

# Modeling Lyman-alpha Emission with Galaxy Formation Simulations



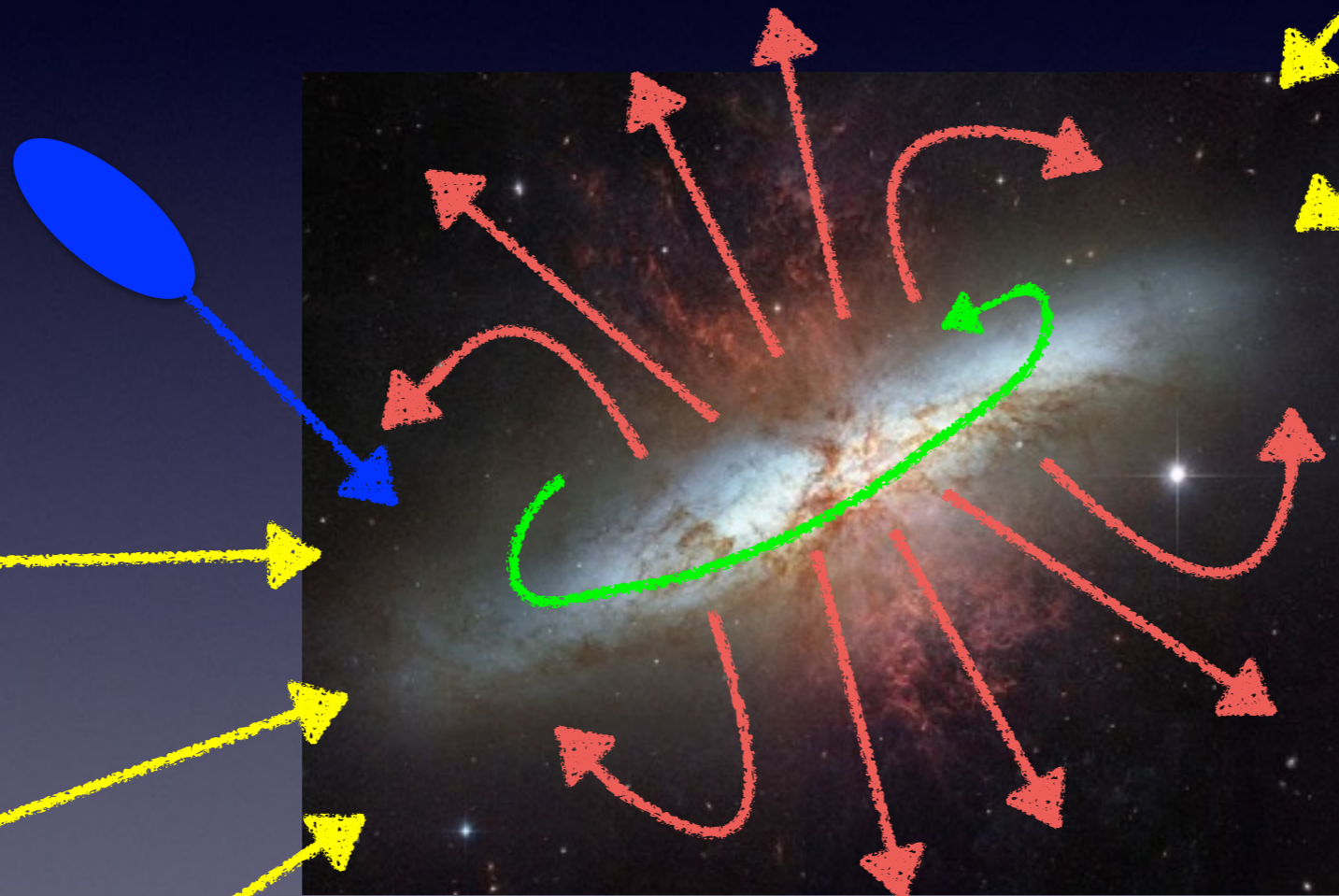
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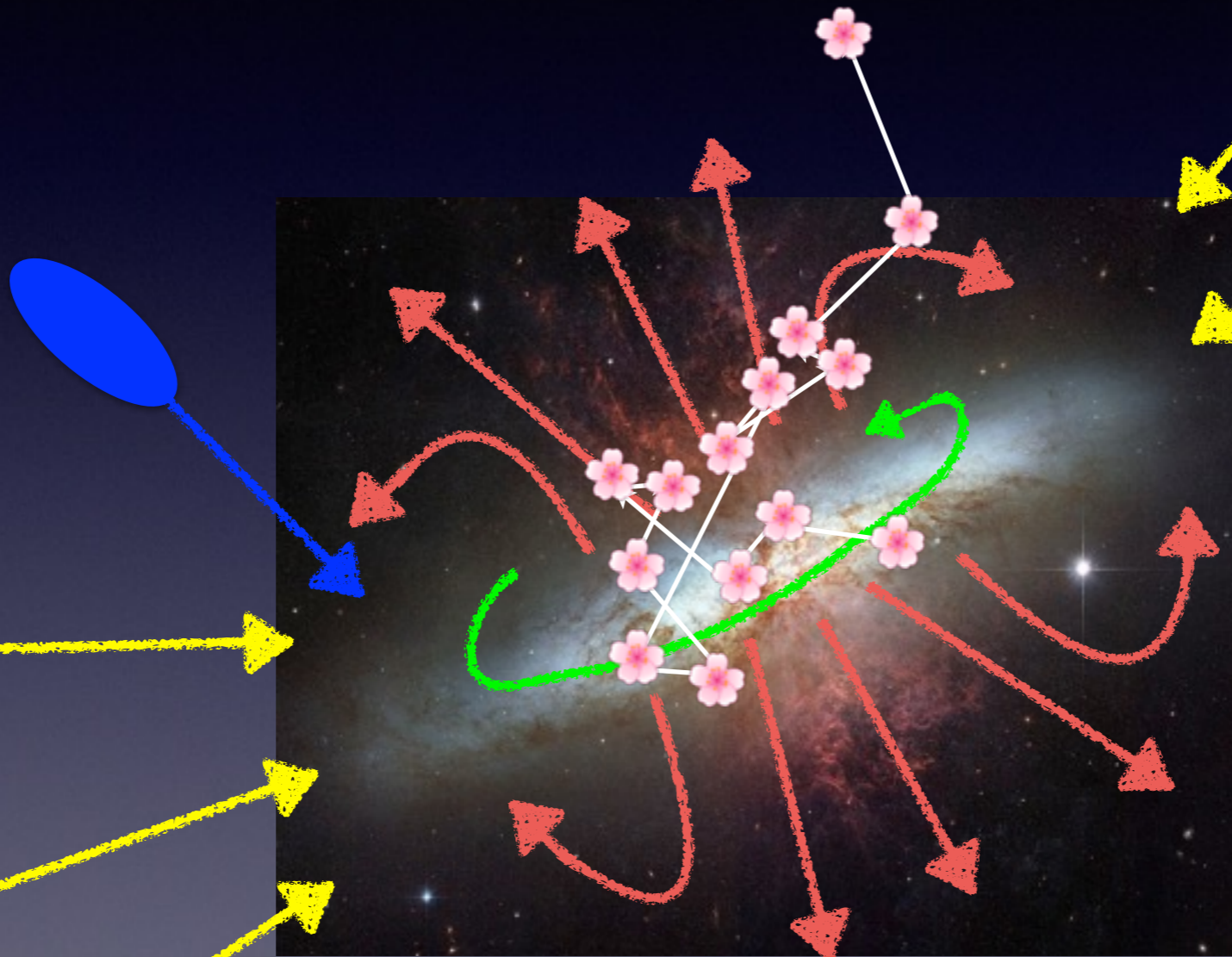
## Analytic or simple models:

understanding of radiative transfer  
insights on what could be going on  
realistic? meaning of parameters?



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## Galaxies from hydro simulations:

more “realistic” gas distribution  
tests of analytic and simple models  
*statistical* properties of Ly $\alpha$  emission (vs observation)

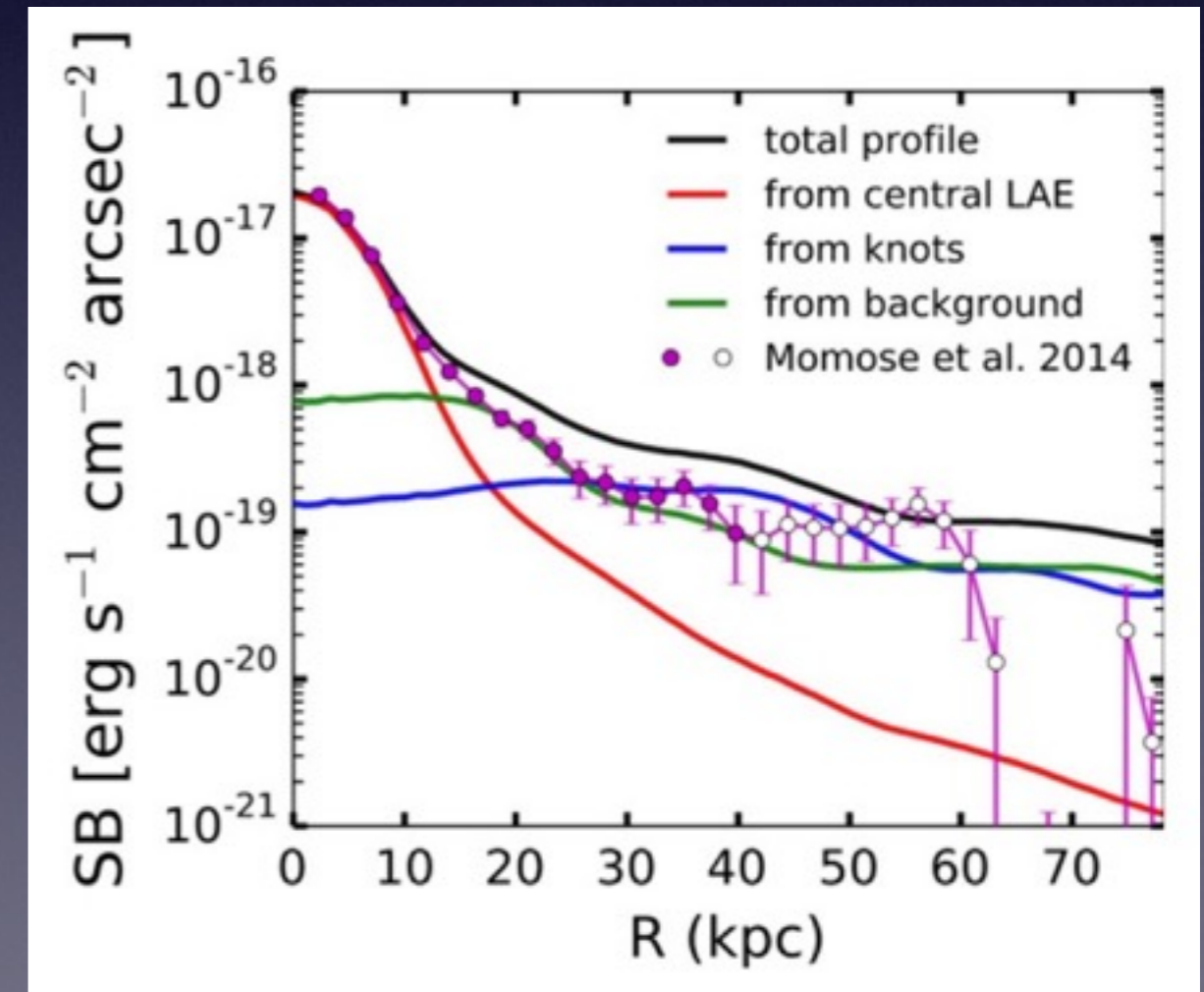
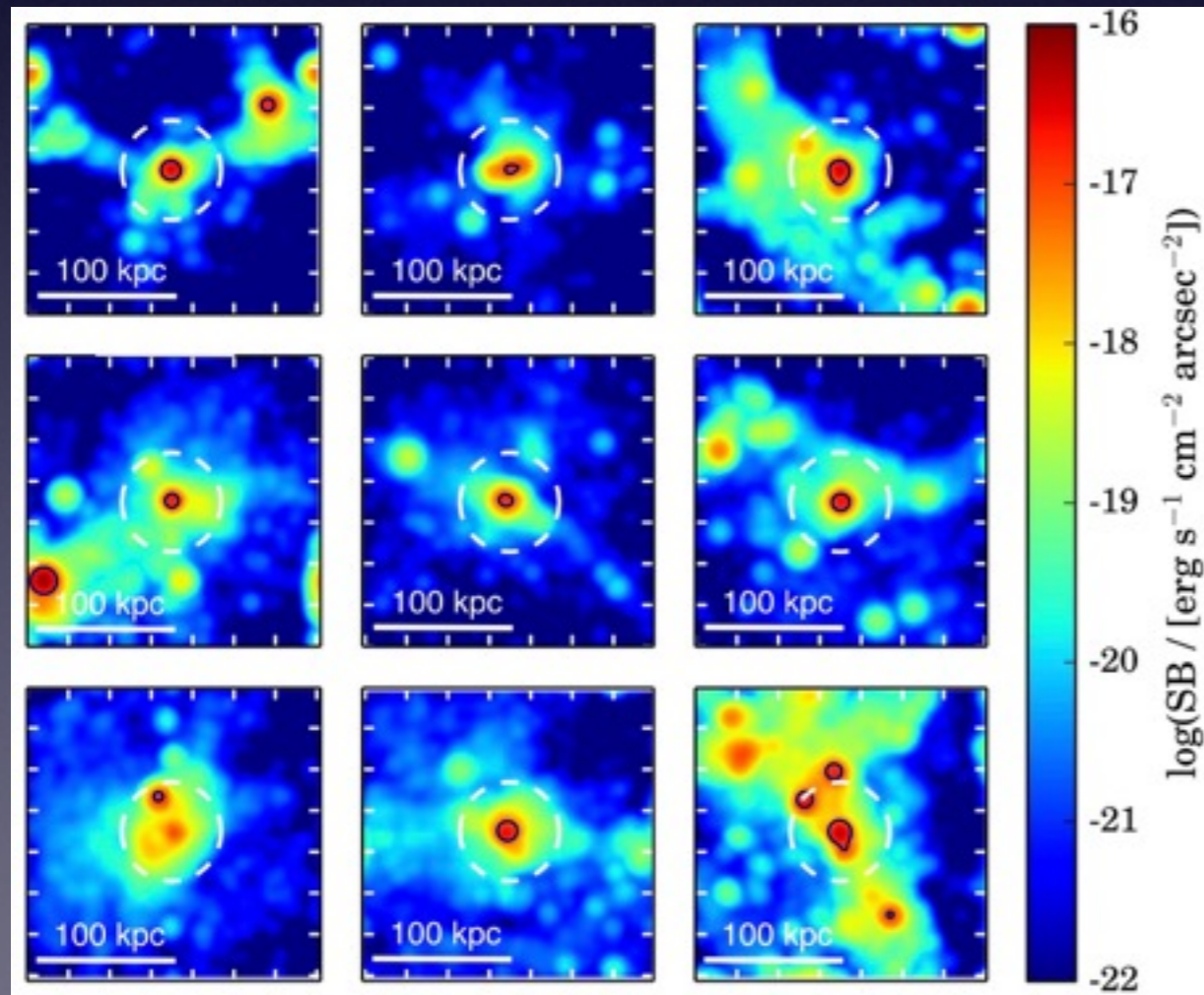
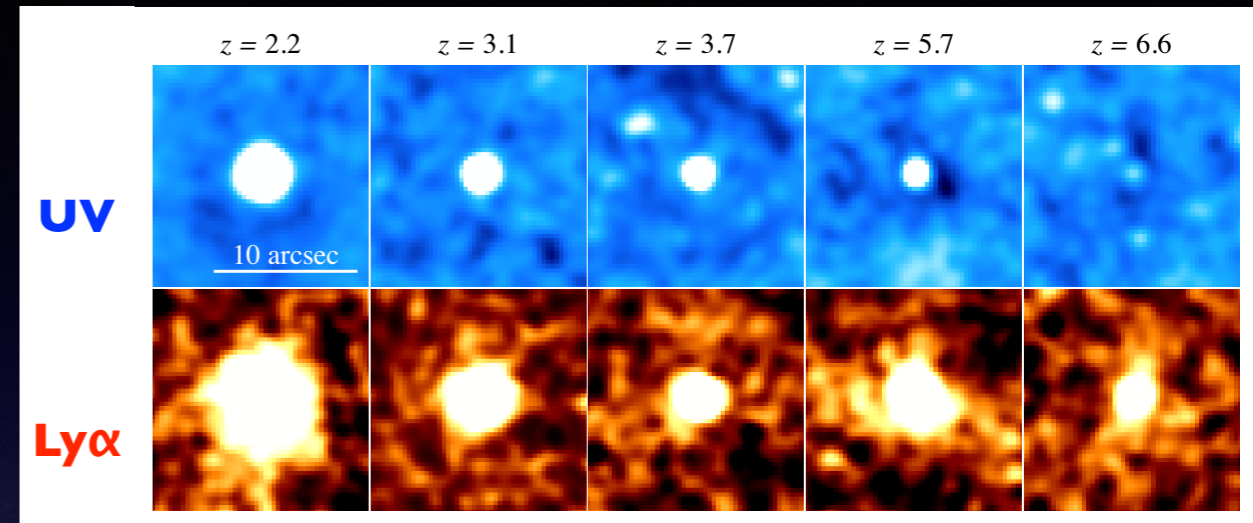
# Hydrodynamic galaxy formation simulations

Haruka Kusakabe's talk

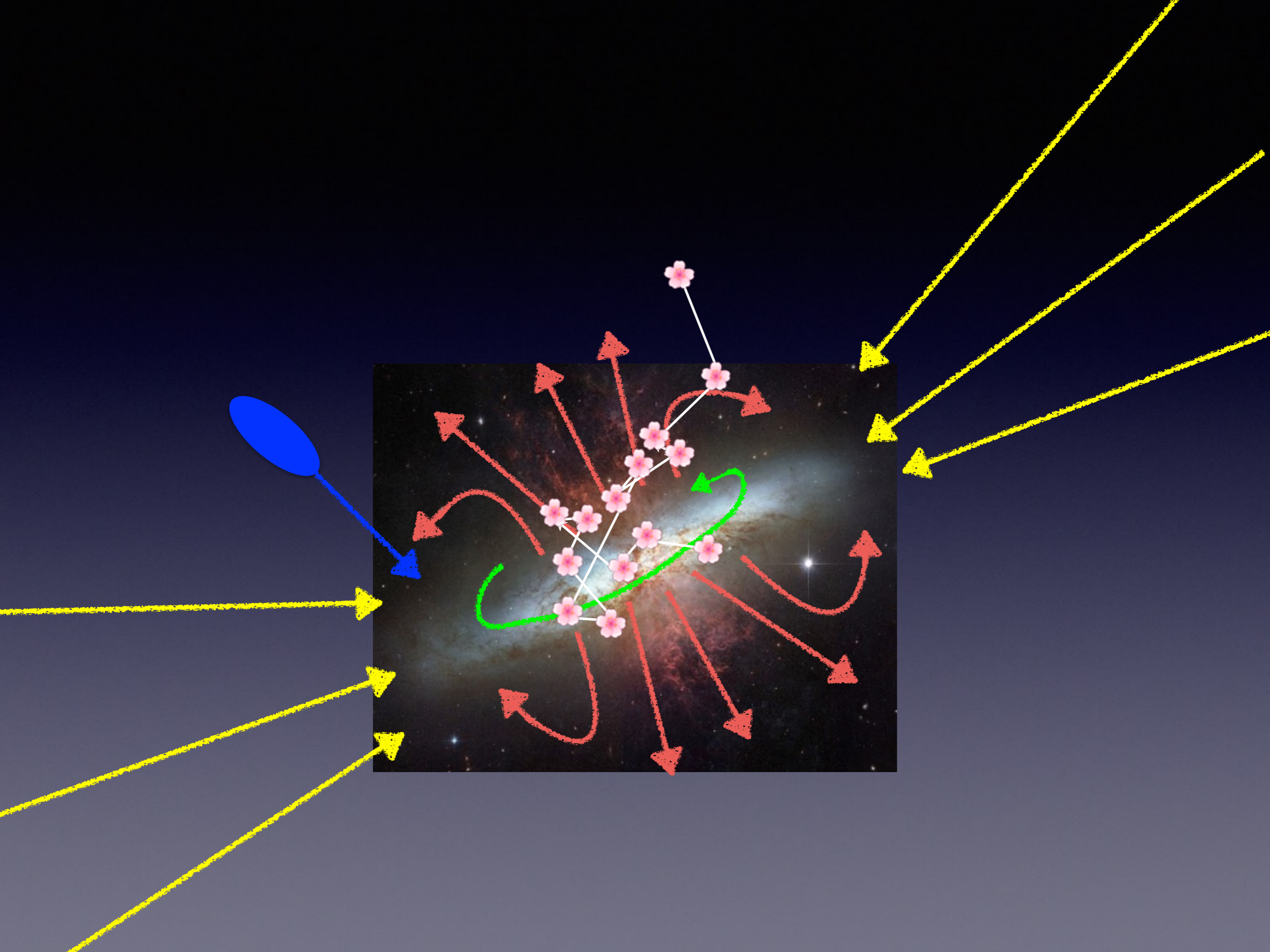
Momose et al. (2014)

Cen (2011), Cen (2012), Cen & Zheng (2013)

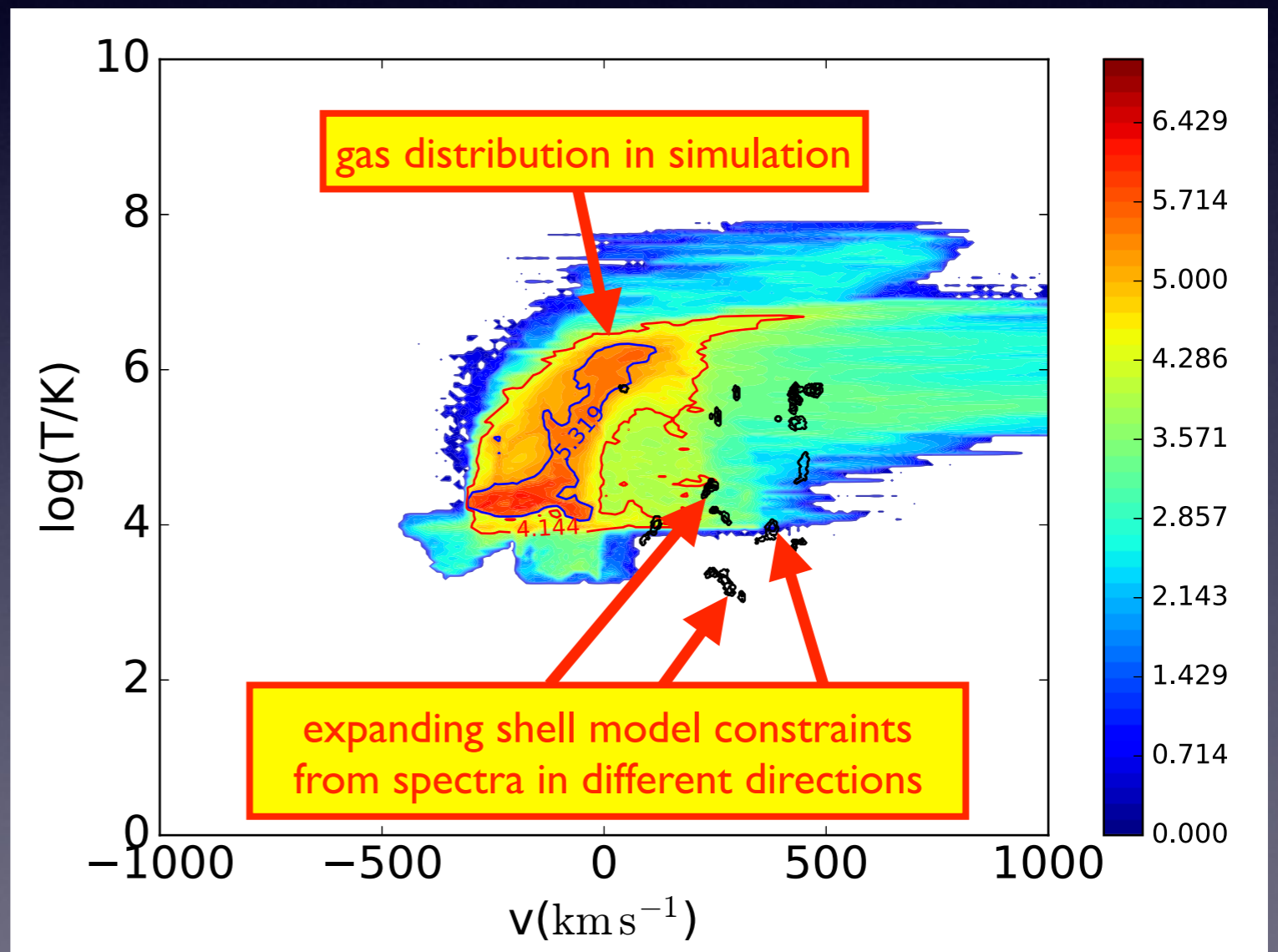
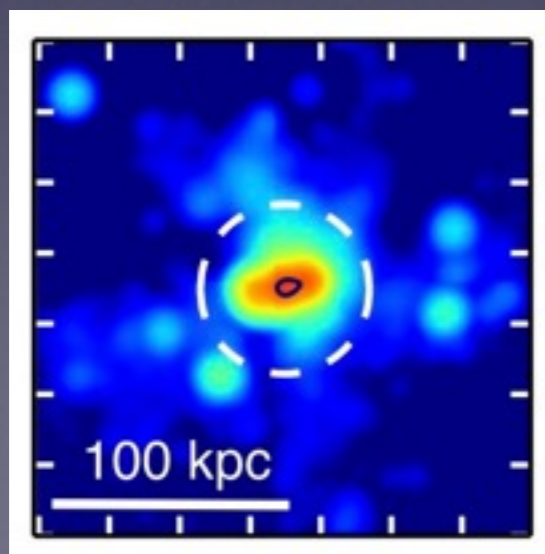
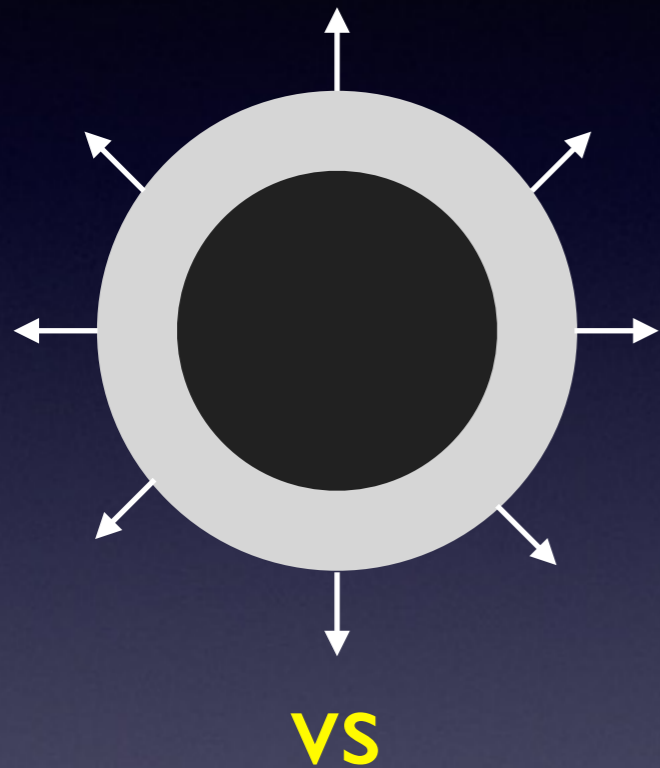
Used to study LAHs



Lake, ZZ, Cen, et al. (2015)

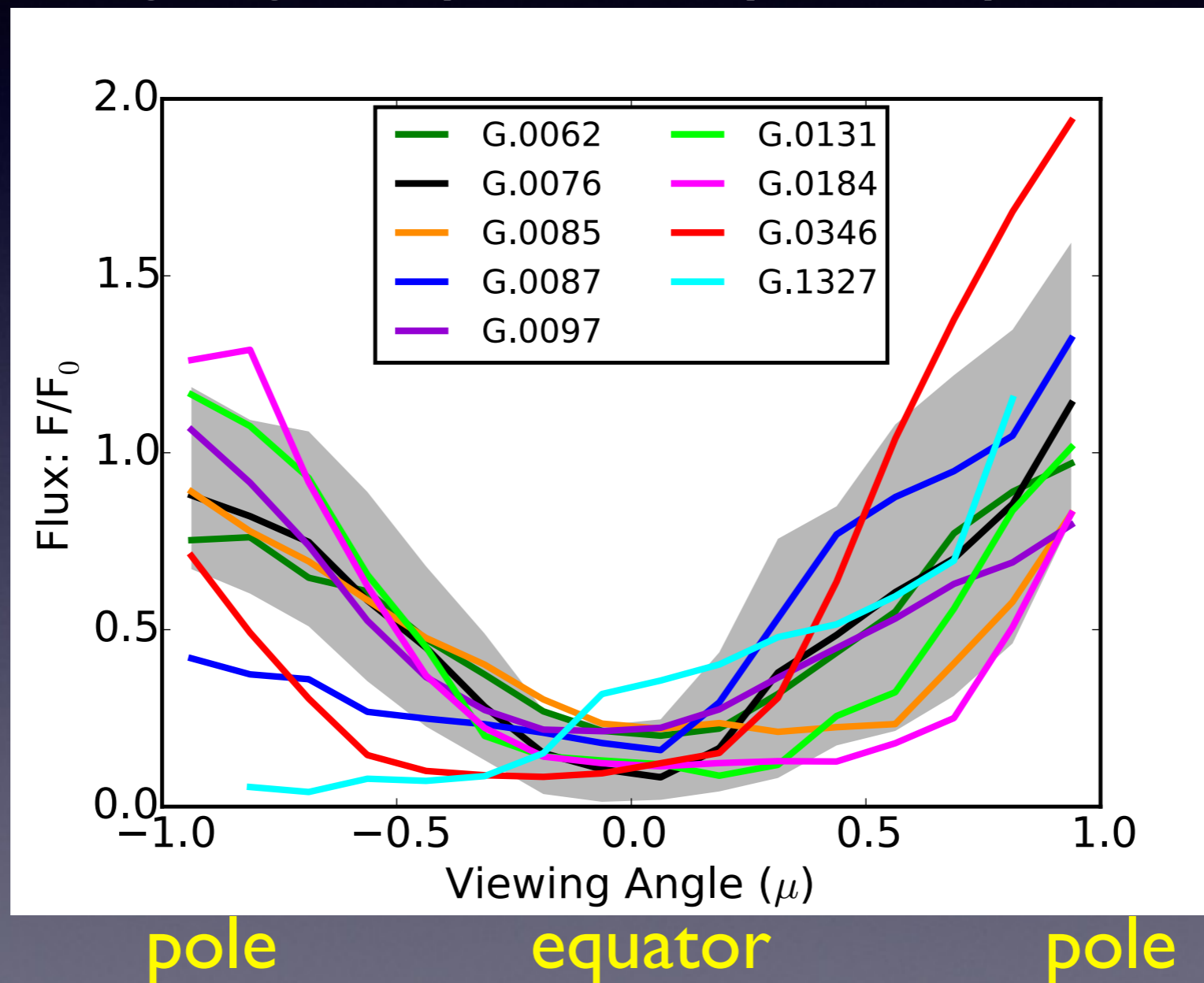


# Anisotropic Lyman-alpha Emission and Expanding Spherical Shell Model



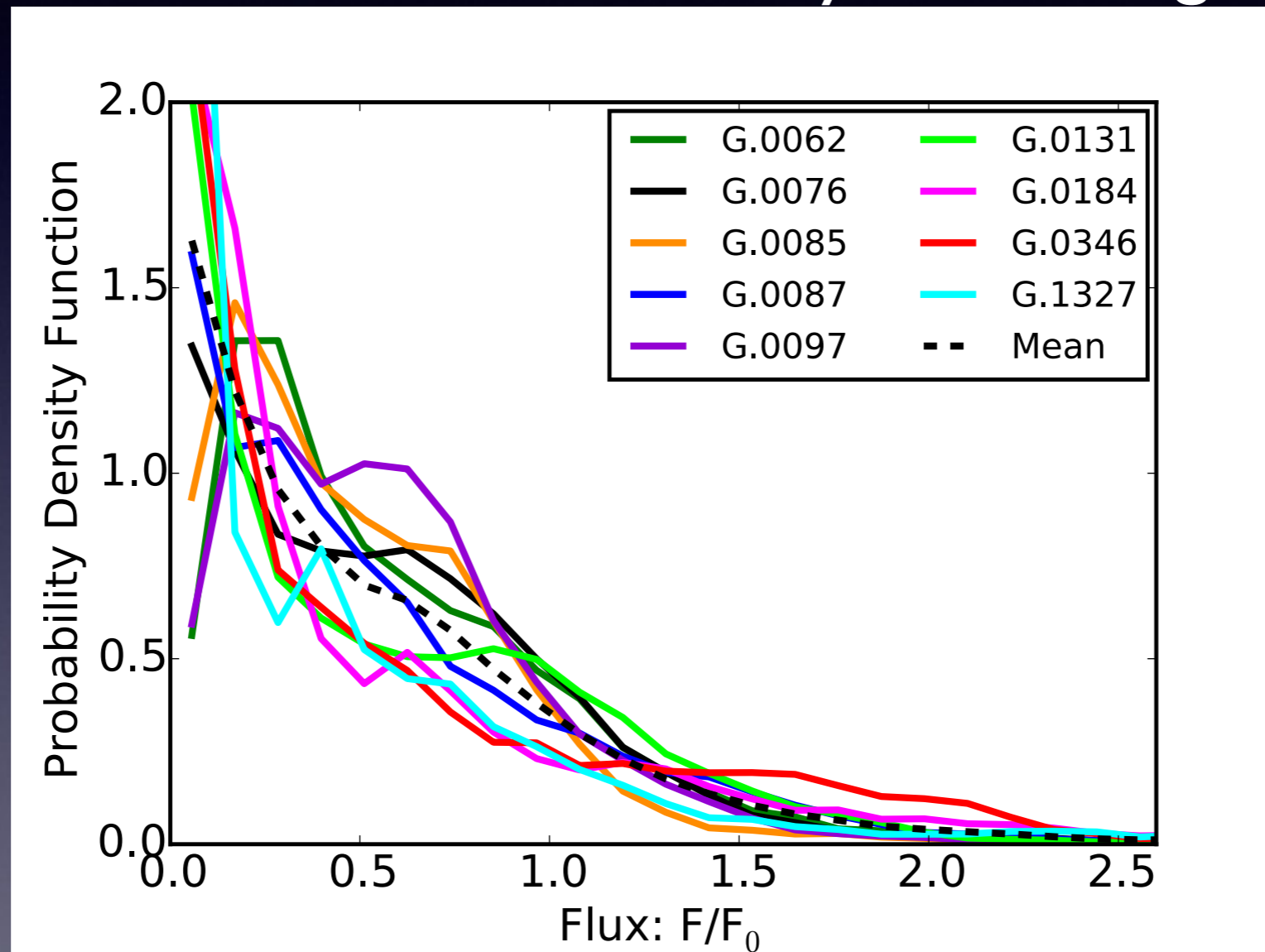
# Anisotropic Lyman-alpha Emission from Galaxies in Hydrodynamic Simulations

viewing angle dependent Lyman-alpha flux



# Anisotropic Lyman-alpha Emission from Galaxies in Hydrodynamic Simulations

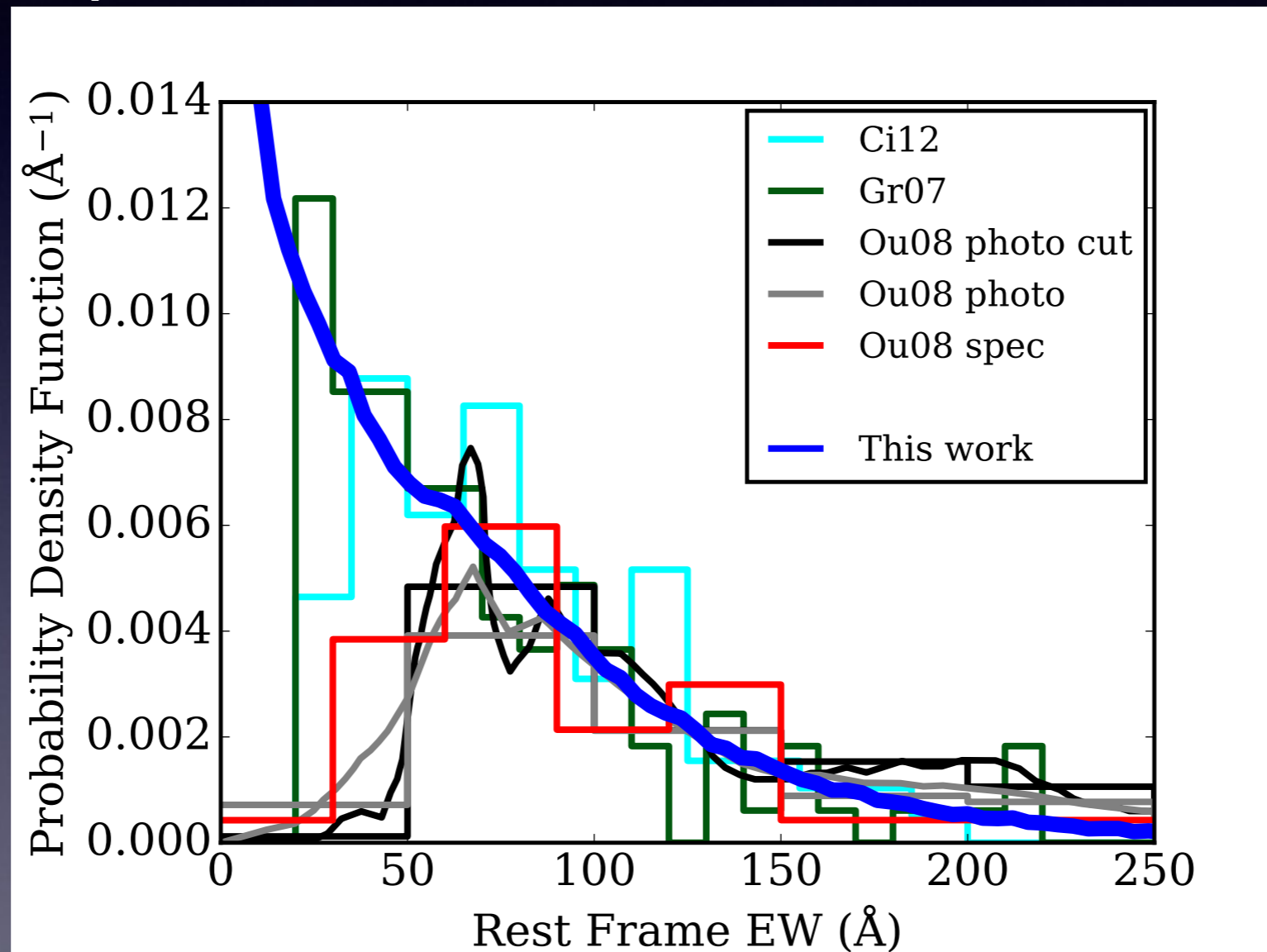
flux distribution from randomly oriented galaxies





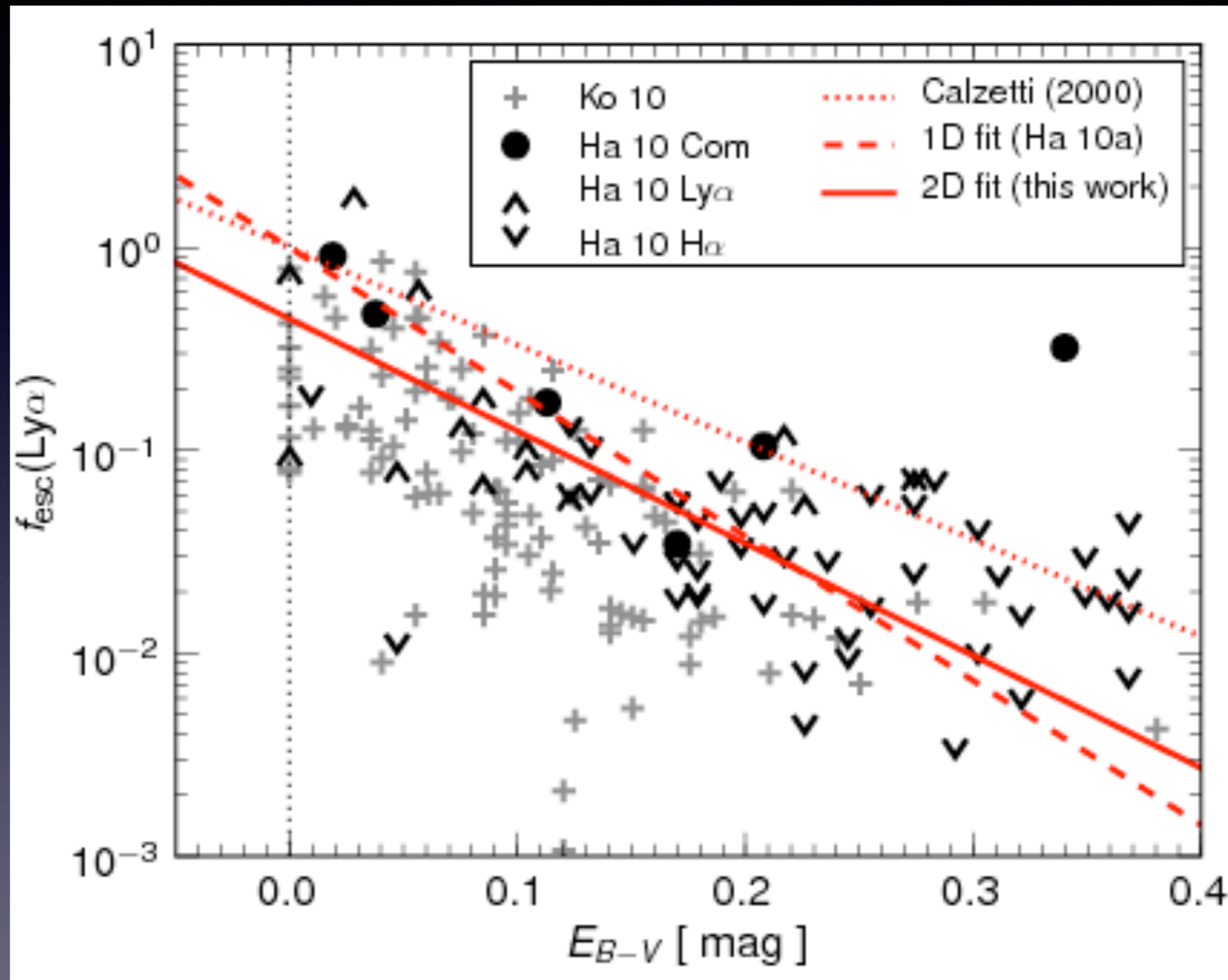
# Anisotropic Lyman-alpha Emission from Galaxies in Hydrodynamic Simulations

## Lyman-alpha EW distribution: Model vs Observation



Ciardullo+12  
Gronwall+07  
Ouchi+08

# Ly $\alpha$ Escape Fraction vs Dust Extinction

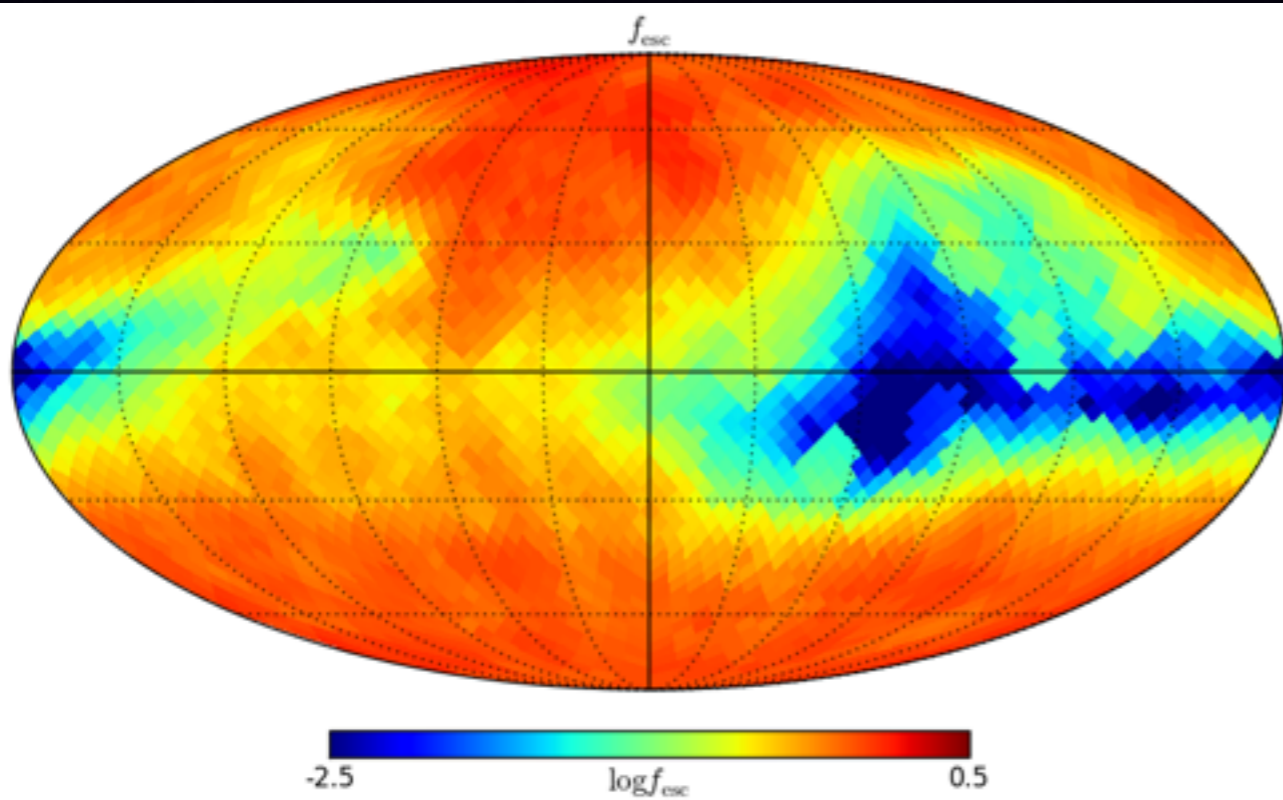


Hayes et al. (2011)

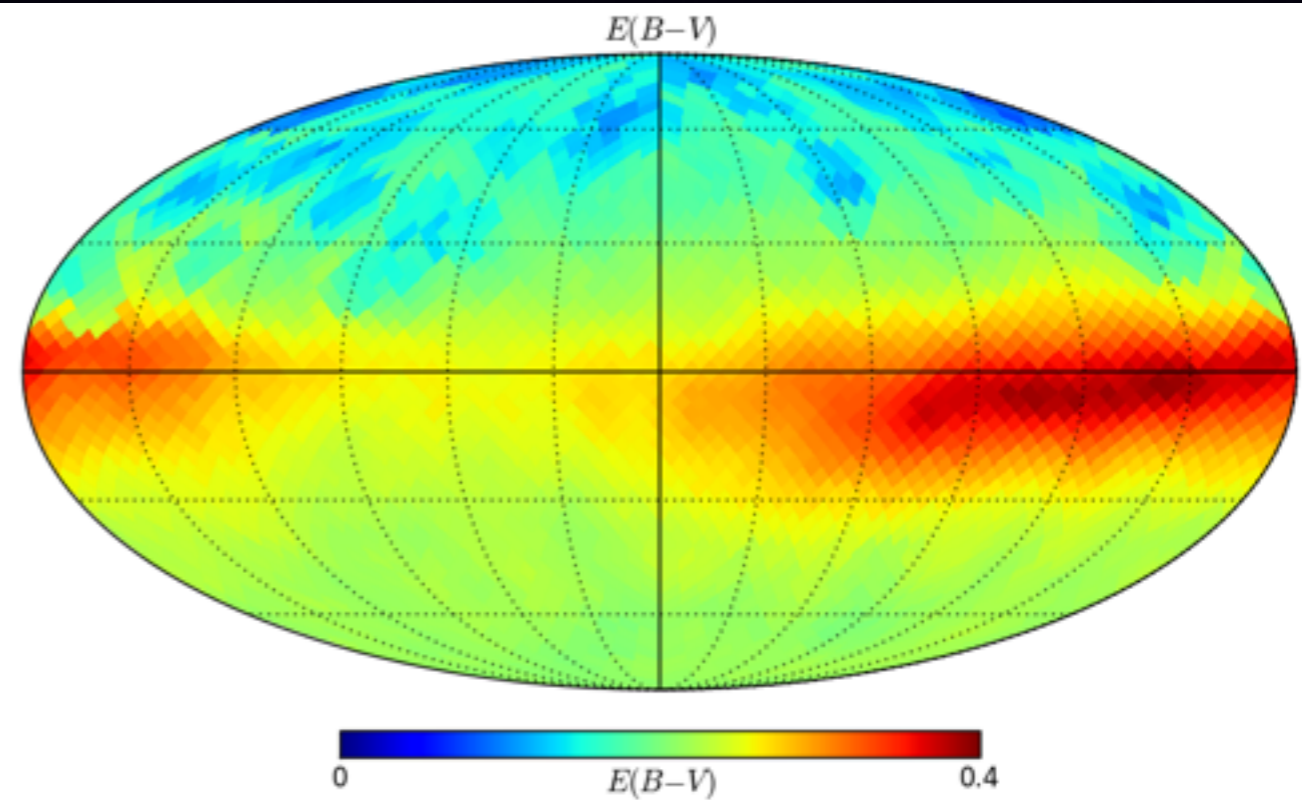
dust effect on  $f_{\text{esc}}$ ?

Correlation  $\neq$  Causation

# Ly $\alpha$ Escape Fraction vs Dust Extinction



Lyman-alpha Escape Fraction  
(no dust effect)



$E(B-V)$

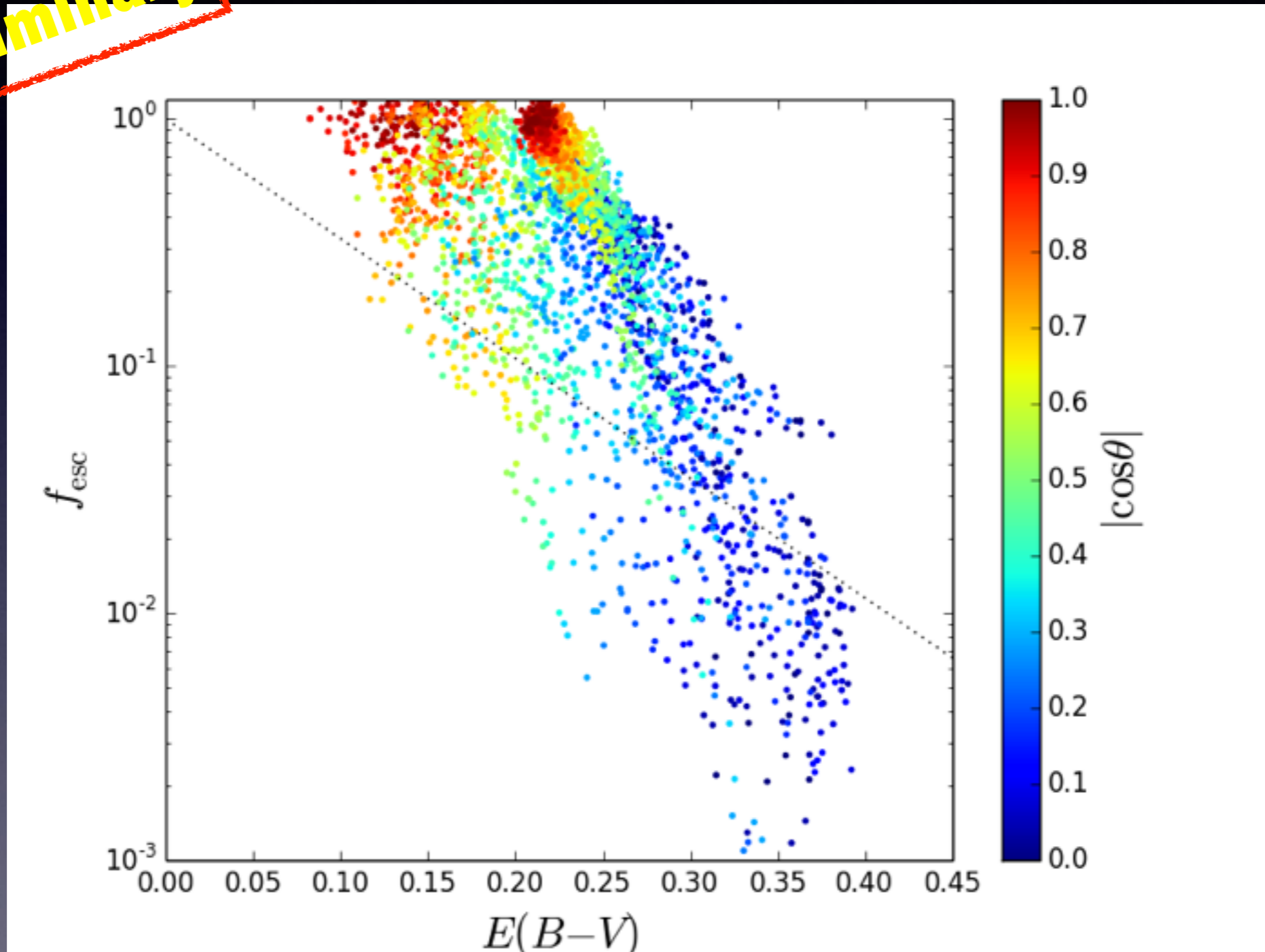
viewing angle effect?

**Preliminary**

Nie, ZZ, Sadoun, & Cen (in prep)

# Lya Escape Fraction vs Dust Extinction

**Preliminary**



viewing angle effect?

Nie, ZZ, Sadoun, & Cen (in prep)

# Summary

**Anisotropic emission** can be one of the key factors in determining and in interpreting the observational properties of Lyman-alpha emission from star-forming galaxies.

