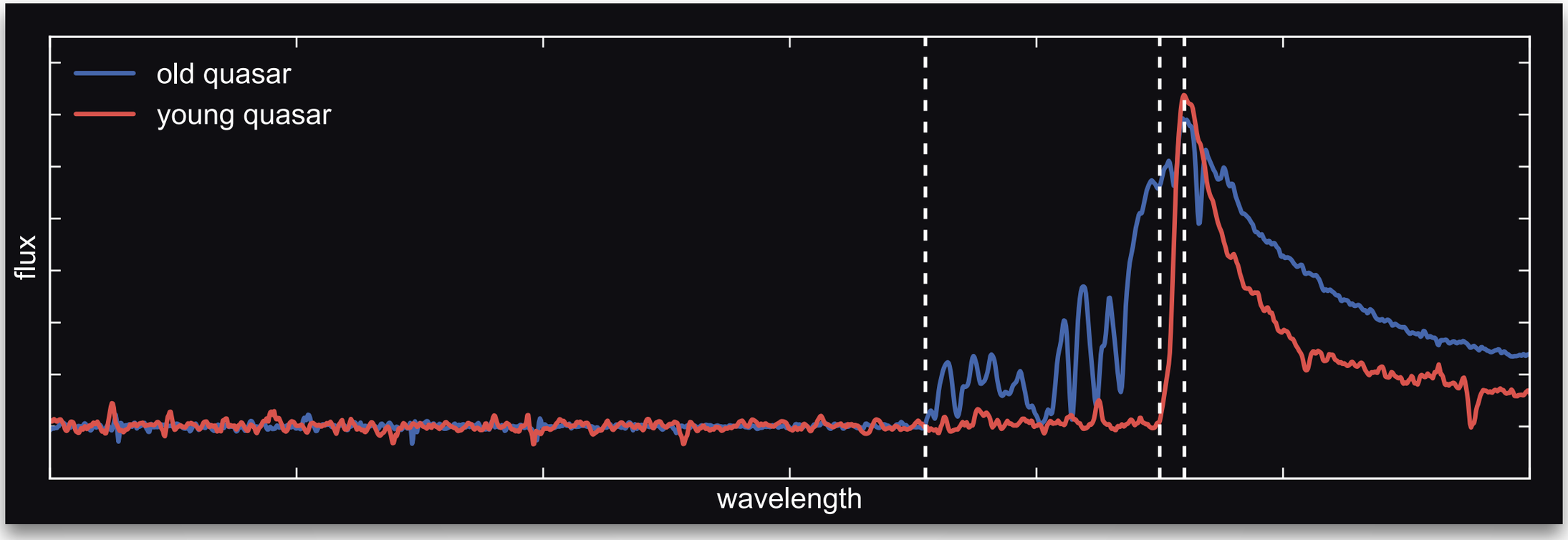
Measuring Lifetimes of High-Redshift Quasars from their Proximity Zones

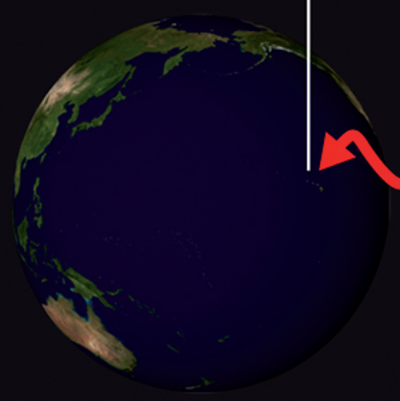
(ApJ, 840, 24)



– Variable AGN Conference, St. Thomas, July 12th, 2017 –

Anna-Christina Eilers (MPIA)
with Joseph Hennawi (UCSB) and Frederick Davies (UCSB)

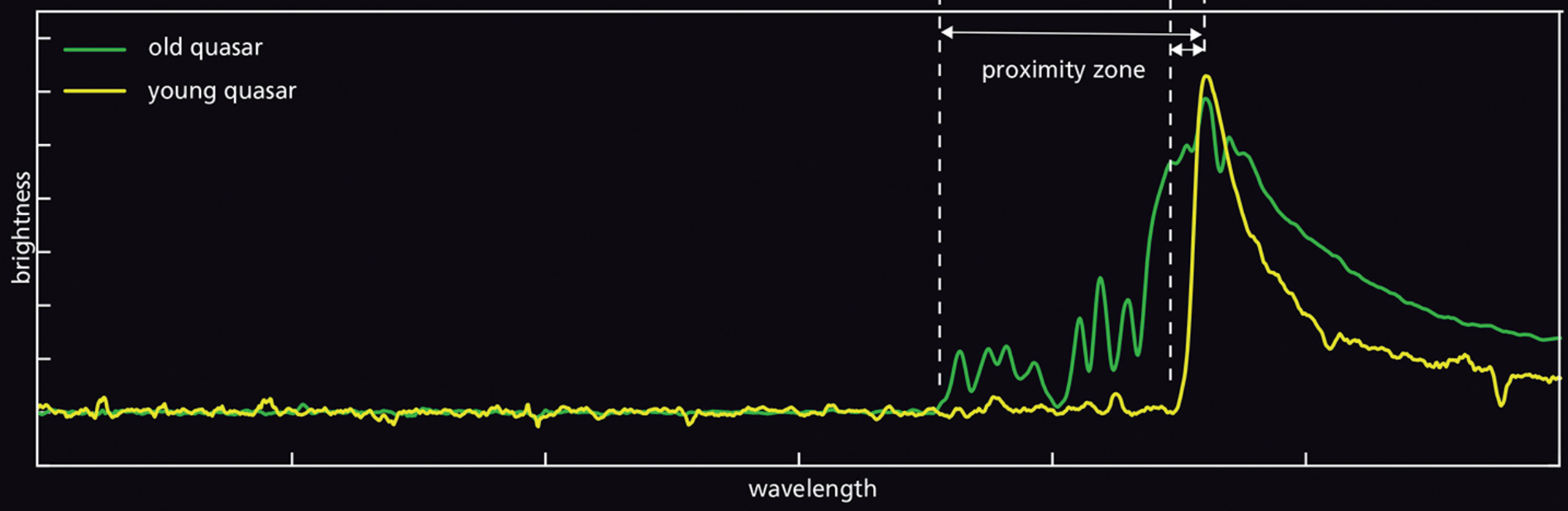
Image credit: NASA/ESA



Light from the quasar

ionized gas around the quasar

quasar

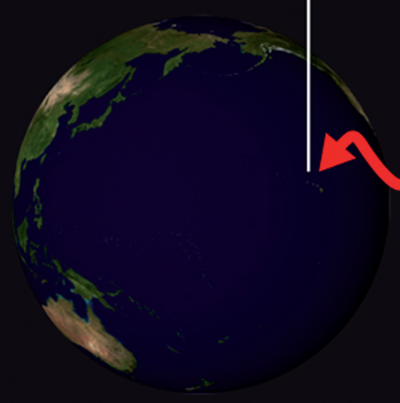


Anna-Christina Eilers, MPIA

evolution of the neutral gas fraction in the IGM:

$$\frac{dx_{\rm HI}}{dt} = -\Gamma_{\rm HI} x_{\rm HI} + \alpha n_e (1 - x_{\rm HI})$$

$$t_{\rm Q} \lesssim t_{\rm eq} \sim \frac{1}{\Gamma_{\rm HI}}$$



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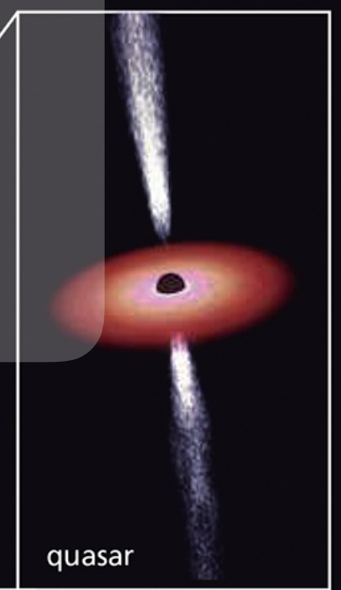
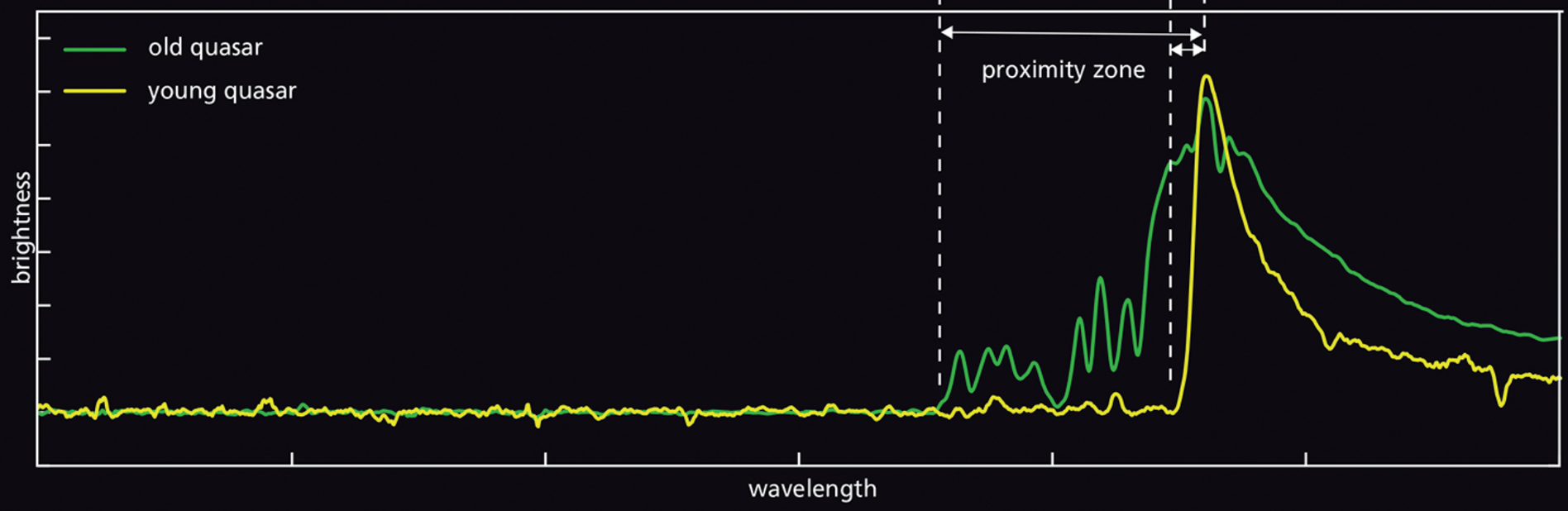
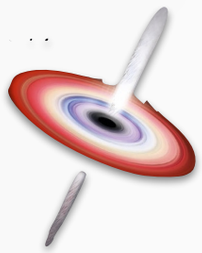


quasar



Measuring Proximity Zones.



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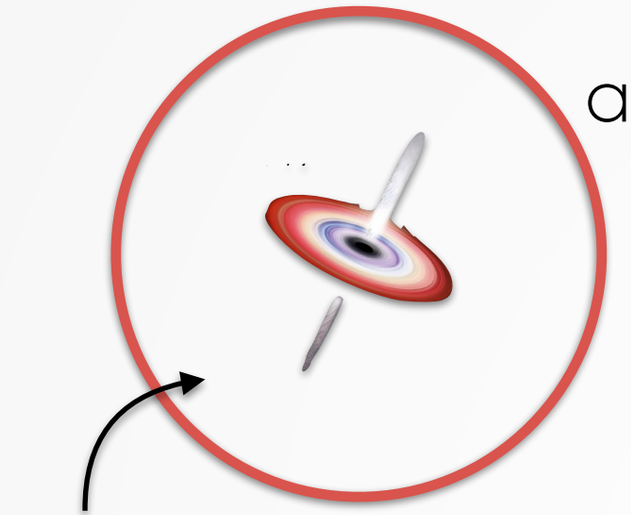

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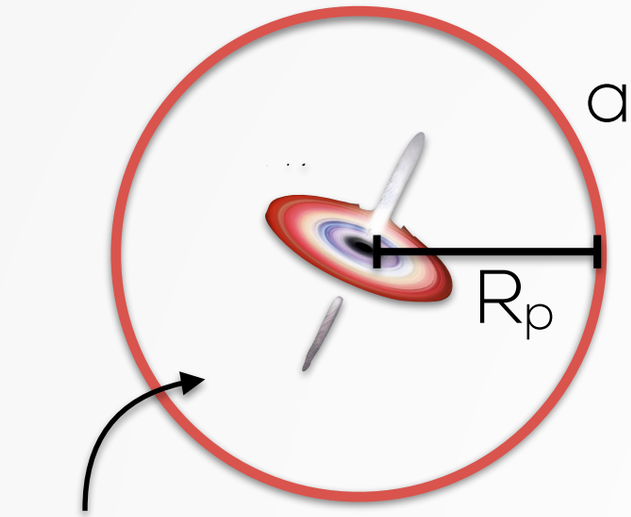

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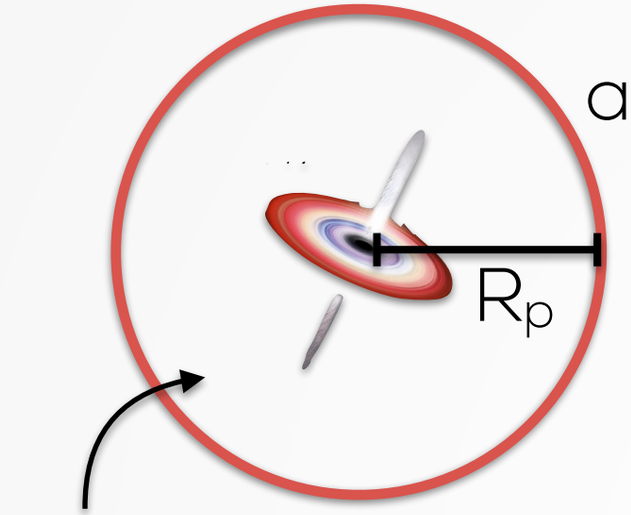

definition based on
Fan et al. 2006

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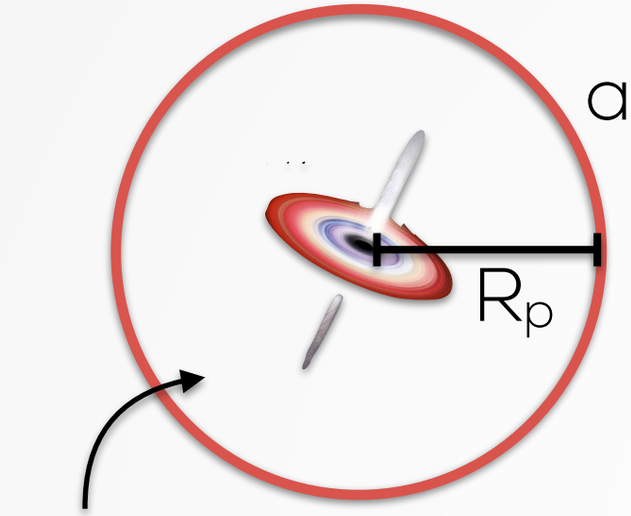

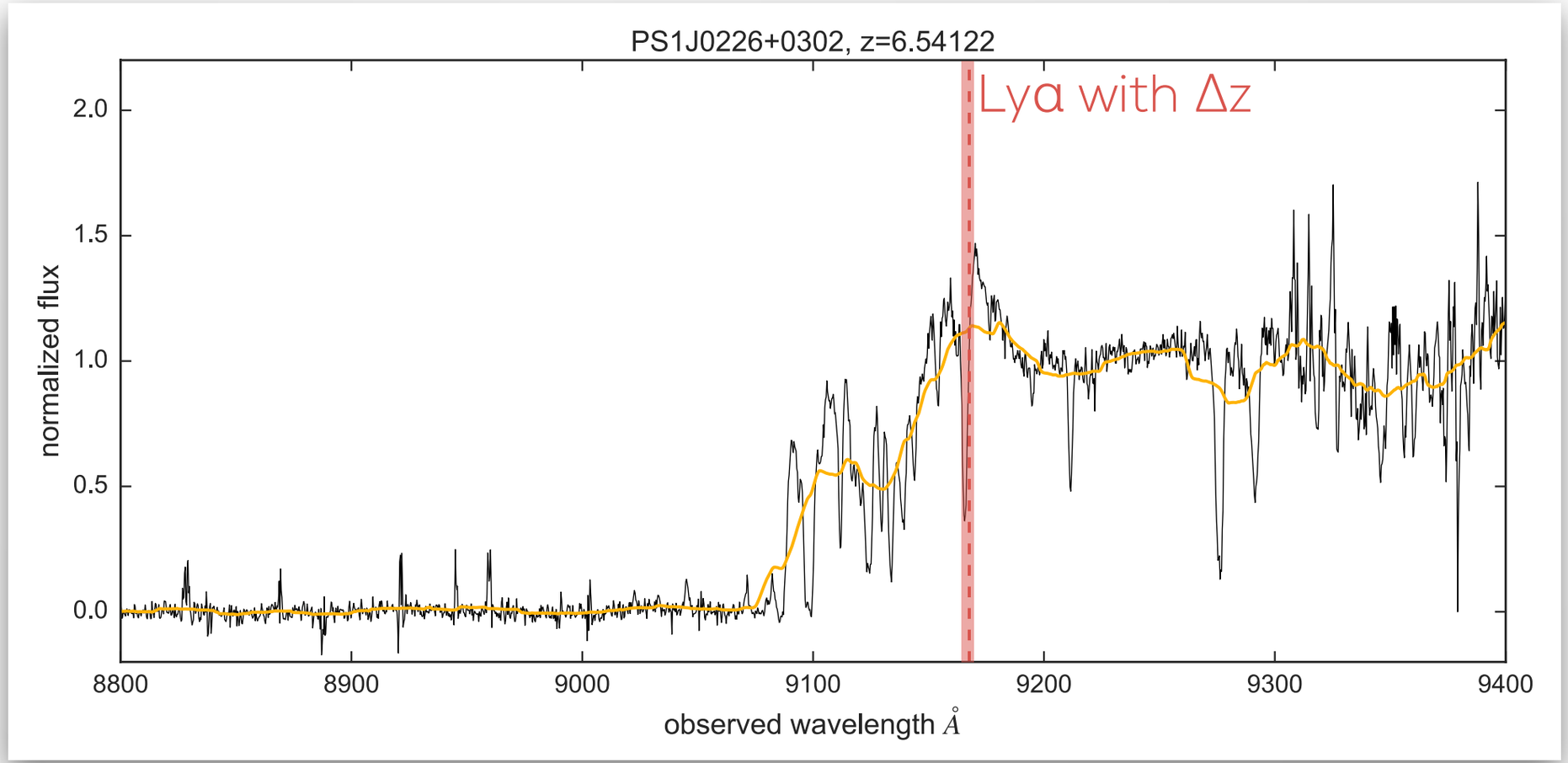

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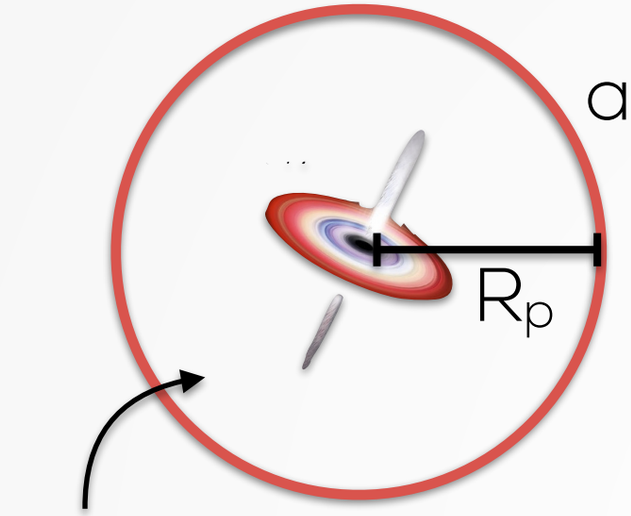

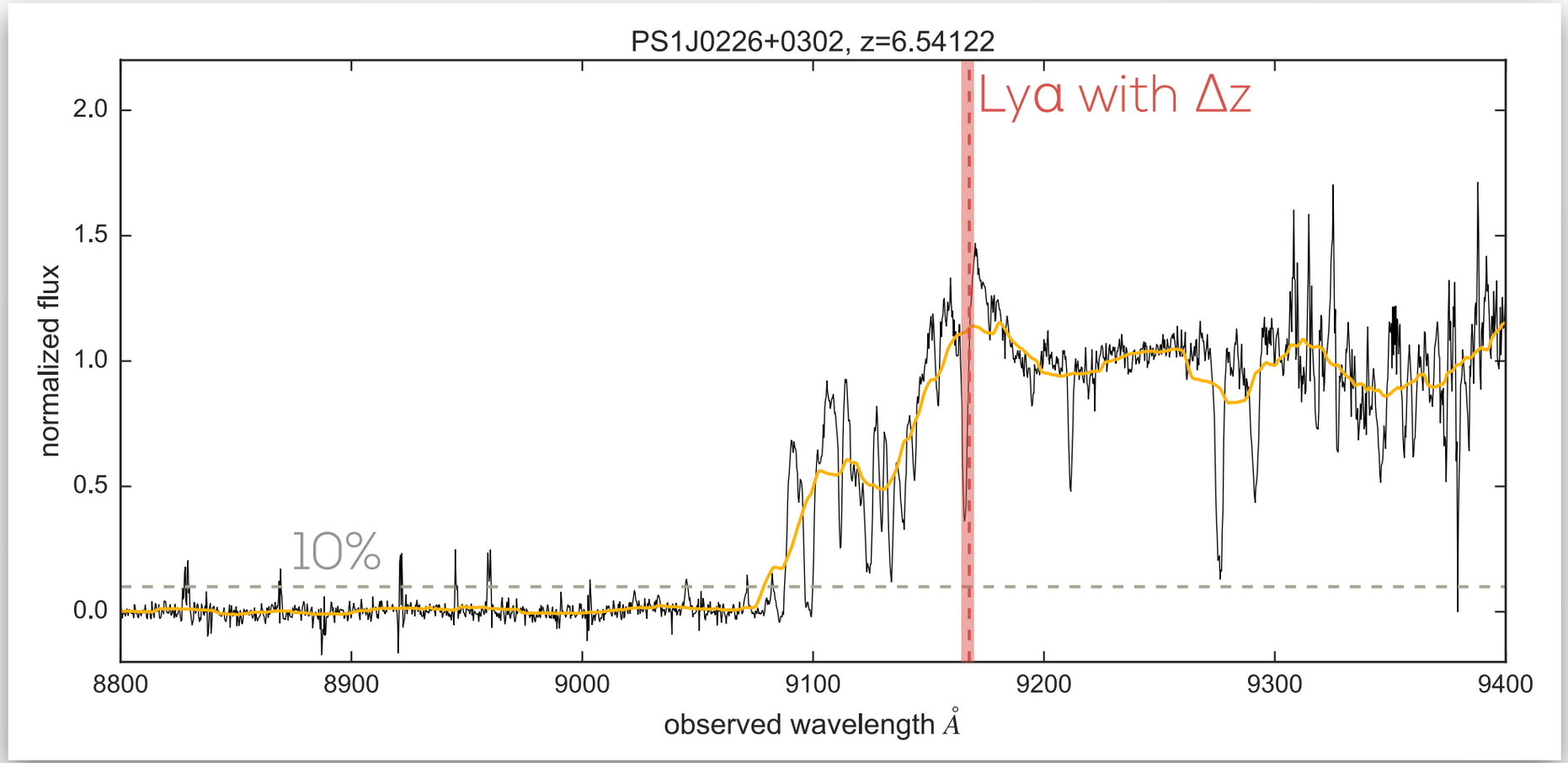

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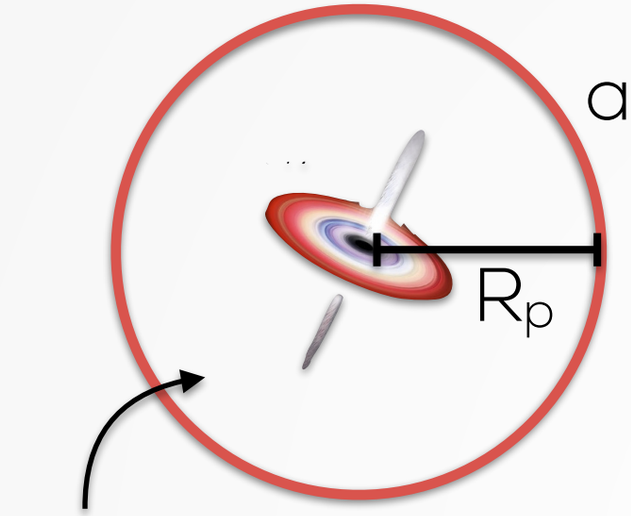

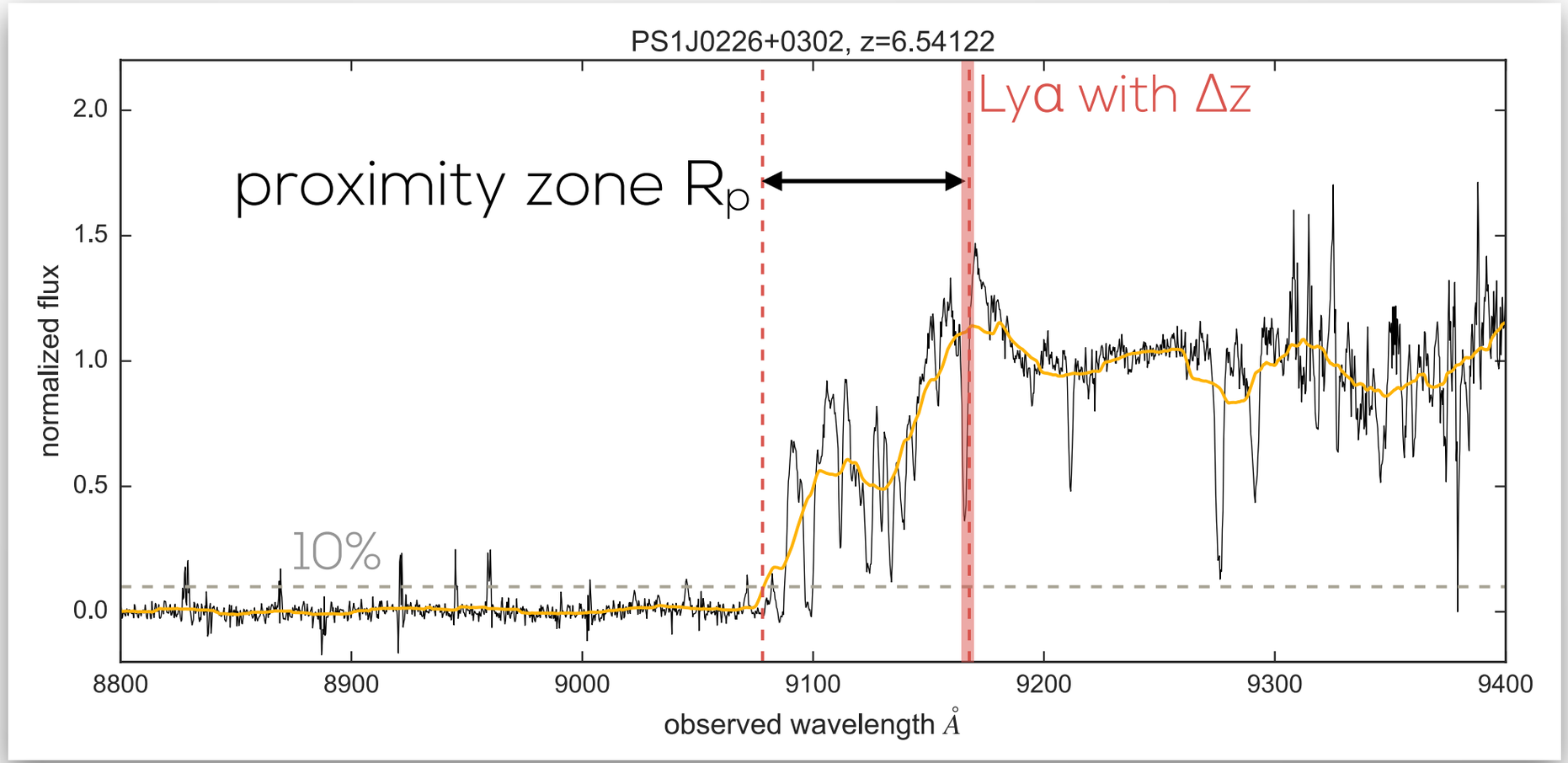

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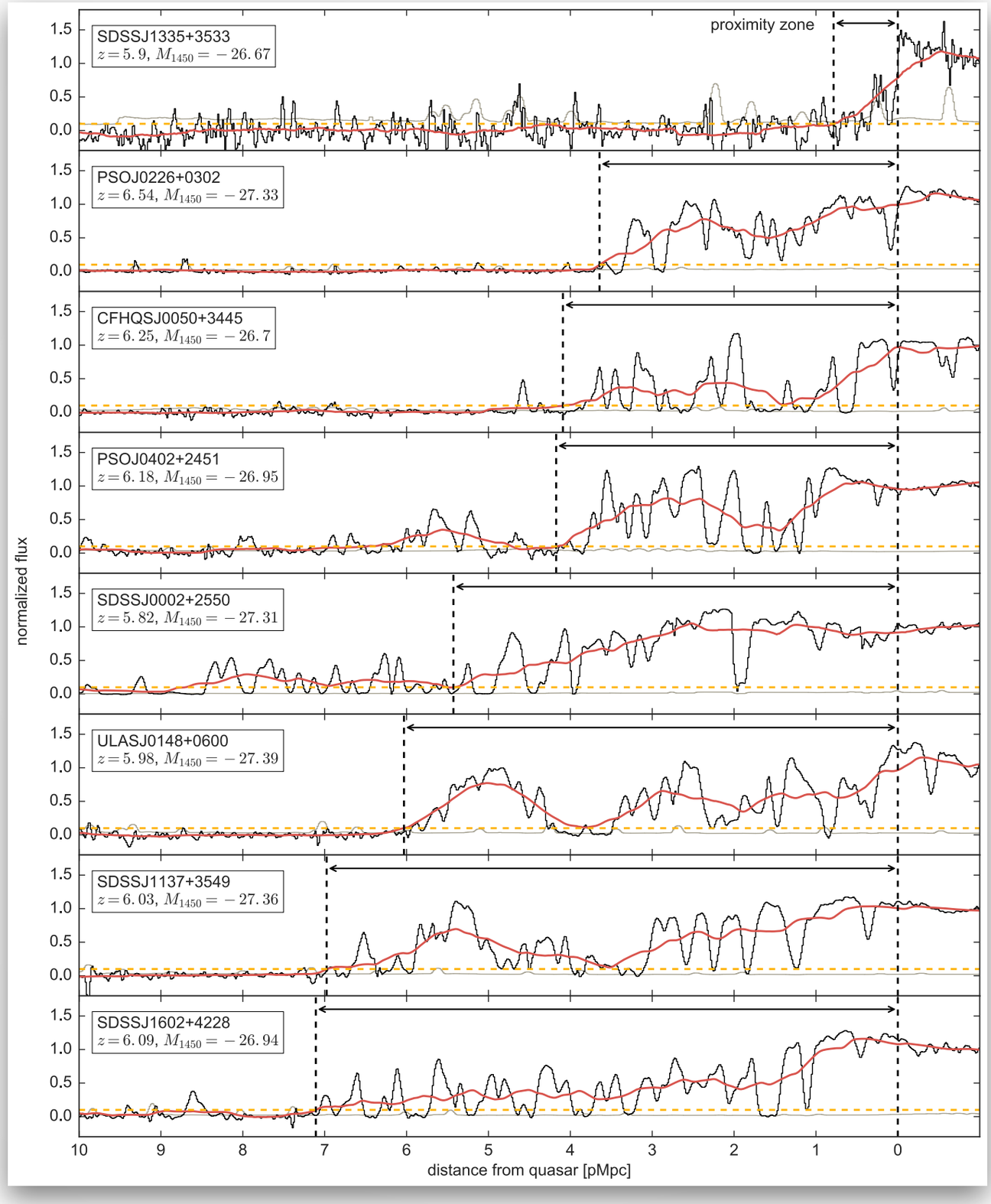
A New Data Set of Quasar Spectra.

- 34 quasar spectra (~10 of them unpublished)
- redshift range: z~5.77-6.54
- Echellette Spectrograph and Imager (ESI) on Keck II
- resolution: R~5000
- homogeneous data reduction
- co-adding of all exposures (~188 hours of telescope time)

Credit: Laurie Hatch

Proximity Zone Measurements.



Eilers et al. 2017

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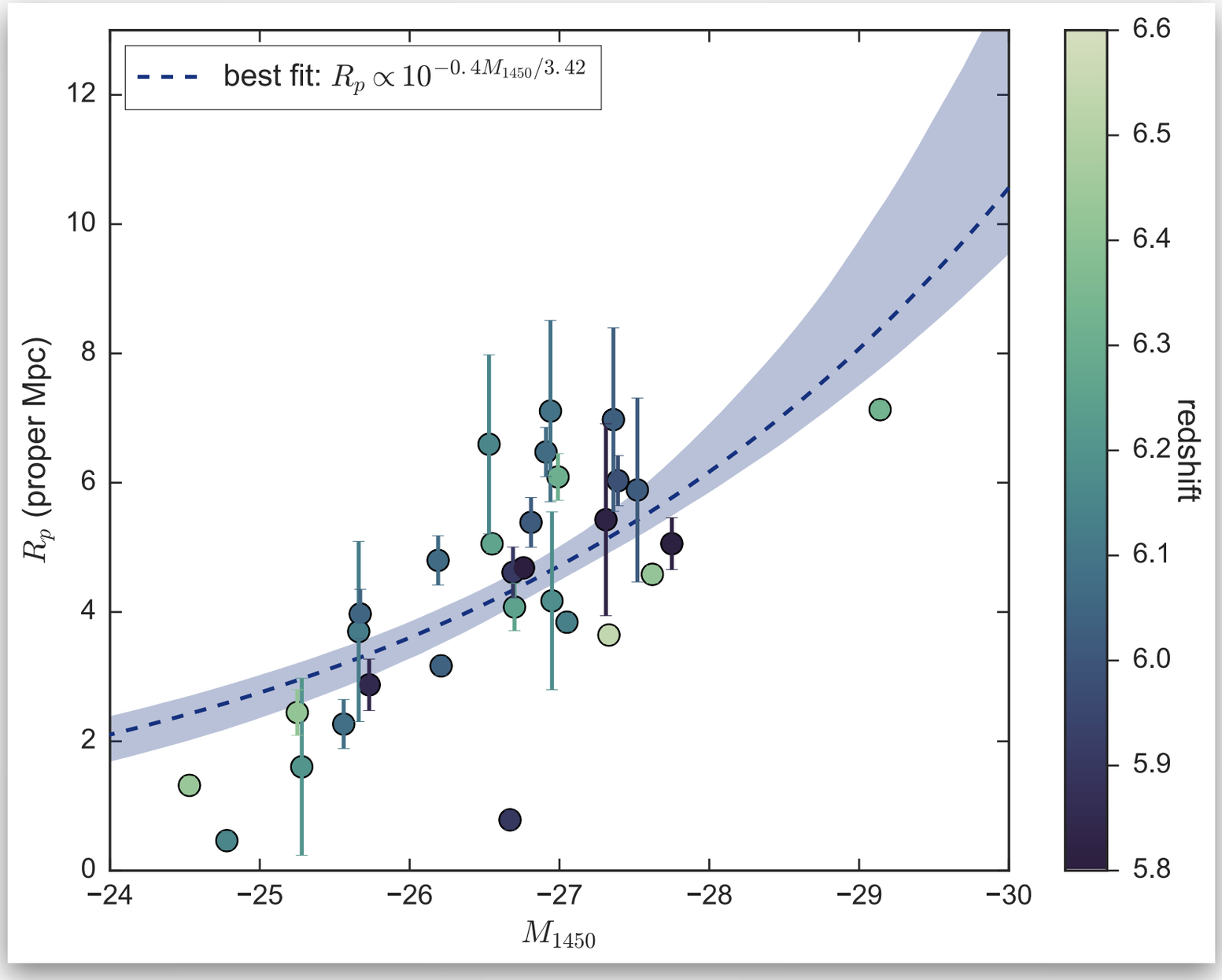

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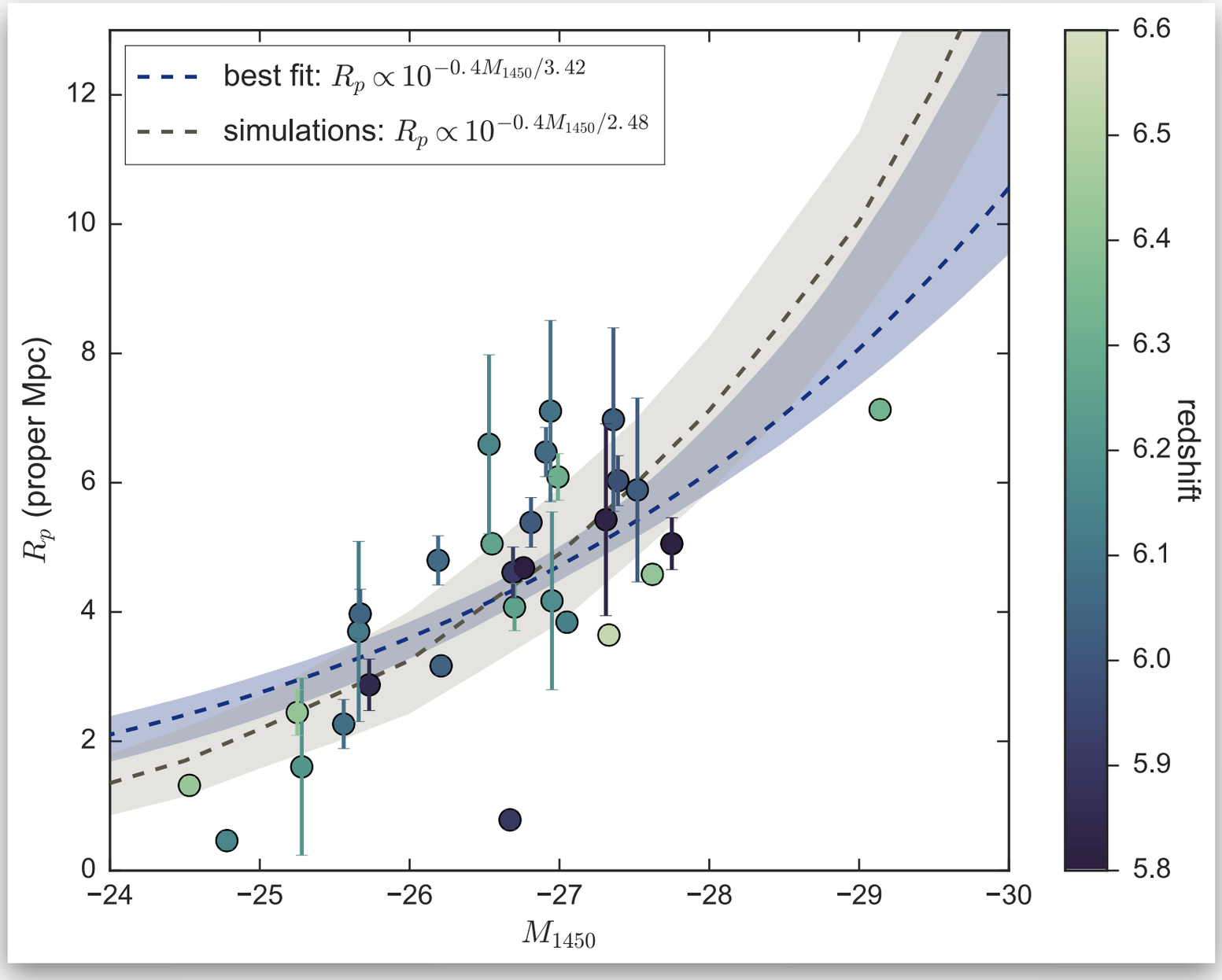

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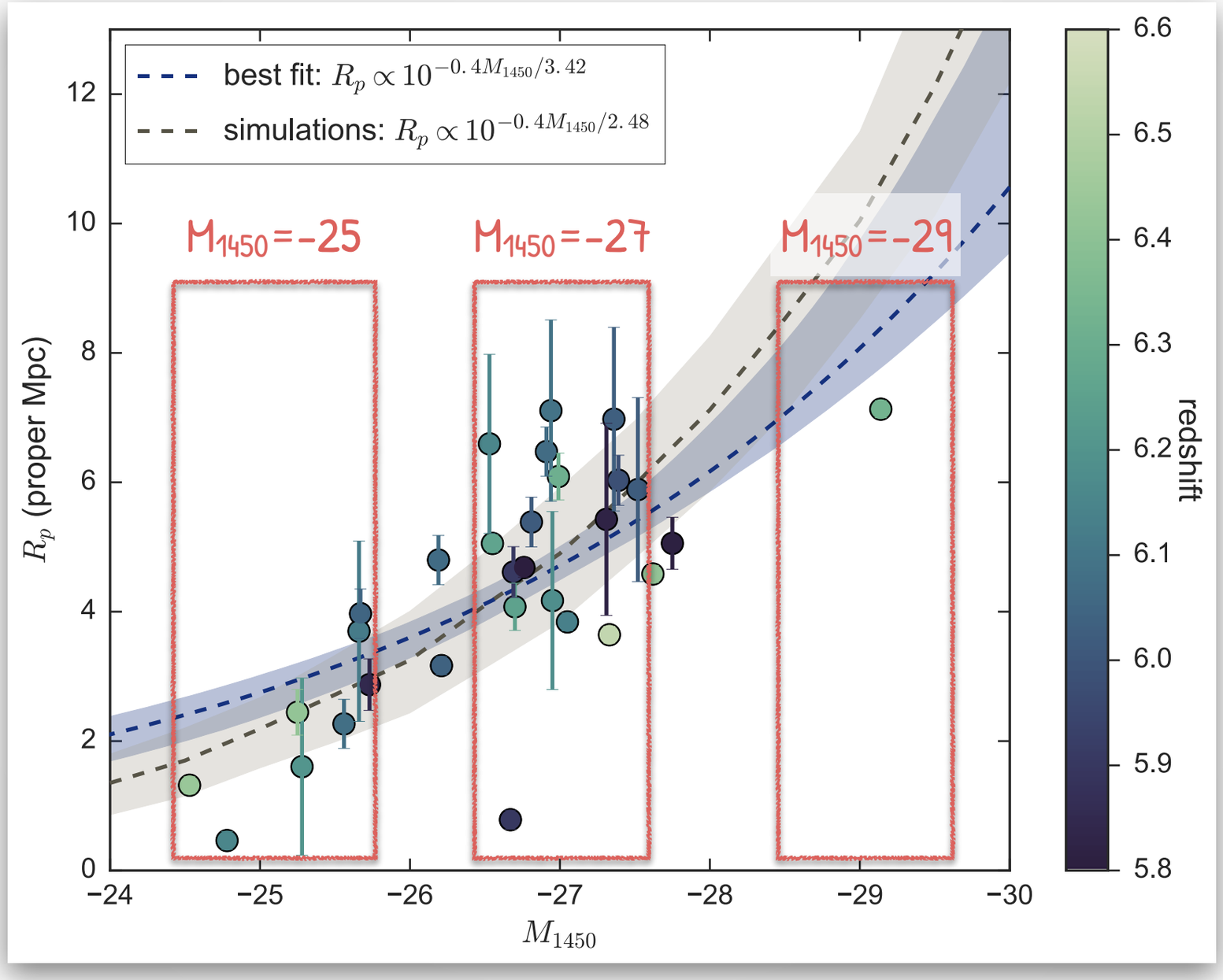

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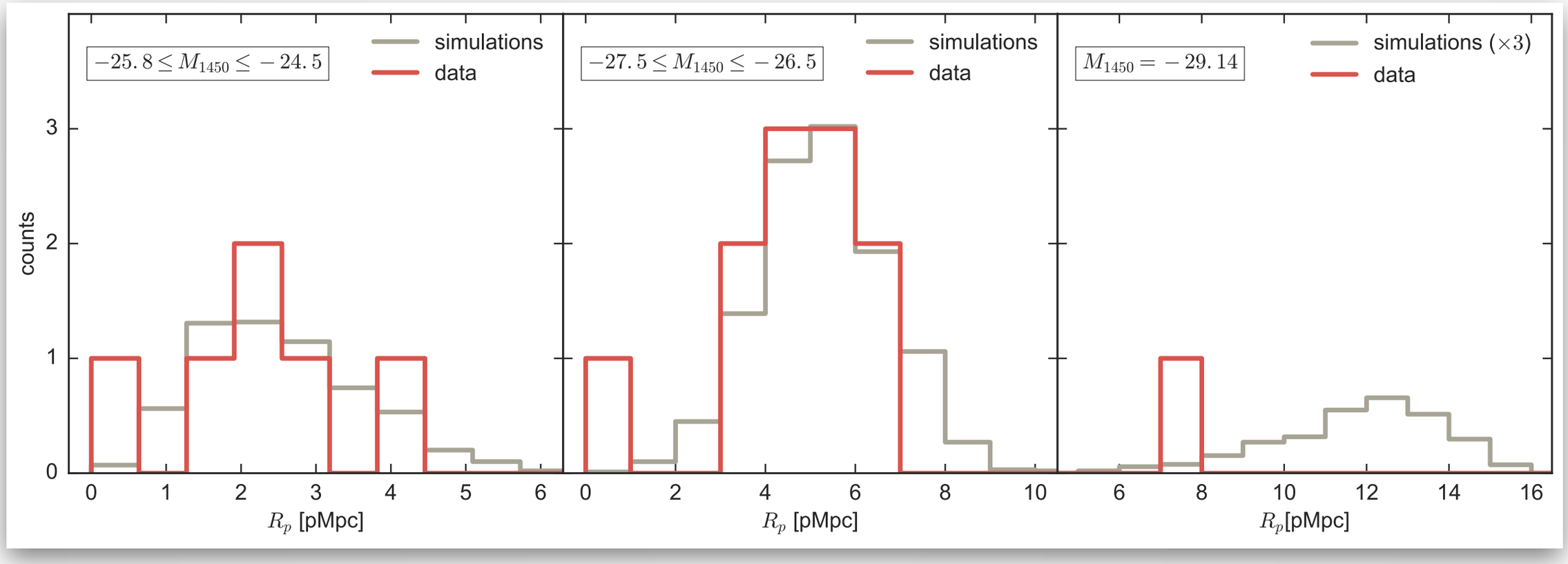

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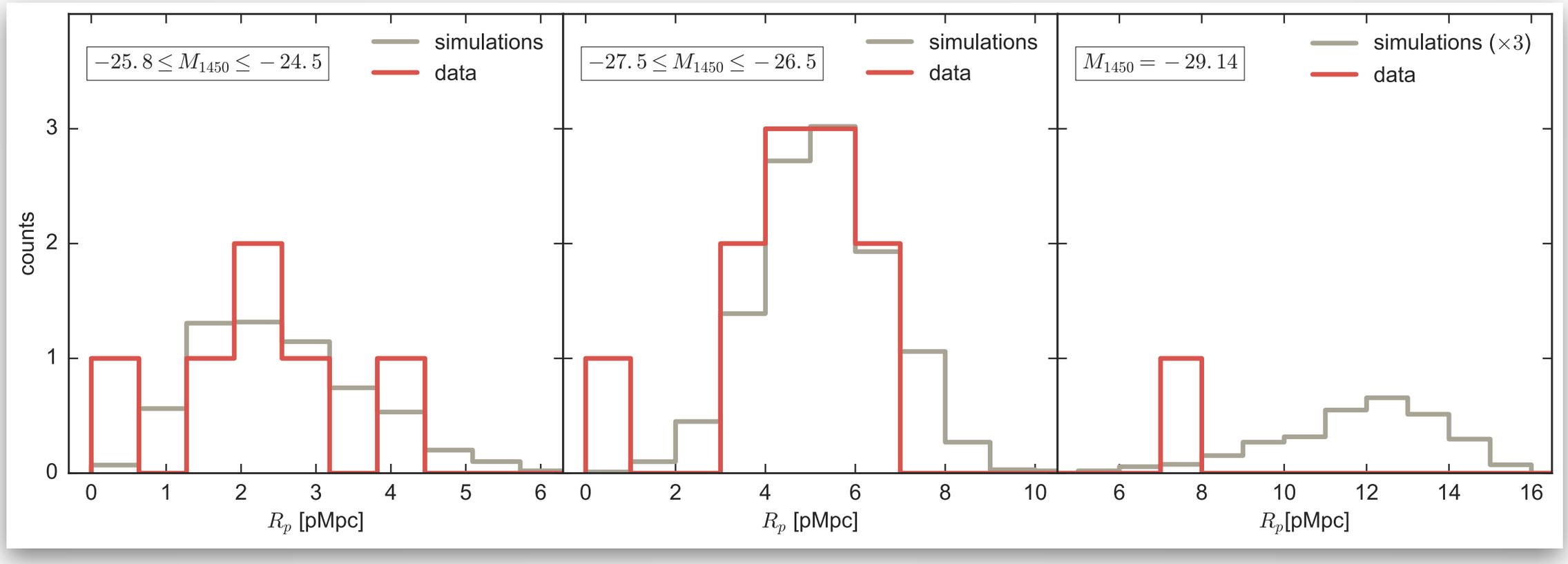

Eilers et al. 2017

possible reasons for such small zones:

1. Damped Lyα Systems
2. islands of neutral gas in the IGM
3. short quasar lifetime

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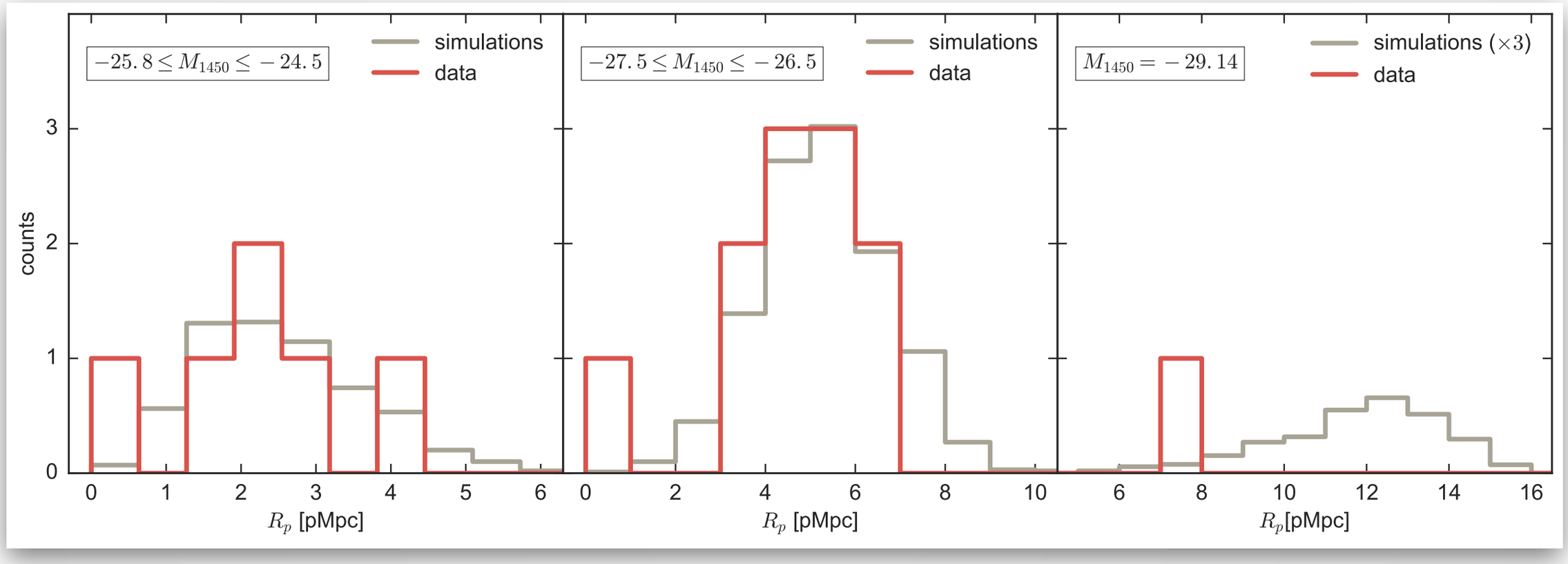

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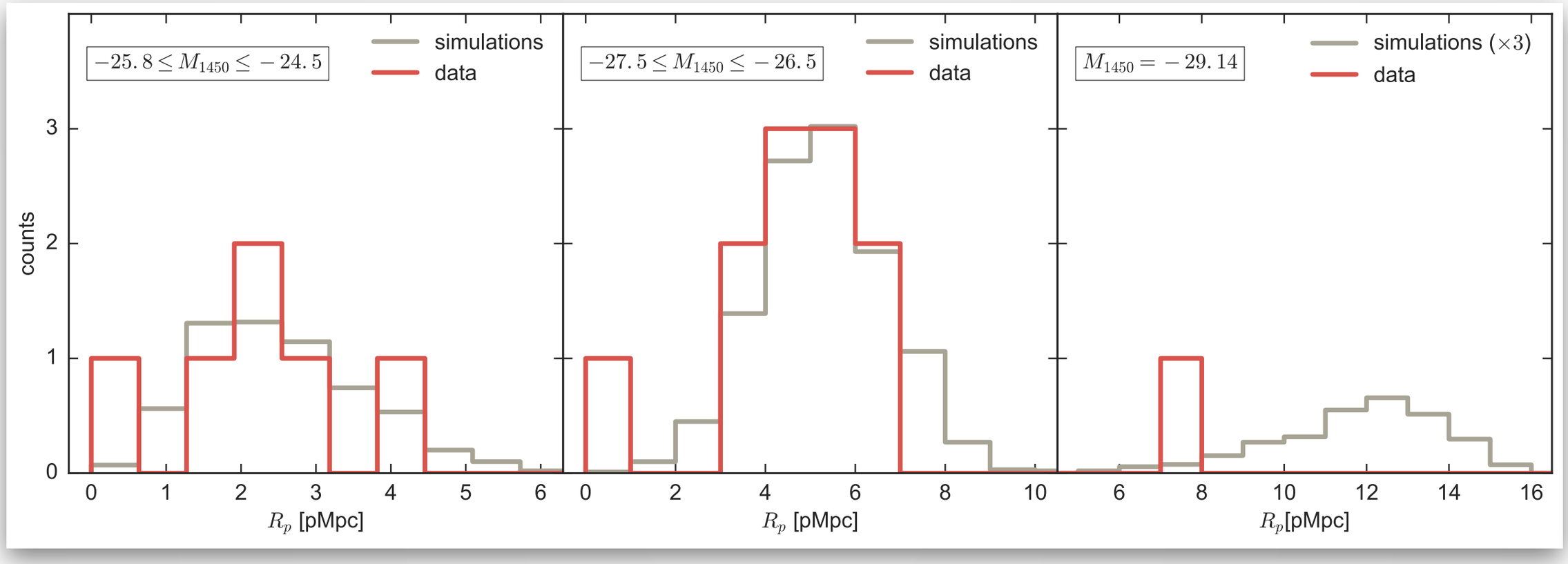

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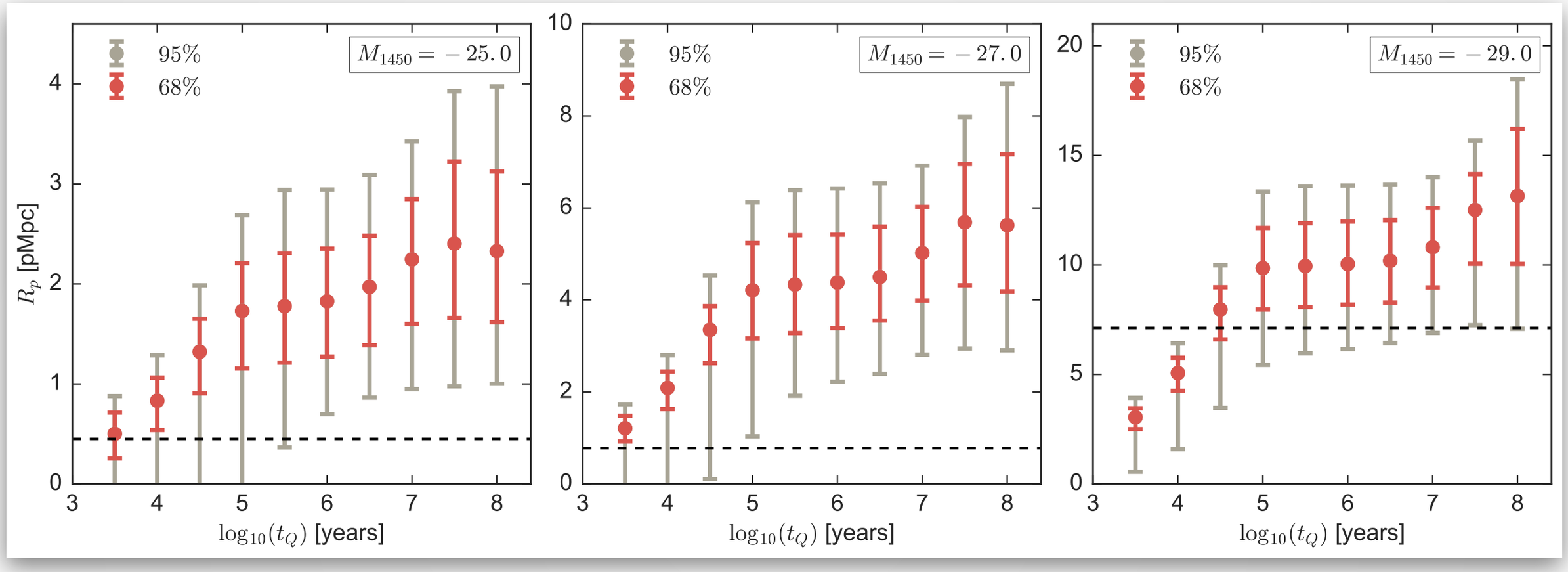

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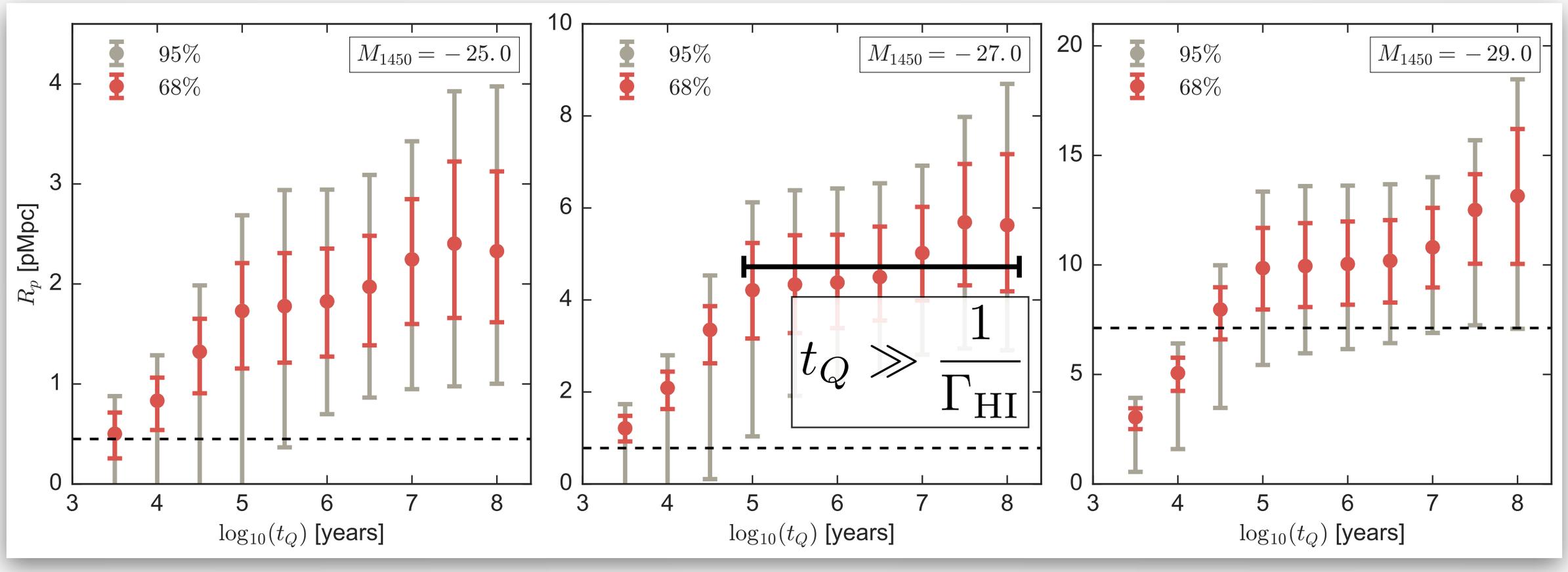

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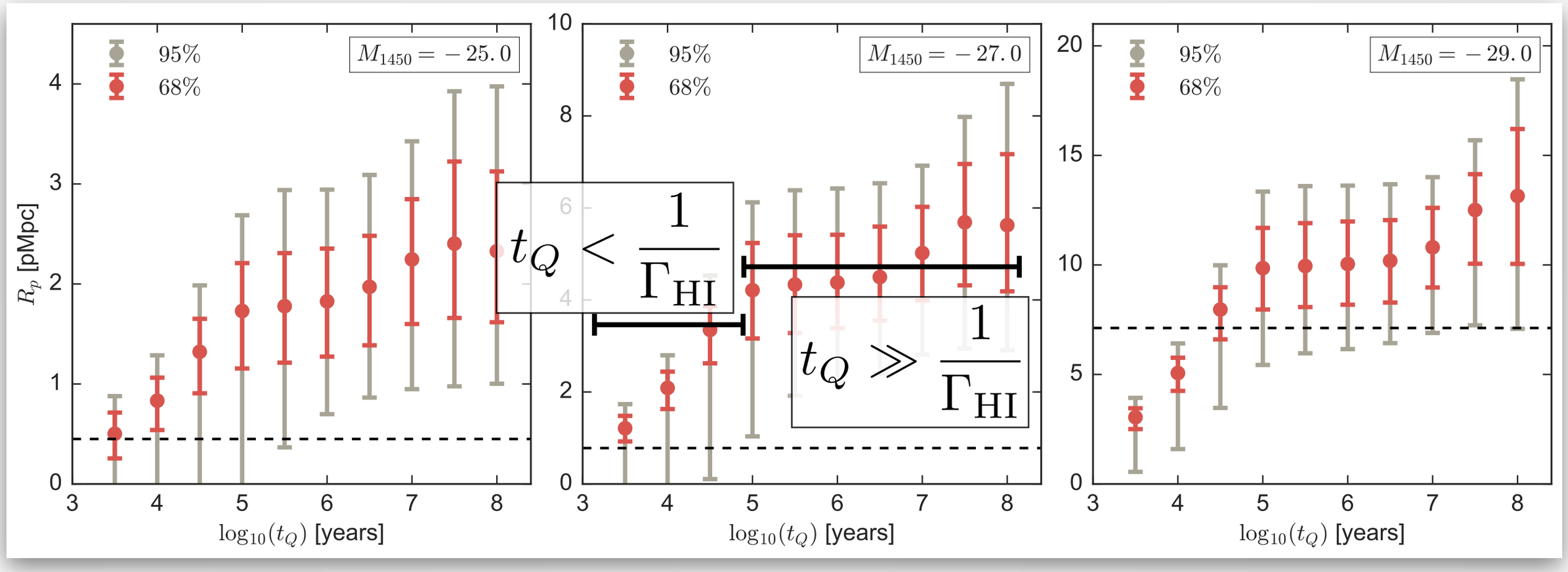

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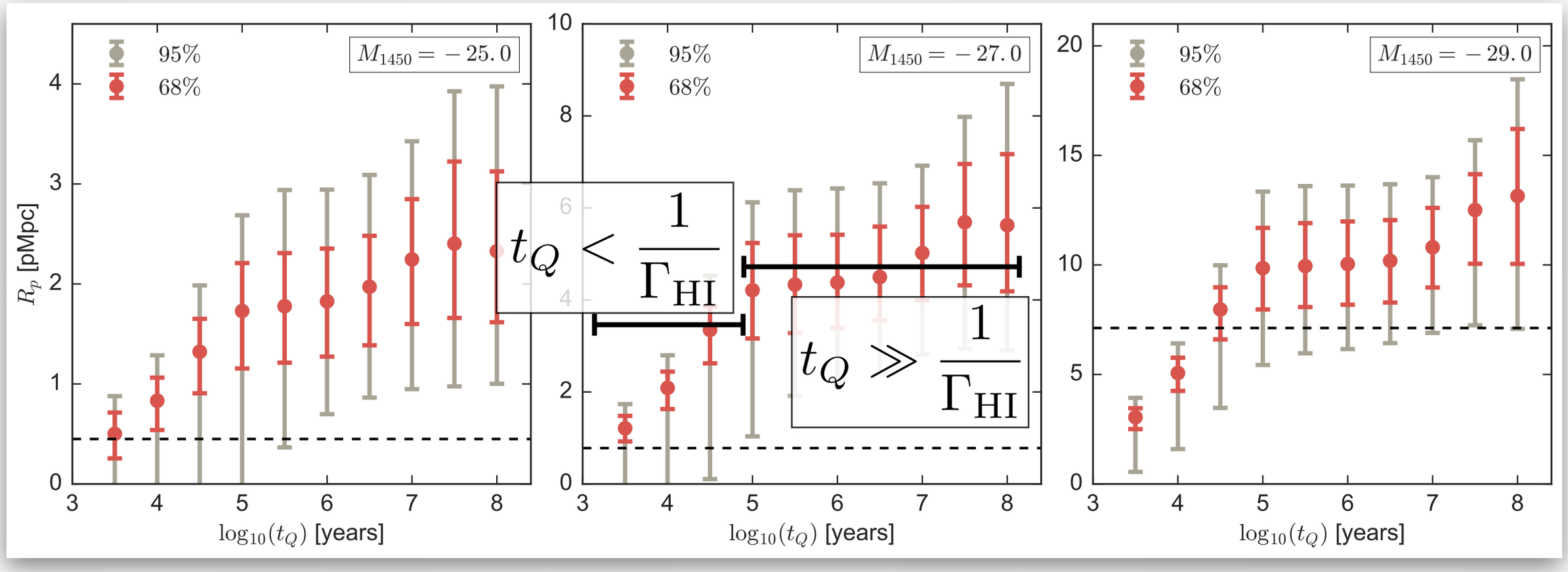

Eilers et al. 2017

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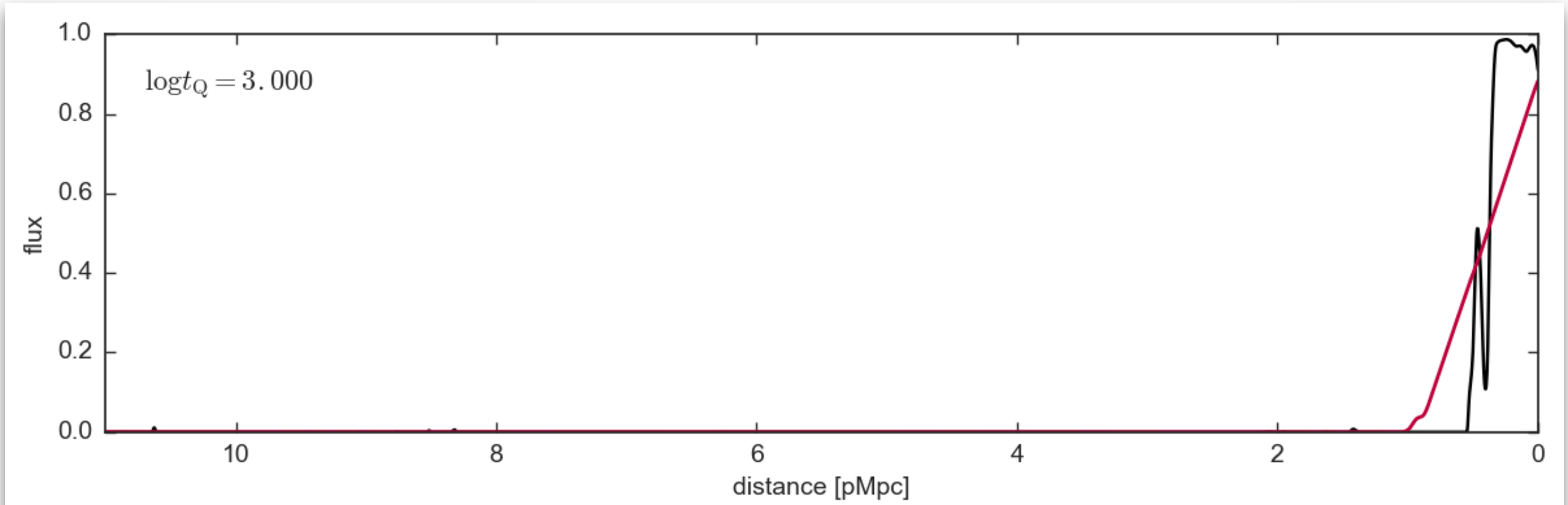
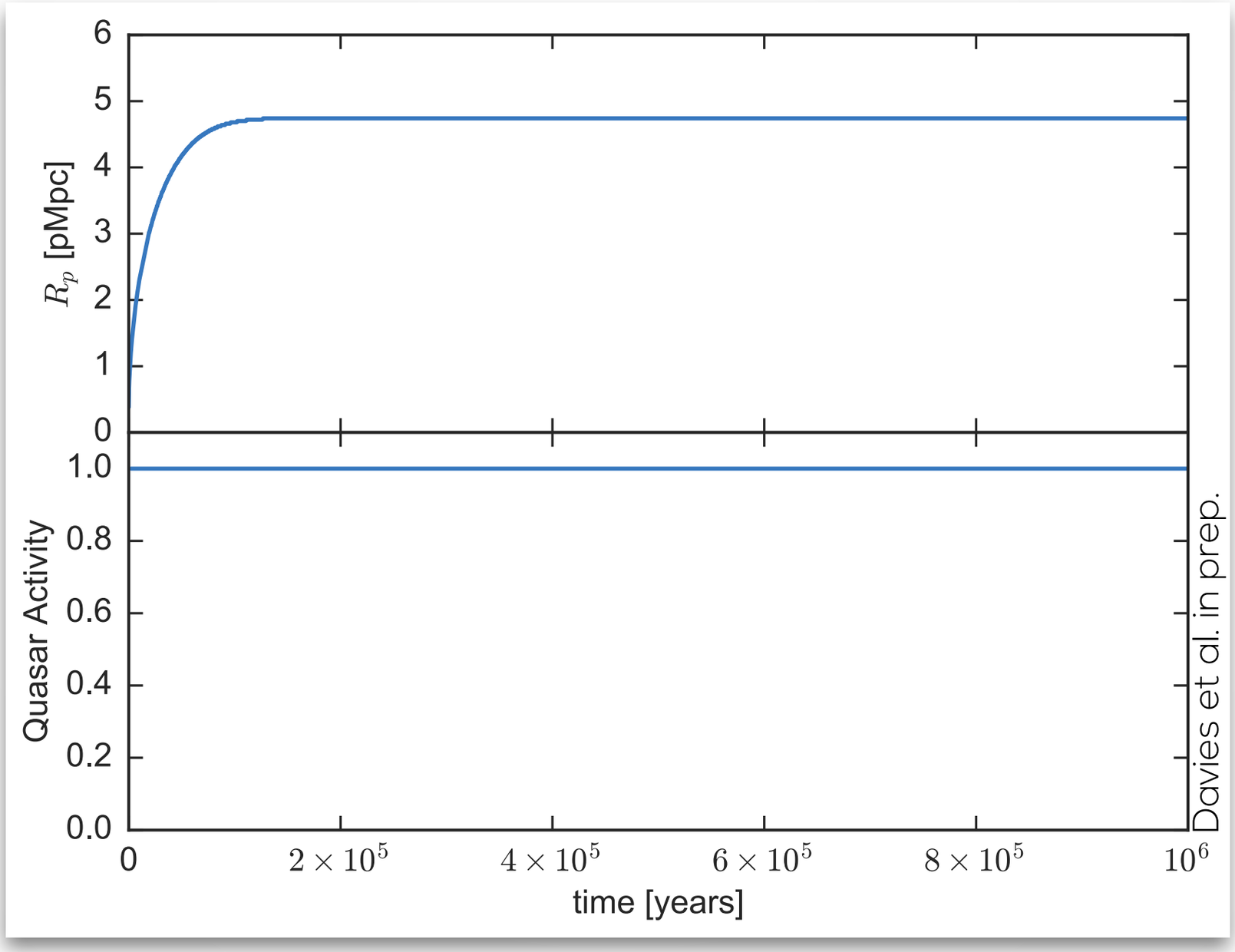
3. short quasar lifetime — IF $<10^5$ YEARS: MAYBE!

Evolution of Proximity Zone Sizes with Quasar Lifetime.



Quasars Flickering On and Off?

– Preliminary Results! –



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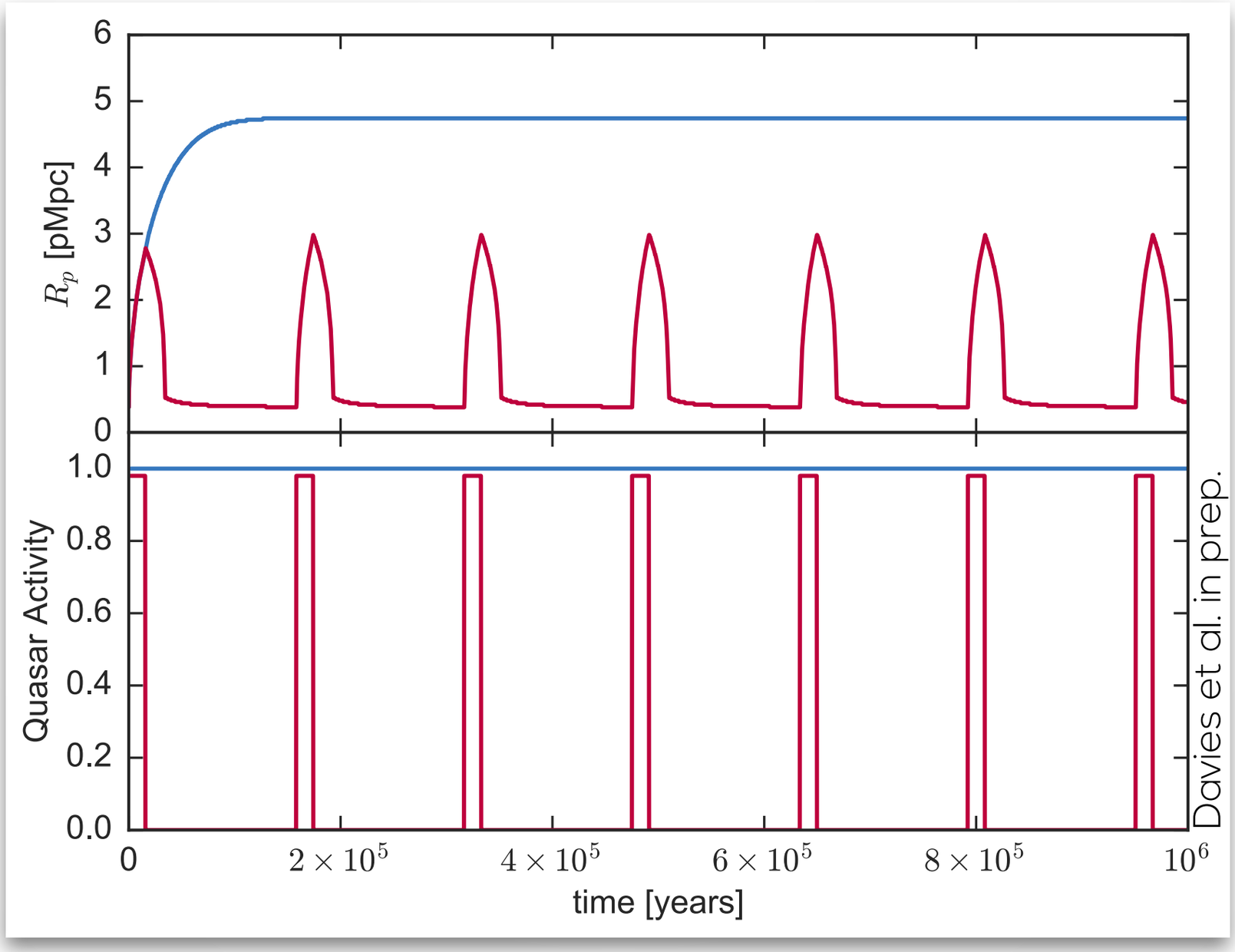

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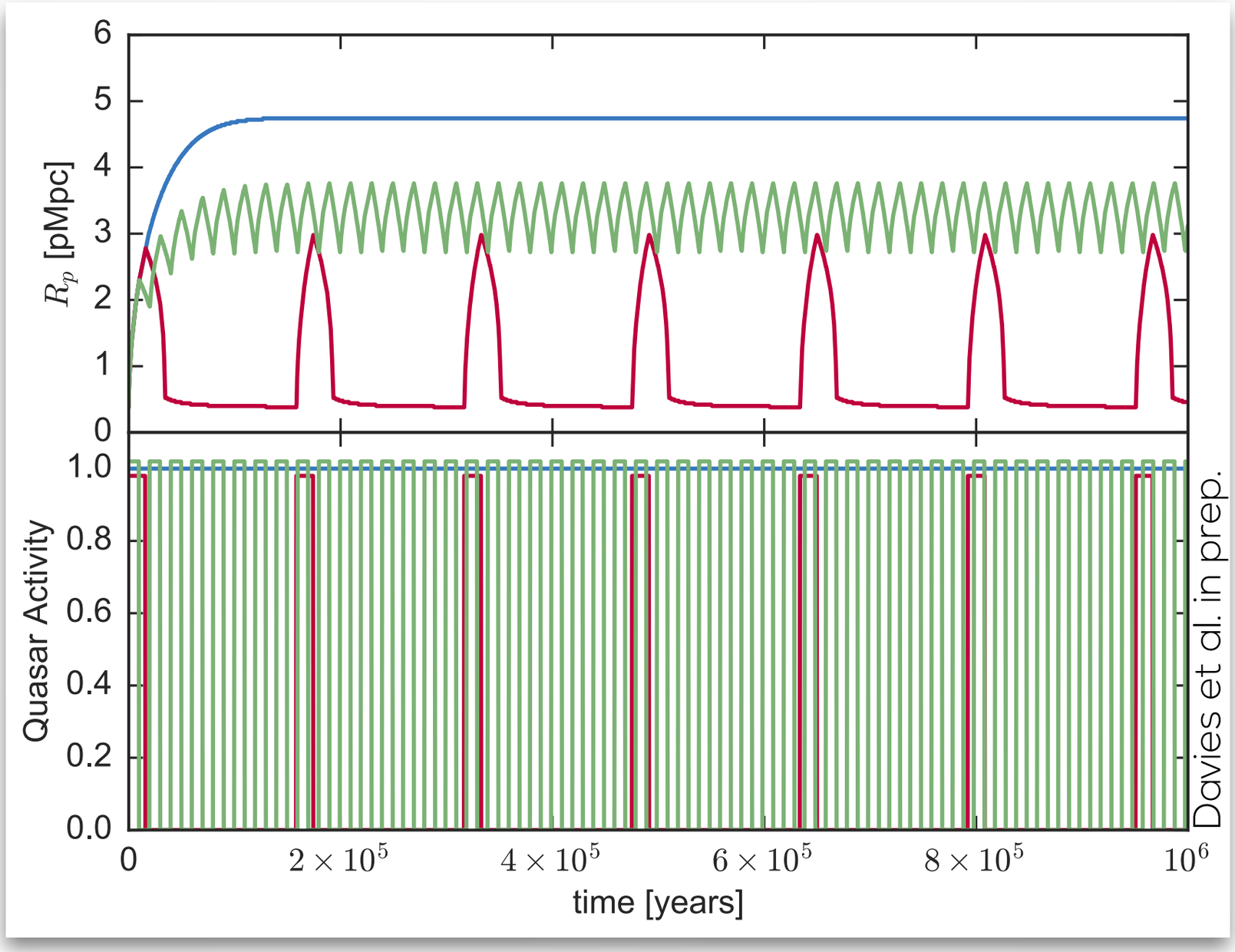

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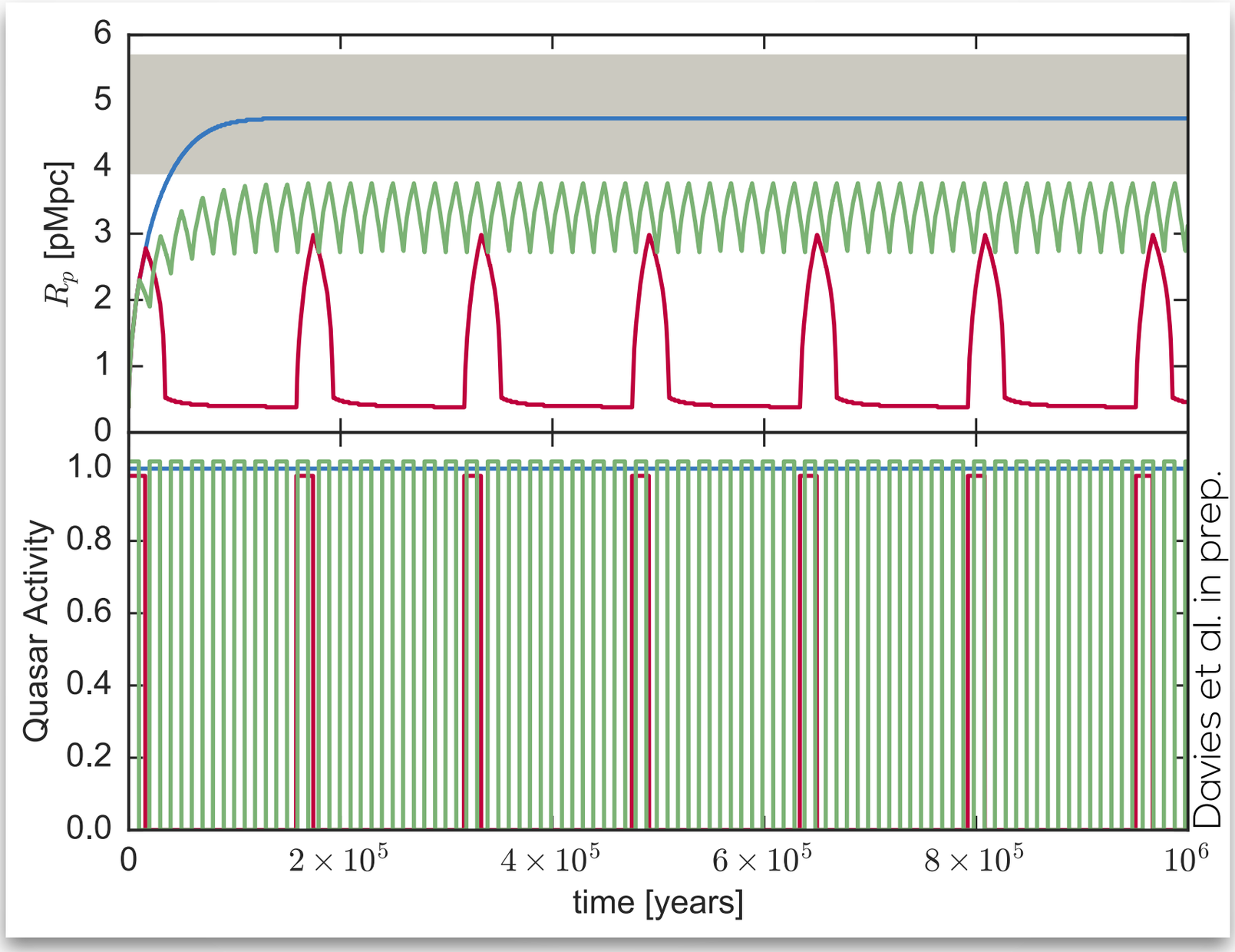
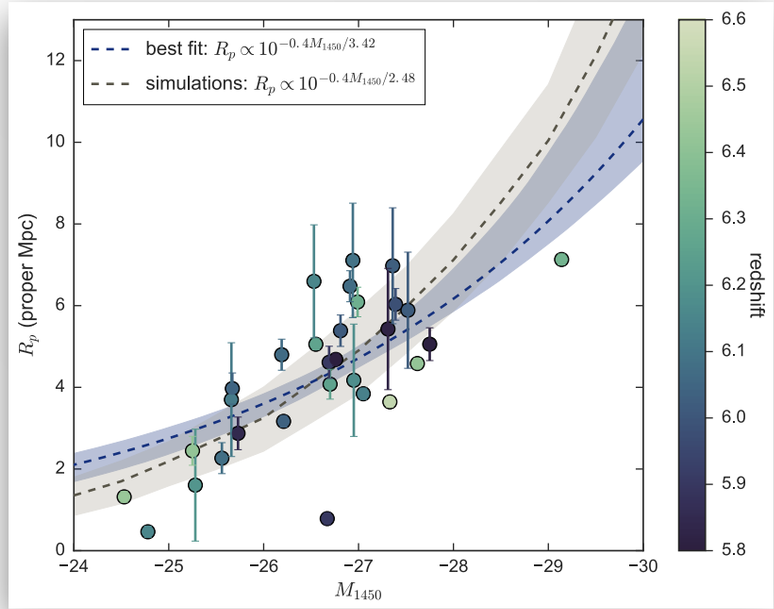


Growth of Supermassive Black Hole?

- super-Eddington accretion rates?
- highly obscured growth phase?
- massive initial seeds from direct collapse black holes?
- Quasar flickering on and off with short duty cycles of $<10^5$ years?

Conclusions.

- we measured the **quasar proximity zones** for a new data set of high-redshift quasar spectra.



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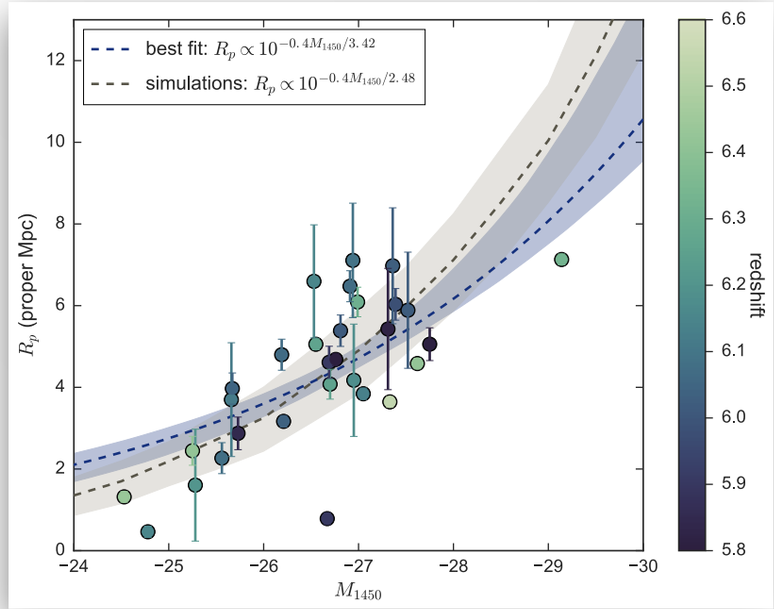

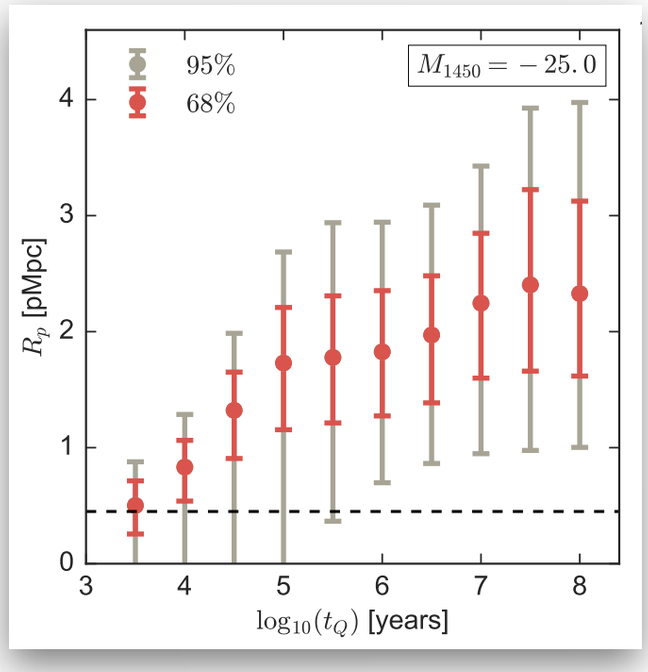

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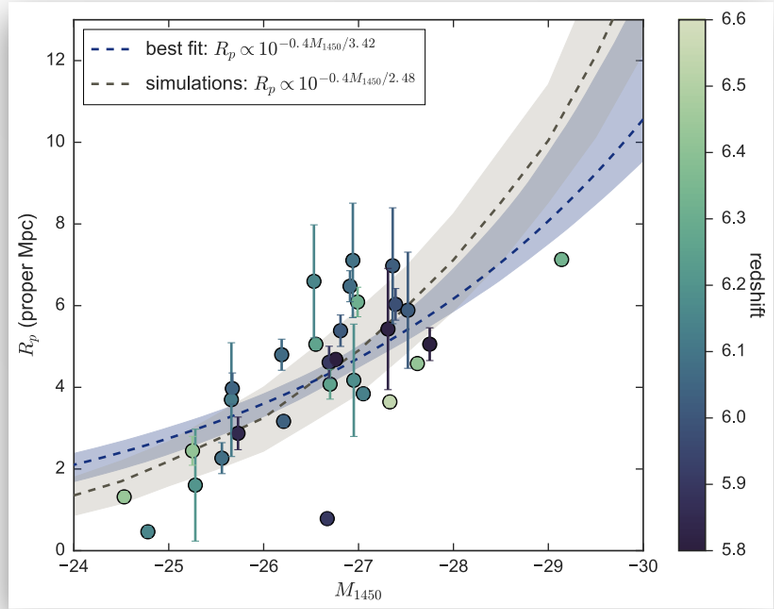

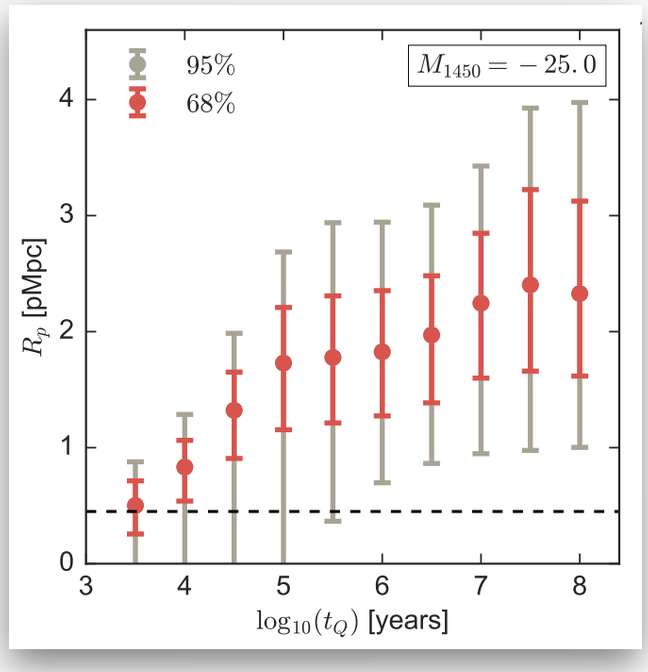

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- rapid **growth rate** of supermassive black holes in center of host galaxies is still an open question.