Probing dust along Supernovae Ia sight lines using linear spectropolarimetry

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Understanding the effect of dust extinction on Supernovae Ia (SNe Ia) is essential for accurate measurement of cosmological parameters and the expansion history of the Universe. Different studies of the host galaxies dust extinction from SNe Ia yielded diverse values of the absorption to reddening ratio, R_V, ranging from R_V=1 to R_V=3.5 (see e.g. Cikota et al. 2016). Furthermore, studies of dust along the lines of sight of SNe Ia might lead to conclusions on the progenitor system, because the single degenerate (SD) and double degenerate (DD) models imply different circumstellar environments.

The wavelength of the peak of continuum polarization, λ_{max}, depends on the dust grain size distribution. For an enhanced abundance of small dust grains, λ_{max} moves to shorter wavelengths, and for an enhanced abundance of large dust grains to longer wavelengths (Serkowski et al. 1975). Thus, linear spectropolarimetry is an independent way to probe dust properties.

SNe Ia with low total-to-selective extinction ratio values, R_V, also show peculiar continuum polarization wavelength dependencies, raising towards blue, with polarization peaks at short wavelengths ($\lambda_{max} \lesssim 0.4\mu m$, Patat et al. 2015), while for comparison, normal sight lines in the Milky Way have polarization peaks at $\lambda_{max} \sim 0.55\mu m$.

It is not well understood why SNe Ia sight lines display such different polarization profiles compared to what we observe in the Milky Way. Possible explanations are that the composition of interstellar dust in SNe Ia host galaxies is different from the dust in our Galaxy, or that there is circumstellar dust with an enhanced abundance of small grains, which was ejected from the progenitor system before the explosion, causing such peculiar polarization profiles.

We will discuss the peculiar polarization profiles of SNe Ia sight lines, compare them to sight lines in the Milky Way, and argue possible implications on the progenitor system.