Modelling of C IV absorption lines in *BAL QSOs* using CLOUDY McD

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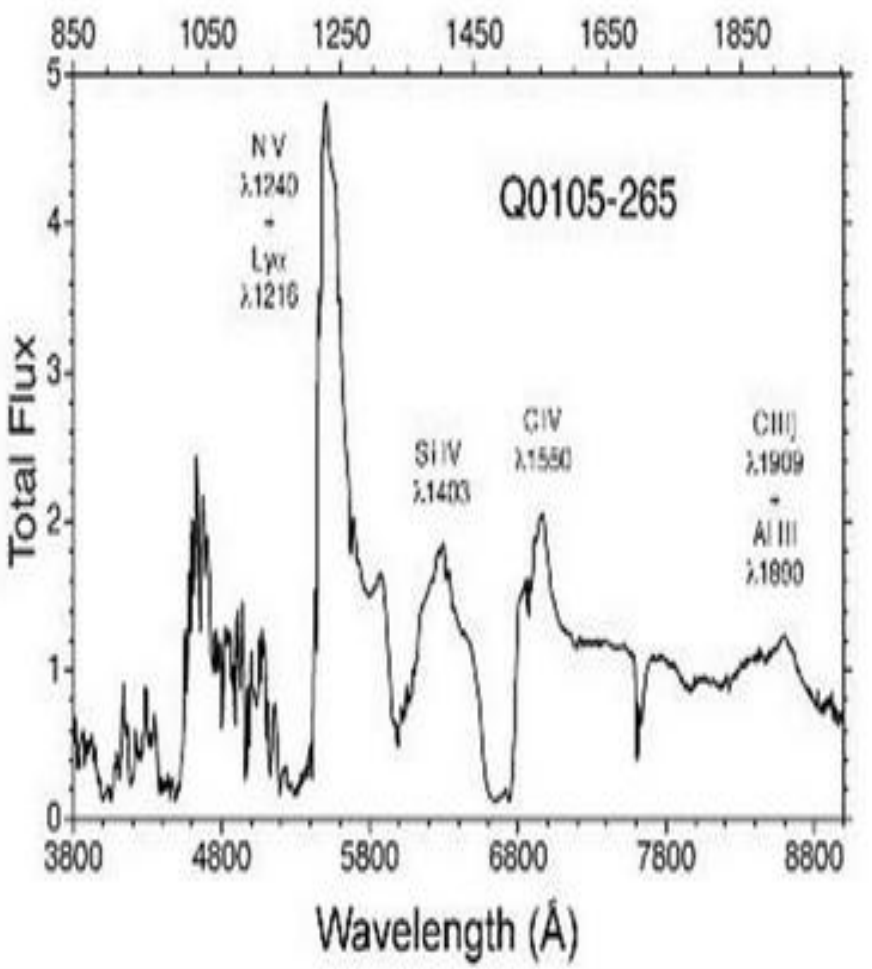
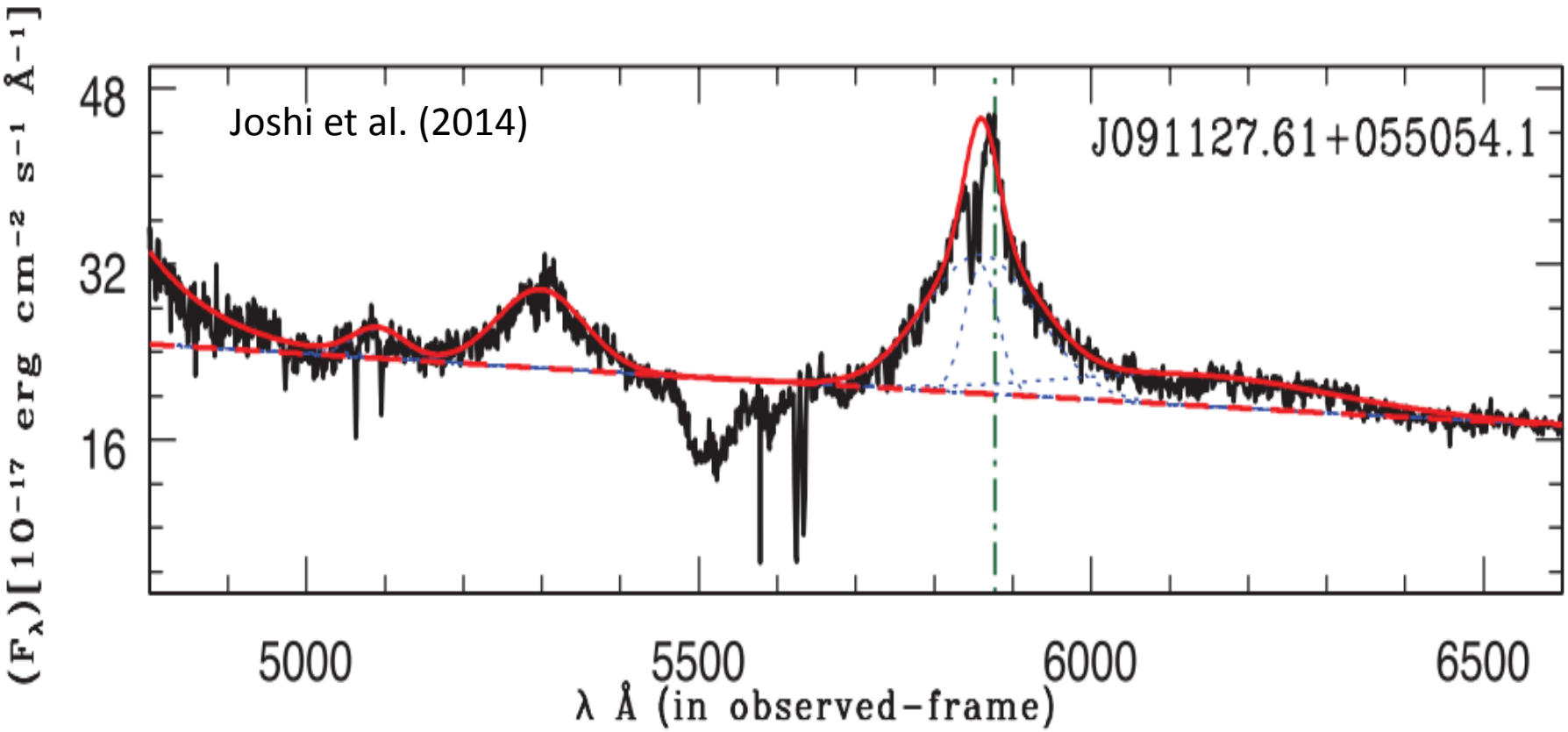
BAL QSO : Broad Absorption Line QSOs

- BAL QSOs comprise about 3-10% of QSO population
- Shows strong blue-shifted broad absorption lines
- Strength of the BAL troughs change with time
- Outflows are signature of AD
- Outflow velocities 10-30k km s^{-1}
- Studies of BAL trough intensity and outflow velocity variability are rare



J091127+055054

- ➔Gravitationally lensed QSO
- ➔ X-ray luminosity ~ 4×10^{46} ergs s^{-1}
- ➔Z = 2.793, α(ox) = −1.58

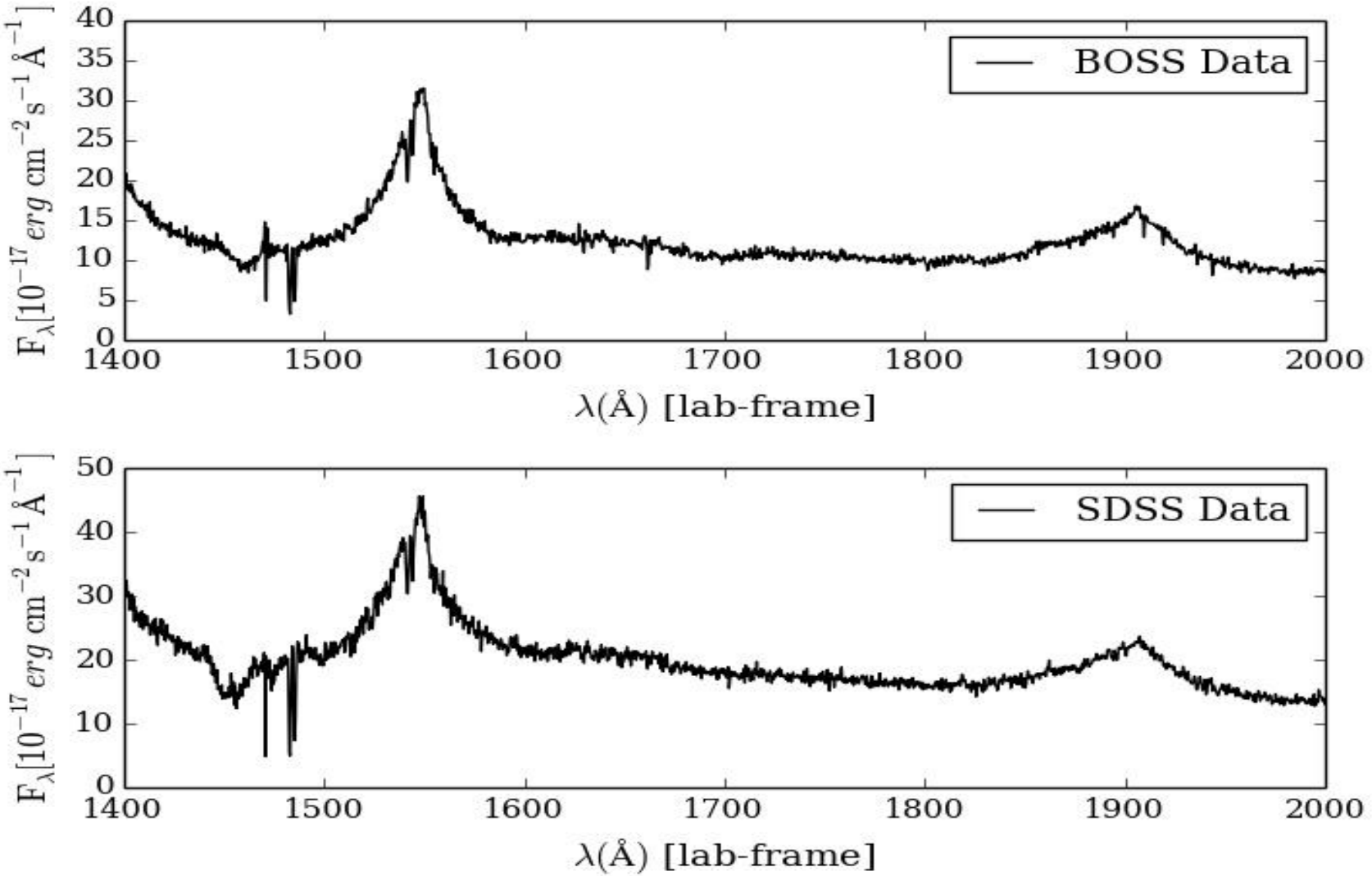


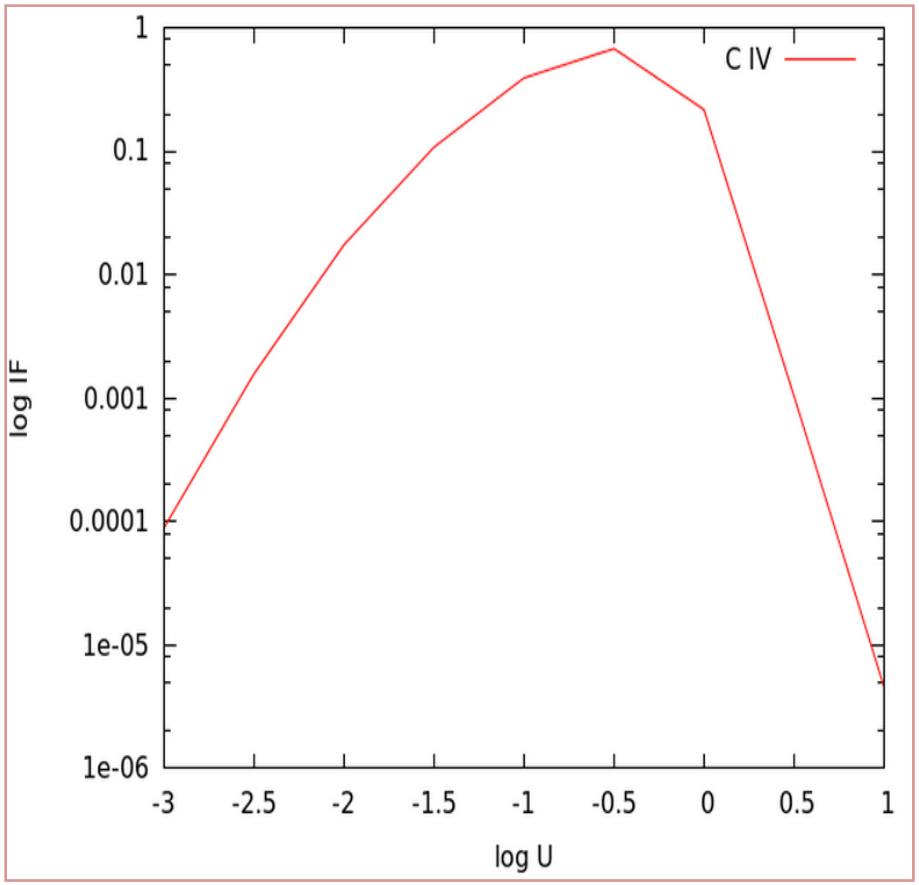
Motivation

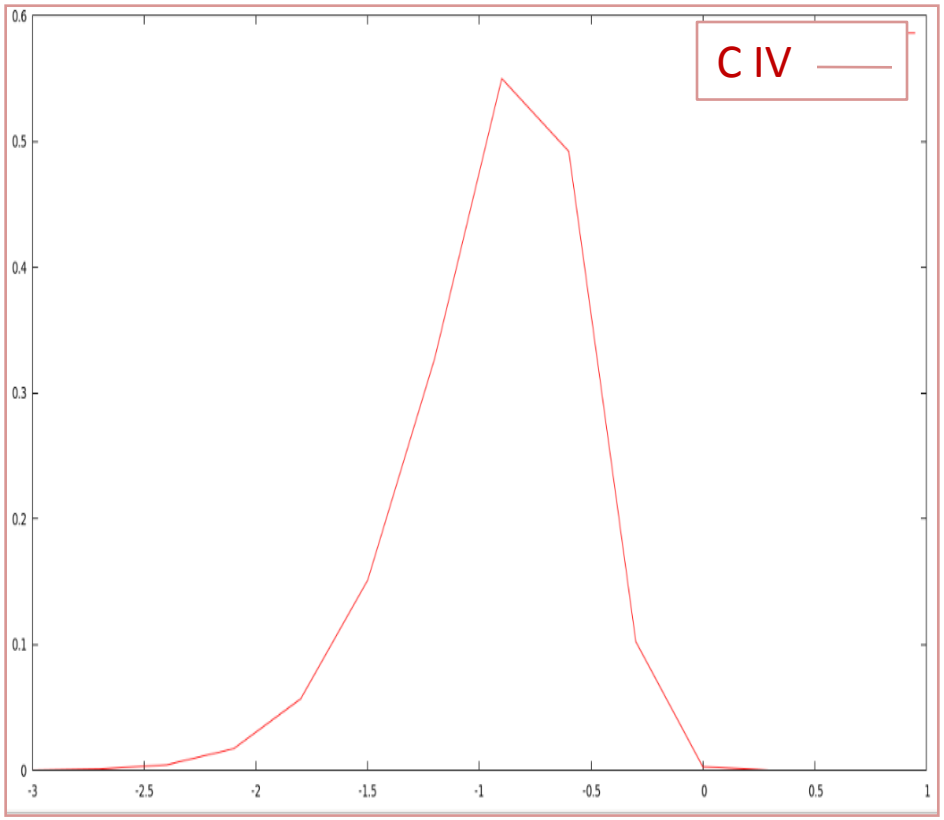
- Observed average deceleration for whole BAL profile ~ −2.0 ± 0.1 cm s^{-2} over time-span of 2-3 years.
- Physical conditions, acceleration mechanisms, location of QSO outflows are poorly understood.
- Line variability helps probing the structure and dynamics of these out flowing gas.

“Cloudy” as a tool!

Spectra obtained from BOSS & SDSS data



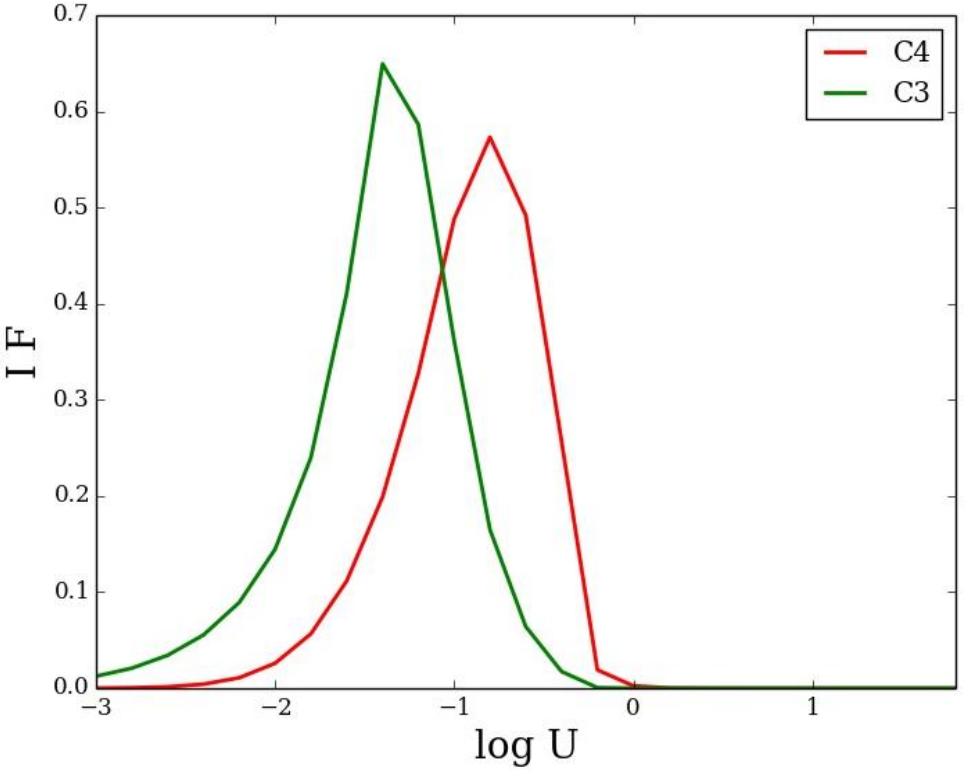




Plot between log (U) and log (I.F.)

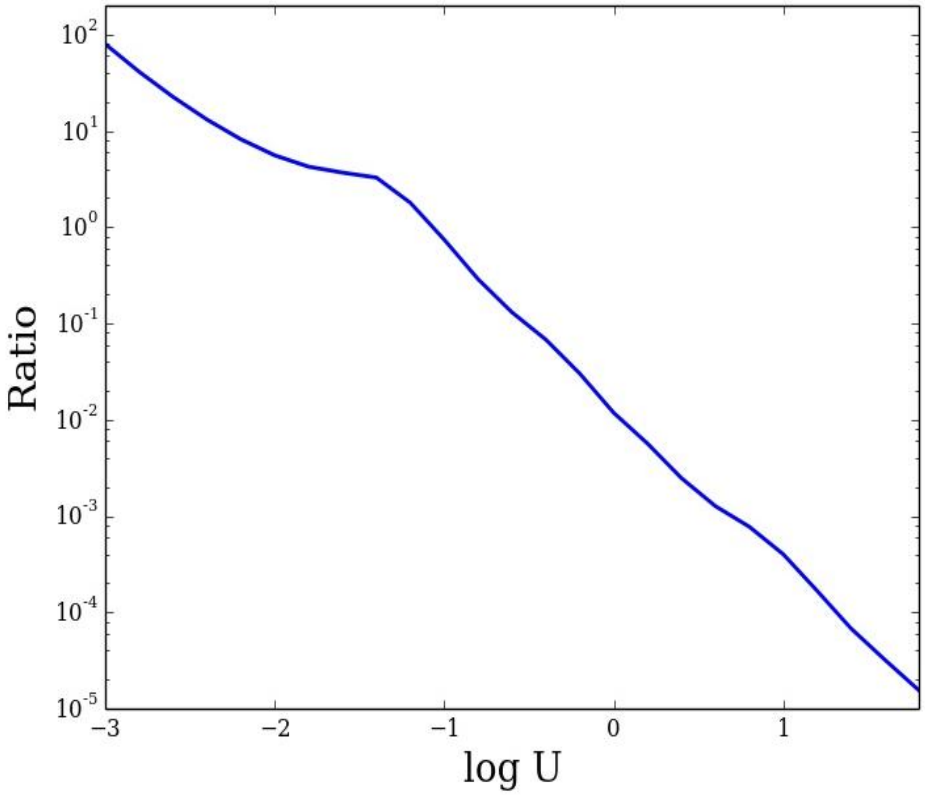
Value at which I.F. is maximum will be given as input for SED modelling.

Model SED for which CIII/CIV ratio best matches with the observed SED

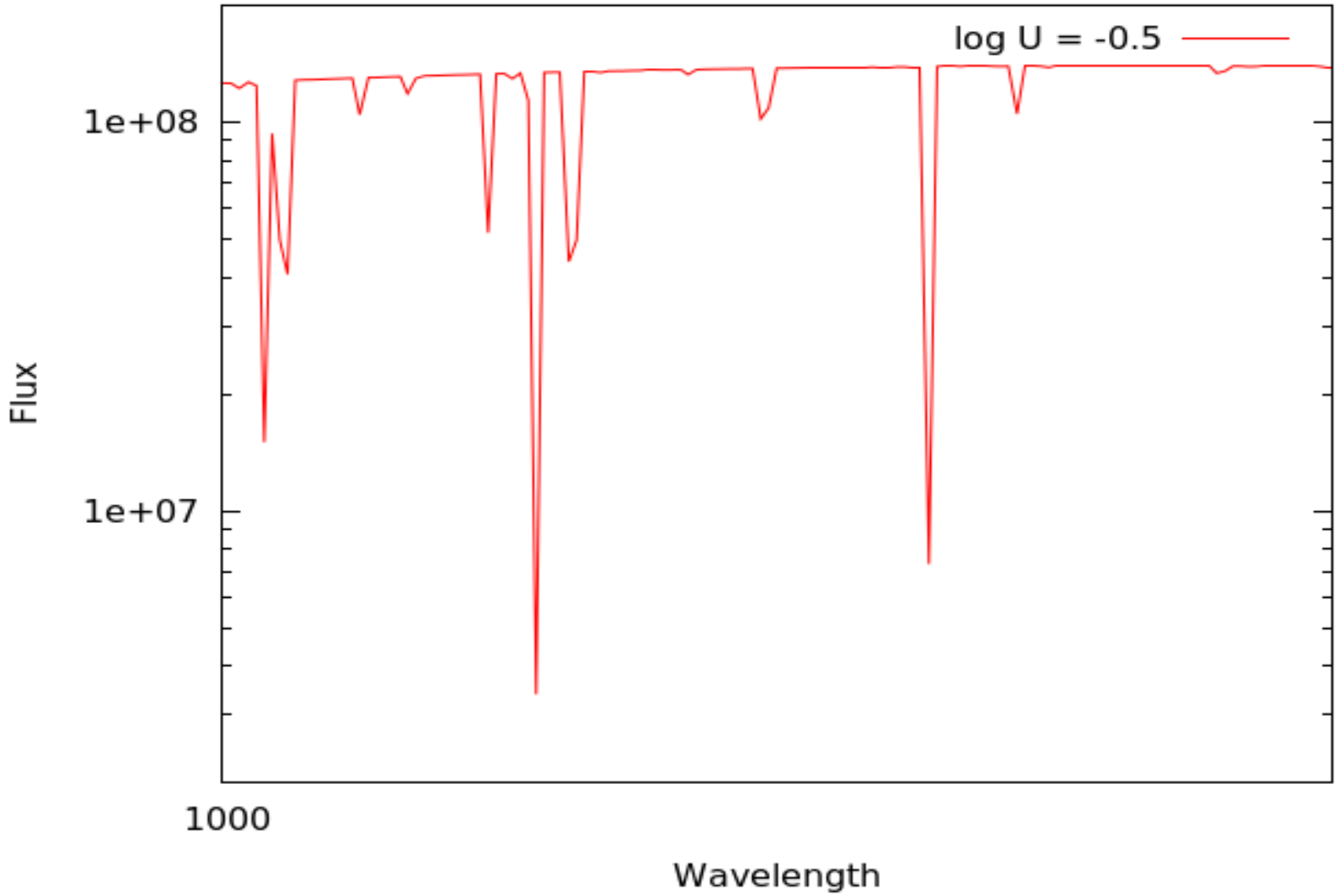


Comparison of I.F.
For C3 and C4 lines.

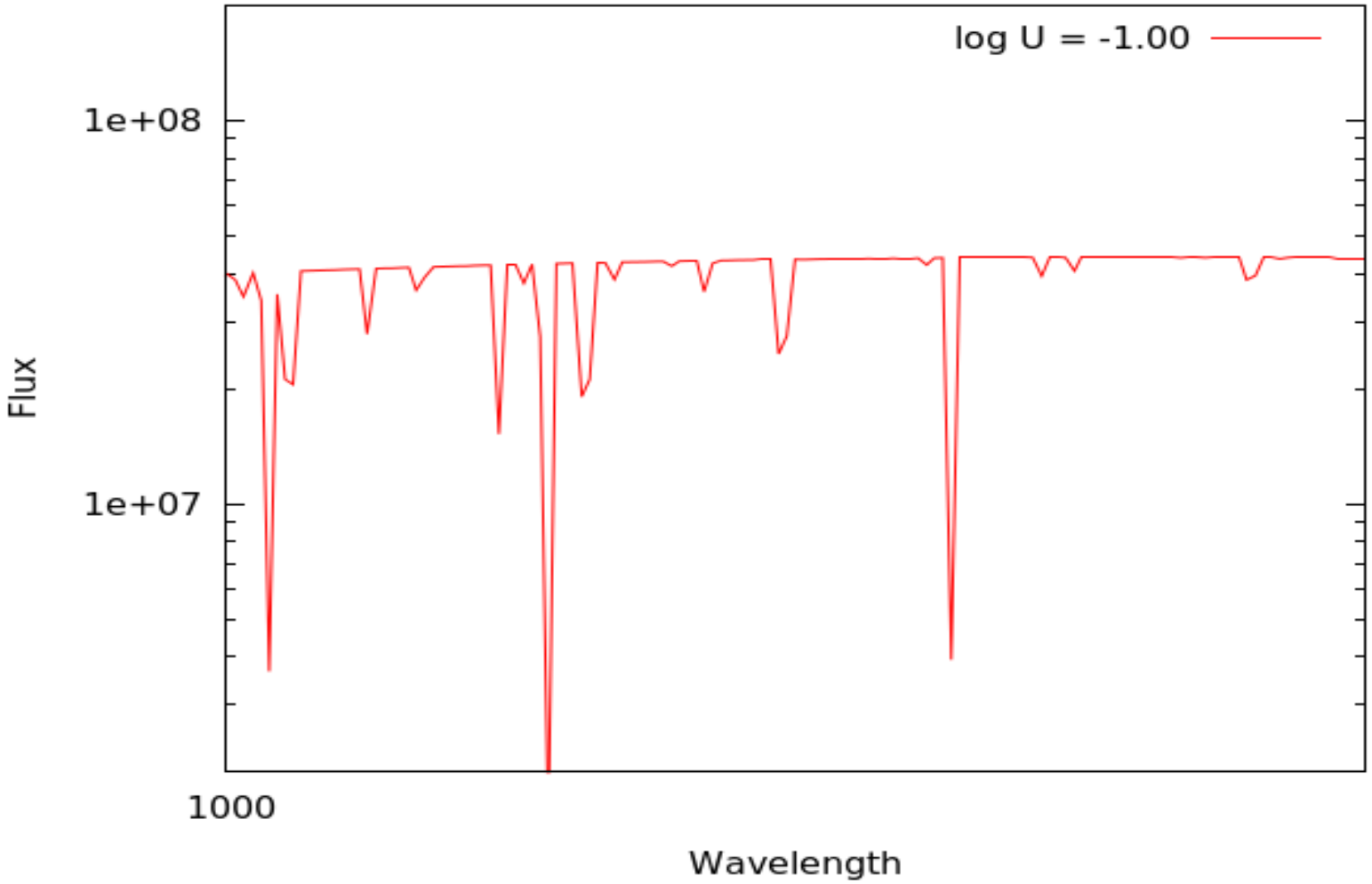
Ratio of C3 to C4



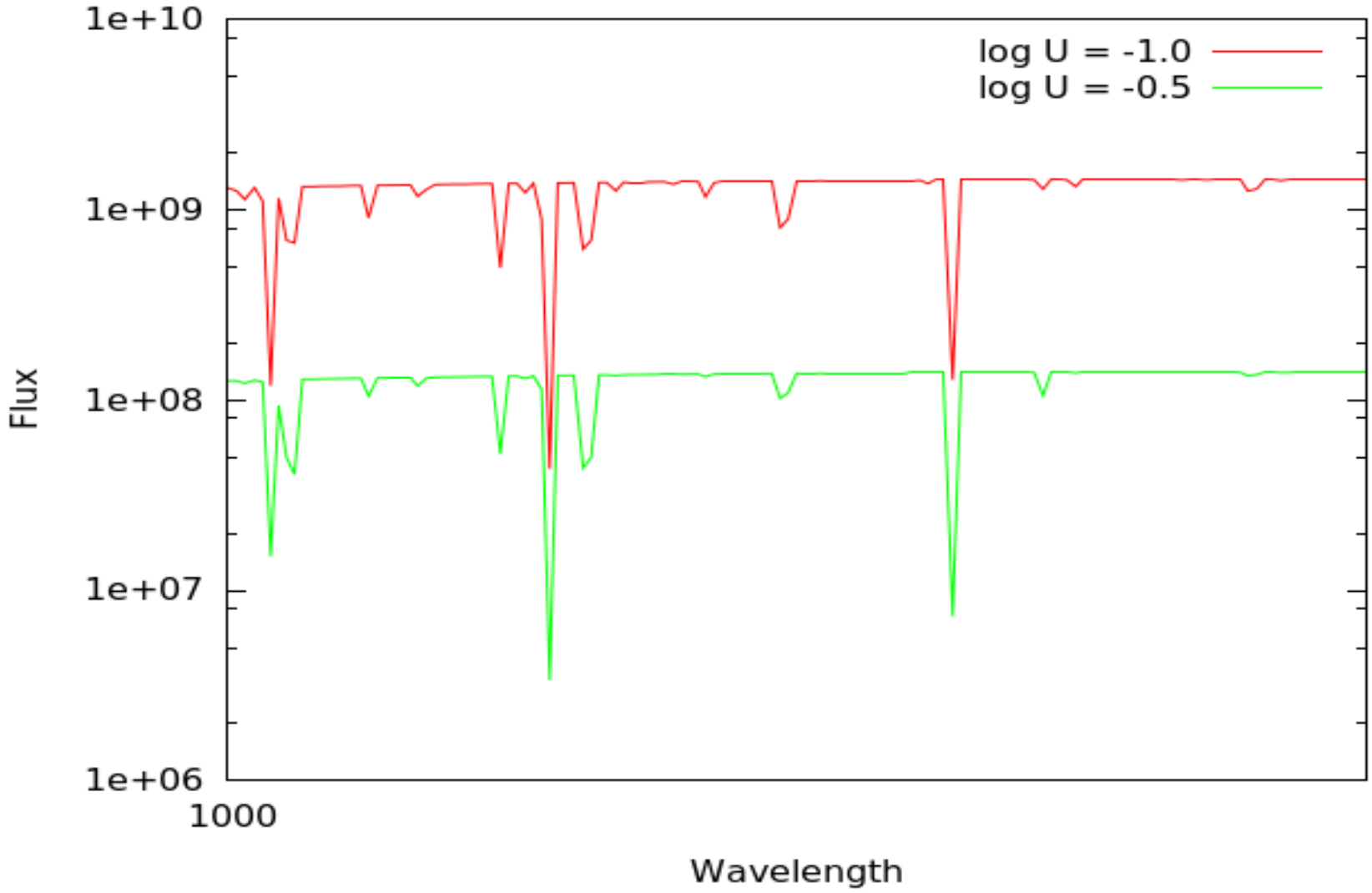
Modelled spectra for log U = -0.5



Modelled spectra for log U = -1.0



Over plotted the spectra for log U = -0.5 , -1.0



$$U = \frac{Q(H)}{4\pi n_H r^2 c}$$

U = Ionization parameter

R = separation [cm] between the center of the source and illuminated face of the cloud.

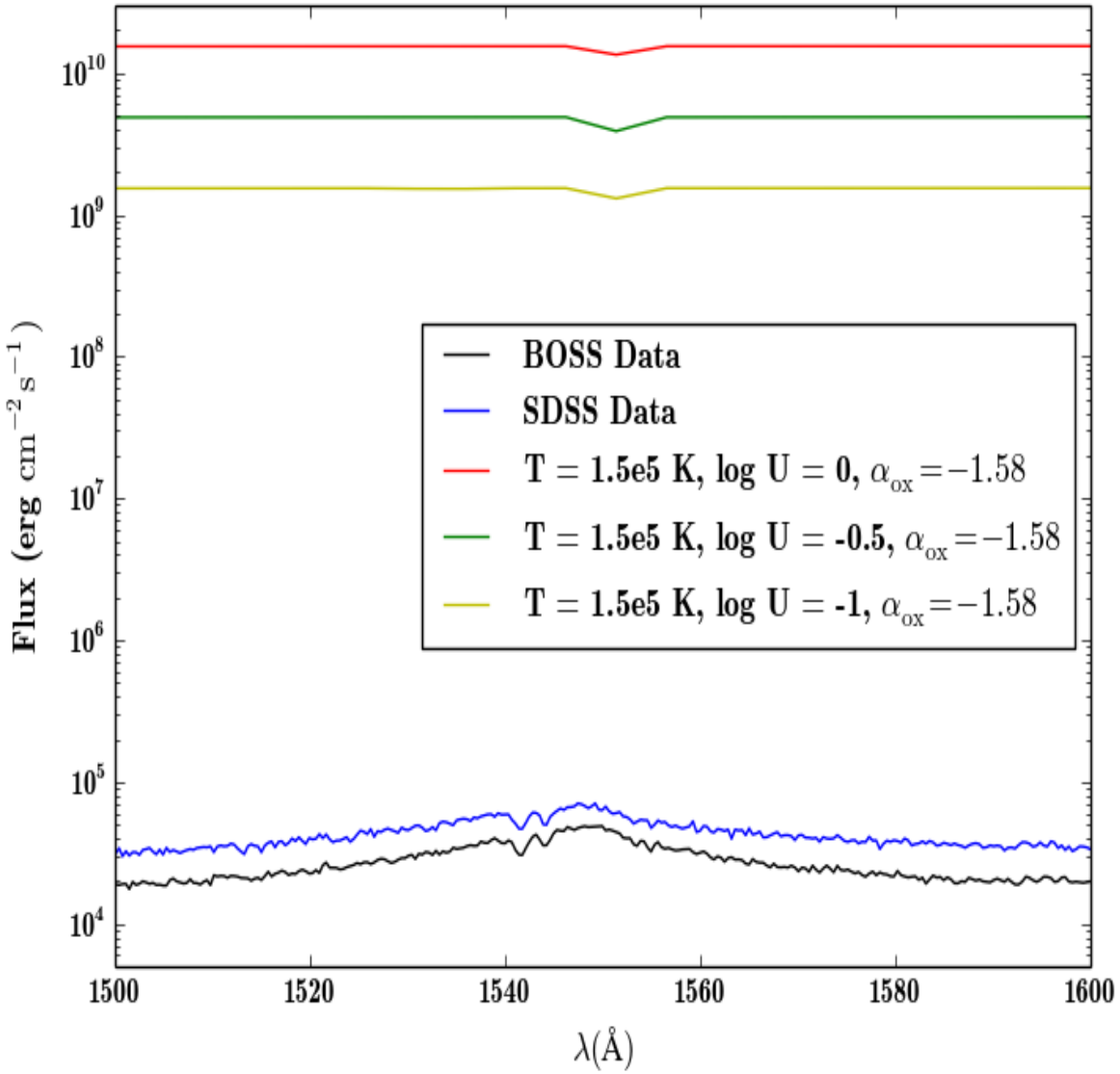
n(H) = total hydrogen density

c = the speed of light

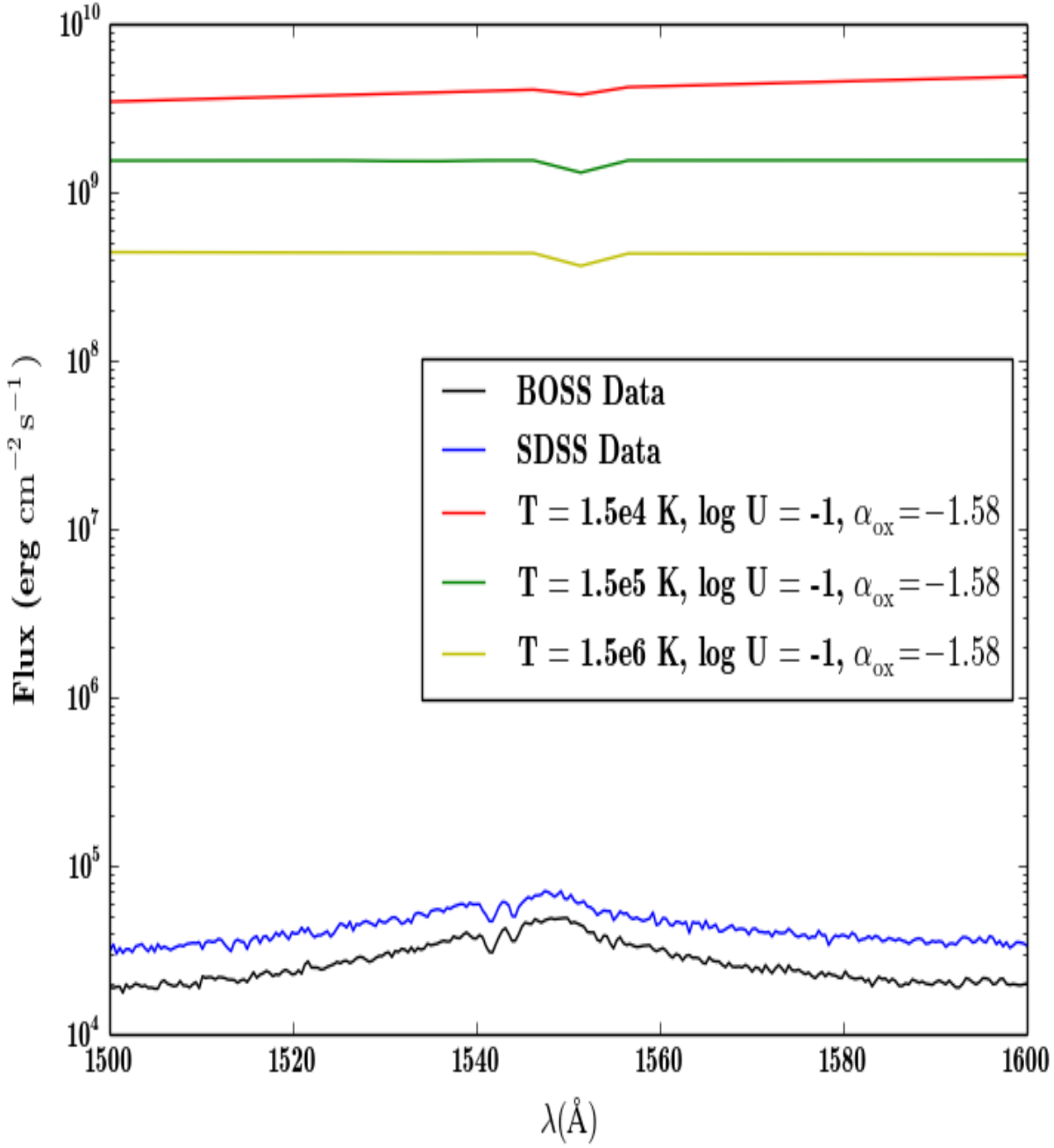
Q(H) = number of hydrogen-ionizing photons

For two different U values which we calculated for the graph, variation in Q(H) can be deduced

RESULTS

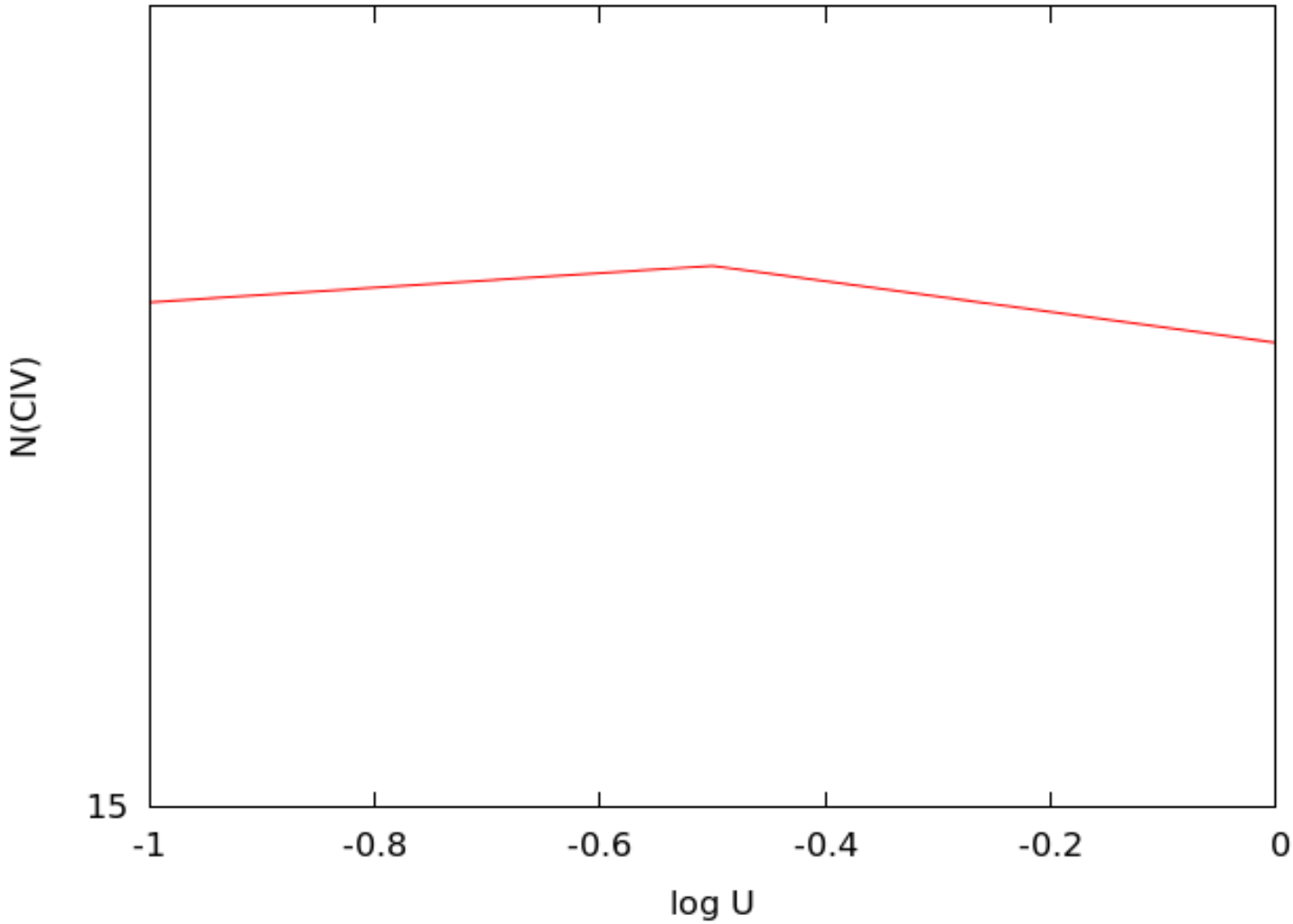


Log U	N (CIV) (in log scale)
0	17.25 cm^{-2}
-0.5	18.22 cm^{-2}
-1	17.78 cm^{-2}



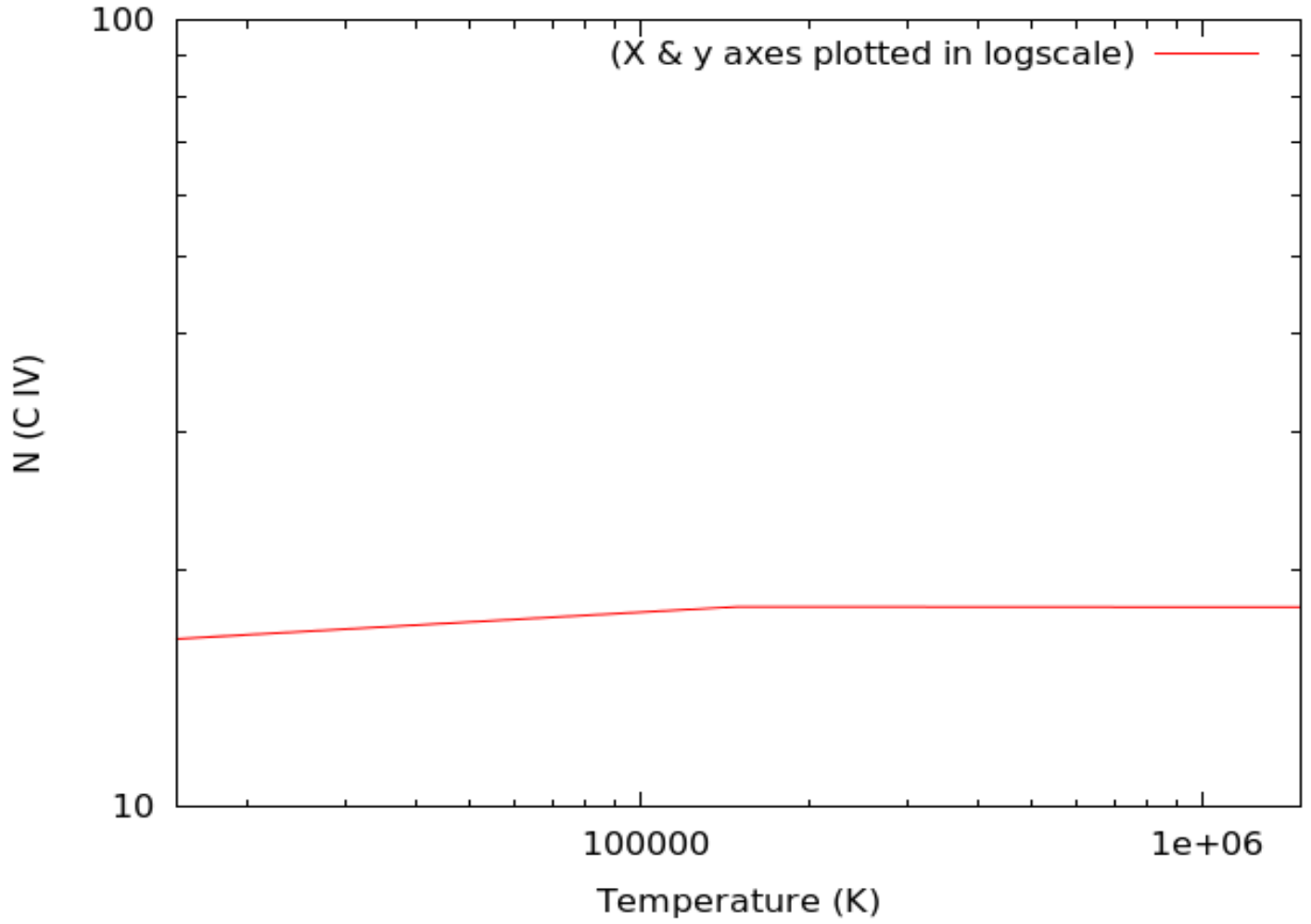
T (in K)	N (CIV) (in log scale)
1.5 x 10^4	16.367 cm^{-2}
1.5 x 10^5	17.983 cm^{-2}
1.5 x 10^6	17.965 cm^{-2}

Plot showing variation of N (CIV) with Ionization parameter



Plot showing variation of

N (CIV) with Ionizing photon Temperature



Observed Results

N1 (at 55896 MJD) = 2.92374×10^{14} cm^{-2}

N2 (at 52652 MJD) = 3.8307182×10^{14} cm^{-2}

(N1- N2) ~ 9.0692×10^{13} cm^{-2}

N1/N2 ~ 1.3102078

Calculated Results

N1 (logU = -1)/N2 (logU = 0) = 1.8113 (at same T)

WHAT COULD BE POSSIBLY DONE..??

To match modelled data with the observed data with possible accuracy

THANKS