



Siddhant Mishra-Sharma (MIT/AI FI) Summer School



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*Sinulators*

$$x \sim p(x)$$

*Simulators are ubiquitous: they prescribe a way to sample from the data distribution*



# Collider data

particles  $\sim p(\text{particles})$

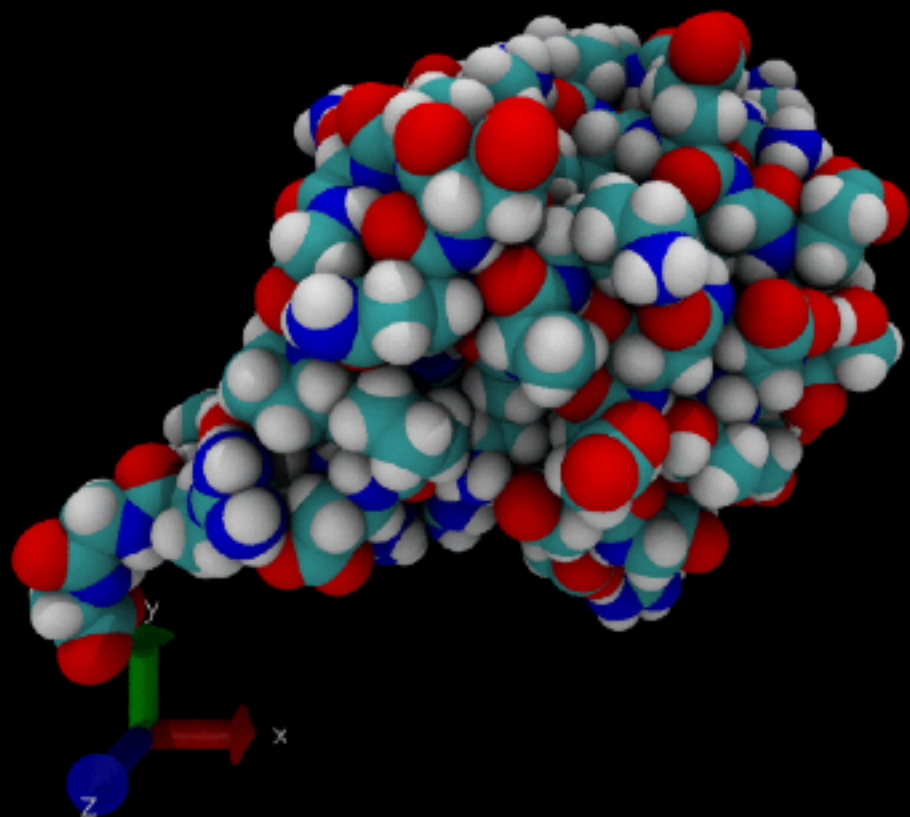


Cosmology data

particles  $\sim p(\text{particles})$

# Molecular dynamics

configurations  $\sim p(\text{configurations})$



[C. Cesaroni with ATLAS]

[Aquarius simulation]


[E. Cances et al]



$z = 30.3$

$T = 0.10 \text{ Gyr}$

500 kpc

A visualization of the cosmic web at redshift  $z = 30.3$  and time  $T = 0.10 \text{ Gyr}$ . The image shows a complex network of dark purple and blue filaments and nodes against a black background. A scale bar at the bottom center indicates a length of 500 kpc.





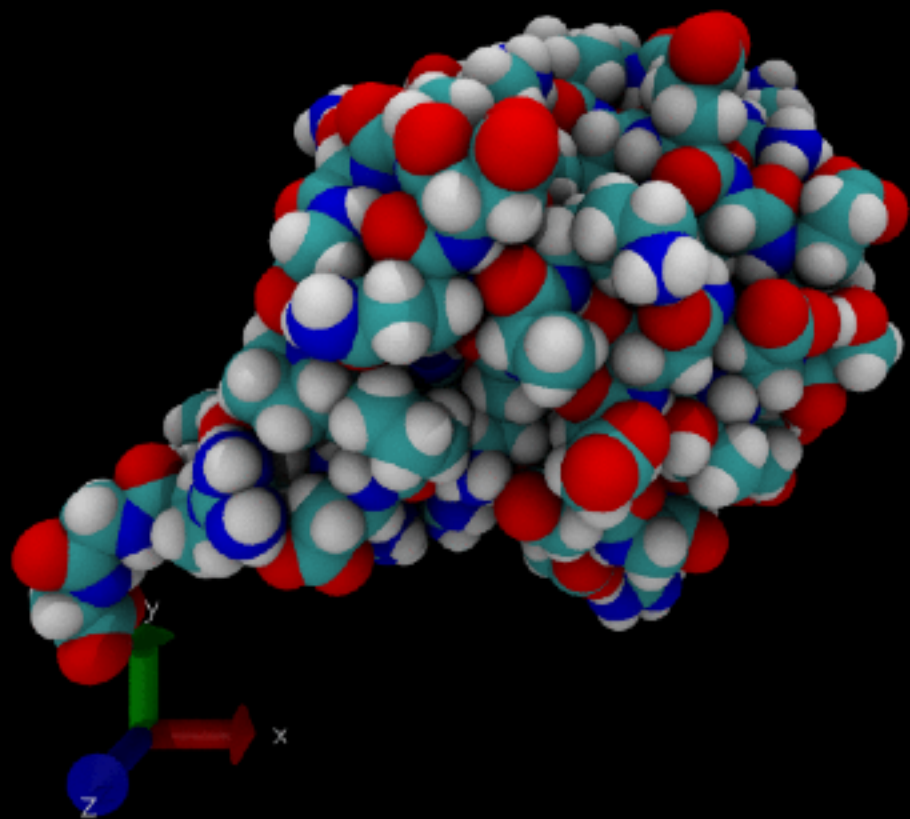
$z = 30.3$

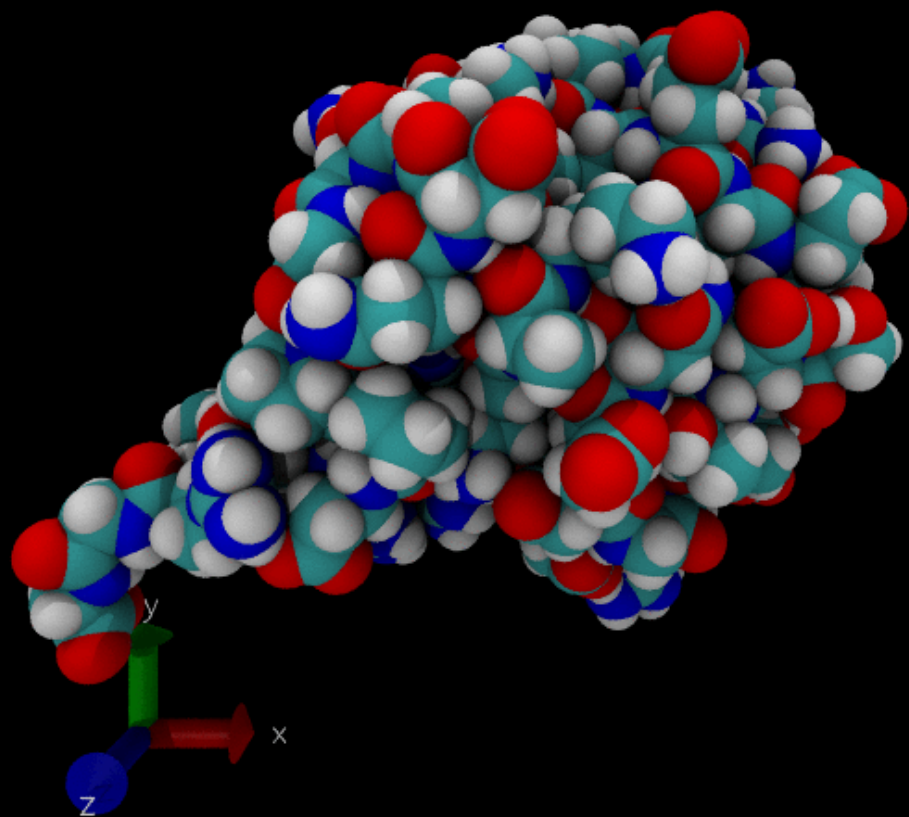
$T = 0.10 \text{ Gyr}$

500 kpc

A visualization of the cosmic web at a high redshift of  $z = 30.3$ . The image shows a complex network of dark purple and magenta filaments and nodes against a black background, representing the distribution of matter in the early universe. A scale bar at the bottom center indicates a length of 500 kpc. The text  $T = 0.10 \text{ Gyr}$  is located in the top right corner.







# Simulators

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Simulators are ubiquitous: *they prescribe a way to sample from the data distribution*

## Collider data

particles  $\sim p(\text{particles})$



[C. Cesarotti with ATLAS]

## Cosmology data

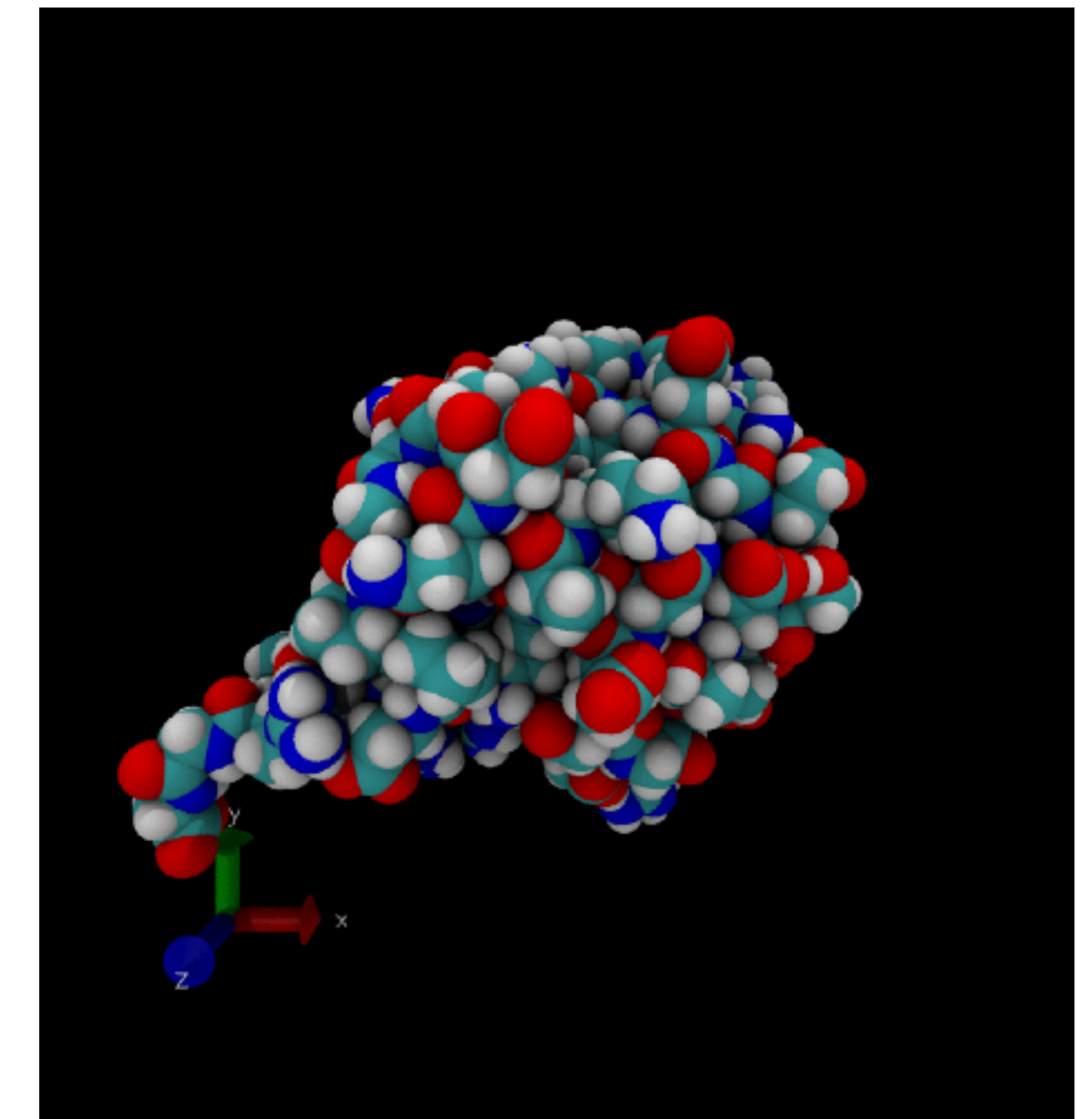
particles  $\sim p(\text{particles})$



[Aquarius simulation]

## Molecular dynamics

configurations  $\sim p(\text{configurations})$



[E. Cancès et al]

# Conditional simulators

Conditional simulations *sample from the likelihood*  $p(x \mid \theta)$

$$x \sim p(x; \mathcal{M})$$

Model

*or*

$$x \sim p(x \mid \theta)$$

Model  
parameters