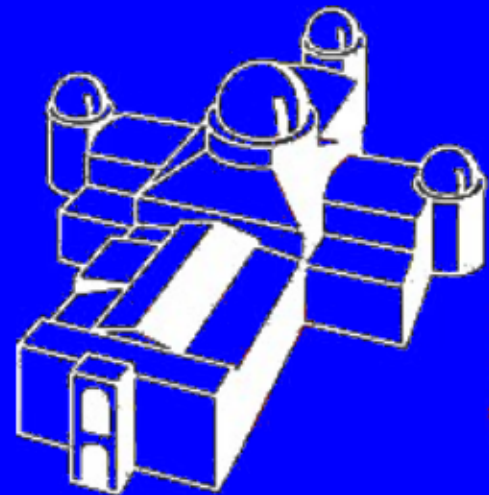


# Cold streams: detectability, relation to structure and characteristics



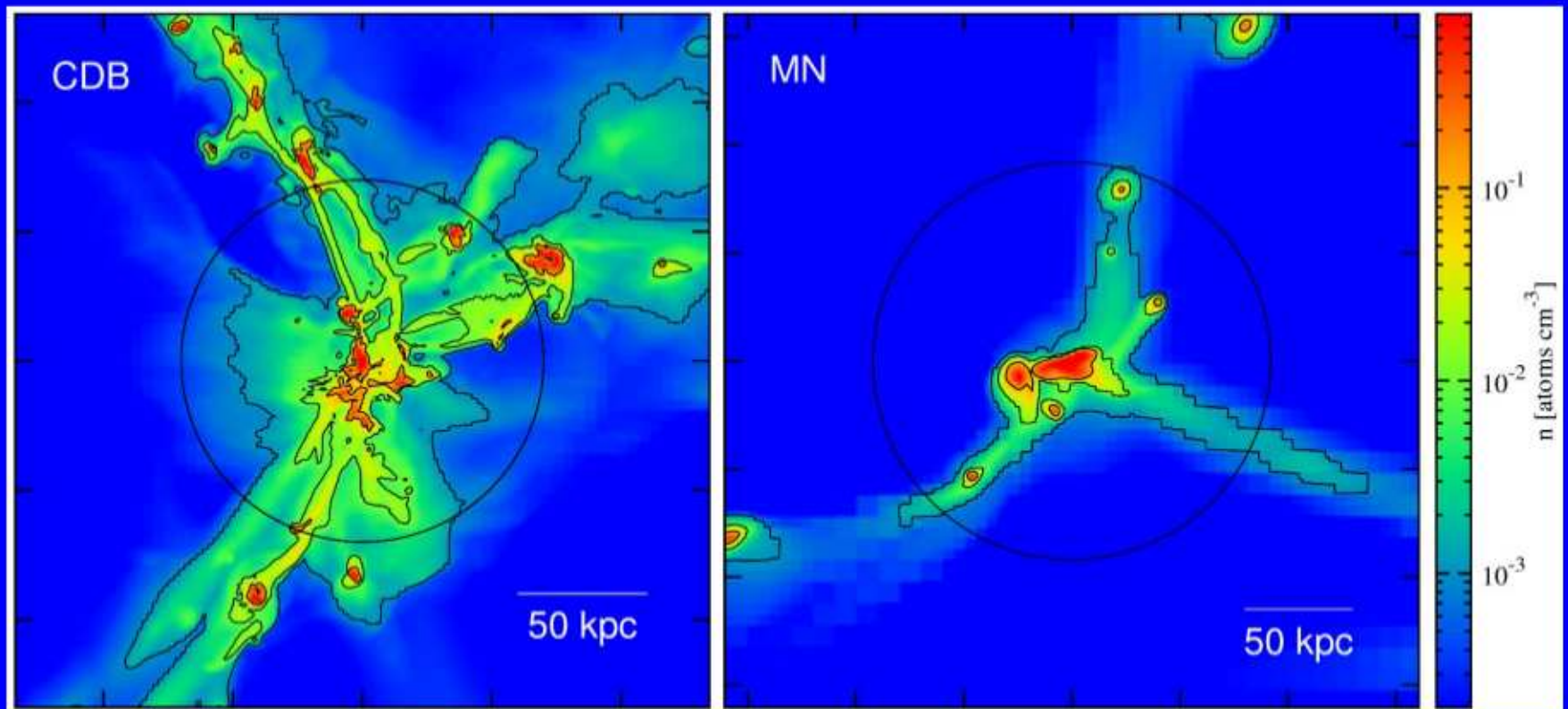
Tobias Goerdt

University of Vienna



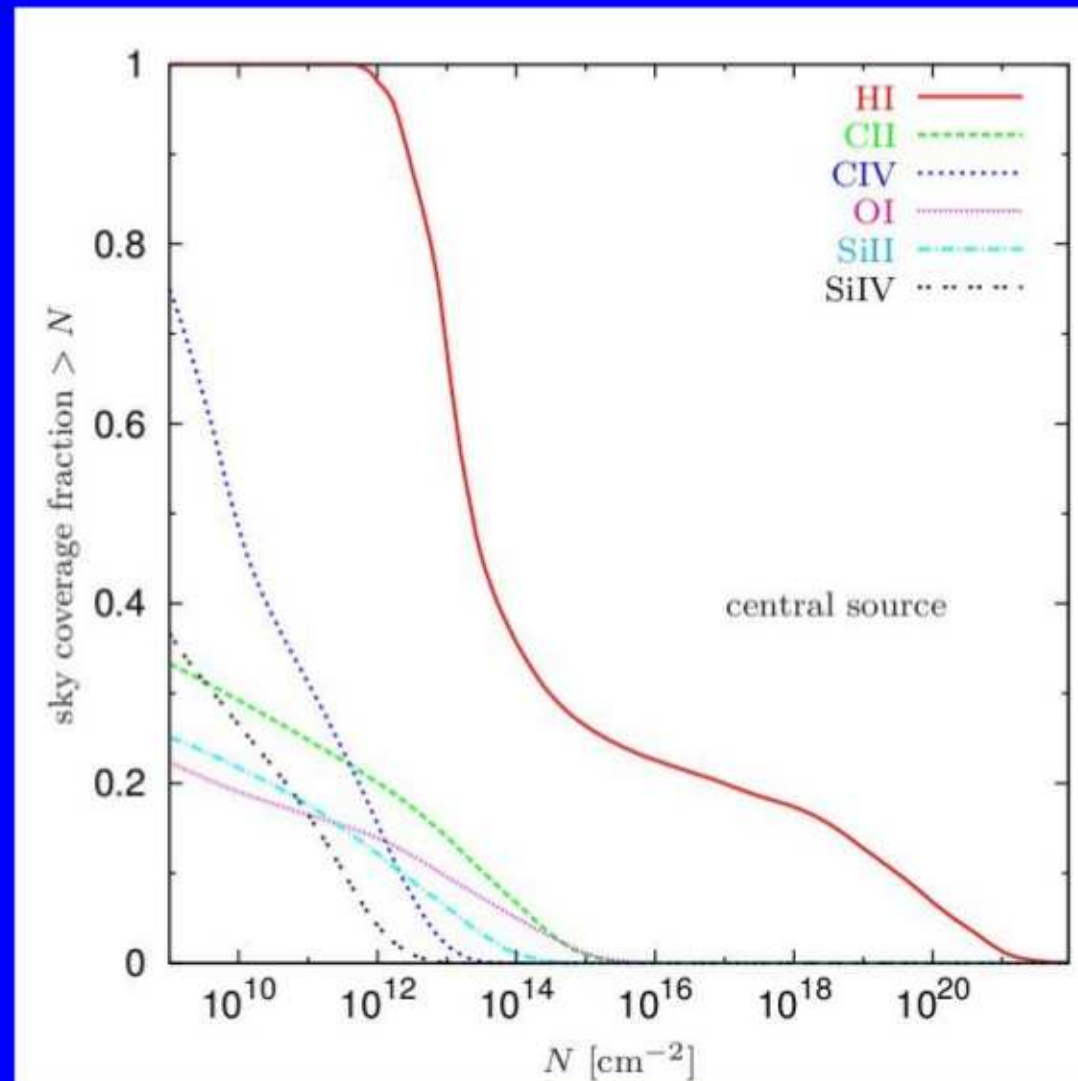
Collaborators: Daniel Ceverino, Andi Burkert,  
Avishai Dekel, Amiel Sternberg

# Cold streams



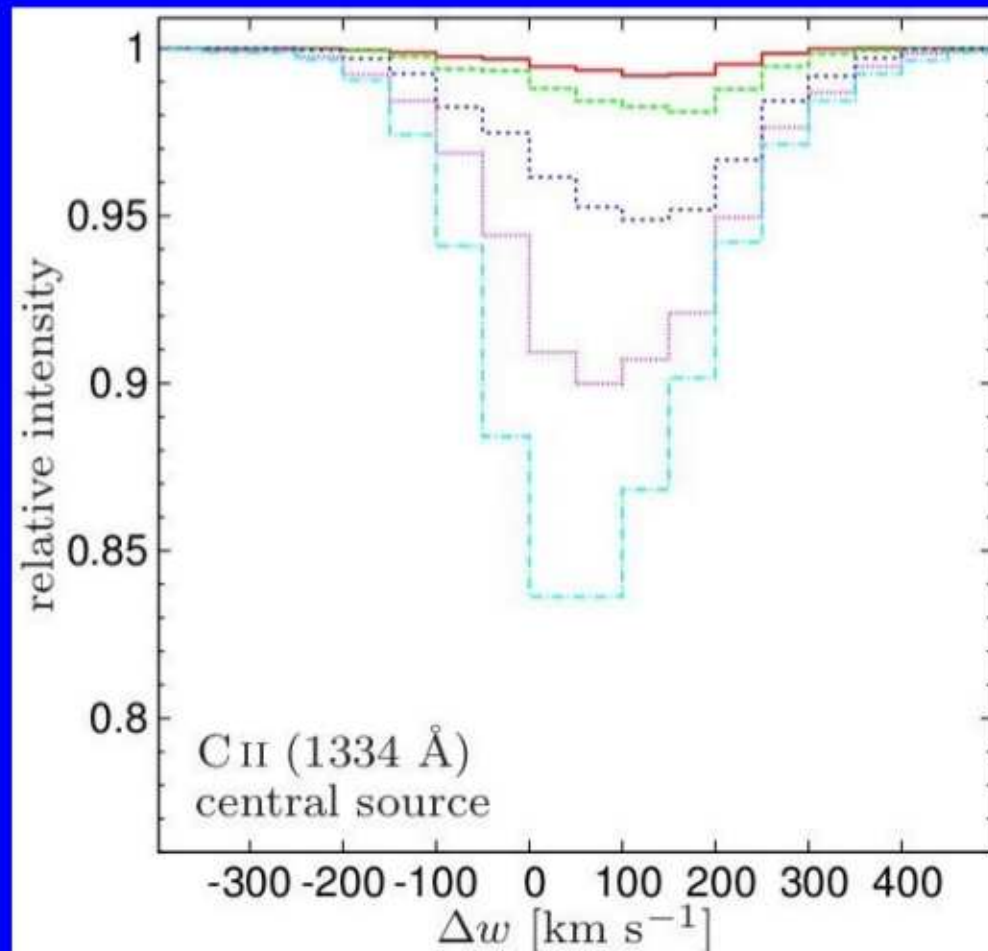
# Detectability in absorption: Computed sky covering fraction

- Very low sky covering fraction
- Low metallicity in streams



# Stacked absorption line profiles

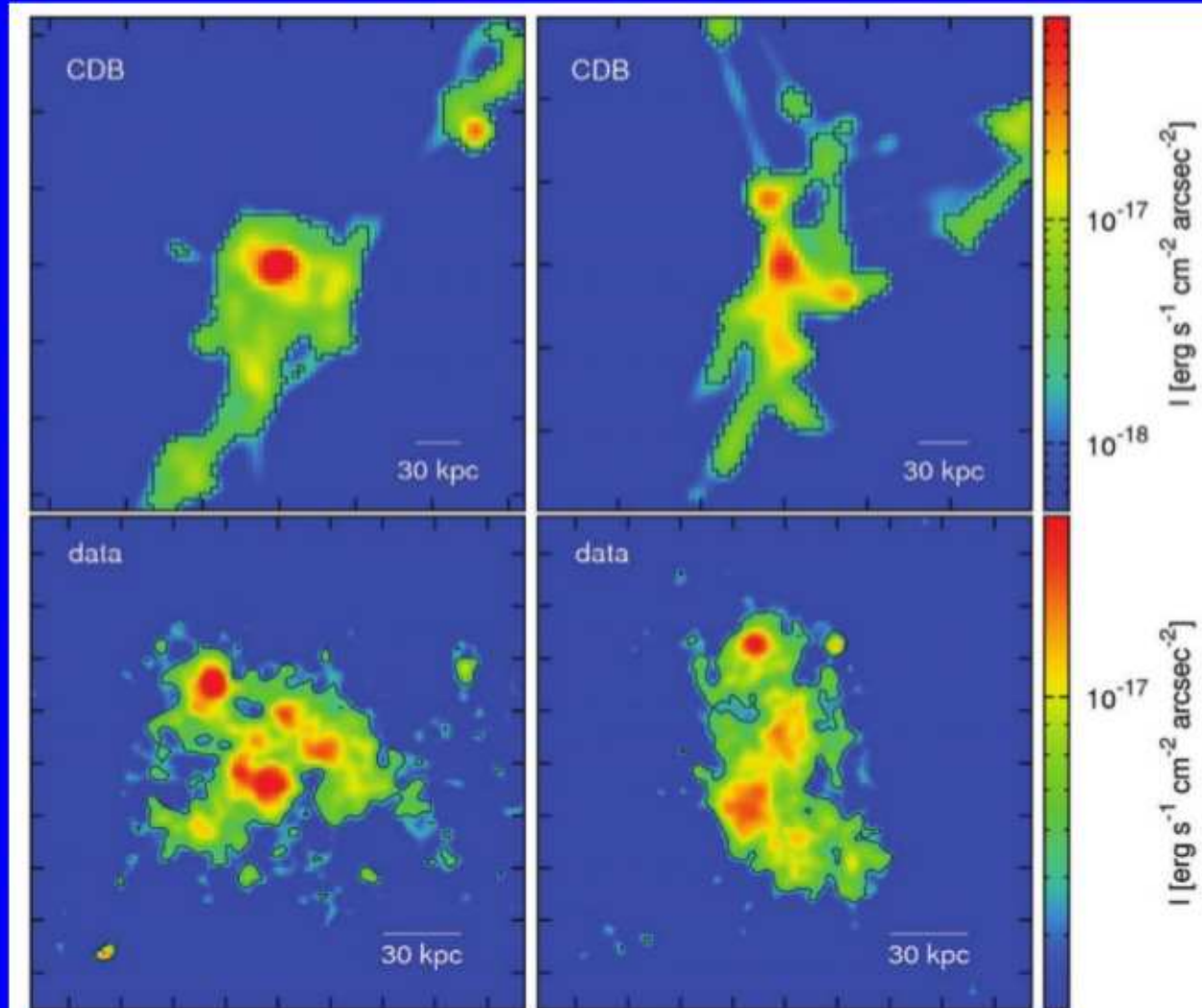
- Central geometry / 'down the barrel'
- In agreement with Steidel et al. (2010) or Bouché et al. (2013)





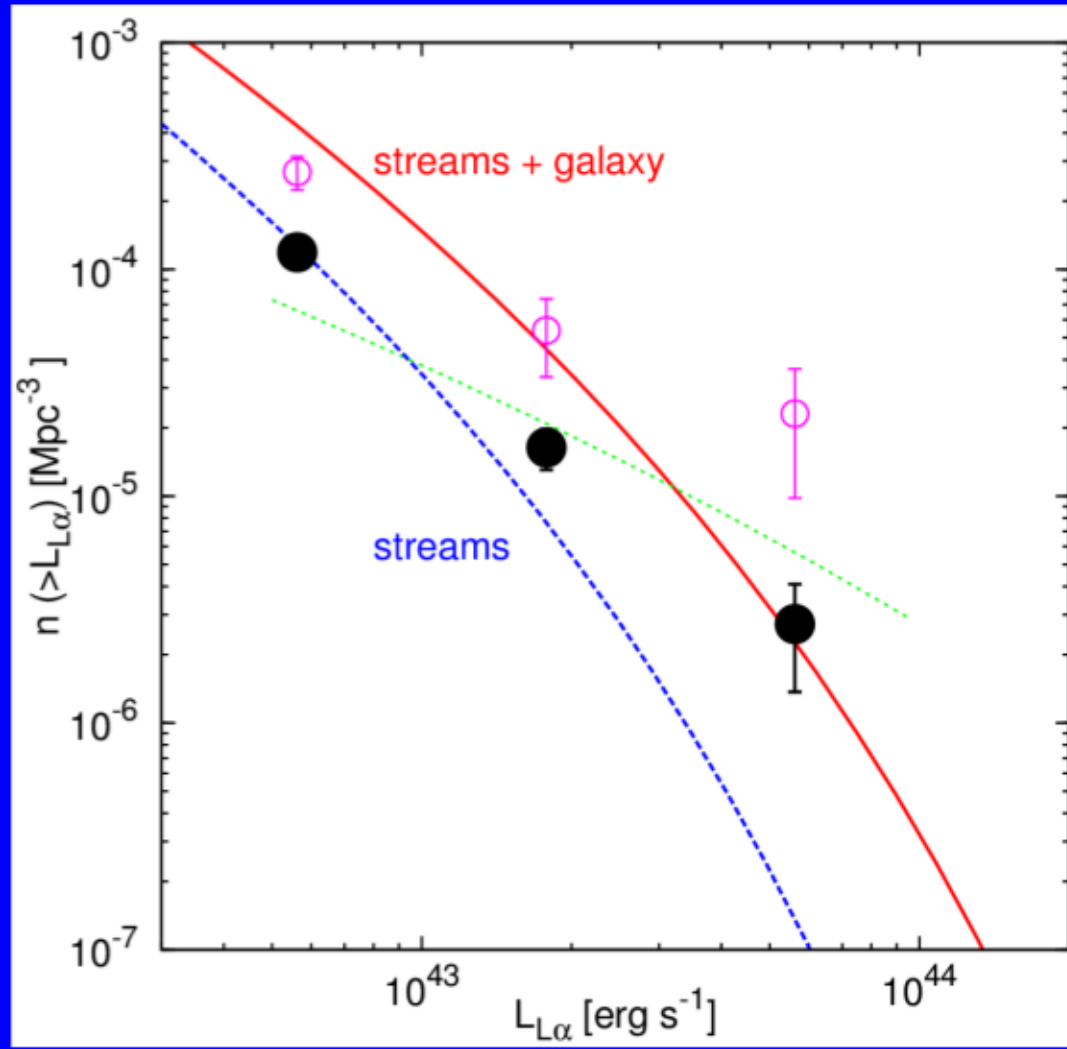
# Emission: Lyman alpha blobs

- Cold streams loose potential energy released as Ly alpha photons.
- Computed vs. Observed Surface brightness maps



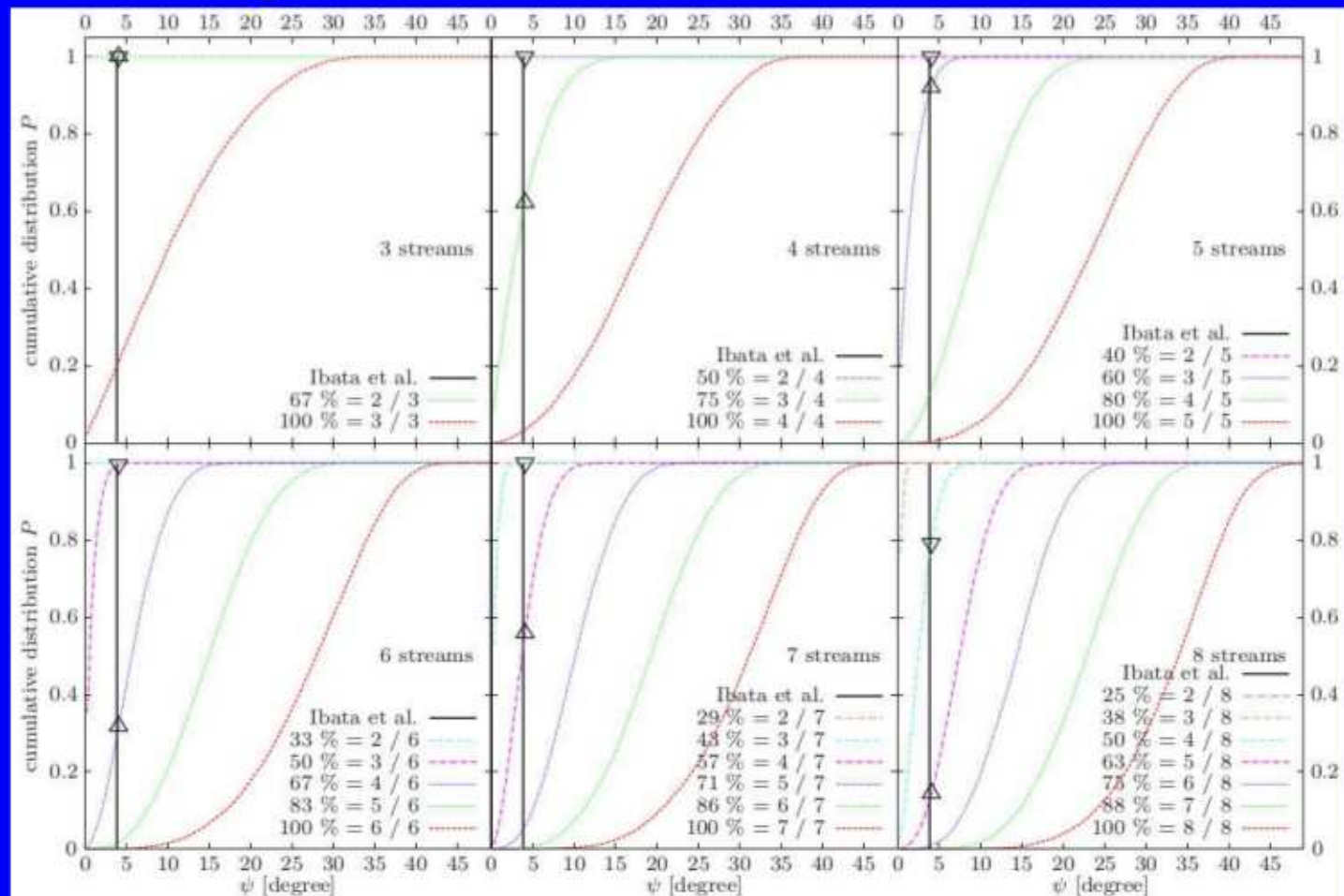
# Ly $\alpha$ blob luminosity function

- Mass luminosity scaling relation correlated with Sheth Tormen mass function
- Observational data from Matsuda et al. (2004, 2009)



# Relation to structure:

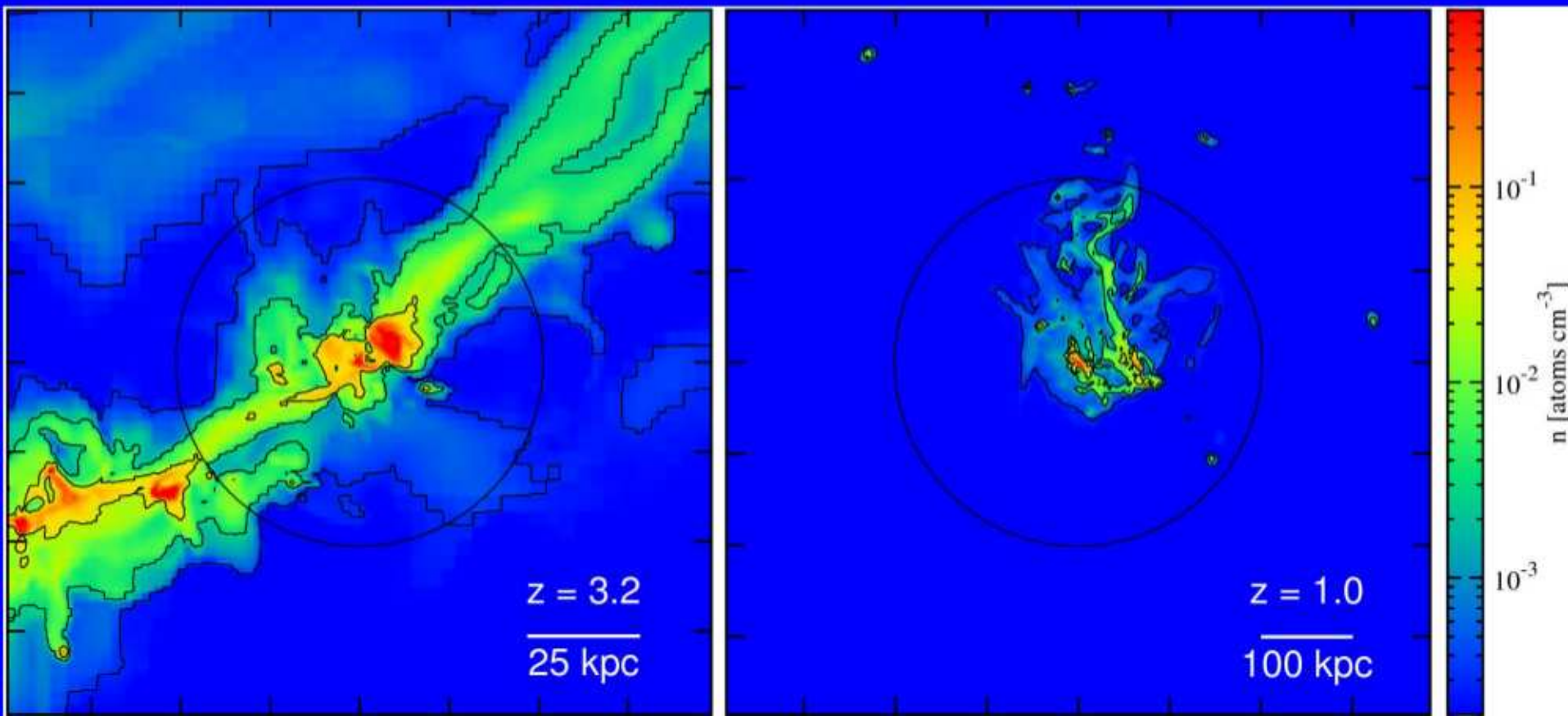
- Ibata et al: Andromeda: thin disk of satellites
- Cold streams carry clumps
- Consequence: Coplanar satellite structure!





# Relation to structure

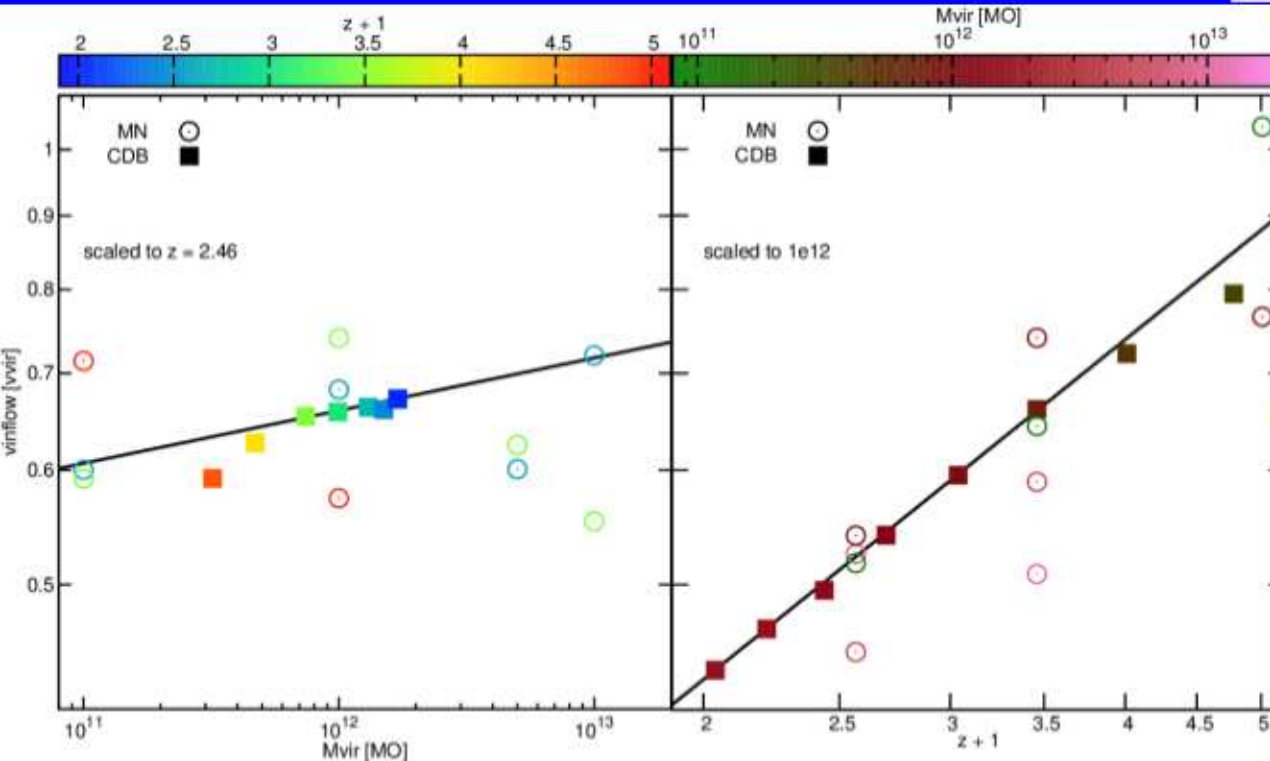
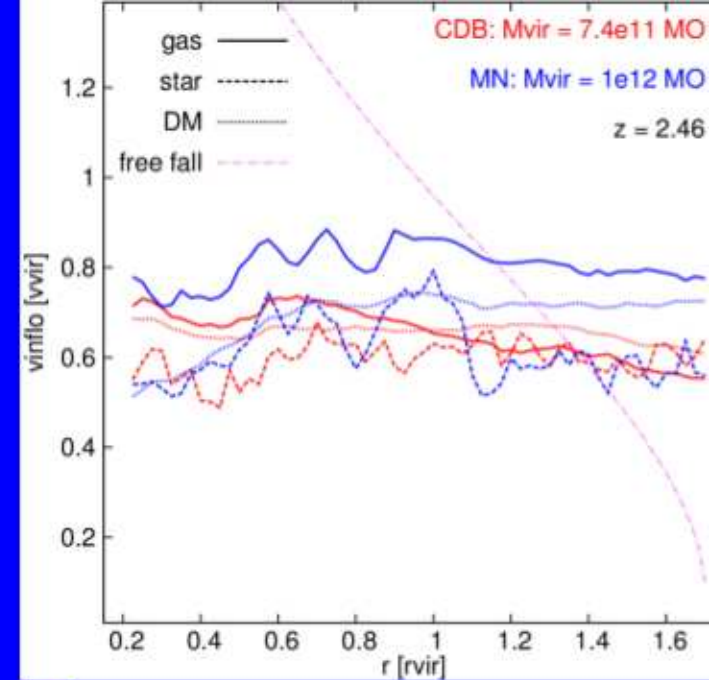
- Double check with simulations:
- High  $z$ : cold stream activity with clumps
- Low  $z$ : Coplanar structure of satellites





# Inflow velocity

- In units of virial velocity
- Constant with radius
- Power law with redshift and host halo mass

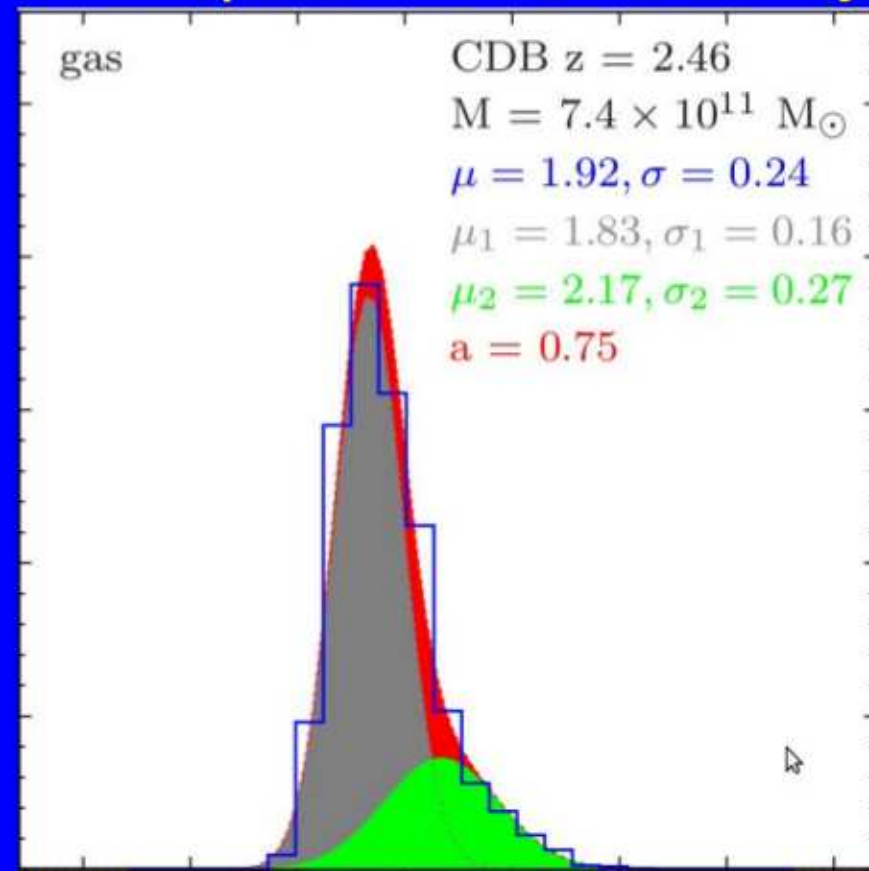
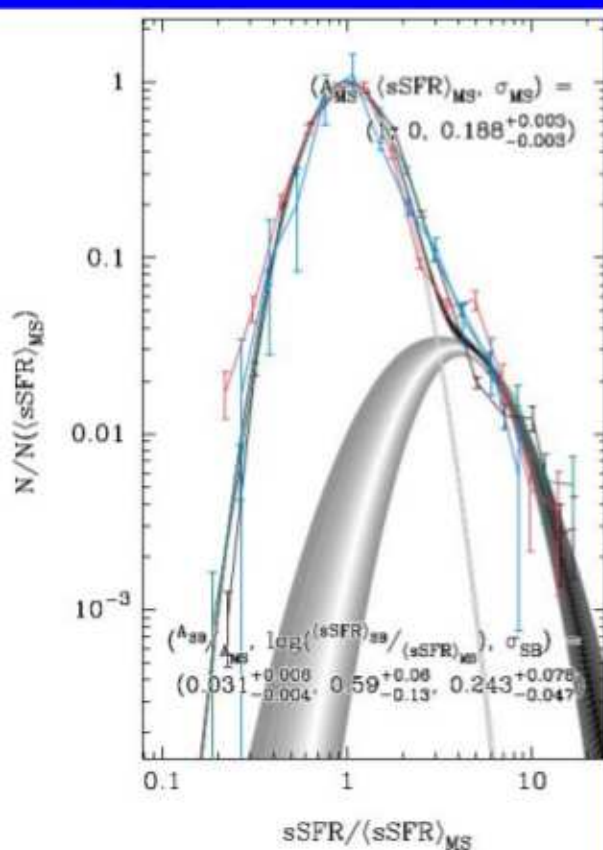


- Emerging equation:

$$v_{\text{inflow}}(M_{\text{vir}}, z) = A \left( \frac{M_{\text{vir}}}{M_{\odot}} \right)^B (z+1)^C$$

# Inflow distribution

- Double Gaussian
- Represents mergers and smooth infall
- Observationally found by Sargent et al. (2012):  
star formation: main sequence | starburst activity



- Detectability in absorption:
  - Difficult (low sky covering fraction / metallicity)
- Cold stream emission: Ly $\alpha$  blobs
  - Simulation maps very similar to observations in extent, shape, luminosity
  - Luminosity function fits data
- Relation to structure:
  - Thin satellite disks: natural consequence of streams
- Characteristics:
  - Velocity vs. radius: constant
  - Velocity vs. mass or redshift: power law
  - Inflow distribution: double Gaussian (like Sargent et al's star formation observations)