

New Worlds

Magnetic Fields & the Formation of New Worlds

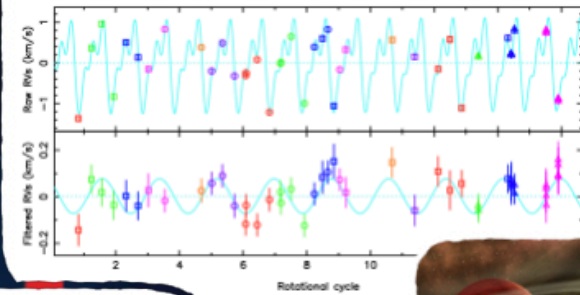
2017 October 01 - 2023 September 30
Advanced ERC Grant #740 651



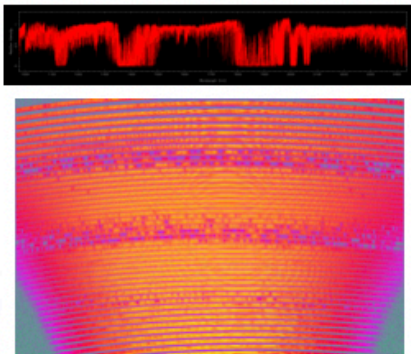
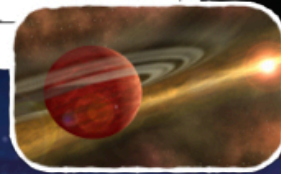
New Worlds

science goals

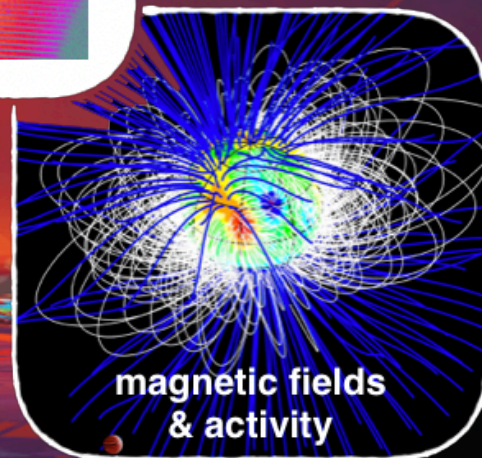
hot Jupiters of young stars
planetary systems of M dwarfs



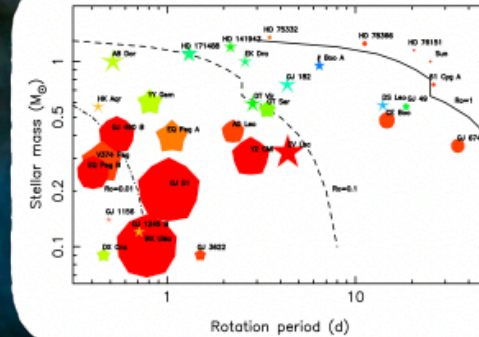
activity
filtering



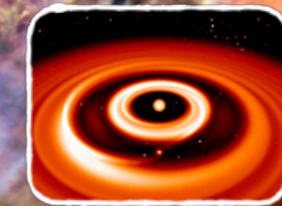
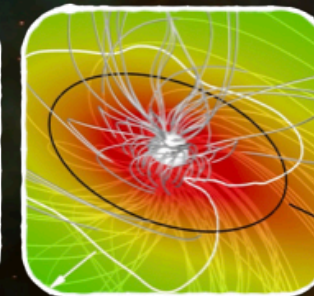
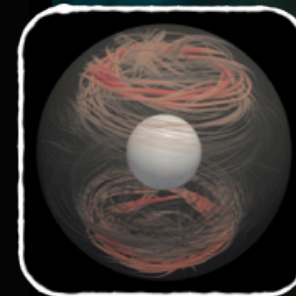
tomographic
imaging



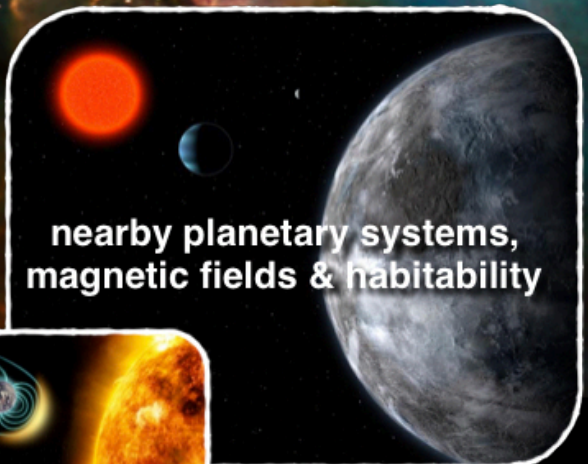
magnetic fields
& activity



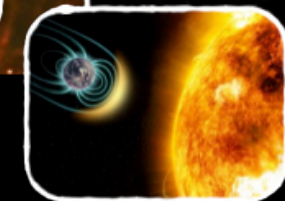
stellar dynamos & winds,
magnetospheric accretion



magnetic fields &
star / planet formation,
angular momentum
evolution



nearby planetary systems,
magnetic fields & habitability



New Worlds

project team

 **4 IRAP staff members**

J-F Donati (PI), C Moutou, C Baruteau, L Jouve



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5 IRAP PhD students

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B Finocietty (PhD 2022), P Charpentier (PhD 2025)



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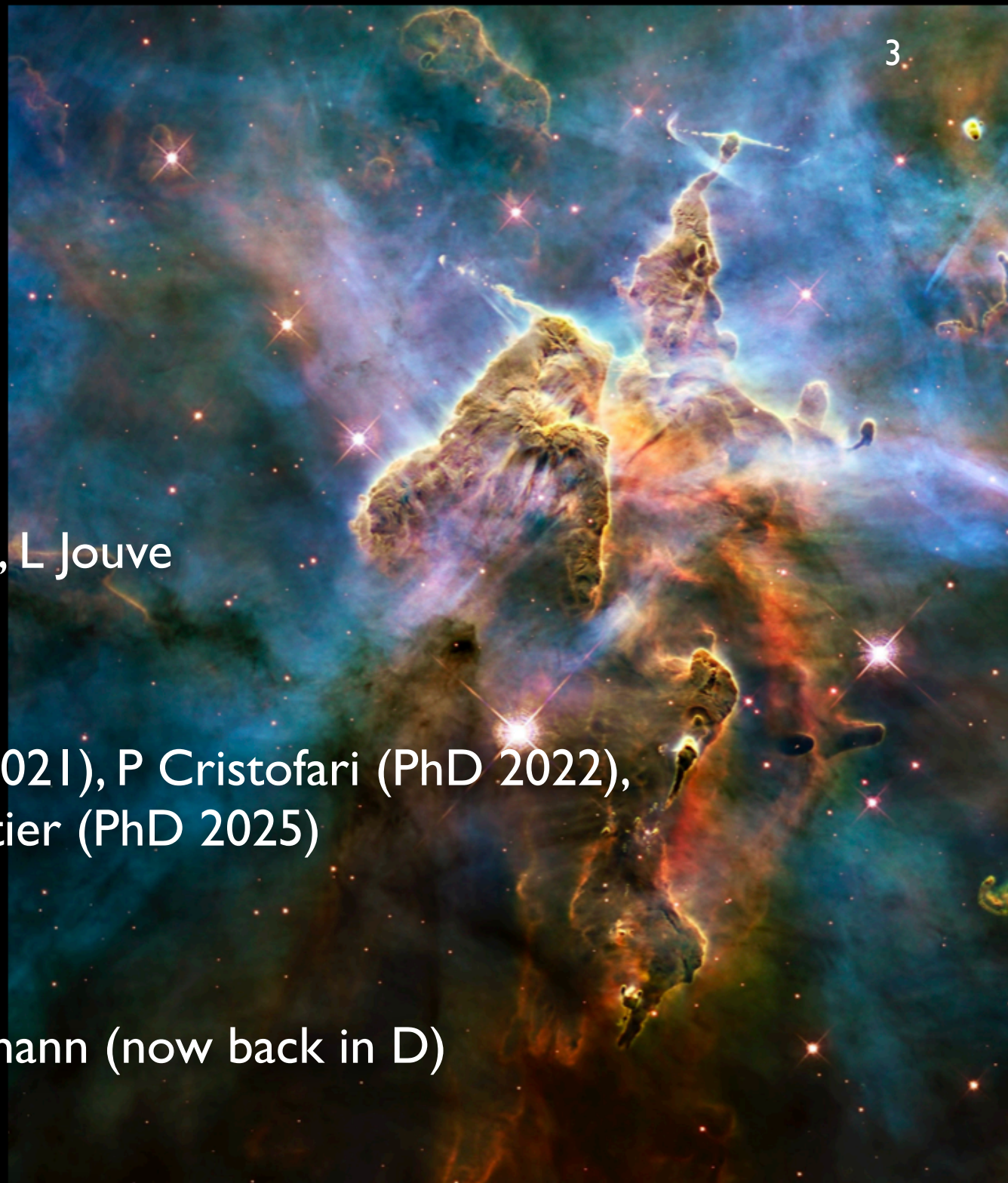
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external collaborators

from France (eg IPAG, CEA), Brazil, ESO, UK



New Worlds

observations w/ SPIRou

the SPIRou Legacy Survey (SLS) & SPICE LPs

SLS: 315 nights on Canada-France-Hawaii Telescope (CFHT) from 2019a to 2022a

SPICE: 175 nights on CFHT from 2022b to 2024a

observations split into 3 main work-packages focused on magnetic fields & planets of nearby M dwarfs (WPI-2, 350n) and of PMS stars (WP3, 140n)



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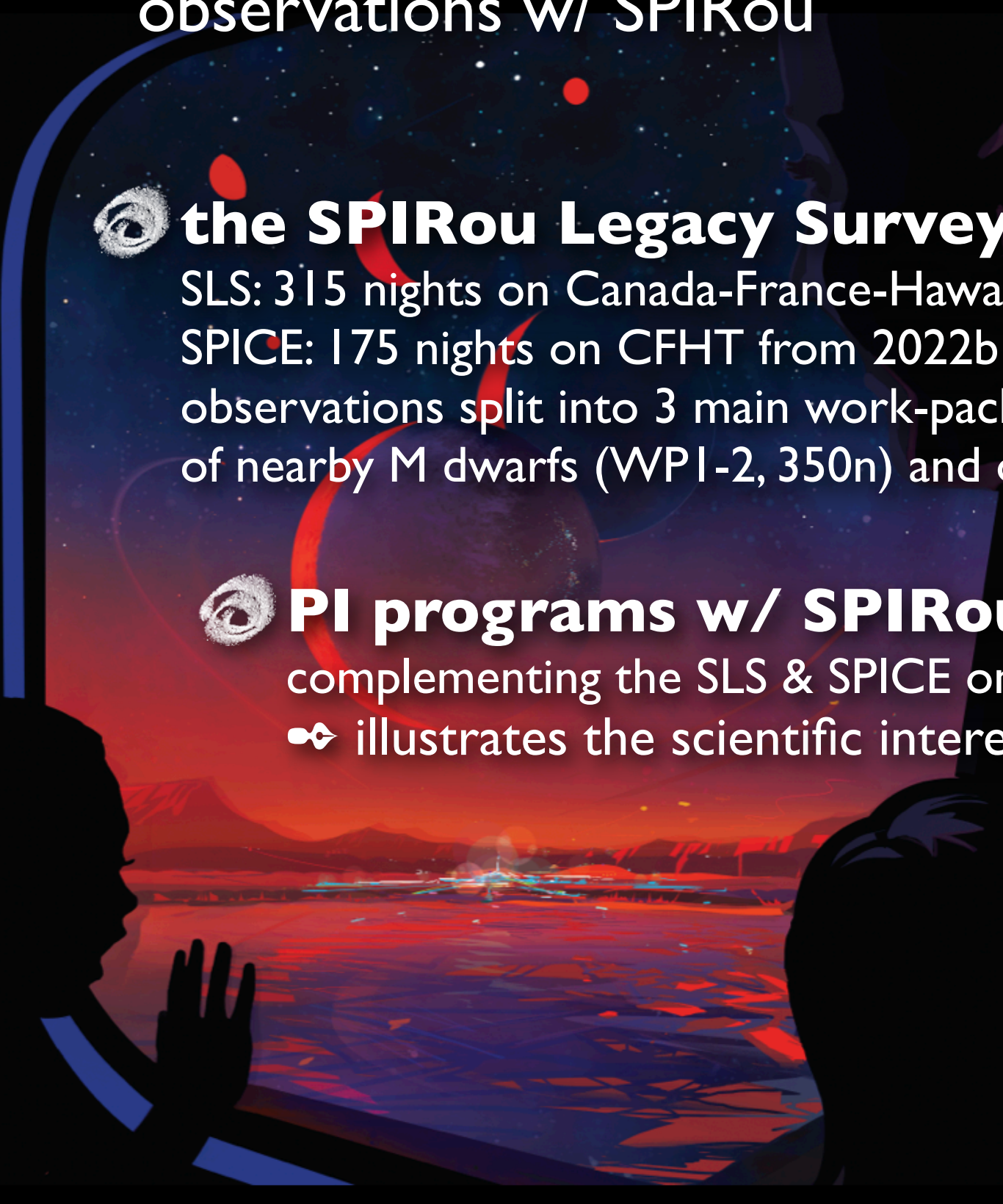
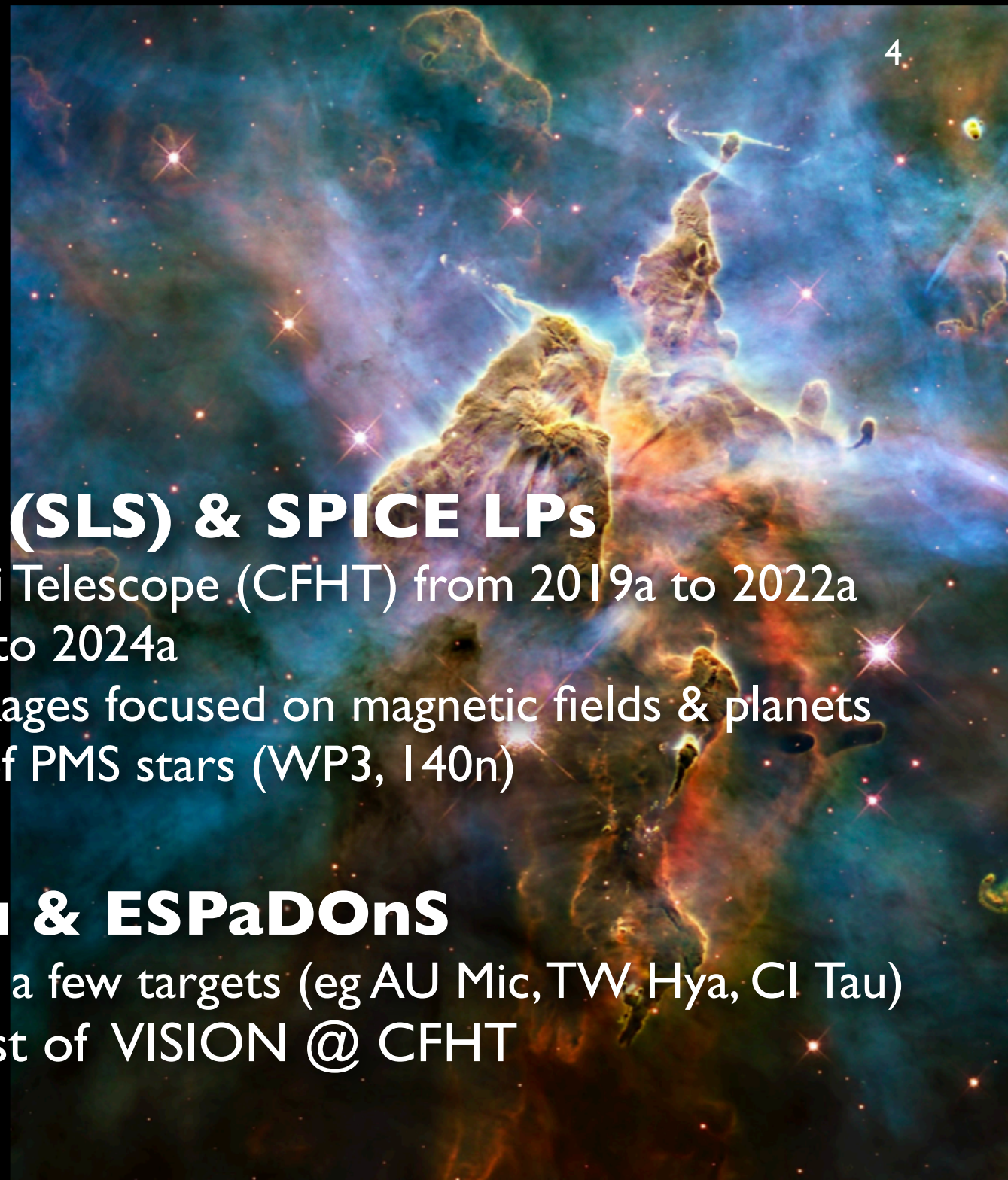
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PI programs w/ SPIRou & ESPaDOnS

complementing the SLS & SPICE on a few targets (eg AU Mic, TW Hya, CI Tau)

☞ illustrates the scientific interest of VISION @ CFHT



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contemporaneous observations

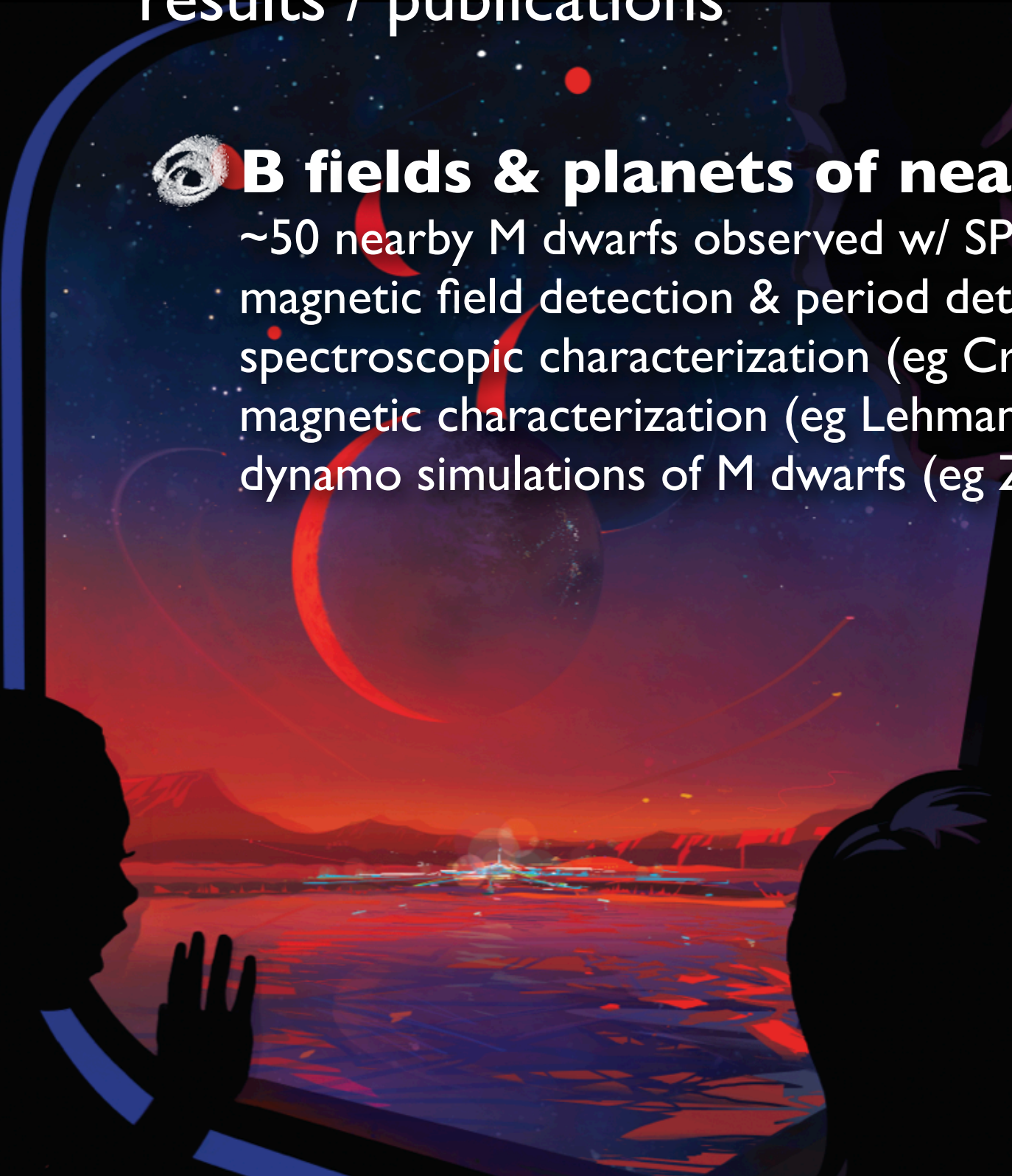
photometry (eg TESS, LCO), spectroscopy (eg HARPS, HST) & interferometry (eg GRAVITY)

New Worlds

results / publications

B fields & planets of nearby M dwarfs

- ~50 nearby M dwarfs observed w/ SPIRou since 2019
- magnetic field detection & period determination (eg Fouqué+, Donati+ 2023)
- spectroscopic characterization (eg Cristofari+ 2022, 2023)
- magnetic characterization (eg Lehmann+ 2022, 2023)
- dynamo simulations of M dwarfs (eg Zaire+ 2022)



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- ~50 classical & weak-line T Tauri stars (eg Finocietty+ 2021, 2022, 2023)
- post T Tauri stars (eg AU Mic, Klein+ 2020, Donati+ 2023)
- MHD simulations of planet migration (eg Debras+ 2021)

New Worlds

results / publications

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numerous publications

40+ in refereed journals directly linked to New Worlds
100+ including related papers



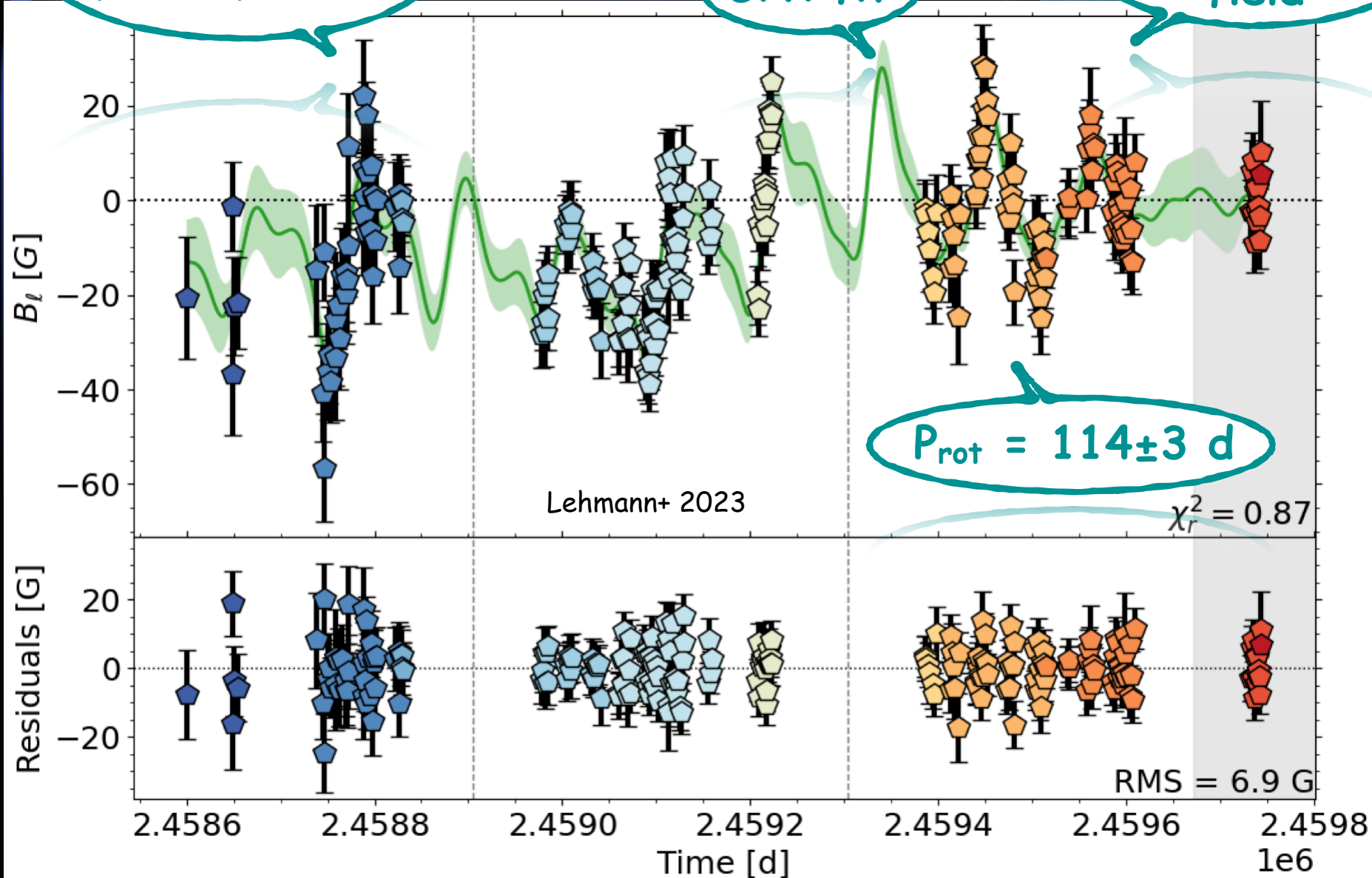
New Worlds

GI 905 / M5.0V

SPIRou
spectropol data

GPR fit

large-scale
field



New Worlds

GI 905 / M5.0V

SPIRou
spectropol data

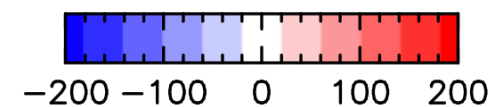
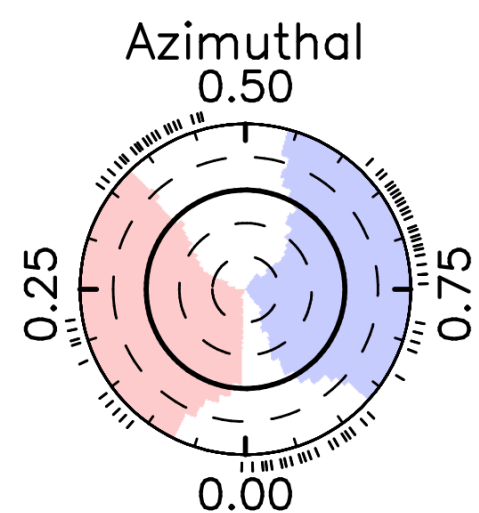
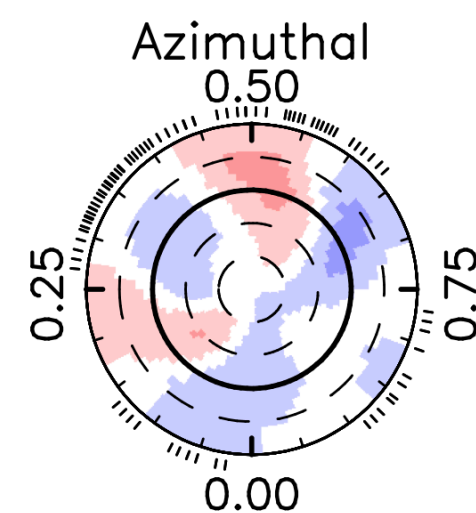
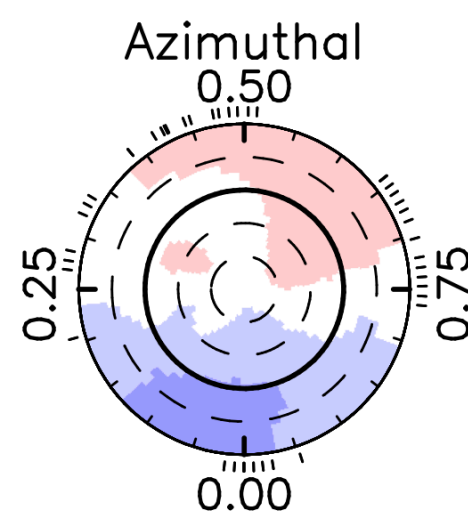
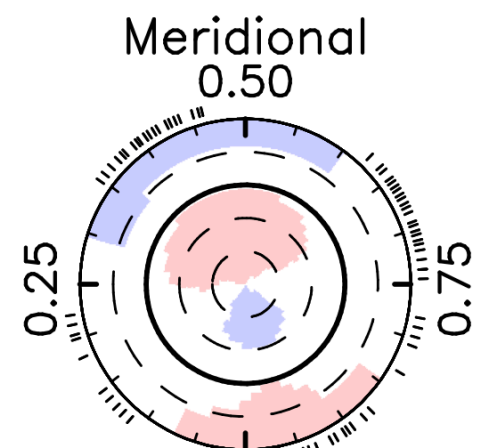
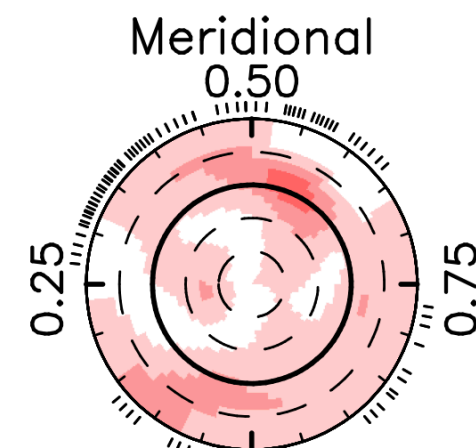
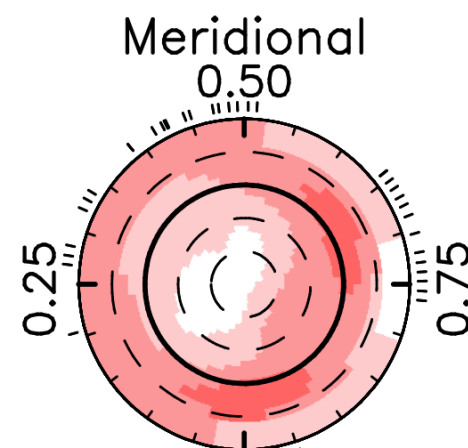
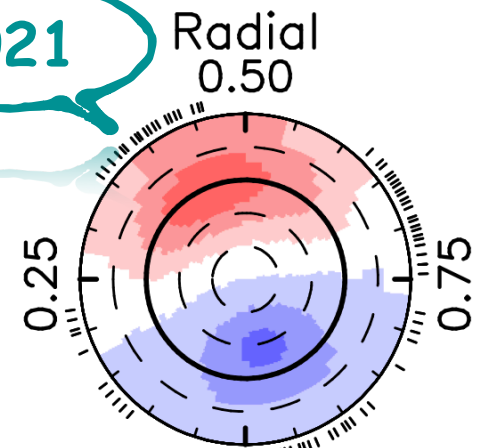
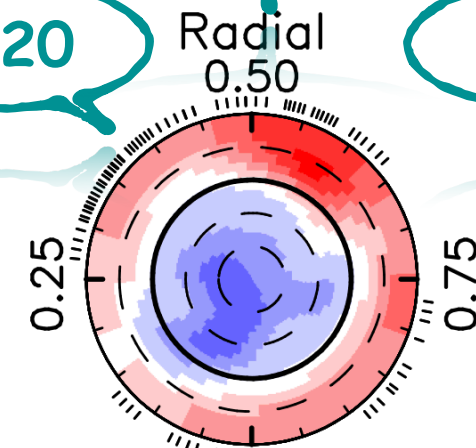
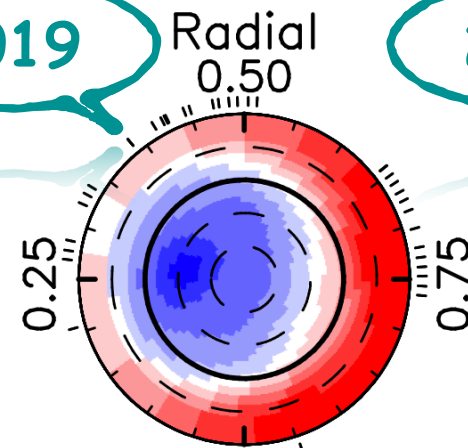
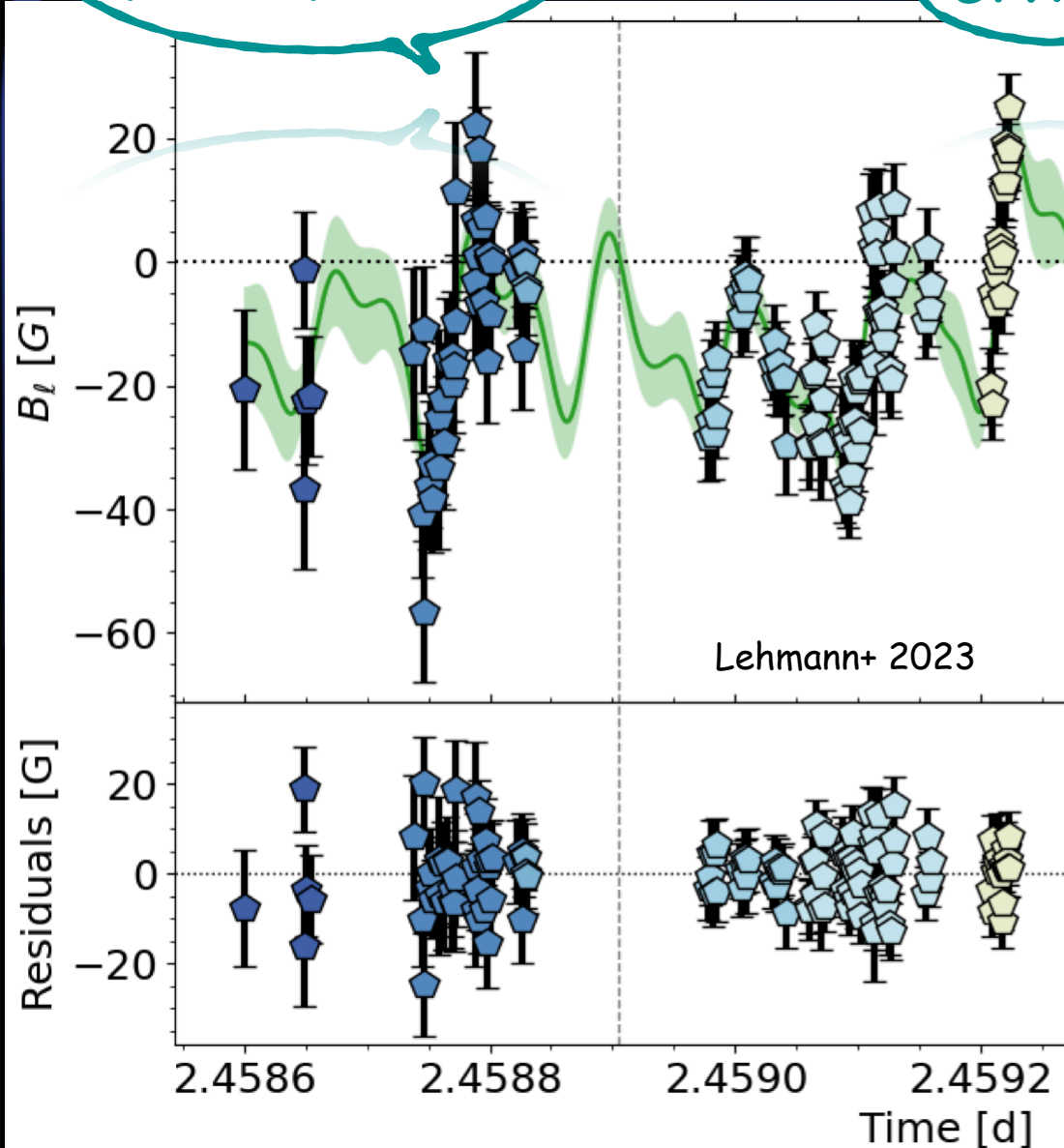
GPR

2019

2020

2021

ZDI maps



Lehmann+ 2023

New Worlds

GI 905 / M5.0V

2019

Radial
0.50

2020

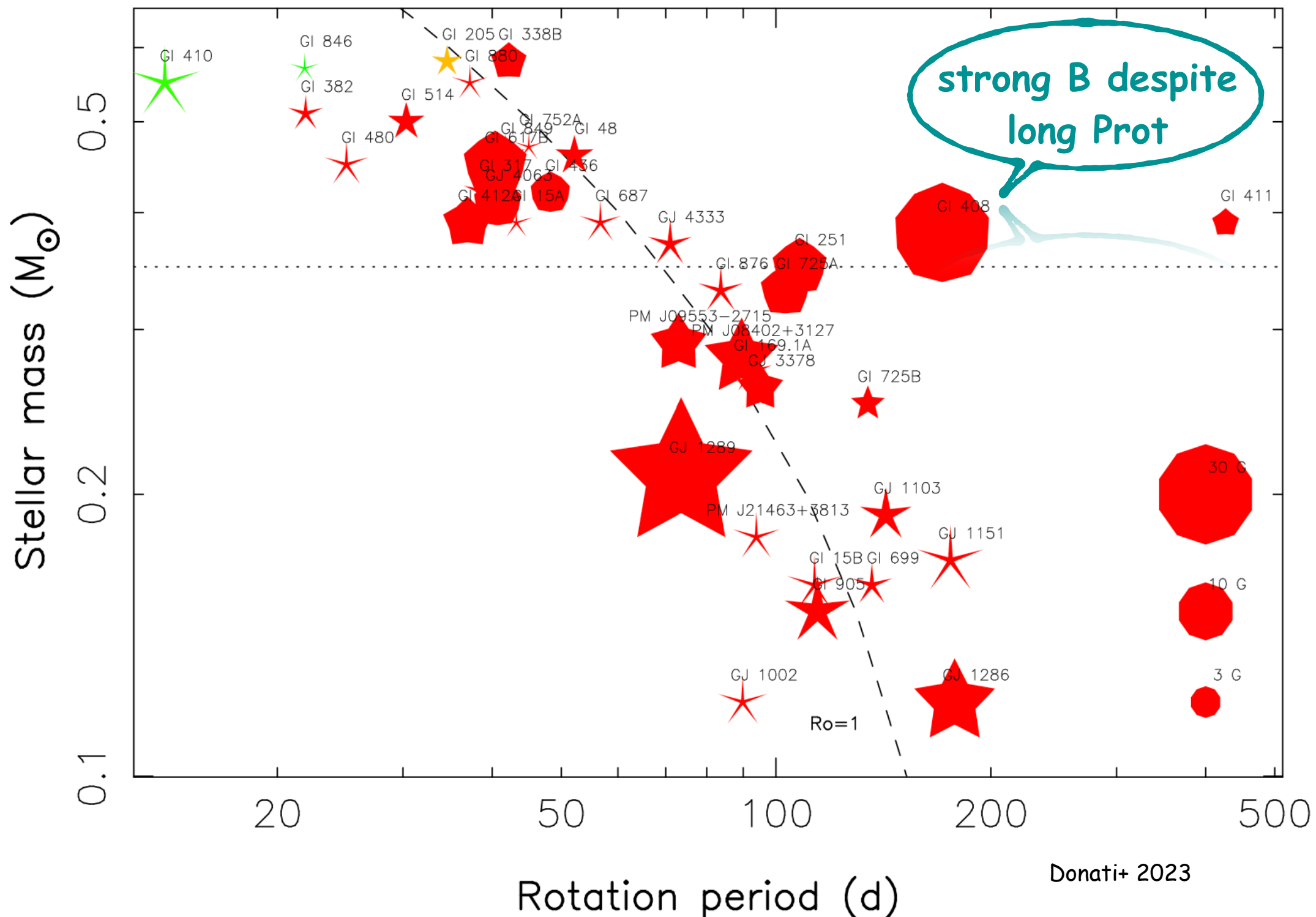
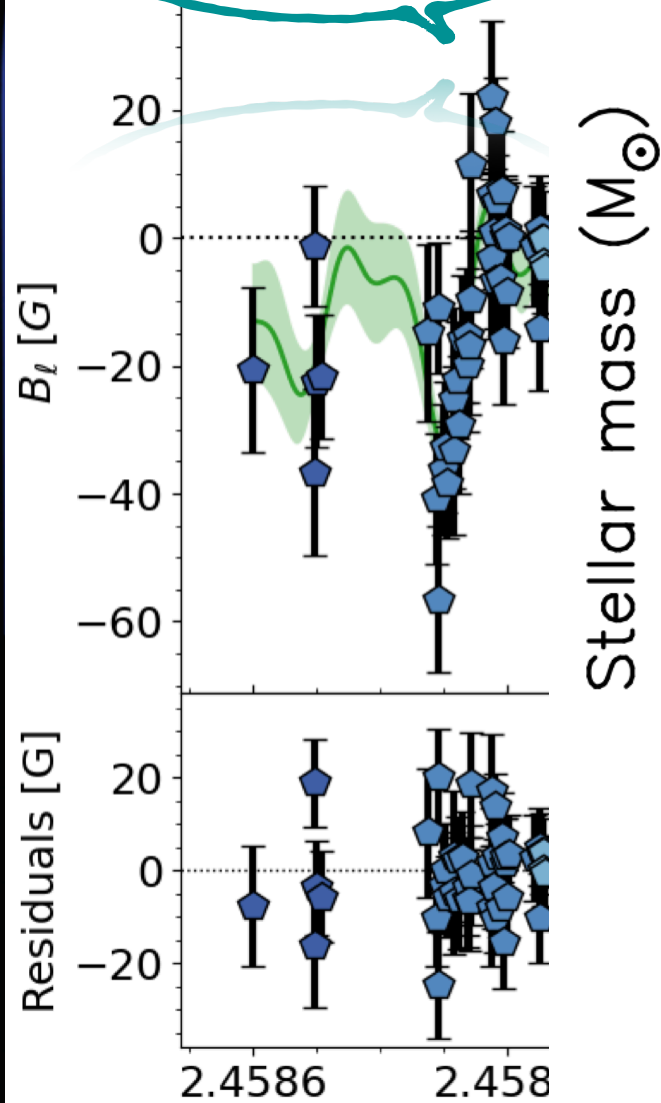
Radial
0.50

2021

Radial
0.50

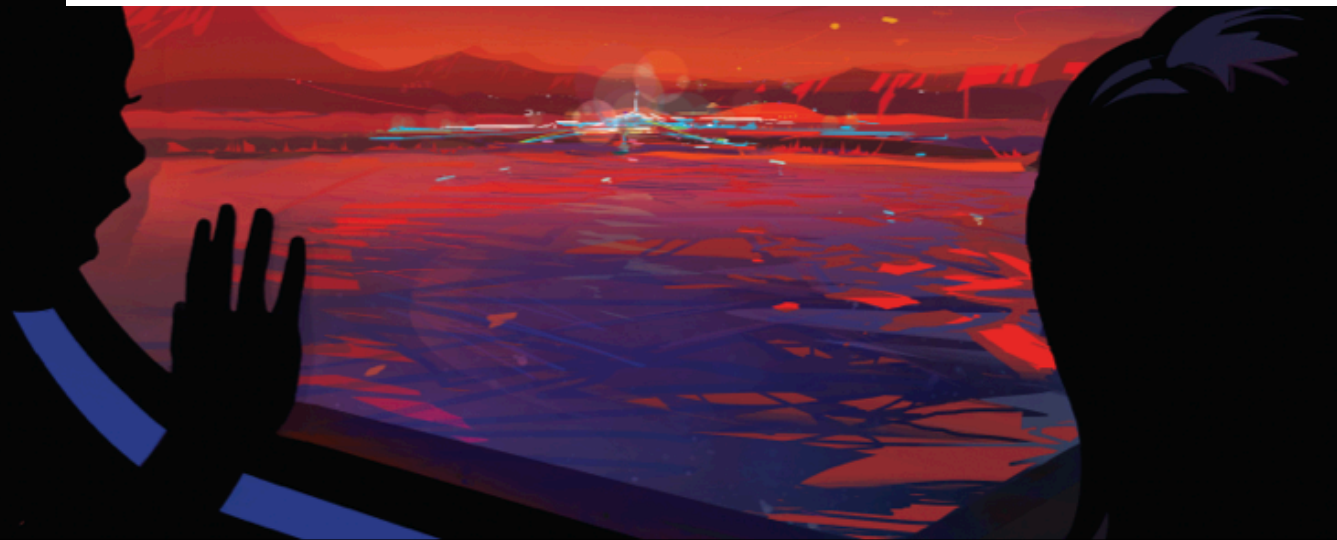
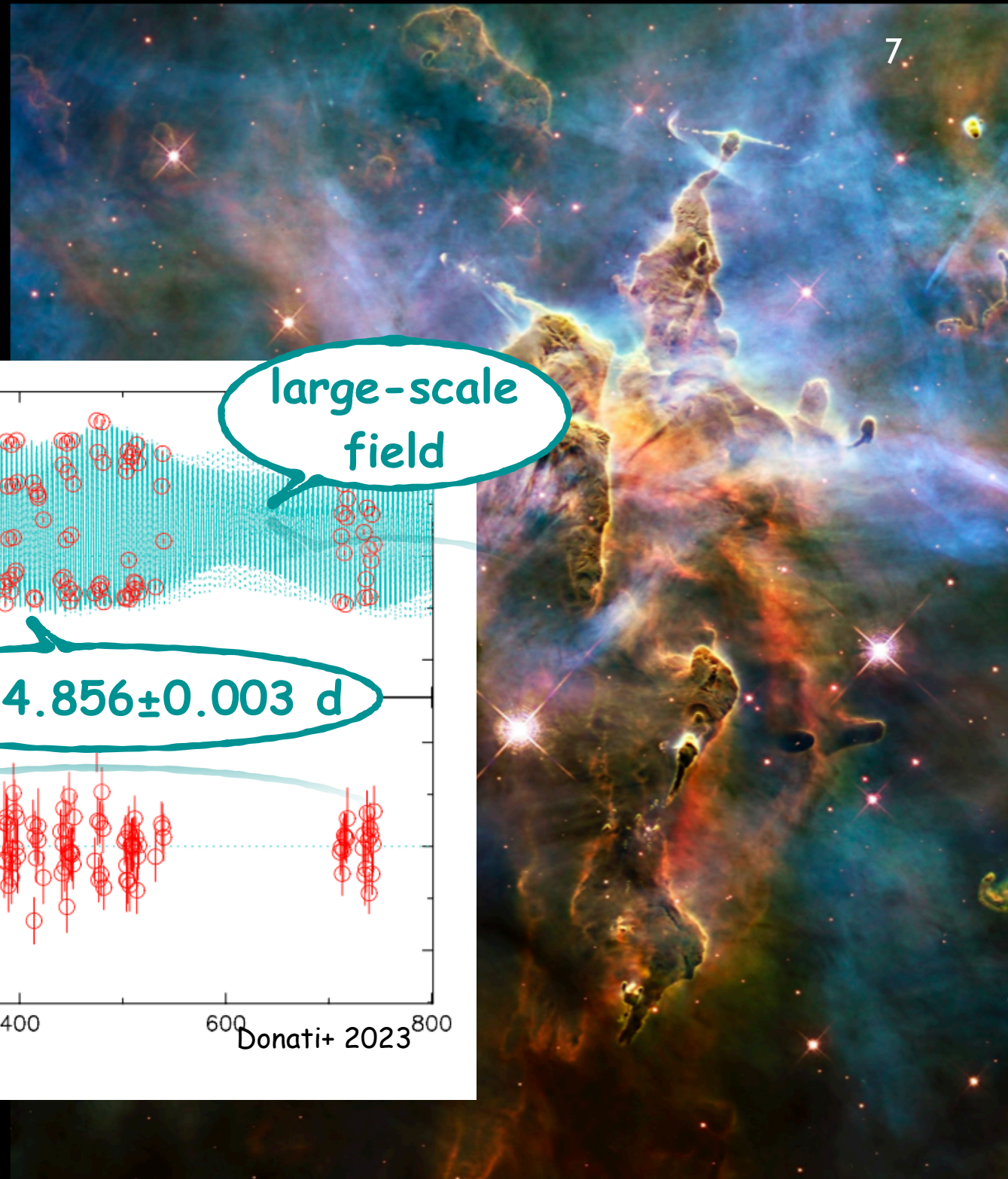
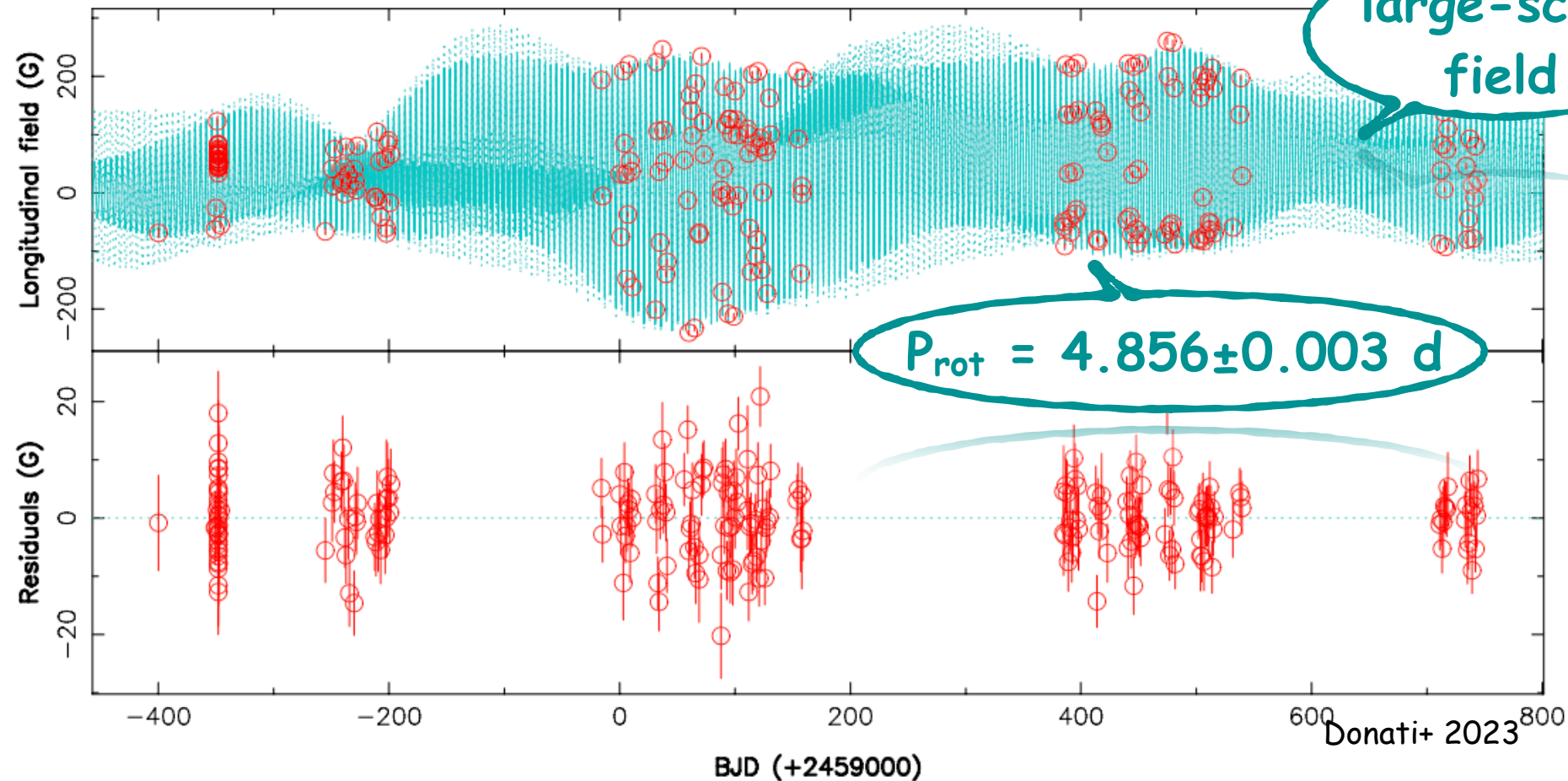
ZDI maps

SPIRou
spectropol data



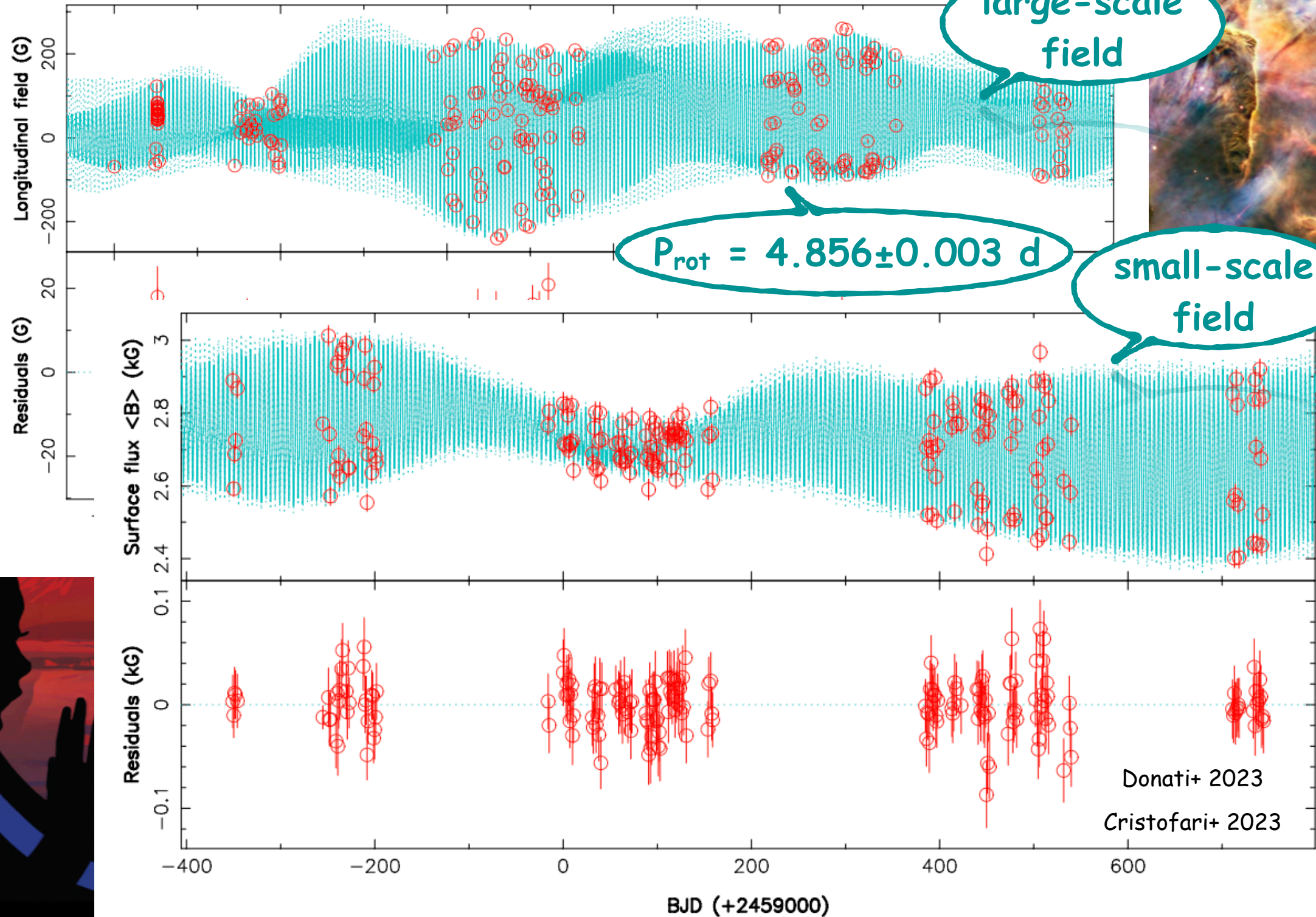
New Worlds

AU Mic / M0V / ~20 Myr



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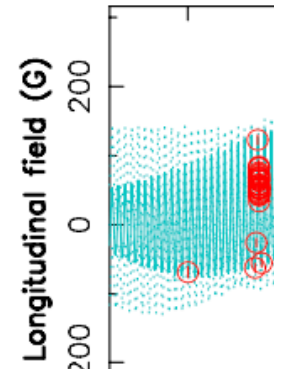


New Worlds

AU M

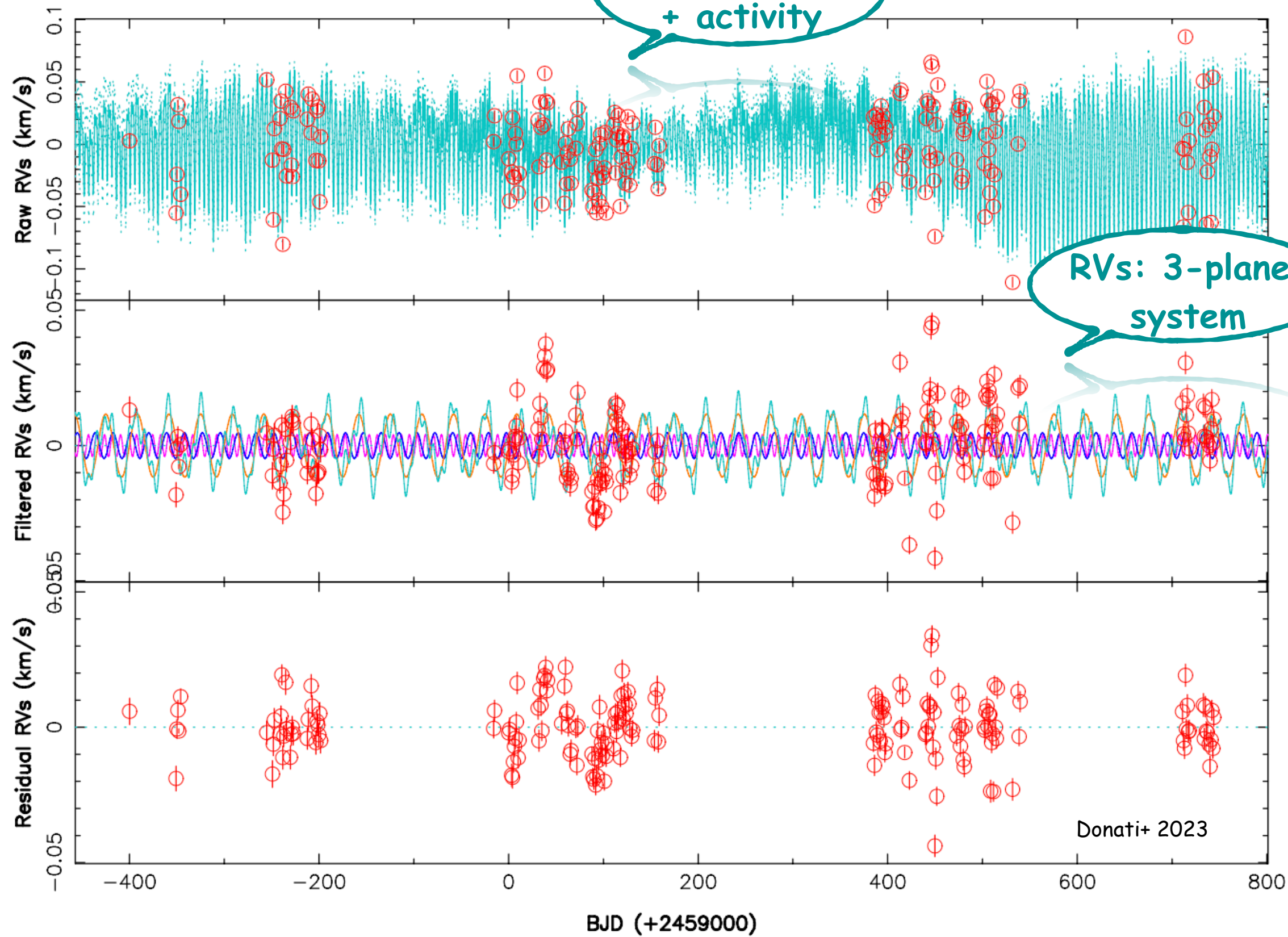
RVs: planets
+ activity

RVs: 3-planet
system



Surface flux $\langle B \rangle$ (kG)

Residuals (kG)



Donati+ 2023

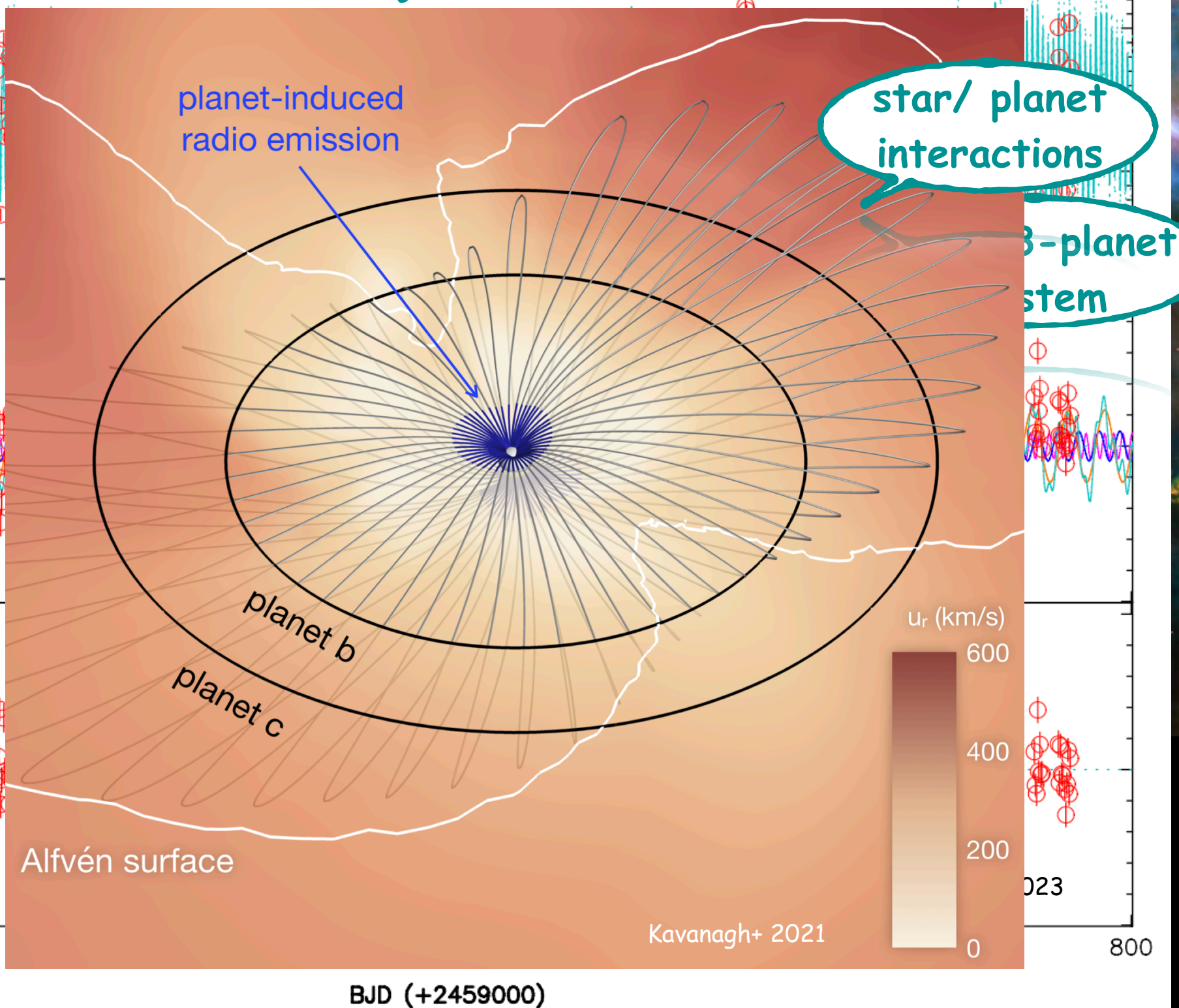
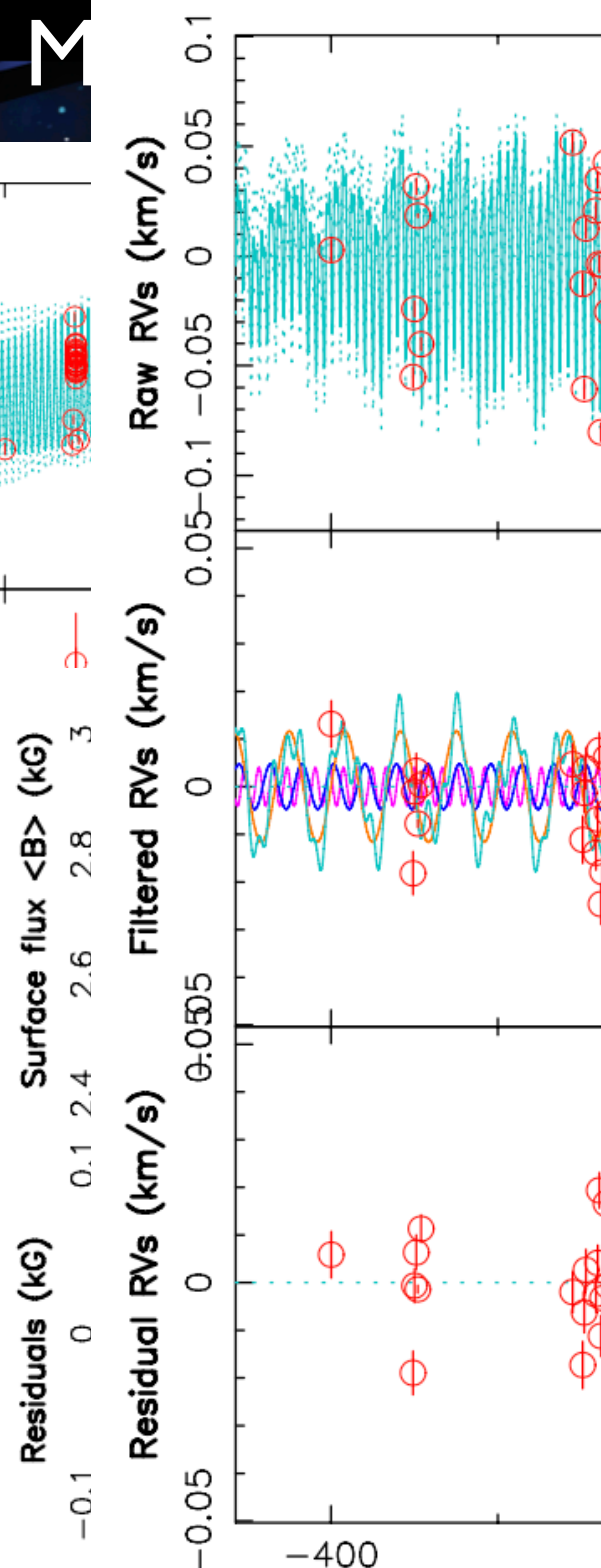
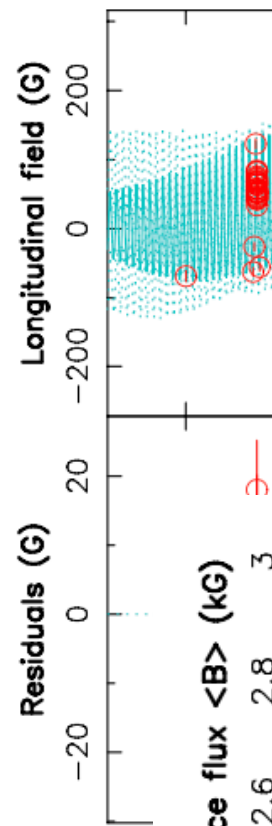
New Worlds

AU M

RVs: planets
+ activity

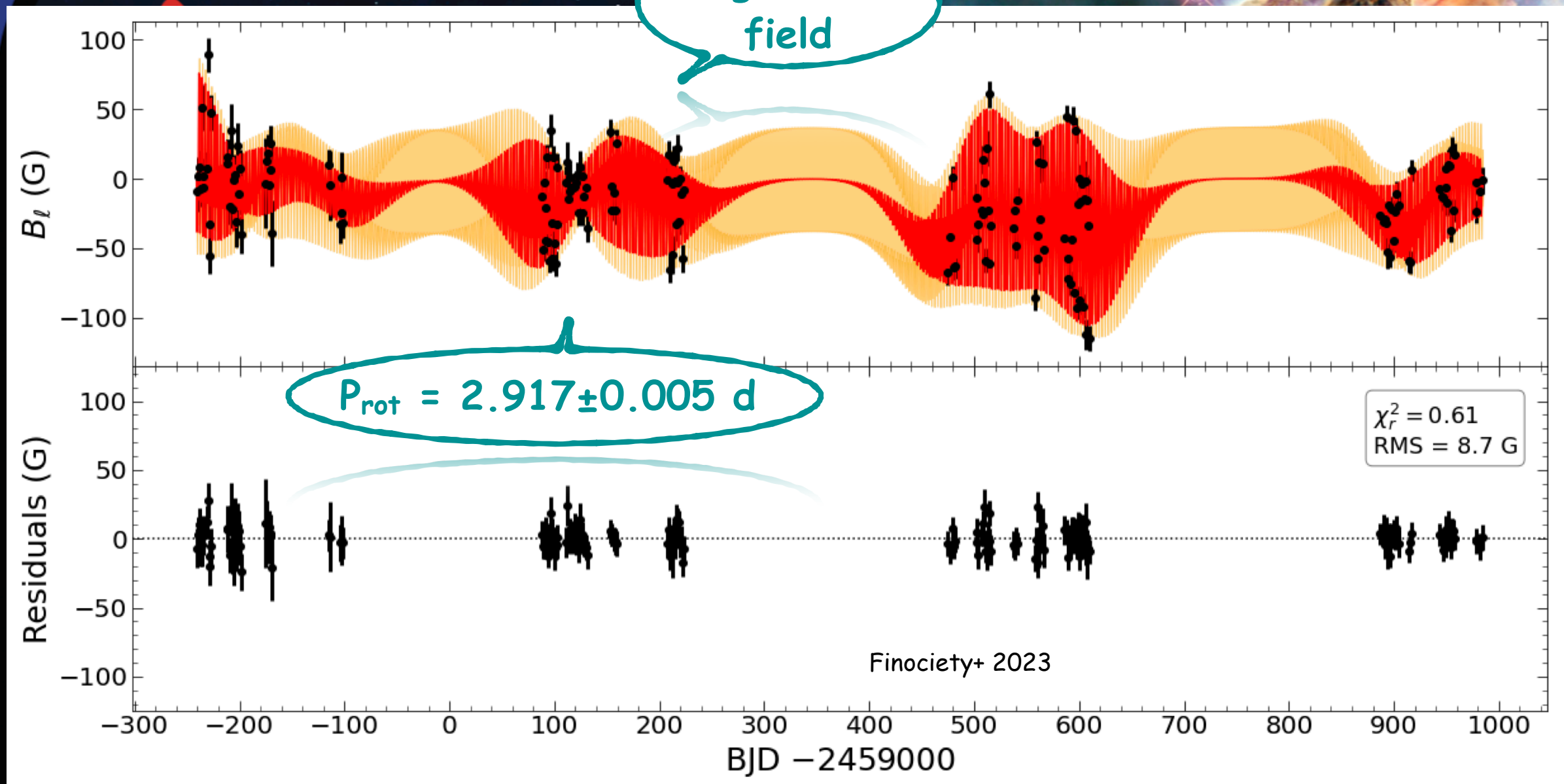
star/ planet
interactions

3-planet
system



New Worlds

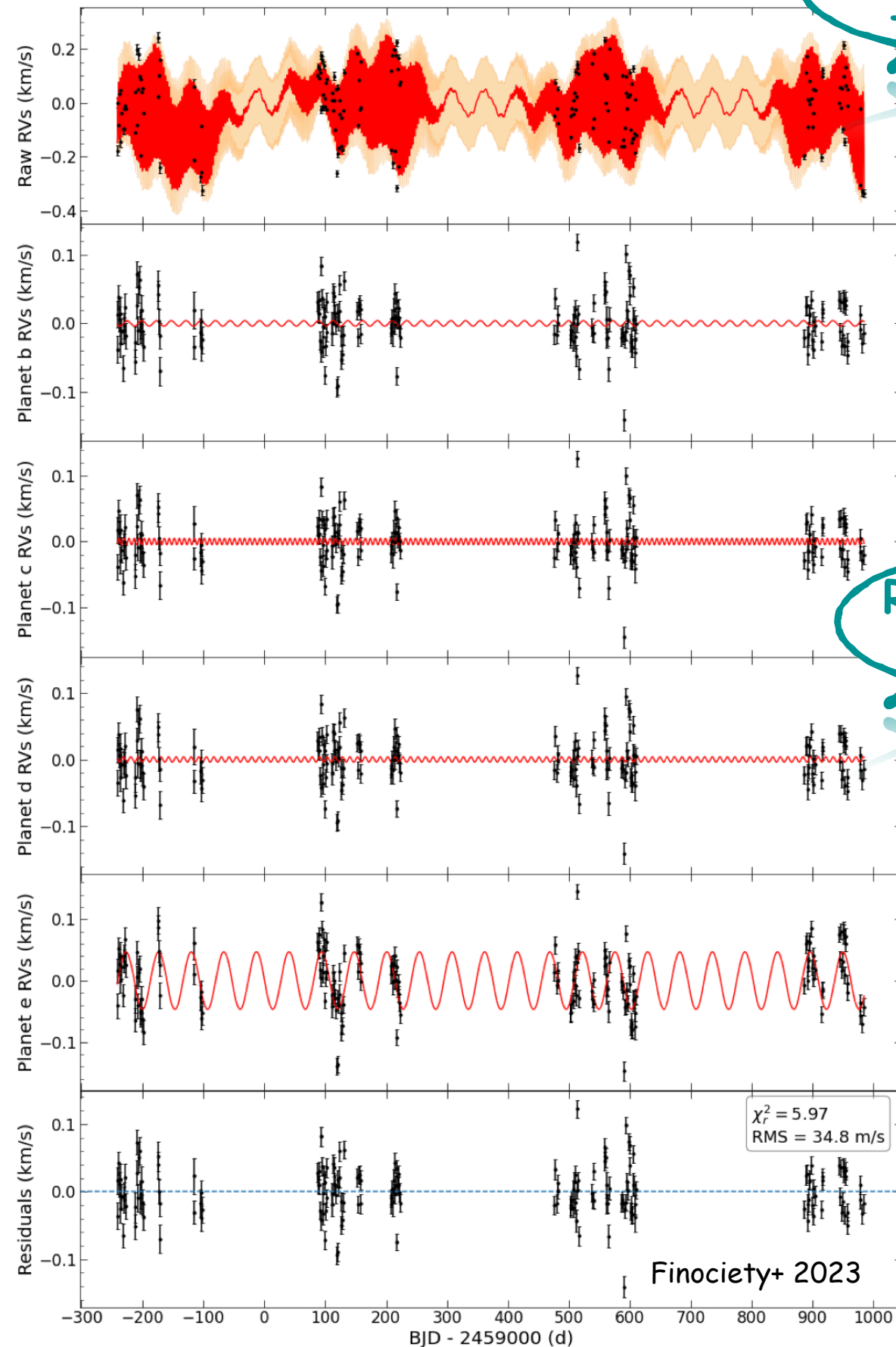
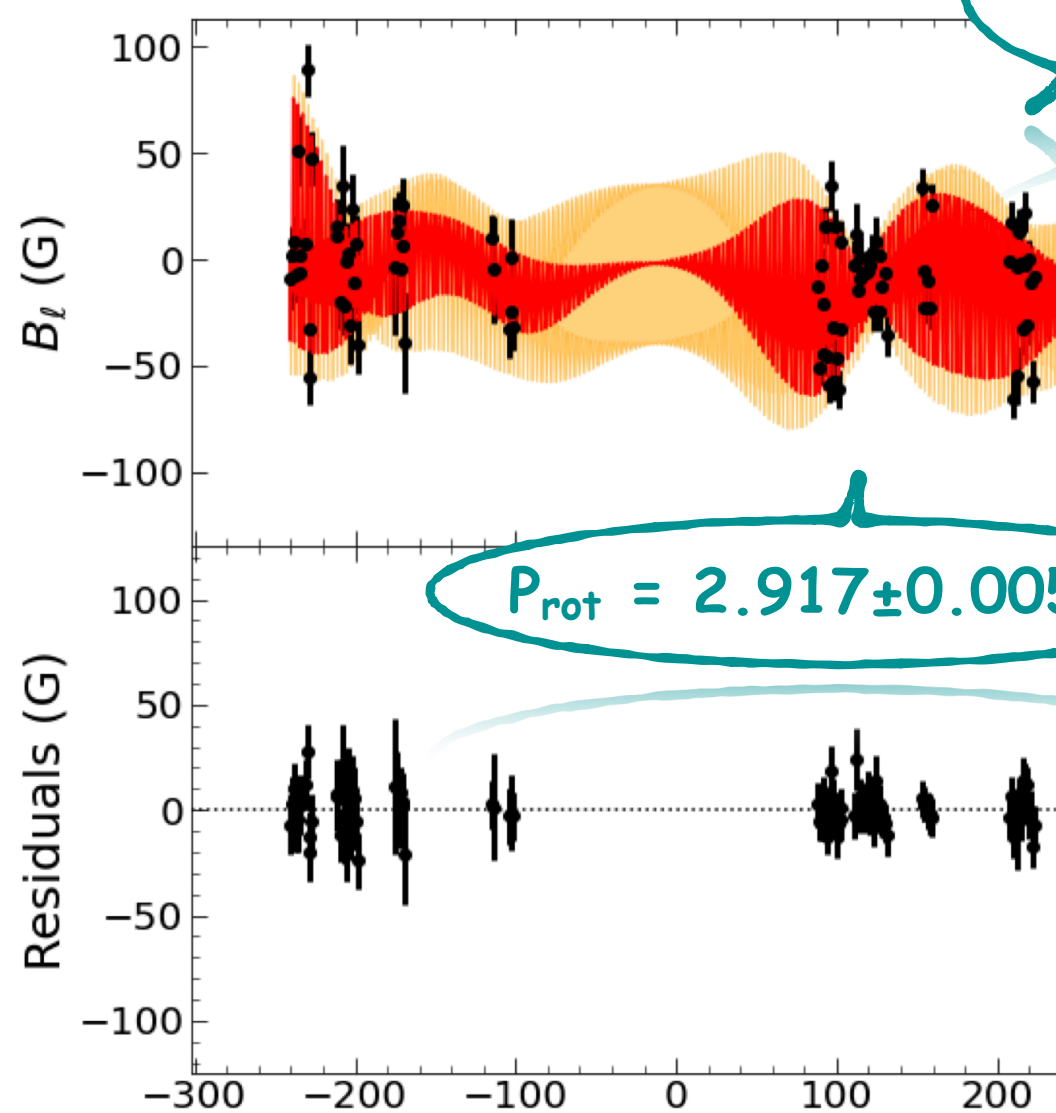
VI298 Tau / K0IV / ~10 Myr



NewWorld

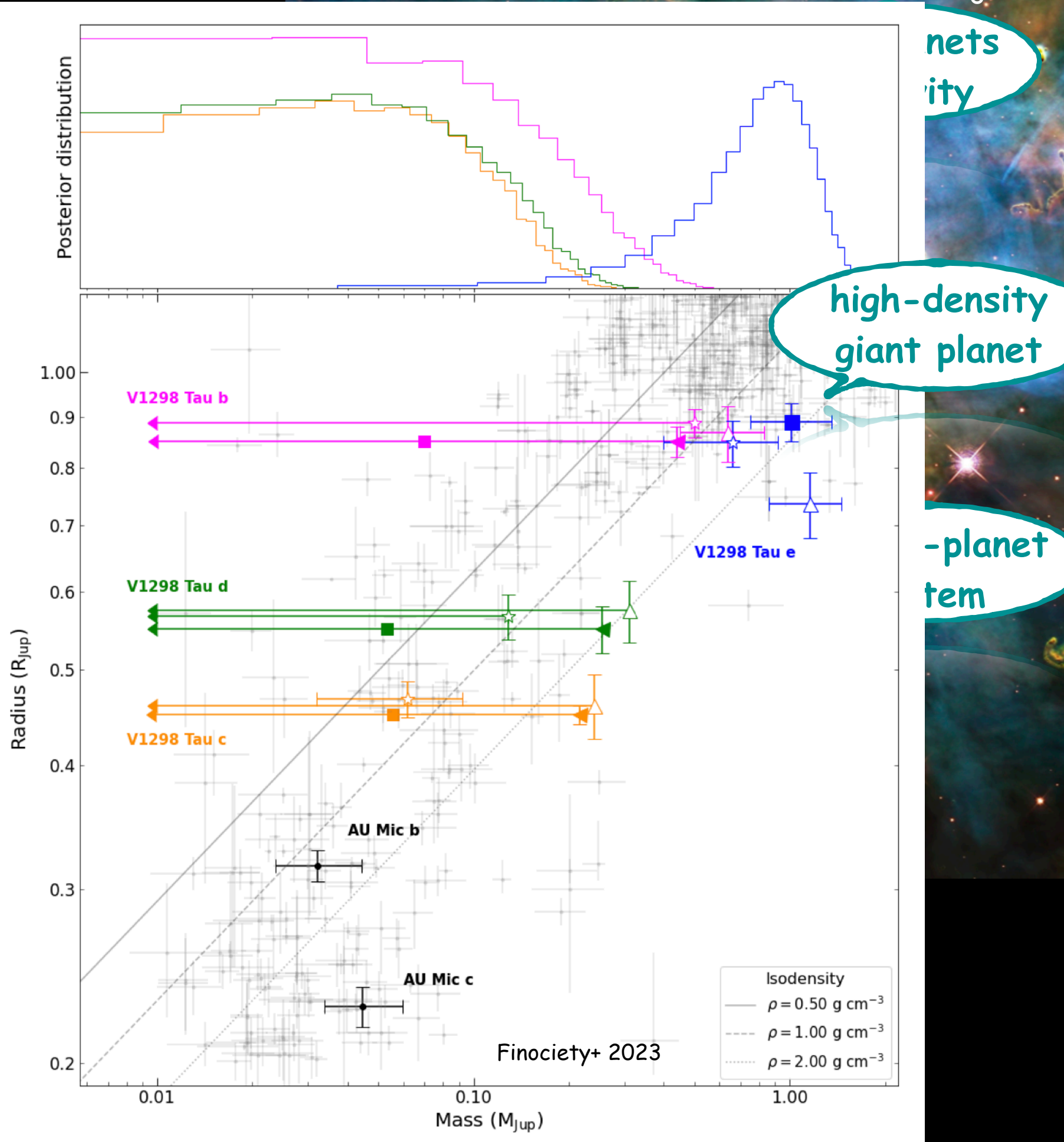
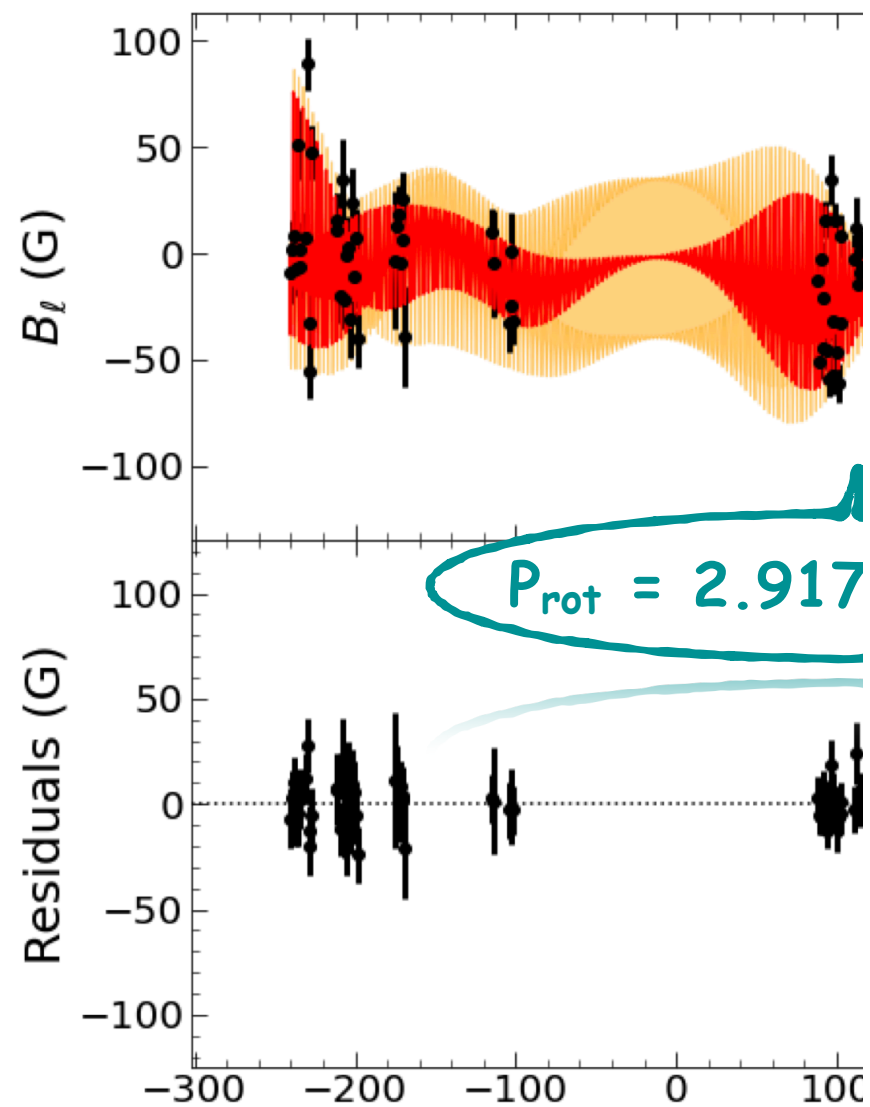
VI298 Tau / K0IV / ~ 10

RVs: planets
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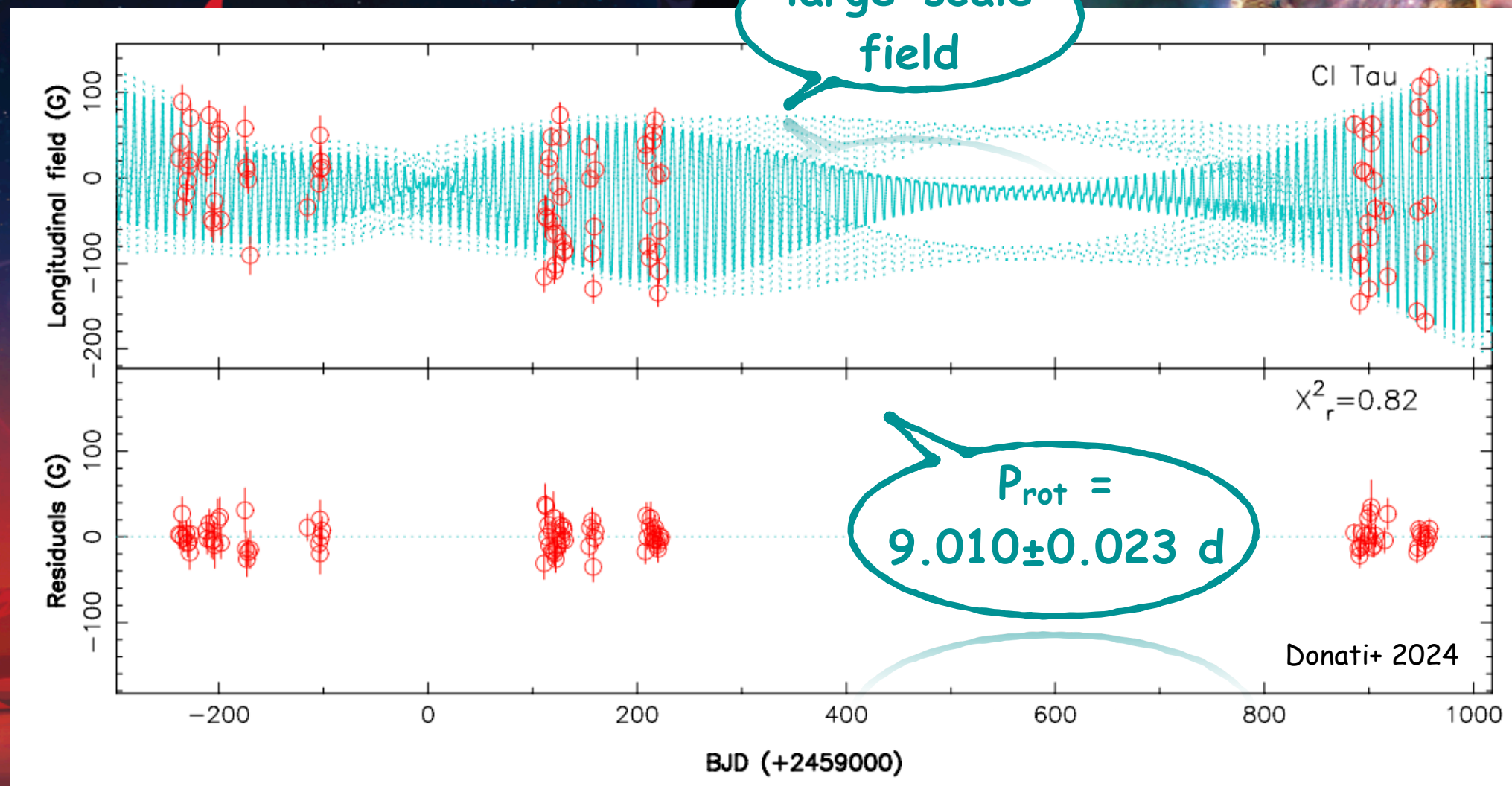
New Worlds

VI298 Tau / K0IV /



New Worlds

CI Tau / K5IV / ~2 Myr



New Worlds

CI Tau / K5IV / ~ 2 Myr

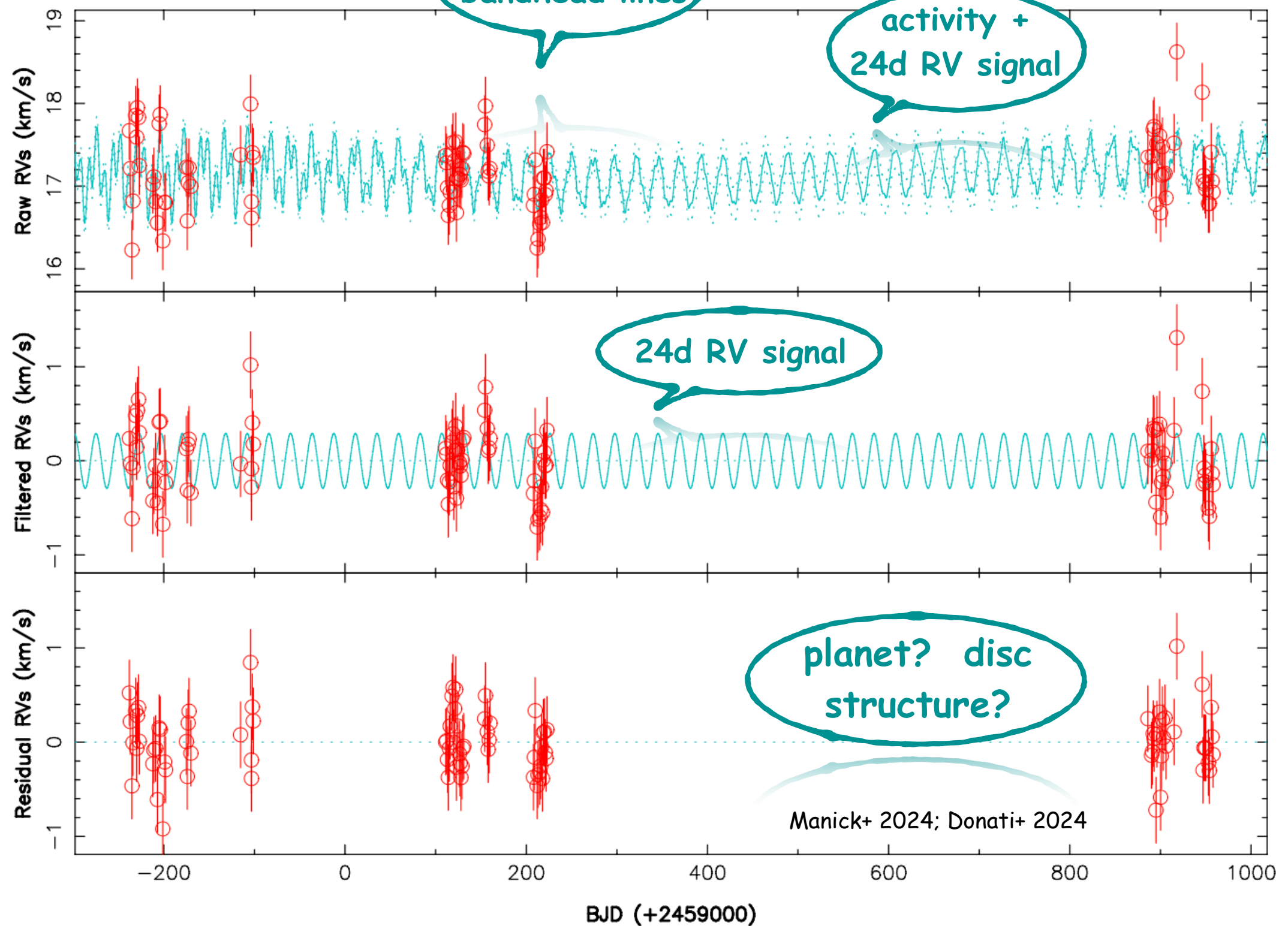
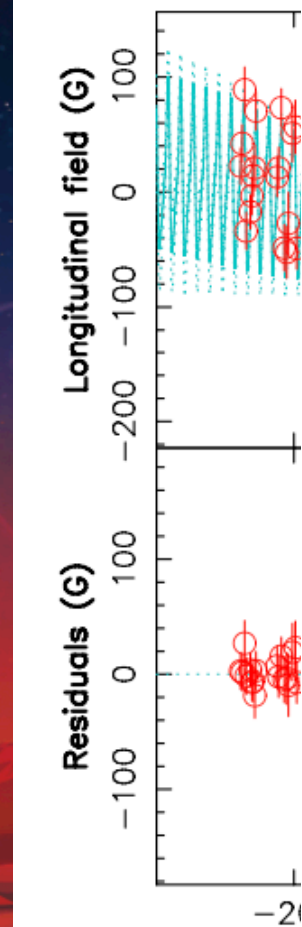
RVs of CO
bandhead lines

activity +
24d RV signal

24d RV signal

planet? disc
structure?

Manick+ 2024; Donati+ 2024



New Worlds

wrap-up

first 5-yr of SPIRou observations

lots of results & publications on nearby M dwarfs & PMS stars
more to come from SLS / SPICE data & SPIP@TBL data
PhDs / postdocs application welcome



10



New Worlds

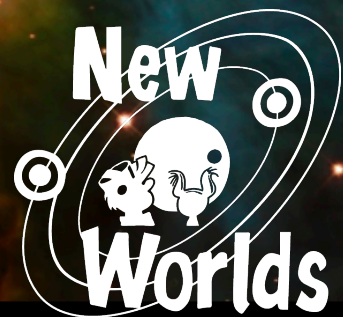
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more SPIRou & SPIP observations

forthcoming 4-yr LP at CFHT (2025-2028) + SPIP@TBL
w/ simultaneous ESPaDOnS observations: VISION@CFHT
w/ contemporaneous GRAVITY observations: IRYSS (ANR)
w/ dedicated photometry: MARSU nanosat?



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SPIRou@CFHT & SPIP@TBL

essential for future surveys w/, eg, JWST, PLATO, ARIEL
top stellar + exoplanet science with CFHT beyond 2033

