Gaia EDR3 comparison of disk fractions from different spatial scales around young stellar clusters

I. Mendigutía[1,*], E. Solano[1,2], M. Vioque[3,4], A. Ribas[5]

CENTRO DE ASTROBIOLOGÍA
ASOCIADO AL NASA ASTROBIOLOGY INSTITUTE

CSIC

[1] Centro de Astrobiología (INTA-CSIC), ESA-ESAC campus, Madrid, Spain
[2] Spanish Virtual Observatory
[3] Joint ALMA Observatory, Santiago, Chile
[4] National Radio Astronomy Observatory, Charlottesville, USA
[5] European Southern Observatory, Santiago, Chile

[*] imendigutia@cab.inta-csic.es

SVO Spanish Virtual Observatory

ALMA NRAO ESO

Background

A stringent upper limit to the timescale when planets form is given by the lifetime of protoplanetary disks around young stars. A typical disk dissipation timescale < 10 Myr was inferred from surveys counting the relative number of stars with disks -the disk fraction- in young stellar clusters with different ages[1,2,3,4]. However, most previous surveys were focused on the compact regions within ~ 2 pc from the clusters' centers. It was hypothesized that due to the use of such a relatively narrow field of view (FOV) and because young clusters expand[5], the currently accepted disk fractions could be significantly underestimated[6]. The potential validity of this hypothesis would have fundamental implications on our view of planet formation and our own solar system.

Our goal is to test if disk fractions depend on the considered spatial scale around the center of the clusters

Method

Gaia EDR3 proper motions, parallaxes, and magnitudes, along with a best-suited, Virtual Observatory-based tool (Clusterix[7,8,9]), were used to identify member stars for a sample of young stellar clusters. Members were identified considering two different FOVs, extended and compact, with radii corresponding to ~ 20 pc and ~ 2 pc from the center of each cluster. Disk fractions associated to each FOV were inferred from 2MASS J-H vs H-K color-color diagrams and compared to each other (Fig. 1)

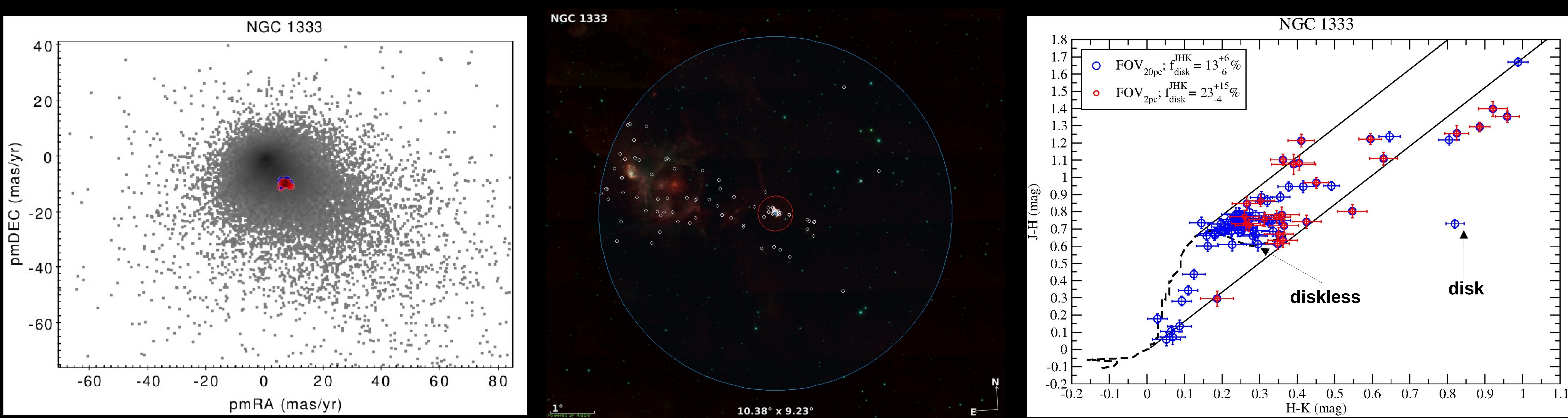

__Fig. 1. Example: the young cluster NGC 1333. (Left)__ Proper motion distribution where the gray symbols are field stars and the blue and red symbols the members identified using the extended and the compact regions, respectively. __(Middle)__ Sky projection where the previous members identified with Clusterix are plotted as white circles. The sizes of the extended and compact regions used for the identification are indicated with the blue and red circles, respectively. __(Right)__ JHK color-color diagram. Disk fractions are indicated in the legend, as inferred from the members within the extended and the compact regions (blue and red symbols, respectively). The dashed line represents the expected position of non-extincted Main Sequence stars in the diagram, and the solid lines the direction of the extinction vector. Sources located to the right of the right-hand solid line are considered disk stars.

Preliminary result

The previous procedure has been applied to 10 young stellar clusters to date. Although the density of members is smaller in the periphery, the absolute number of member stars in the extended regions can be up to a factor 10 larger than in the compact regions. However, __our preliminary analysis reveals no significant difference between the corresponding disk fractions, considering errorbars__ (Fig. 2)

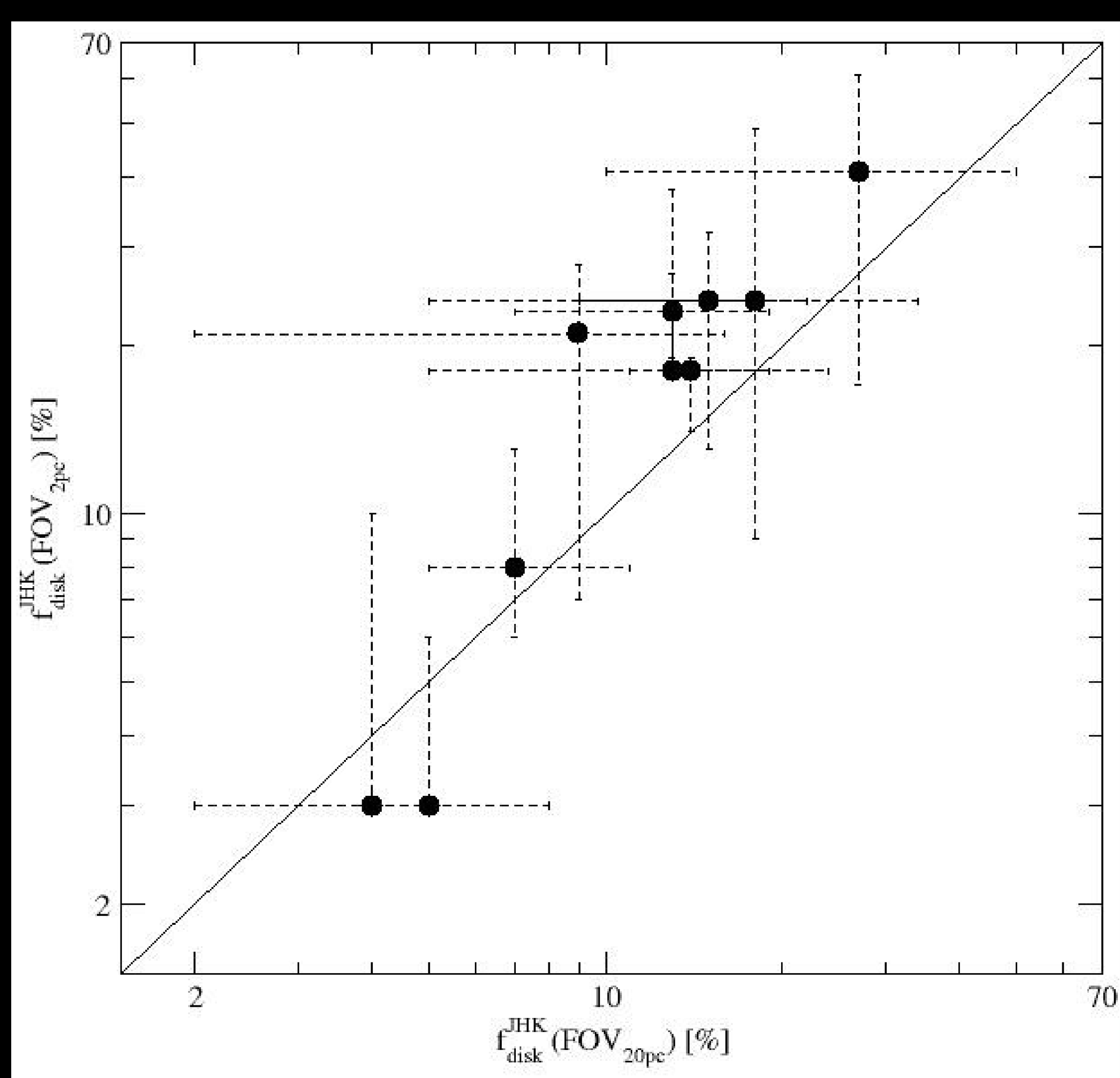

__Fig. 2. Preliminary result:__ Comparison between disk fractions inferred from the compact and the extended region for the 10 young clusters analysed so far. The solid line indicates equal values.

Near Future

We aim at establishing a firm conclusion on the possible influence of the spatial scale on disk fraction estimates. To this end, we will populate the diagram in Fig. 2 with a statistically significant sample of young and nearby clusters (< 15 Myr; < 2 kpc) representing different conditions in terms of evolutionary stage, mass, and cluster expansion. The resulting database will be stored in a Virtual Observatory-compliant archive. It will constitute a benchmark for future, detailed studies of young stellar clusters and disk fractions.

References

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9: See poster by Balaguer-Nuñez