Kinematic of stellar systems with HRMOS

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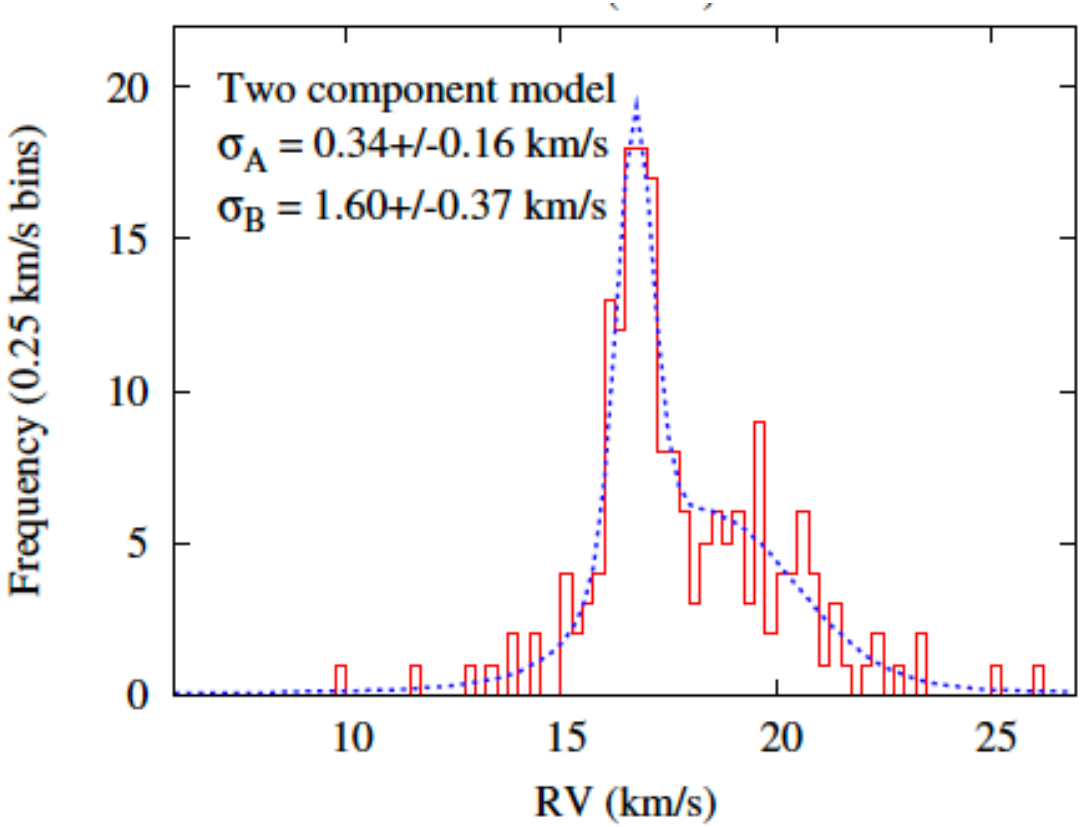
Kinematic of stellar systems

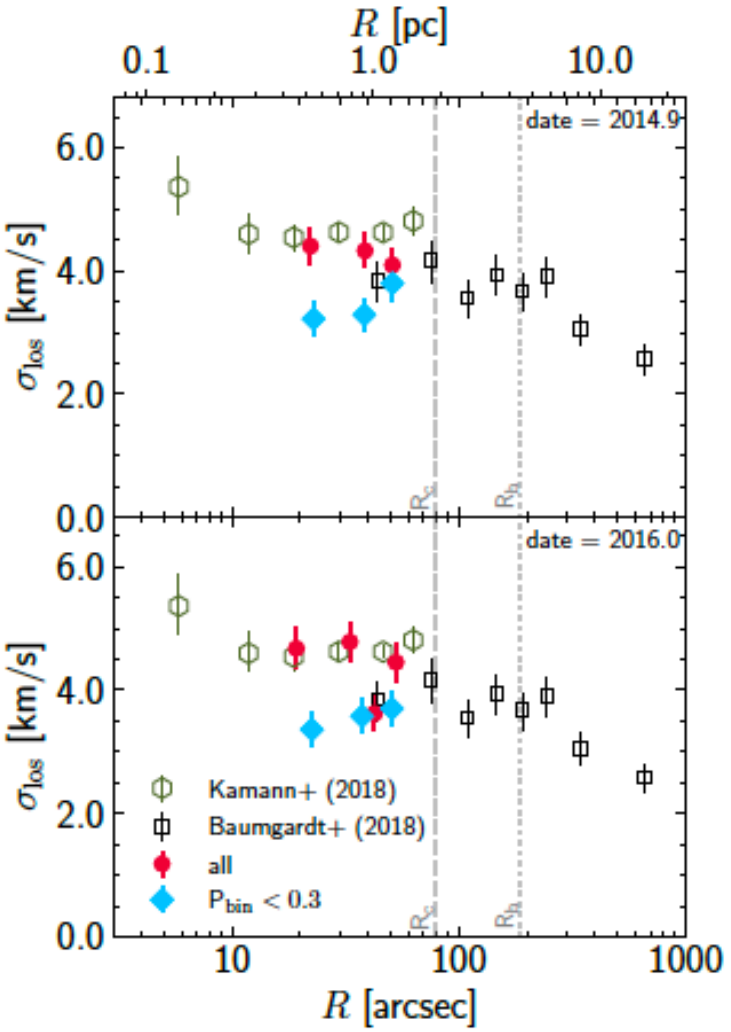
- Powerful way to separate genuine members from field stars and separate multiple populations
- Only way to measure the total mass of the system
- Allow us to investigate the past and future dynamical evolution
- Based on measurements that are not model dependent



(Jeffreis et al. 2014)

Kinematic of stellar systems

- Projection effects and stochasticity need to be taken into account
- Presence of binaries (e.g. Rastello et al. 2021, Aros et al. 2021)
- Error distributions not gaussian and difficult to determine (e.g. Jackson et al. 2015)



(Aros et al. 2021)

Kinematic of stellar systems with MOS

Stellar systems in the local group and beyond

Disperse and unbound populations

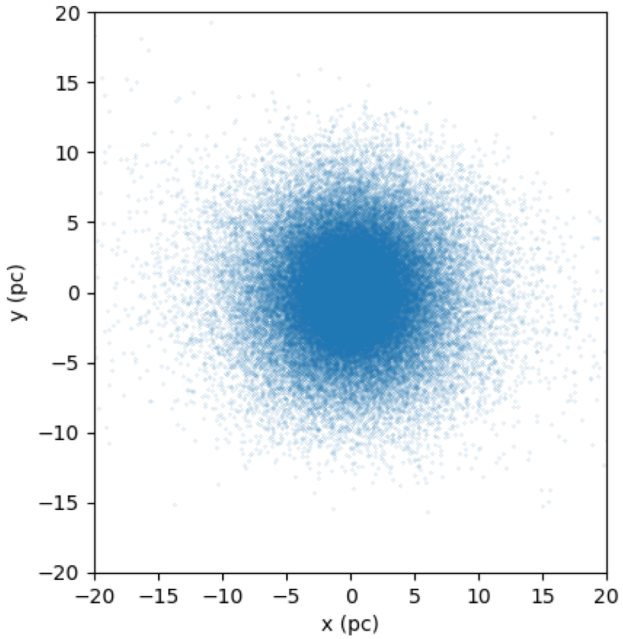
HRMOS

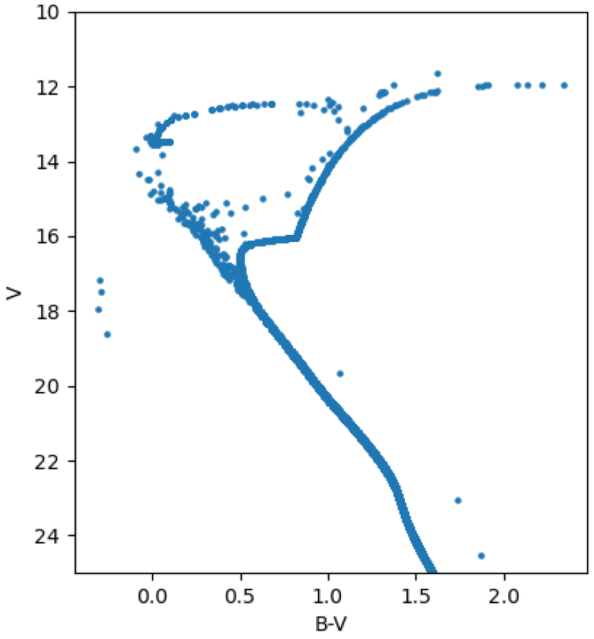
High precision kinematic of compact system

Extincted and embedded populations

Kinematic of M4 with HRMOS

Snapshot of a simulation aimed to reproduce the evolution of M4
(Heggie 2014, Henault-Brunet et al. 2019)





Age = 12 Gyr
Mass = 7 x 10^4 $M_\odot$
R_{hm}= 3.14 pc

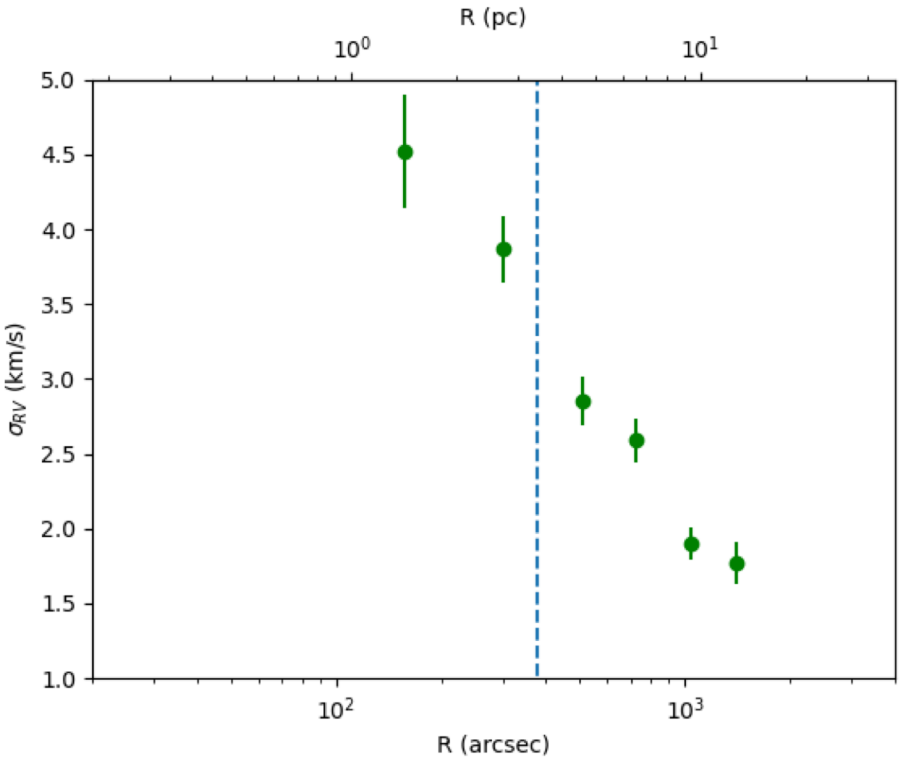
d= 1.8 kpc
E(B-V) = 0.37 mag
(Hendricks et al. 2012)

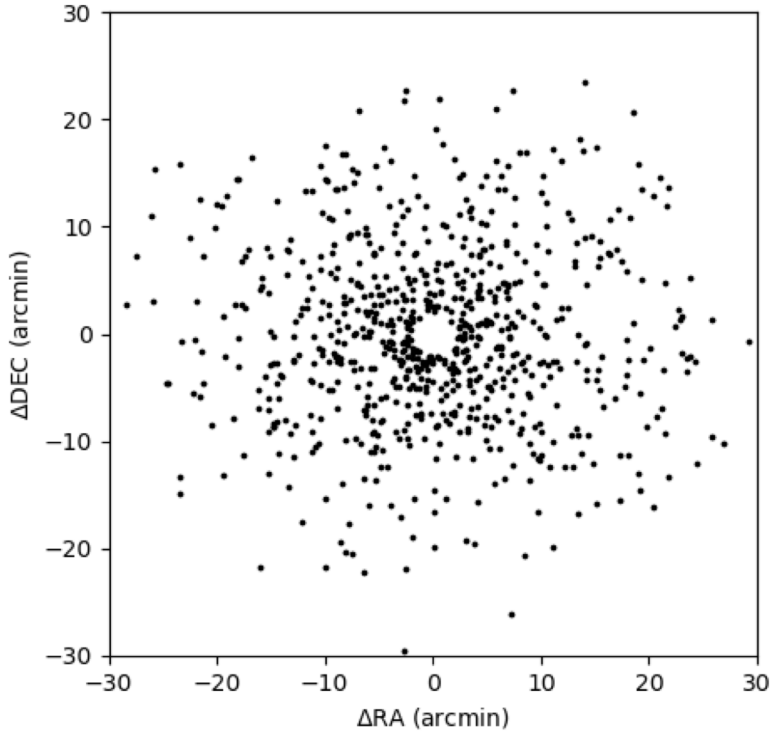
<u>The goal is to test HRMOS performance for studying:</u>

1. velocity dispersion
2. rotation
3. binarity

Velocity dispersion of M4 with HRMOS

Stars = 750
Magnitudes = 15 < V < 19 mag
$\Delta RV = 50\ m/s$
Gaussian errors
Seeing limited
VLT FoV



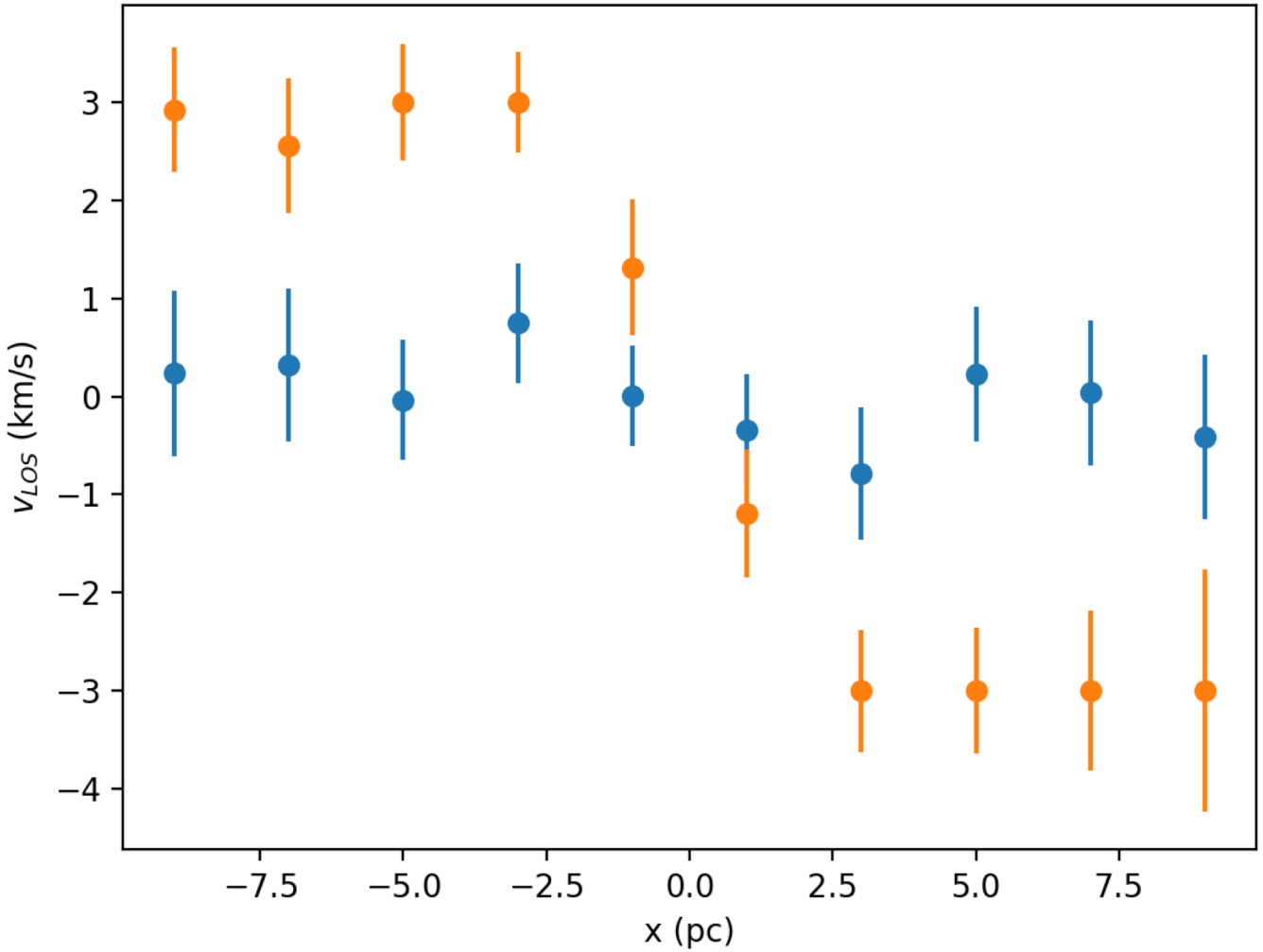


- Errors in the inner part of the clusters dominated by projection effects and stochasticity
- Very complementary to AO assisted spectrograph

Rotation of M4 with HRMOS

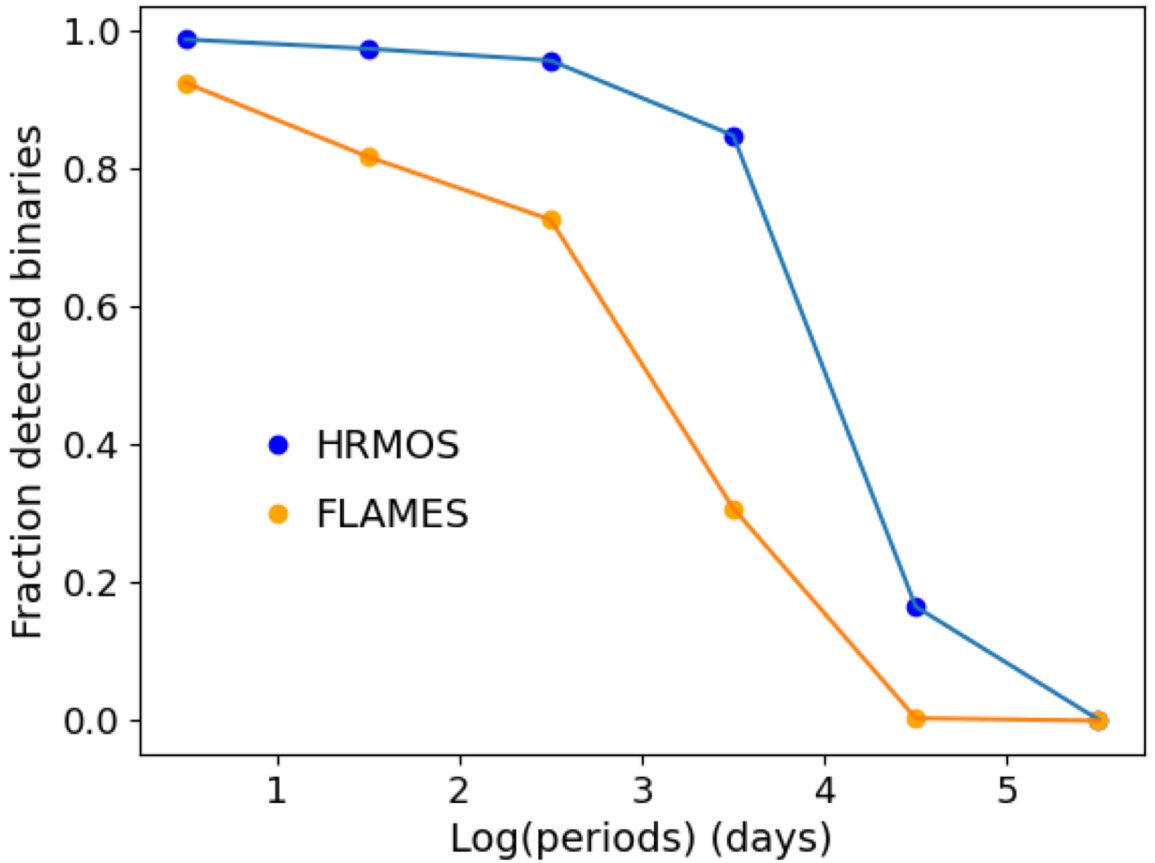
Model of a rotating cluster based on the M4 snapshot

- Fast rotating cluster $\frac{v_{rot}}{\sigma}$ =0.2
- Slow rotating cluster $\frac{v_{rot}}{\sigma}$ =0.04



Binaries with HRMOS

- Binary velocity shift calculated as in Cottaar et al. (2012) assuming a mass ratio distribution from Reggiani & Meyer 2011
- Gaussian error on RV measurements $\Delta RV = 50\ m/s$ for HRMOS and $500\ m/s$ for FLAMES
- We classified as detected binaries all stars with RV variation in one year > 4σ

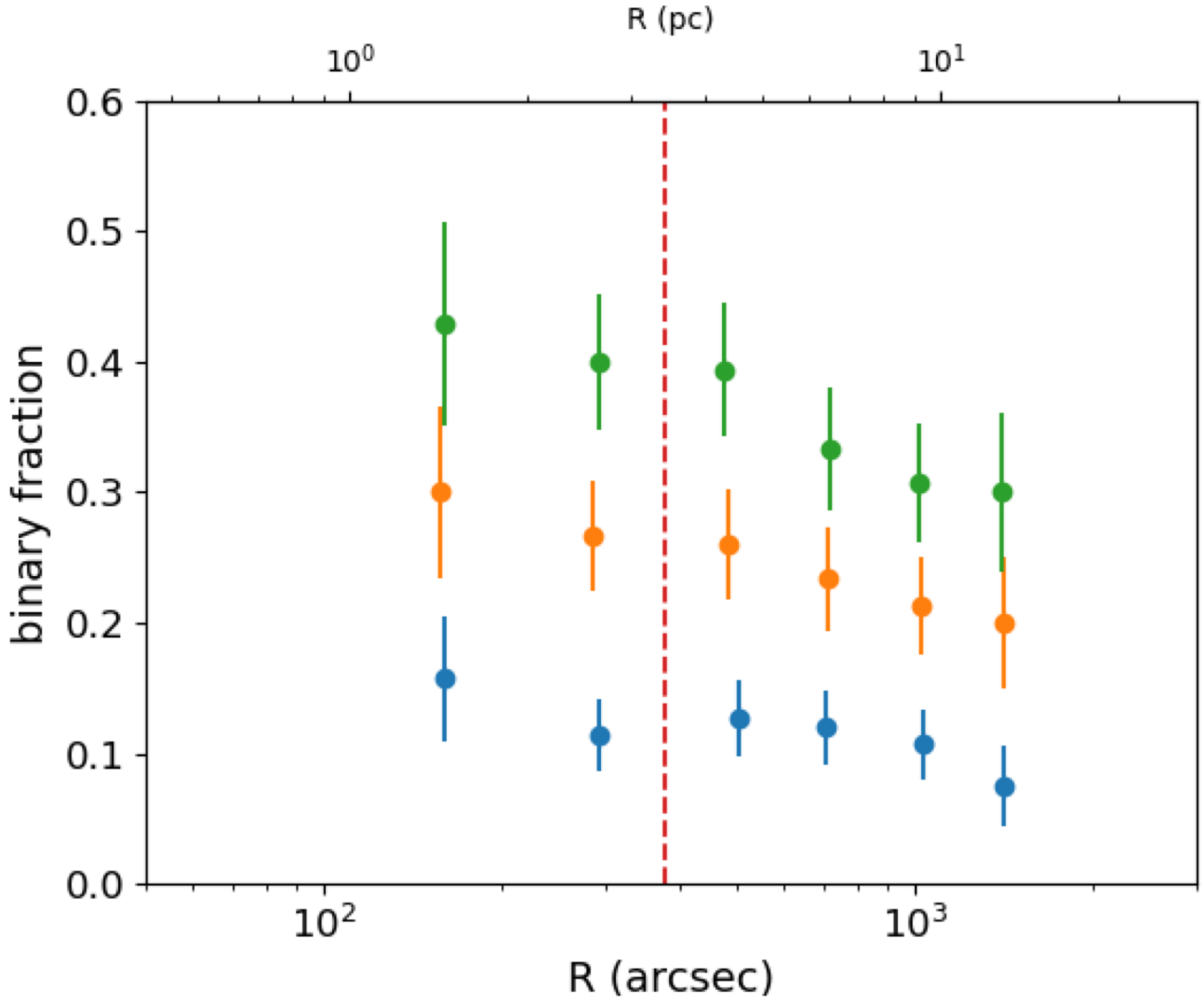


Binaries of M4 with HRMOS

Measured binary fraction assuming that

$$f_{bin} = f_{bin}(0)\left(\frac{R}{R_{HM}}\right)^{-0.25}$$

- $f_{bin}(0) = 0.3$
- $f_{bin}(0) = 0.2$
- $f_{bin}(0) = 0.1$



Conclusions

- HRMOS could become a powerful machine to investigate the kinematic of compact stellar systems
- HRMOS can play a complementary role to high spatial resolution instruments for studying velocity dispersion, rotation and asymmetries
- A better understanding of binary properties is fundamental for dynamical modelling of stellar systems and HRMOS is the right instrument for significant progresses
- This is just a very preliminary study, but we will be happy to expand it