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# Simultaneous Optical and Near-Infrared Spectropolarimetry of Type 2 Seyfert Galaxies with TRISPEC

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**Abstract.** We present 0.46–2.5 $\mu$m spectropolarimetry of four type 2 Seyfert nuclei, Mrk 463E, Mrk 1210, NGC 1068, and NGC 4388, obtained with TRISPEC (Triple Range Imager and SPECtrograph) at UKIRT. The polarizations from dust or electron scattering in ionization cones, dust scattering in a torus surrounding a type 1 nucleus, and dichroic absorption by aligned dust grains in the torus are modeled. In the near-infrared, dichroic absorption ($A_V$ = 10–20) by aligned grains can explain the continuum polarization of Mrk 463E and Mrk 1210, as well as that of NGC 1068. Dust scattering in the torus, whose grain size distribution is assumed to be the same as in the Galactic diffuse interstellar medium, cannot reproduce the observed spectral slope of the near-infrared polarization and total nuclear flux simultaneously. However, this might only indicate that the grain size distribution in the torus of AGNs is different, and dust scattering with moderate optical depth and dominated by large grains might provide a reasonable explanation for the near-infrared radiation from AGNs.

## 1. Introduction

According to the unified model of Seyferts, electron scattering (optical) and dichroic absorption (near-infrared) are the principal mechanisms for the continuum polarization of type 2 Seyfert nuclei [e.g., NGC 1068, Antonucci & Miller (1985); Young et al. (1995)]. However, dust scattering in ionization cones and the torus surrounding a type 1 nucleus may also produce the polarization. We modeled the dust scattering and compared the spectral slope with the observation [Figure 1; Watanabe et al. (2003)]. The data were obtained simultaneously, covering the wavelength range 0.46–2.5 $\mu$m with TRISPEC (Watanabe et al. 2004) at UKIRT.

## 2. Polarization Models

At optical wavelengths, we confirmed electron scattering can explain the continuum polarization. The small deviation of the slope from zero suggests significant contributions of dust scattering for Mrk 463E and Mrk 1210. In the near-infrared, dichroic absorption by aligned dust grains can explain the continuum polarization of Mrk 1210 and Mrk 463E, as well as that of NGC 1068. Assuming a typical spectral slope of type 1 Seyfert nuclei ($f \propto \lambda^{\beta}$; $\beta \sim 0$)

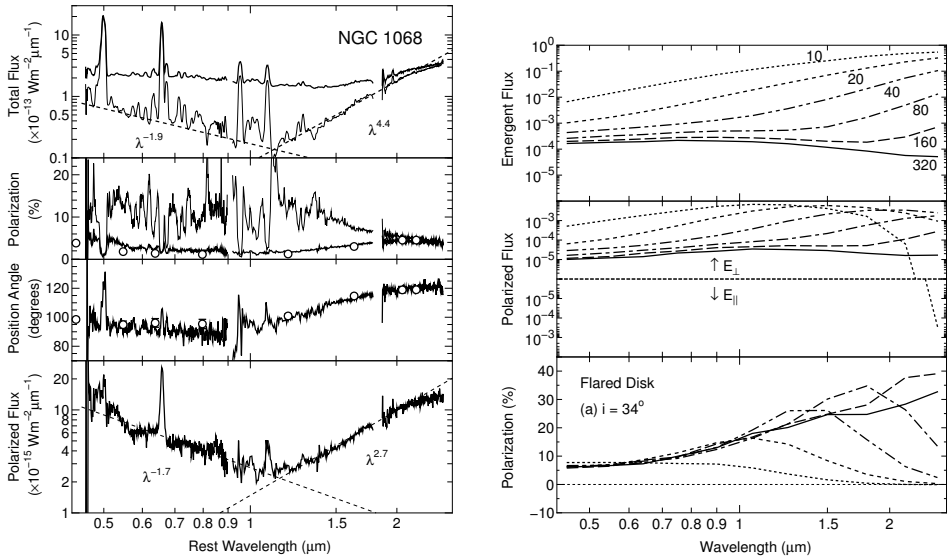


Figure 1. Observed polarization spectrum of NGC 1068 (*left*) and model polarization (*right*) (Watanabe et al. 2003).

as a background source, we have estimated $\tau_V = 10$–$20$ for the torus from the spectral slope of the polarized flux.

We also modeled dust scattering in a torus with the same grain size distribution as in the Galactic diffuse interstellar medium and a fared disk geometry [Figure 1 (*right*)]. We found that this model cannot reproduce the observed spectral slope of the near-infrared polarization and total flux of these nuclei simultaneously. This model requires a very high visual optical thickness ($\tau_V =$ 40–60) for the torus to reproduce the spectral slope of polarization, while it requires a moderate visual optical thickness ($\tau_V = 10$–$20$) to reproduce the total flux. However, this might only indicate that the grain size distribution in the torus of AGNs is different from that in our Galaxy. Dust scattering in a torus with moderate optical depth and dominated by large grains might provide a reasonable explanation for the near-infrared radiation from AGNs.

## References

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