Contribution ID: **22** Type: **not specified**

Francesca Bacciotti - Layered molecular outflows and disk substructures: the HL Tau case

Tuesday, 13 June 2023 09:25 (20 minutes)

The HL Tau young system includes the iconic ringed disk revealed by the first ALMA images, but also powerful outflows, in the form of a collimated atomic jet, a wide angle H2 wind and a conical CO outflow. During the recent ALMA-DOT campaign, conducted at 0.”25 resolution, we found that the CO outflow shows a peculiar substructure in the velocity channel maps, consistent with a flow arranged in nested, detached flow surfaces with decreasing velocity toward the outer layers. This distribution is in line with the flow being an extended, inhomogeneous magnetized disk-wind launched from a region between 4 and 20 au from the star. As such, the outflow would be responsible for the removal of the excess angular momentum from the intermediate disk portion in which the effective turbulent viscosity is suppressed. In addition, the outermost two layers appear to be launched from the regions immediately adjacent to the first gap. This supports recent non-ideal MHD models (e.g. Suriano et al. 2019) according to which magnetic instabilities in the disk produce at the same time inhomogeneous layered MHD winds and rings/gaps in the disk, alternatively to the action of yet elusive protoplanets. The outflow from at least three other targets show similar features to the HL Tau one. The study of such winds in the millimeter range proves therefore to be crucial for the investigation of the planet formation process.

Session Classification: Planet-forming disks