PhD Open Days

Polarimetric Study of NGC-3244

PhD Program in Physics

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Motivation

Polarized light can be used to characterize dust in the interstellar medium (ISM). The largest effects of dust on astronomical observations are the extinction of light in the line of sight and the wavelength reddening it causes, both affecting distance measurements for cosmology when using extragalactic sources such as supernovae [1] (SNe). The size, shape and distribution of dust grains may also polarize the light as it traverses the ISM [2].

Interstellar polarization at optical, ultraviolet and infrared wavelengths has been widely studied in the Milky Way [3,4] (MW) but far less in other galaxies.

Objective

To perform a comprehensive study of multi-band polarimetric imaging data of Sne host galaxies. Accuratly describing the polarization of light by a target galaxy requires accounting, and correcting, for other sources of polarization, such as the sky, the instrumentation [5,6] and even dust within the Milky Way. Consequently, developing a reliable polarimetric imaging reduction methodology is of the utmost importance.

Past Work

Using polarimetric imaging data of NGC-3244, taken with the FORS2/IPOL instrument at the ESO Very Large Telescope, a preliminary study was performed to determine the best approach [5,7] to calibrate the raw acquisition data and obtain polarization estimates from the combination of several, calibrated, polarimetric images.

Fig. 1 presents both a calibrated polarimetric image of NGC-3244 in the B band and a polarization degree (P) map obtained from 8 such images.

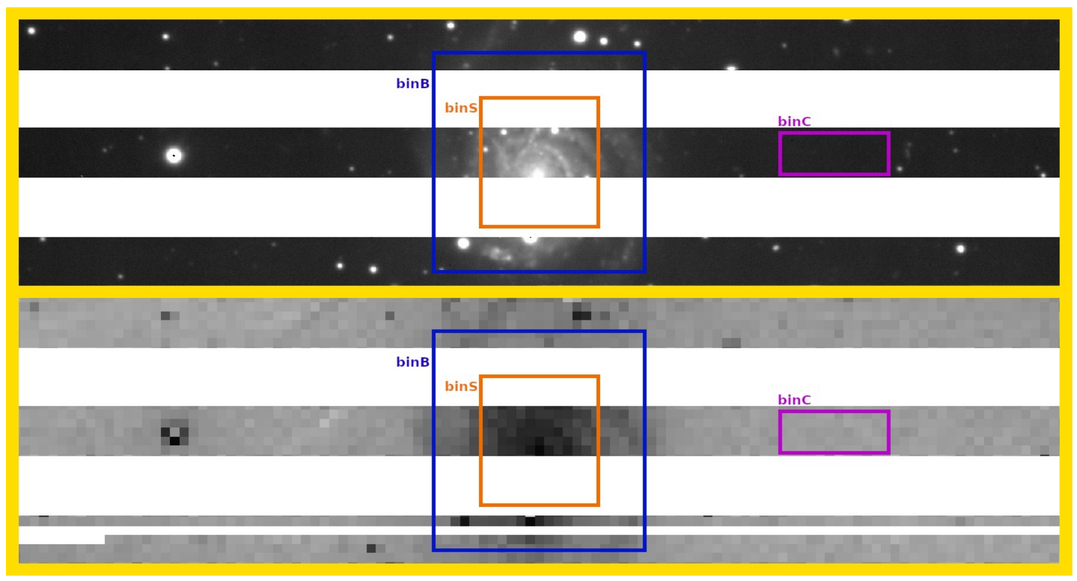

Fig.1: *On top, a polarimetric image, in the B band, of NGC-3244, taken with FORS2/IPOL; on the bottom, a binned, uncorrected, polarization degree map of NGC-3244, obtained by combining several polarimetric images. To study how polarization within the galaxy region three larger bins were selected: binS, focused on the center; binB, capturing most of the galaxy; and, binC, a control bin with no discernible objects, only sky.*

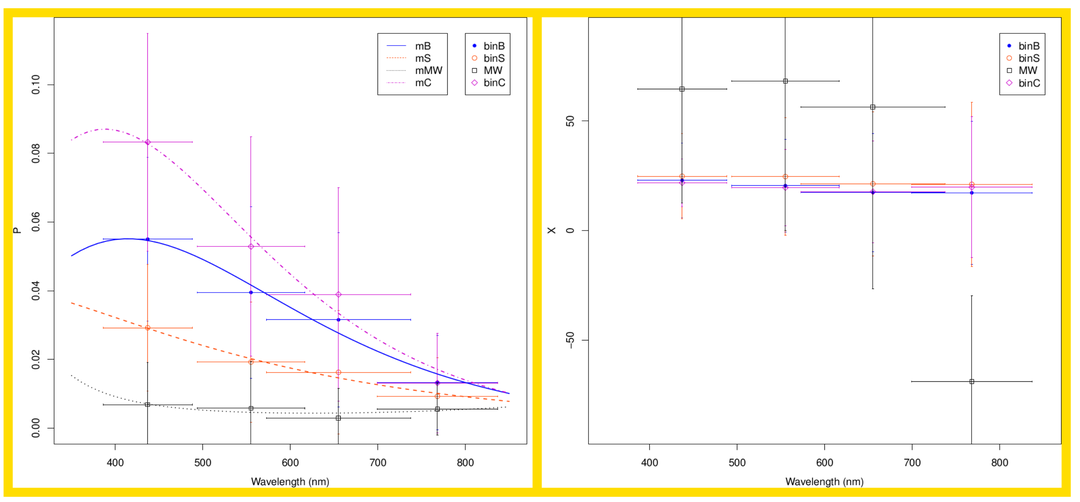

Fig.2: *On the left, the uncorrected polarization degree, P, - for binned regions of NGC-3244, delimited in Fig.1, and the Milky Way (estimated using a sample of field stars) - as function of the wavelength; the lines represent a Serkowski law model fitted to the data points. On the right, the polarization angle, χ, as function of the wavelength for same bins and Milky Way. The control bin displays greater P across the wavelength range, while for χ only the MW value appears to be significantly separated from others.*

Results

As mentioned previously, besides calibrating the acquisition data, proper accounting of polarimetric systematics is required. Comparing uncorrected polarization estimates for different regions of NGC-3244 and a polarization estimate of MW via photometry of a sample of field stars - whose photometry involves the statistical estimation and removal of the sky flux component - shows that the sky polarization signal dominates uncorrected estimates. In Fig.2 not only does the control bin display the higher P for all wavelength bands but also the values of χ for the MW are the only ones that significantly stand out.

It is also worth mentioning that the Serkowski law (1) fitted to the P of MW is not compatible with the literature [8,9], indicating another inadequacy of the unrefined methodology.

$$P = P_{max}\, e^{-K \ln^2\left(\frac{\lambda}{\lambda_{max}}\right)} \quad (1)$$

Ongoing Work

A preliminary methodology that accounts for sky, instrumental and Milky Way polarization has been developed. Present effort lies in attempting tunning it to adequately correct for sky induced polarization while at the same time keeping statistically significant polarimetric estimates.

References

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