



Exoplanet discovered in Clusters – Are they different?

Mingjie Jian¹ M1
1 Department of Astronomy, Graduate School of Science, University of Tokyo



ABSTRACT

More than three thousand exoplanets are discovered nowadays. Most of them are orbiting a field star which located in a subtle environment with a low stellar density inside our galaxy. Clusters, the assemble of stars, create an environment with a much higher stellar density and stars inside are easier to be effected by other companion. The planet formation inside clusters, as well as the possible migration and even the intelligent communication, will be distinguished from normal exoplanets.

OBSERVATION

Global Cluster

Only 1 exoplanet (PSR B1620-26 b) is discovered in global cluster (Messier 4). It orbits the binary star form by a pulsar and white dwarf; this system may be formed by a capture of neutron star and a single-planet system.

Figure 1 | The evolution of the PSR B1620-26 system.

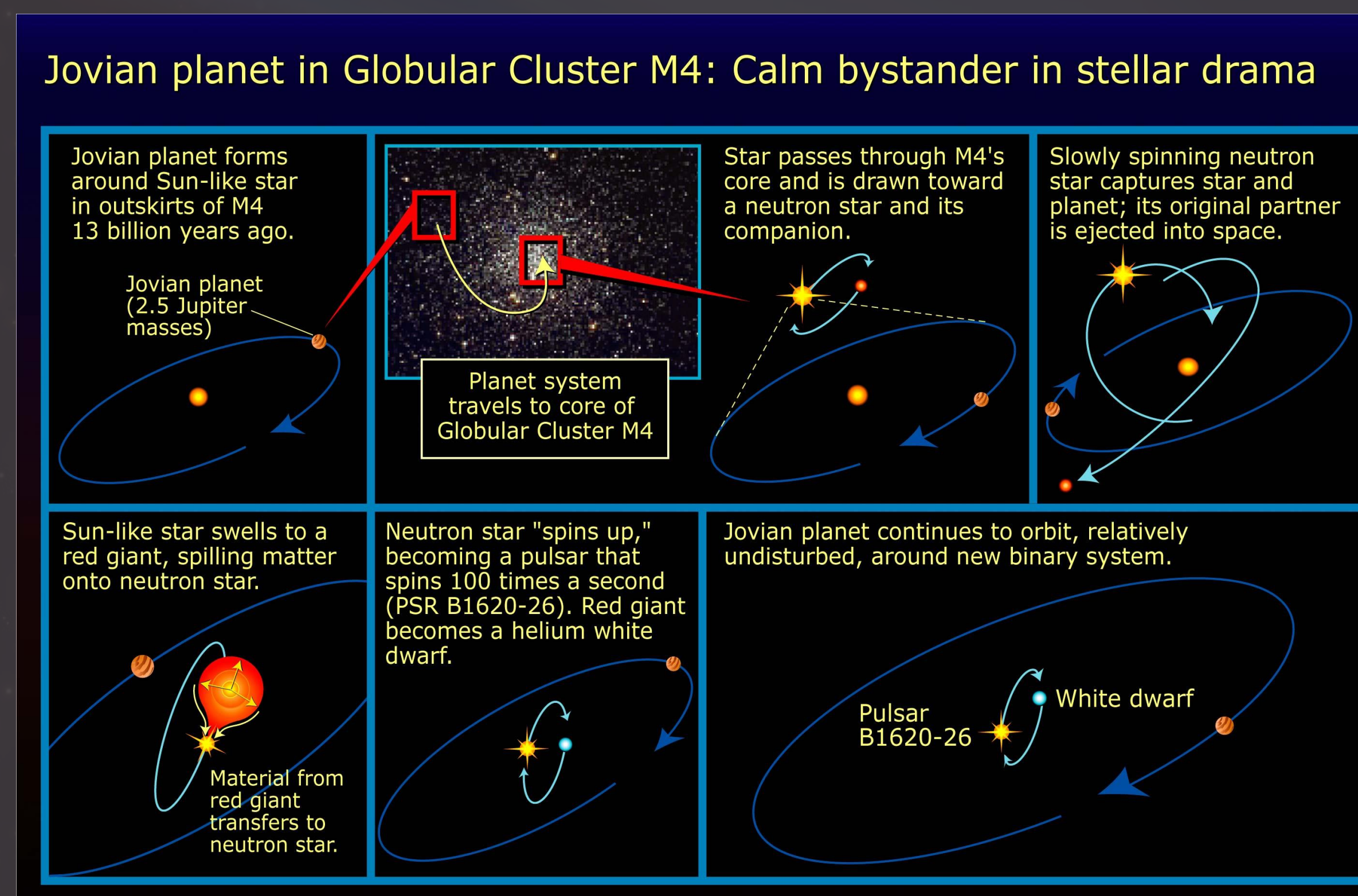
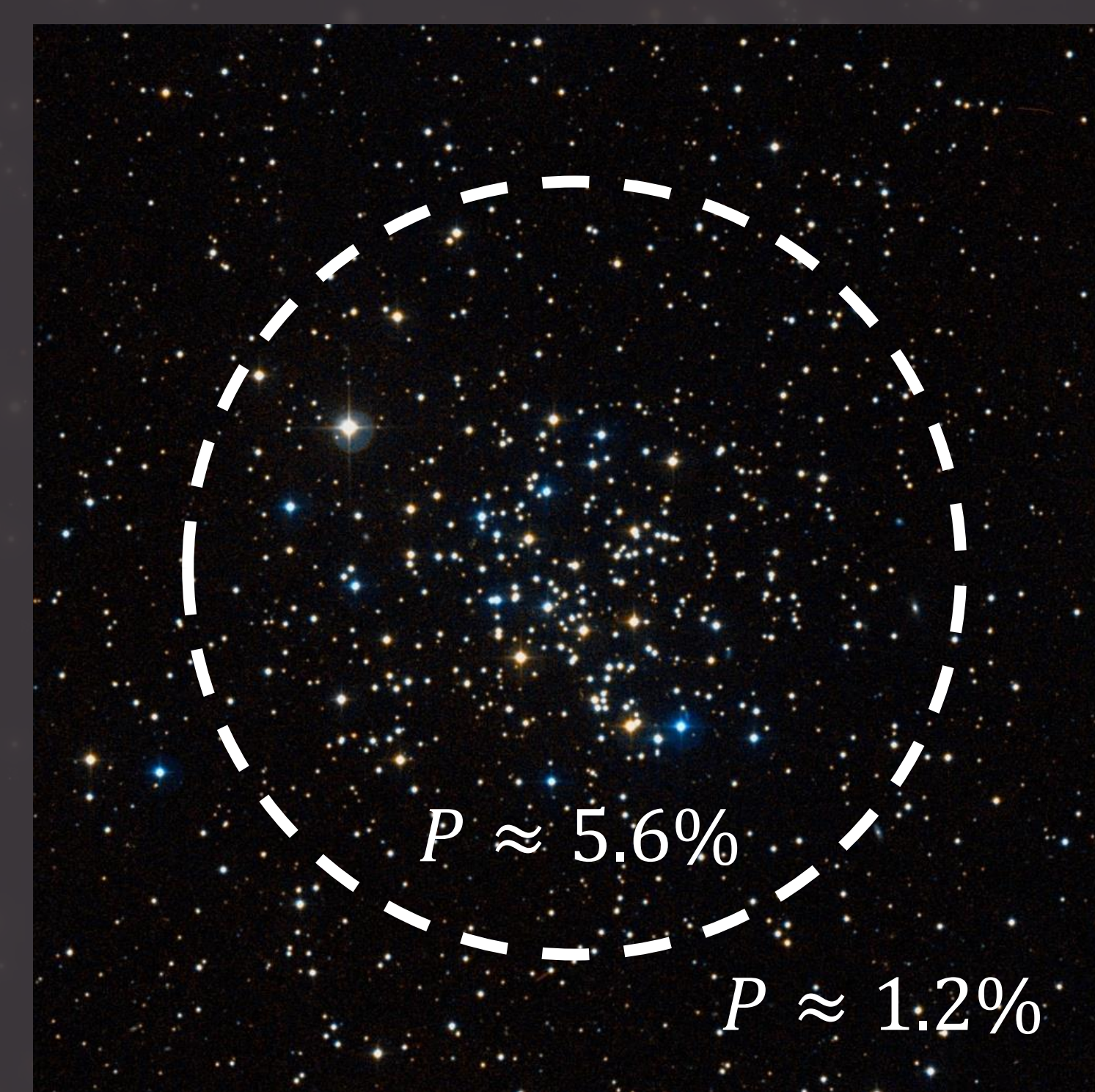


Figure 2 | Hot Jupiter discover rate inside and outside M 67



Open Cluster

At least 13 exoplanets are discovered. They include 2 long-period massive planets, 6 hot Jupiters, 2 Neptune like planets, 2 hot Neptunes and a long period giant planet.

Higher discover rate of hot Jupiter is presented inside open cluster than outside. Brucalassi et al derived the rate of 5.6% from observing the radial velocity of 53 single star in open cluster M67, which is fourth higher than the rate of 1.2% for field stars. Though there are many possible reasons, such as stellar metallicity and mass, effective to the increase of the rate, Brucalassi et al state the environment is the most important effective element.

MODELS

Models of exoplanets inside clusters, which contains a large amount of stars, cannot be easily finished until recently, the improvement of software and hardware. Three types of modelling and a summary of the result are listed here:

Single Planet System

Single planet system provide the upper stability limit. However, they are easier to be disrupted by the encounters.

Free Floating Planet (FFP)

Four kinds of FFP movement are predicted by the models.

1. FFPs with high velocity will escape from the cluster immediately;
2. Few others will re-captured by other star;
3. The majority of low velocity FFPs will likely migrate to outside part of the cluster;
4. Finally, they will escape through ejection or evaporation.

Multi-Planet System

The modeling of multi-planet system is much harder than those two. Hao et al state that both star encounter and a close-in planet will effect the planet movement, cause orbit variation or planet collision.

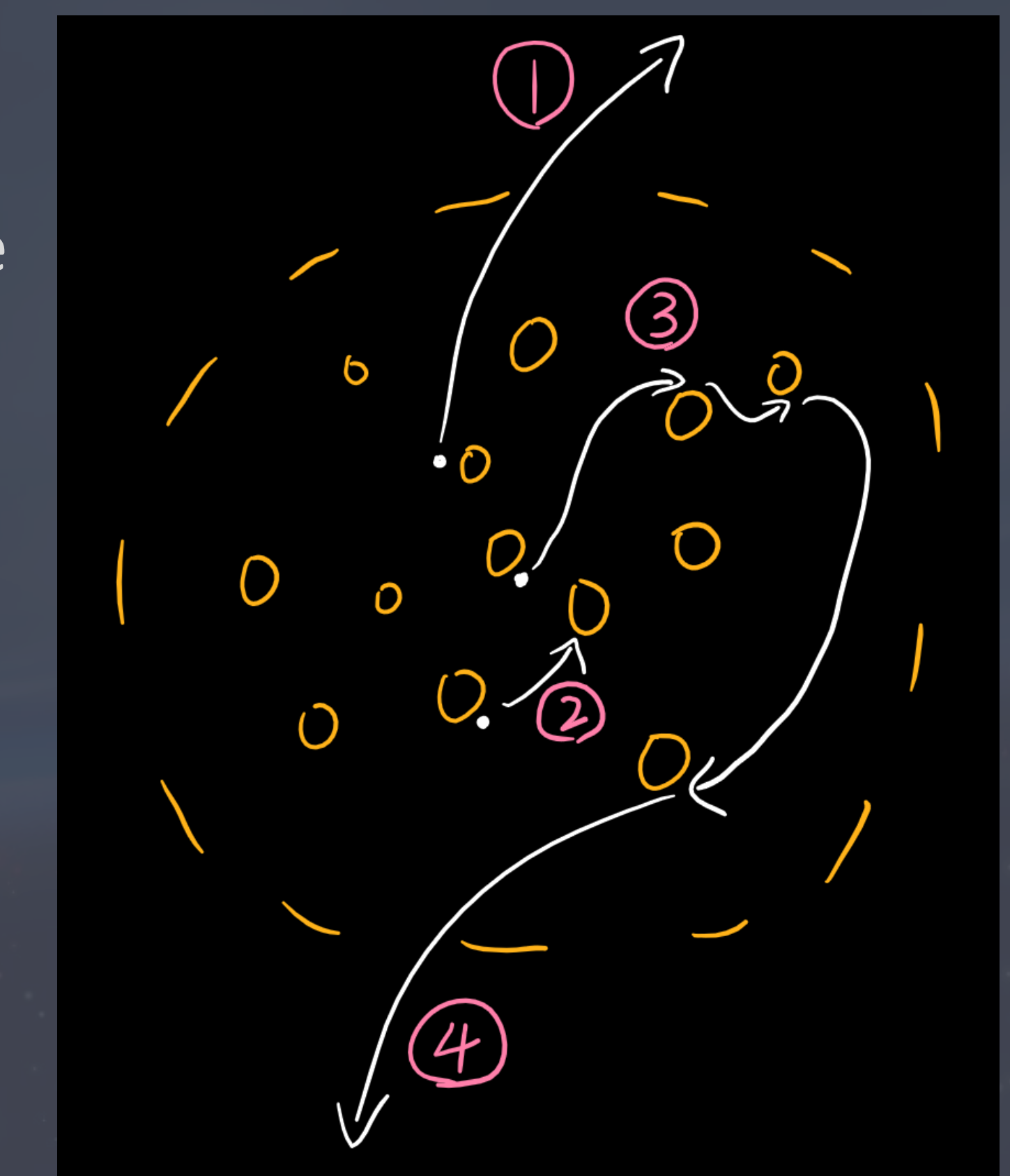


Figure 3 | Four movements of stars inside cluster by modelling.

CONCLUSIONS

- The hot Jupiter discover rate inside open cluster is higher.
- Planets inside cluster will encounter more serious effect from other stars.
- Based on the number discovered, it is hard to say whether they have different physical properties then those outside cluster.

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