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Magnetic fields in disks: A solution to an polarized ambiguity

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Abstract. Numerous numerical studies suggest that magnetic fields influence the transport of dust and gas, the disk chemistry, the migration of planetesimals within the disk, and above all the accretion of matter onto the star. In short: Magnetic fields are crucial for the evolution of planet-forming disks. First indirect comparisons of theory and observations support this picture (Flock *et al.* 2017); however, profound observational constraints are still pending. Recent studies show that the intrinsically polarized continuum emission, the classical tracer of magnetic fields, might trace other physics as well (radiation field or dust grain size). The nearly face-on protoplanetary disk HD 142527 shows predominantly radial polarization vectors consistent with aspherical grains aligned by a toroidal magnetic field (Fig. 1; Bertrang *et al.* 2017a,b; Ohashi *et al.* 2018). However, the number of cutting-edge polarization observations presenting inconclusive data, for which these three different origins of polarization are not clearly distinguishable, increases continuously. We present a solution to this polarized ambiguity: observations

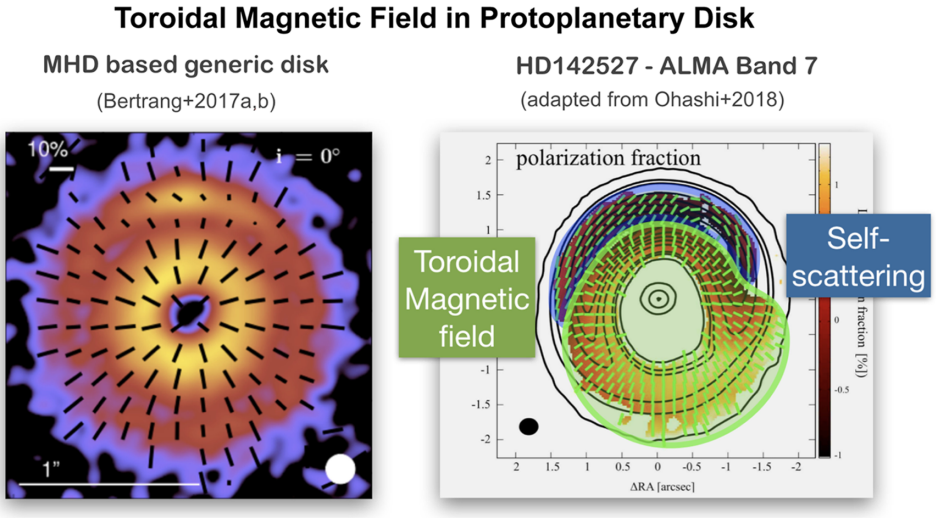

Figure 1. The predicted intrinsically polarized continuum emission of aspherical grains aligned by a toroidal magnetic field (*left*; Bertrang *et al.* 2017a,b) explains both the observed radial polarization vectors as well as the polarization fraction in the protoplanetary disk HD 142527 (*right*; green region). In the Northern part (blue region), the disk is optically thick and the polarization signal consistent with current models of self-scattering (Ohashi *et al.* 2018).

and simulations of the most direct tracer of magnetic fields, polarized gas emission, in combination with multi-wavelength continuum polarization observations will disentangle the sources of continuum polarimetry with ALMA (Bertrang *et al.* 2017a,b; Bertrang & Cortés in prep.).

Keywords. (stars:) planetary systems: protoplanetary disks, magnetic fields, polarization, radiative transfer, astrochemistry, radiation mechanisms: thermal, scattering, line: formation, (magnetohydrodynamics:) MHD, instabilities

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