

## Dynamical Analysis of Nearby ClustErs

#### Hervé BOUY

and the DANCe Team:

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# NEED TO COMPLEMENT GAIA

GAIA complete up to G~20mag ~15 M<sub>Jup</sub> at 3Myr and 150 pc

#### Reason #I: Sensitivity

Mass Function goes down to  $3 \sim 4 M_{Jup}$ 

(cf. E. Moraux Talk yesterday)



# NEED TO COMPLEMENT GAIA Reason #2: Extinction & Nebulosity



#### Scientific Goals: Young Clusters & Associations

I.Detailed census (mass & luminosity functions) beyond Gaia's limit

2.Study of internal dynamics as a function of mass, age, environment. Compare with numerical simulations (cf E. Moraux Talk)

#### Method

Using multi-wavelength photometry and high precision astrometry:

- I. Find members down to the substellar and planetary mass regimes
- 2. In the embedded cores of young nearby associations

#### FIRST DANCE FLOOR: THE PLEIADES

5 telescopes

9 instruments 15 yr time baseline ~16500 images 1.ITB of data 100×10<sup>6</sup> detections

I TB of RAM



# RESULTS

#### In the ICRS!



# RESULTS

#### In the ICRS!





I) Select in VPD

 $\begin{array}{c} 20 \\ 0 \\ 0 \\ -20 \\ -40 \\ -60 \\ -20 \\ 0 \\ 20 \\ 0 \\ -60 \\ -20 \\ 0 \\ -60 \\ -20 \\ 0 \\ -60 \\ -20 \\ 0 \\ -60 \\ -20 \\ 0 \\ -60 \\ -20 \\ 0 \\ -60 \\ -20 \\ 0 \\ -60 \\ -20 \\ 0 \\ -60 \\ -20 \\ -20 \\ -60 \\ -20$ 

2) Clean in successive Color-Mag diagrams



I) Select in VPD







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2) Clean in successive Color-Mag diagrams



1921 astrometric candidates...

only 823 have both i and J

#### I) Select in VPD

2) Clean in successive Color-Mag diagrams



#### Problems:

- Censored data?
- Theoretical isochrones: unreliable at young ages!
- Uncertainties on the measurements?
- How to derive robust **quantitative** membership probabilities?









- ✓ Best combination of color-magnitude diagram is found using Bayesian Information Criterion
- ✓ full treatment of **censored** data
- ✓ full treatment of **uncertainties**
- ✓ coherent and homogeneous membership probabilities
- ✓ fully empirical sequences (using Principal Curves, not theoretical tracks)
- ✓ scalable: add more dimensions! variability, Vrad, rotation, spatial distribution, ...

## RESULTS



# PERSPECTIVES

| FAST ASSOCIATIONS |              |                  |                 |                  |  |
|-------------------|--------------|------------------|-----------------|------------------|--|
| Name              | Age<br>[Myr] | Distance<br>[pc] | µRA<br>[mas/yr] | µDec<br>[mas/yr] |  |
| Pleiades          | 120          | 120              | -35             | -15              |  |
| CrA               |              | 130              | -35             | 51               |  |
| <b>η</b> Cha      | 9            | 100              | -30             | 28               |  |
| Cha I, II & III   | 3            | 140              | -20             | -5               |  |
| Upper Sco         | 5            | 125              | -9              | -24              |  |
| $\alpha$ Per      | 50           | 180              | 24              | -26              |  |
| IC2391            | 55           | 155              | -25             | 23               |  |
| IC2602            | 50           | 145              | -22             | 10               |  |
| Lupus             | 3            | 140              | -17             | -27              |  |
| Praesepe          | 650          | 180              | -36             | -13              |  |
| Ophiuchus         | I            | 145              | -10             | -25              |  |
| Taurus            | 3            | 140              | -8              | -25              |  |
| Blanco I          | 100          | 210              | 19              | 4                |  |
| Hyades            | 625          | 40               | 90              | -20              |  |
| $\gamma$ Velorum  | 5            | 350              | -6              | 10               |  |
| NGC2451           | 10           | 300              | -10             | 4                |  |

"EAST" ACCOCLAT

| <b>"SLOW"</b> Associations |              |                  |  |  |  |
|----------------------------|--------------|------------------|--|--|--|
| Name                       | Age<br>[Myr] | Distance<br>[pc] |  |  |  |
| Cygnus OB2                 |              | 2000             |  |  |  |
| IC348                      | 3            | 350              |  |  |  |
| NGC1333                    | I            | 350              |  |  |  |
| Serpens                    | 3            | 450              |  |  |  |
| ONC                        | I            | 400              |  |  |  |
| NGC1980                    | 10(?)        | 400(?)           |  |  |  |
| NGC2264                    | 5            | 670              |  |  |  |
| IC4665                     | 40           | 350              |  |  |  |
| <b>λ</b> -Ori              | 5            | 400              |  |  |  |
| <b>σ</b> -Ori              | 5            | 350              |  |  |  |





# PROBLEMS AND LIMITATIONS

#### Very inhomogeneous datasets:

- very different sensitivities
- different resolution (seeing)
- different ambient conditions (hence astrometric accuracy)...

making it sometimes difficult to interpret the results

#### But Gaia will have similar problems...

#### So far limited to proper motion:



- need parallax for 6D





#### but DANCe is very rich nevertheless!

We are interested in cluster and associations but much more science can be extracted from our catalogues!

#### **"DANCe is like a Poor Man's LSST"** E. Bertin

- galactic populations,
- asteroids,
- white dwarfs,
- nearby brown dwarfs

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~3 mag deeper than Gaia, and up to K-band !

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# Wanna DANCe with us?

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