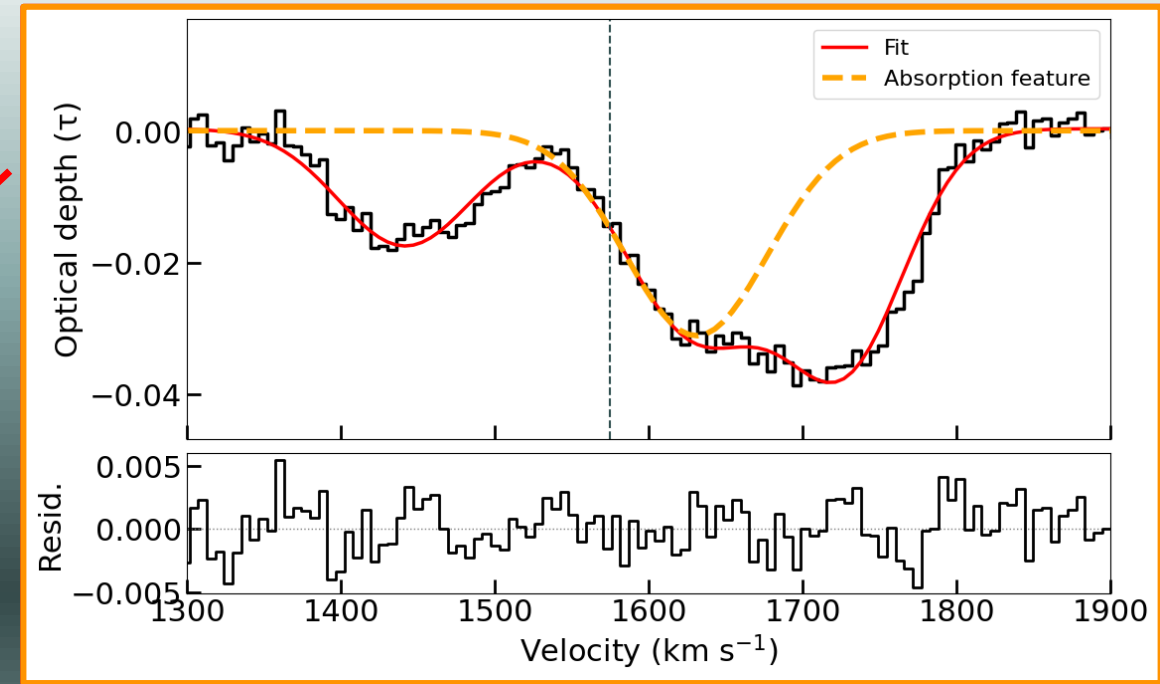
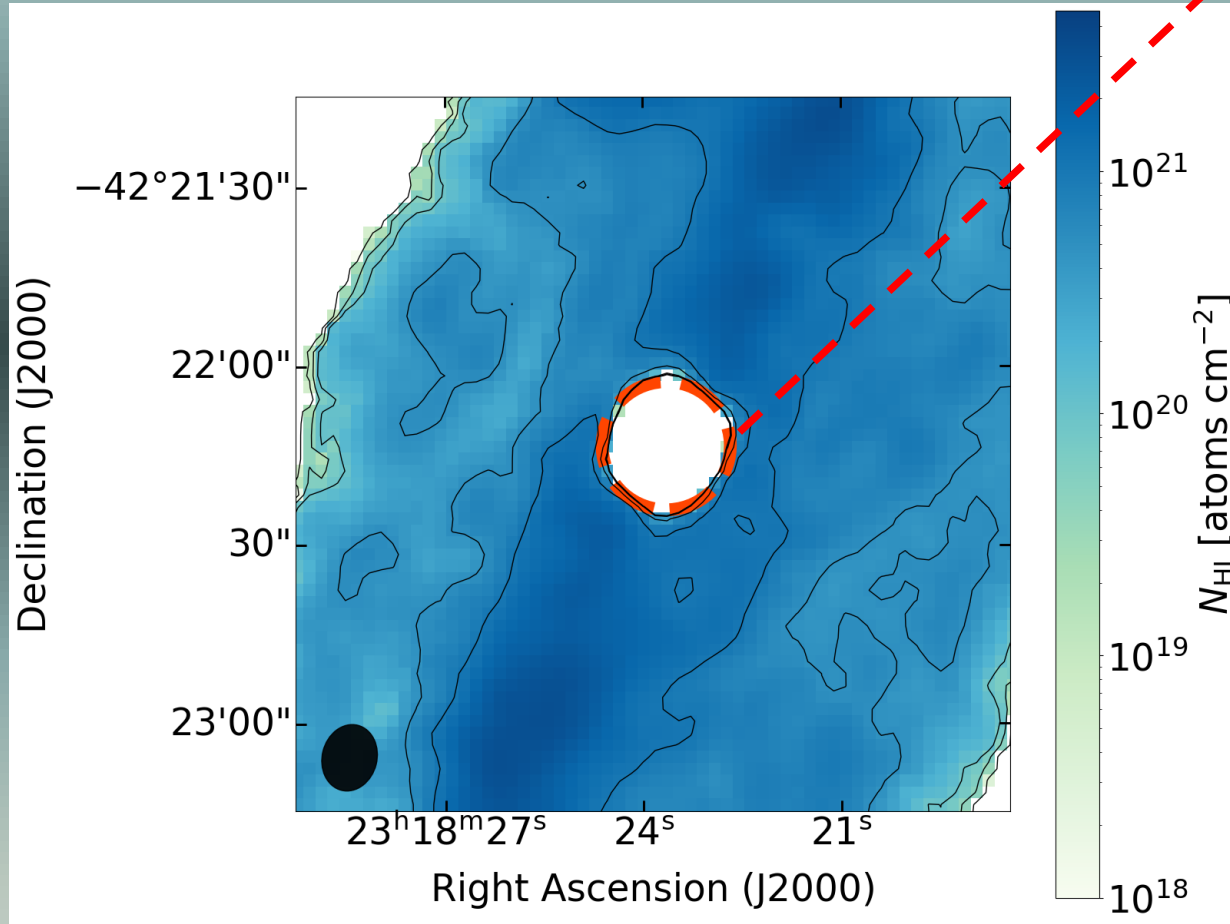


Component masses ($\times 10^7 M_{\odot}$)



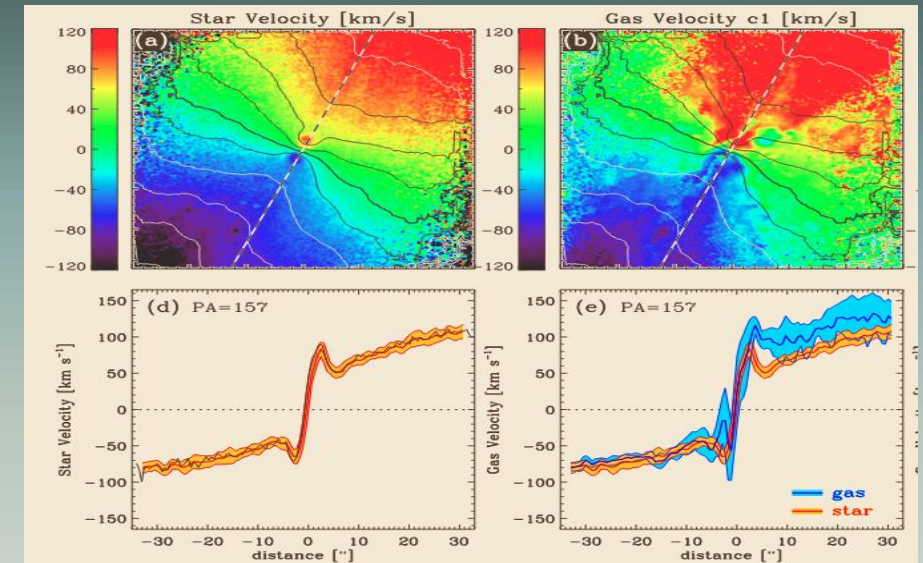
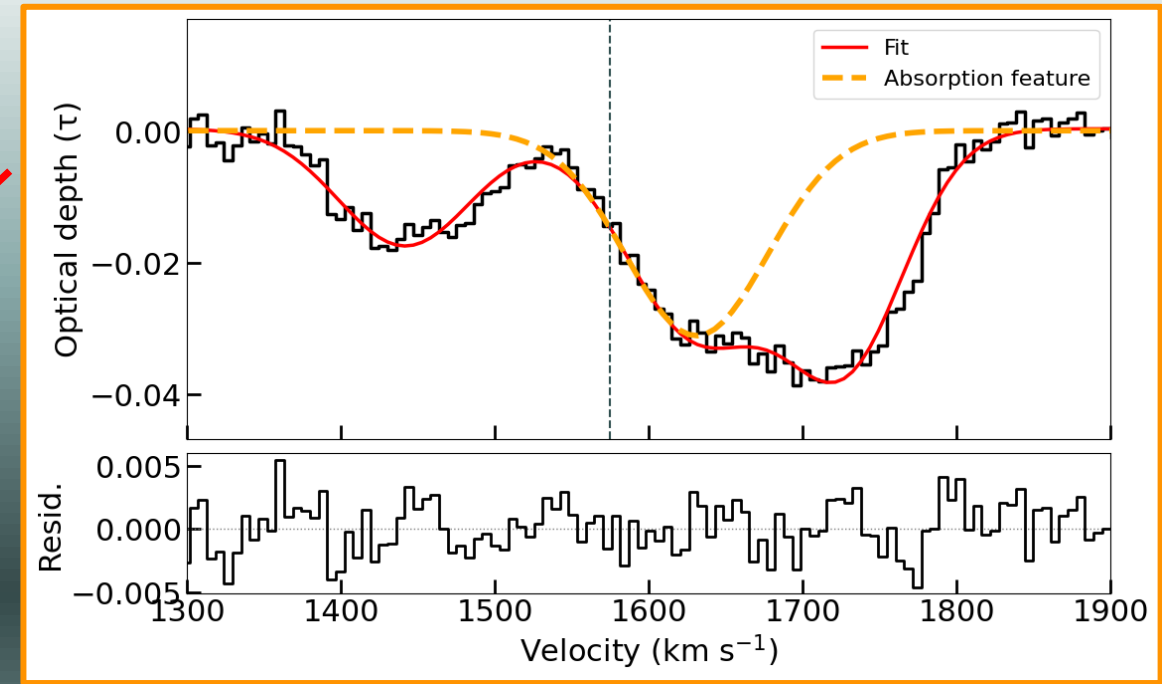
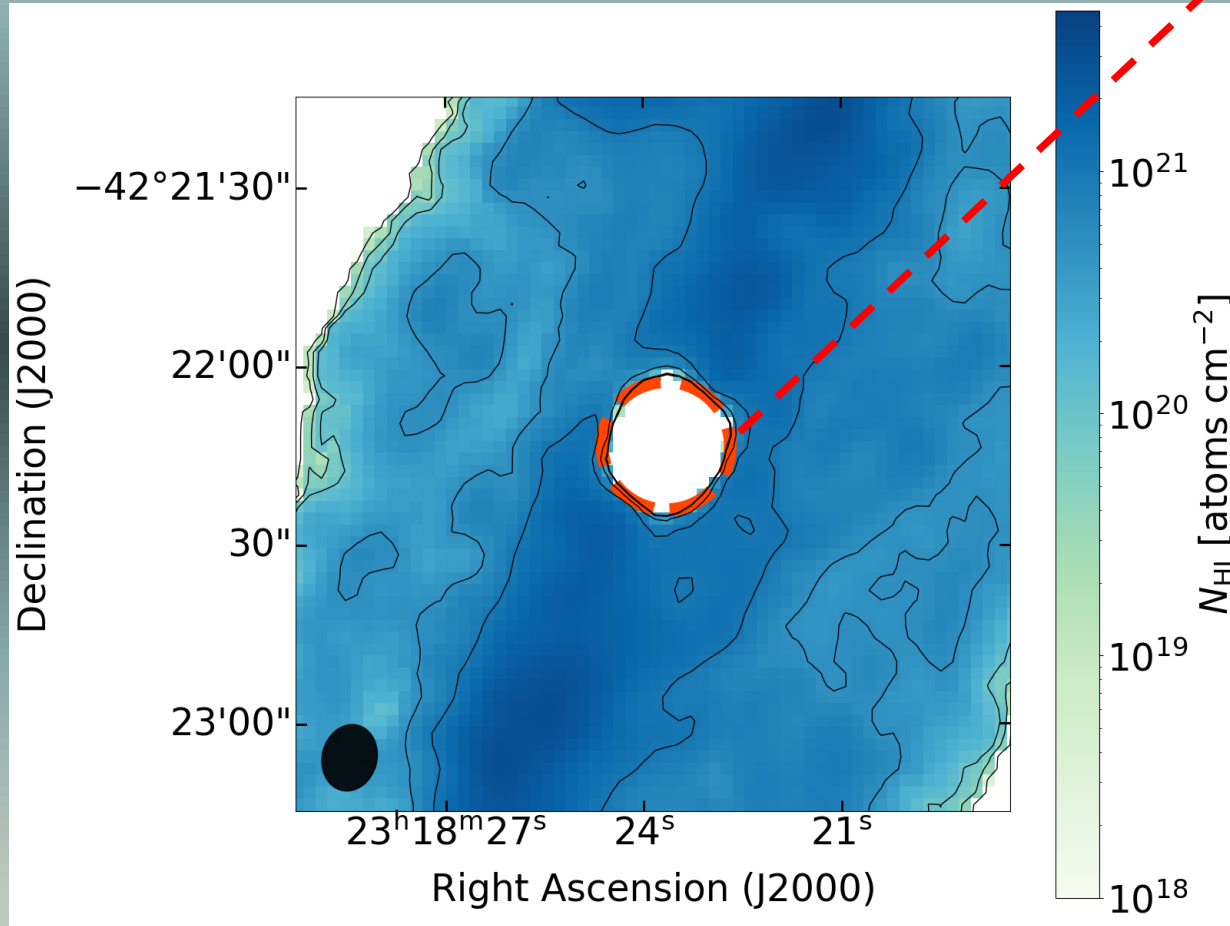
Adopting a spin Temp = 100 K

HI absorption in NGC 7582

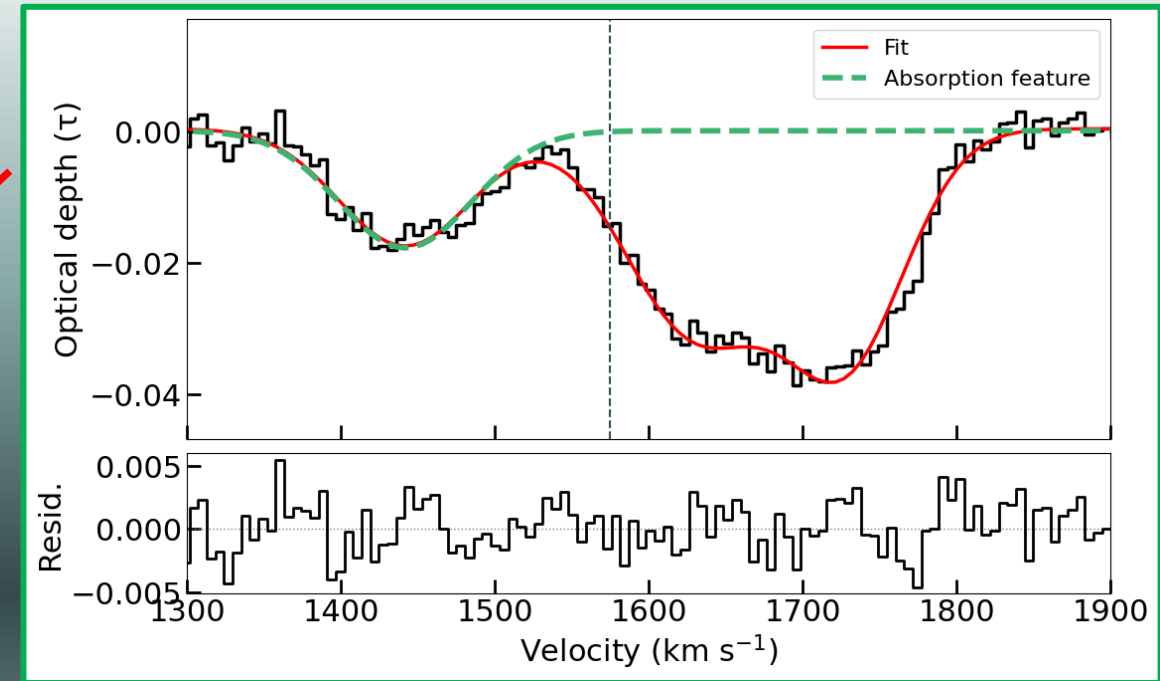
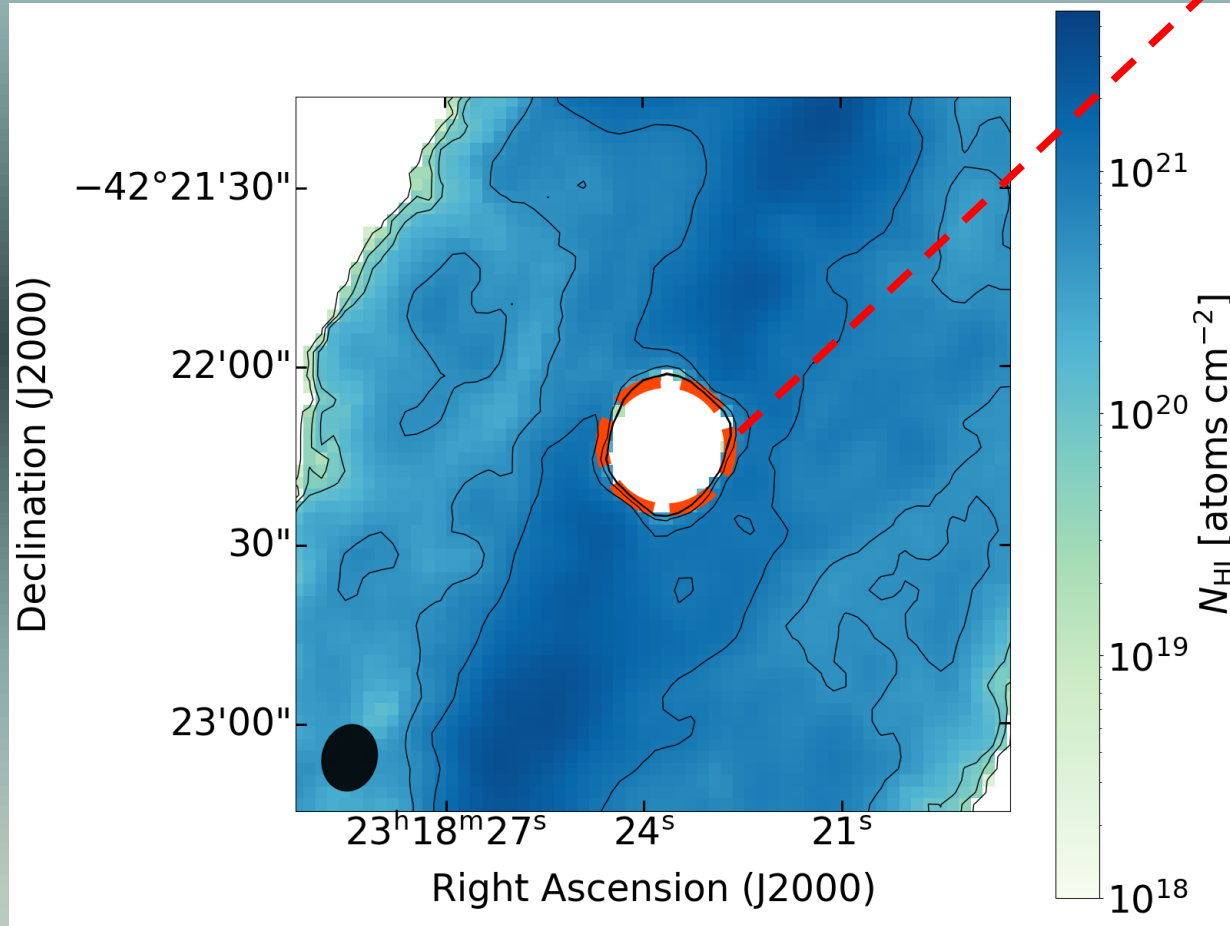


- **Redshifted comp (56 km/s) peaks close to V_{sys}**
- **Likely tracing a circumnuclear ring**
- **Juneau et al 2022 show that the gas is rotating faster than the stars by ~50 km/s in the inner region**

HI absorption in NGC 7582

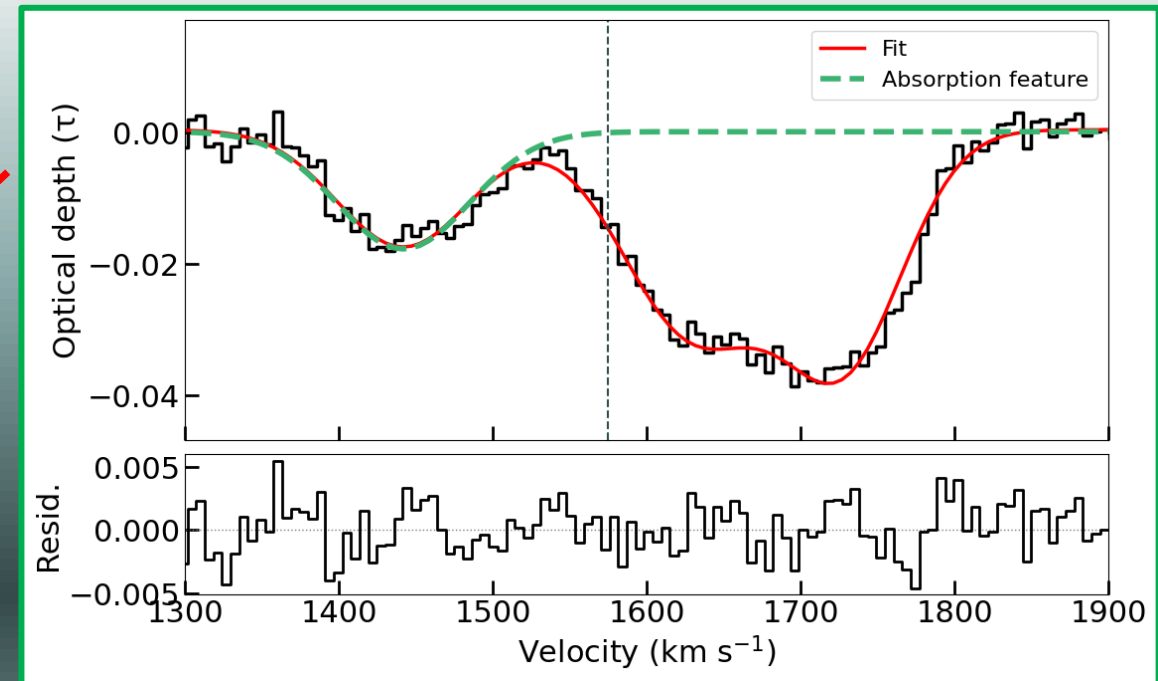
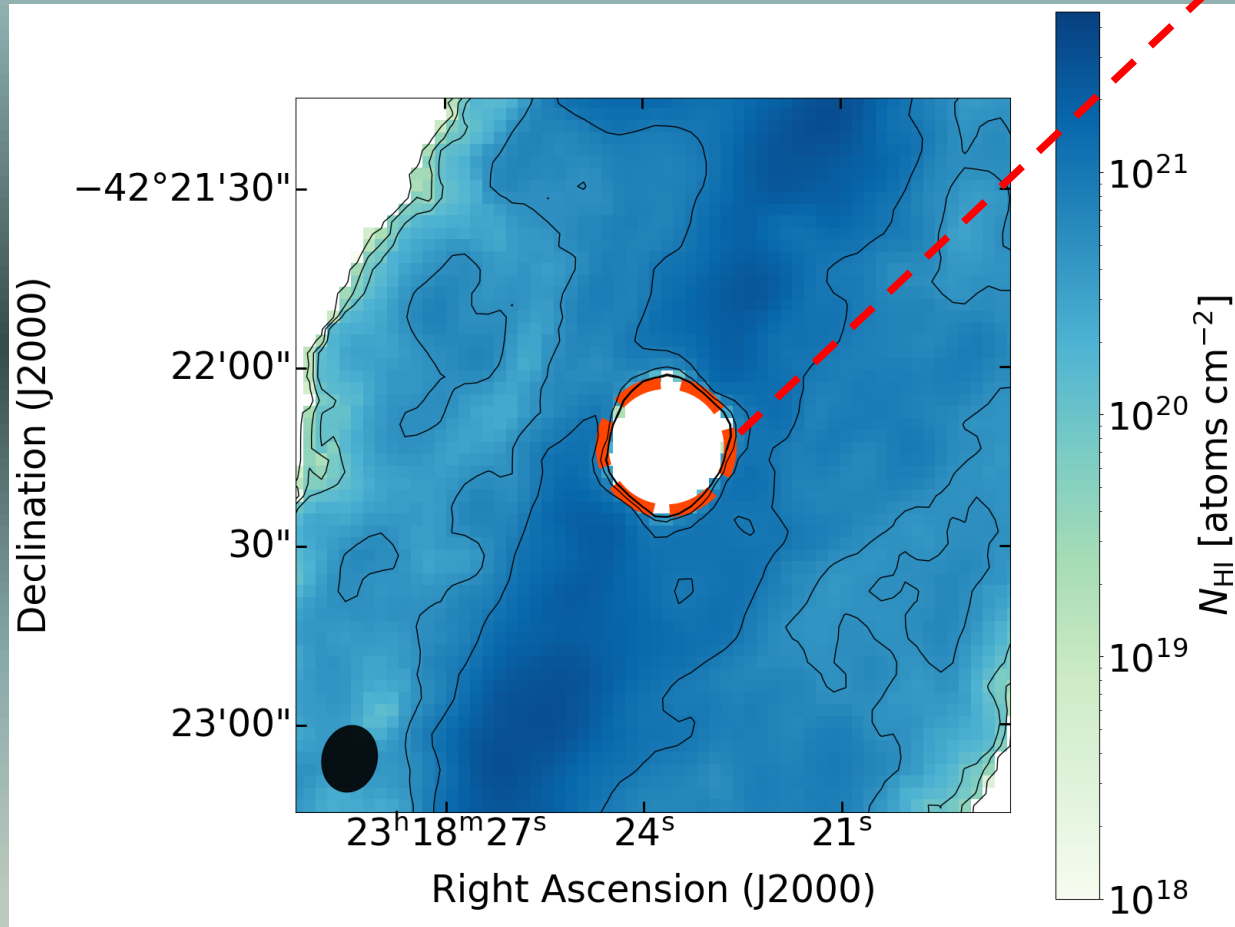


HI absorption in NGC 7582



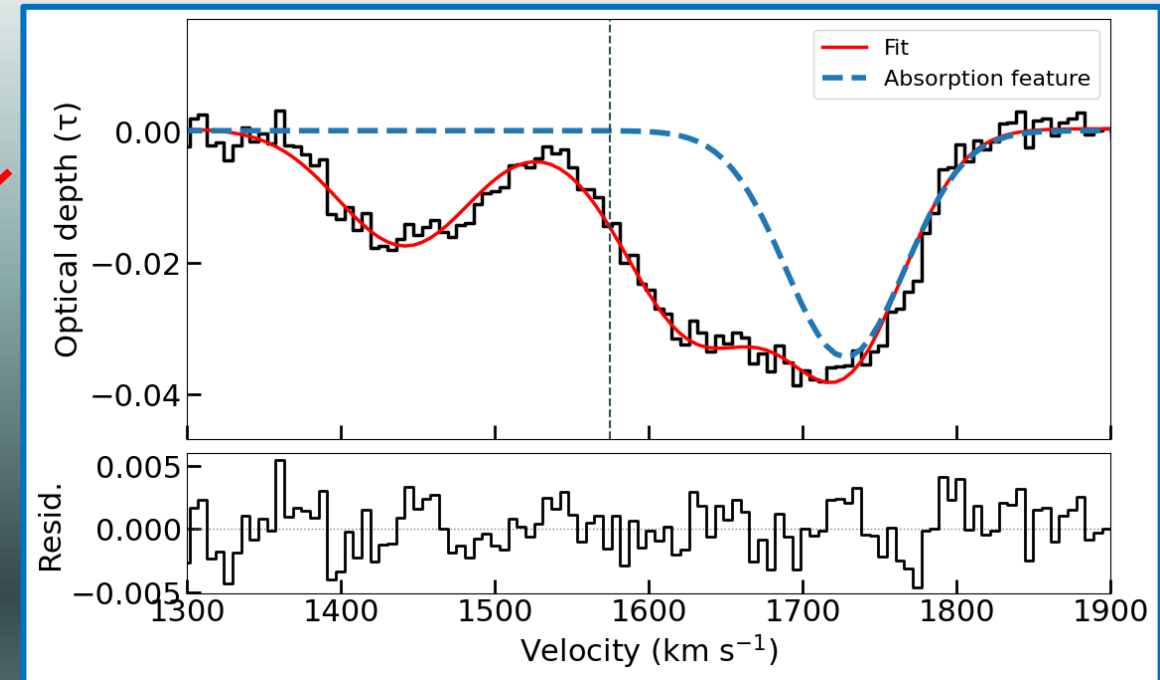
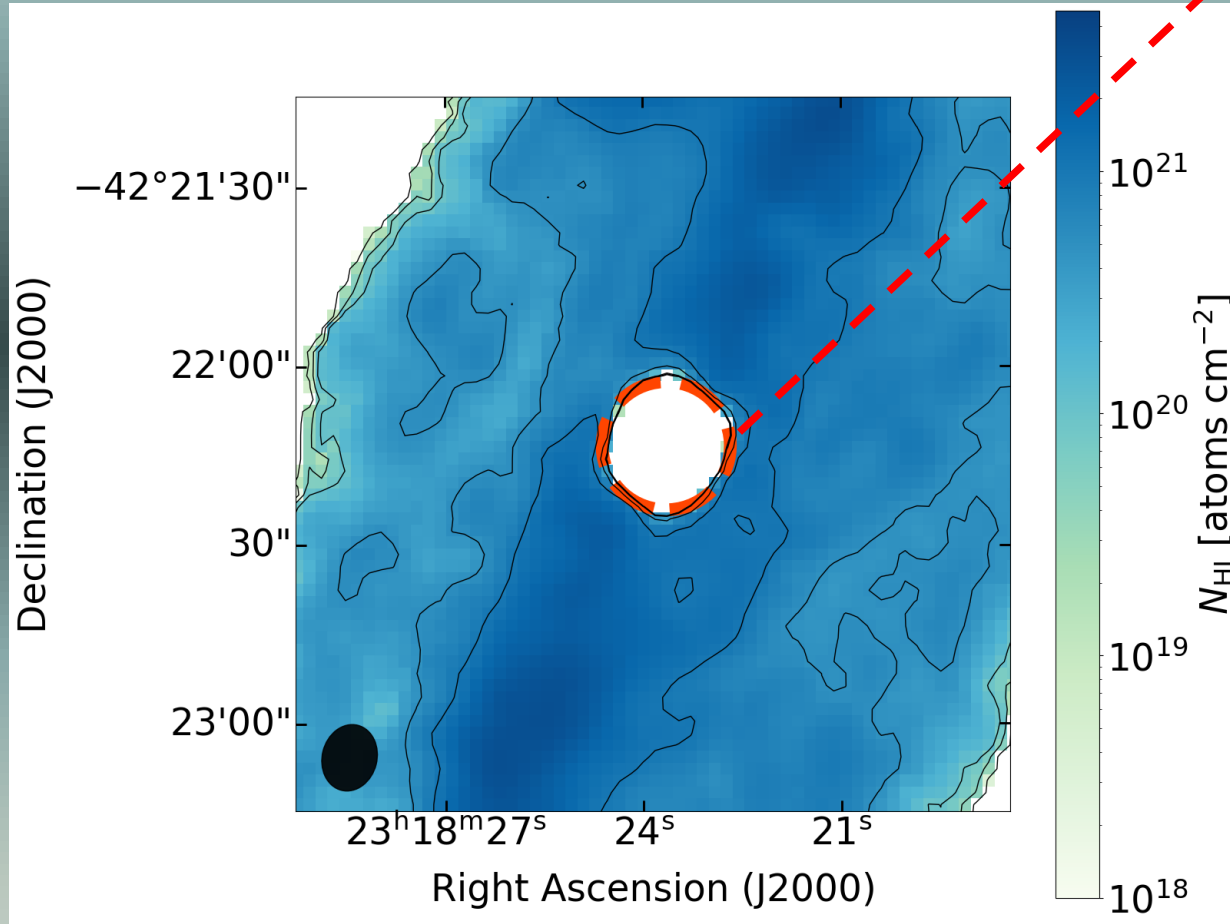
- **Blueshifted comp has consistent velocities with outflows in other wavelengths**
- **Typical optical depth for outflows**
- **Peak $V \sim 133 \text{ km/s}$**
- **Ionised outflow exceeds V_{esc} of 580 km/s**

HI absorption in NGC 7582



- Assume that gas has same origins (200 pc)
- Adopt spin Temp = 1000 K
- HI mass outflow rate $\sim 2.35 M_{\odot}/\text{yr}$
- Ionised gas mass outflow rate $\sim 0.05 M_{\odot}/\text{yr}$

HI absorption in NGC 7582



- **2nd redshifted comp (153 km/s) likely tracing infalling clouds**
- **Required accretion rate to sustain luminosity: $2.6 \times 10^{-3} M_{\odot}/\text{yr}$**
- **Assuming the gas lies at 200 pc SF disk: $16.95 M_{\odot}/\text{yr}$. Cloud infall rate onto galaxy**
- **Gas can be as far as 1300 kpc along LOS to match required rate**

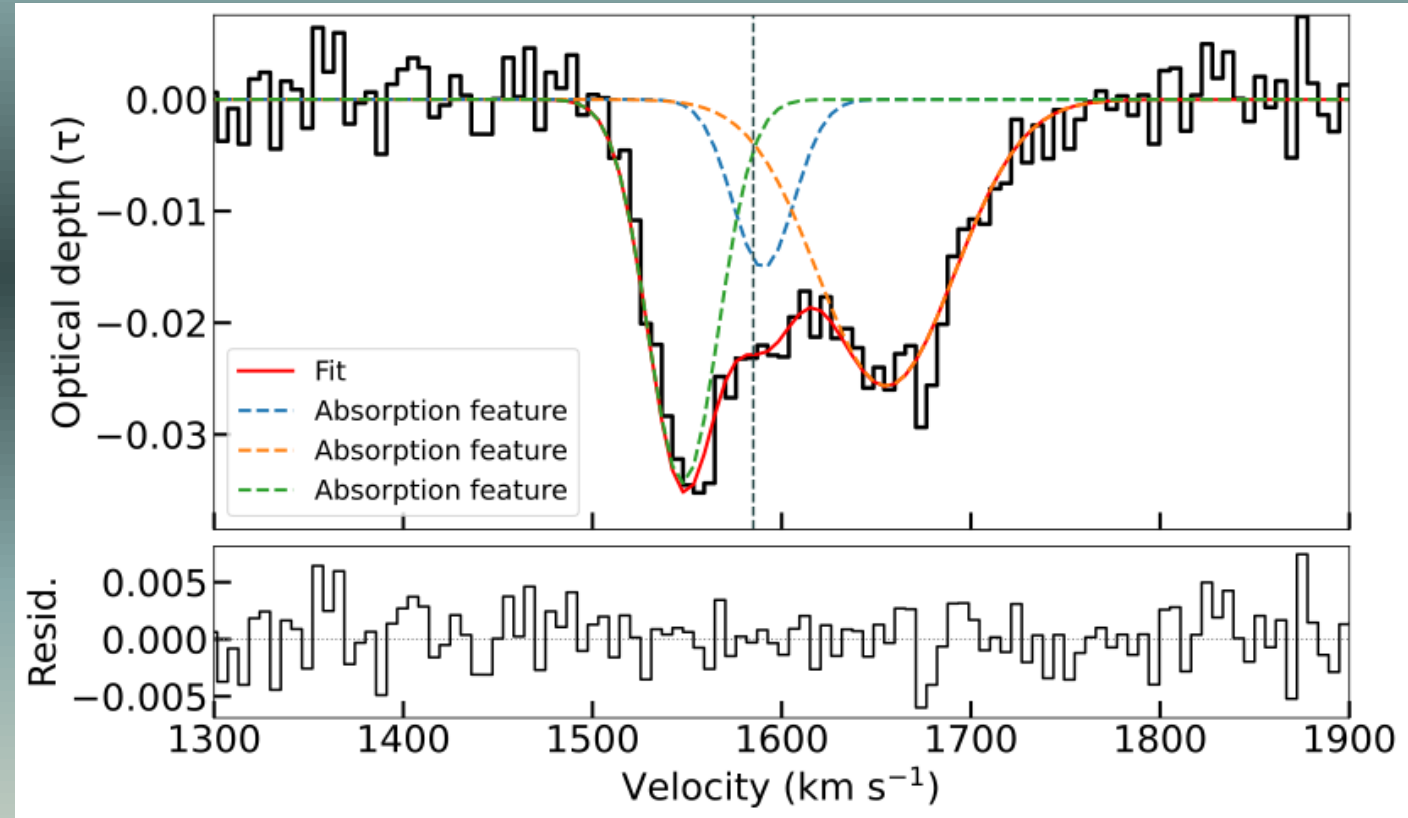
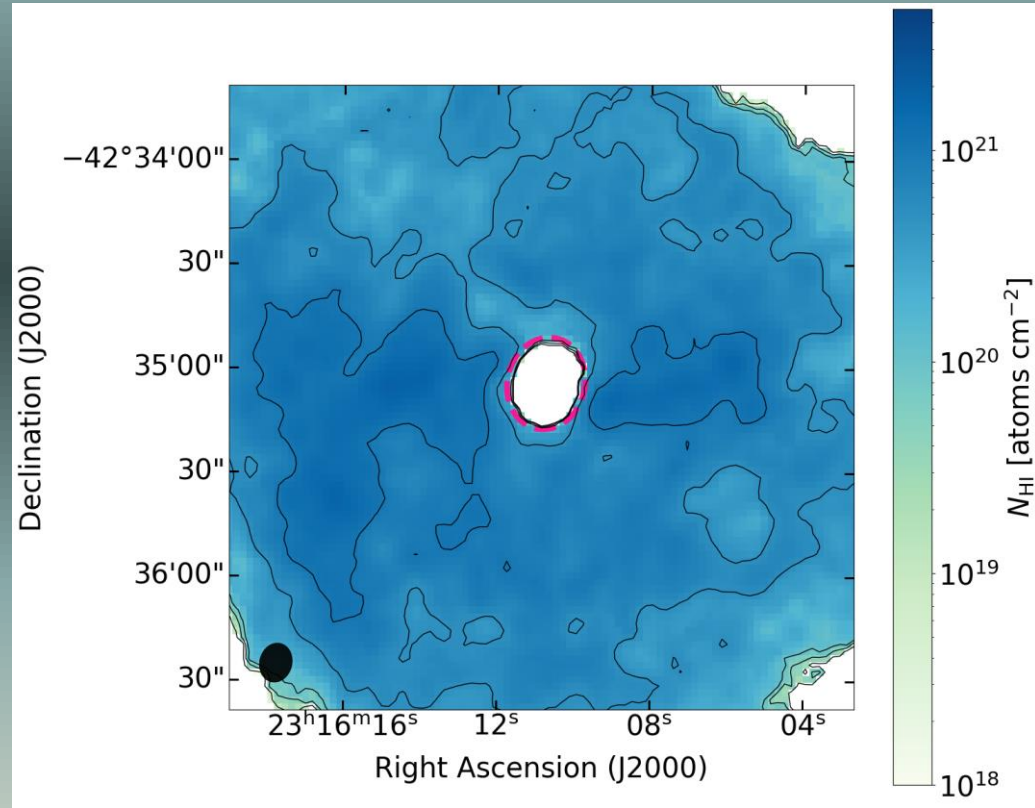
Summary

- **MeerChoirs MeerKAT HI data reveals the presence of HI absorption in NGC 7582**
- **The absorption profile is complex with multiple gas components along the LOS**
- **Evidence for both an outflow and infalling clouds**
- **A fraction of the HI in outflow may be launched into the CGM or even IGM**
- **The infalling HI could feed the AGN**
- **The AGN may 'loosen up' the disk H, making it more susceptible to tidal stripping from group members.**
 - **It is vital to assist the relative importance of internal factors compared to external factors in shaping the HI morphology of a galaxy**

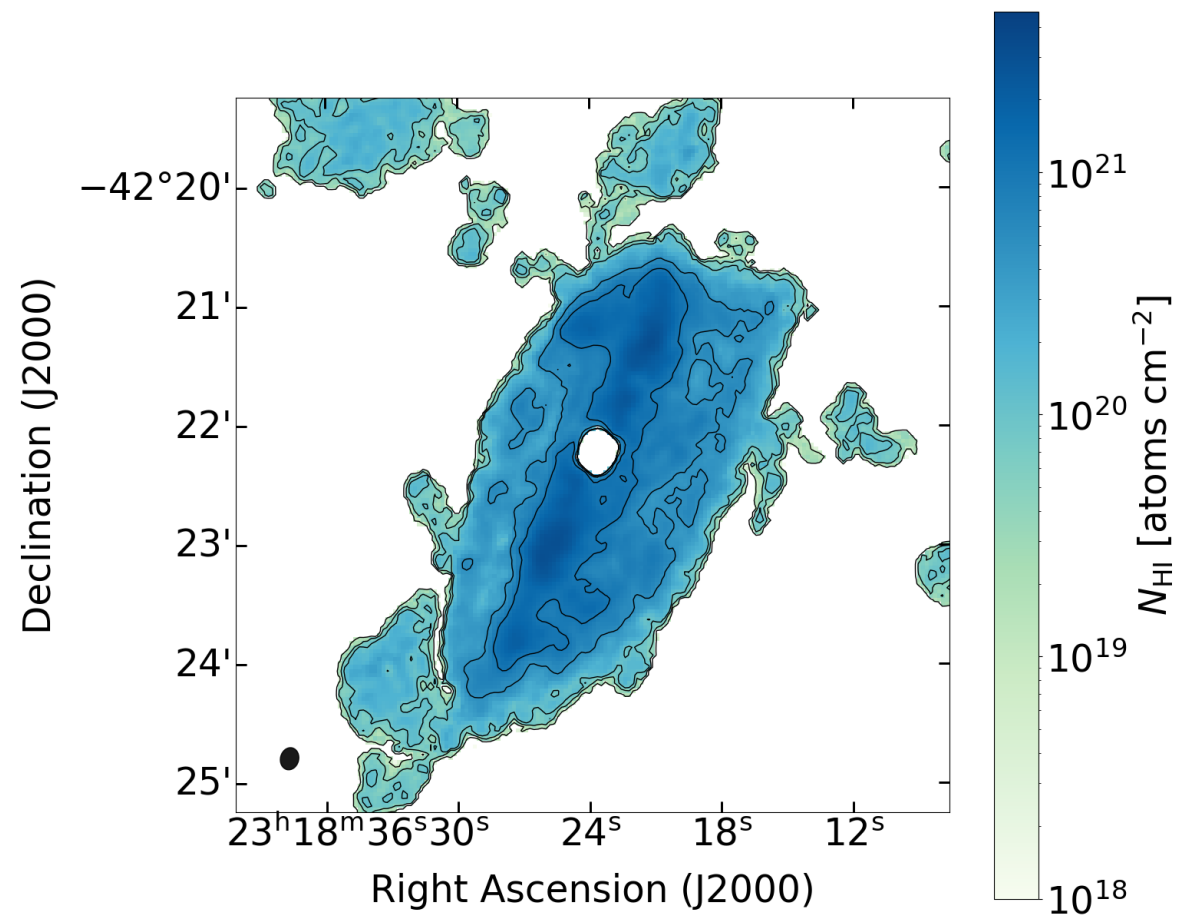
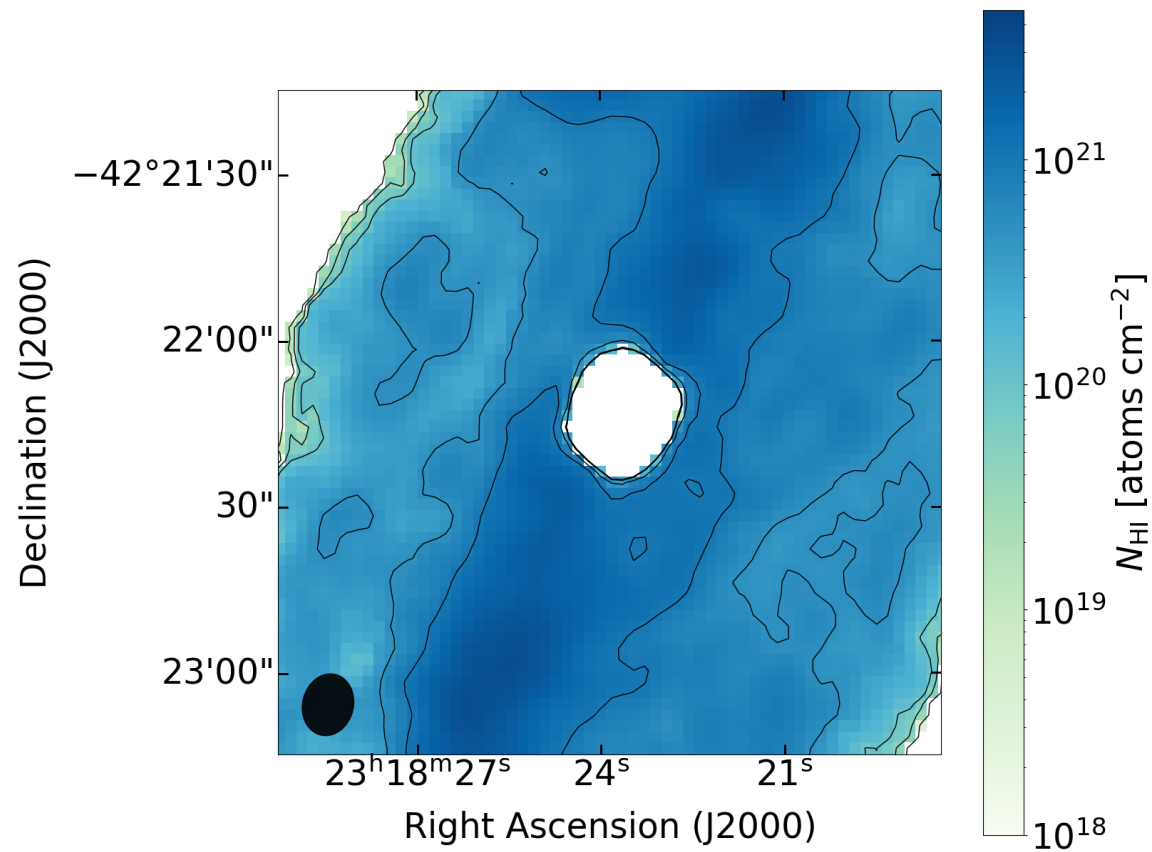
The background is a vast, dark cosmic space filled with a multitude of galaxies and stars. In the upper left, there's a prominent blue and white spiral galaxy. Below it, a bright, elongated yellowish-white galaxy is visible. The lower right corner features a large, bright yellowish-white spiral galaxy. The entire field is peppered with countless smaller stars and distant galaxies, creating a sense of immense scale and depth.

**THANK
YOU!**

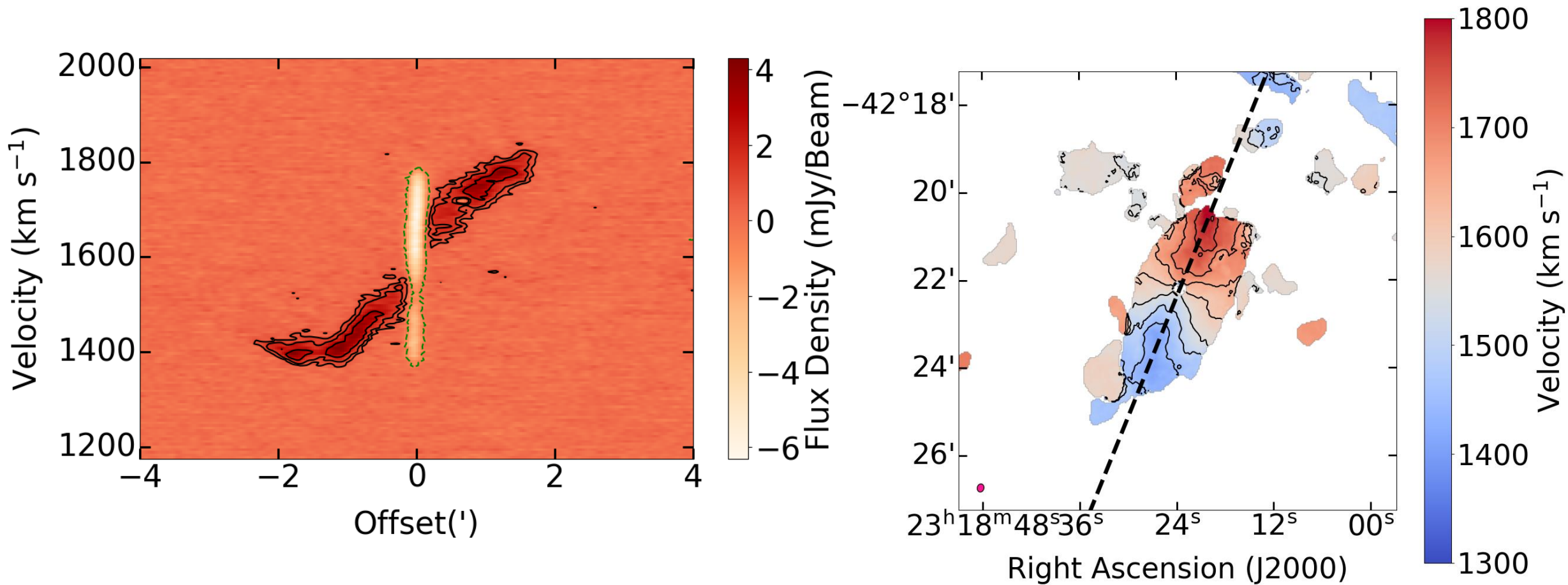
NGC 7552 is also here



HI absorption in NGC 7582



HI absorption in NGC 7582



HI absorption in NGC 7582

