Probing magnetic fields and dust content in Protoplanetary Disks using mid-infrared imaging polarimetry

Eric Pantin[1,2], Dan Li[1], Charles Telesco[1], Han Zhang[1] , Christopher M. Wright[3], Peter J. Barnes[1,4], Chris Packham[5,6], and Naibí Mariñas[1]

[1] Department of Astronomy, University of Florida, USA, [2]DRF/IRFU/SAp, CE Saclay, FRANCE, [3]School of Physical, Environmental, and Mathematical Sciences, University of New South Wales, Canberra, ACT 2610, Australia, [4]School of Science and Technology, University of New England, Armidale, NSW 2351, Australia, [5]Physics and Astronomy Department, University of Texas at San Antonio, 1 UTSA Circle, San Antonio, TX 78249, USA [6]National Astronomical Observatory of Japan, 2-21-1 Osawa, Mitaka, Tokyo 181-8588, Japan.

Polarimetry is a powerful tool to probe both magnetic fields and dust content in protoplanetary disks. As part of our broad program to understand the properties of magnetic fields in young disks and their environments, we carried out mid-IR polarimetric observations with CanariCam at the GTC of several Herbig Ae star disks, including AB Aur, HL Tau, and CQ Tau providing new insights into their physical properties.

AB Aurigae newly obtained datasets allow both to estimate stringent boundaries on the magnetic strength in the inner ~70 AU region and its spatial structure at a ~35 AU angular resolution. In the cases of CQ Tau and HL Tau, we also tentatively detect in the polarimetric signal signposts of the presence of magnetic fields in the inner regions.

In this paper, we will present the latests results from the analysis of CanariCam polarimetric data with emphasis on the key information they provide about the inferred magneto-rotational instability (MRI) mechanism, currently the best candidate for the source of disks viscosity. Finally, we show how the detection; or not; of 10 um scattered light by dust grains located at the surface of the disks carries also very new and crucial information about the size of the largest dust particles in these regions; establishing another possible connection with the MRI process through vertical mixing efficiency.