

# Measuring $f\sigma_8$ with the ZTF SN Ia sample

## Simulation of the Sample Bias

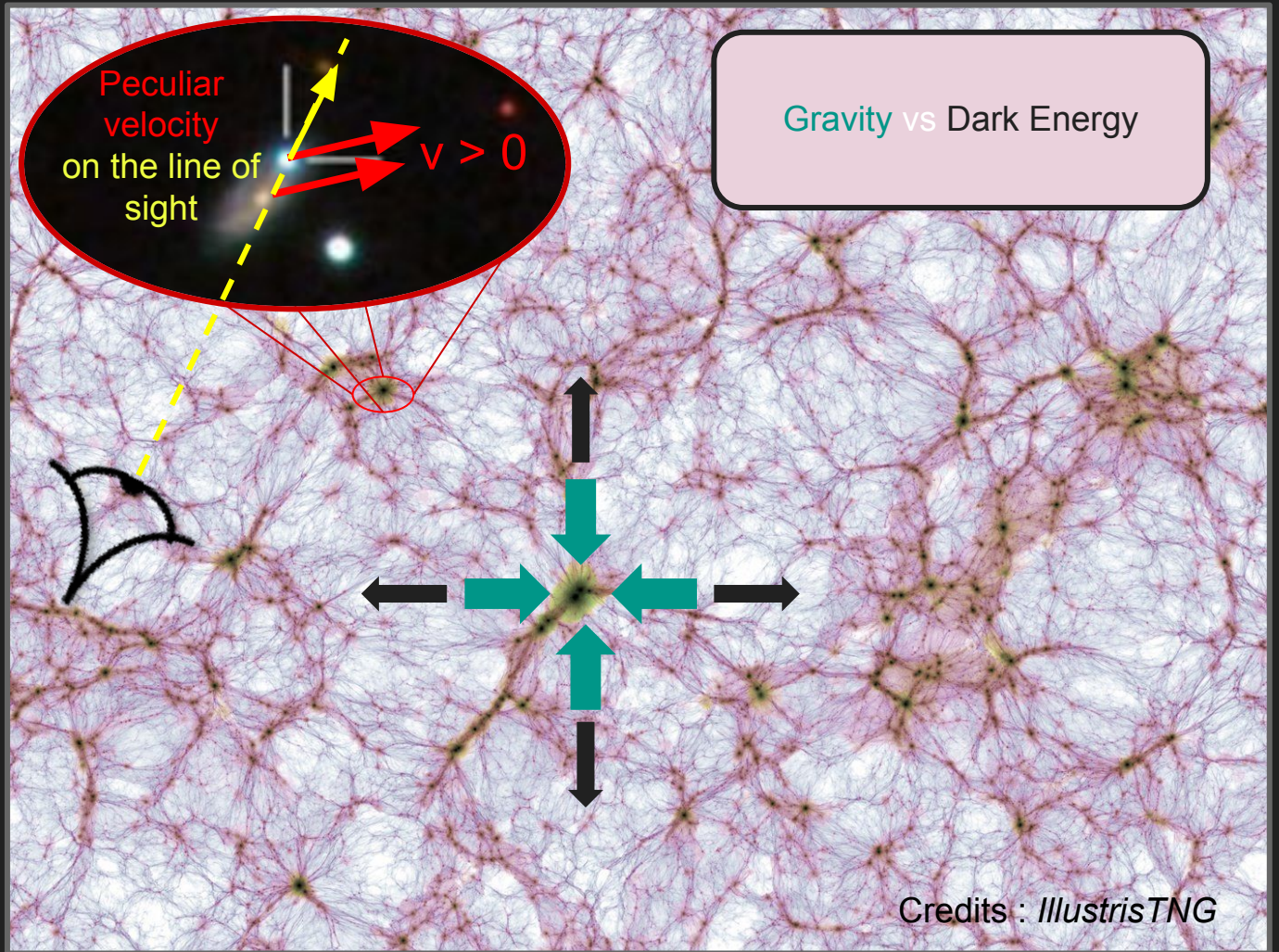
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# What is $f\sigma_8$ ?

Peculiar velocities

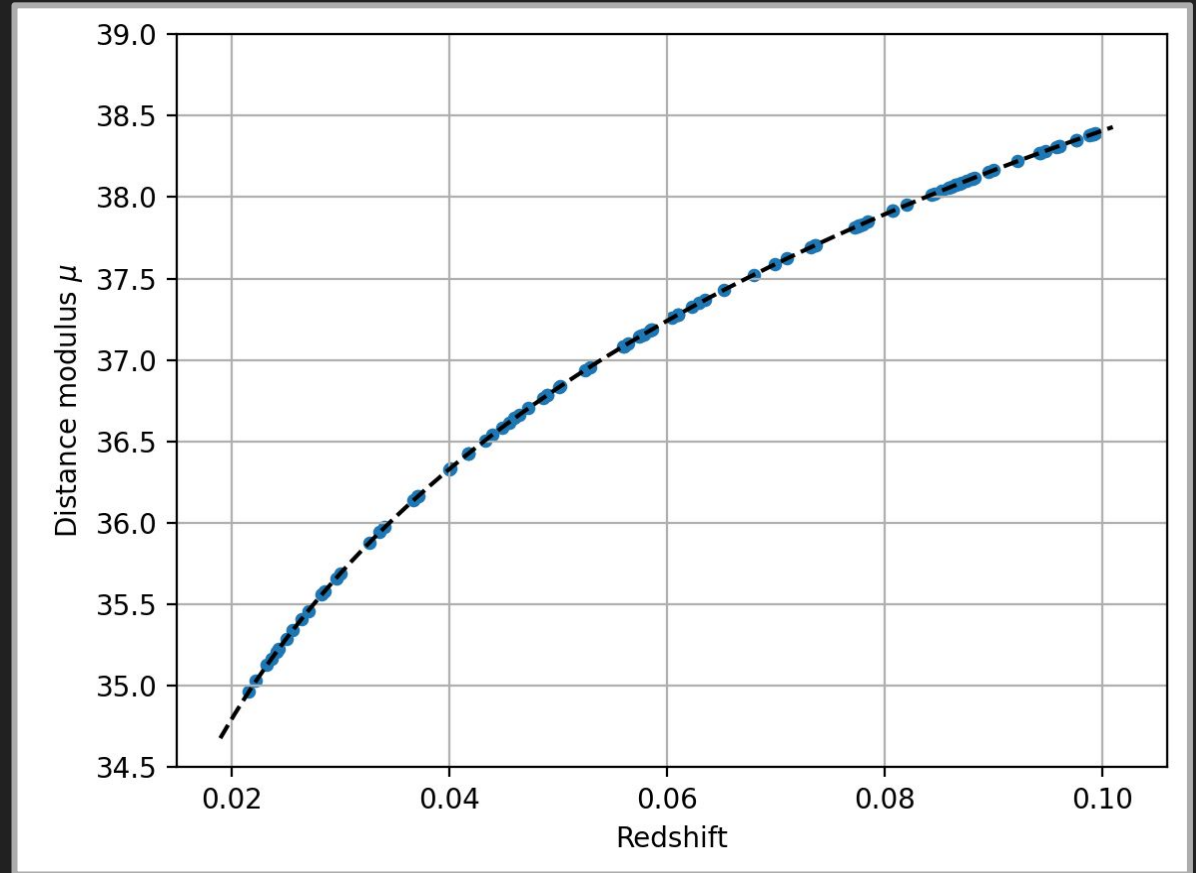
$$\nabla \cdot \mathbf{v} \propto f\sigma_8$$



Gravity vs Dark Energy

Credits : *IllustrisTNG*

# The Hubble diagram : without peculiar velocities



# The Hubble diagram : with peculiar velocities

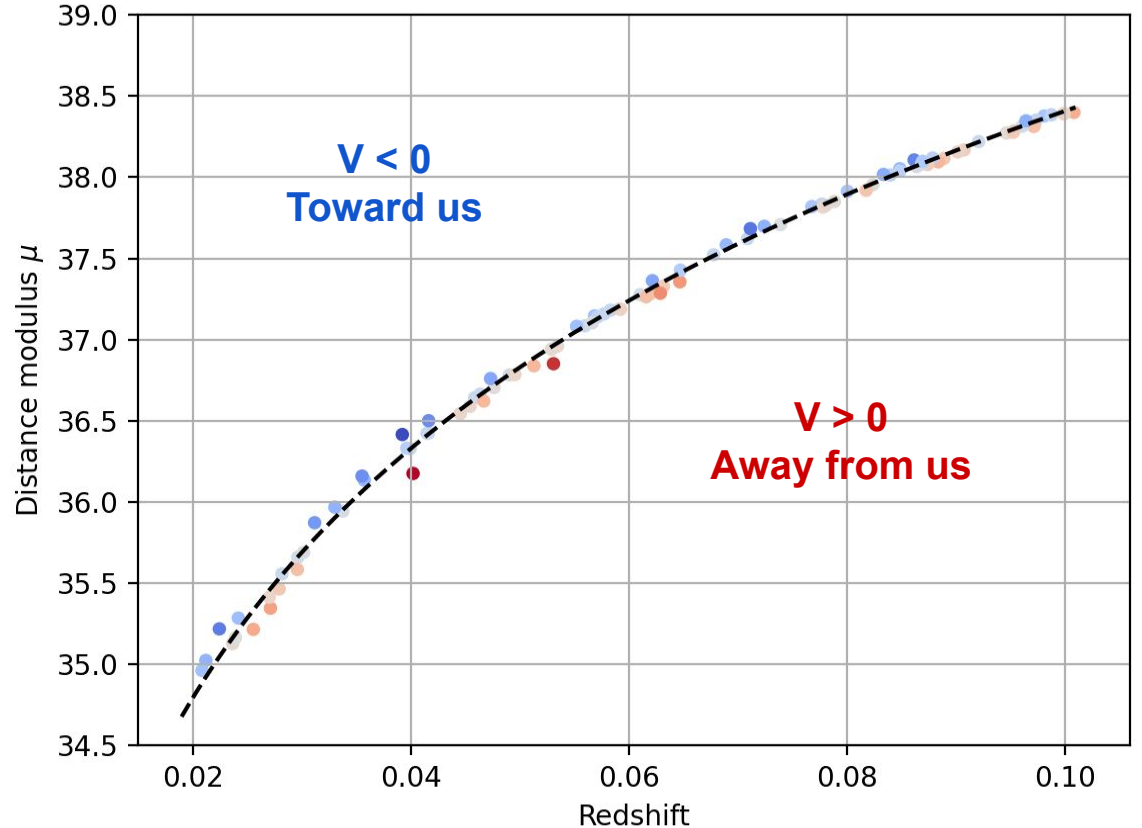
## Peculiar velocity:

Effect of  $v \sim 300 \text{ km / s}$

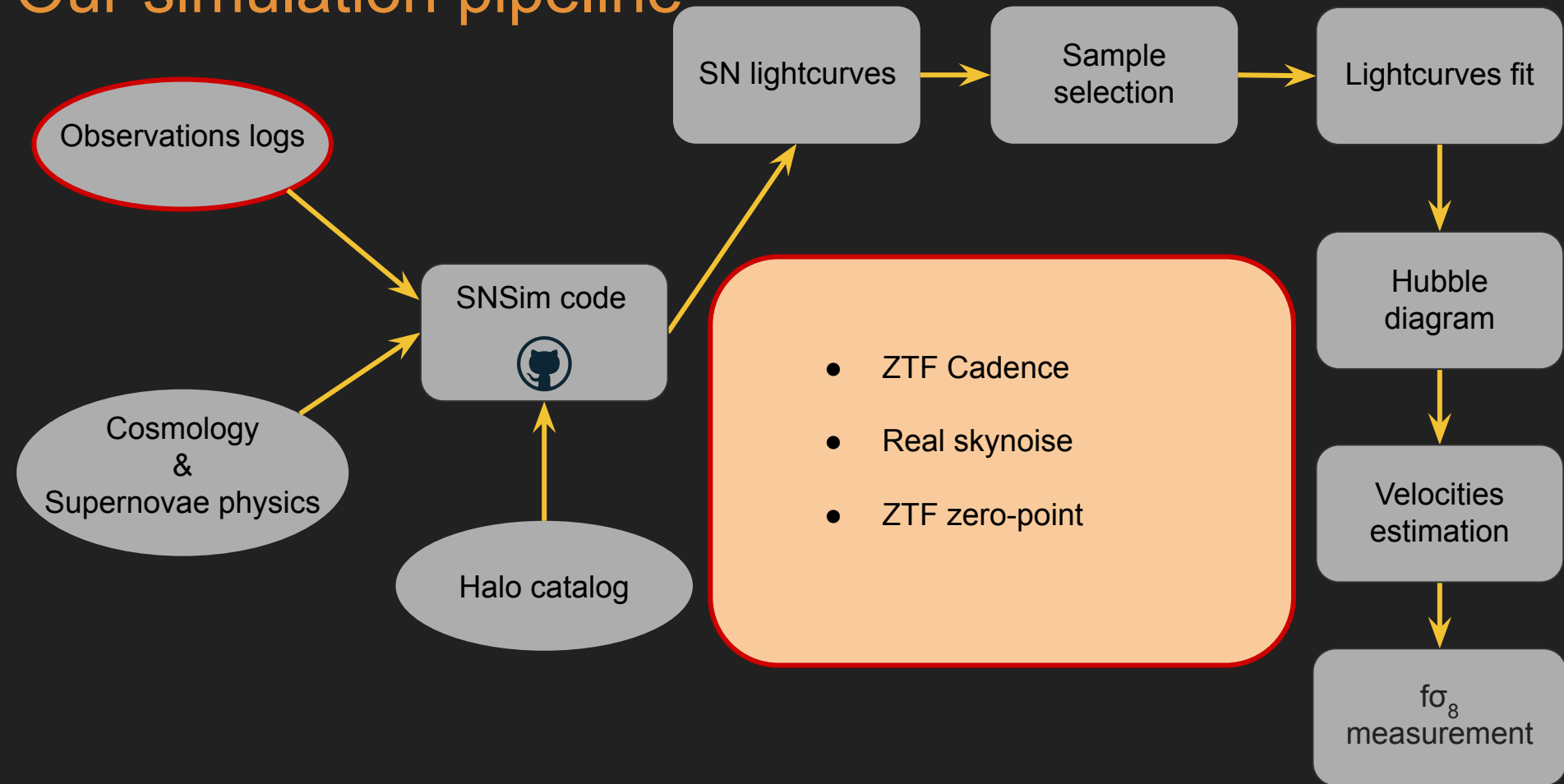
$\Delta z \sim 0.001 (v / c)$

$\Delta \mu \sim 0.004 \text{ mag}$

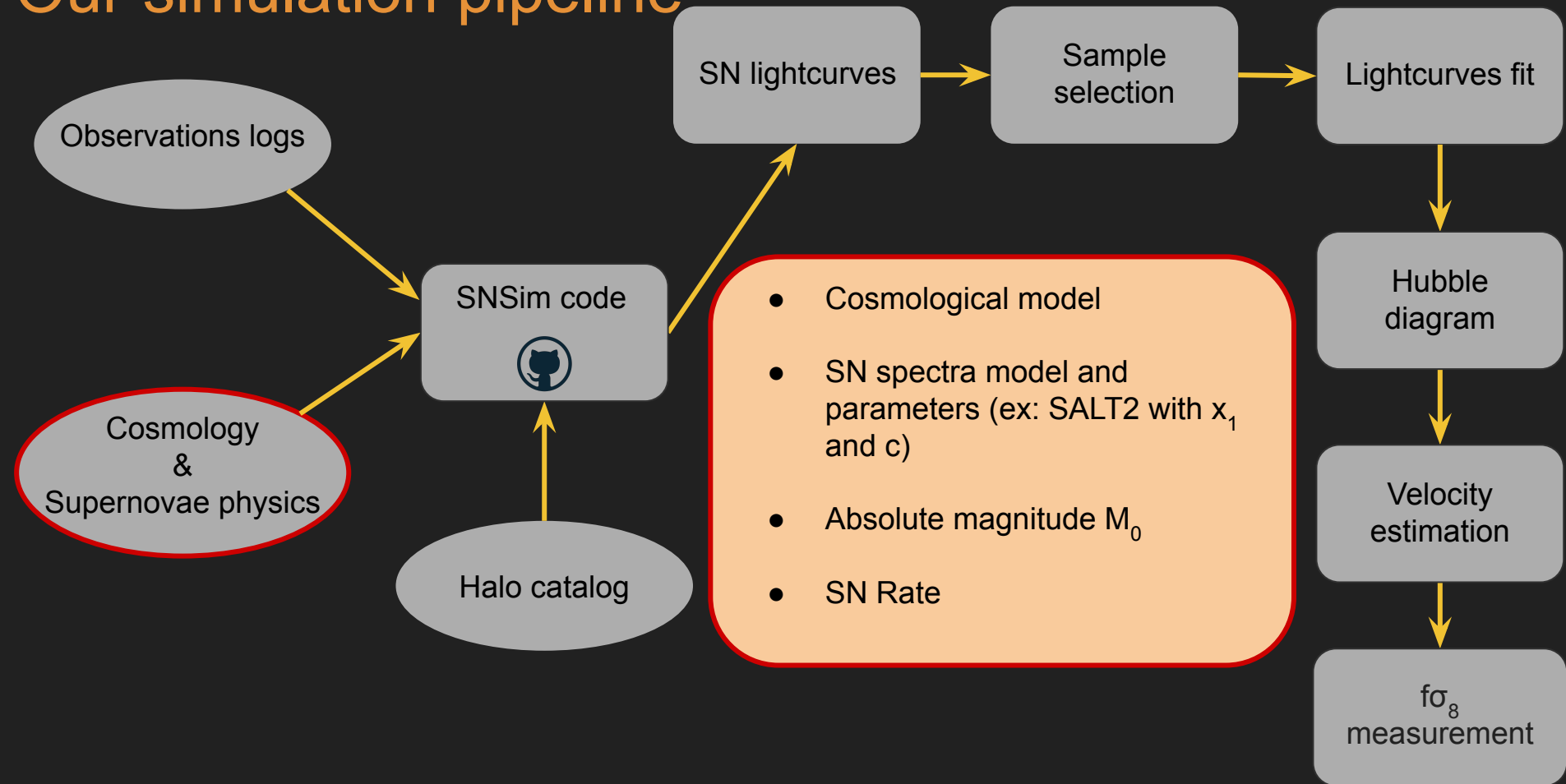
$\Delta z$  and  $\Delta \mu$  variations have the same sign as  $v$



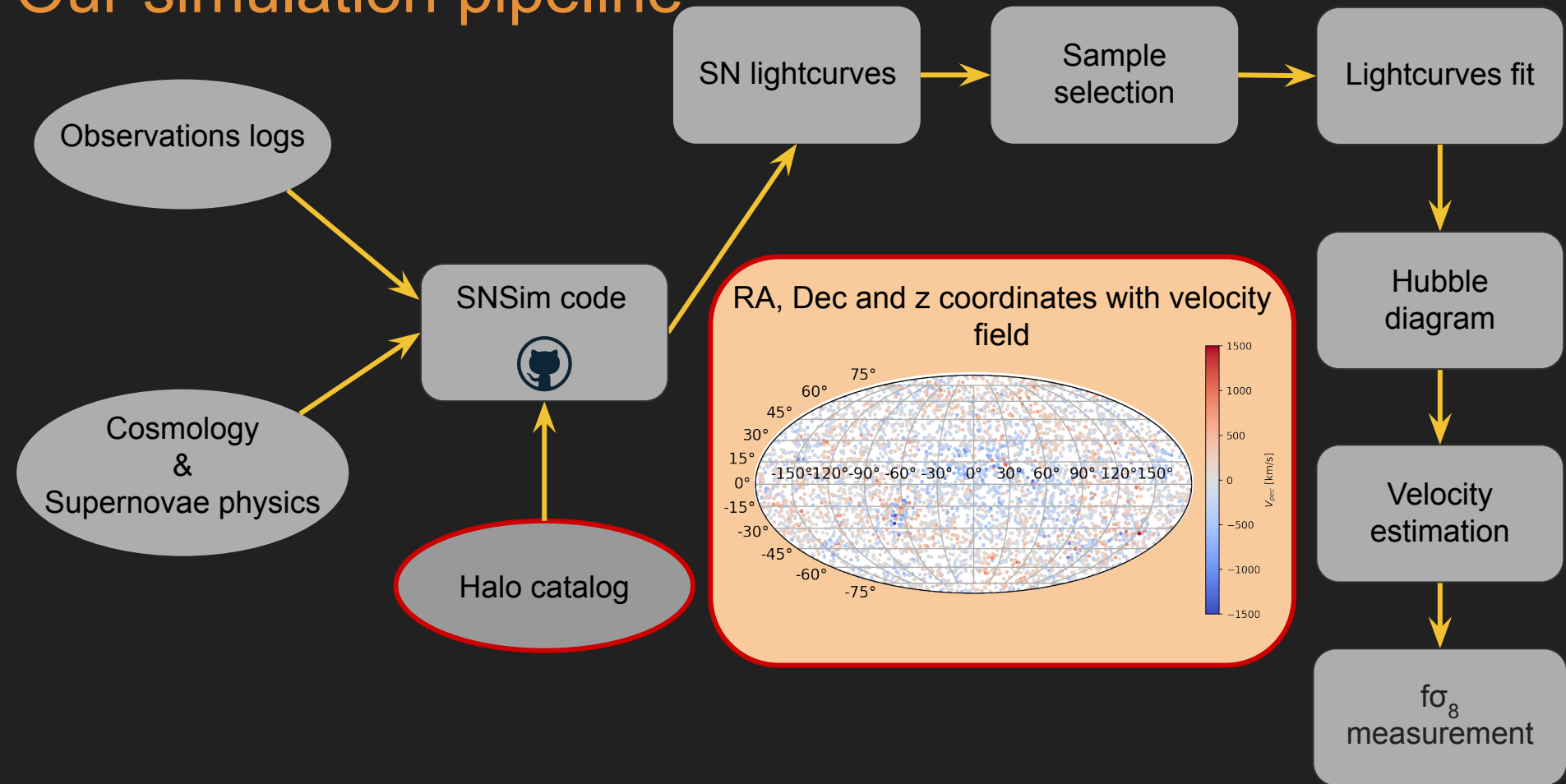
# Our simulation pipeline



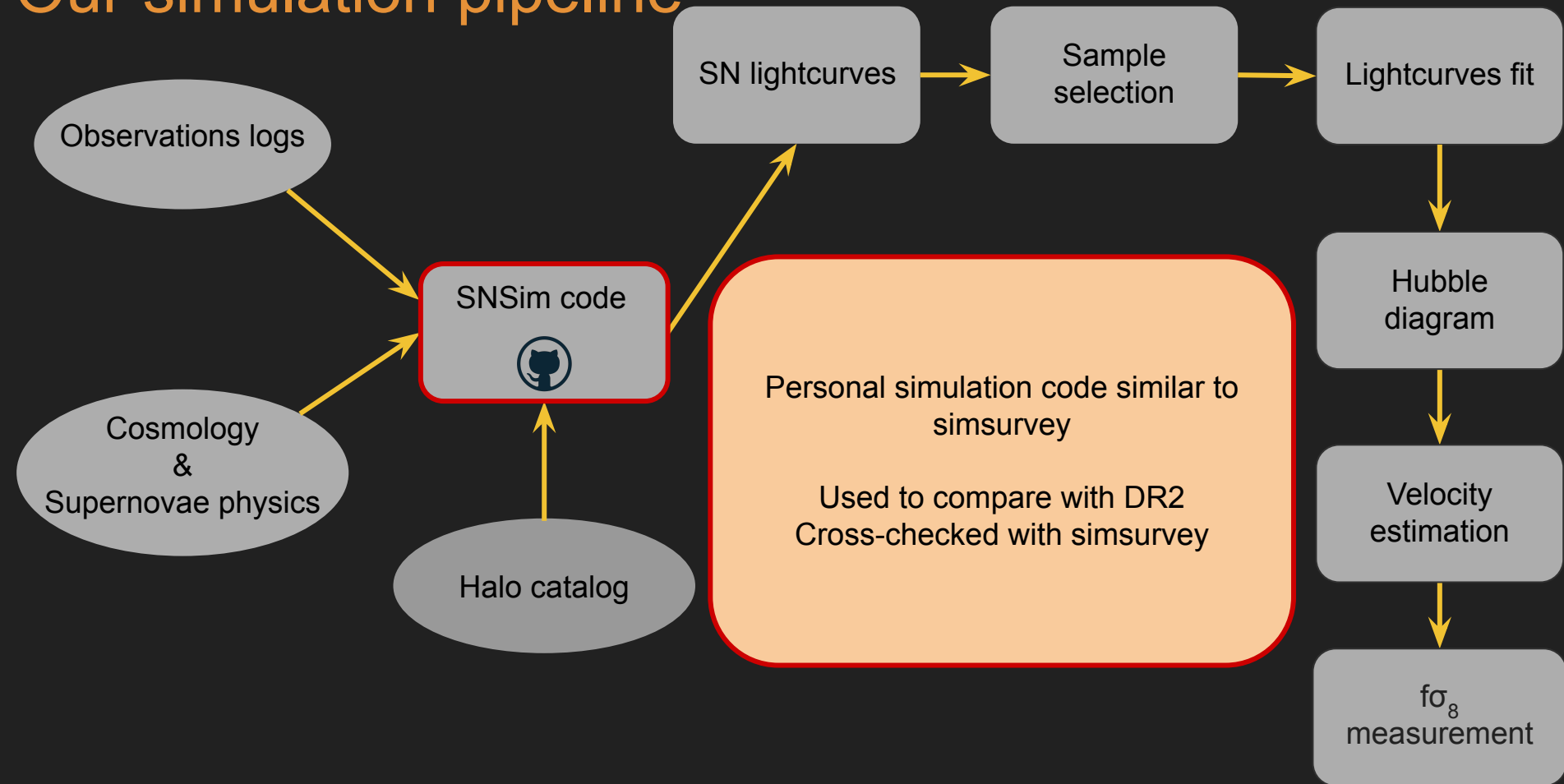
# Our simulation pipeline



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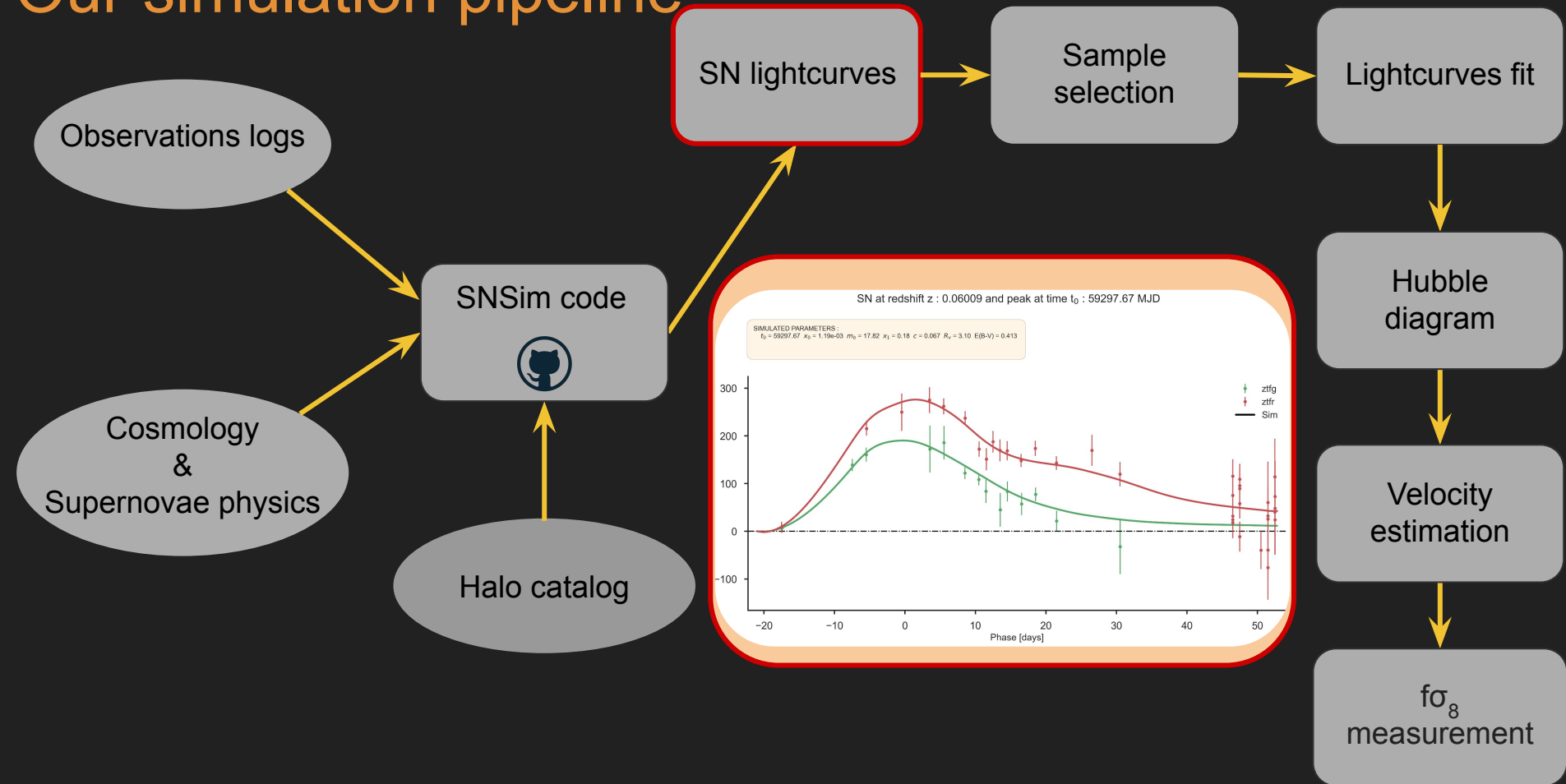


# Our simulation pipeline

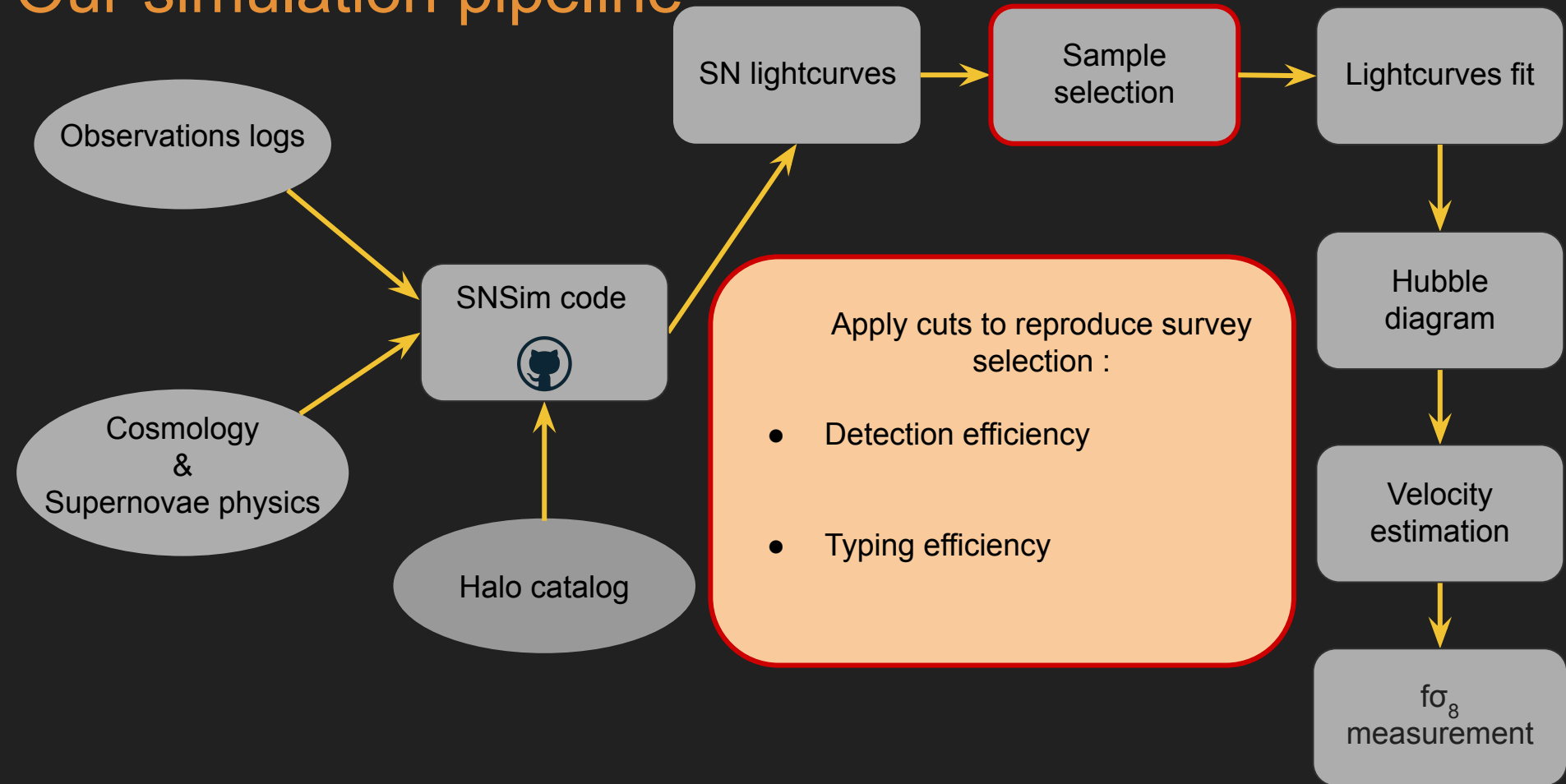




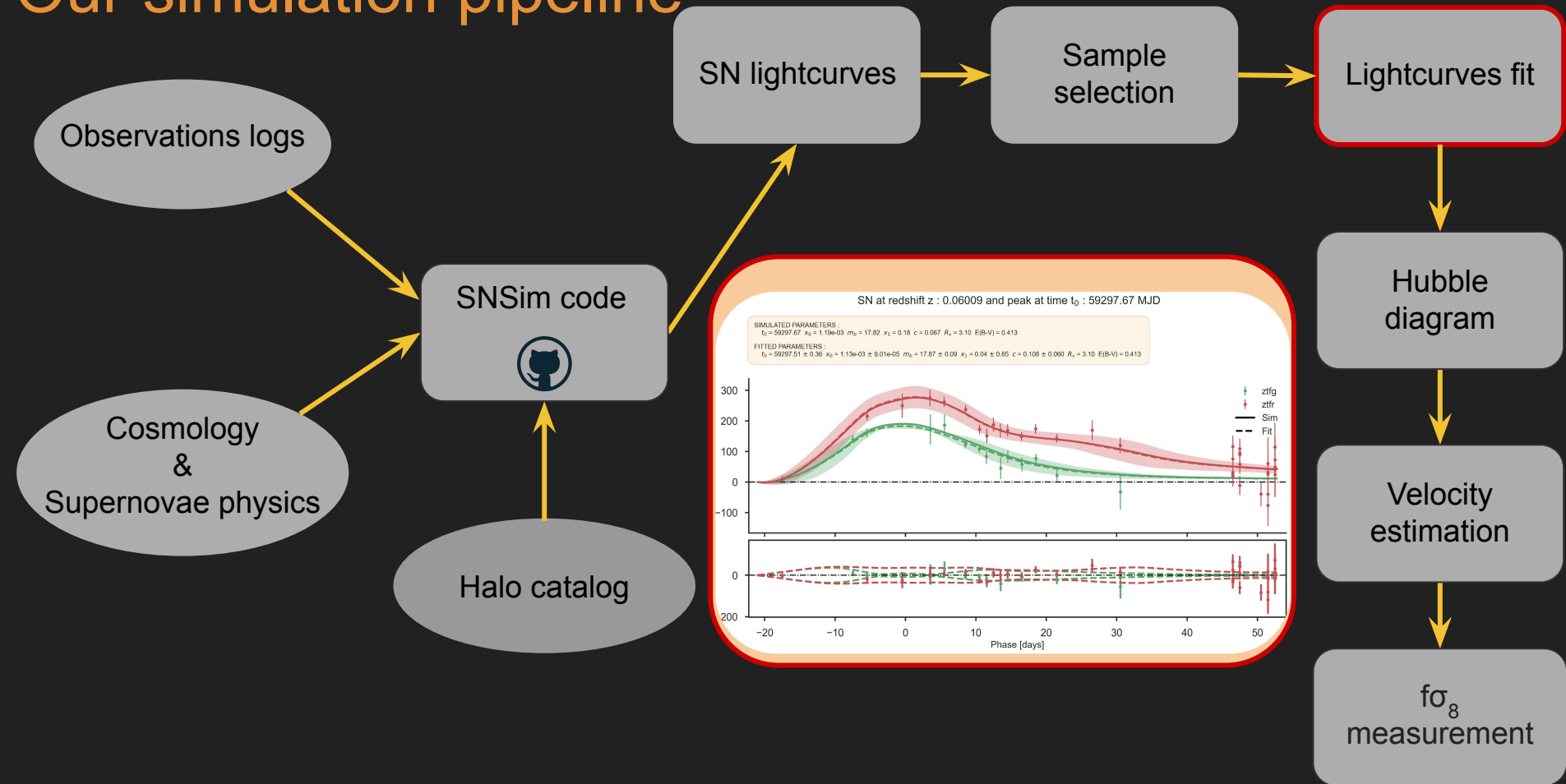
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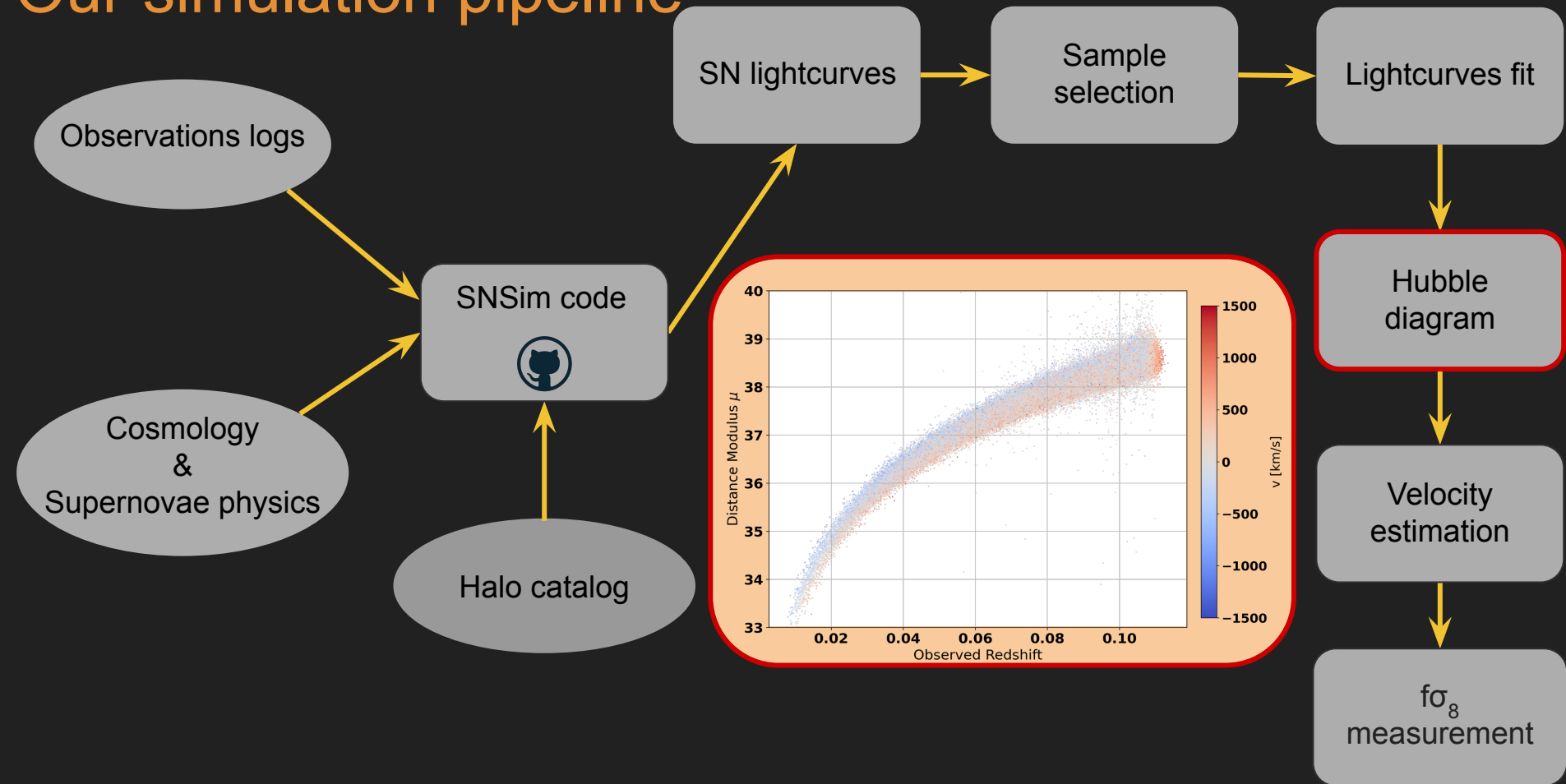
# Our simulation pipeline



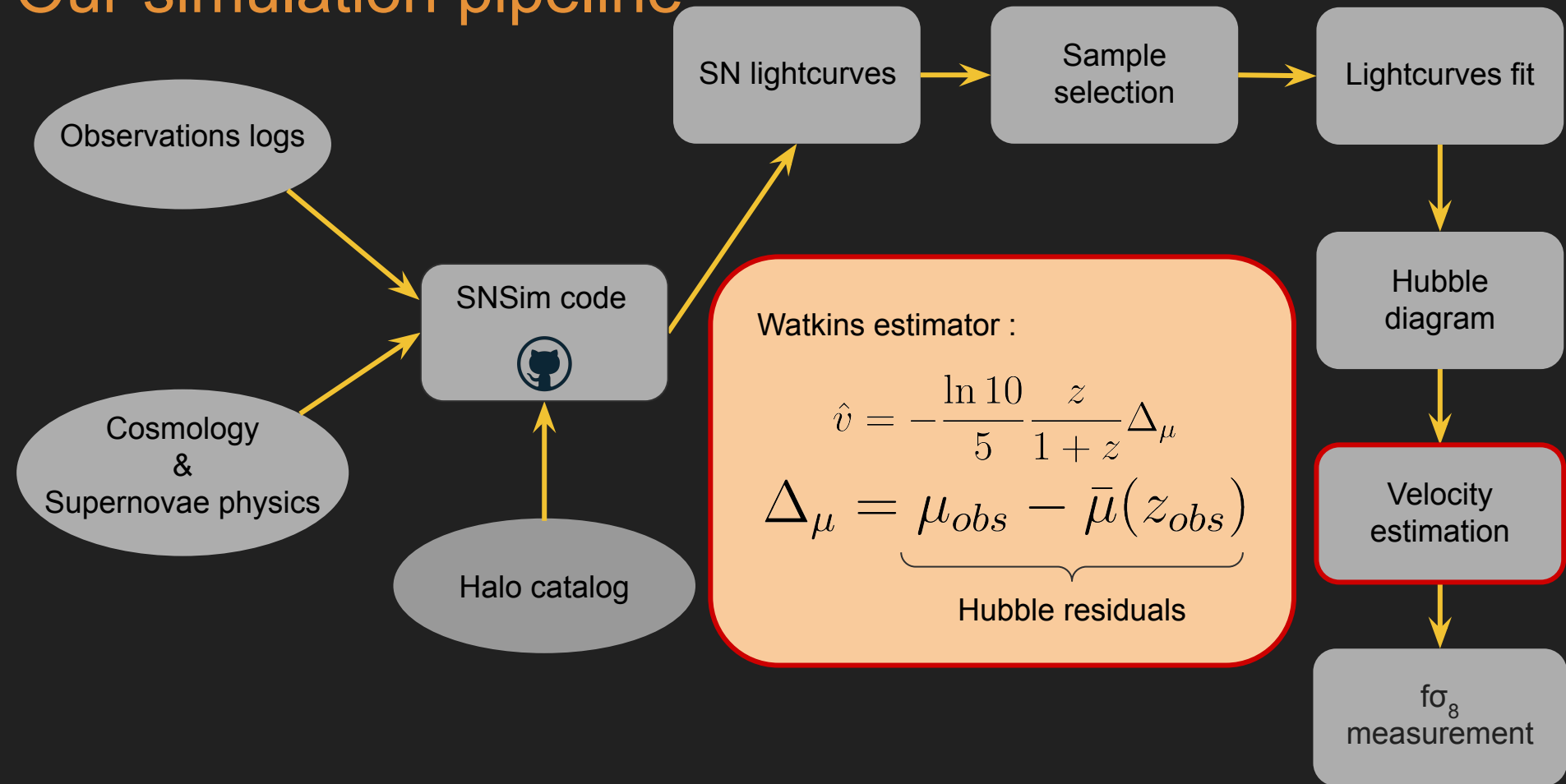
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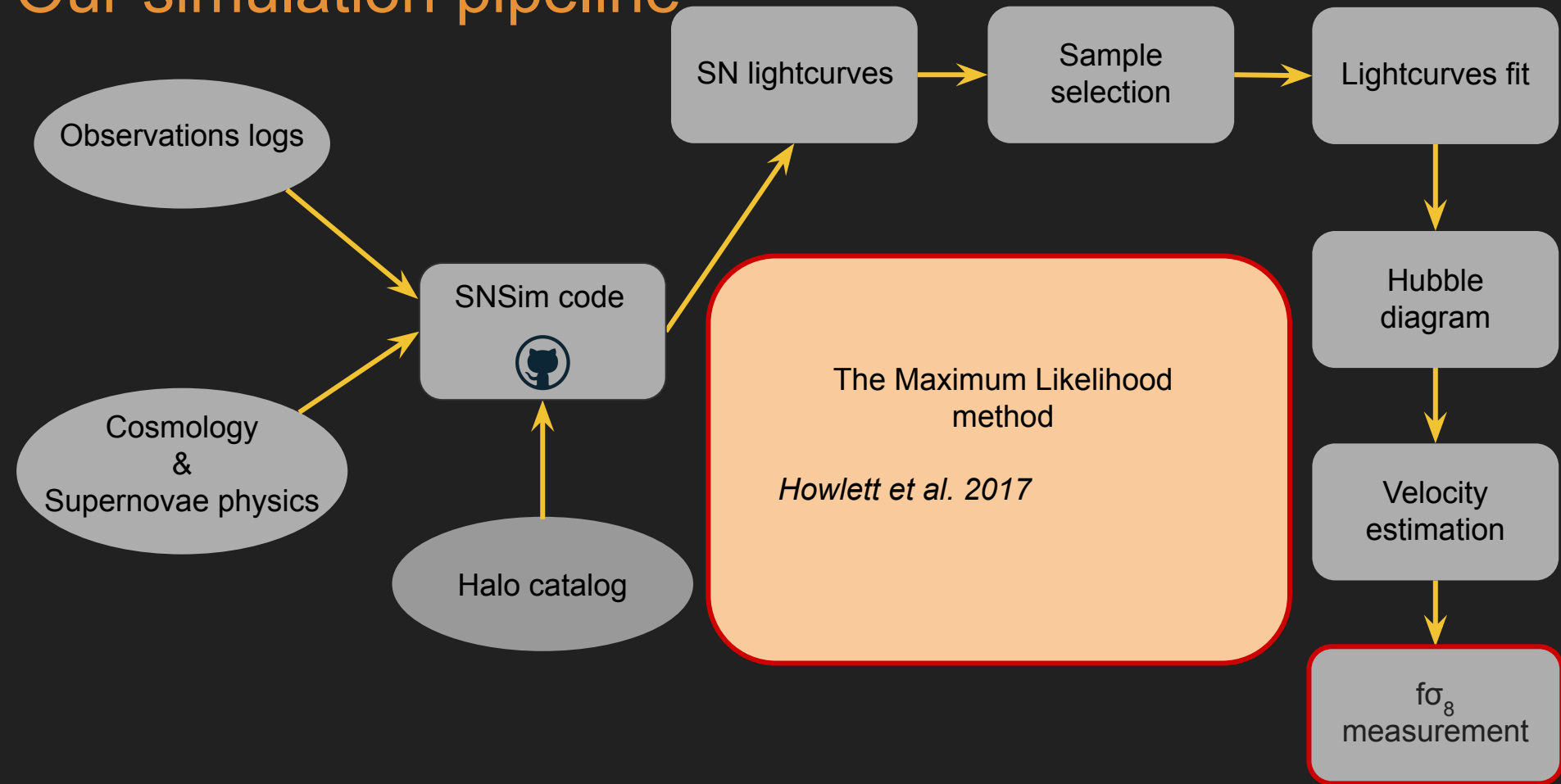
# Our simulation pipeline



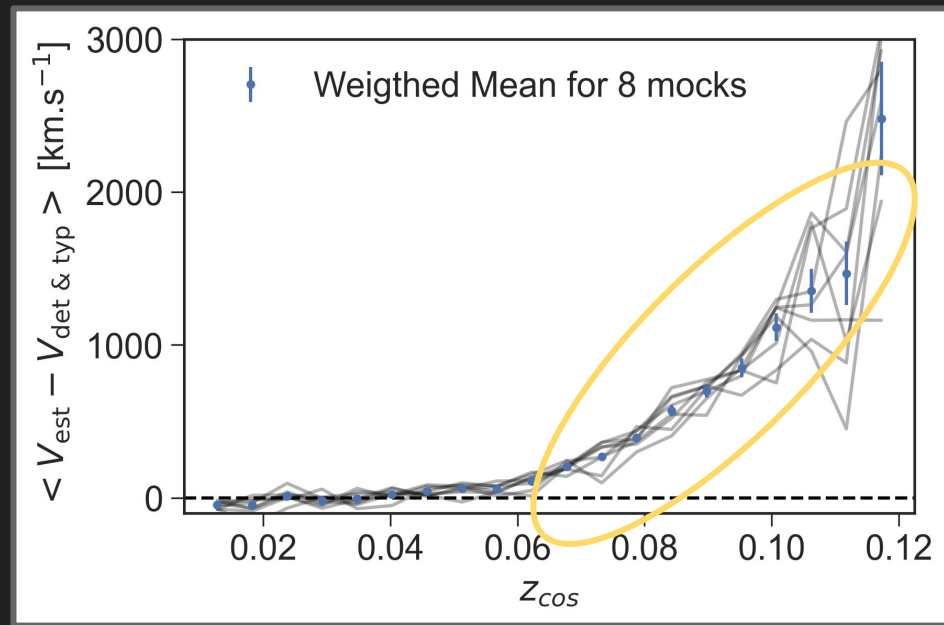
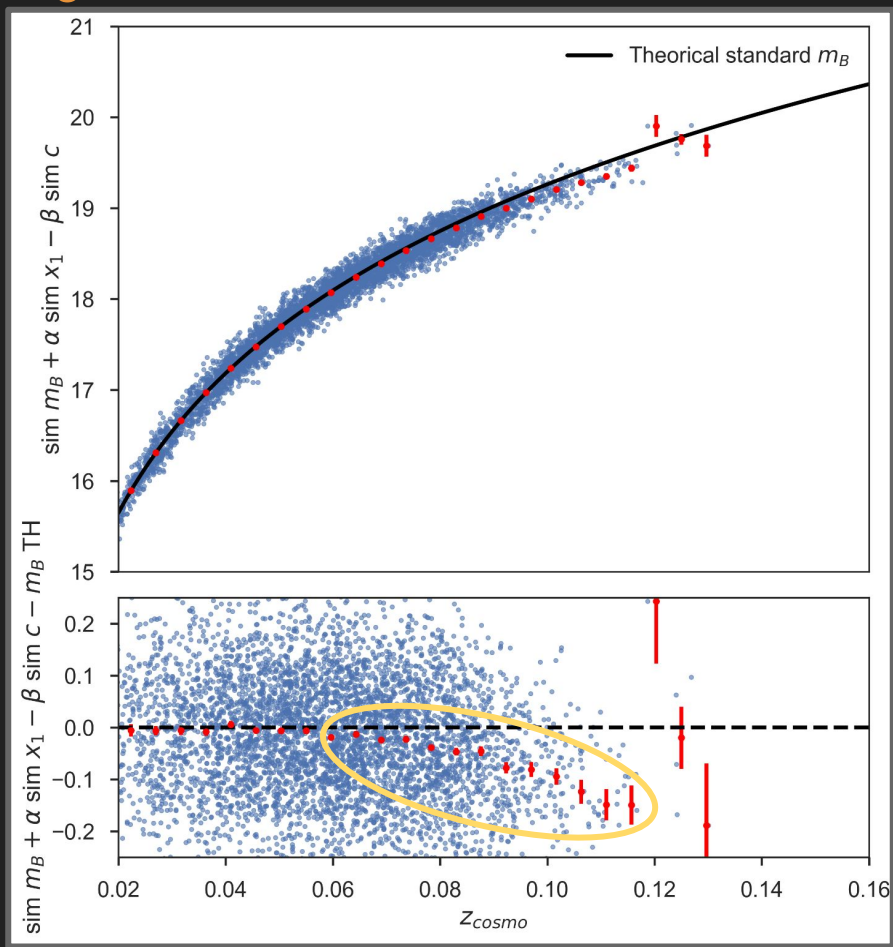
# Our simulation pipeline



# Our simulation pipeline



# $f\sigma_8$ measurement : bias effect



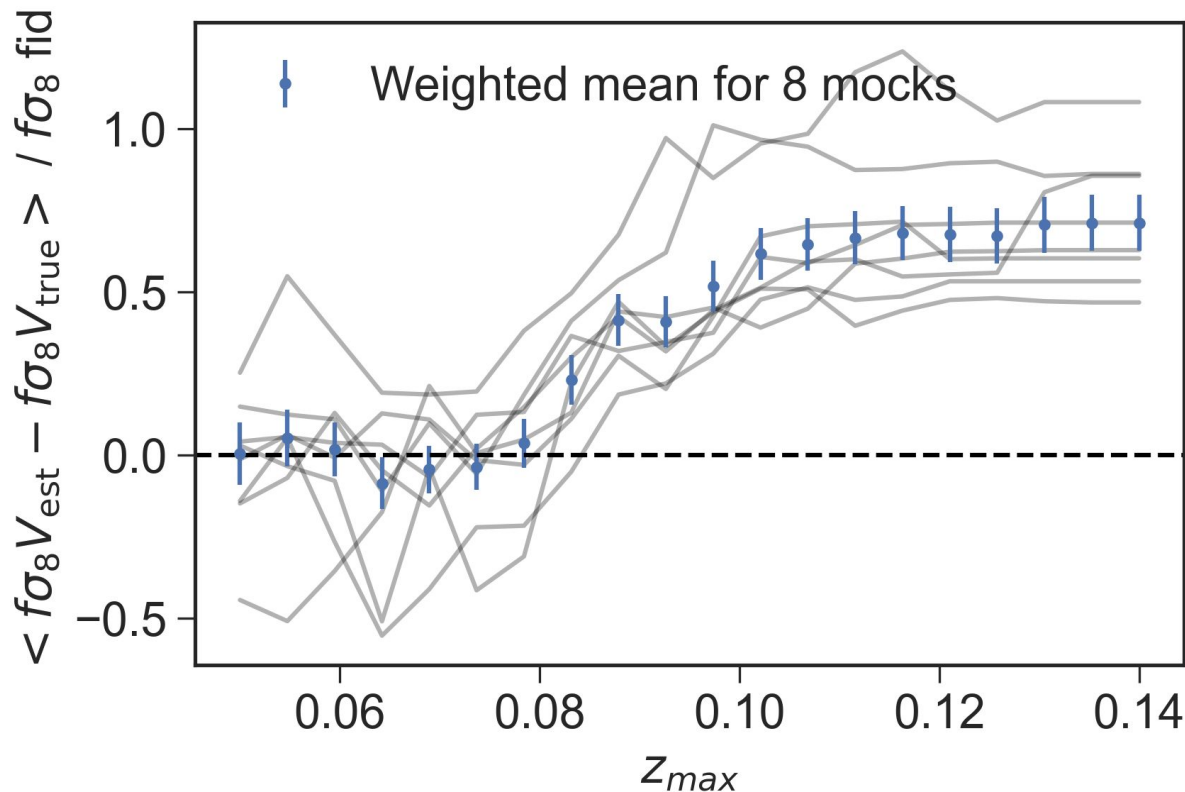
# $f\sigma_8$ measurement : bias effect

Difference between  $f\sigma_8$  from true velocities and  $f\sigma_8$  from estimated velocities

No bias for  $z < 0.08$

Effect of selection bias is clear after  $z \sim 0.08$

Bias at  $z = 0.14 \sim 60\%$

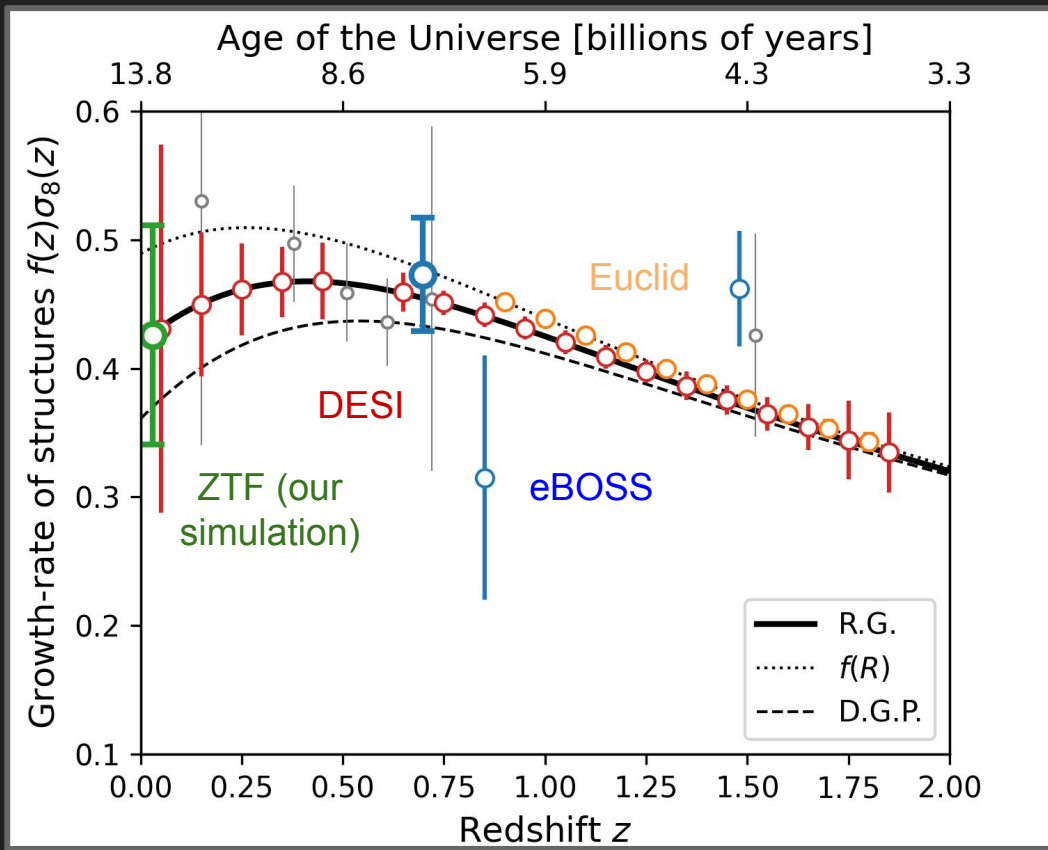




# $f\sigma_8$ measurement : forecast for $z < 0.06$

$f\sigma_8$  measurement comparison with actual data and future survey

With sample at  $z < 0.06$  no bias and relative error of ~ 20 %



Thanks for your attention