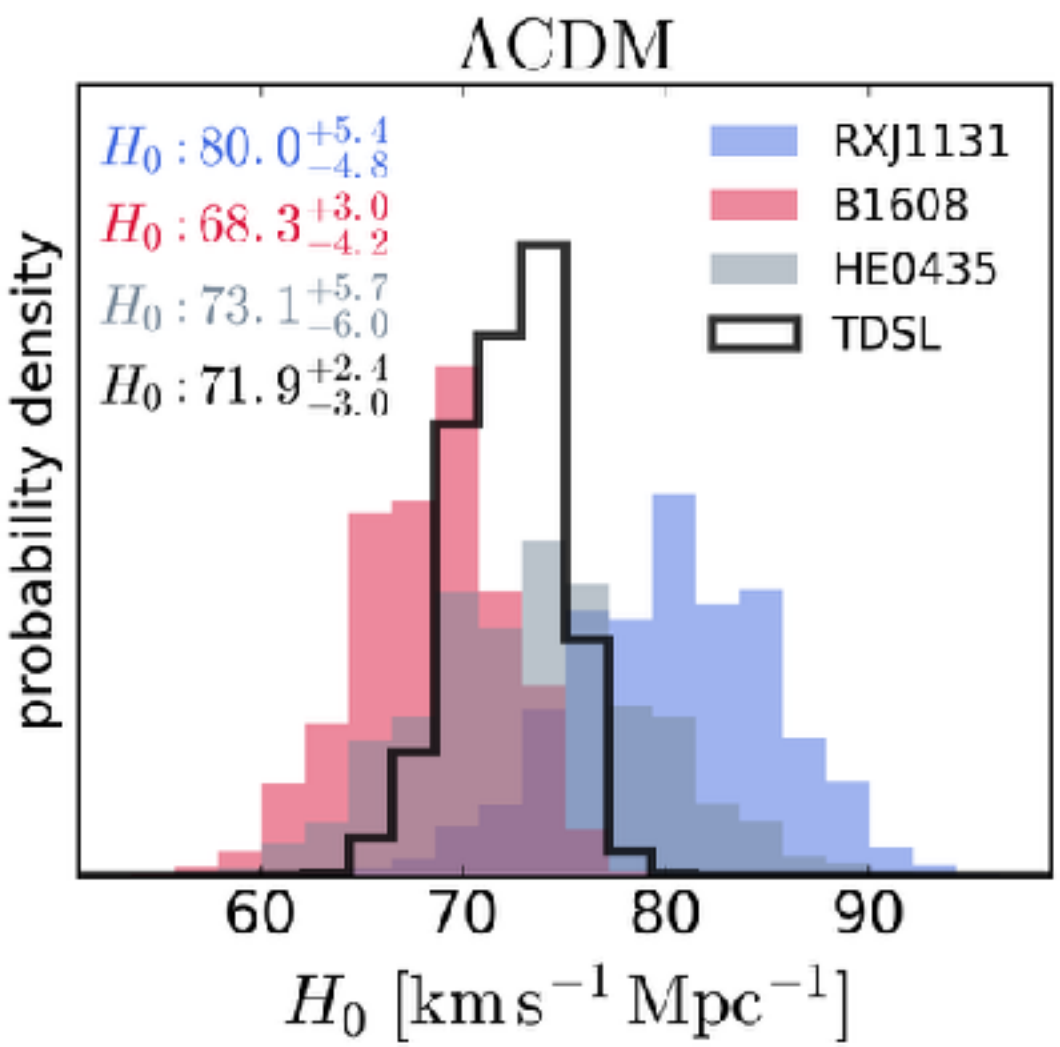
TIME-DELAY DISTANCES IN THE ERA OF JWST

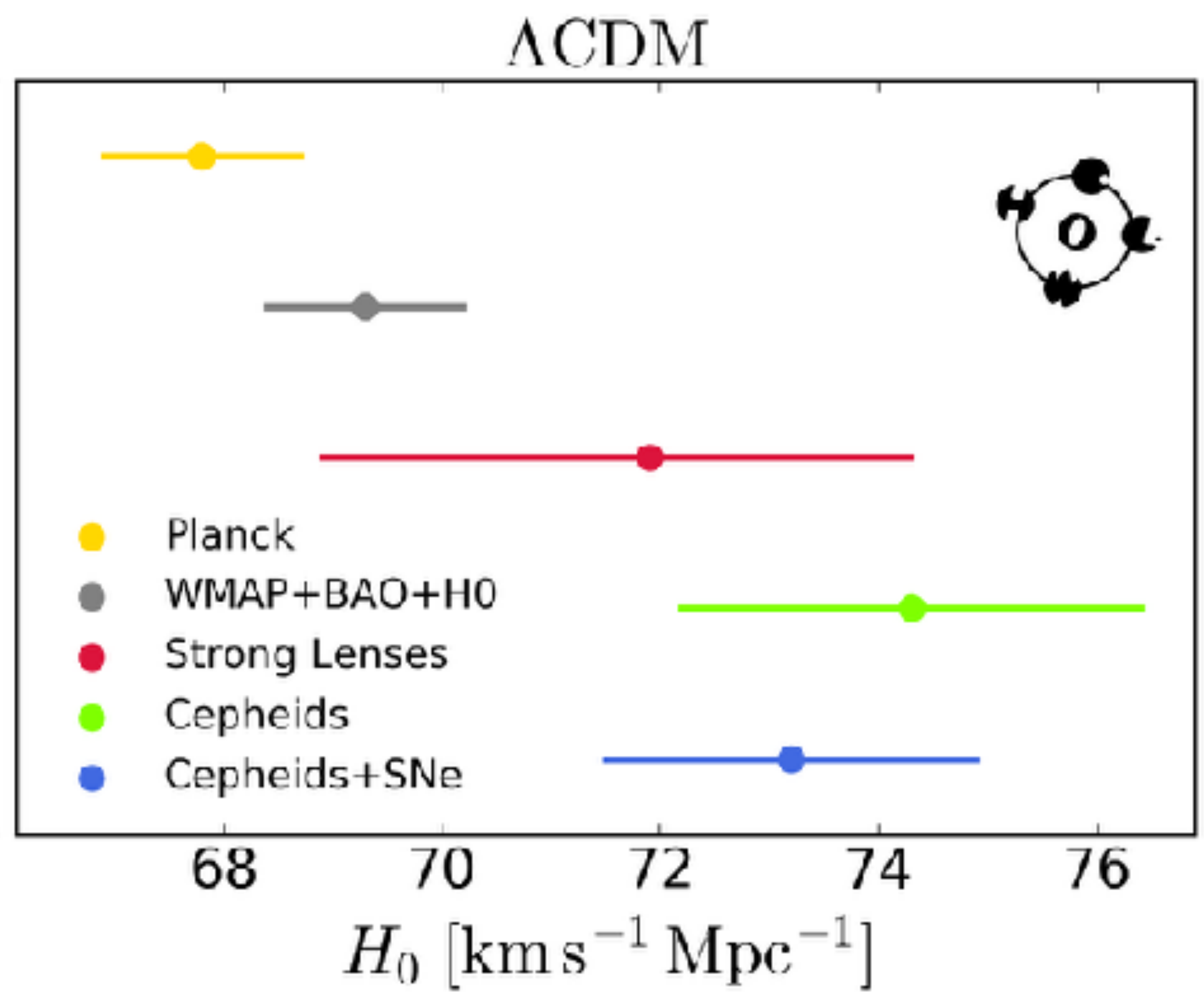
Akın Yıldırım, Sherry Suyu &
H0LiCOW Collaboration

Time-delay distances in the era of JWST

Time-delay measurements - An intermediary

- 4% precision measurement of H0 based on 3 gravitational lens systems.
- Time-Delay Strong Lensing (TDSL) in agreement with local distance ladder results for flat LCDM.





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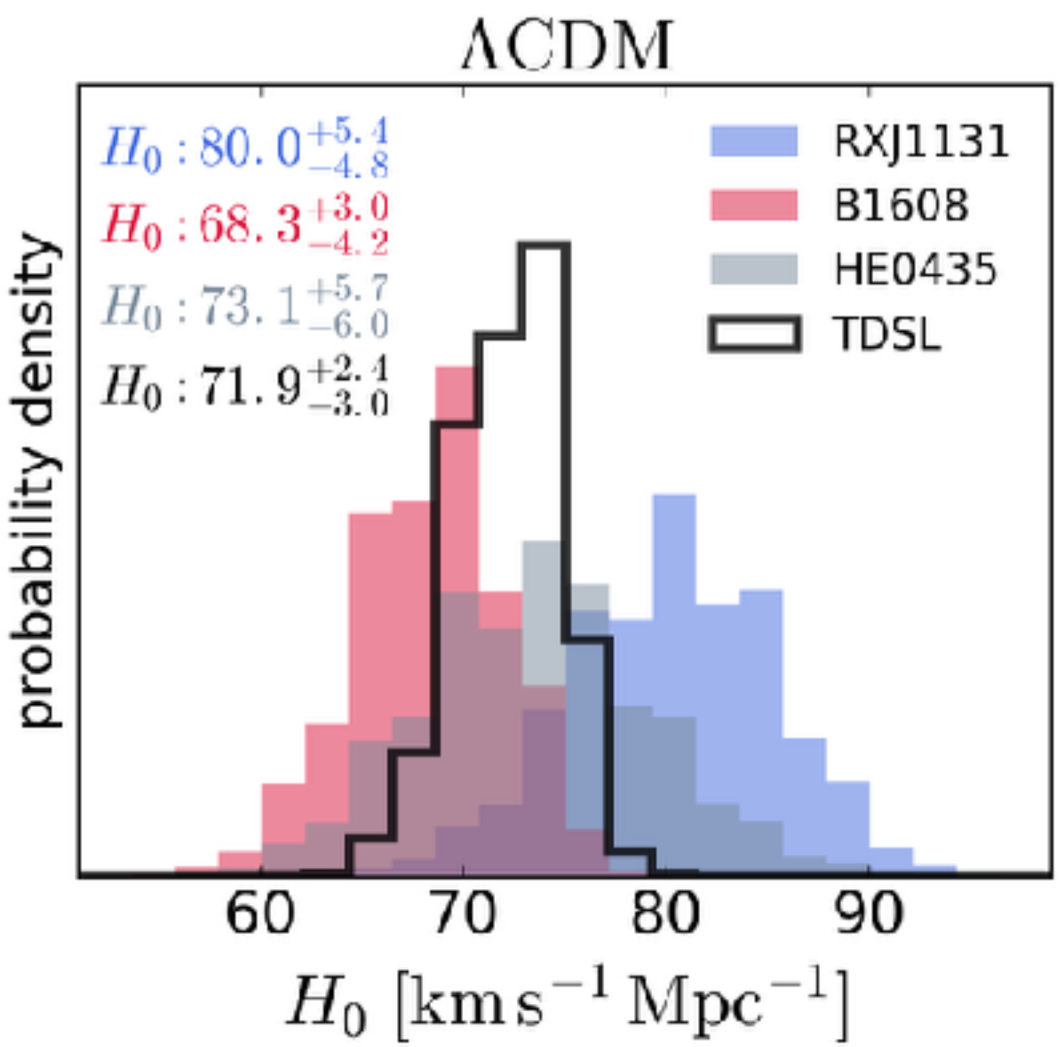
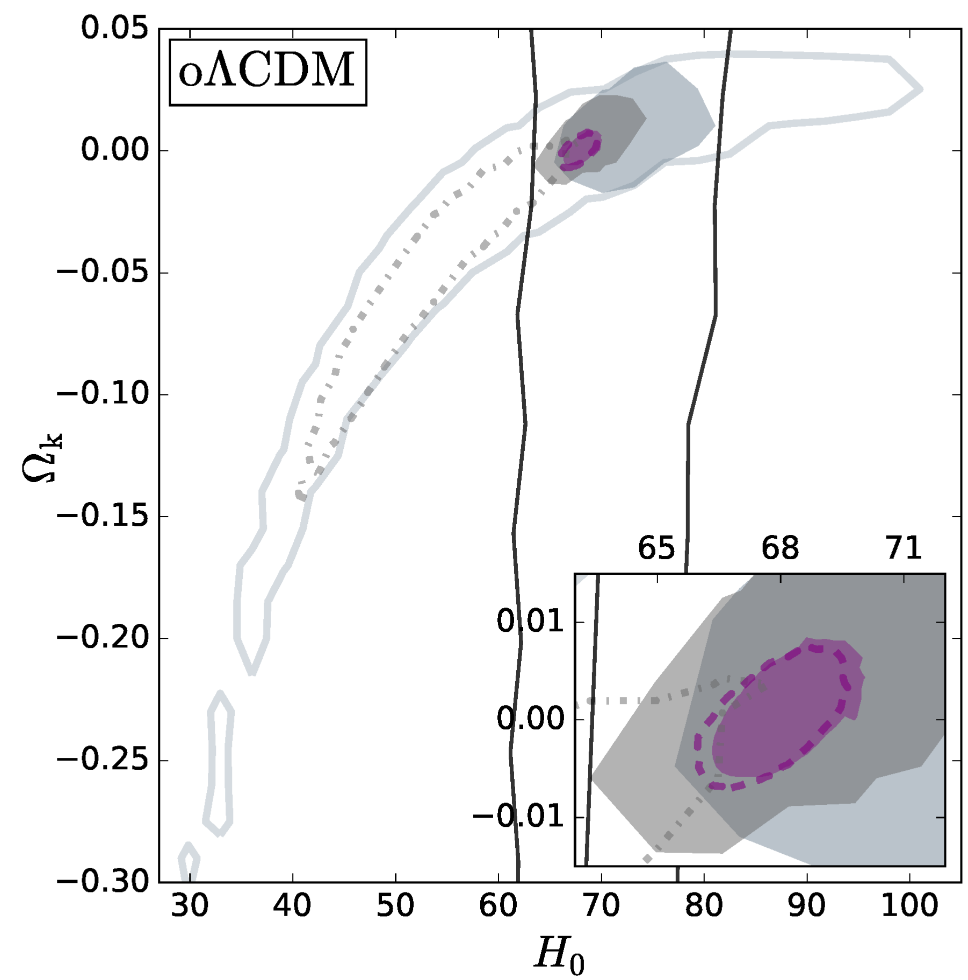


- TDSL as a powerful probe to constrain cosmological world models, when combined with the CMB.

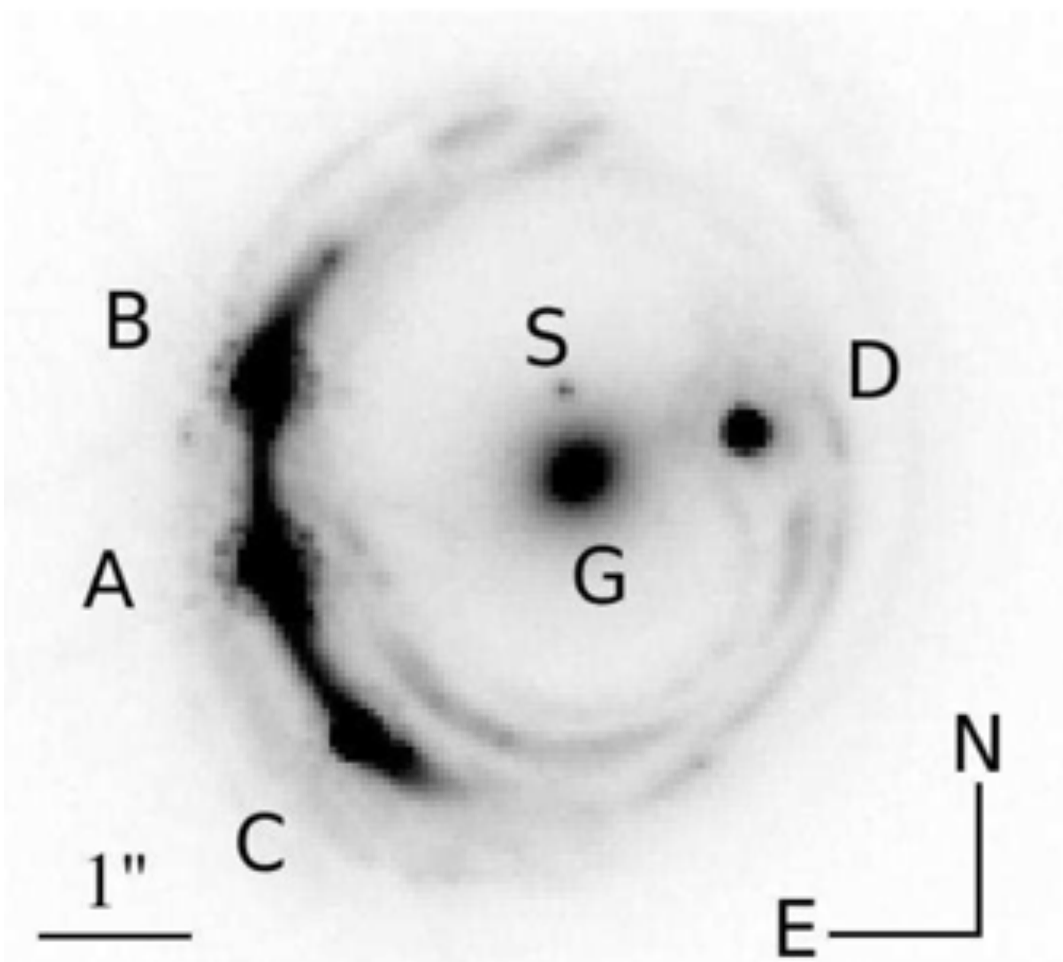


Bonvin et al. 2017

Time-delay distances in the era of JWST

RXJ 1131 - The poster child

- RXJ 1131 is a well studied system with plenty ancillary data for a variety of science cases.
- With more than 13 yrs of high-cadence monitoring, RXJ 1131 has the smallest time-delay uncertainties among the H0LiCOW sample.



	Suyu et al. 2014	Future
Time-delay	1.3%	
Lens mass profile	6.0%	
Line-of-sight	3.5%	
$D_{\Delta t}$	>6.6%	

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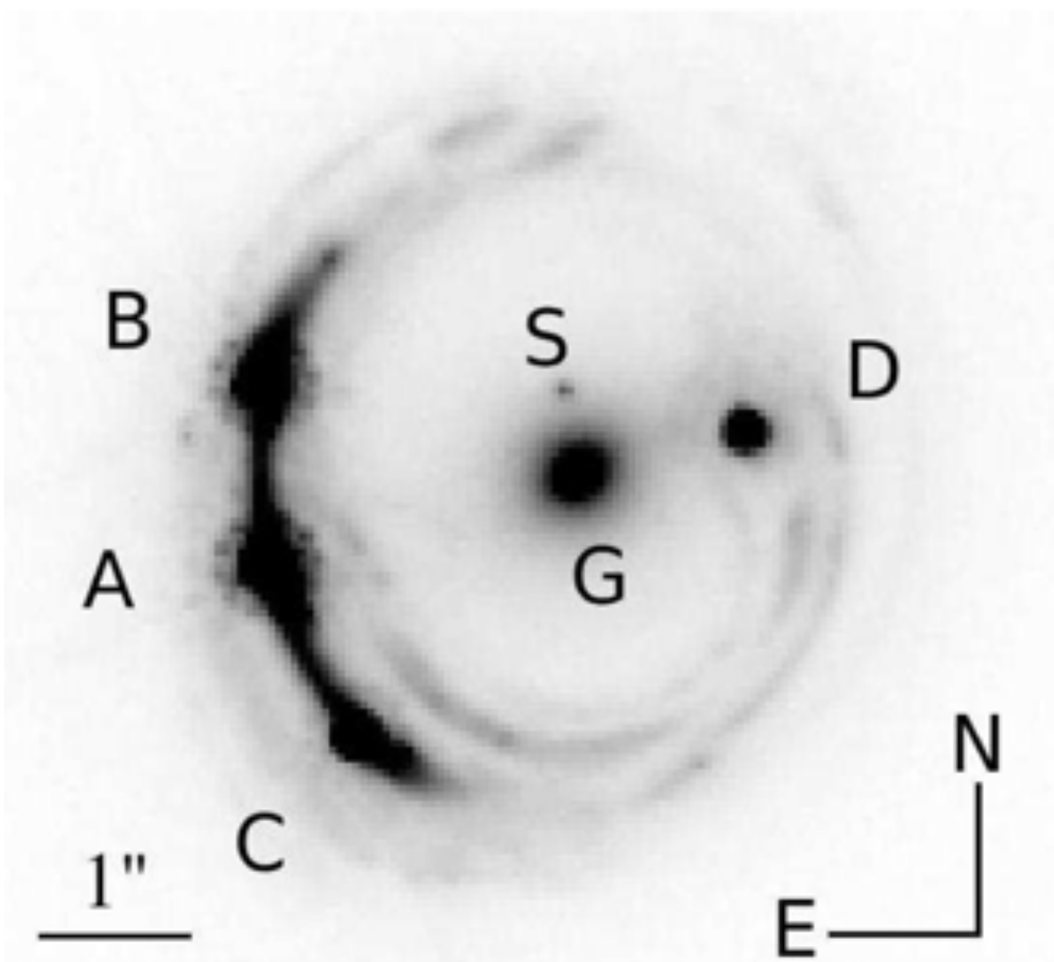

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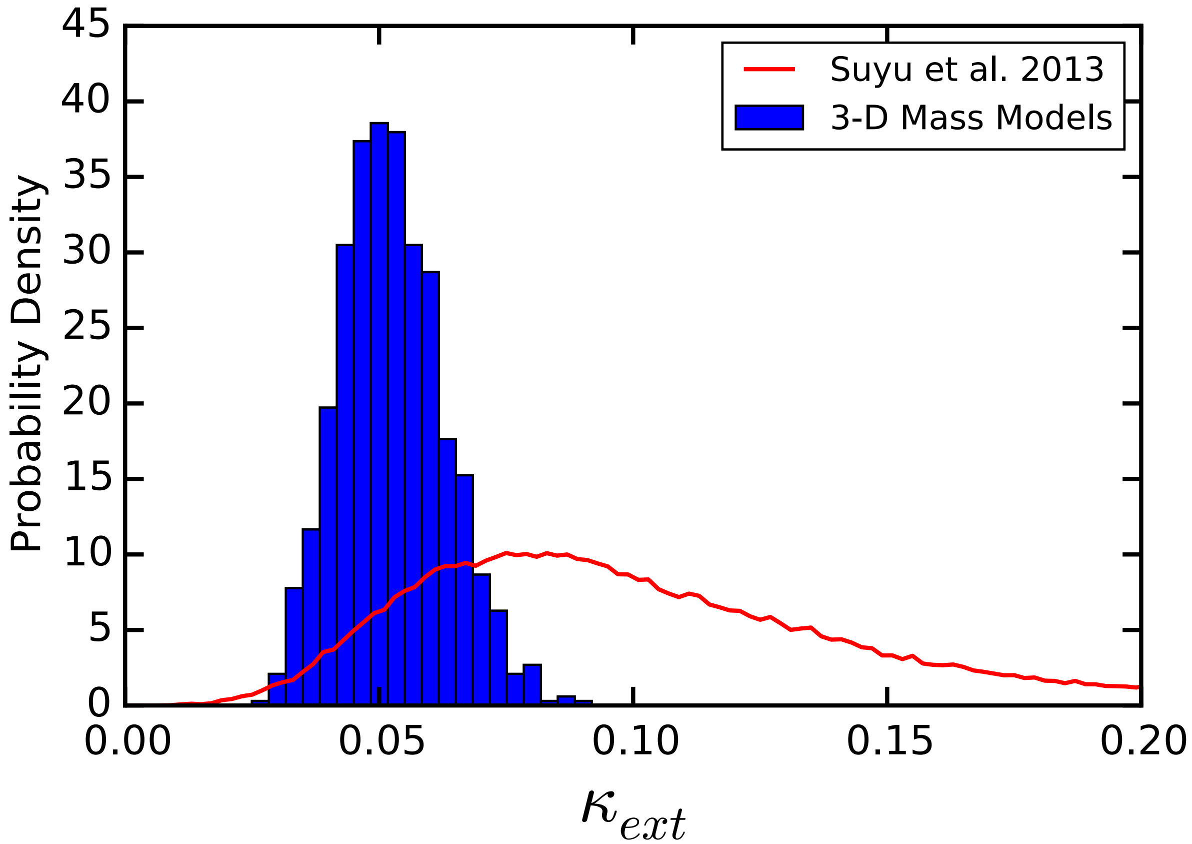
Modelling discrepancies and limits from lensing-only analyses



McCully et al. 2017

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Yıldırım & Suyu, in prep.

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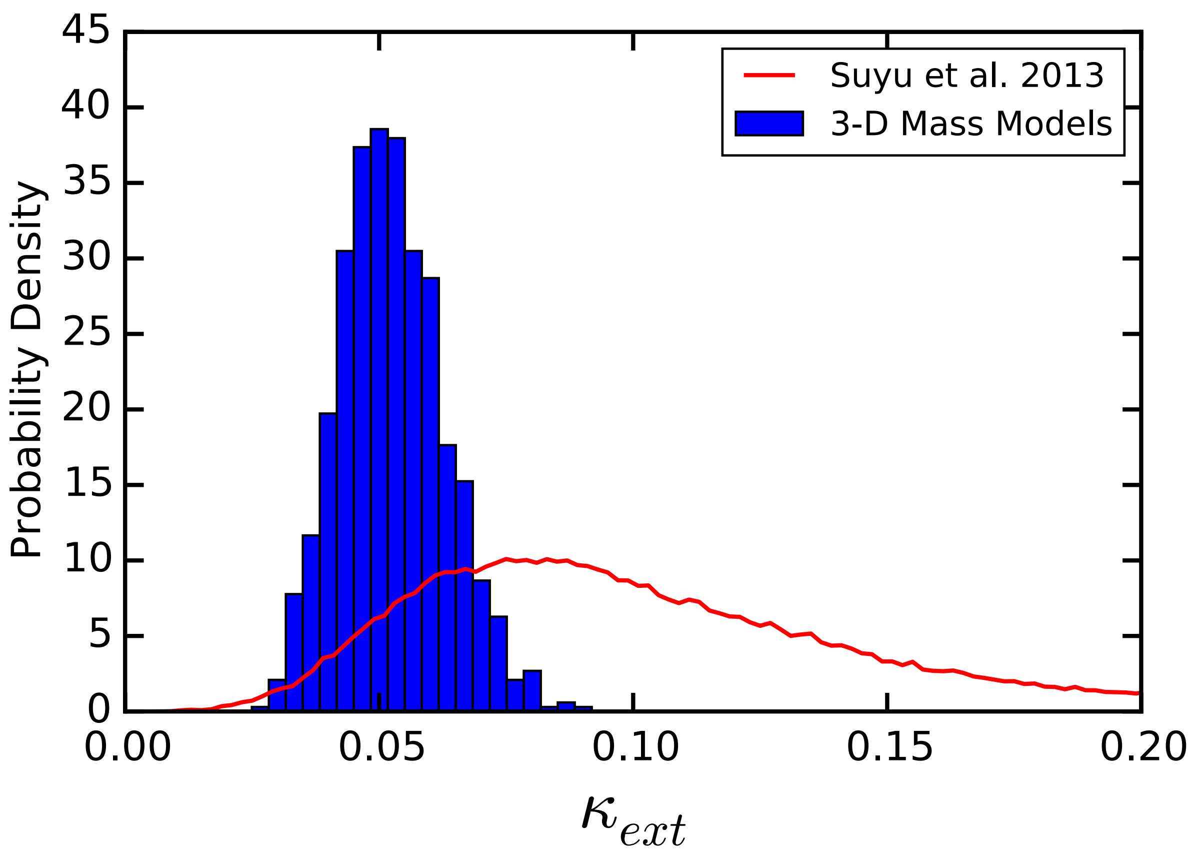

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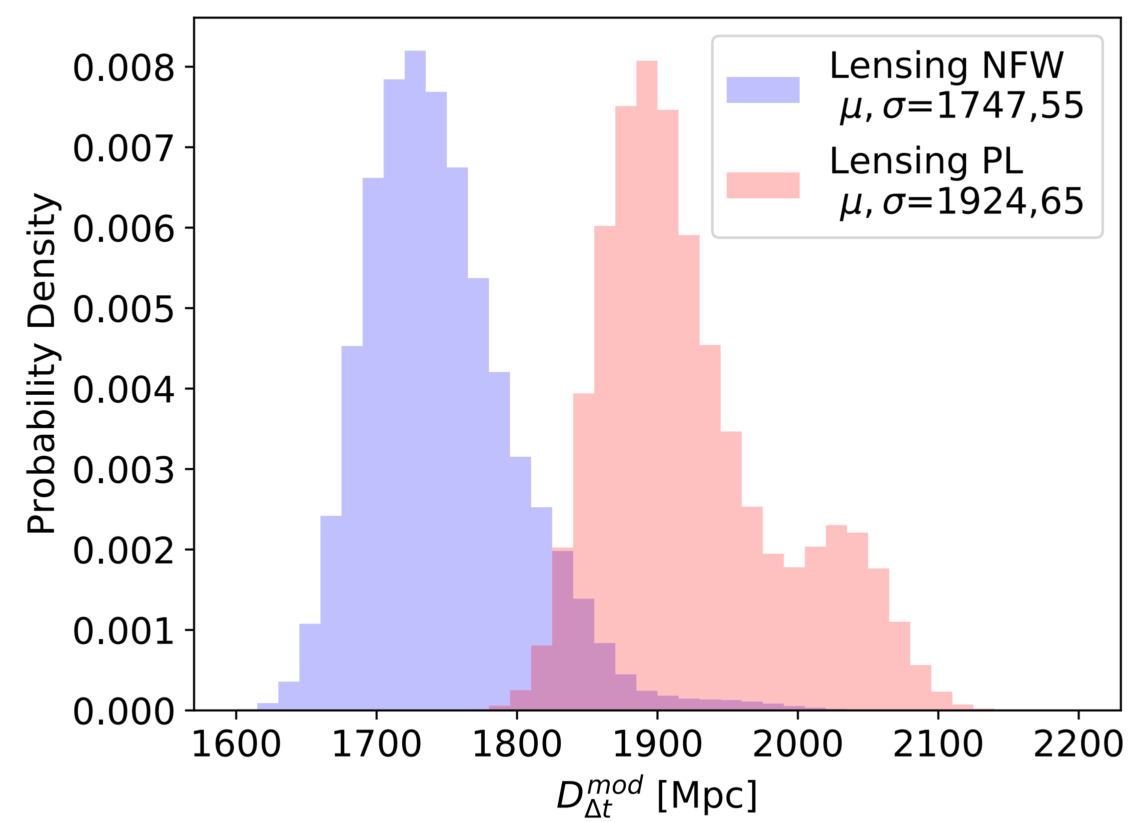

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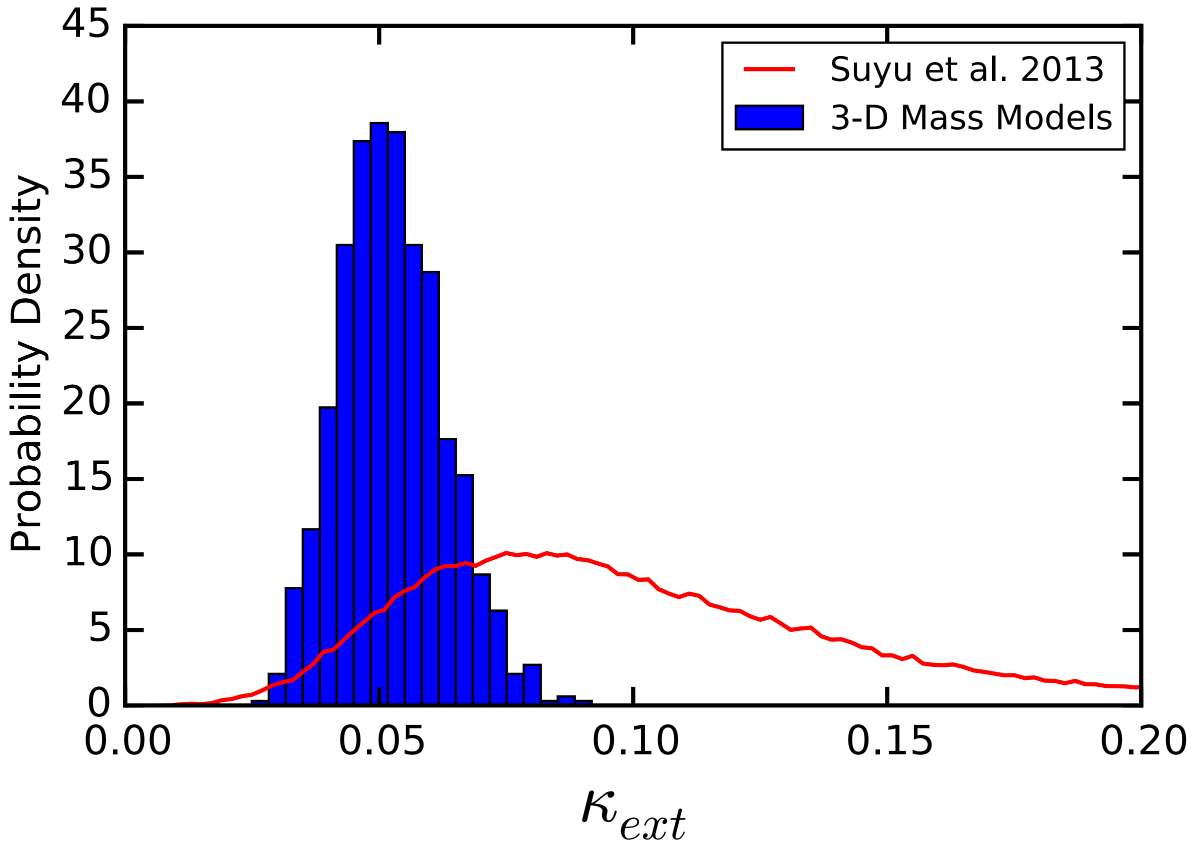

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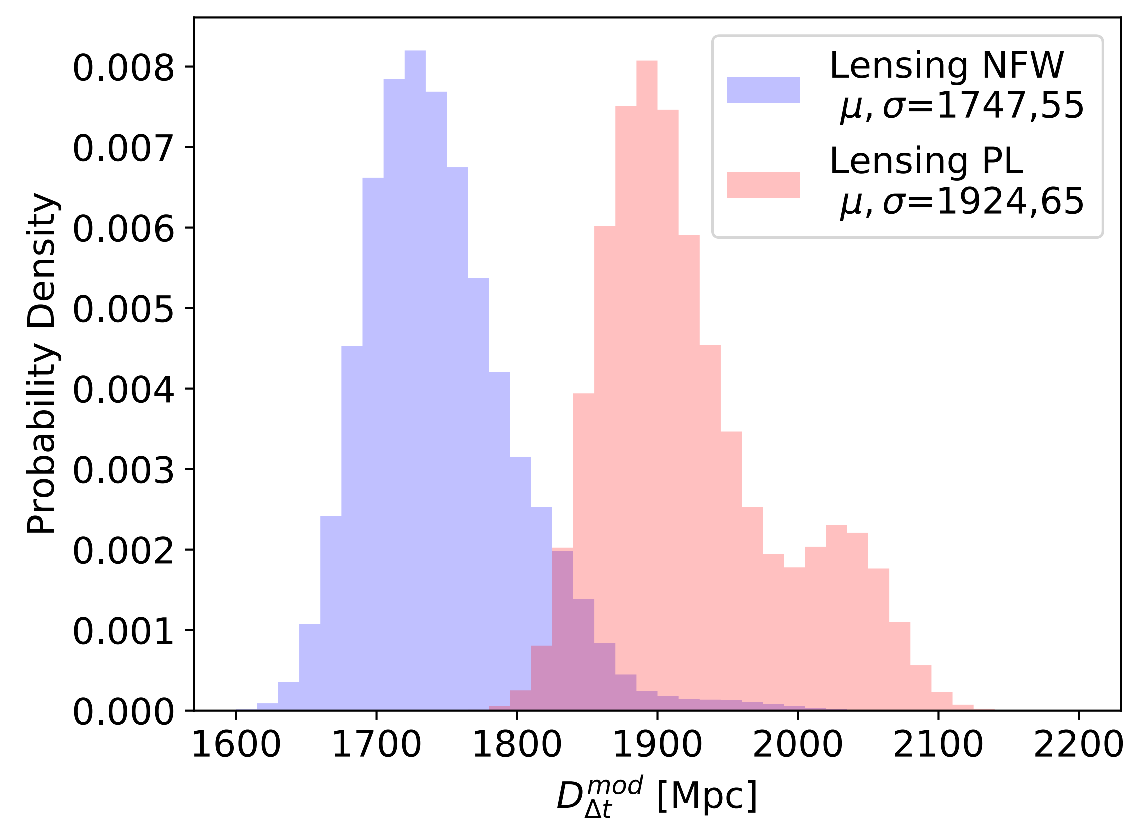

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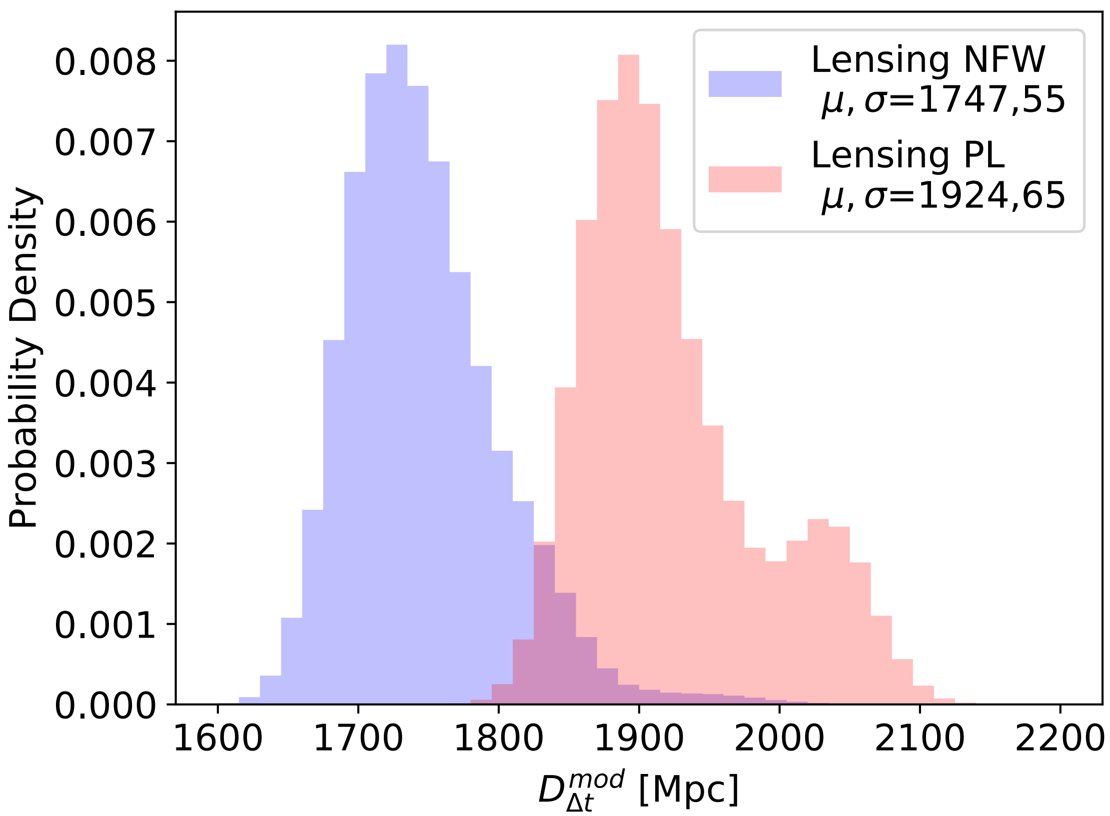

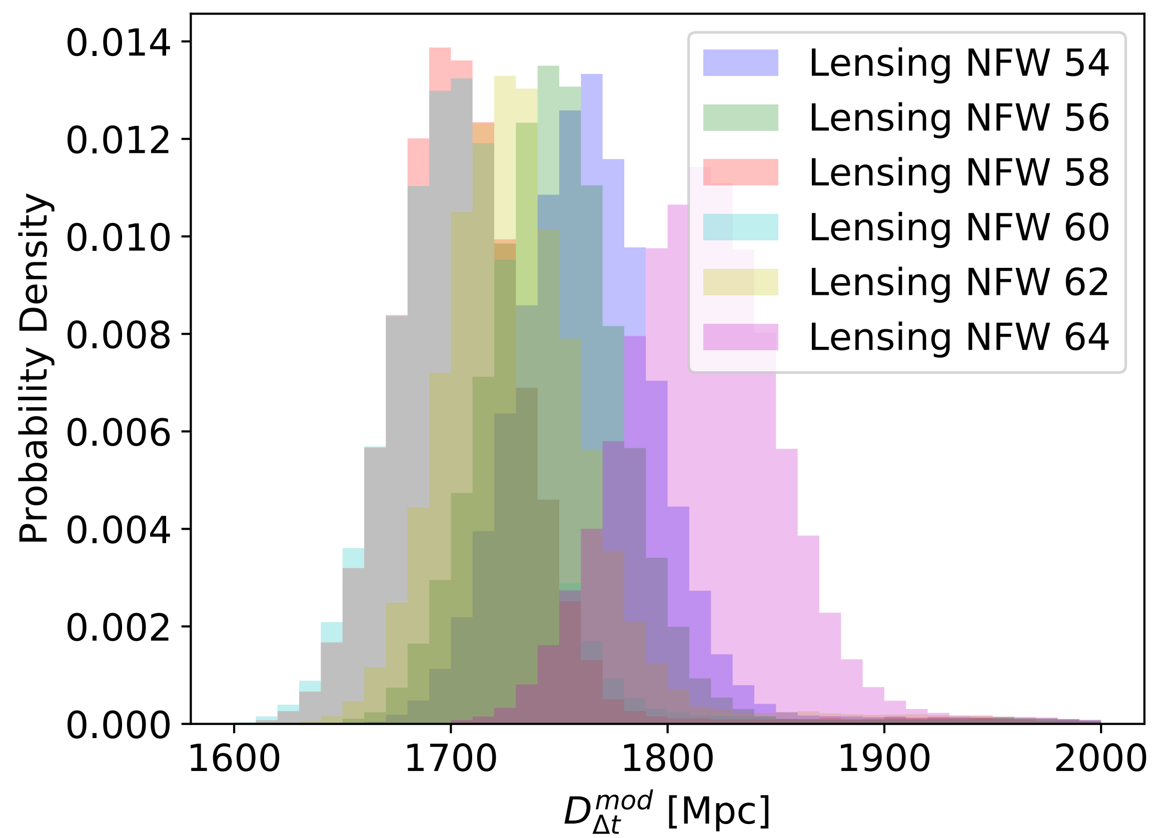

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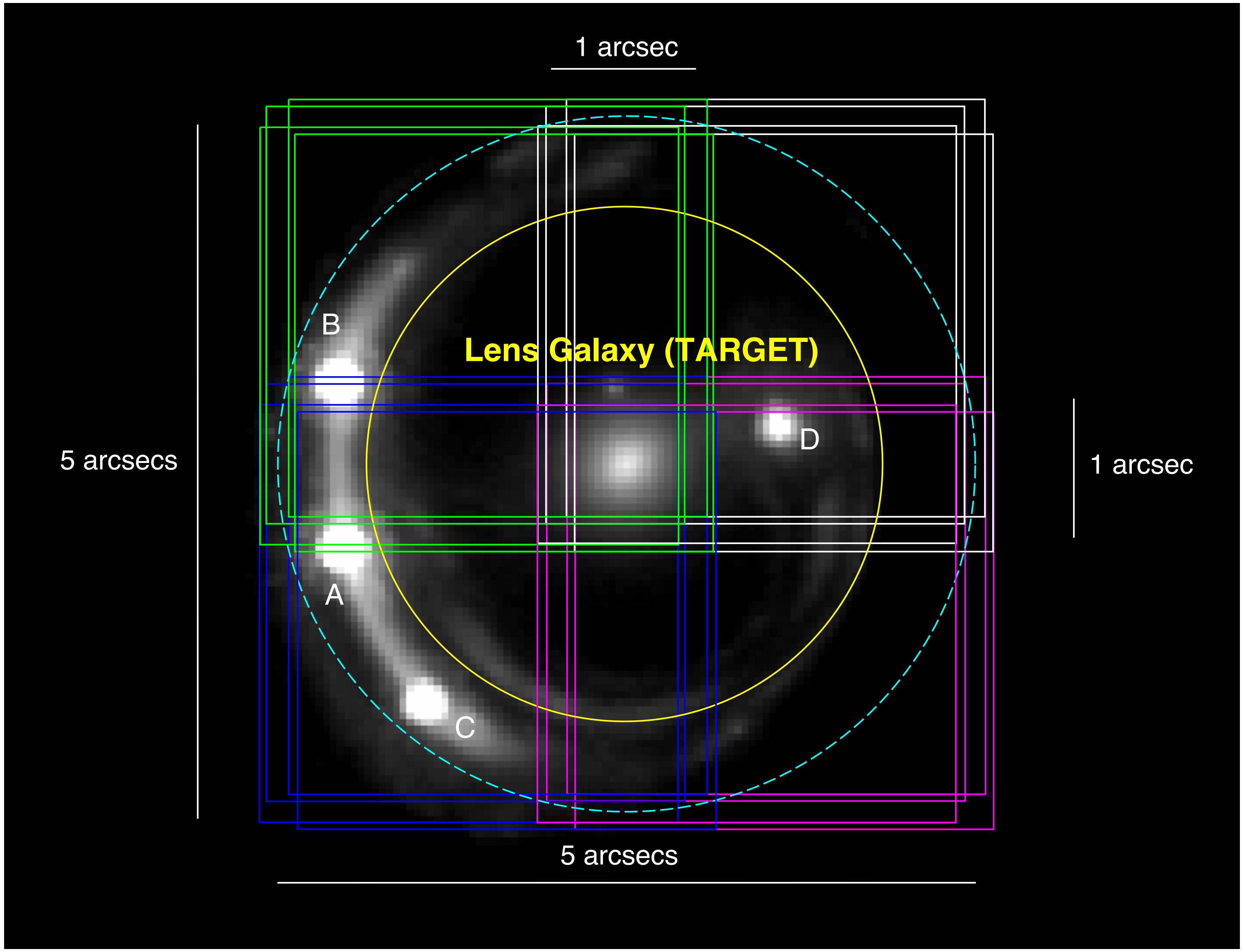
RXJ1131 - Preparation is key

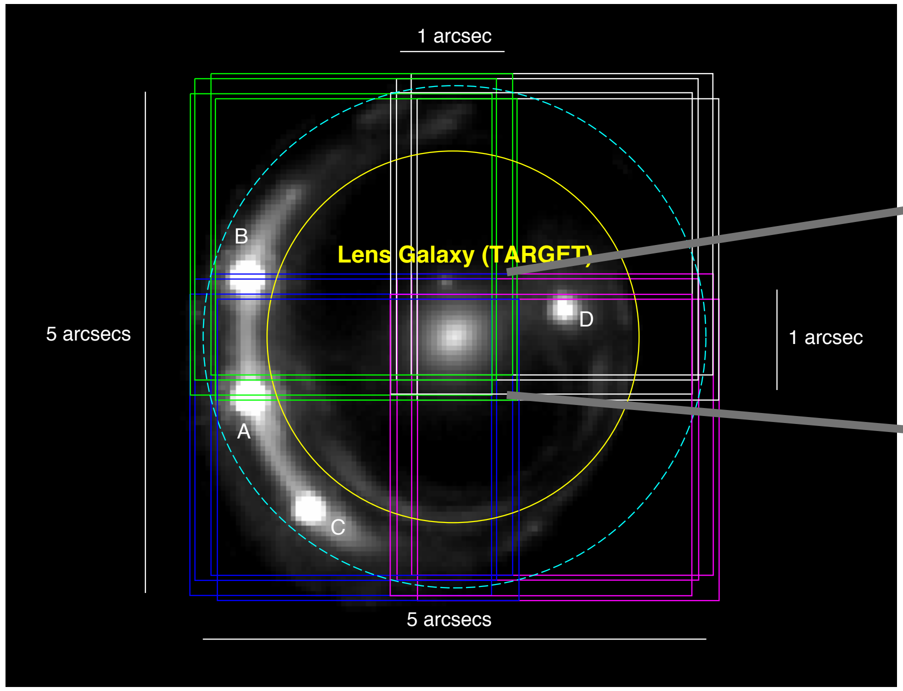


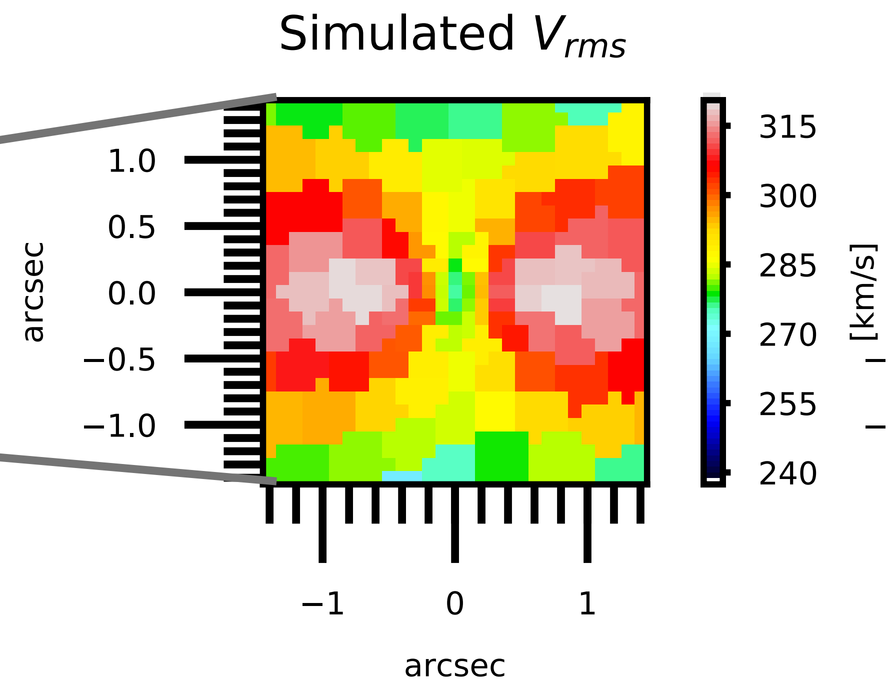
Chirivì, G.

Time-delay distances in the era of JWST

RXJ1131 - Predicted JWST NIRSPEC kinematics

- Exploiting JWST's mosaicking capabilities for ancillary science.
- Mocking JWST IFU stellar kinematics within the lens effective radius.





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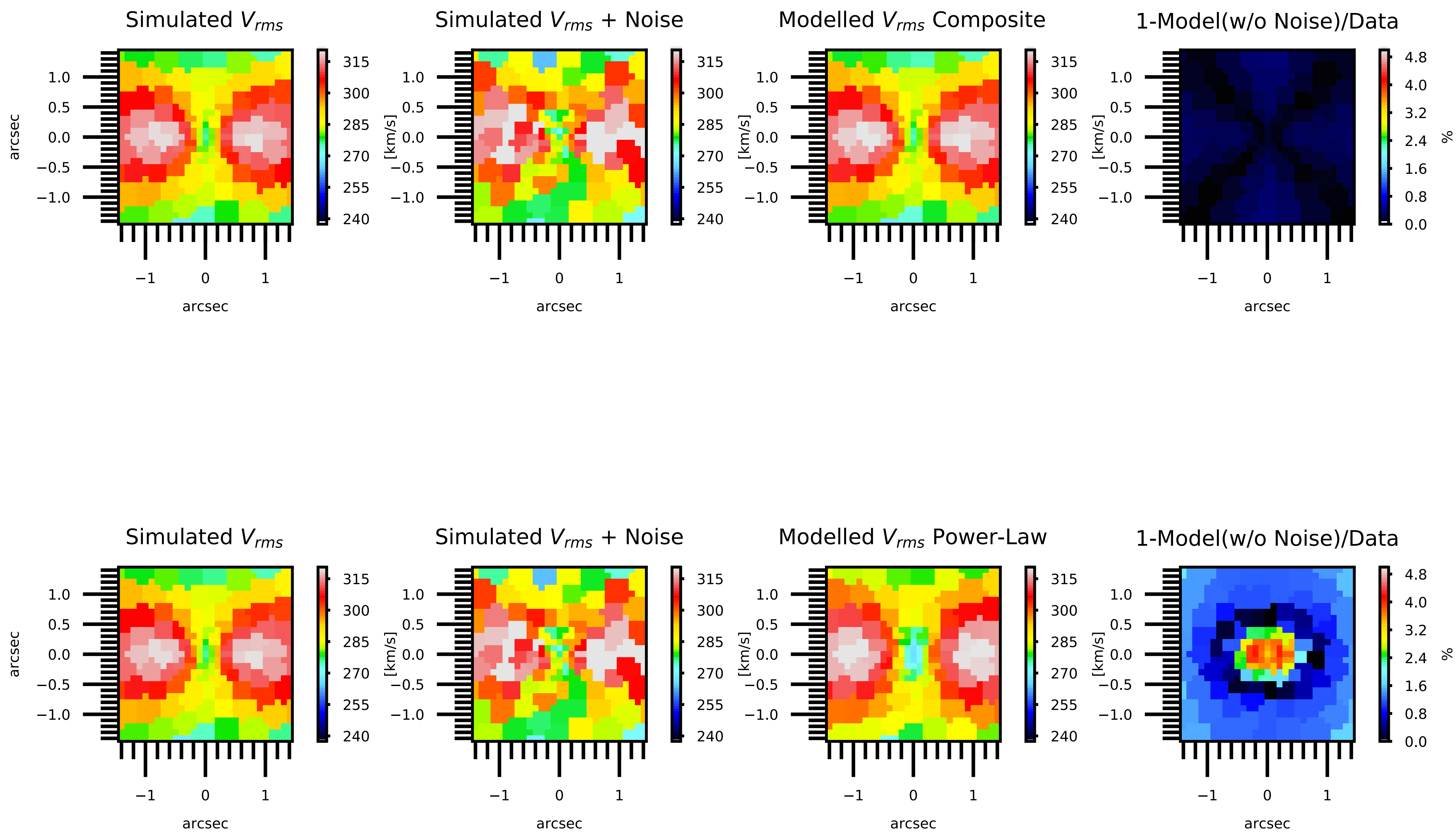
Time-delay distances in the era of JWST

Simulating and modelling realistic JWST NIRSPEC kinematics



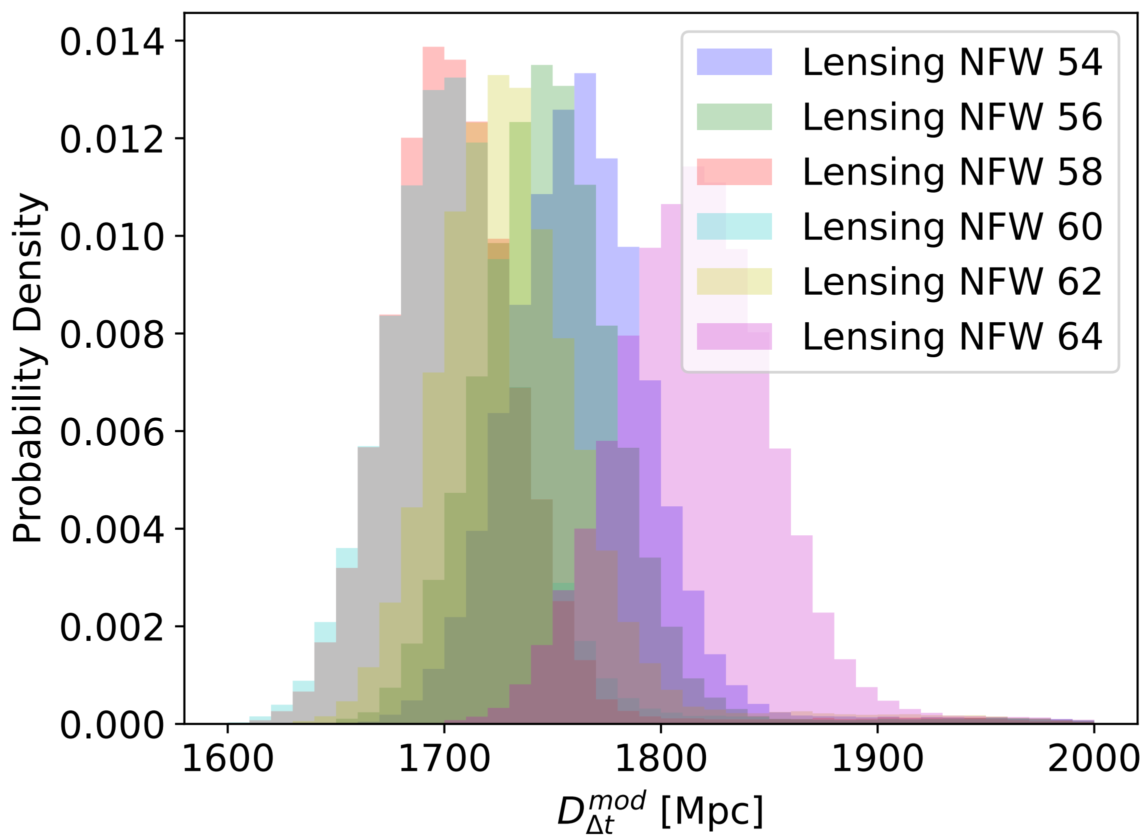
Yıldırım & Suyu, in prep.

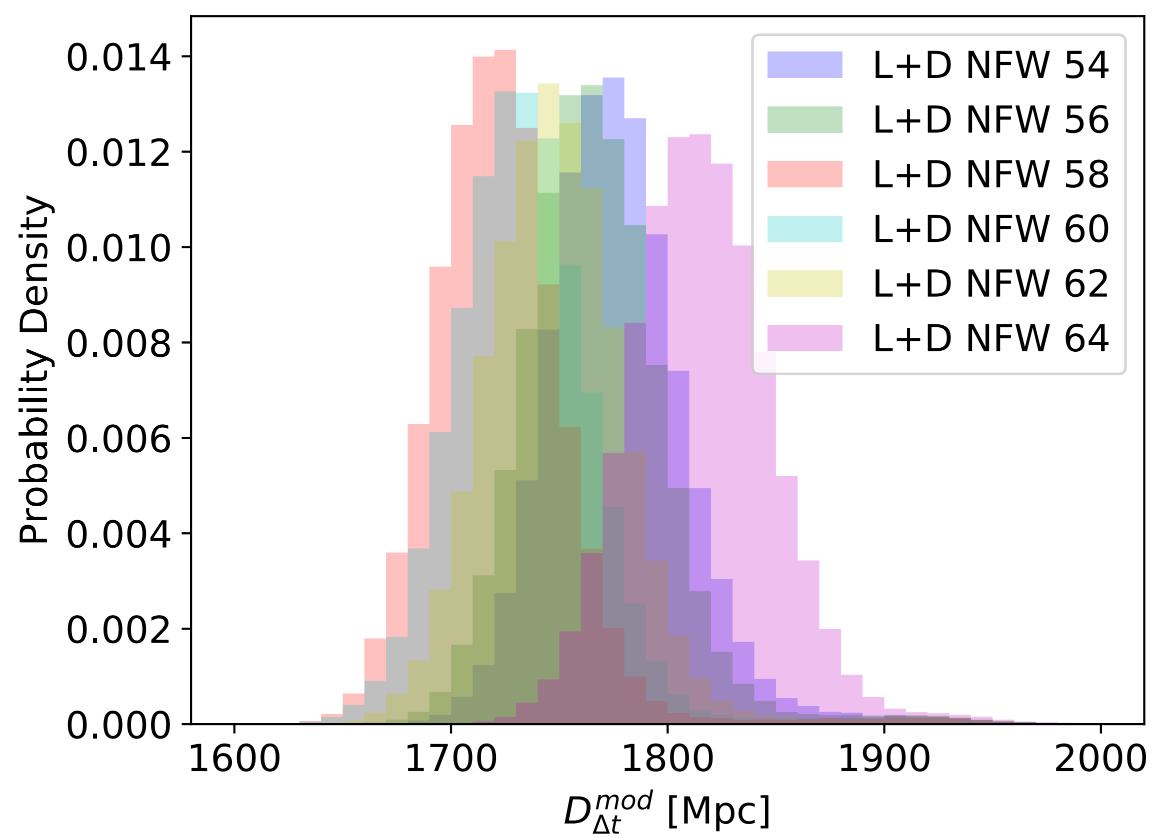
Time-delay distances in the era of JWST

Lensing & Dynamics - Closing the gap

- Source resolution differences are the main source of uncertainty for a given lens mass profile.

- Source resolution uncertainties can be reduced by including high-spatially resolved stellar kinematics.





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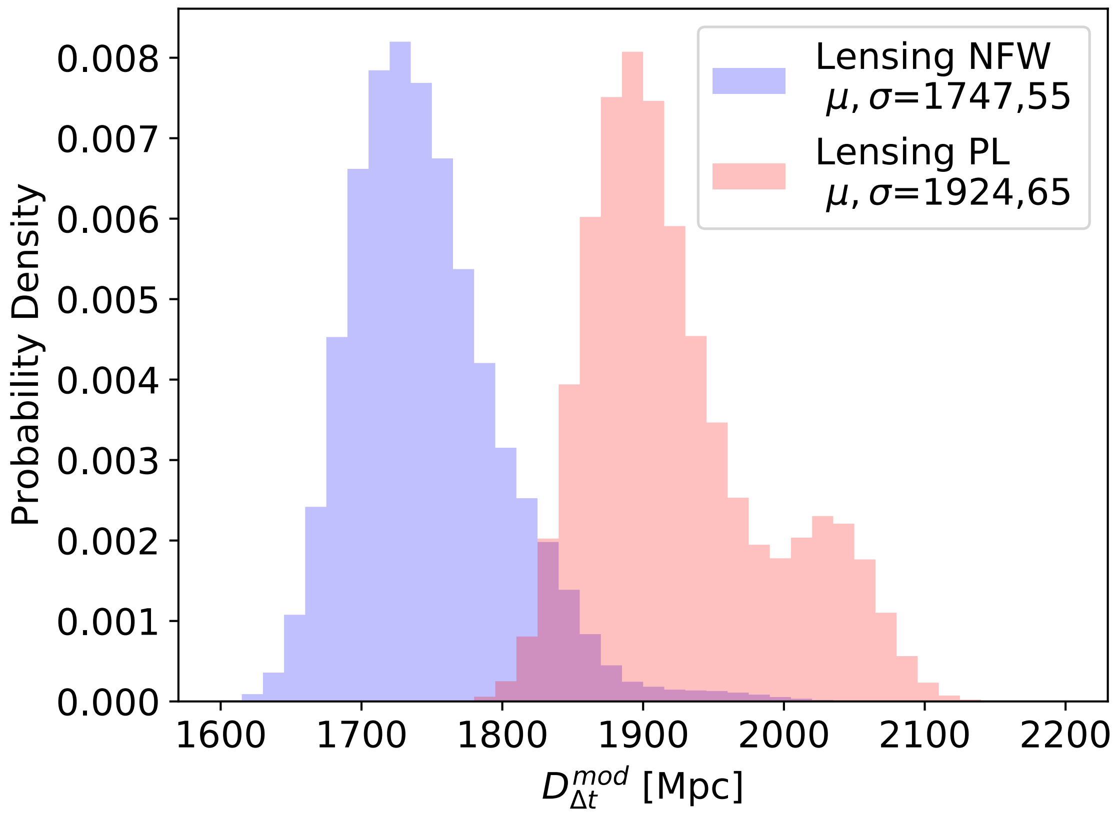
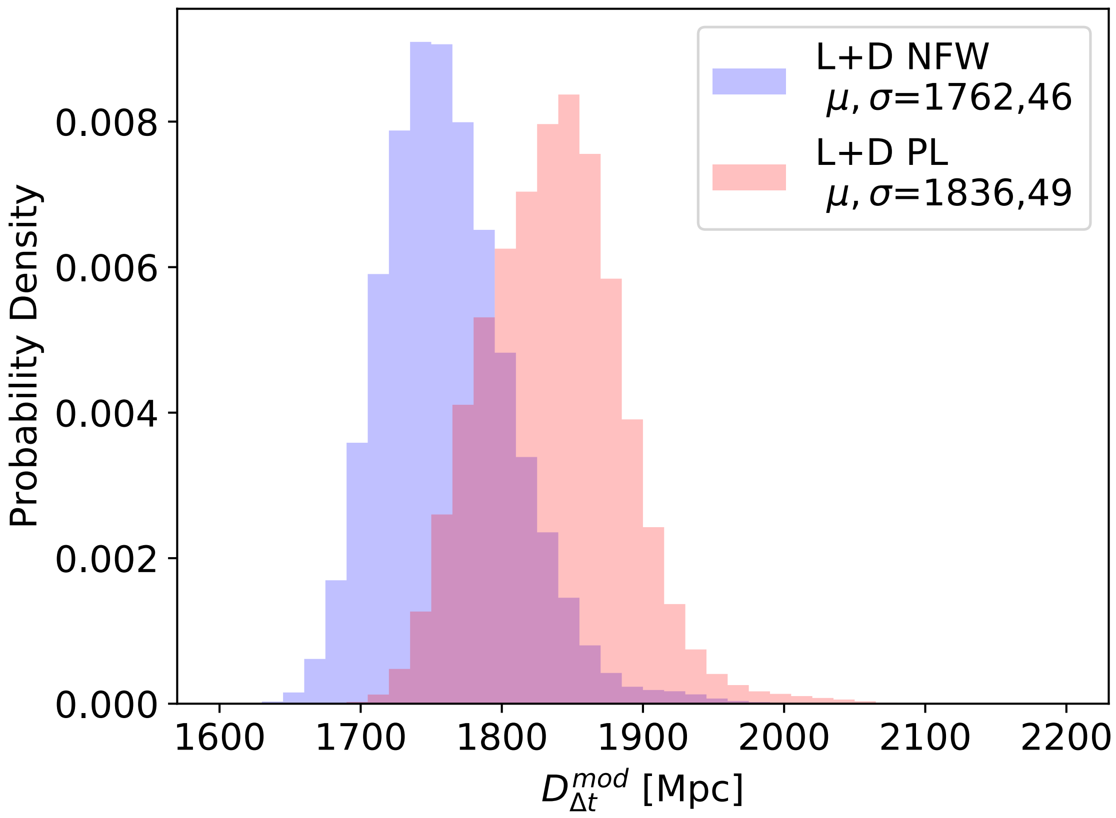
Time-delay distances in the era of JWST

Lensing & Dynamics - Closing the gap

- Main source of uncertainty due to lens mass parameterisation.



- IFU Stellar kinematics reconcile time-delay distances.



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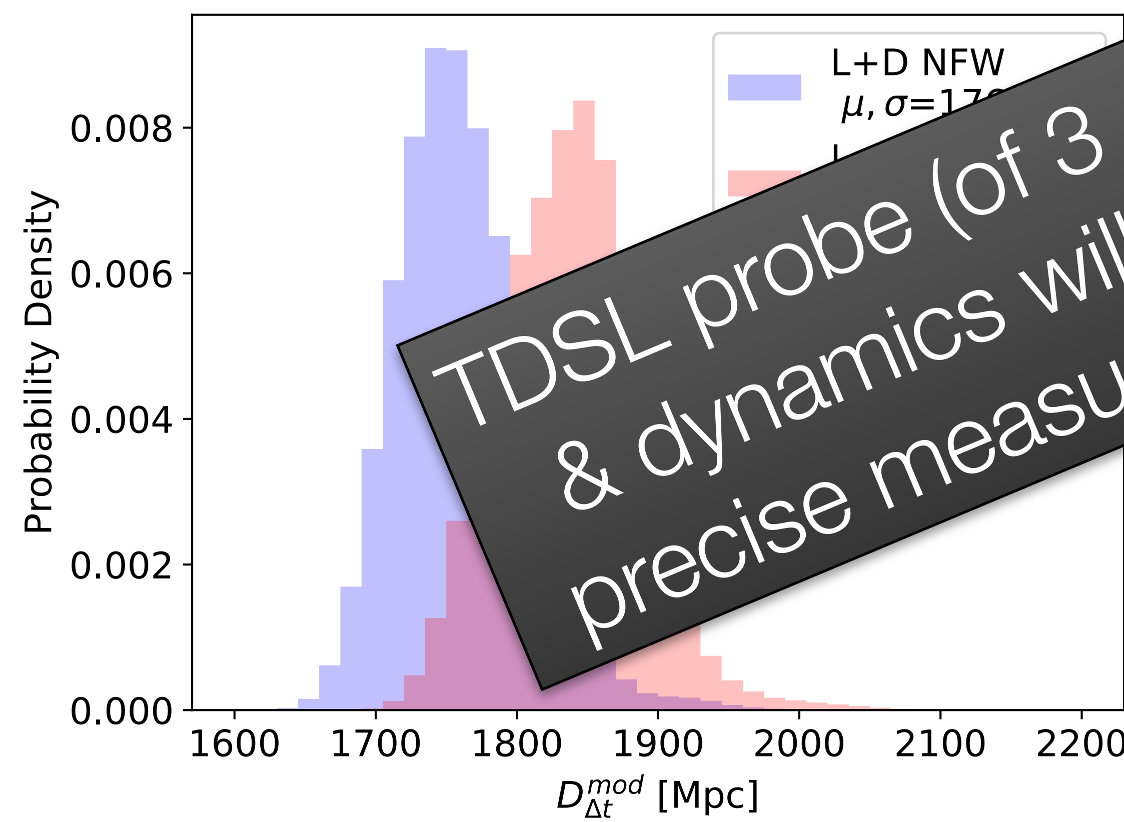
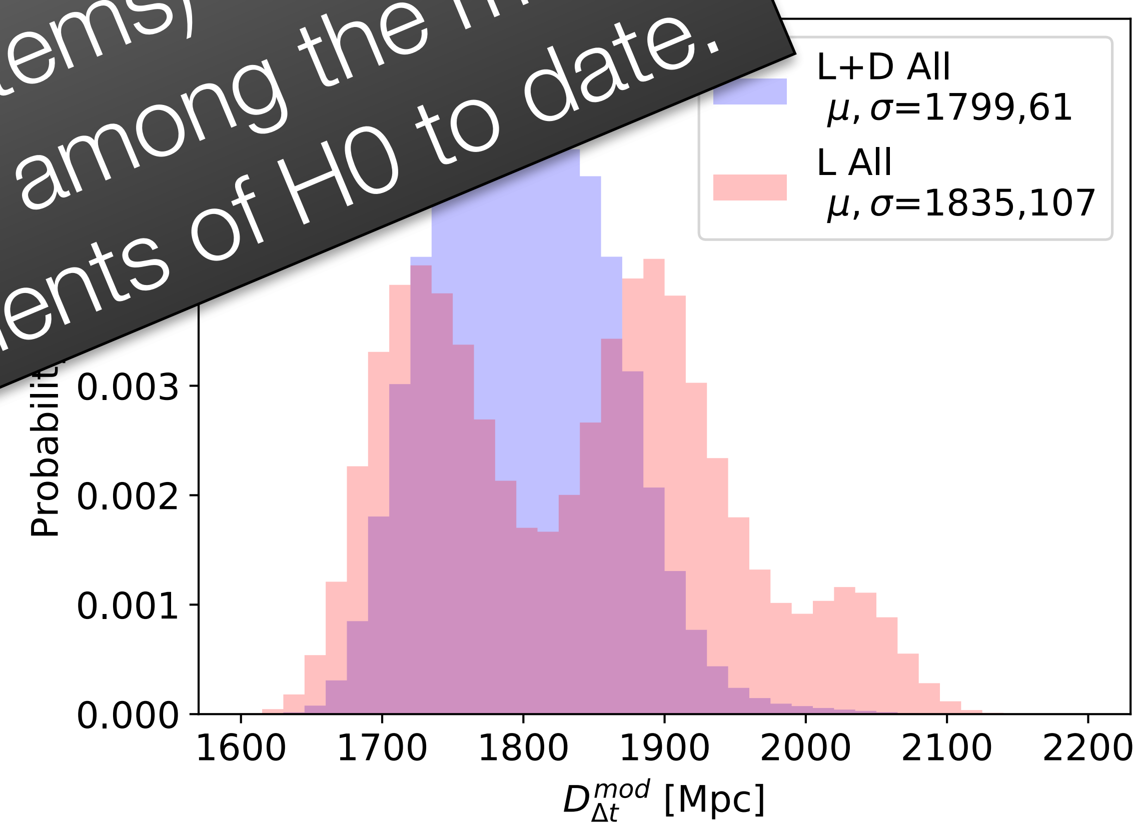
Time-delay distances in the era of JWST

Lensing & Dynamics - Closing the gap

- IFU Stellar kinematics reconcile time-delay distances.
- Feasible observations with next generation of telescopes reduce the time-delay error budget of a single lens to < 4

TDSL probe (of 3 systems) with lensing & dynamics will be among the most precise measurements of H0 to date.





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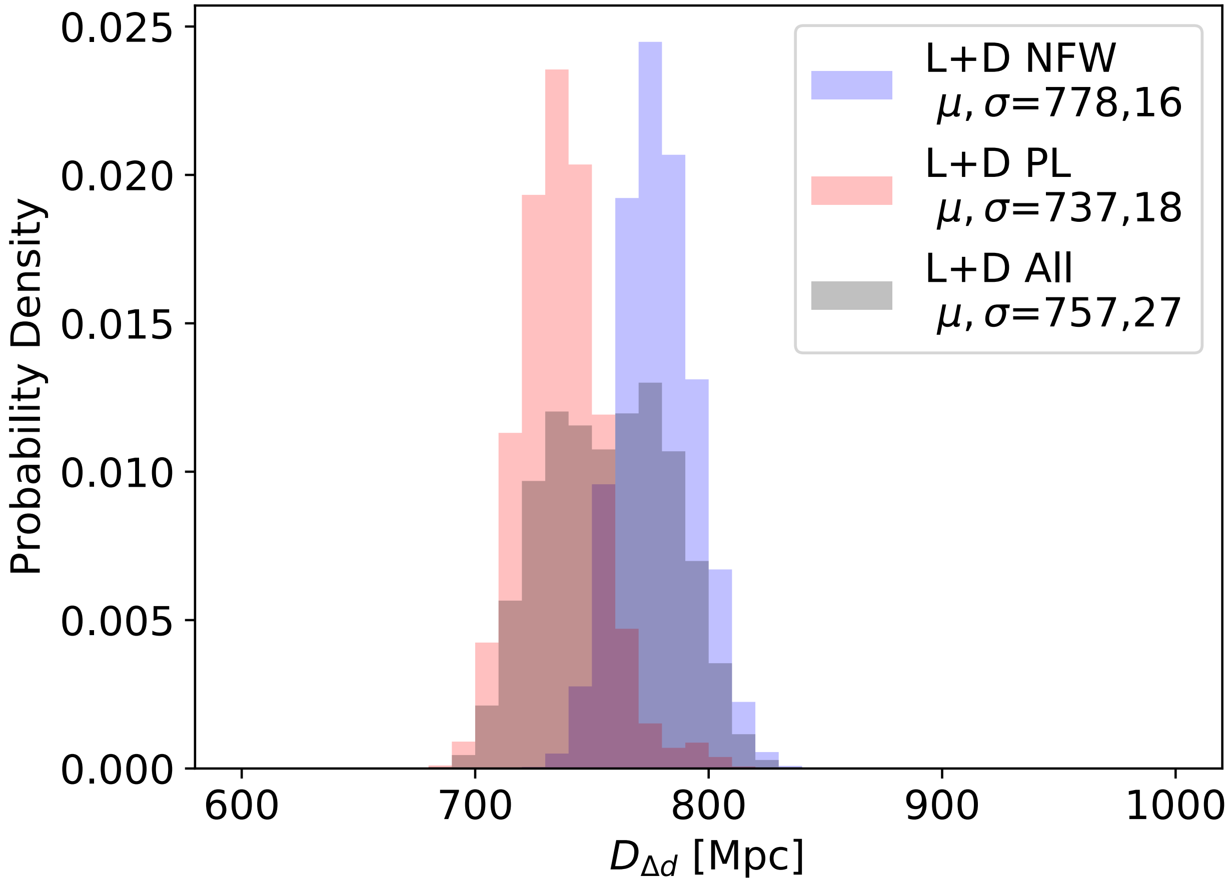
A secondary cosmological distance estimate

- Lens distance (i.e. another independent cosmological distance) will be constrained in parallel.

- Lens distance not constrained very well for profiles that deviate from the input.
- Possibly use informative priors to narrow down the large parameter space (external convergence, intrinsic shapes).



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Summary/Ancillary Science

- Unprecedented, spatially-resolved kinematics of high-z lenses.
- Lensing & stellar dynamics reduce the uncertainties due to the mass profile by ~2.
- Combination of 3 lenses are expected to yield tight H0 constraints, comparable to and challenging the local distance ladder.

- Kinematic characterisation of high-z sources.
- Dark matter (substructure) studies of high-z lenses.
- Spatially resolved stellar populations of high-z lenses.
- SMBH host studies at high-z.

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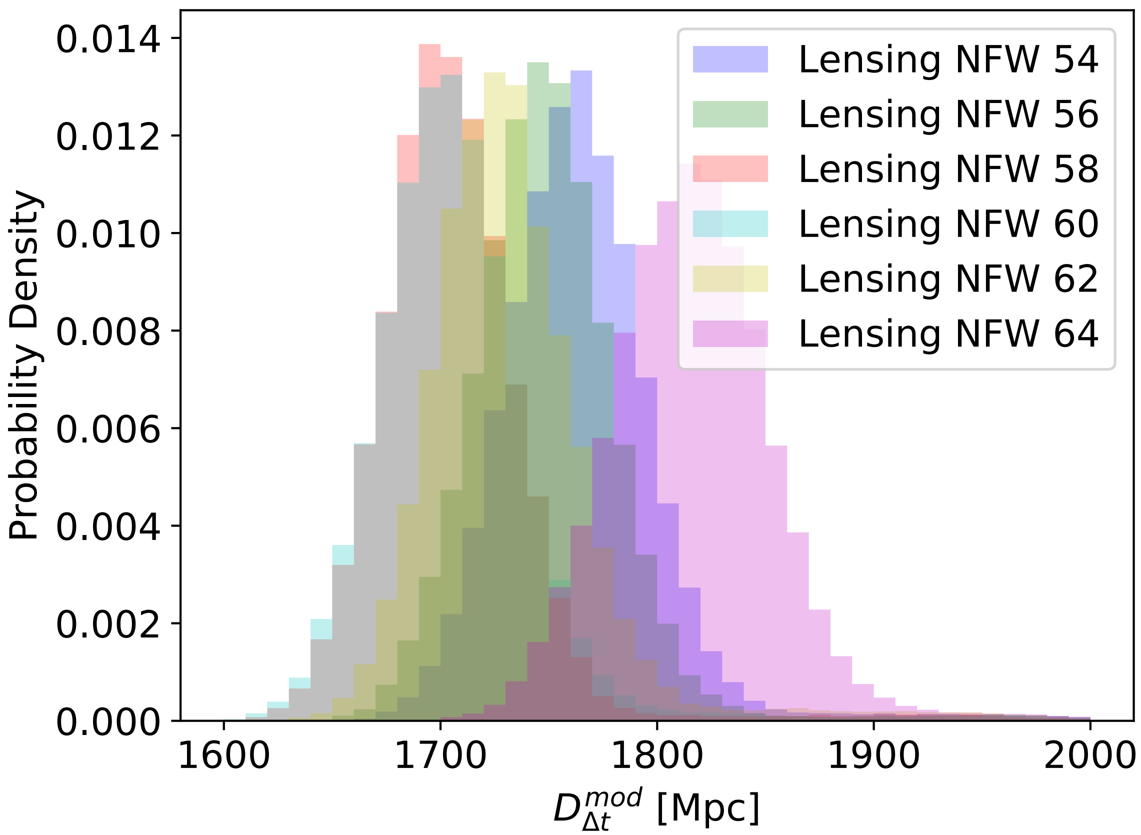
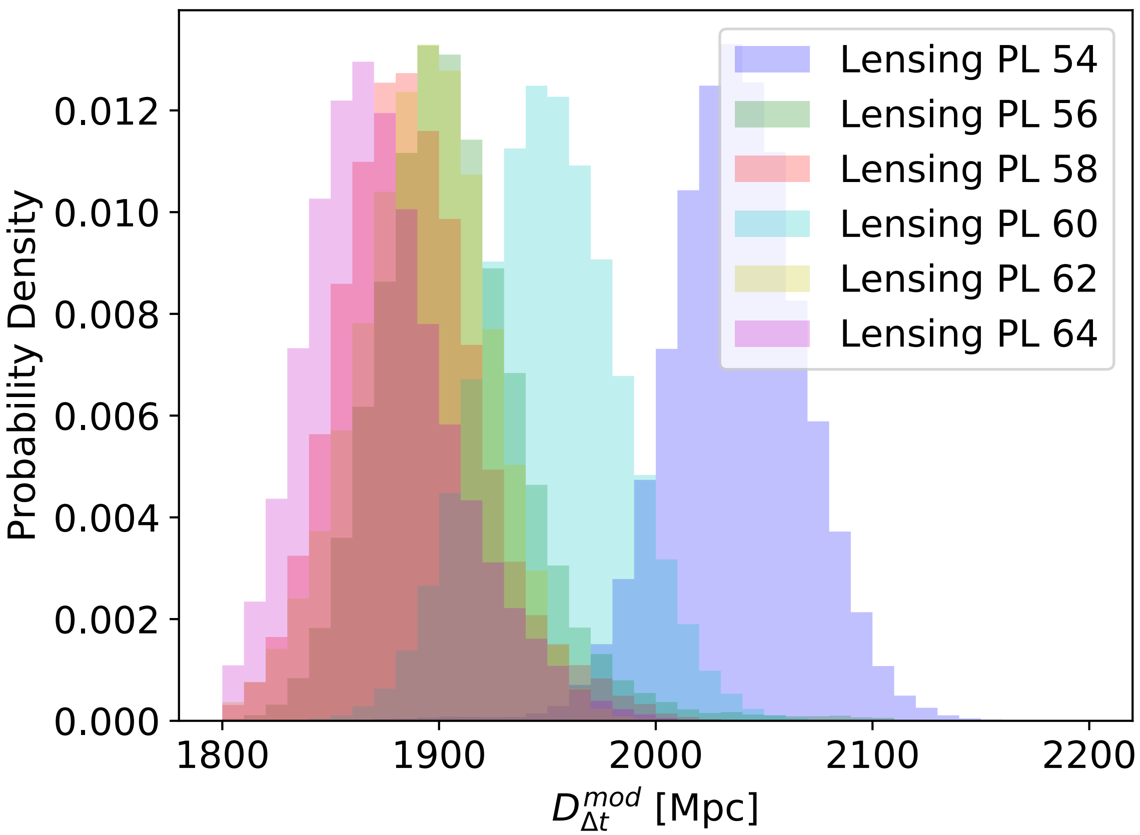
Source resolution uncertainties





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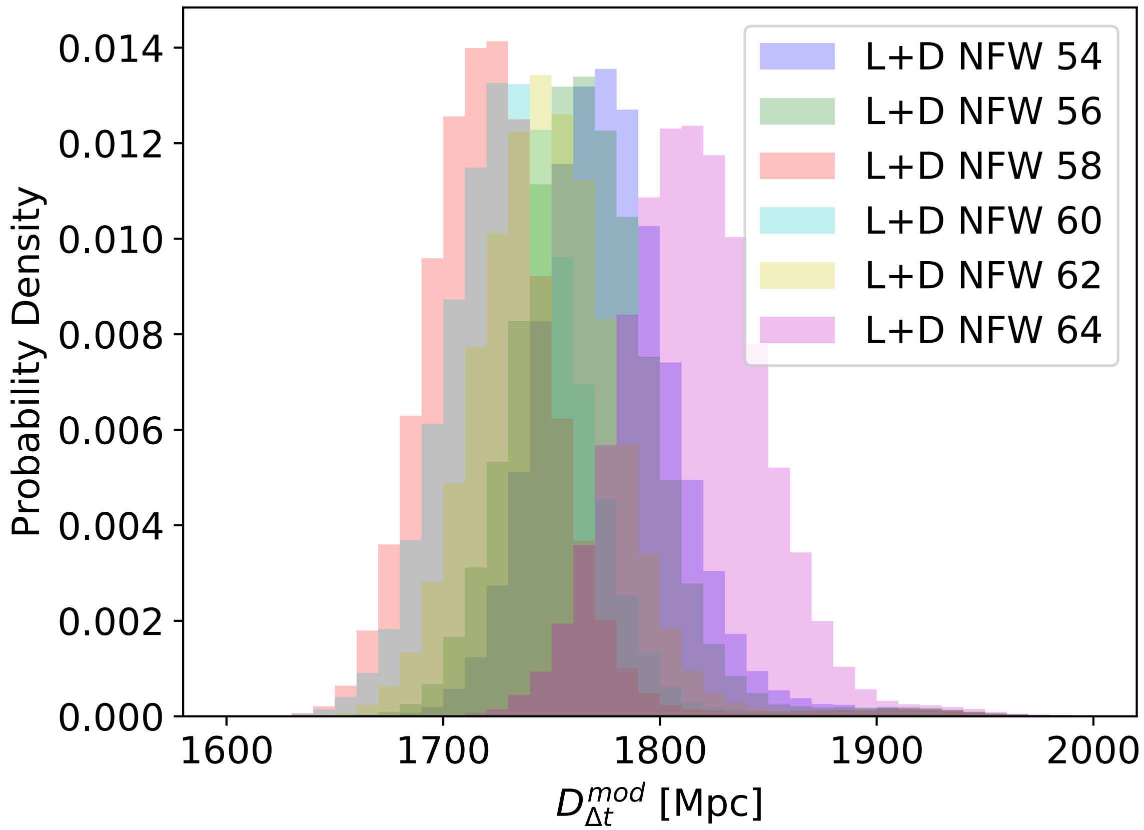

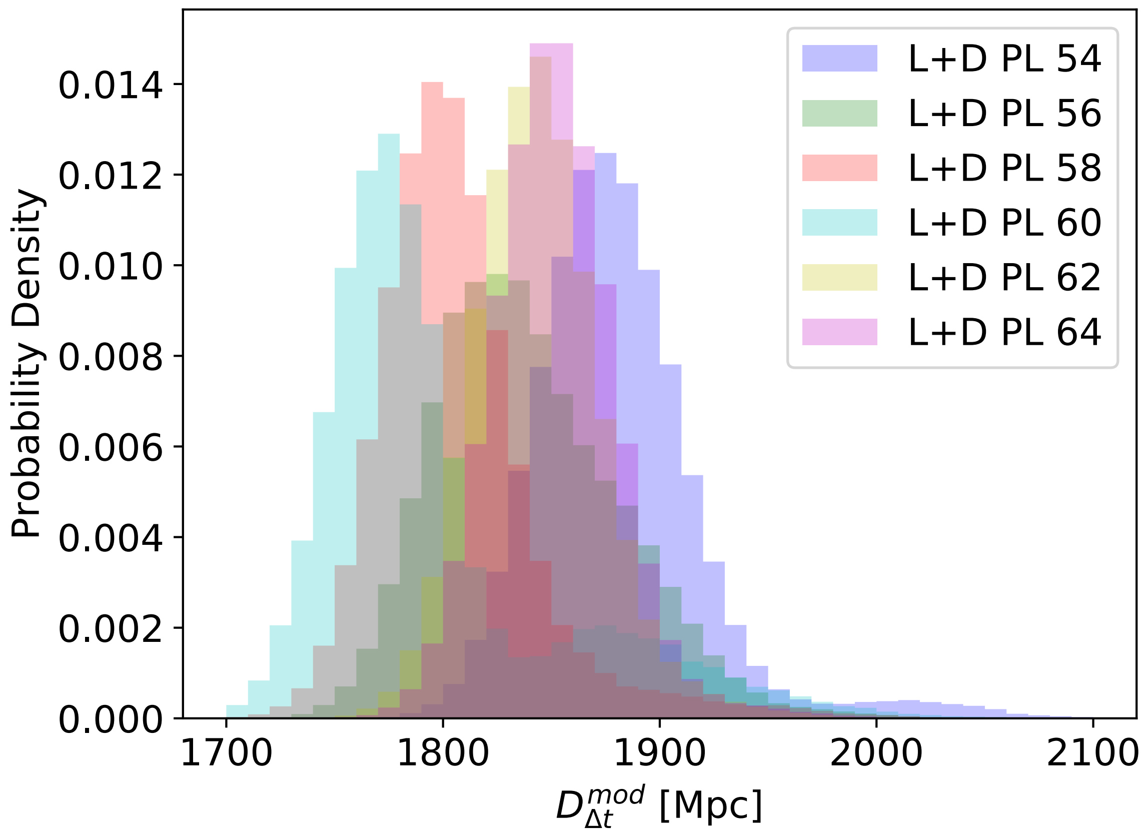

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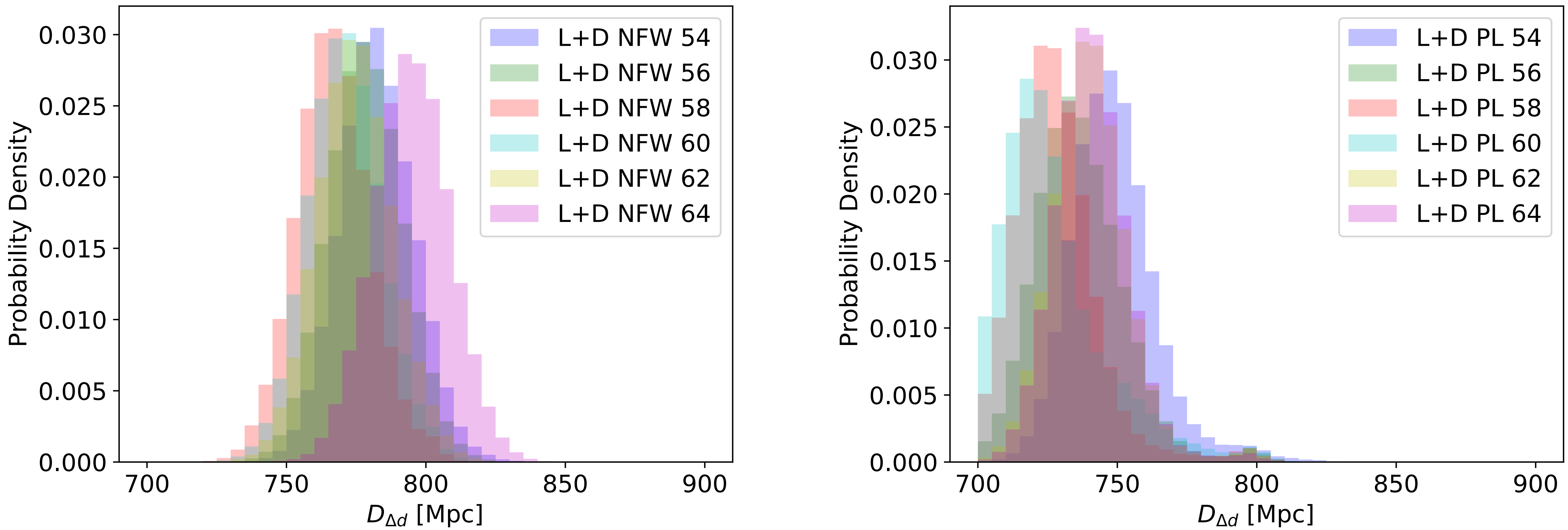

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