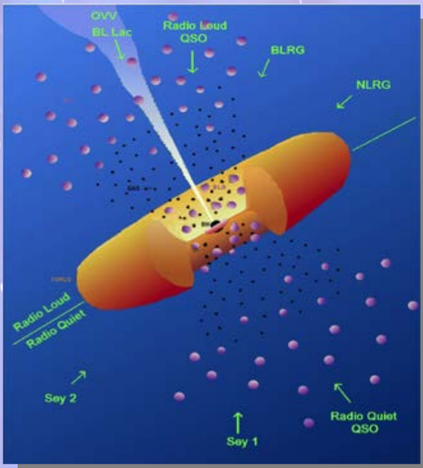
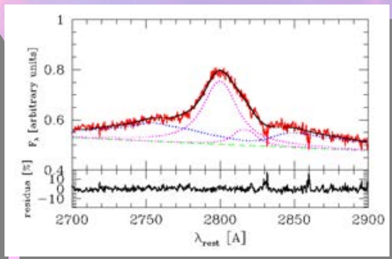
Mg II line: Covering factor of BLR in QSO HE 0435-4312

T.P. Adhikari[1], R. Basak[1], M. Krupa[2], A. Kurcz[2], J. Modzelewska[1], B. You[1]

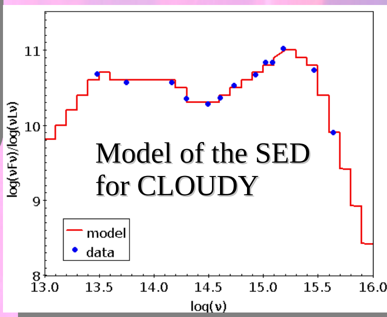
[1] Nicolaus Copernicus Astronomicla Center PAS, Warsaw, Poland; [2] Jagiellonian University, Krakow, Poland



Abstract: The Broad Line Region (BLR) is a part of a quasar where the broad emission lines are created. The BLR clouds are ionized by the optical/UV photons from the thermal emission of the accretion disk with ~10^5 K and produces Mg II line. In this work, we use the plasma simulation code, CLOUDY (e.g., Ferland+98, 13) to calculate the equivalent width (*EW*) of the Mg II line with and without **turbulence** and for various physical parameters related to the cloud's location ($\boldsymbol{R}_{\rm in}$), hydrogen density ($\boldsymbol{n}_{\rm H}$). Comparing this *EW* with that observed for the QSO HE 0435-4312, we find that in order to obtain a covering factor of ~0.1-0.3, the required values of the physical parameters are consistent for a BLR region.

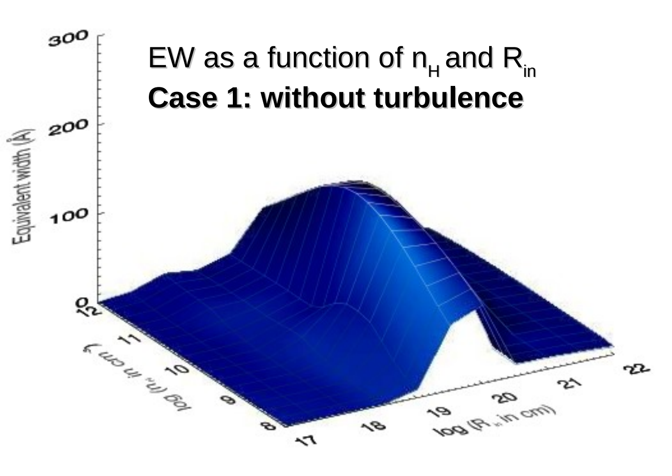


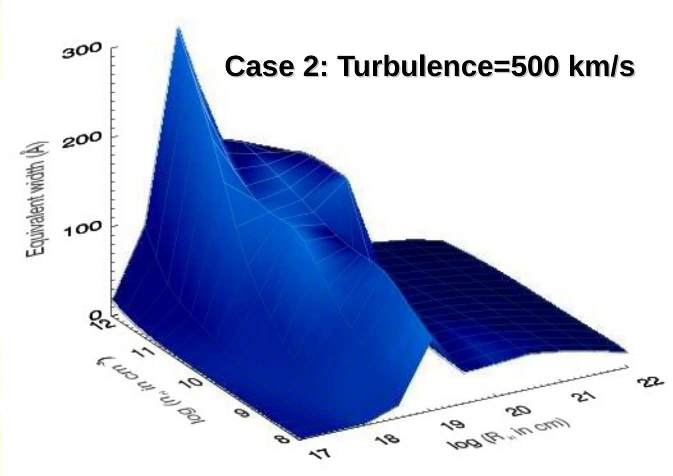
Mg II line in HE 0435-4312



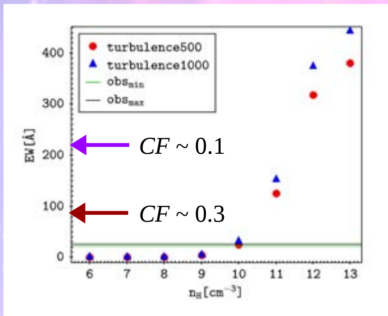
Definition of *CF*

$$CF = \frac{\Omega}{4\pi} = \frac{L_{\rm obs}}{L_{\rm cloudy}} = \frac{EW({\rm MgII})_{\rm obs}}{EW({\rm MgII})_{\rm cloudy}} \sim 0.1 - 0.3$$

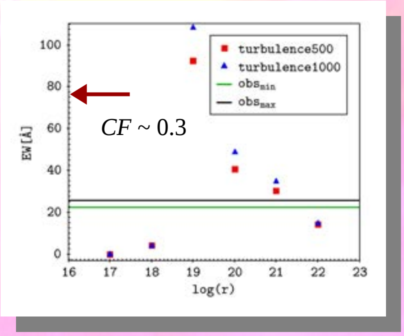




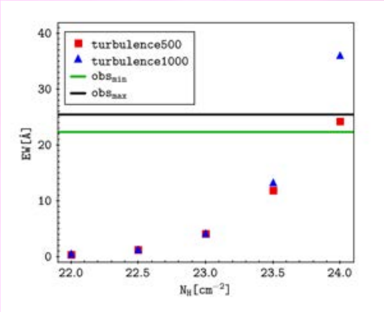
$n_{\rm H}$ v/s EW



$R_{\rm in}$ v/s EW



$N_{\rm H}$ v/s EW



Conclusion and Future directions

- We need turbulence to get high EW. In order to get a *CF*~0.1-0.3, we need at least a turbulence ~ 500 km/s
- For a given turbulence, the EW is strongly dependent on $n_{\rm H}$, $R_{\rm in}$. Changing $N_{\rm H}$ cannot make it that high.
- The location of the BLR is well constrained ~1 pc
- **Future:** 1. Larger sample; study the evolution of *CF* with redshift, 2. Different turbulence, 3. Constraints on the parameters with better mesh, may be with grain etc.