SCIENCE WITH IMAGING VETTING DATA

Mariangela Bonavita

The Open University

The Open University

WHY IS IMAGING VETTING NEEDED?

PIC NOT BIASED

AGAINSTBINARY HOSTS

PIC INCLUDES MOSTLY FGK STARS:

> 50% OF PLATO HOSTS COULD BE BINARIES

MULTIPLICITY ASSESSMENT NEEDED

TO PROPERLY CHARACTERISE HOST

AND AVOID ERRORS ON PLANET PARAMETERS

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GAIA ALLOWS TO IDENTIFY MOST COMPANIONS > 1”

AND

MOST CLOSE SB2 ARE ALREADY KNOWN

A DEDICATED IMAGING CAMPAIGN IS NEEDED TO IDENTIFY COMPANIONS AT INTERMEDIATE SEPARATIONS

WHAT ELSE CAN WE DO WITH ALL THE PIC BINARIES?

PIC NOT BIASED AGAINSTBINARY HOSTS

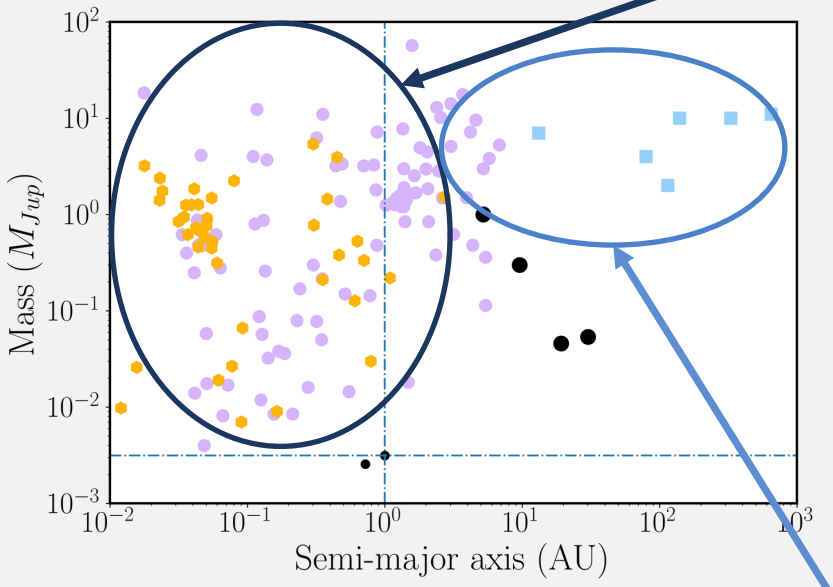
PIC INCLUDES MOSTLY FGK STARS:
> 50% OF PLATO HOSTS COULD BE BINARIES

MULTIPLICITY ASSESSMENT NEEDED TO PROPERLY CHARACTERISE HOST AND AVOID ERRORS ON PLANET PARAMETERS

THE BY-PRODUCT OF THE VETTING WILL BE AN IDEAL SAMPLE TO CHARACTERISE THE IMPACT OF BINARITY ON PLANET FORMATION AND OCCURRENCE

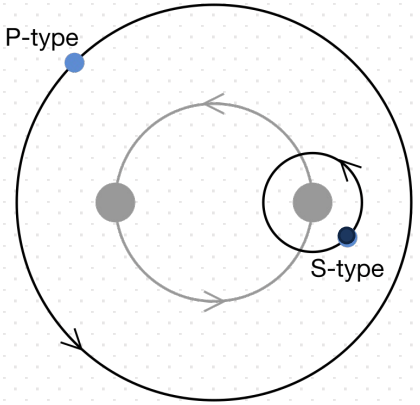
WHY (EXOPLANETS IN) BINARY STARS?

EXOPLANETS IN BINARY STARS



S-type

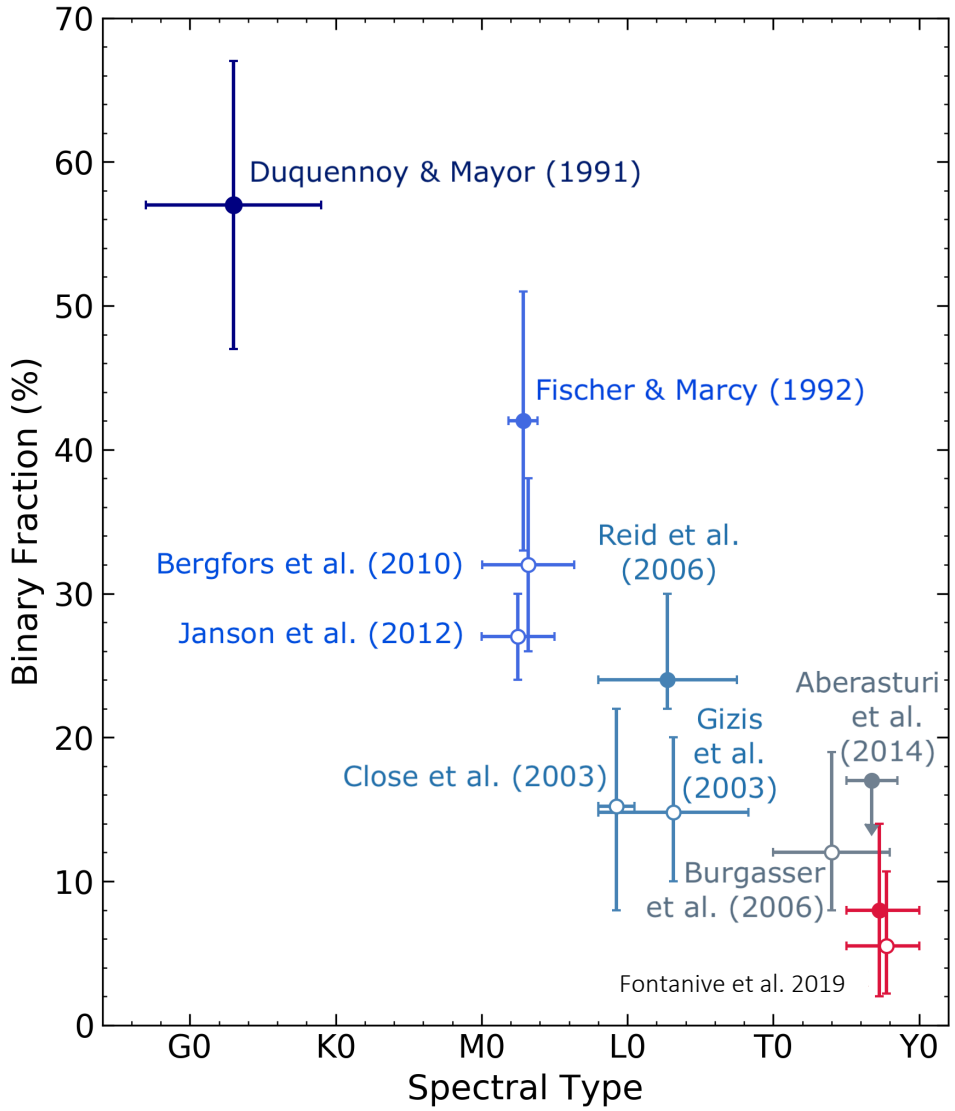
- ❑ THE PLANET ORBITS ONE OF THE STARS
- ❑ STABLE ORBITS ARE CLOSER TO THE HOST
- ❑ MOSTLY DETECTED WITH INDIRECT METHODS



P-type

- ❑ THE PLANET ORBITS BOTH STARS
- ❑ WIDER ORBITS ARE MORE STABLE
- ❑ GOOD TARGETS FOR DIRECT IMAGING

EXOPLANETS IN BINARY STARS?



COULD REPRESENT A SIGNIFICANT PORTION OF THE GALAXY'S PLANET POPULATION

MOST EXOPLANET SURVEYS EXCLUDE BINARIES FROM THEIR TARGET LISTS

SEVERAL EXOPLANET HOSTS HAVE BEEN FOUND TO HAVE STELLAR COMPANIONS

WHY DO WE NEED AN UNBIASED SAMPLE?

SPOTS (Search for Planets Orbiting Two Stars)

FIRST MULTIPLICITY CENSUS OF DIRECT IMAGING SURVEY TARGETS

(Bonavita et al. 2018)

FIRST RV TARGETS

FIRST COMPLETE ASSESSMENT OF THE BINARITY OF THE TARGETS OF THE FIRST RV SURVEYS

(Bonavita & Desidera al. 2020)

SHINE BINARIES

FULL CENSUS OF BINARY EXOPLANETS HOSTS WITHIN 200pc

(Fontanive & Bardalez-Gagliufi 2021)

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DESPITE A STRONG EXPLICIT BIAS AGAINST BINARIES

~30-40%

OF DIRECT IMAGING AND RV SURVEYS TARGETS HAVE STELLAR COMPANIONS

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BECAUSE OF THE SELECTION BIASES

THE RESULTING SAMPLE OF PLANETS IN BINARIES IS INCOMPLETE

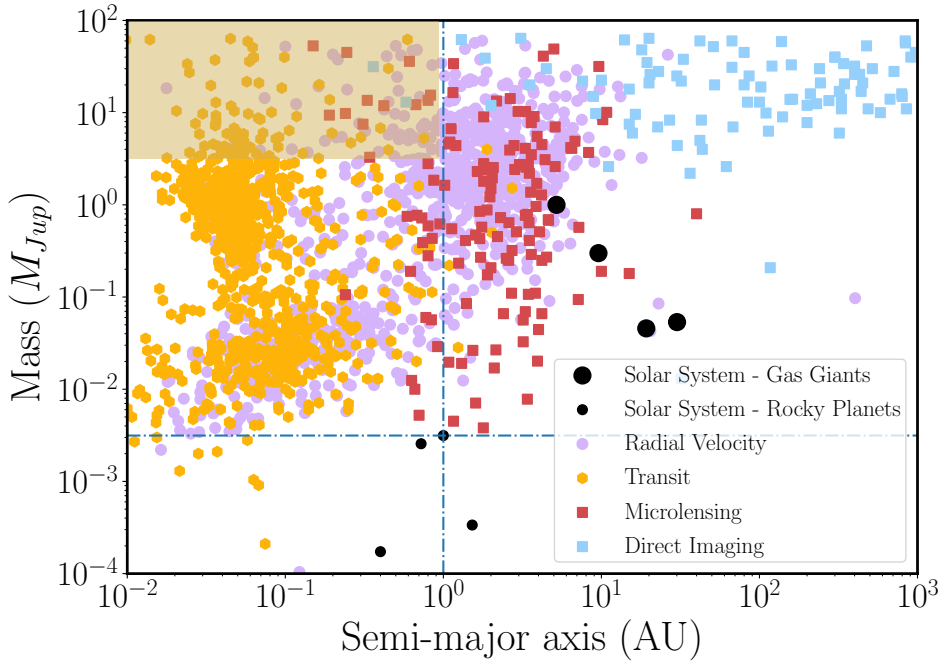
THE FRIENDS OF HOT JUPITER SURVEY (Fontanive et al. 2019)

THE POWER OF A FOCUSED BINARITY ASSESSMENT

CAN BINARITY SOLVE THE MASSIVE HOT JUPITER PROBLEM?

DEDICATED IMAGING SURVEY
+
GAIA CROSS MATCH
+
LITERATURE SEARCH

THE FORMATION OF MASSIVE (>7M_{JUP}) HOT JUPITERS (< 1AU) COULD BE EXPLAINED BY GRAVITATIONAL INSTABILITY + A MASSIVE COMPANION WITHIN 200-250AU



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38 STARS HOSTING MASSIVE HOT JUPITERS

DEDICATED IMAGING SURVEY
+
GAIA CROSS MATCH
+
LITERATURE SEARCH

80% BINARIES

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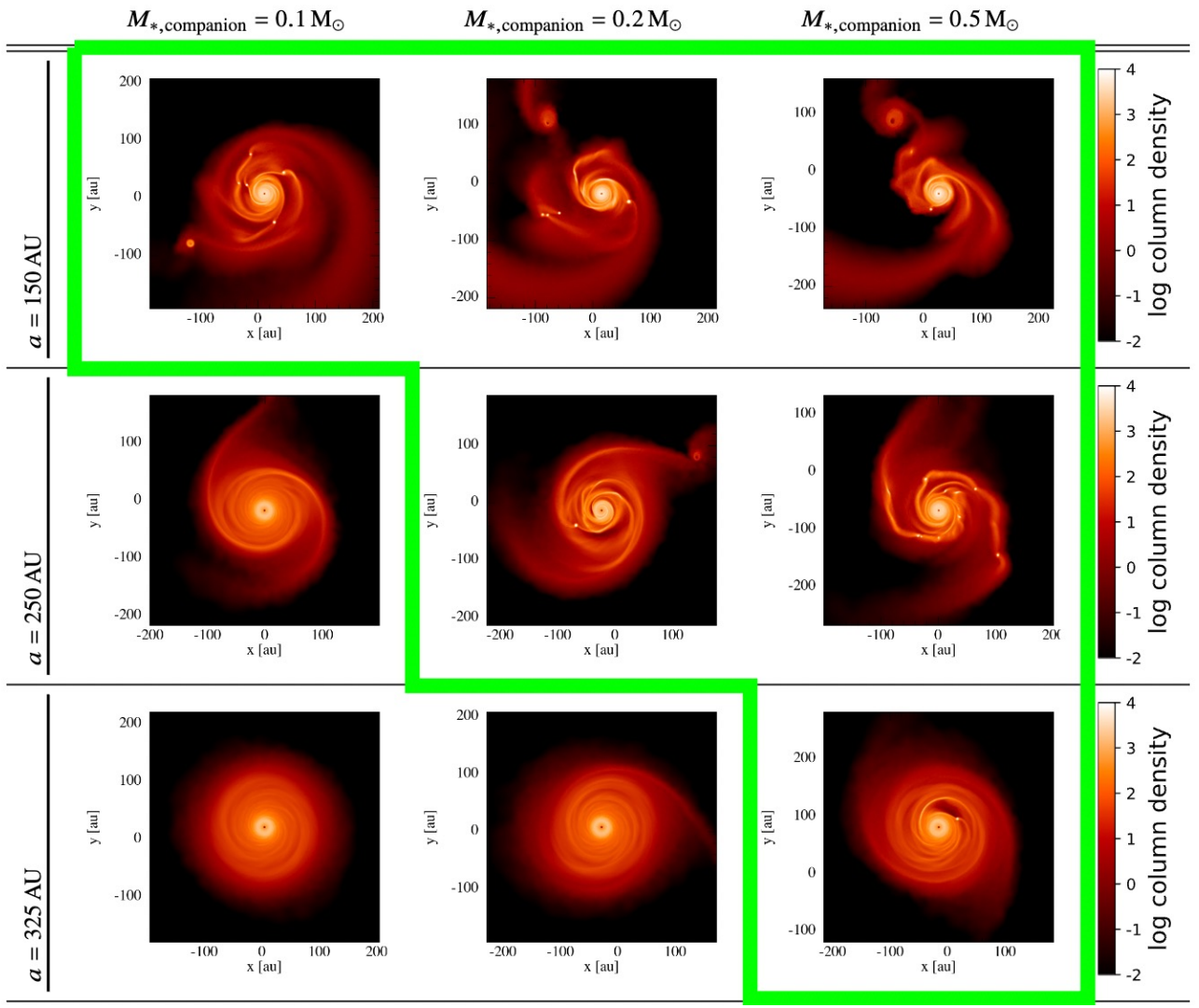
80% BINARIES

MASSIVE HOT-JUPITERS PREFERENTIALLY FORM IN BINARY SYSTEMS

A THEORETICAL CONFIRMATION (Camden et al. 2019)

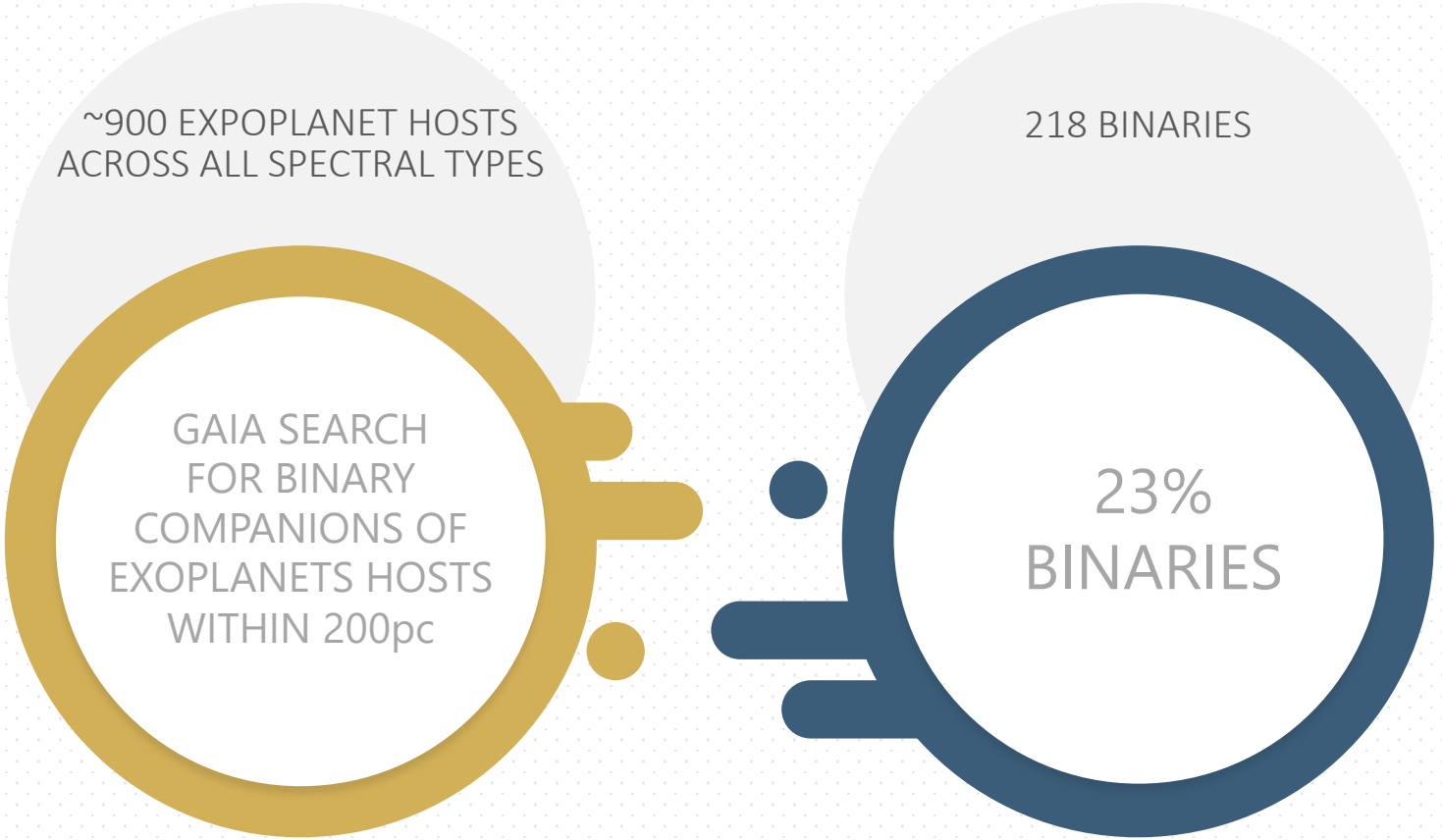


Cadman et al. 2021

THE PRESENCE OF A COMPANION TRIGGERS FRAGMENTATION IN SELF-GRAVITATING DISKS

THE GAIA VOLUME LIMITED SAMPLE
A FIRST STEP TOWARDS A MORE COMPLETE ANALYSIS

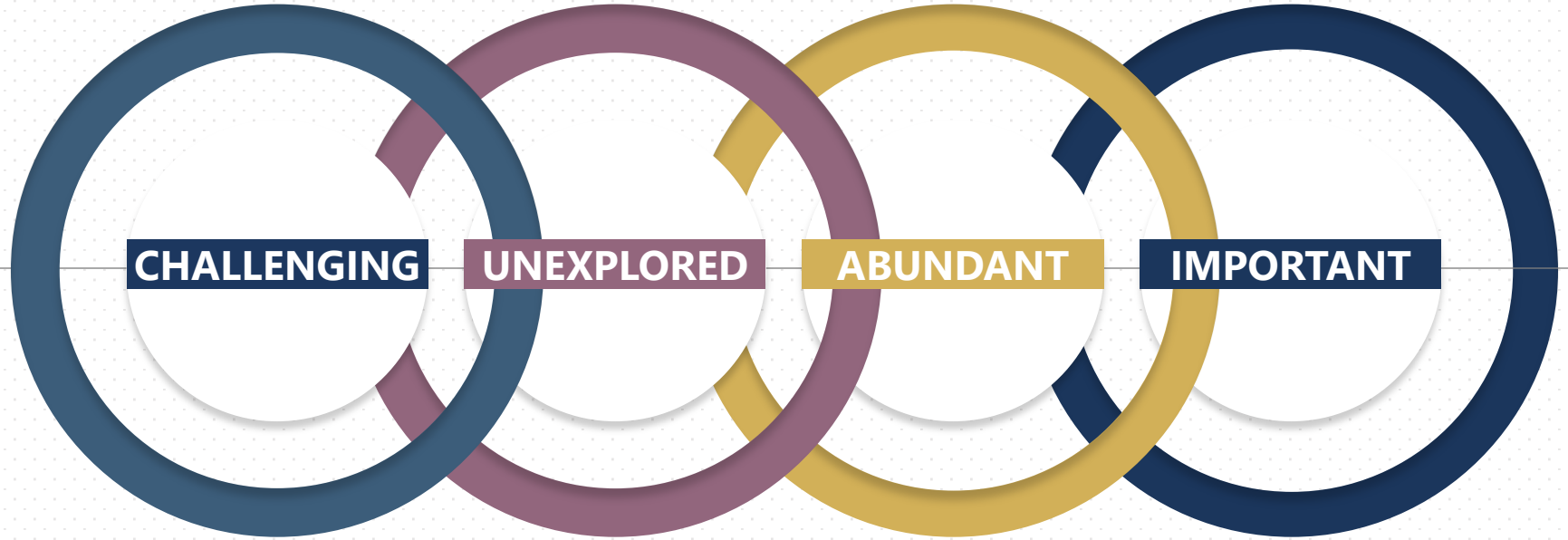
(Fontanive & Bardalez-Gagliufi 2021)



SEVERAL TRENDS HIGHLIGHTED*, BUT ONCE AGAIN THE SAMPLE IS INCOMPLETE

*and the massive Jupiters one confirmed

EXOPLANETS IN BINARY STARS



- THE SECONDARY AFFECTS THE DETECTION/CHARACTERISATION
- STILL EXCLUDED FROM MOST SURVEYS
- 30-40% OF EXOPLANET HOSTS ARE MULTIPLE STARS
- CAN HAVE A STRONG IMPACT ON PLANET FORMATION

EXOPLANETS IN BINARY STARS

EXOPLANET SURVEY TARGET LISTS ARE "POLLUTED"

A SIGNIFICANT FRACTION OF BINARIES HAVE BEEN OBSERVED AS PART OF EXOPLANET SURVEYS

THE IMPACT ON THE STATISTICS NEEDST TO BEEN TAKEN INTO ACCOUNT

THE FINAL CHARACTERISTICS OF A SAMPLE OFTEN DO NOT REFLECT THE CRITERIA USED TO SELECT IT

THE SAMPLE OF PLANETS IN BINARIES IS INCOMPLETE

BINARITY DOESN'T SEEM TO AFFECT THE OVERALL FREQUENCY OF PLANETS

INTERESTING TRENDS ARE EMERGING, HIGHLIGHTING THE IMPACT OF BINARITY ON PLANET FORMATION

NONE OF THE CURRENT RESULTS CAN BE CONFIRMED WITHOUT A TRULY UNBIASED SAMPLE

EXOPLANETS IN BINARY STARS: THE PLATO-GOP CONTRIBUTION

AN UNBIASED SAMPLE
WHICH WILL ALLOW
TO EASILY COMPARE
THE FREQUENCY OF PLANETS IN
MULTIPLE VS SINGLE HOSTS

SINGLE SYSTEMS OR GROUP OF SYSTEMS THAT WILL BE THE OBJECT OF DEDICTED STUDIES TO HIGHLIGHT INTERESTING TRENDS AND CLARIFY THE IMPACT OF BINARITY ON PLANET FORMATION