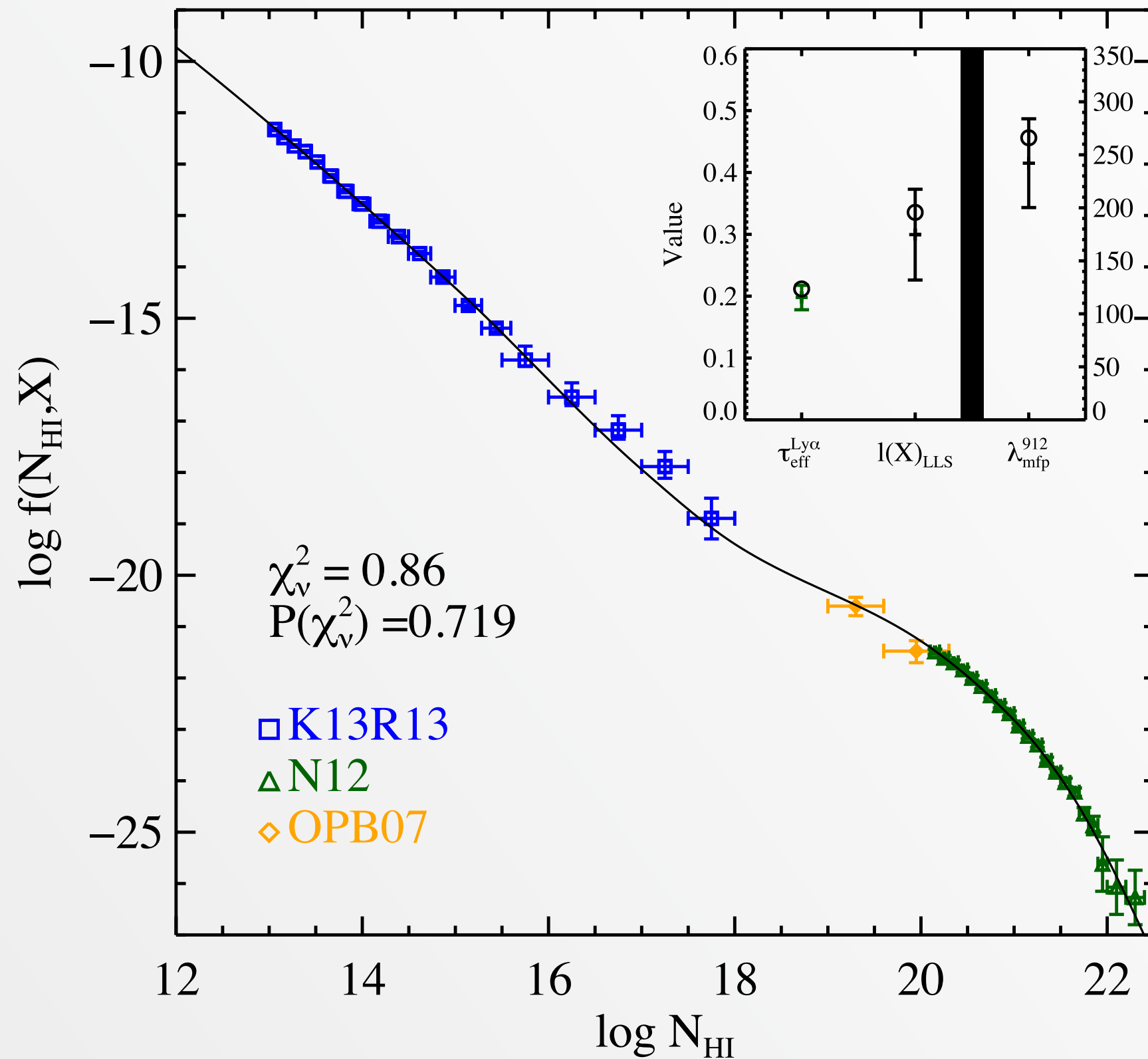
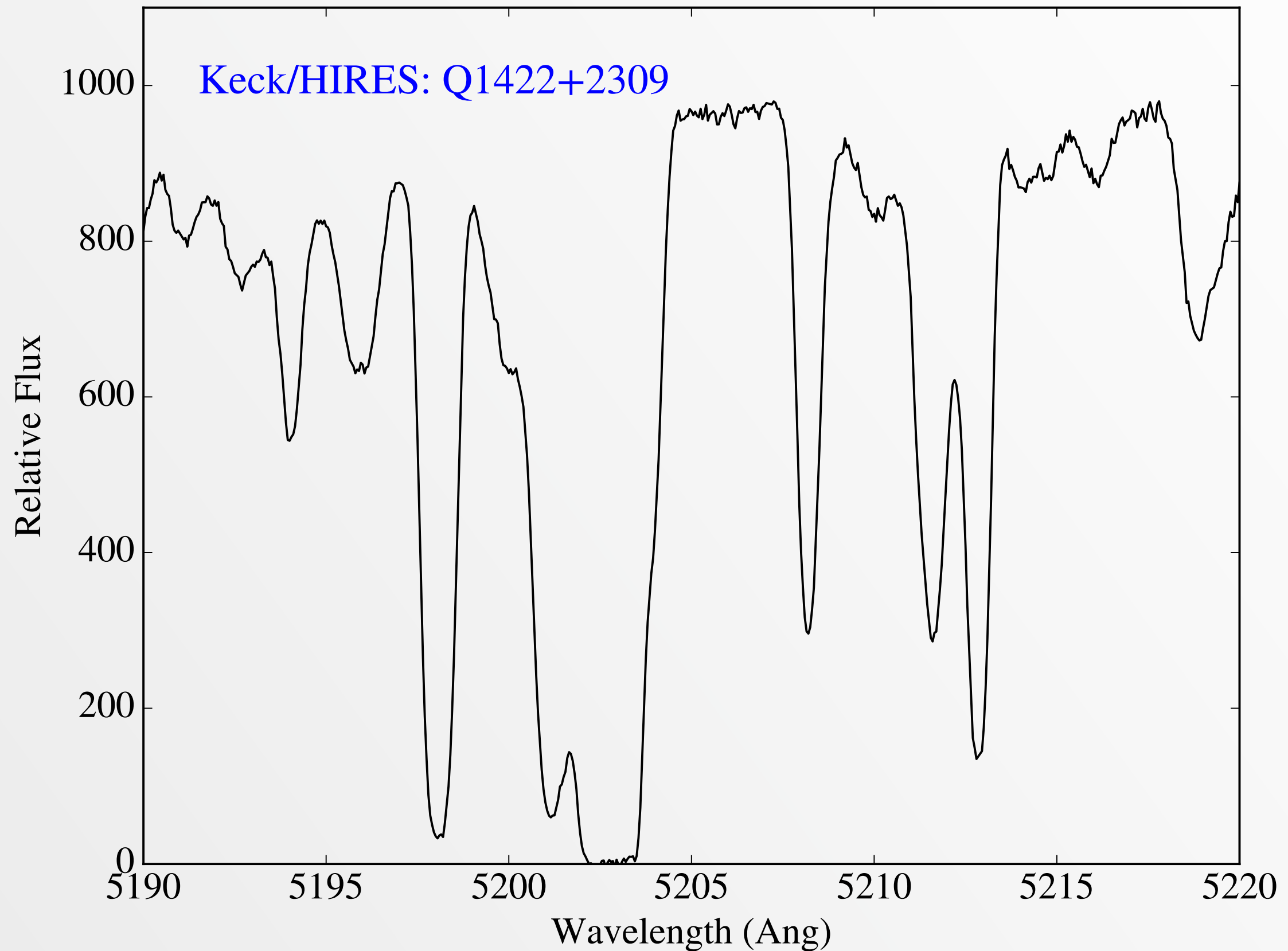


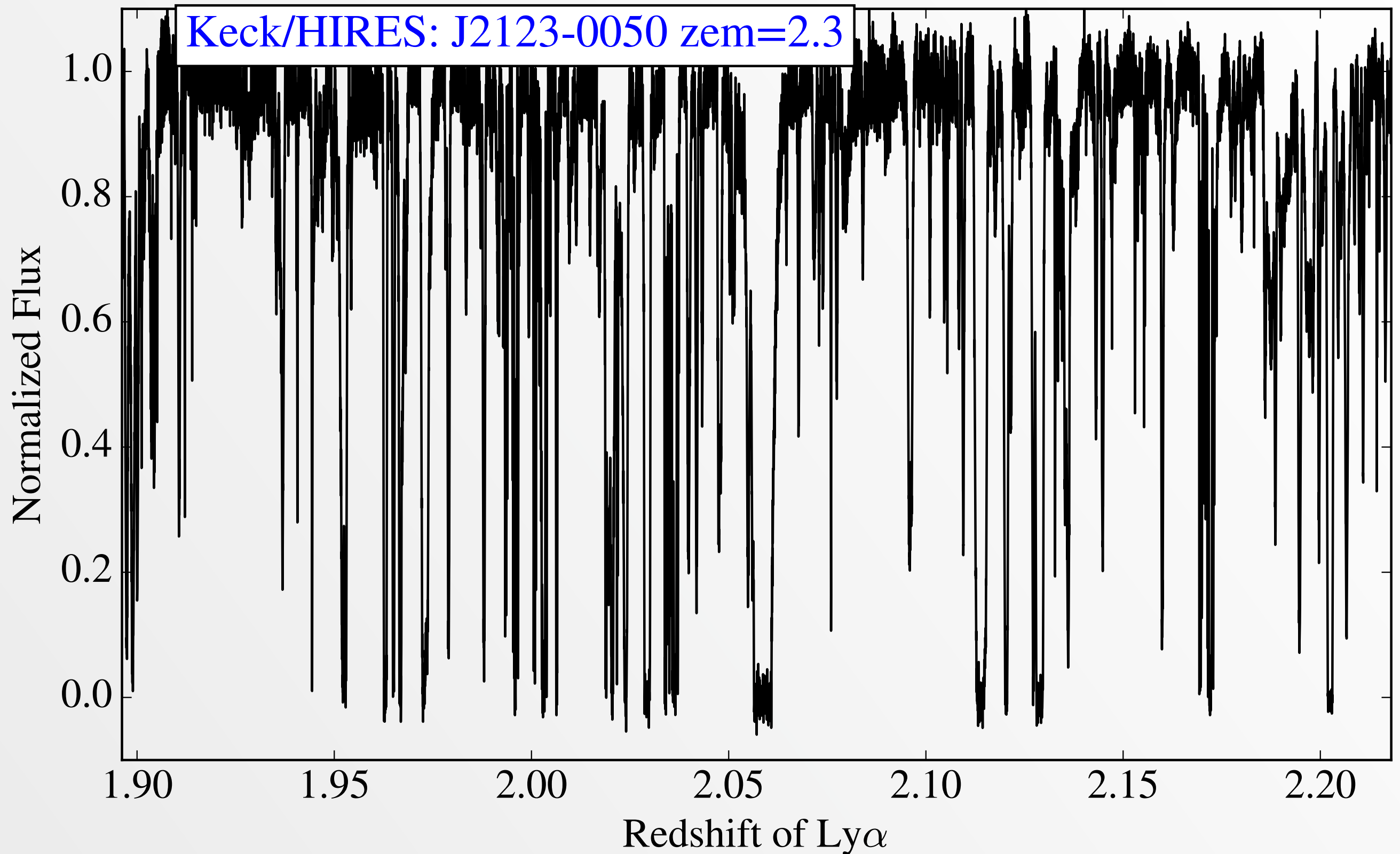
# Characterizing the Ly $\alpha$ Forest



# Absorption Lines



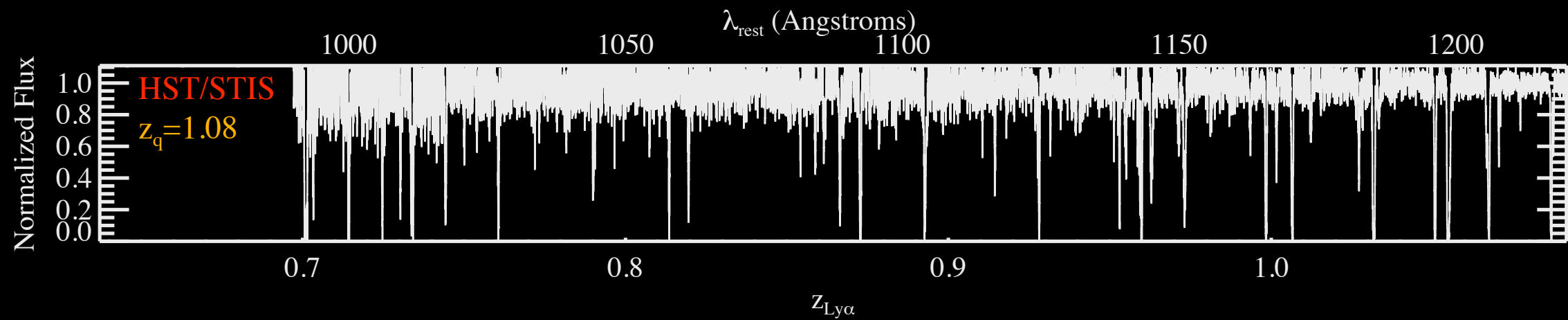
# Evolving Ly $\alpha$ Forest (see PDF in Figures/)



# Evolving Ly $\alpha$ Forest Absorption

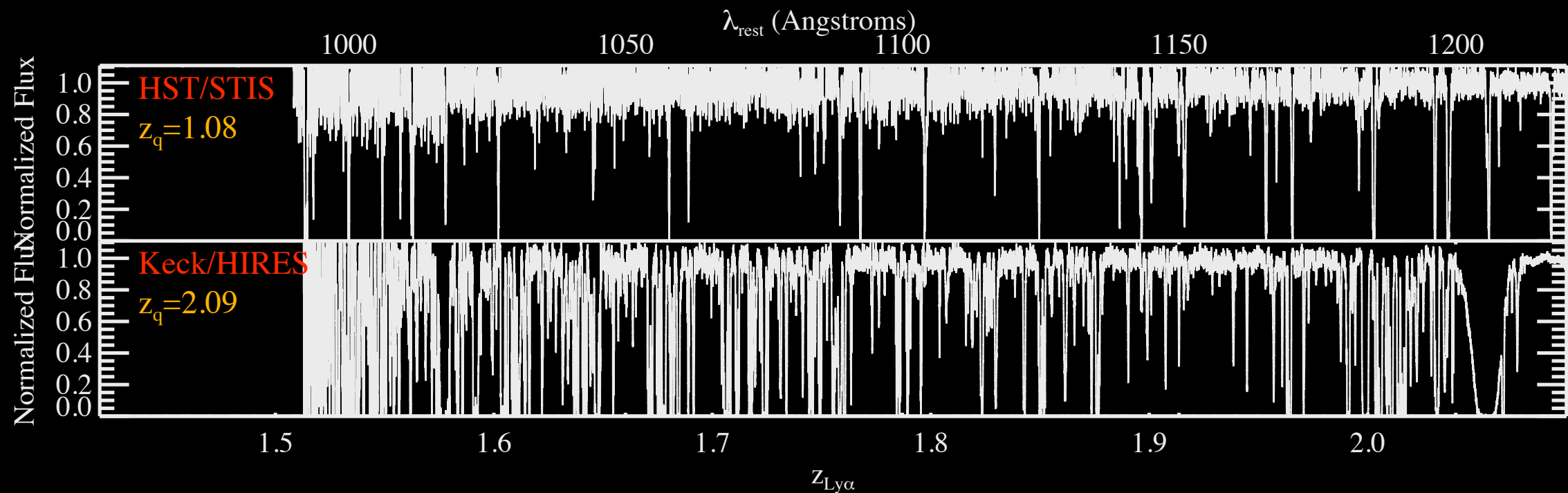
The expanding (contracting) universe  
implies higher Ly $\alpha$  absorption at higher  $z$ .

# Evolving Ly $\alpha$ Forest Absorption



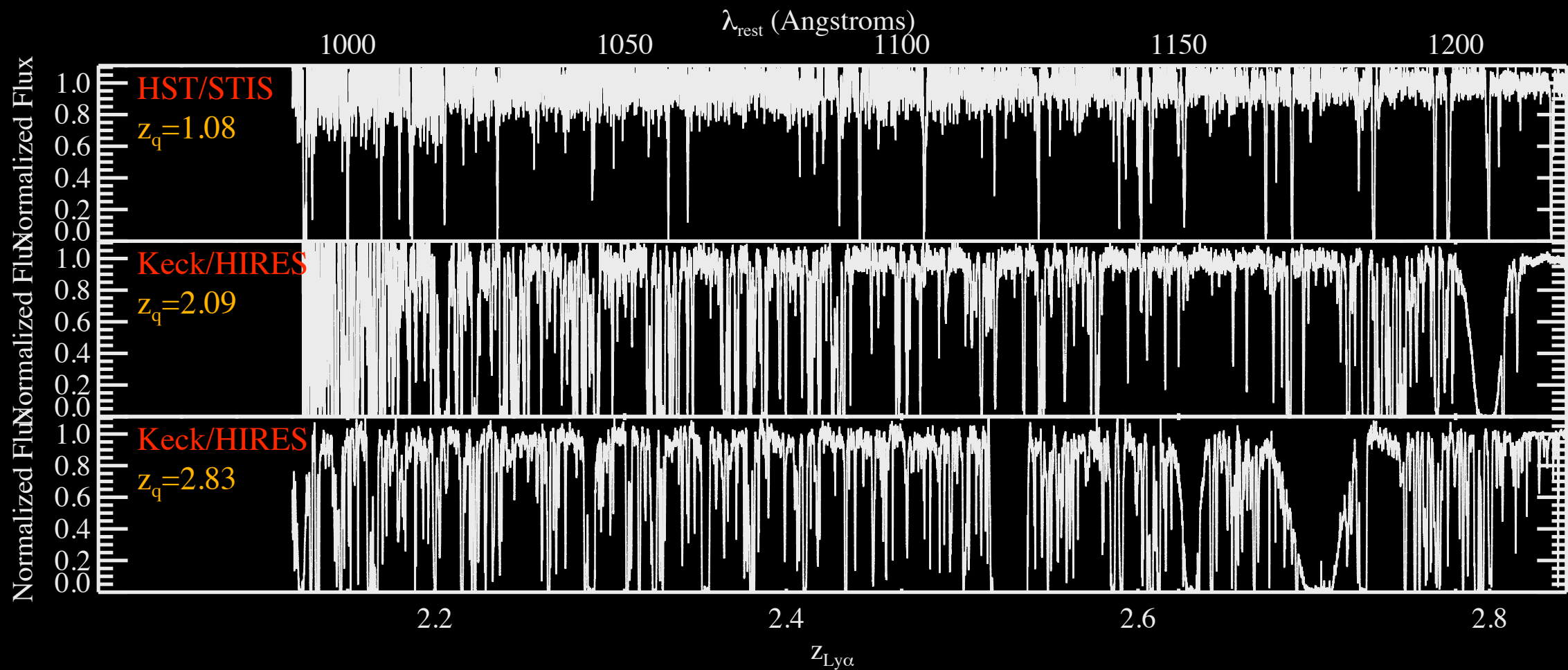
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# Evolving Ly $\alpha$ Forest Absorption



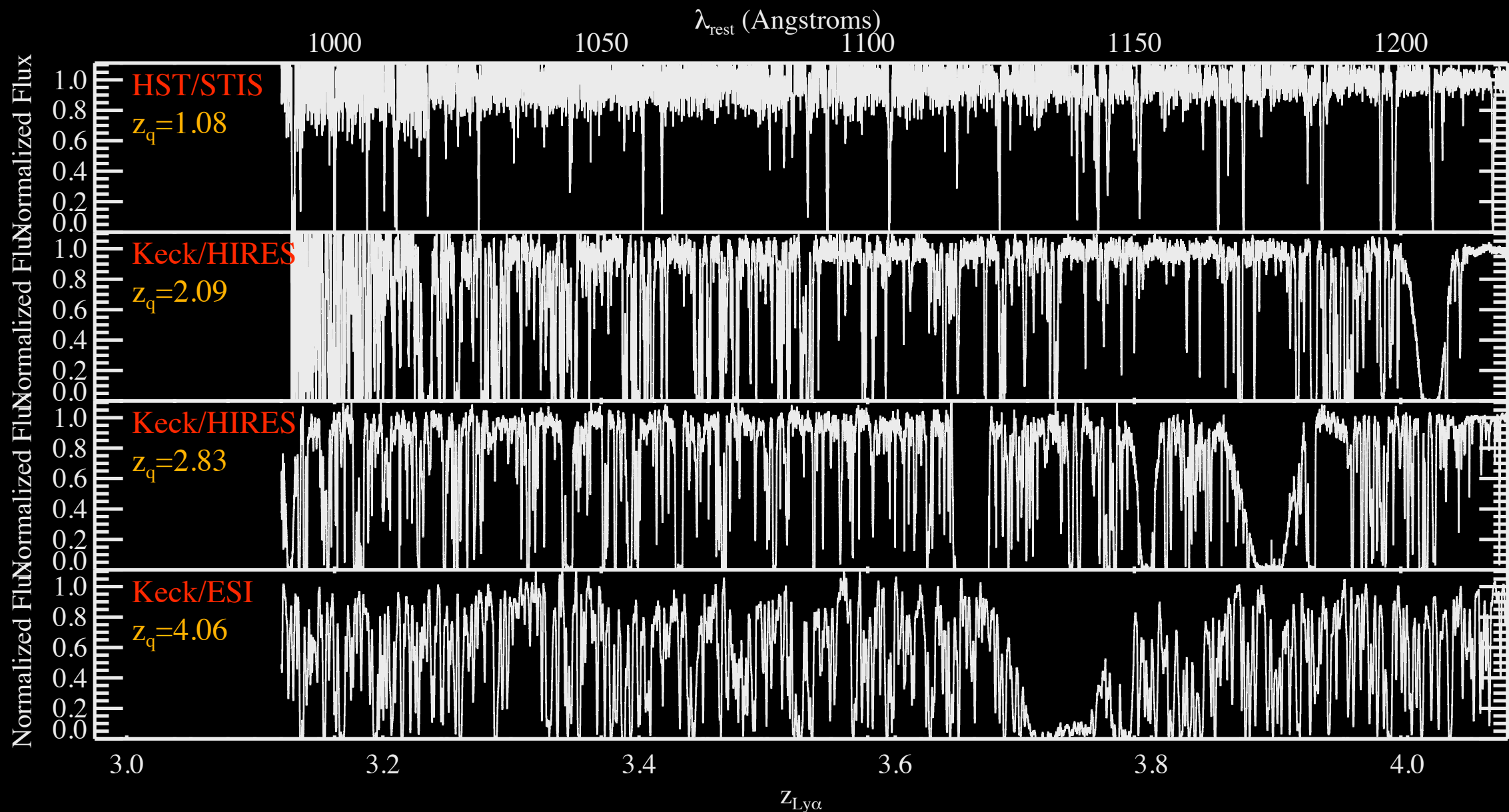
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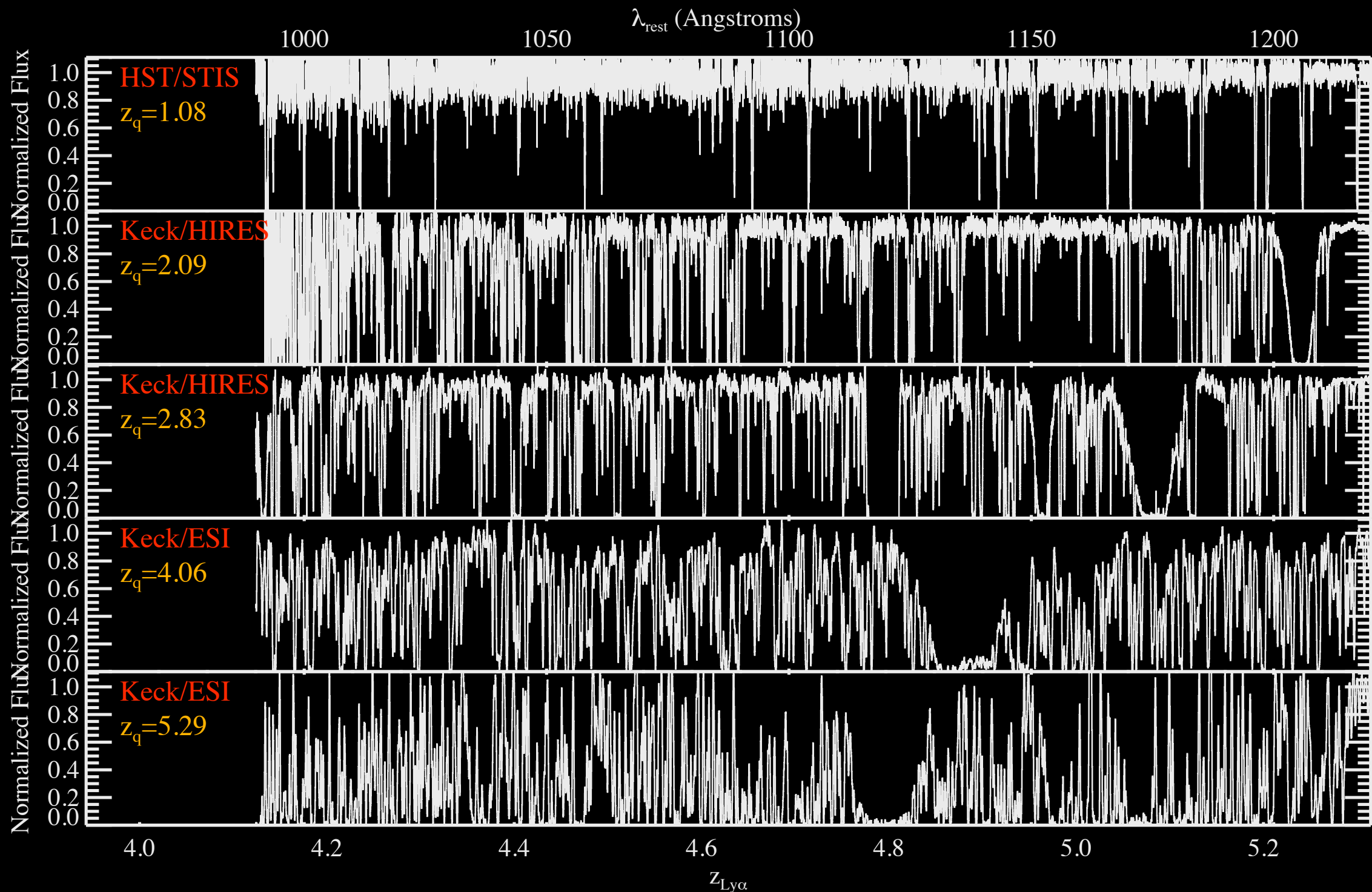
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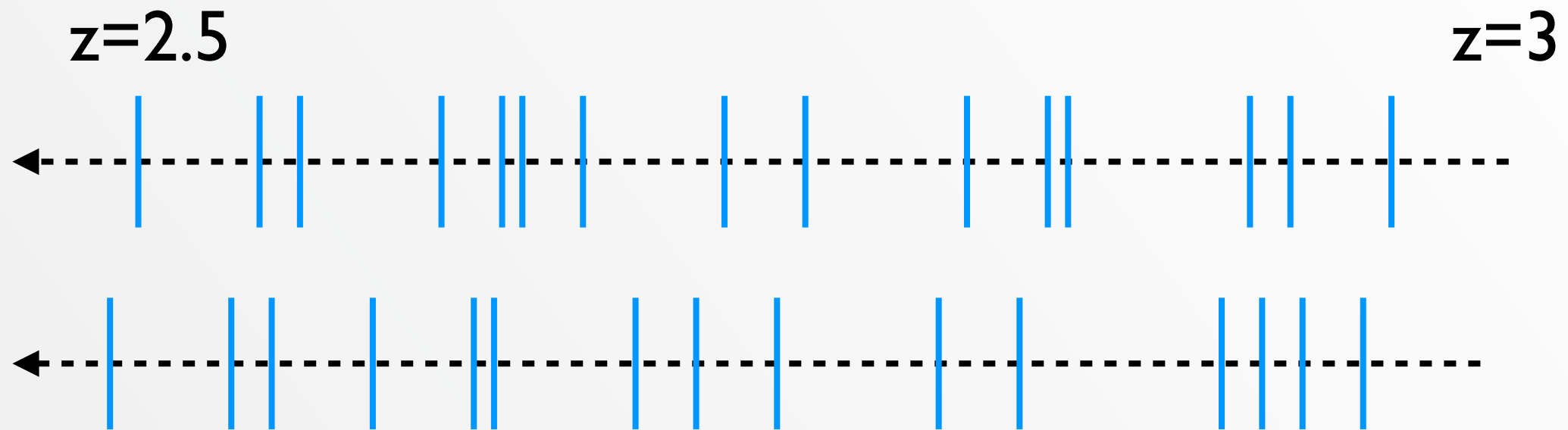
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# Survey Path



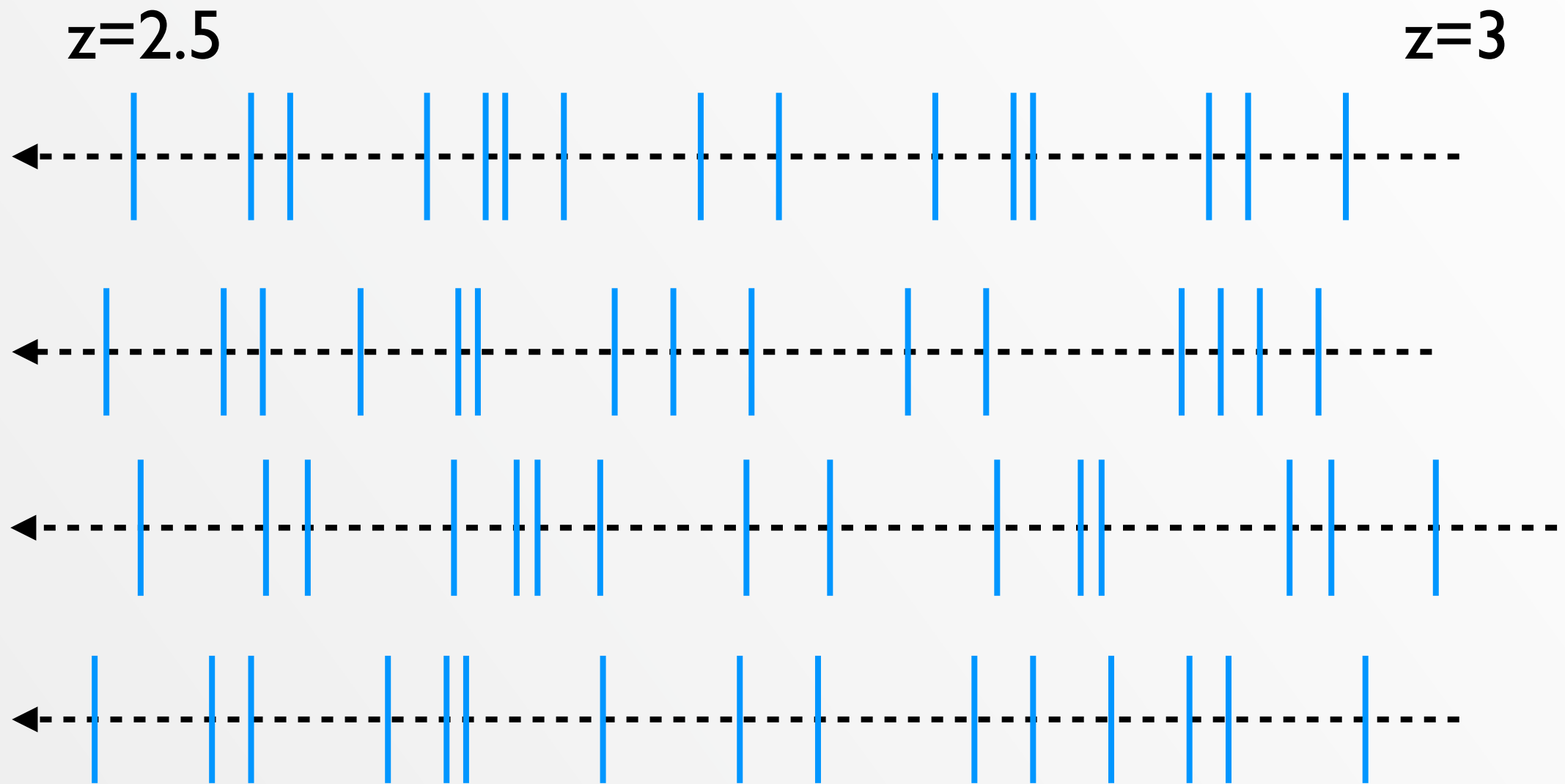
Each quasar contributes  $dz=0.15$  of survey path for a total of  $Dz = 0.6$ .  $f(N_{\text{HI}})$  is derived from the set of lines

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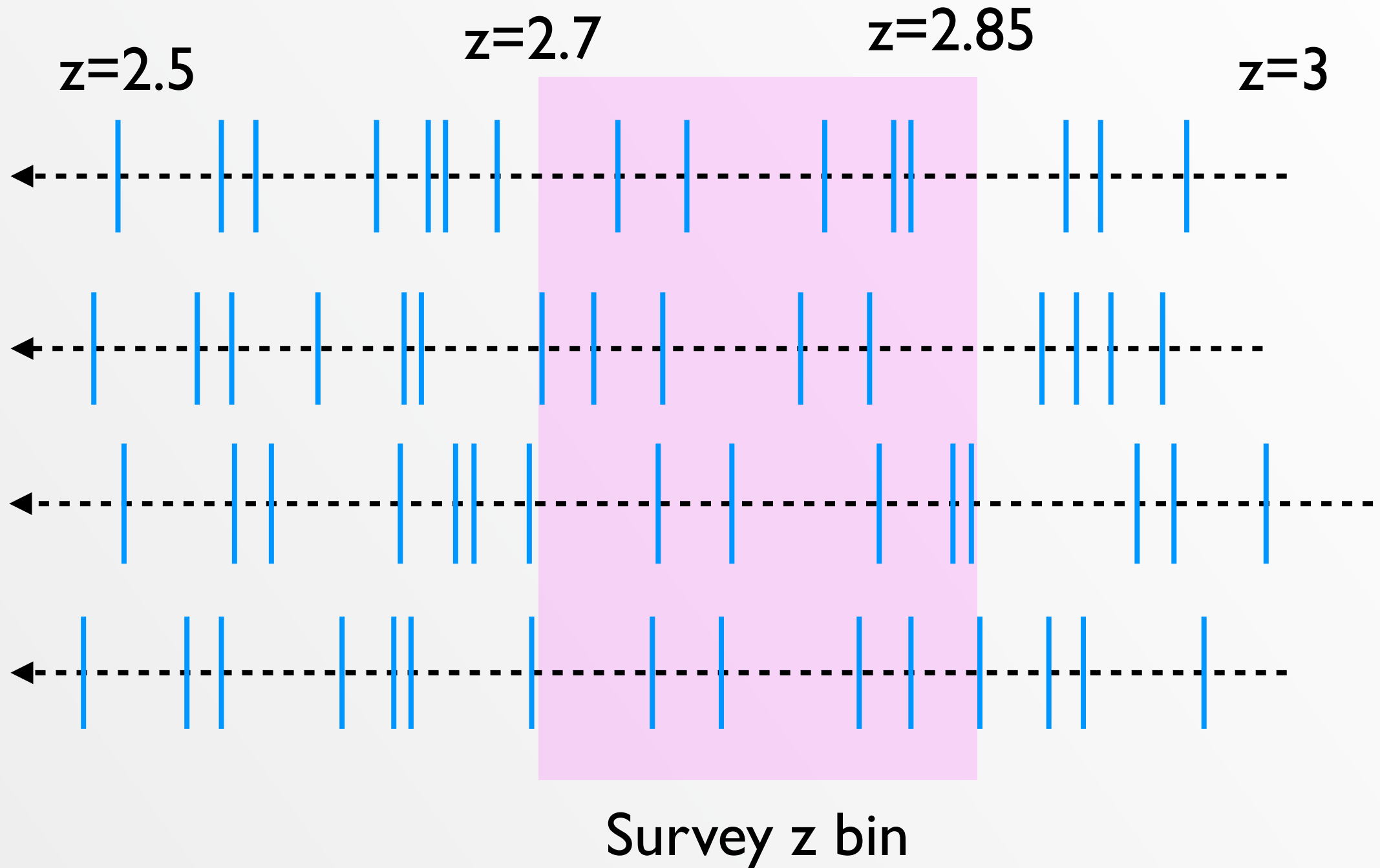
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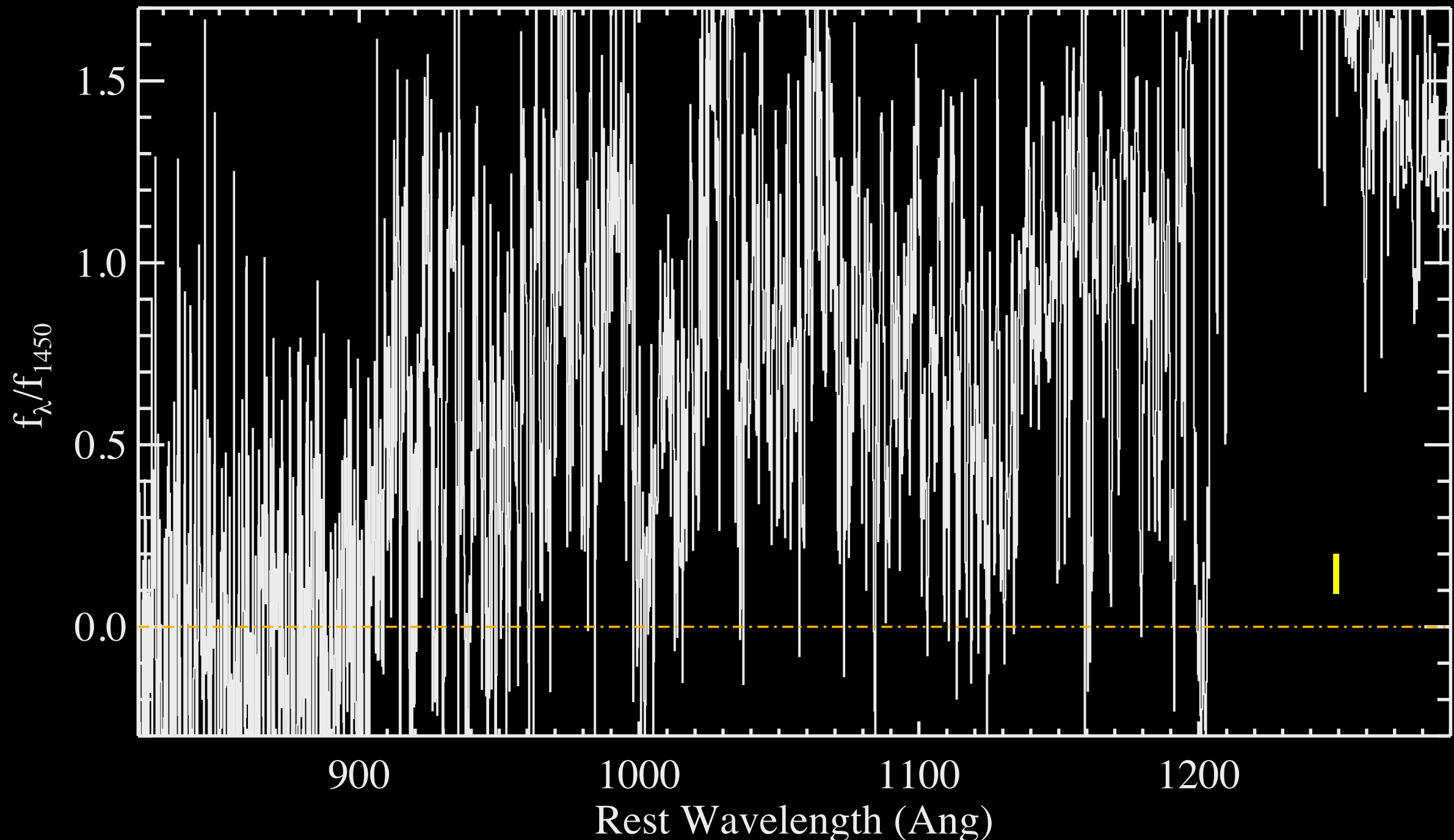
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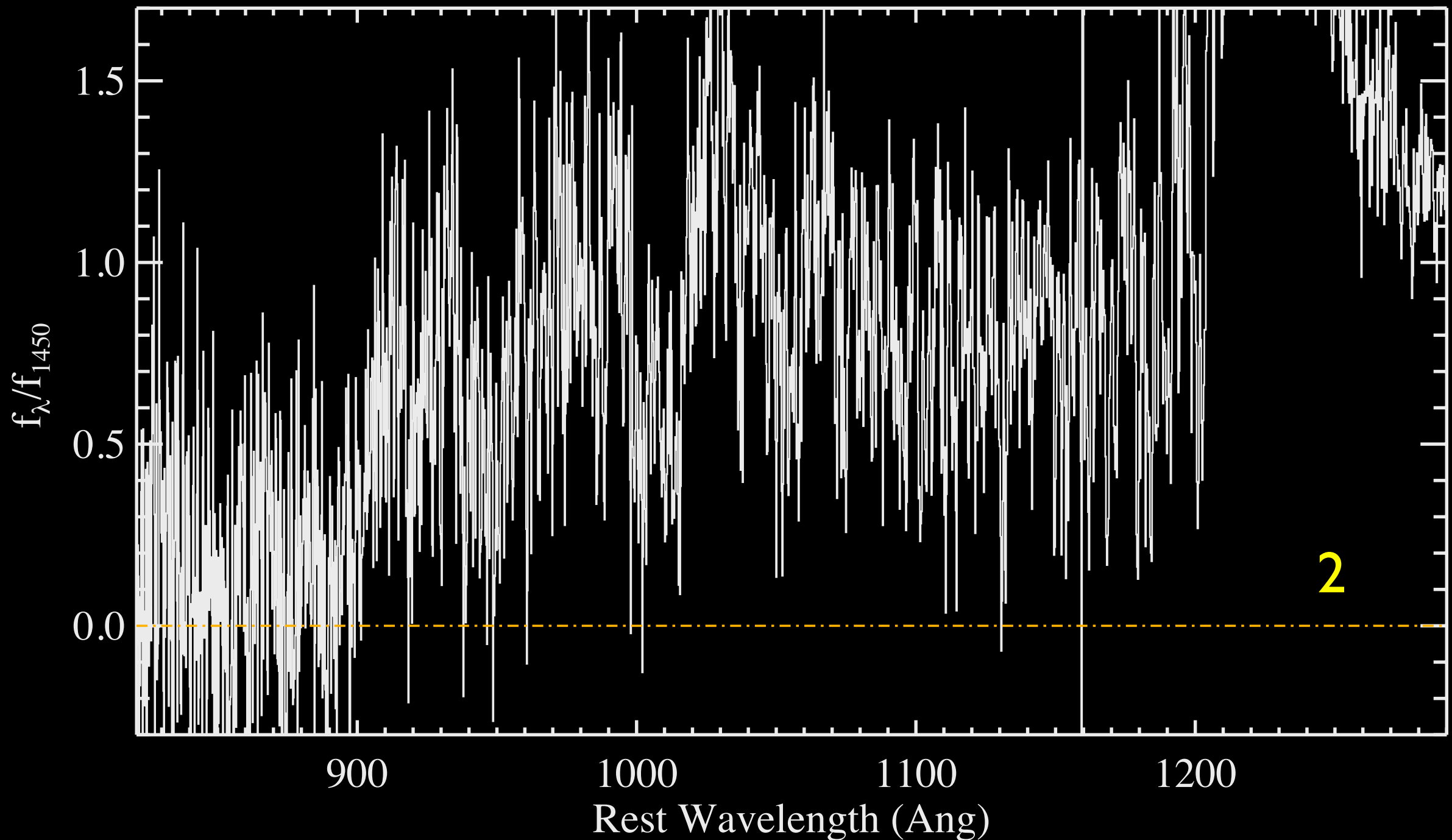
# Stacking Quasar Spectra

- Narrow range of  $z_{\text{qso}}$  per stack
- Straight average (no weighting)
- Normalized at 1450Å (rest)



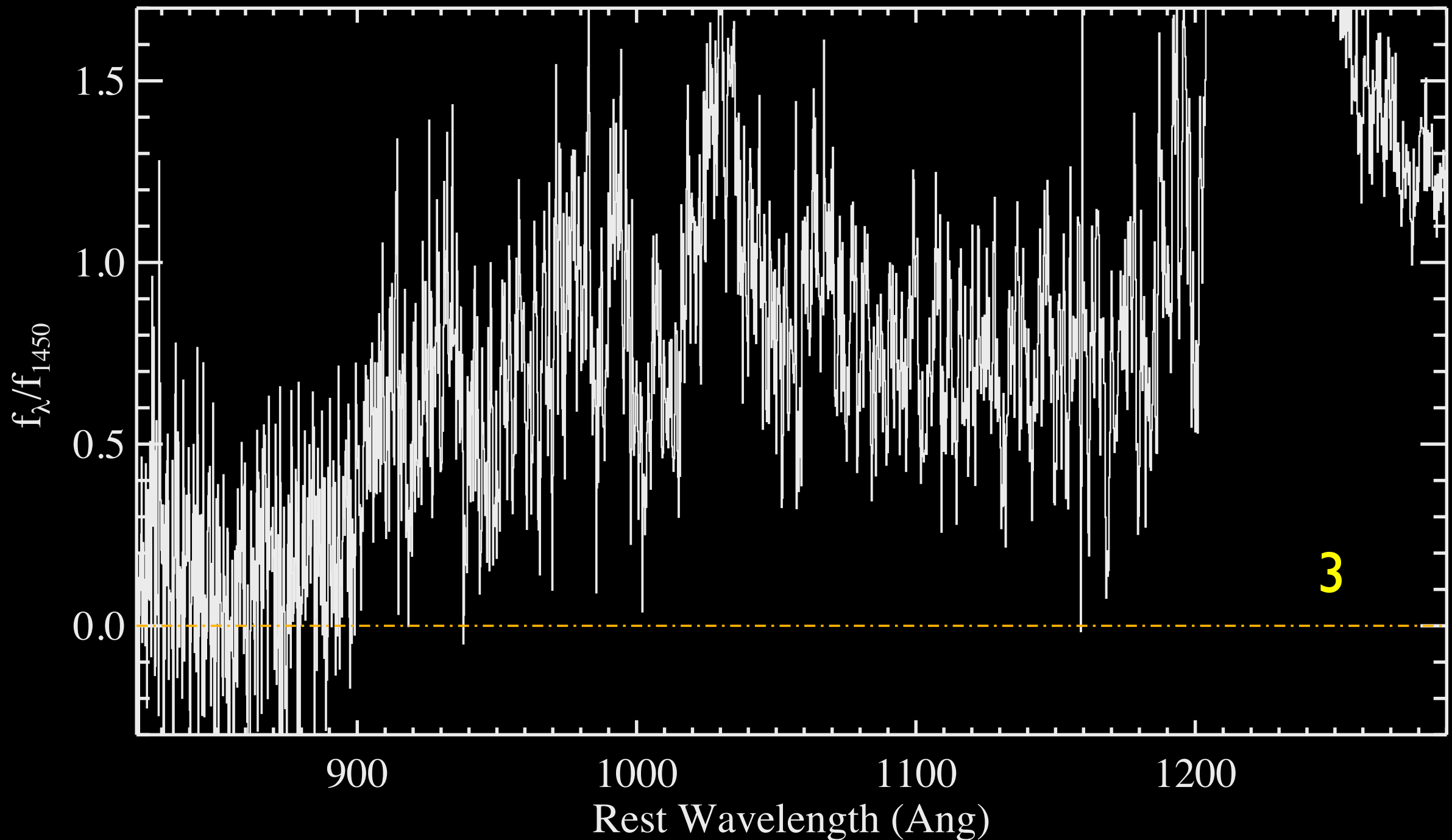
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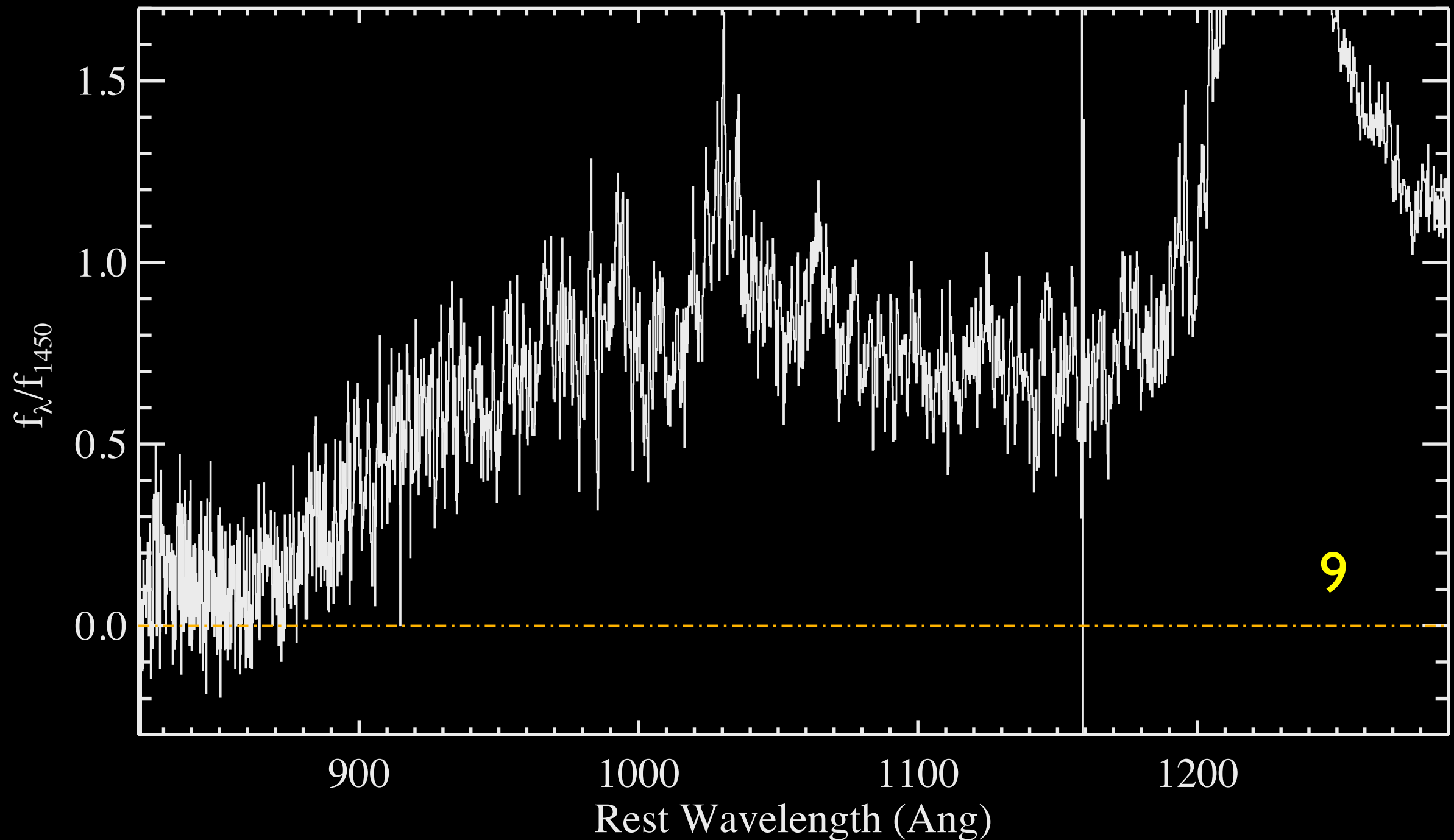
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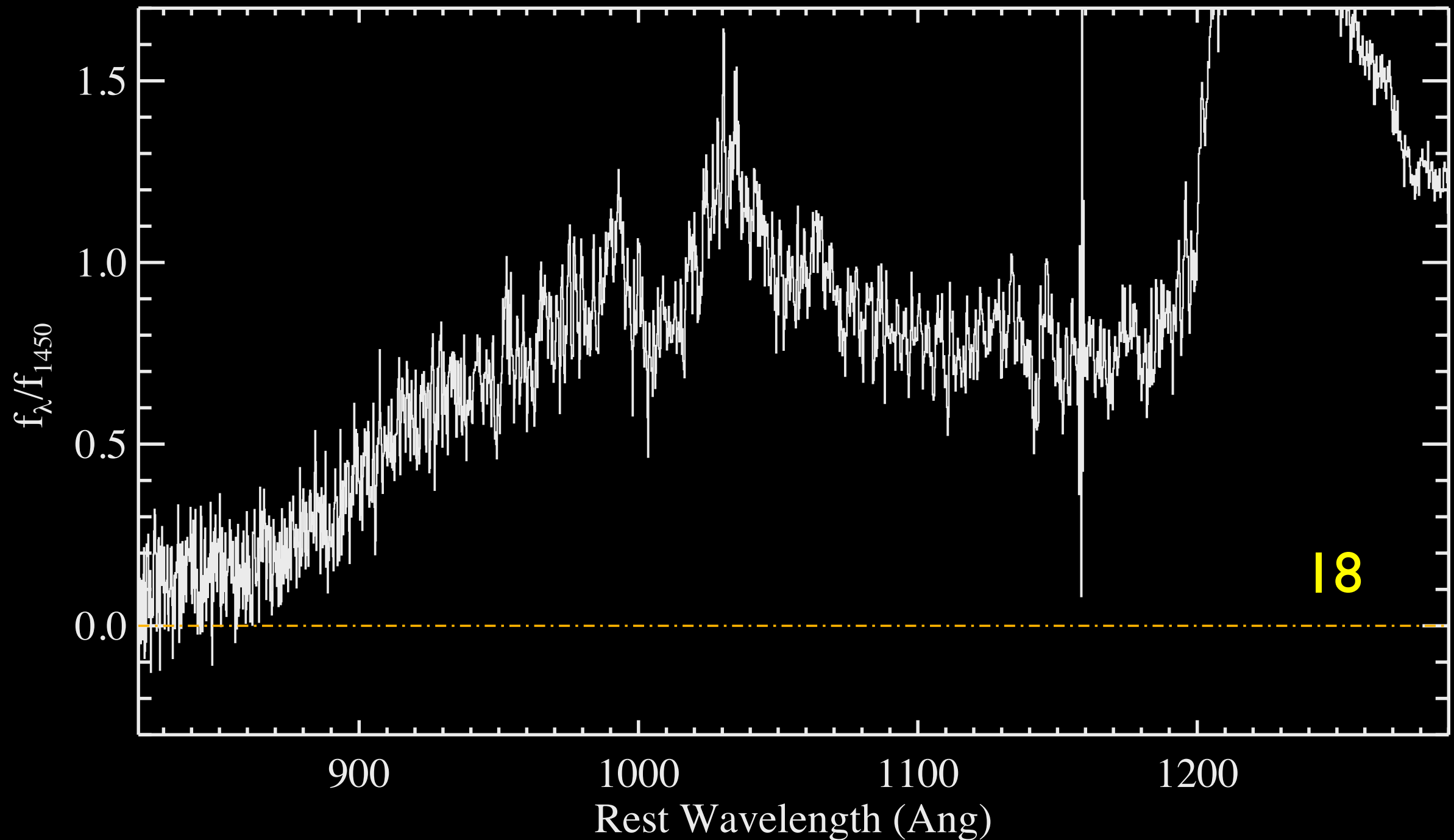
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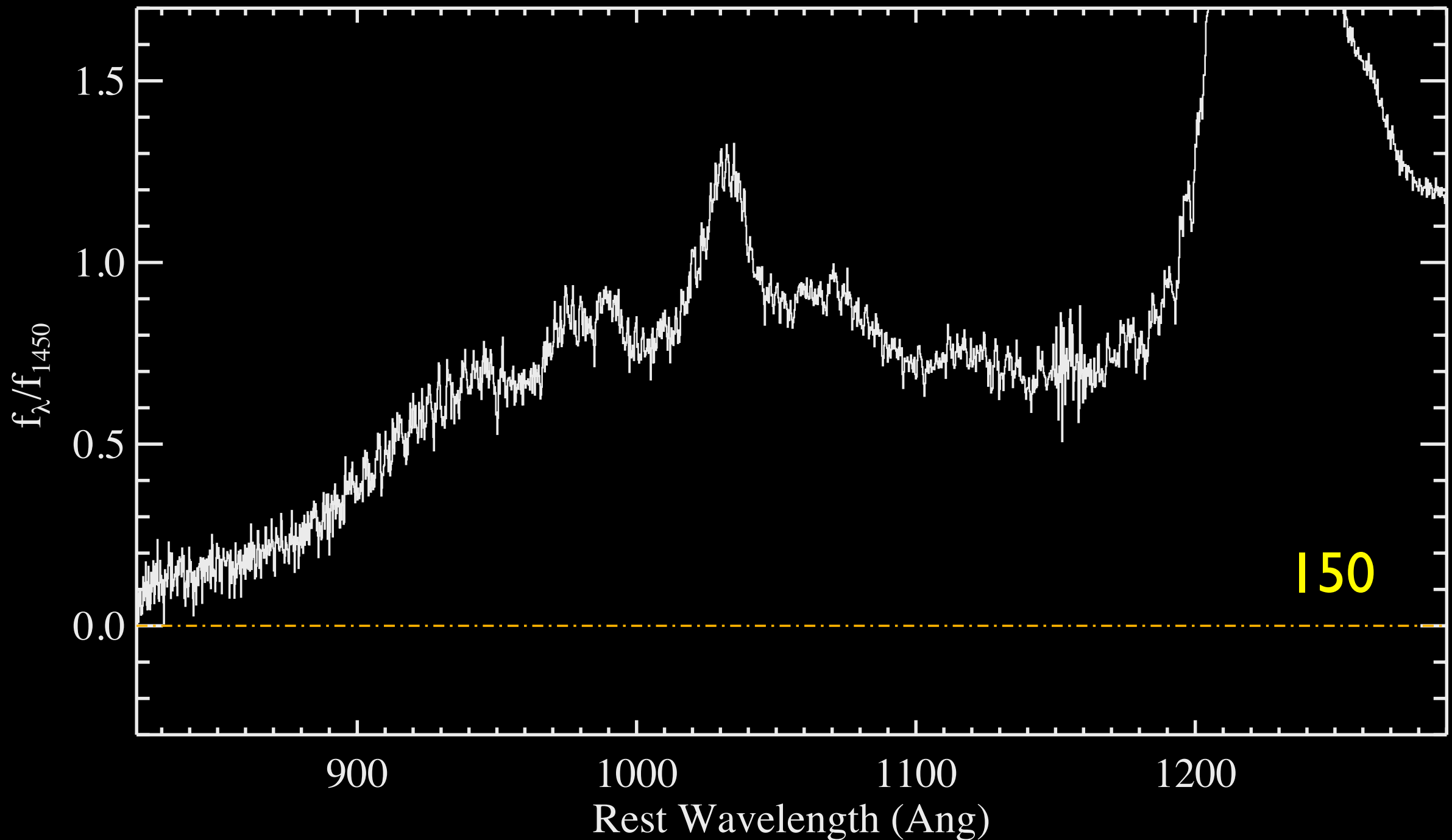
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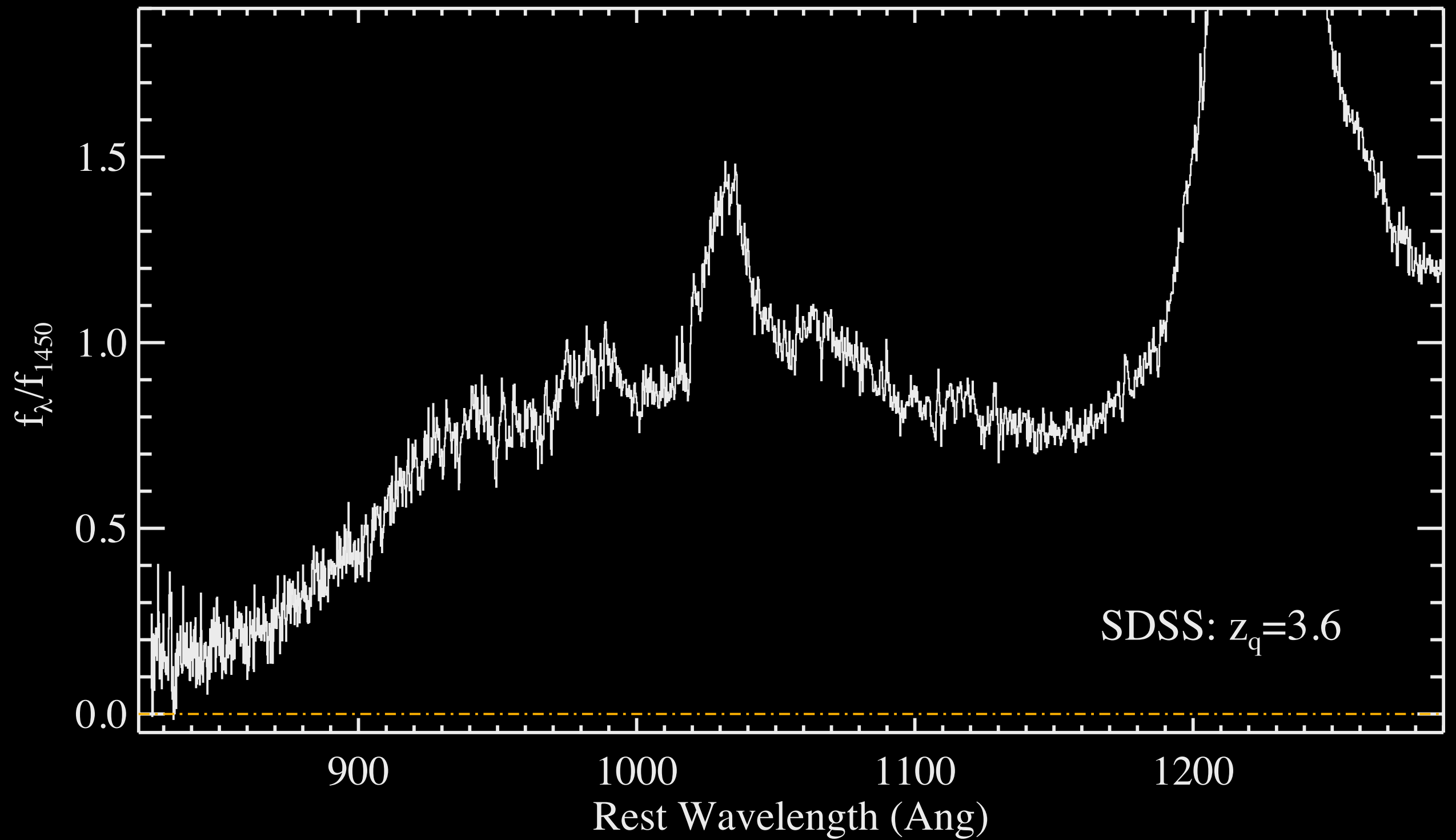
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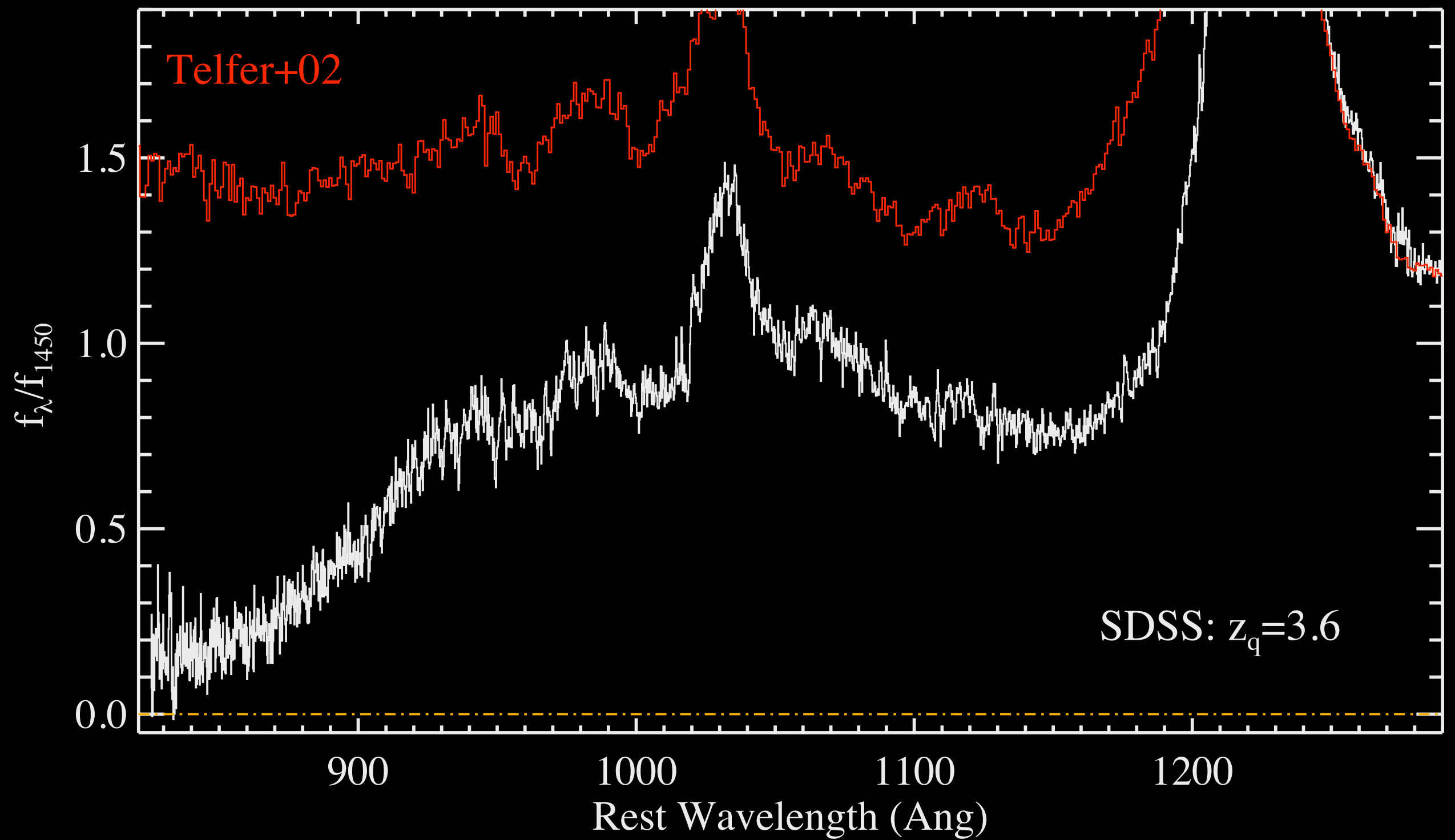


# Effective Ly $\alpha$ Opacity

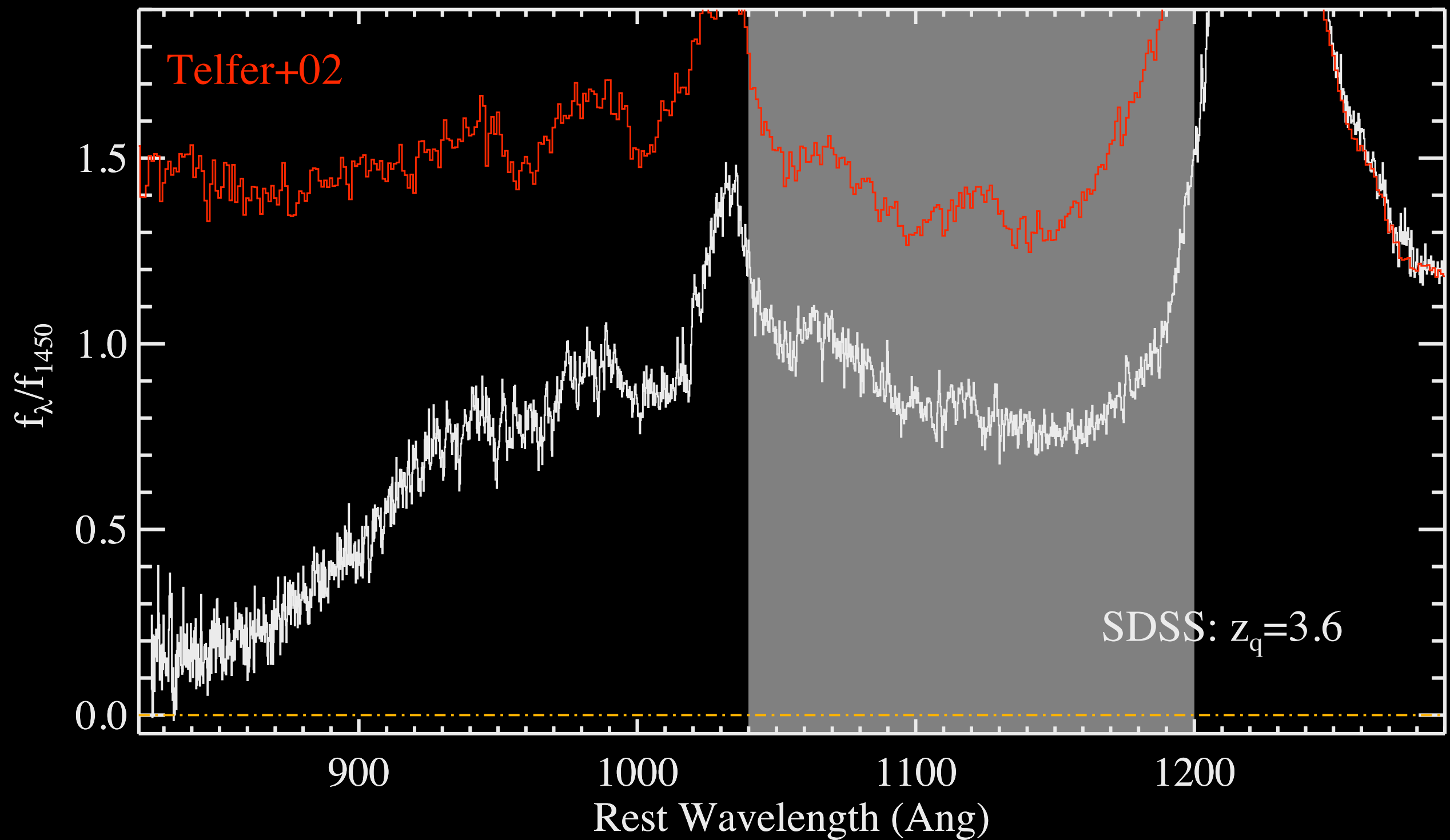
# Effective Ly $\alpha$ Opacity



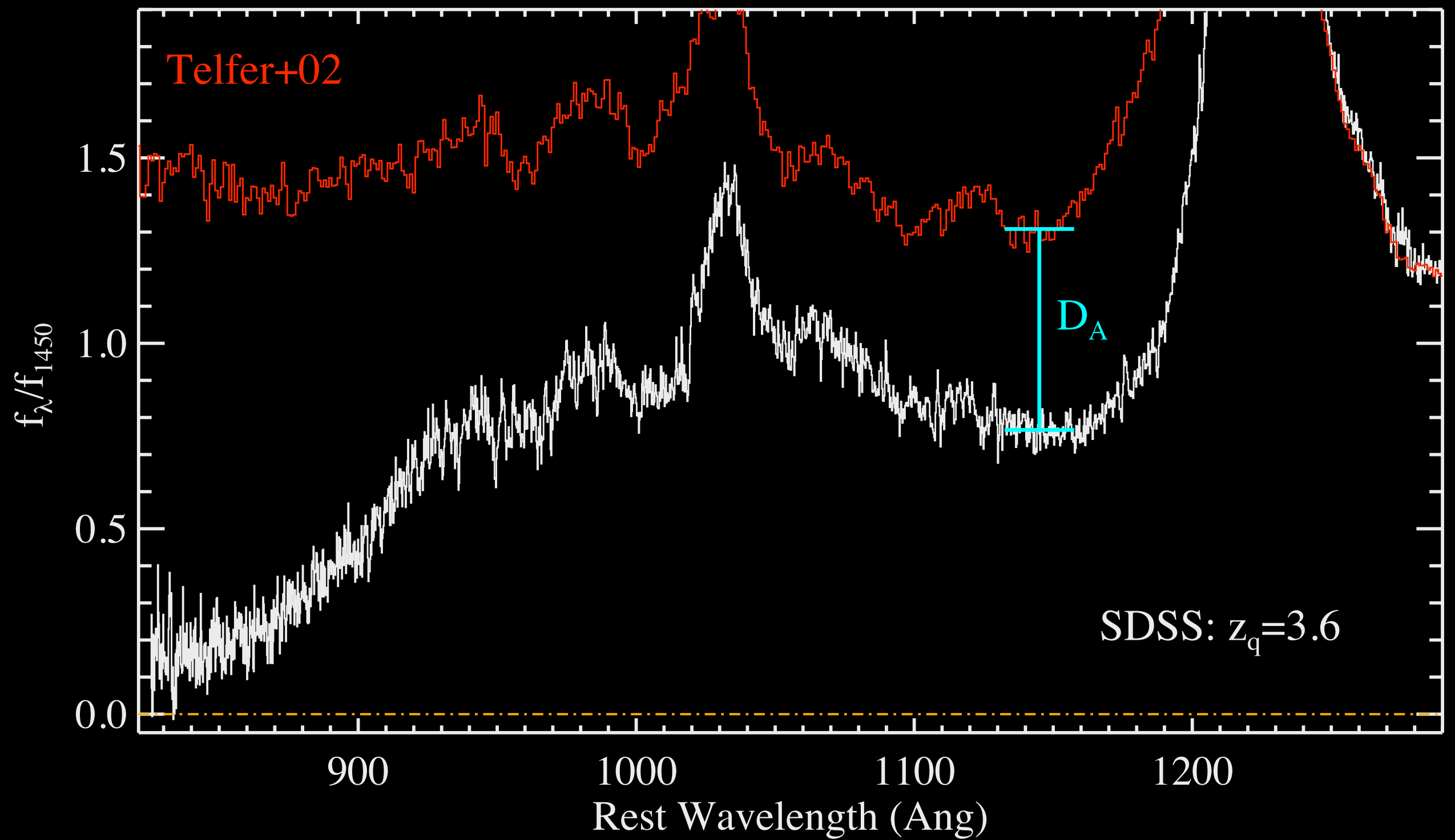
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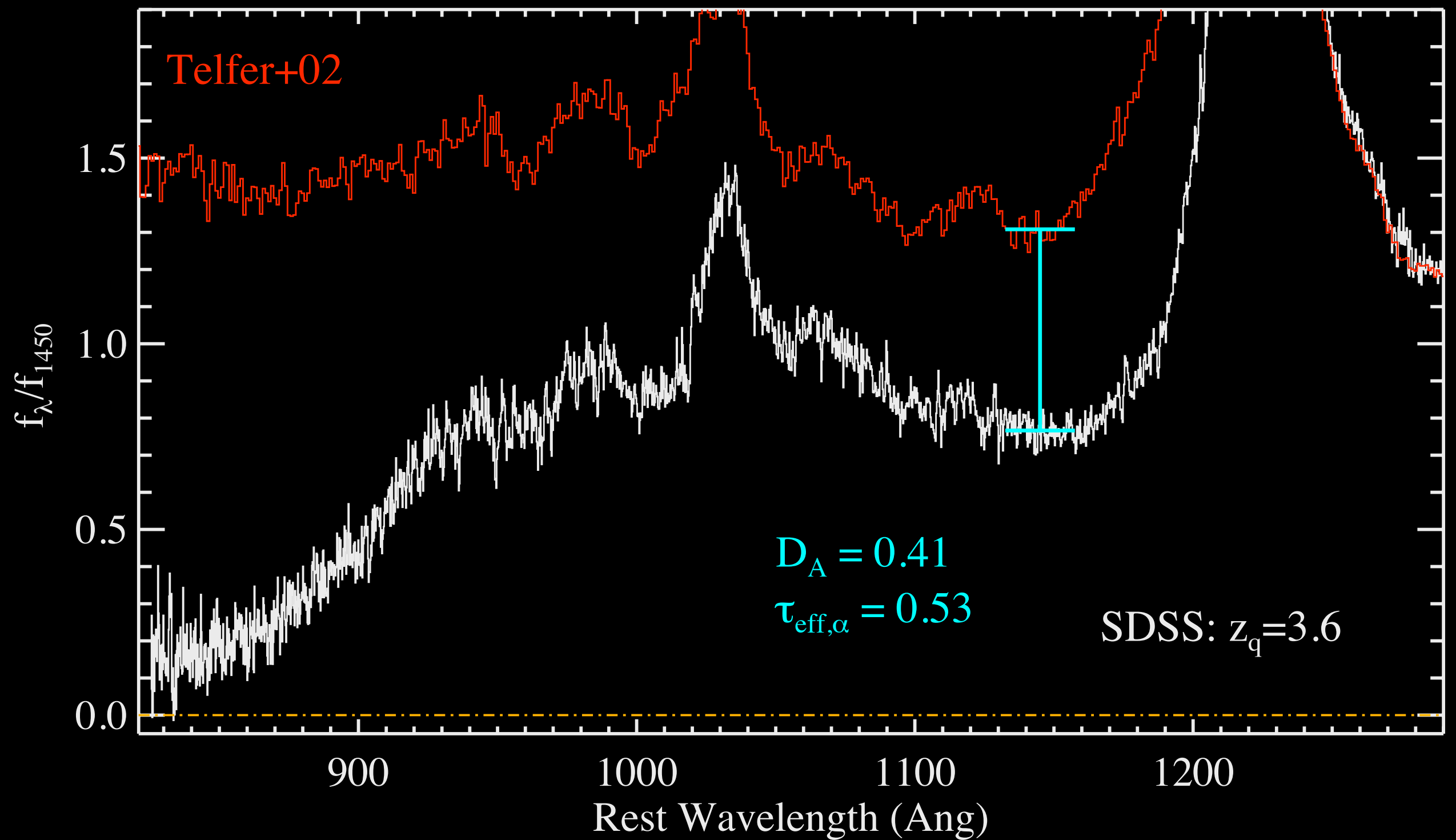


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