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Resolving the BLR in NGC 3783

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Abstract. We present results from very high signal-to-noise spectropolarimetric observations of the Seyfert 1 galaxy NGC 3783. Position Angle (PA) changes across the Balmer lines show that the scatterer is *resolving* the Broad-Emission Line Region (BLR). A broad component seen in polarized light and located bluewards from the Hβ line very likely corresponds to HeIIλ4686. The lack of PA changes across this line suggests that the region responsible for this emission appears to the scatterer as unresolved as the continuum source, in agreement with the stratified BLR structure determined from reverberation mapping.

1. Observations

We have obtained very high S/N spectropolarimetric observations of NGC 3783 using the VLT and the 3.6m telescope at La Silla in 2006, with total exposure times of 3.4 and 6.2 hours, respectively. The data were reduced following Miller, Robinson & Goodrich (1988) and special care was taken to correct for the interstellar polarization in our Galaxy along the line of sight towards NGC 3783.

2. Main Results

The left panel in Figure 1 shows the total flux and PA of the polarized emission in the 4000-5000 Å range. Strong PA changes are coincident with the broad Balmer emission lines. This is consistent with near-field scattering, i.e., with the scatterer being close enough to the Balmer emitting region to *resolve* it. These PA changes, however, are not consistent with a simple, pure rotational motion of the BLR as seen by an equatorial scattering medium, which predicts a horizontal *S-shaped* PA swing, as already observed in several other Seyfert 1 galaxies, and modeled by Smith et al. (2005). Instead, a *M-shaped* pattern is seen in all Balmer lines (also clear in Hα, which is not shown here). The Balmer lines also show a narrow dip in polarized flux which is blue-shifted from the position of the emission peak seen in total flux (central panel in Figure 1). In a forthcoming paper we will present detailed modeling of our data.

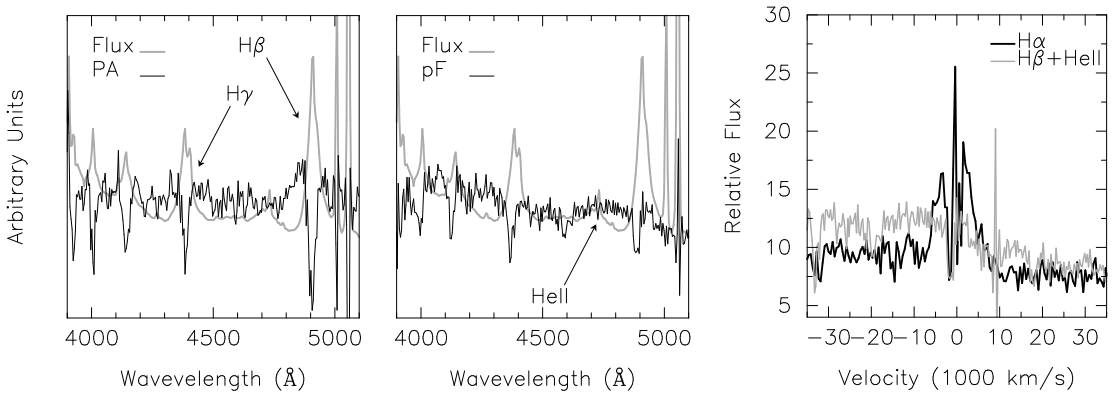

Figure 1. *Left and central panels:* Comparison between total flux and polarization position angle (PA), and total and polarized flux spectra. *Right panel:* Hα and Hβ emission line profiles in velocity space. We identify the excess seen in the blue wing of Hβ as emission from the HeIIλ4686 line.

The HeIIλ4686 line, very conspicuous in total flux, does not show the features observed in the polarized flux of the Balmer lines, and essentially no PA change. The right panel in Figure 1 compares the Hα and Hβ profiles in velocity space. An excess is clearly seen extending from the blue wing of Hβ, which is coincident with the position of the HeIIλ4686 emission line. We therefore interprete this excess as polarized emission from the broad HeIIλ4686 line. The lack of a PA change across the HeIIλ4686 line strongly suggests a smaller solid angle subtended by the emitting region as seen by the scatterer when compared with the Balmer emitting region.

3. Discussion

We have found clear evidence that the scatterer is resolving the Balmer emitting region in NGC 3783. The geometry and kinematics will be explored in a forthcoming paper which will model the spectropolarimetric observations.

Reverberation mapping results show clear evidence for a stratified BLR which is also consistent with Virial motion of the BLR (Onken & Peterson, 2002). We have found strong evidence that the high ionization HeIIλ4686 line is produced in a region much more compact than that producing the Balmer lines, in good agreement with the idea of a stratified BLR.

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