Lyα Radiation Transfer in an isolated dwarf galaxy

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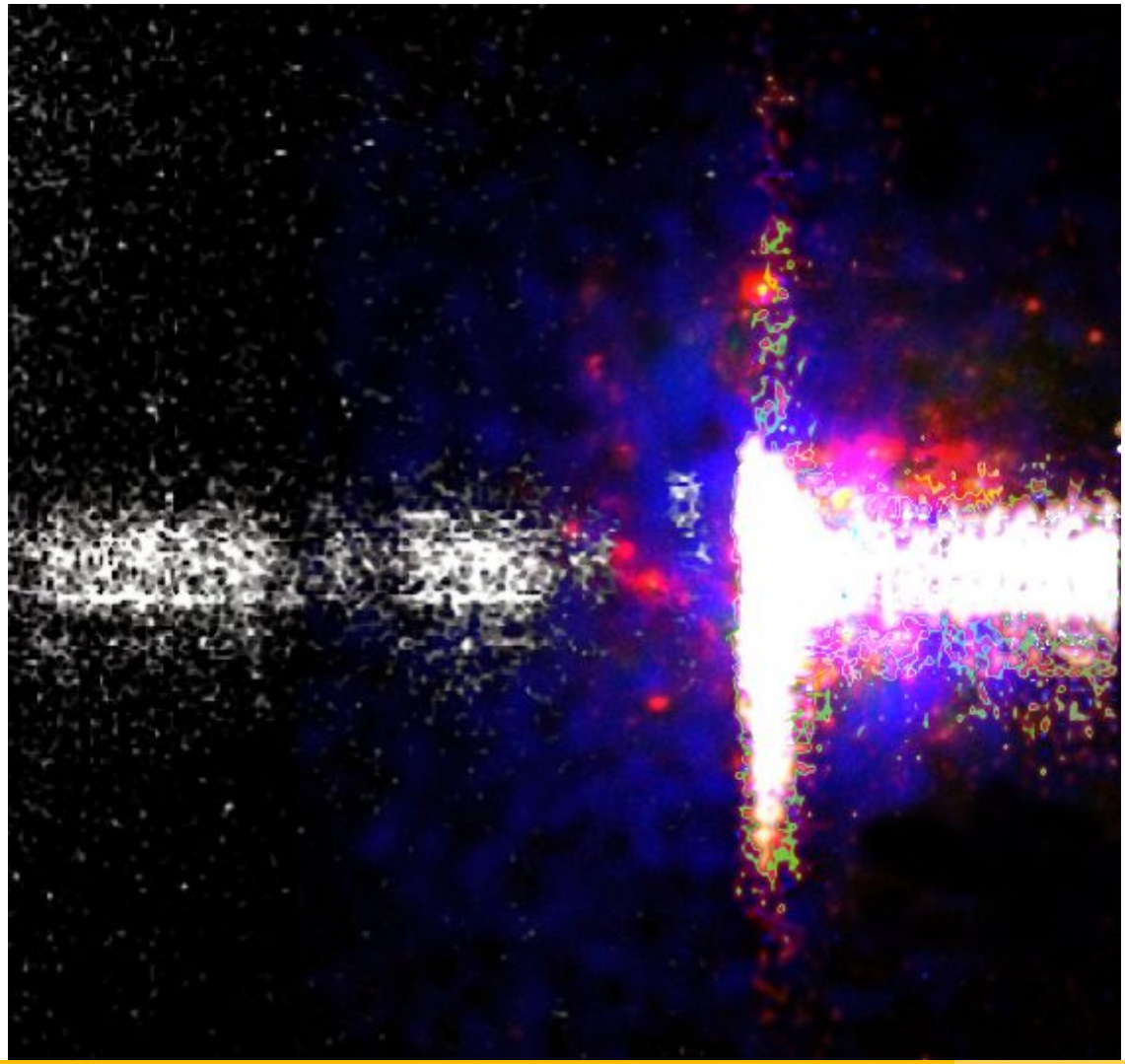
Motivations



what governs Lyα escape from galaxies ?

- time sequence ?

  Mori et al., Nagamine et al.

- geometry ?

  Mallery et al., Finkelstein et al.

- kinematics ?
- size of the galaxy ?

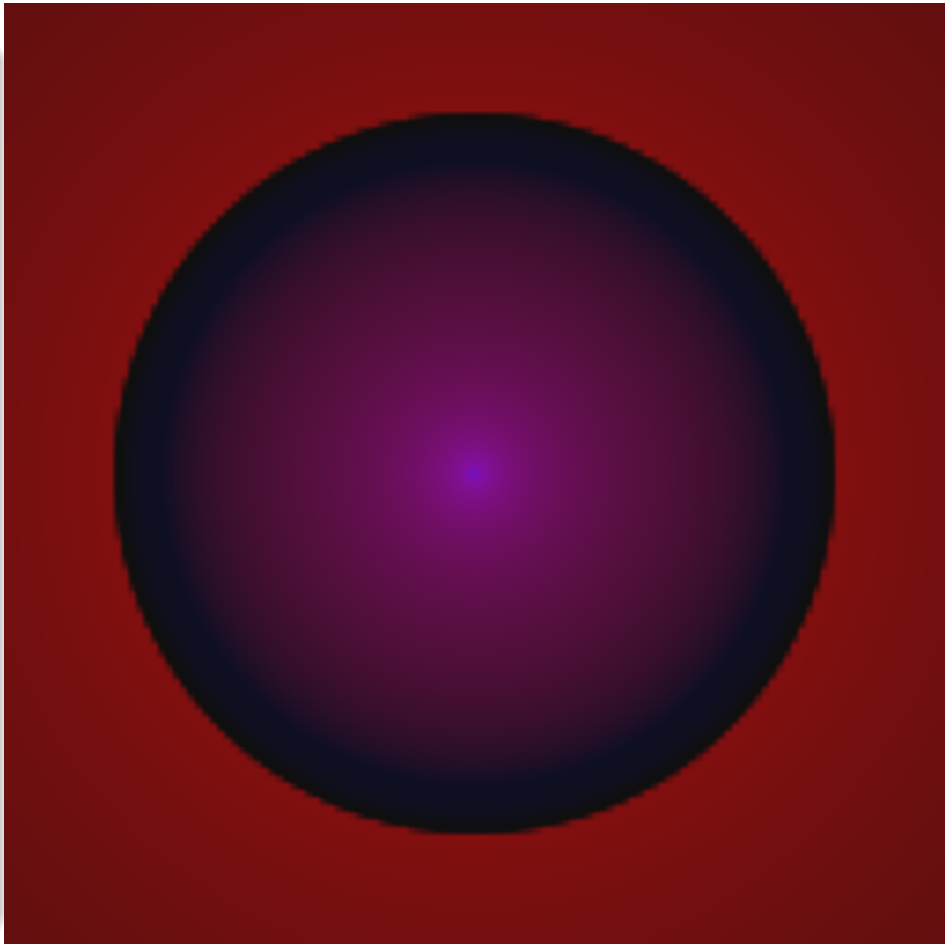
  Malhotra et al.

Hydrodynamical simulations of a dwarf isolated galaxy

Description of the simulations

- AMR code RAMSES *Teyssier 2002*
- total halo mass $M = 10^{10}$ M$_\odot$
- physical size of the box $L = 150$ kpc
- gas fraction $f = \Omega_b/\Omega_m \sim 15\%$
- spin parameter $\lambda = 0.04$
- NFW density profile *Navarro etal 1996*
- cooling function : polytrop
- SN feedback $\Longrightarrow$ metallicity

Dubois & Teyssier 2008



MCLya : 3D Lyα radiation transfer code

General description of the code

- Monte Carlo technics, 3D, cartesian grid *Verhamme et al. 2006*
- MPI - parallelised
- physics included : HI, dust, Deuterium

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Inputs

- distribution of sources
- HI and dust geometry
- temperature distribution
- velocity field

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Inputs

- distribution of sources
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Outputs

- integrated or resolved spectra
- Lyα images along any line of sight
- number of (back-)scatterings
- escape fraction

GALAXYWIND and GALAXYCLUMPS

GALAXYWIND

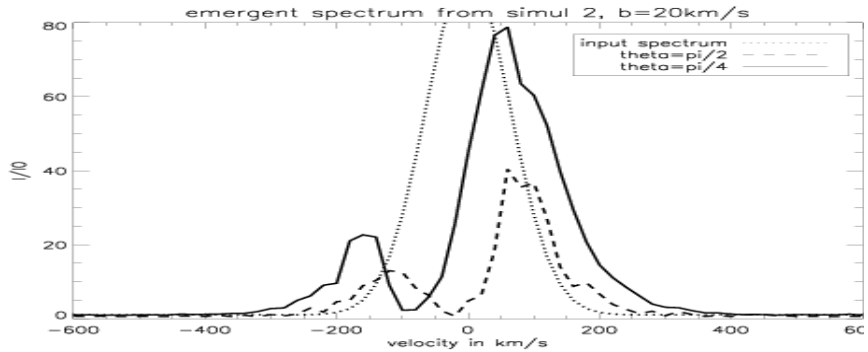
- total halo mass $M = 10^{10} M_\odot$
- physical size of the box $L \sim 150$ kpc
- gas fraction $f = 15\%$
- spin parameter $\lambda = 0.04$
- cooling threshold $T_0 = 10^4 K$
- SN feedback ON

GALAXYCLUMPS

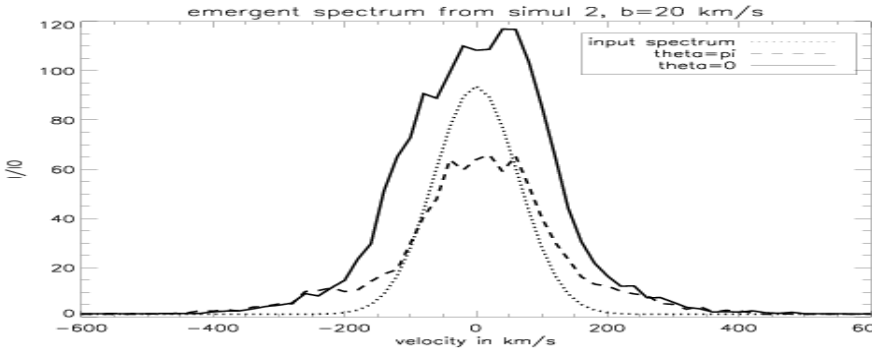
- total halo mass $M = 10^{10} M_\odot$
- physical size of the box $L \sim 150$ kpc
- gas fraction $f = 15\%$
- spin parameter $\lambda = 0.04$
- cooling threshold $T_0 = 10^2 K$
- SN feedback OFF

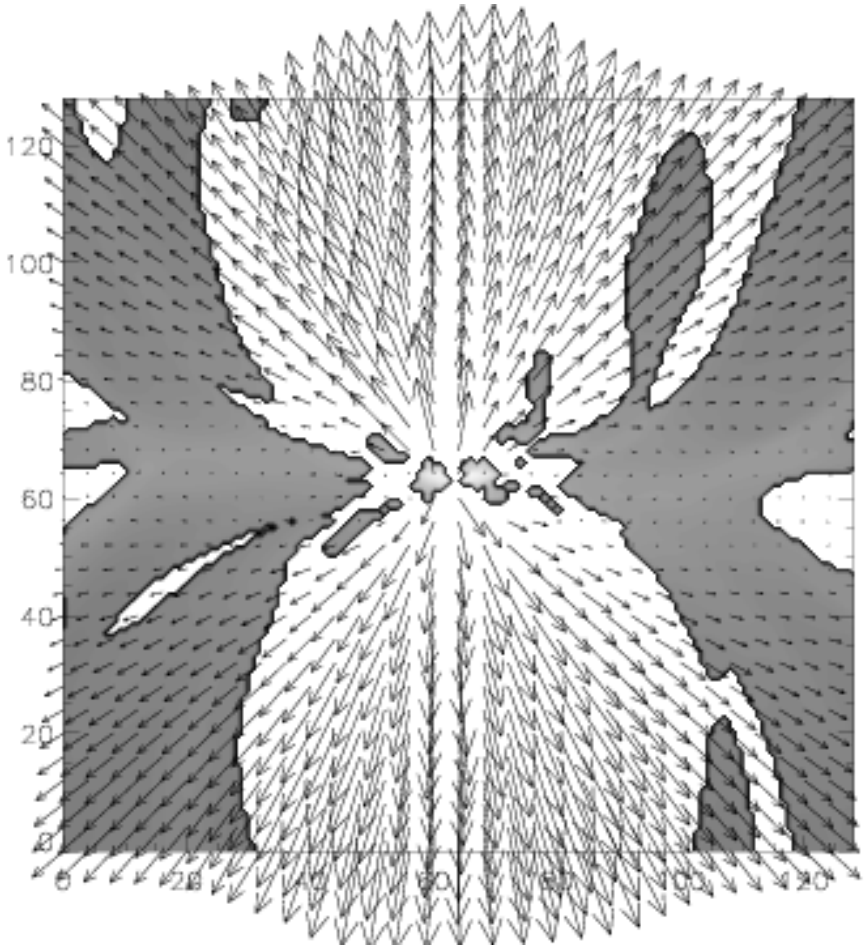
GALAXYWIND : Emergent Lyα spectra vs viewing angle

EDGE-ON



FACE-ON





GALAXYCLUMPS : Emergent Lyα spectra vs viewing angle

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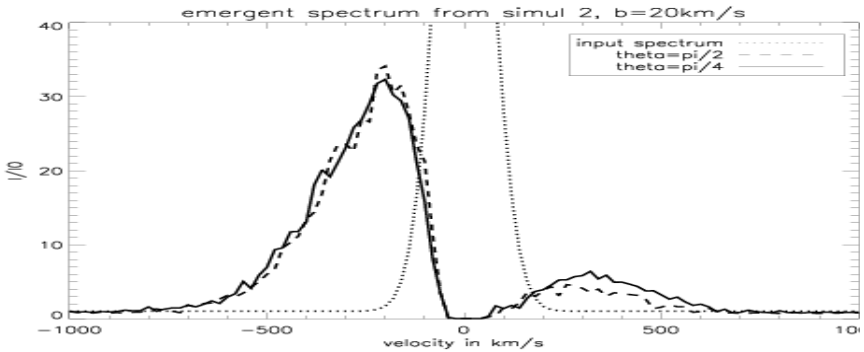

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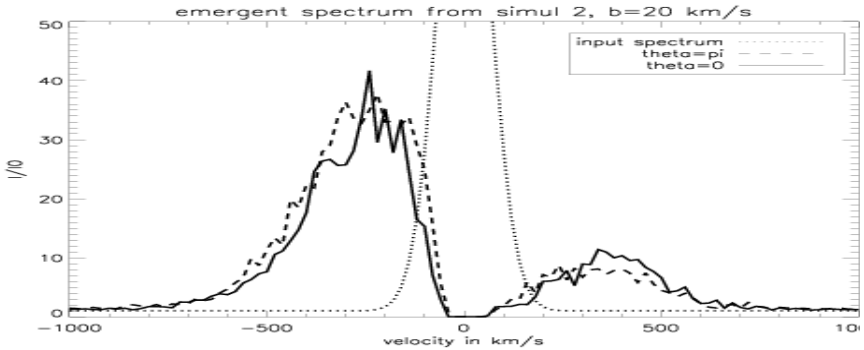
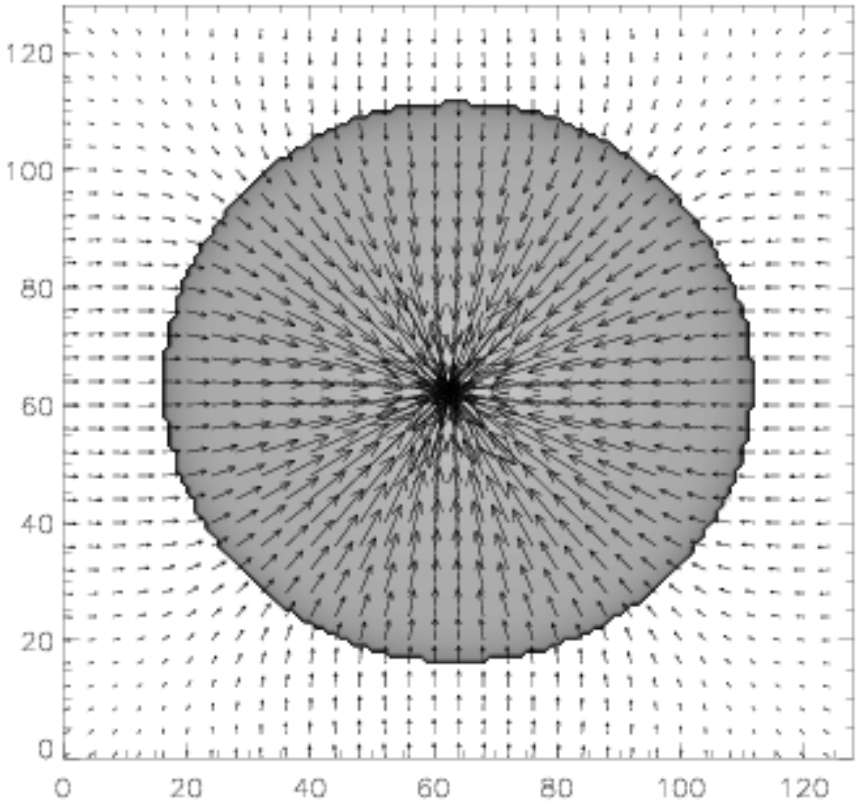
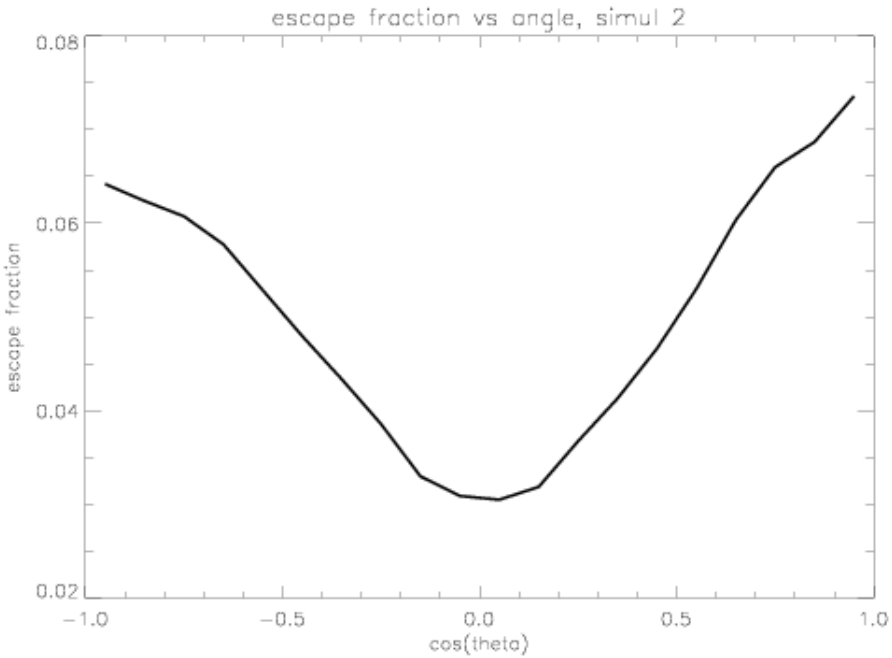




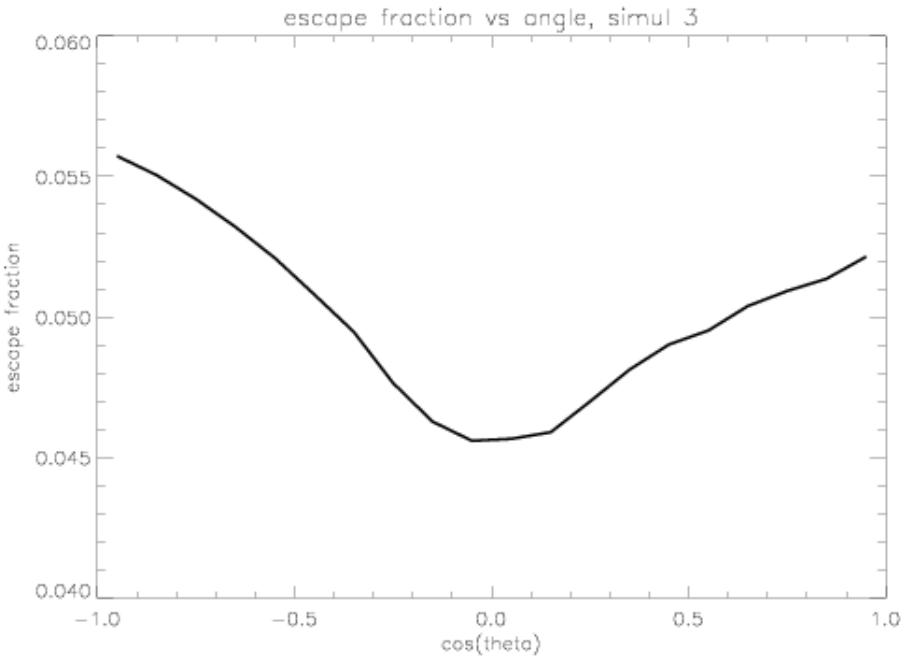
GALAXYWIND : Escape fraction vs viewing angle



Lyα escape fraction

- global escape fraction $f_{esc} = 0.47$
- symetry against $\theta = \pi/2$
- minimal escape fraction edge on

GALAXYCLUMPS : Escape fraction vs viewing angle



Lyα escape fraction

- global escape fraction $f_{esc} = 0.23$
- symetry against $\theta = \pi/2$
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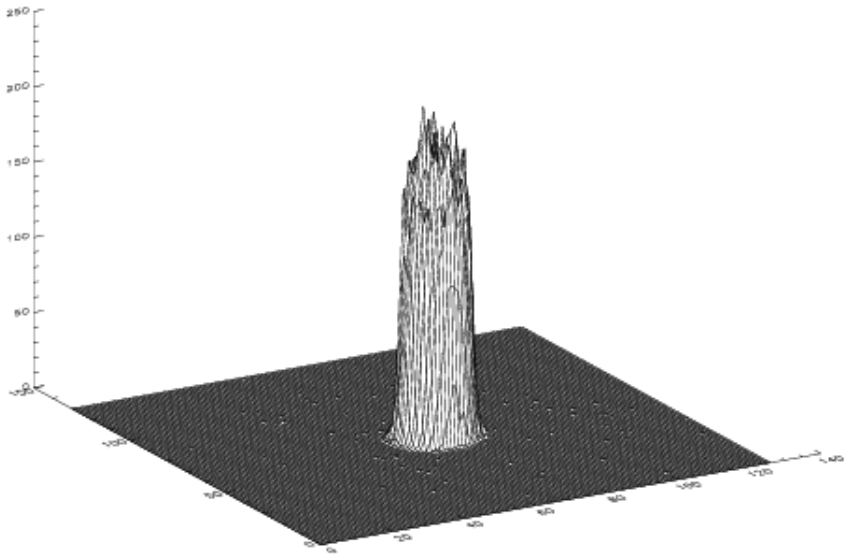
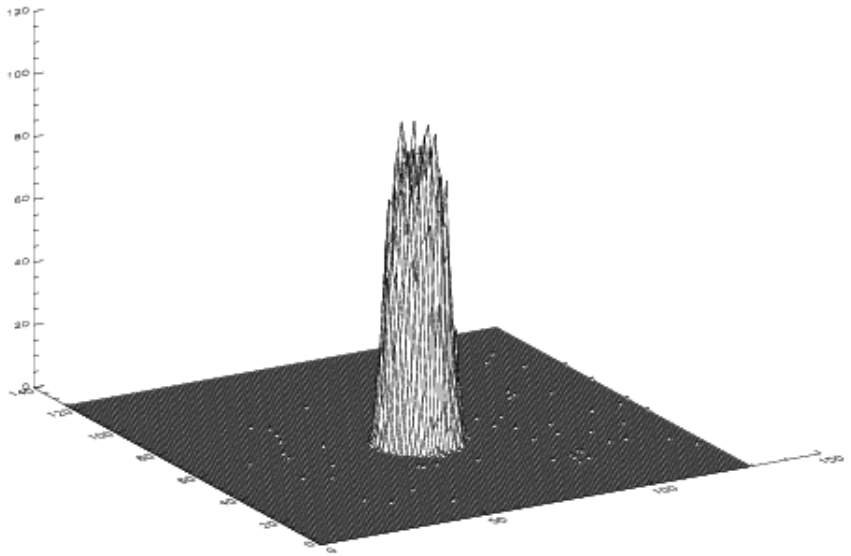
GALAXYWIND : Lyα image vs viewing angle

FACE-ON



EDGE-ON



Preliminary Results from Lyα RT in hydro sims

GALAXYWIND

- evolution of spectra with viewing angle

GALAXYCLUMPS

- the same spectrum in all directions

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- tracing infall of the halo $\Longrightarrow$ lack of resolution to see orientation effects ?

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- collimation of Lyα beam by the wind
- global escape fraction $f_{esc} = 0.47$
- "broad-band" Lyα image doesn't show scattering halo $\Longrightarrow$ not enough photons ?

GALAXYCLUMPS

- the same spectrum in all directions
- tracing infall of the halo $\Longrightarrow$ lack of resolution to see orientation effects ?
- global escape fraction $f_{esc} = 0.23$
- not enough statistics to build an image

Improvments, next steps

Concerning the isolated dwarf galaxy

- develop a tool to investigate velocity profiles of the outflow
- zoom on the clumpy disk in GALAXYCLUMPS, need for AMR ?
- evolution of the Lyα escape fraction/spectra with time ?
- evolution of the Lyα escape fraction/spectra with the halo mass ?

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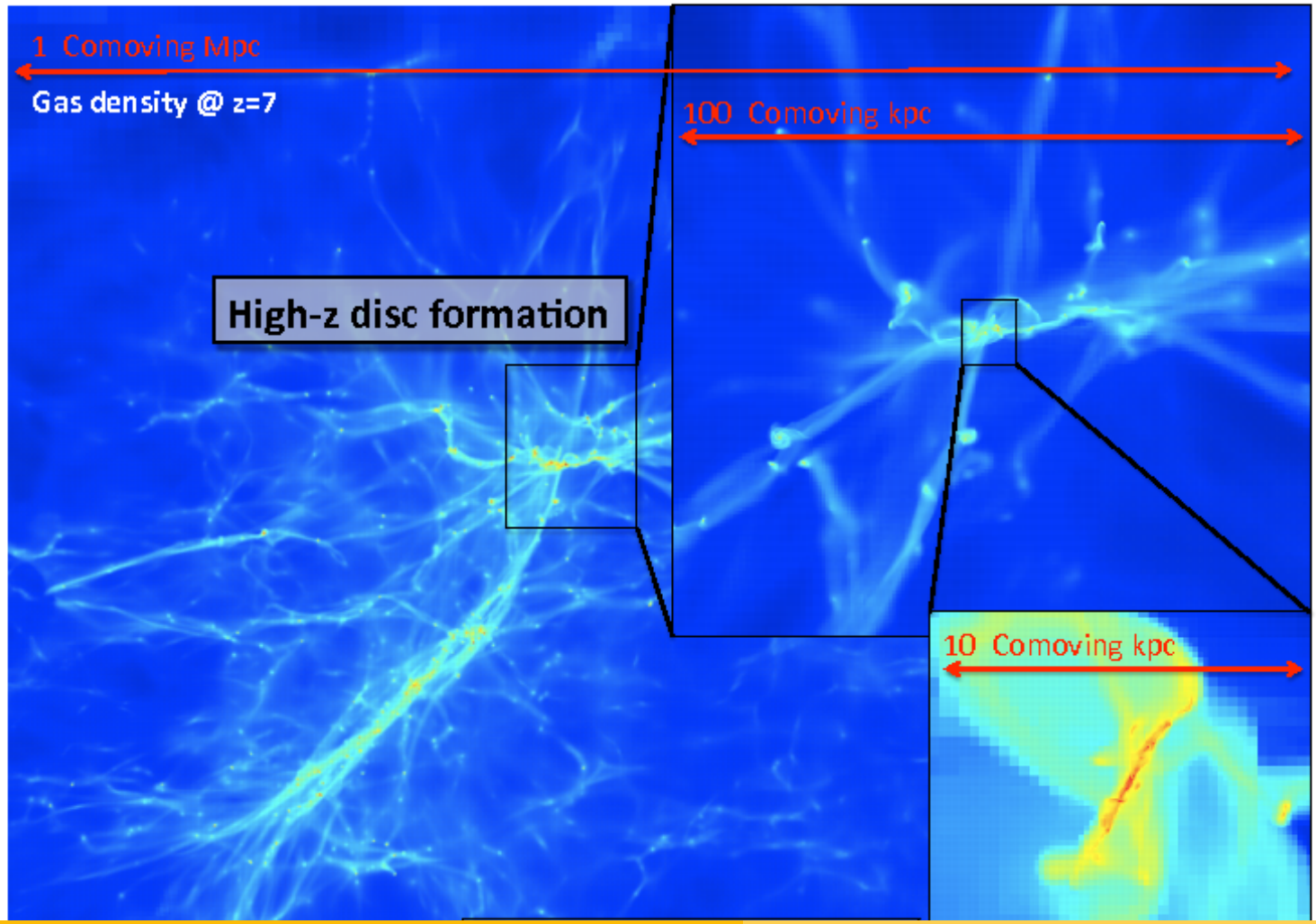
Lyα radiation transfer...

- in a galaxy in its cosmological context
- in a cosmological sample of galaxies

Lyα RT in a $z \sim 3$ LBG at very high resolution



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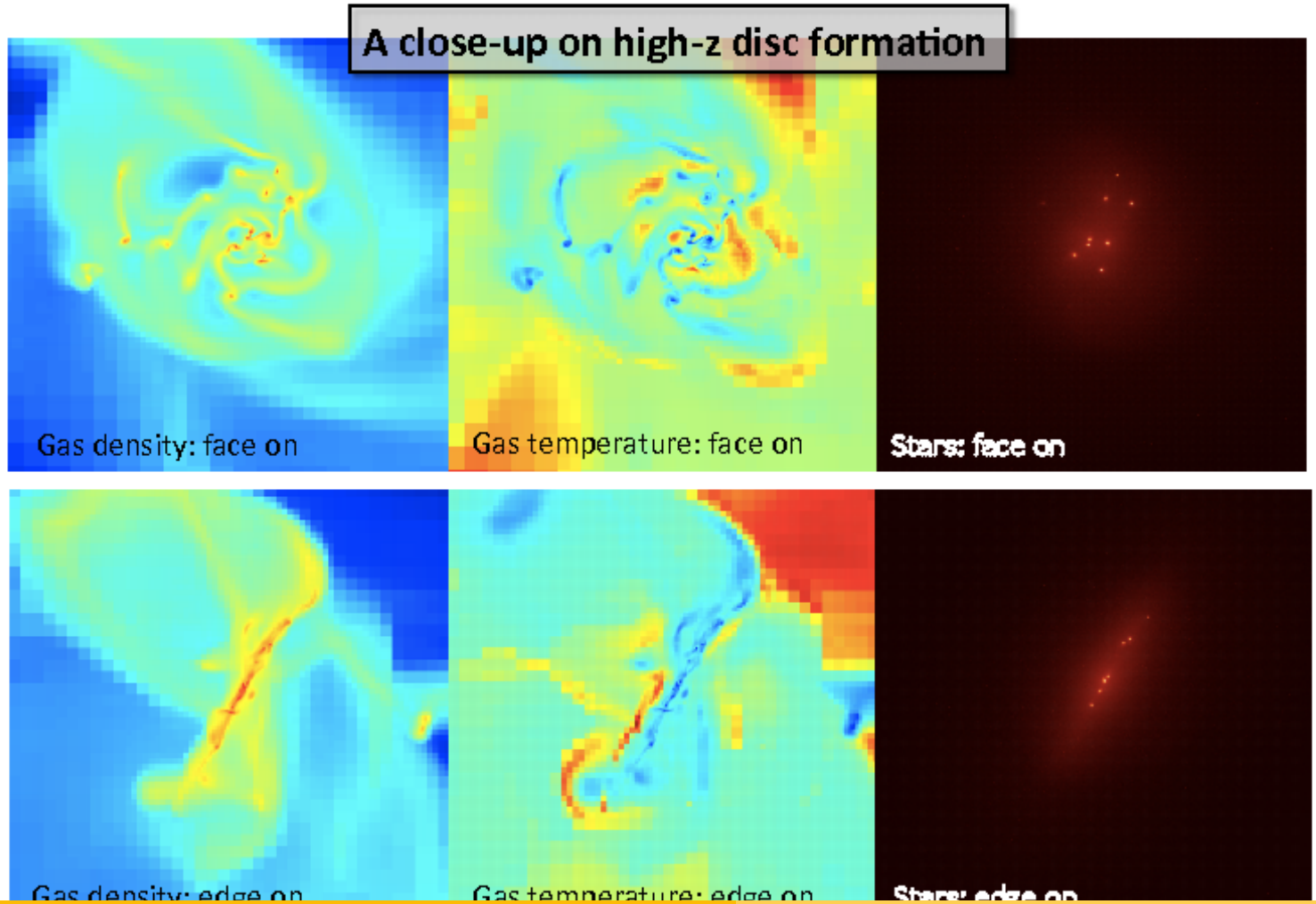

Lyα RT in a cosmological volume