



INSTITUTO DE ASTROFISICA
PONTIFICIA UNIVERSIDAD CATÓLICA DE CHILE



Probing AGN dynamics through a natural language processor lens

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Supervisor : Franz Bauer (Pontificia Universidad Católica de Chile)

Co-supervisor : Guillermo Cabrera (Universidad De Concepcion)

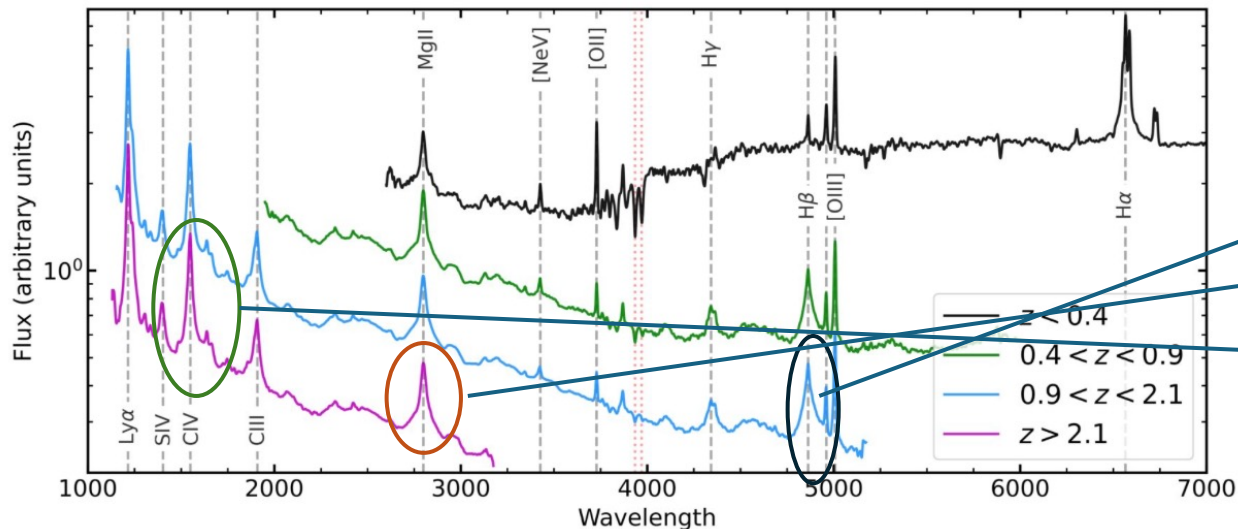
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**MACHINE LEARNING
FOR ASTROPHYSICS**
2ND EDITION CATANIA, 8-12 JULY, 2024



CENTRO DE ASTROFÍSICA Y TECNOLOGÍAS AFINES



Victoria Fawcett, www.desi.lbl.gov

$$\log \left(\frac{M_{SE, H\beta}}{M_{\odot}} \right) = \log \left[\left(\frac{L_{5100, AGN}}{10^{44} \text{ erg s}^{-1}} \right)^{0.5} \left(\frac{FWHM}{\text{km s}^{-1}} \right)^2 \right] + 0.85 \quad (3)$$

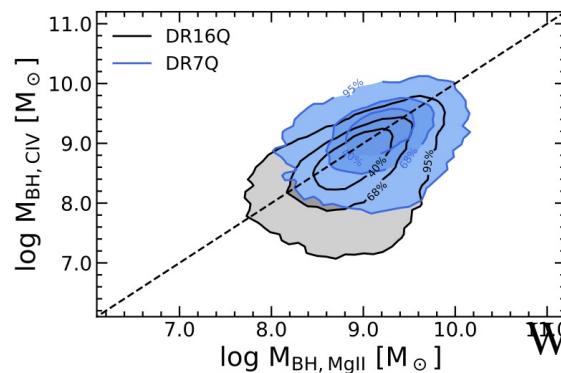
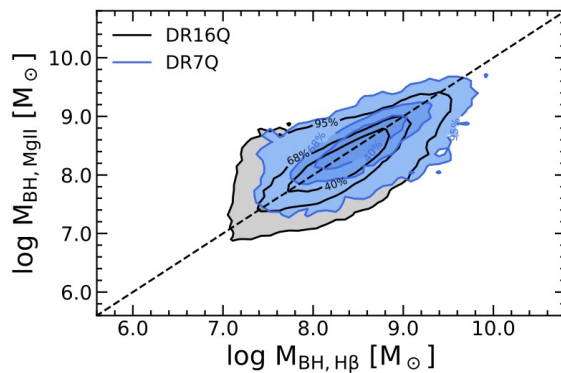
$$\log \left(\frac{M_{SE, MgII}}{M_{\odot}} \right) = \log \left[\left(\frac{L_{3000}}{10^{45} \text{ erg s}^{-1}} \right)^{0.6} \left(\frac{FWHM}{\text{km s}^{-1}} \right)^3 \right] - 2.05 \quad (4)$$

$$\log \left(\frac{M_{SE, CIV}}{M_{\odot}} \right) = \log \left[\left(\frac{L_{1350}}{10^{45} \text{ erg s}^{-1}} \right)^{0.5} \left(\frac{FWHM}{\text{km s}^{-1}} \right)^2 \right] + 1.40 \quad (5)$$

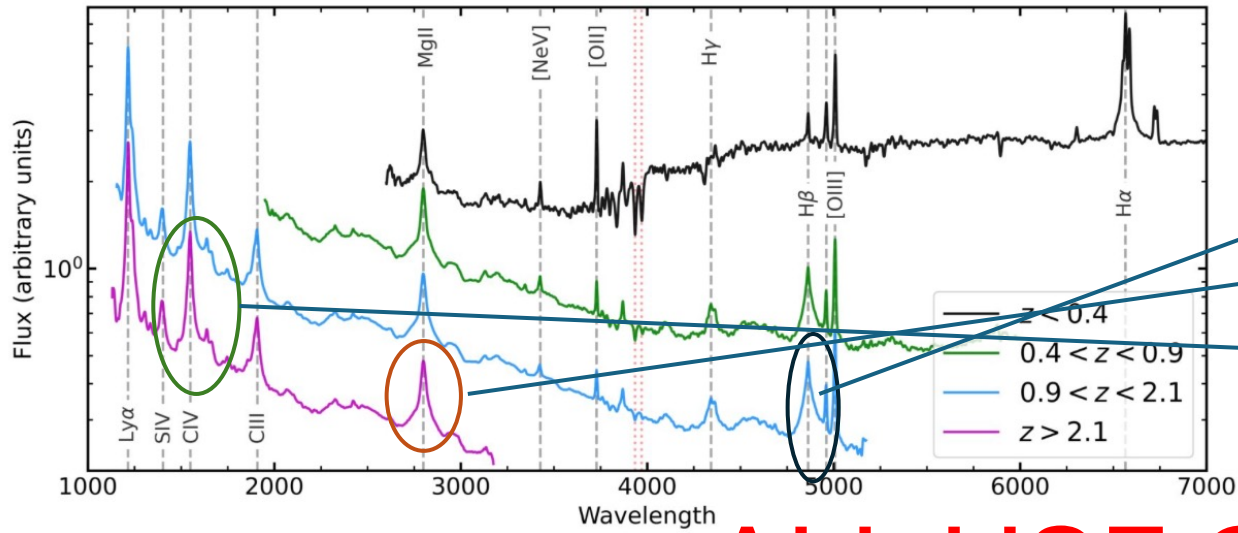
$$R_{BLR} \approx c\Delta\tau,$$

$$R_{BLR} \sim L_{line}^{1/2},$$

Shen et al. (2024)



Wu & Shen (2022)



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**ALL USE ONE
BROAD LINE**

$$\log \left(\frac{M_{SE, H\beta}}{M_{\odot}} \right) = \log \left[\left(\frac{L_{5100, AGN}}{10^{44} \text{ erg s}^{-1}} \right)^{0.5} \left(\frac{FWHM}{\text{km s}^{-1}} \right)^2 \right] + 0.85 \quad (3)$$

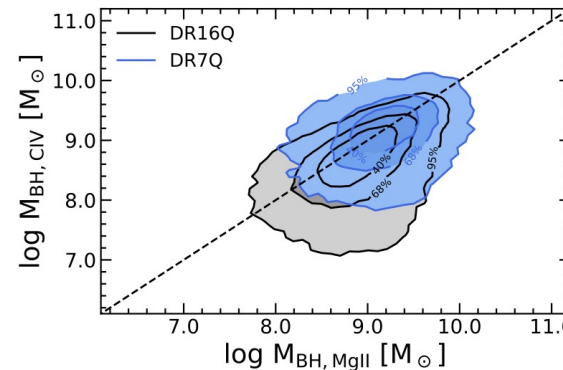
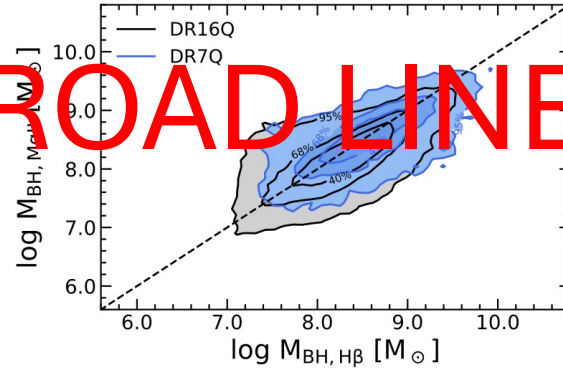
$$\log \left(\frac{M_{SE, MgII}}{M_{\odot}} \right) = \log \left[\left(\frac{L_{3000}}{10^{45} \text{ erg s}^{-1}} \right)^{0.6} \left(\frac{FWHM}{\text{km s}^{-1}} \right)^3 \right] - 2.05 \quad (4)$$

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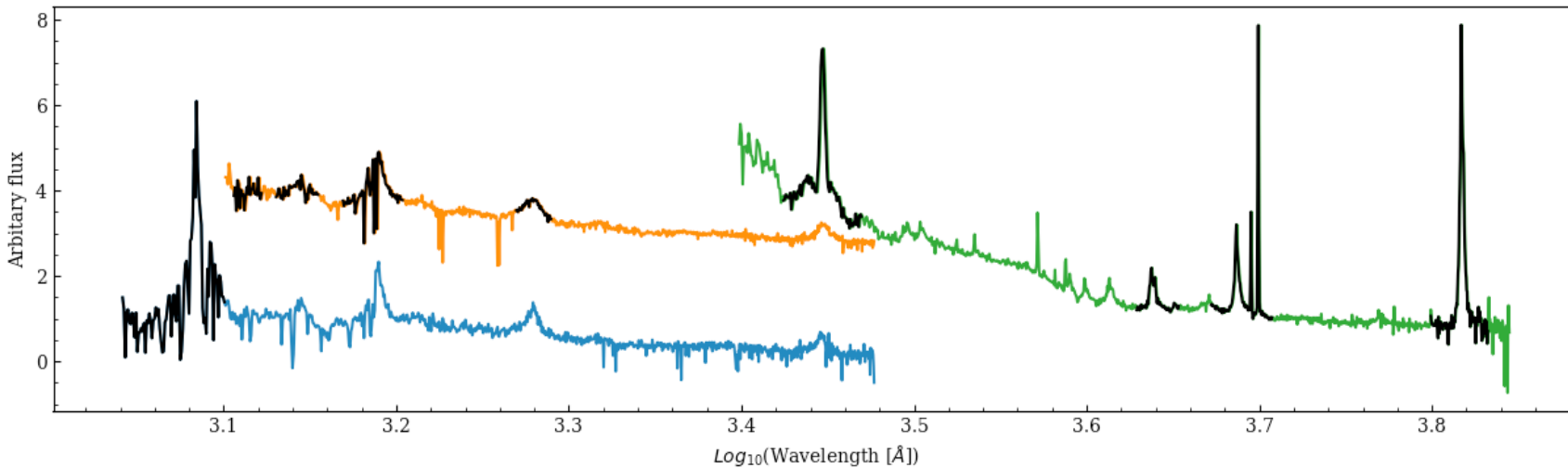
$$R_{BLR} \approx c\Delta\tau,$$

$$R_{BLR} \sim L_{line}^{1/2}$$

Shen et al. (2024)



Wu & Shen (2022)

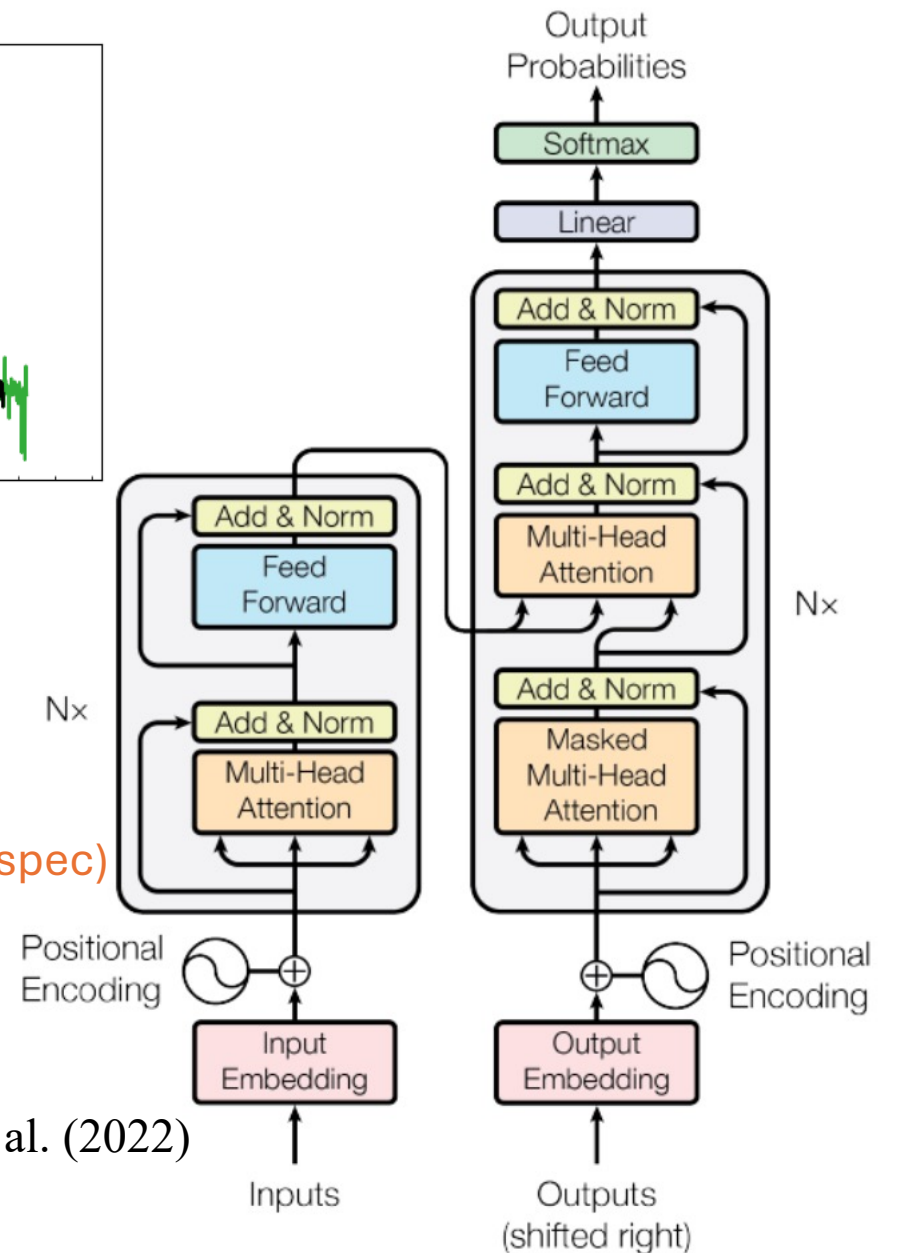


N = 1125

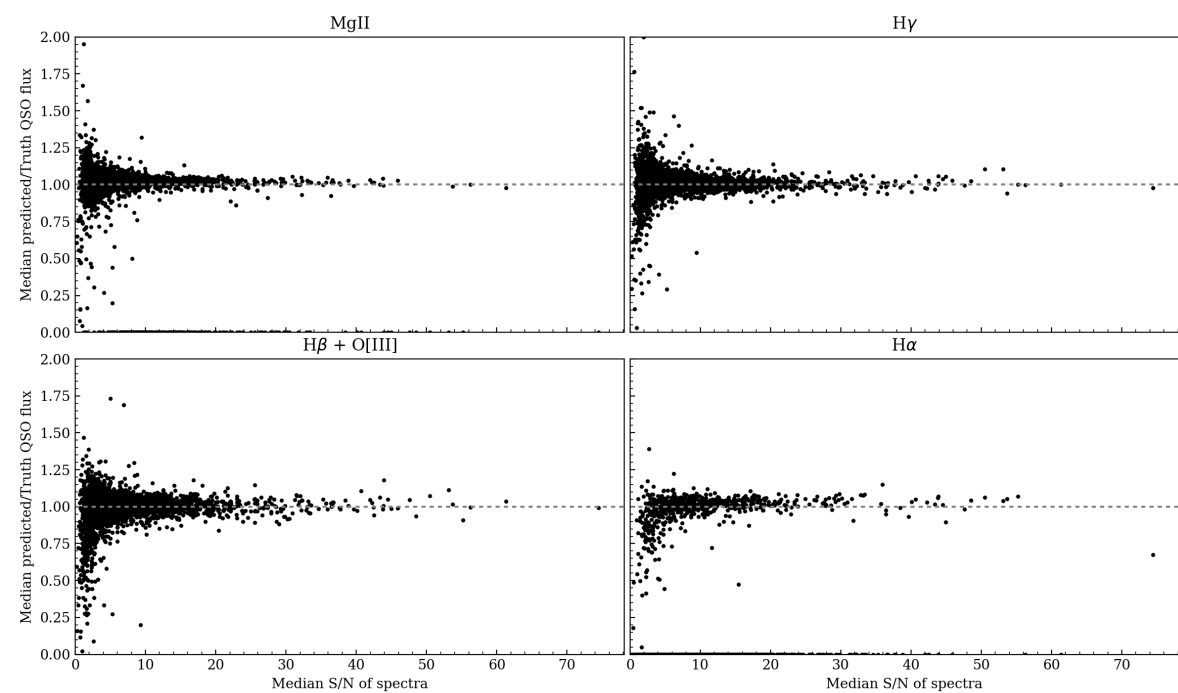
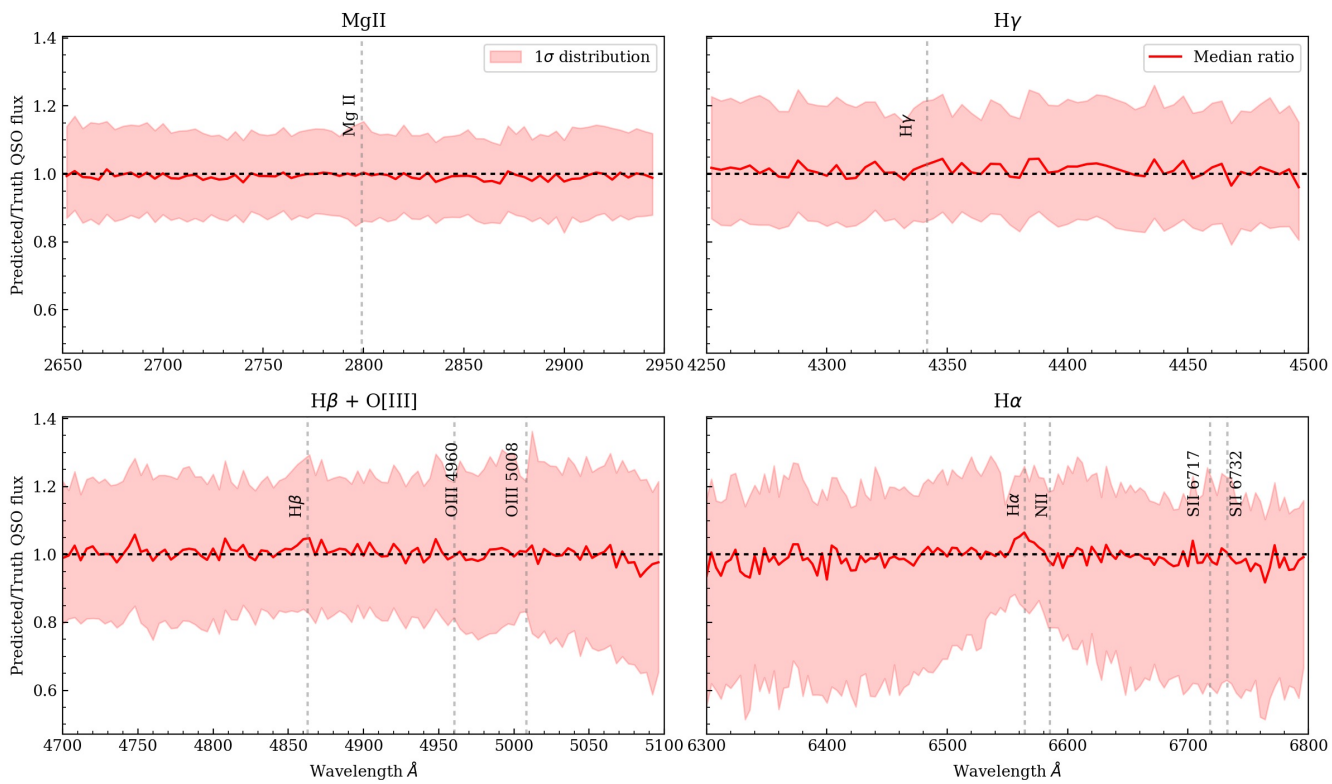
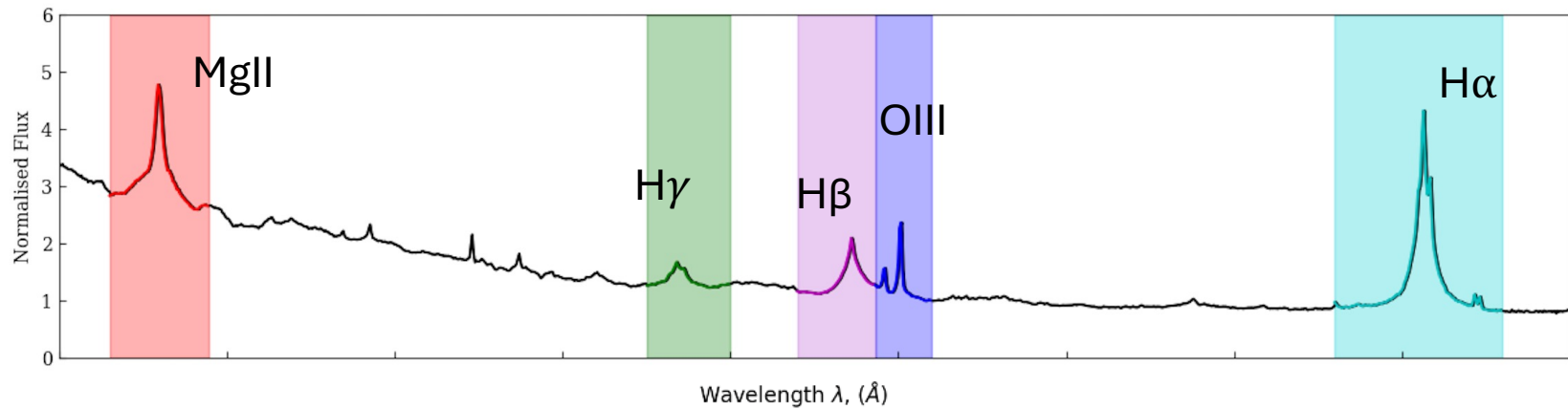
Input AGN SDSS spec, to predict:

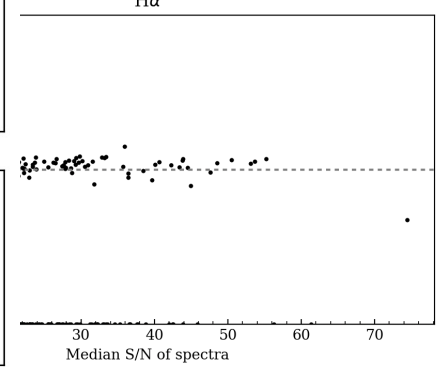
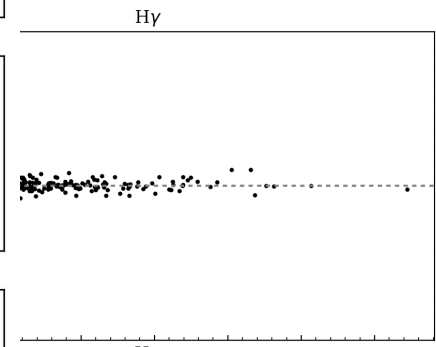
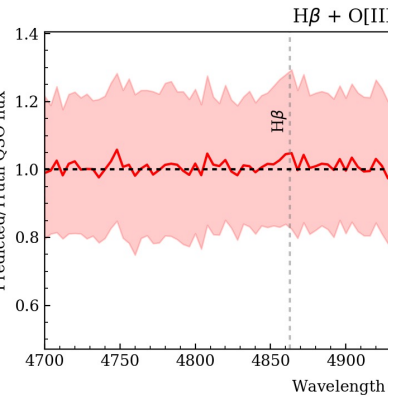
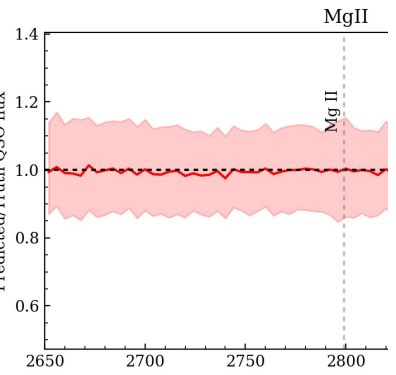
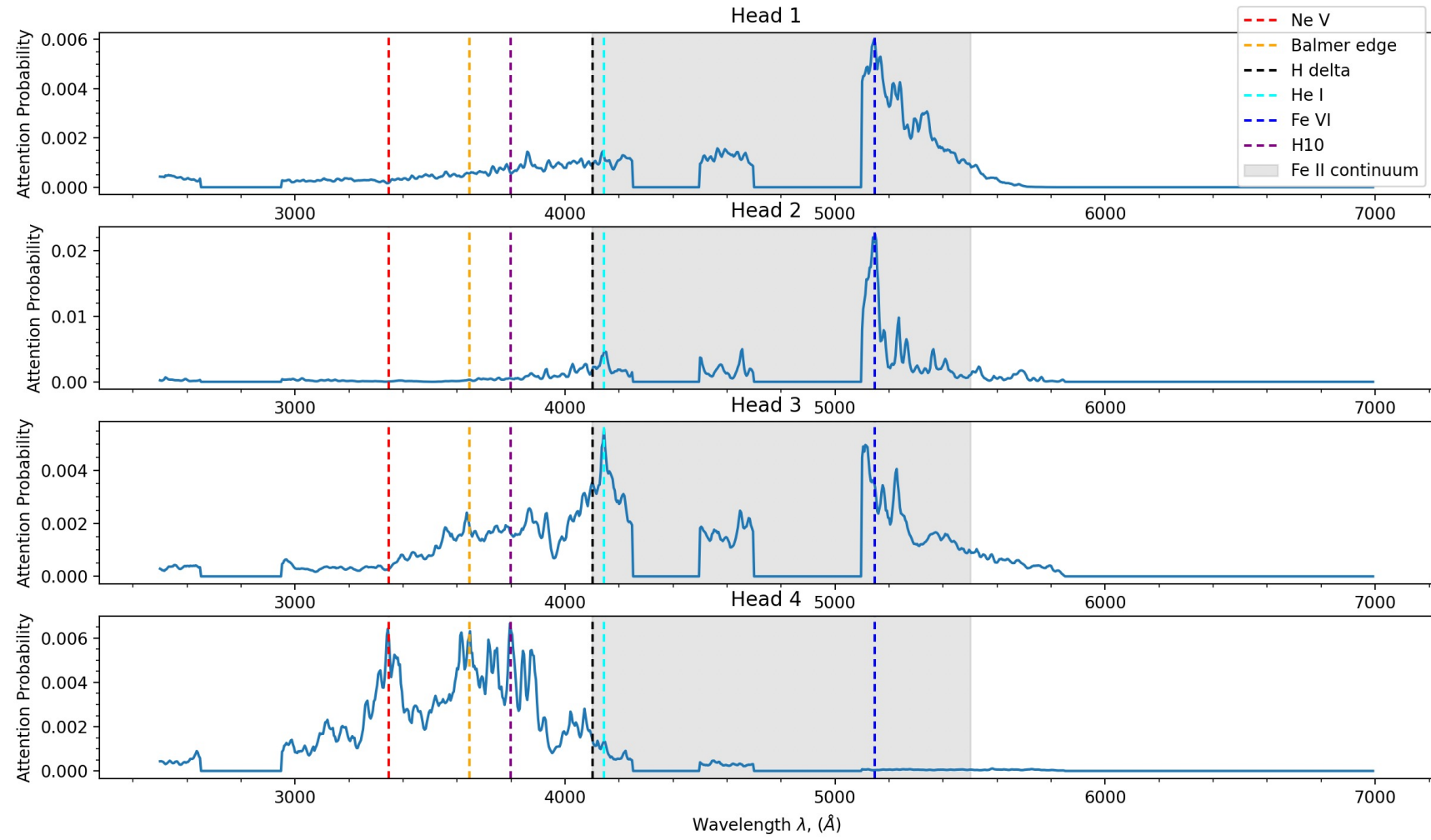
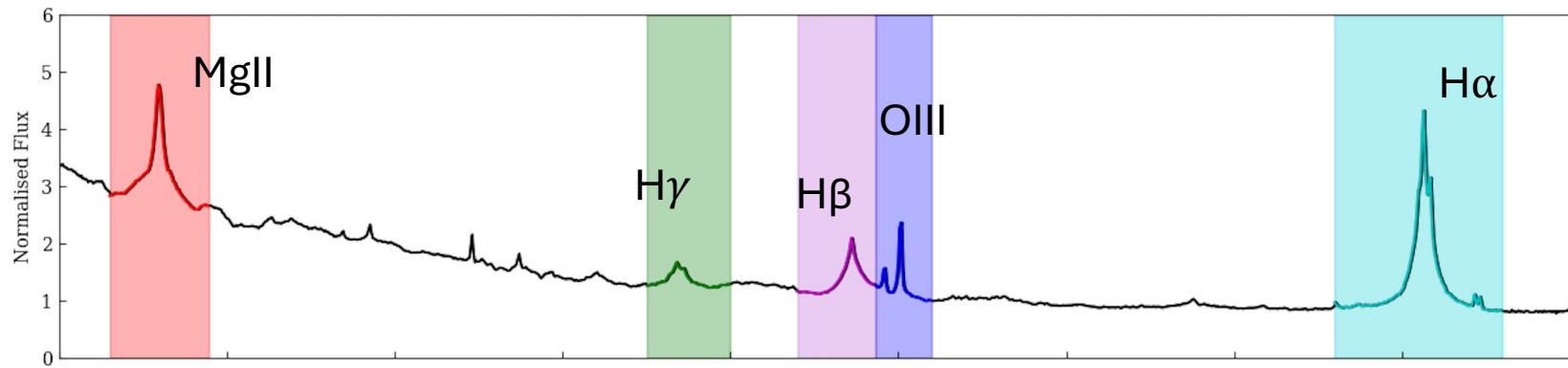
- Optical broad lines (120,000 spectra)
- Reconstruct broad line in CIV in presence of absorption (200,000 spec)
- Reconstruct Lyman- α + forest at high z (200,000 spec)

Sequence length = 1125, scaled up to 10'000 with FlashAttention. (Dao et al. (2022))

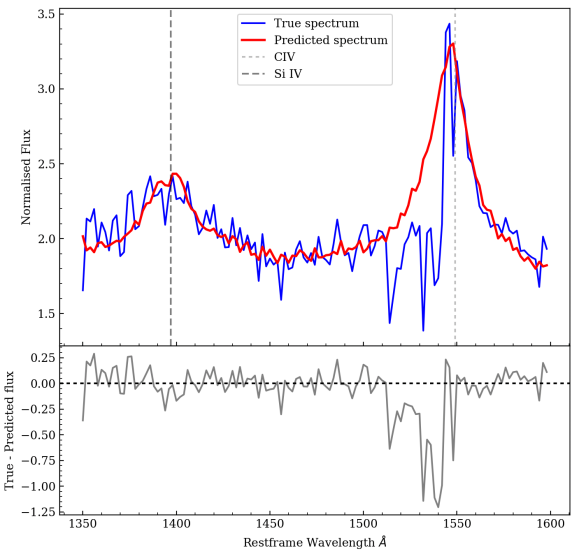


Vaswani et al. (2017)

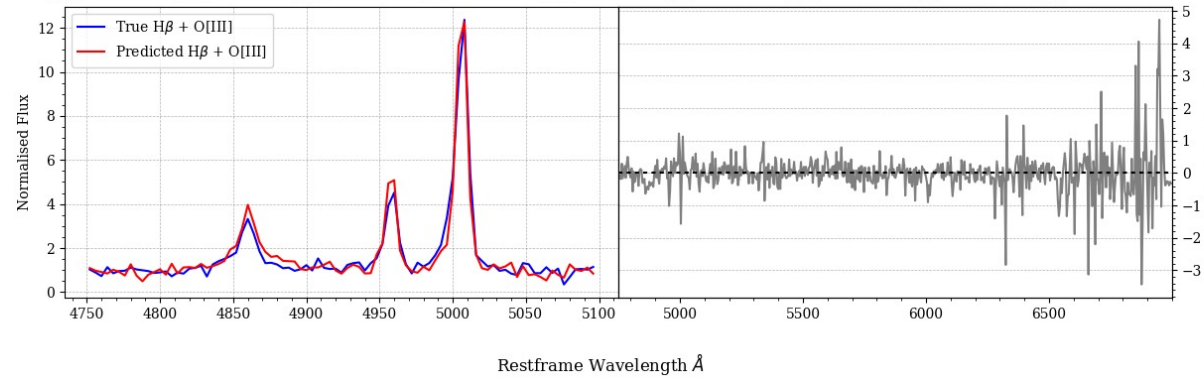
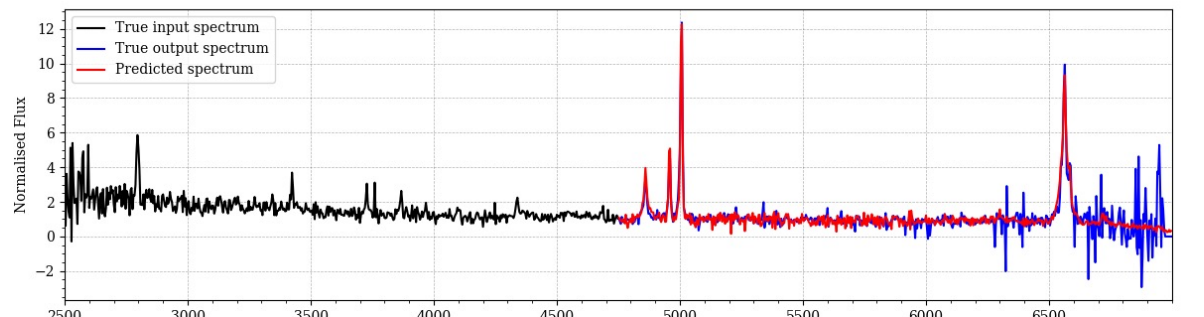
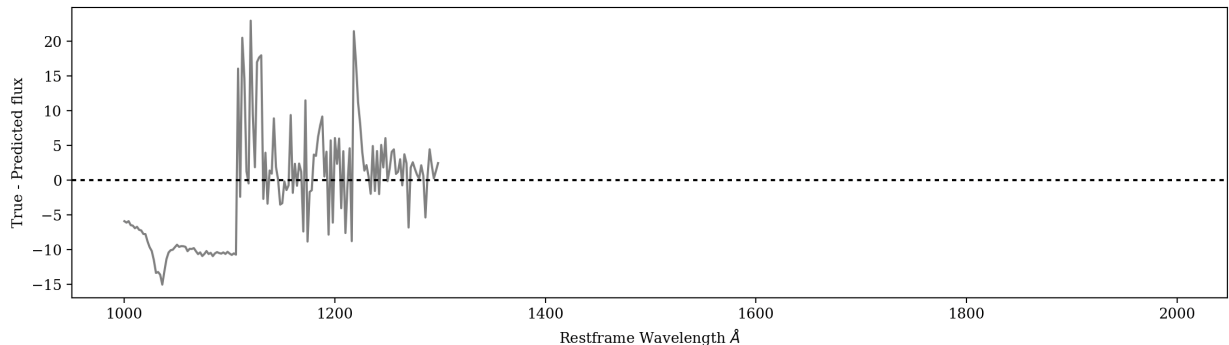
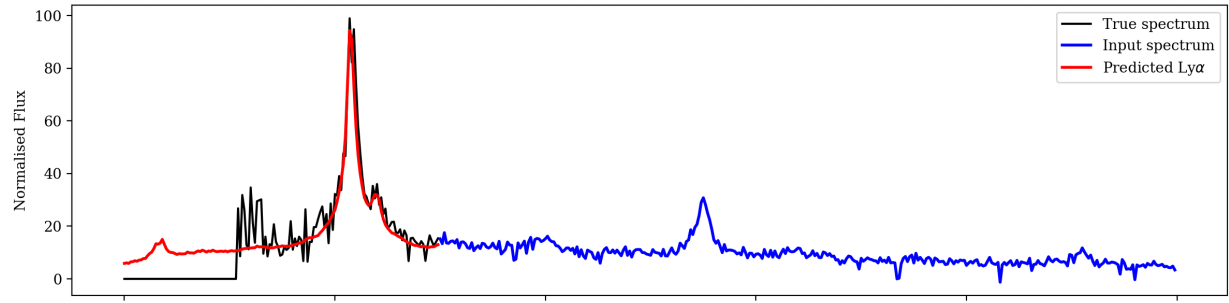
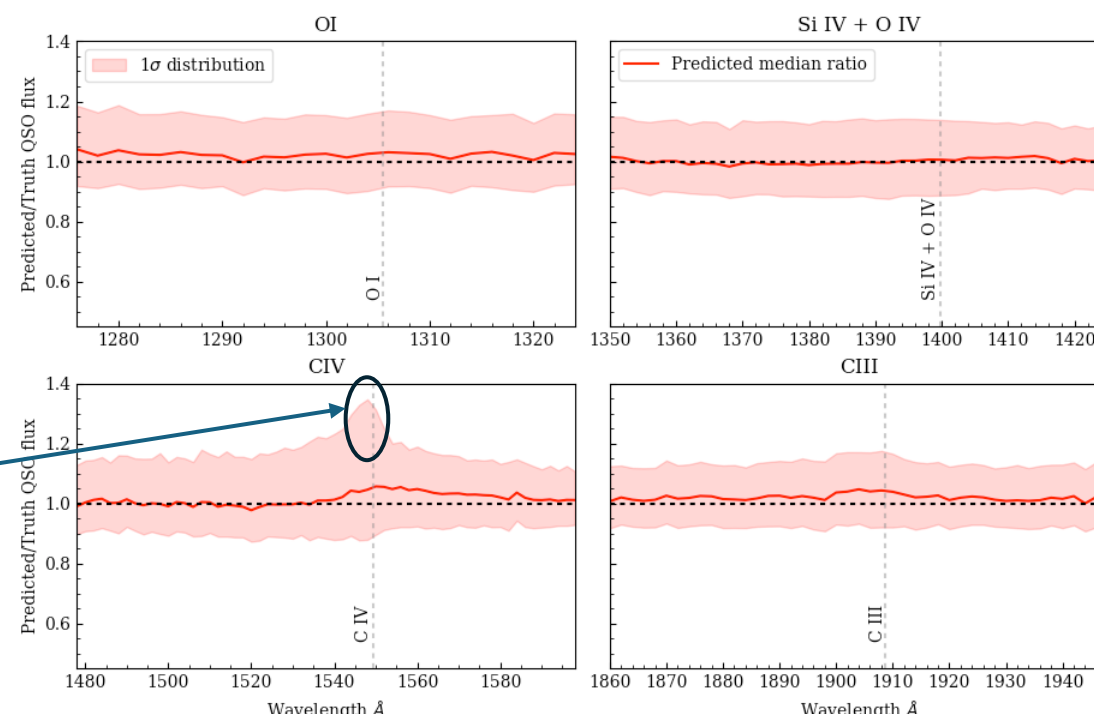




BALs / Lyman / half spec



Overprediction expected



Thank you!

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