A Quasar Wind Model

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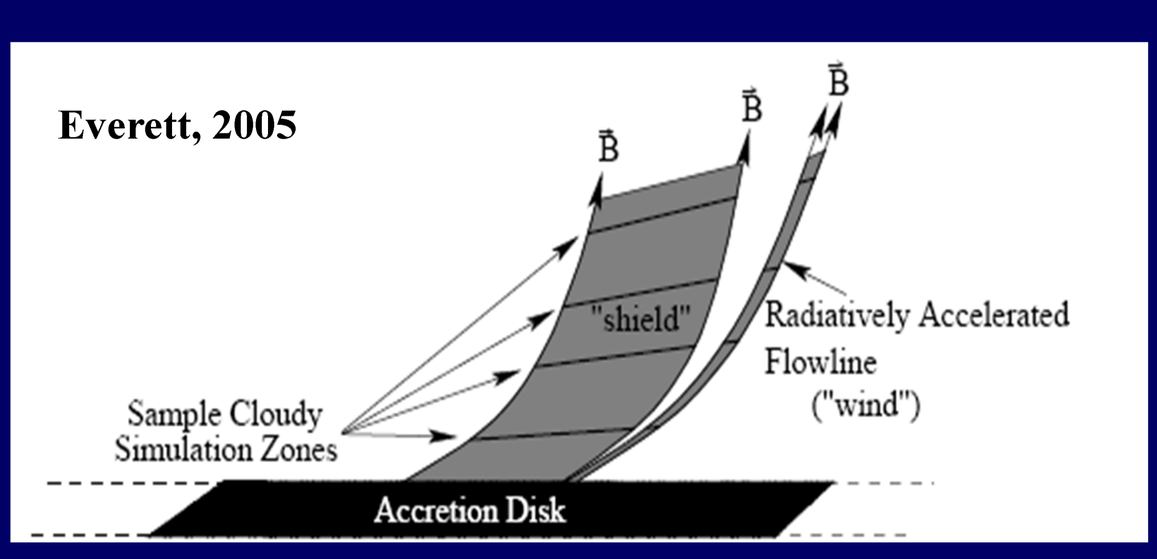
This model aims to constrain the spatial and velocity structure of the broad emission line region. In the future, we will use recent observational data from micro-lensing, in conjunction with diverse existing observations, to constrain the dynamics and physics of this region that characterise our model.

Broad Emission Lines

- Broad emission lines are a prominent spectral feature of quasars.
- The broadening is so extreme that speeds of up to 0.1c are observed.
- Temperature and number density limits can be inferred from observations of the relative strengths of broad emission lines.
- The temperature inferred from observations is too low for the broadening to be thermal.
- Therefore, the gas producing broad emission lines is moving at high speed.
- Direct spatial resolution is not possible, so the geometry, origin and nature of the gas is poorly understood and simulations are required.

Accelerating the Gas

- The gas that produces the broad emission lines originates in the accretion disk.
- It is then accelerated both magneto-hydrodynamically and radiatively by continuum and line driving.
- This model includes X-ray shielding gas, which prevents the wind from being over-ionized.



Photoionisation

- This model aims to simulate a spectrum of the broad line region using photoionisation.
- The photoionisation code, *Cloudy* (Ferland) will be used to calculate both the radiative driving of the gas and to predict a spectrum from a set of input conditions.
- Free parameters can be constrained by varying input conditions.
- The asymmetrical profile of broad emission lines is strong evidence for an out-flowing wind.
- In the case of an out-flowing gas, the optical depth is modified:

$$\tau_l = \kappa_l \, \rho_{gas} \, v_{thermal} \, | \, a_{gas} \, |^{-1} \qquad \text{(Castor, 1974)}$$

where is the κ_l is the line opacity, ρ_{gas} the gas density, $v_{thermal}$ the thermal velocity of the gas and a_{gas} the acceleration of the gas.

Tests of this model

- Observations of broad line flux ratios can be used to constrain free parameters and test the accuracy of the model.
- Cloudy simulations also predict the radius at which the broad emission lines are produced. These predictions can then be compared to reverberation mapping observations to confirm the validity of the model.
- It is possible to extend this model to include gas clumping, which might alter the velocity profile significantly.

References

Everett, 2005, ApJ **631**, 689
Castor, 1974, MNRAS **169,** 279
Elvis, 2000, ApJ **545**, 63
Murray & Chiang, 1998, ApJ **494**, 125