Abstract
The Seyfert 1 galaxy NGC 7469 was the target of an extensive observing campaign with XMM-Newton in 2015. Analysis of the 640 ks RGS spectrum[1] with the spectral fitting code SPEX, and the physically self-consistent photoionisation model PION, shows that the emission line region (ELR) is multi-phased, while still accounting for three warm absorber (WA) components. We discuss how adjusting the volume filling factor (C_v) could resolve the differences of distance estimates obtained from variability arguments. Further comparisons made with other AGN (NGC 5548 and NGC 3783) are presented.

We find three WA components and three emission components (two narrow and one broad) within the nucleus of NGC 7469.

We characterise the emission features in NGC 7469 for the first time, deriving estimates for the minimum distances of the ELR from the central engine using Eq. 1, below.

- $r \geq 2.5$ pc for the two narrow line components (EM1 & EM2).
  - Adopt an extended emission region;
  - Assume $C_v = 0.1$ (see third column in Table 1).
  - This places the ELR further out from the black hole than the WA (Figure 1).

For the broad emission line region (EM3) the distance is found at either 0.03 pc (assuming $C_v = 0.001$) using the ionisation parameter ($\xi$), or 0.004 pc if the outflow velocity ($v = -4460$ km s$^{-1}$) is used.

We compare the ELR of NGC 7469 with those within NGC 5548[4] and NGC 3783[5], calculating the lower ELR distance limits within each AGN using Eq. 1 (see Table 2).

The ELRs in NGC 5548 are comparable to previous analysis of the NLR ($r = 13.9$ pc)[8].

The narrow (N1) and broad (B1) ELR distances in NGC 3783 are comparable to each other (Table 2) due to the large ionisation parameter of N1.

We overcome this problem by allowing $0.1 < C_v < 1$ for the narrow ELRs.

Alternatively, the broad emission component may have $C_v < 0.001$.

Conclusions
- Minimum distances of the narrow ELR within NGC 7469 have been estimated at $r \geq 2.5$ pc (Figure 1).
  - For the ELR to be further away from the black hole than the WA, $C_v = 0.1$ (third column of Table 1).
  - However, from variability arguments, the WA distance is $\sim 10$ times larger than ELR distance.
  - Therefore, we require a range of $0.1 < C_v < 1$ to overcome this inconsistency (Figure 2).

- If the broad ELR has $C_v < 0.001$, then the ionisation and kinematic distance measurements for EM3 are consistent within NGC 7469.

- Large uncertainties in $C_v$ mean further work is required to investigate this parameter.

References