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How to identify magnetic field activity in young circumstellar disks

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Abstract. Recent advanced simulations of protoplanetary disks allow us to search for observational constraints to identify the magnetic field activity in protoplanetary disks. With our 3D radiation non-ideal magneto-hydrodynamical (MHD) models including irradiation from an Herbig type star we are able to model the thermal and dynamical evolution in a so far never reached detail (Flock *et al.* 2017). The activity of the magneto-rotational instability in the inner hot ionized regions comes along with a magnetic dynamo. The oscillations in the mean toroidal magnetic field with a timescale of 10 local orbits can slightly bend the inner dust rim and so the irradiation surface. This causes a clear variability pattern in the near infrared (NIR) emission at the dust inner rim surface. Another way to identify the presence of magnetic fields are to search for polarization signatures. Using 3D non-ideal MHD simulations of the outer disk regions (Flock *et al.* 2015) we calculate synthetic images of the intrinsically polarized continuum emitted by aspherical grain aligned with the dominantly toroidal magnetic field (Bertrang *et al.* 2017). Our results show a clear radial polarization pattern for face-on observed disk, similar to recent observations by Ohashi *et al.* (2018). Additionally, we are even able to see the change of the polarization pattern inside the vortex as the poloidal magnetic field dominates therein.

Keywords. (stars:) planetary systems: protoplanetary disks, magnetic fields, (magnetohydrodynamics:) MHD, instabilities, polarization

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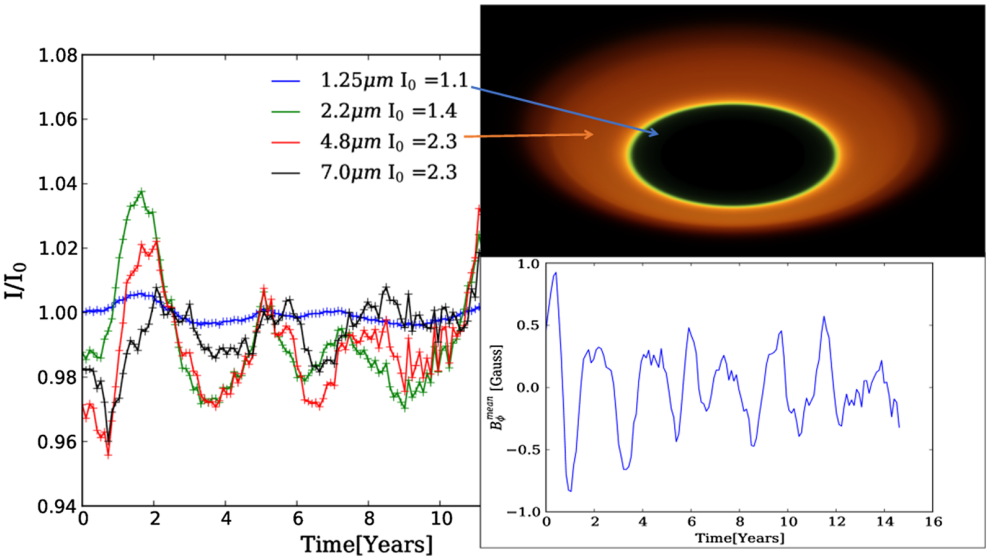

Figure 1. Left: Lightcurve of the simulation for different wavelengths. Top right: synthetic image for 3 different wavelength bands for the model. Bottom right: time evolution of the mean toroidal magnetic field at the inner dust rim.

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