EXOPA

La ricerca sui sistemi esoplanetari a Palermo

SPECULA PANORMITANA MDCCXC

INAF
ISTITUTO NAZIONALE DI ASTROFISICA
OSSERVATORIO ASTRONOMICO DI PALERMO

DIFC

UNIVERSITÀ DEGLI STUDI DI PALERMO

Il Gruppo ExoPa

Laura Affer

Serena Benatti

Alfredo Biagini

Davide Cardinale

Cesare Cecchi Pestellini

Angela Ciaravella

Salvatore Colombo

Fabio D'Anca

Mattia D'Arpa

Claudia Di Maio

Elisa Guerriero

Antonio Jiménez-Escobar

Daniele Locci

Antonio Maggio

Jesus Maldonado

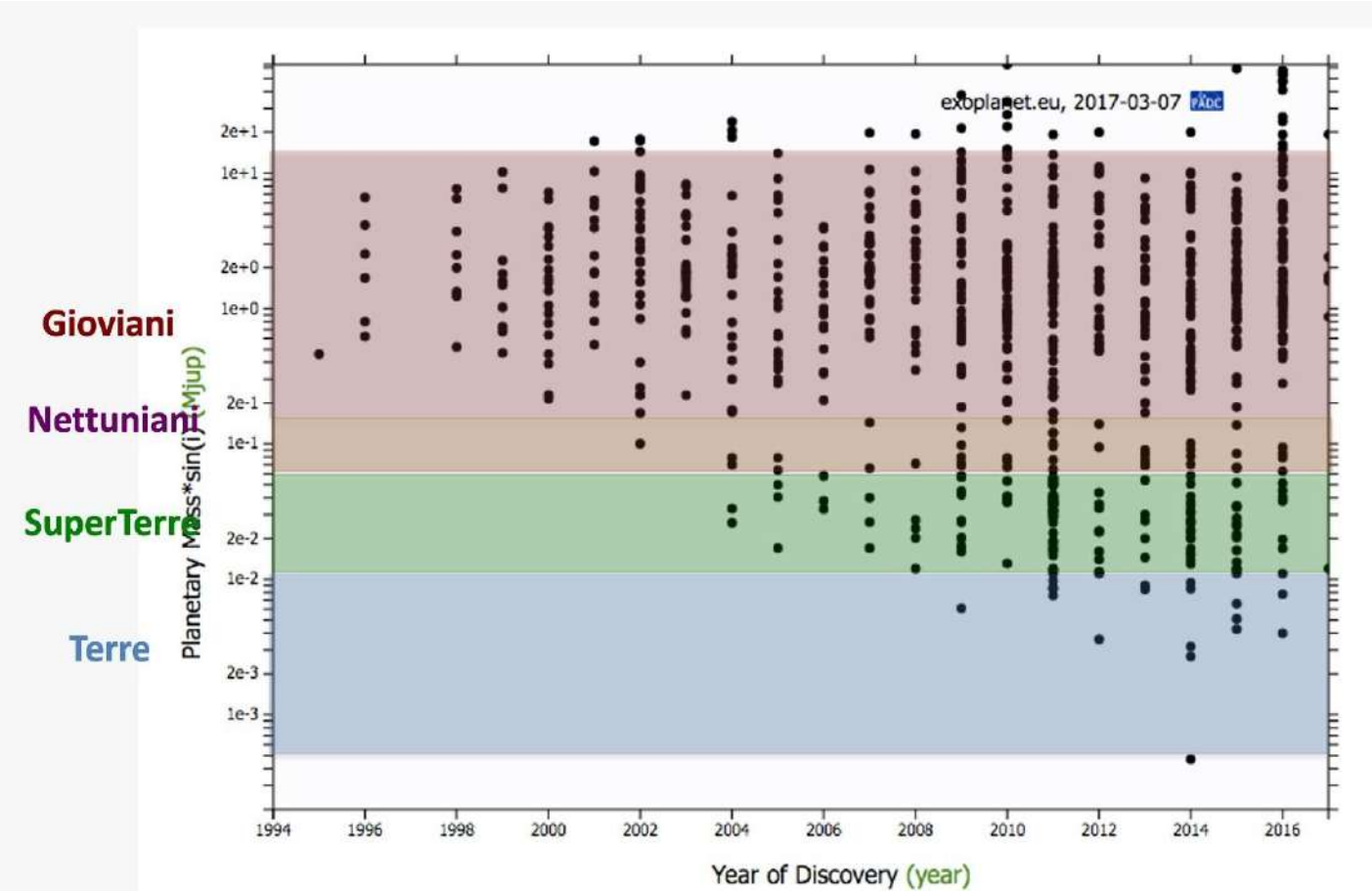
Giusi Micela

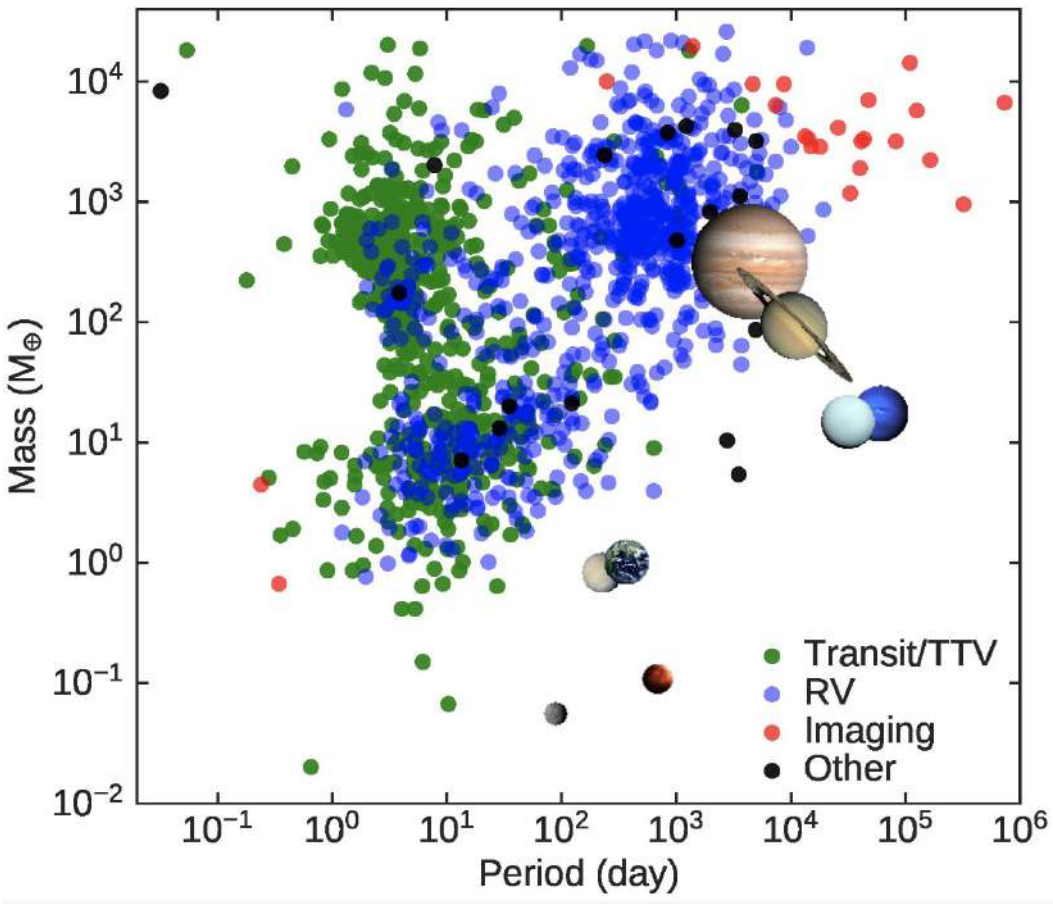
Antonino Petralia

Ignazio Pillitteri

Valerio Fardella

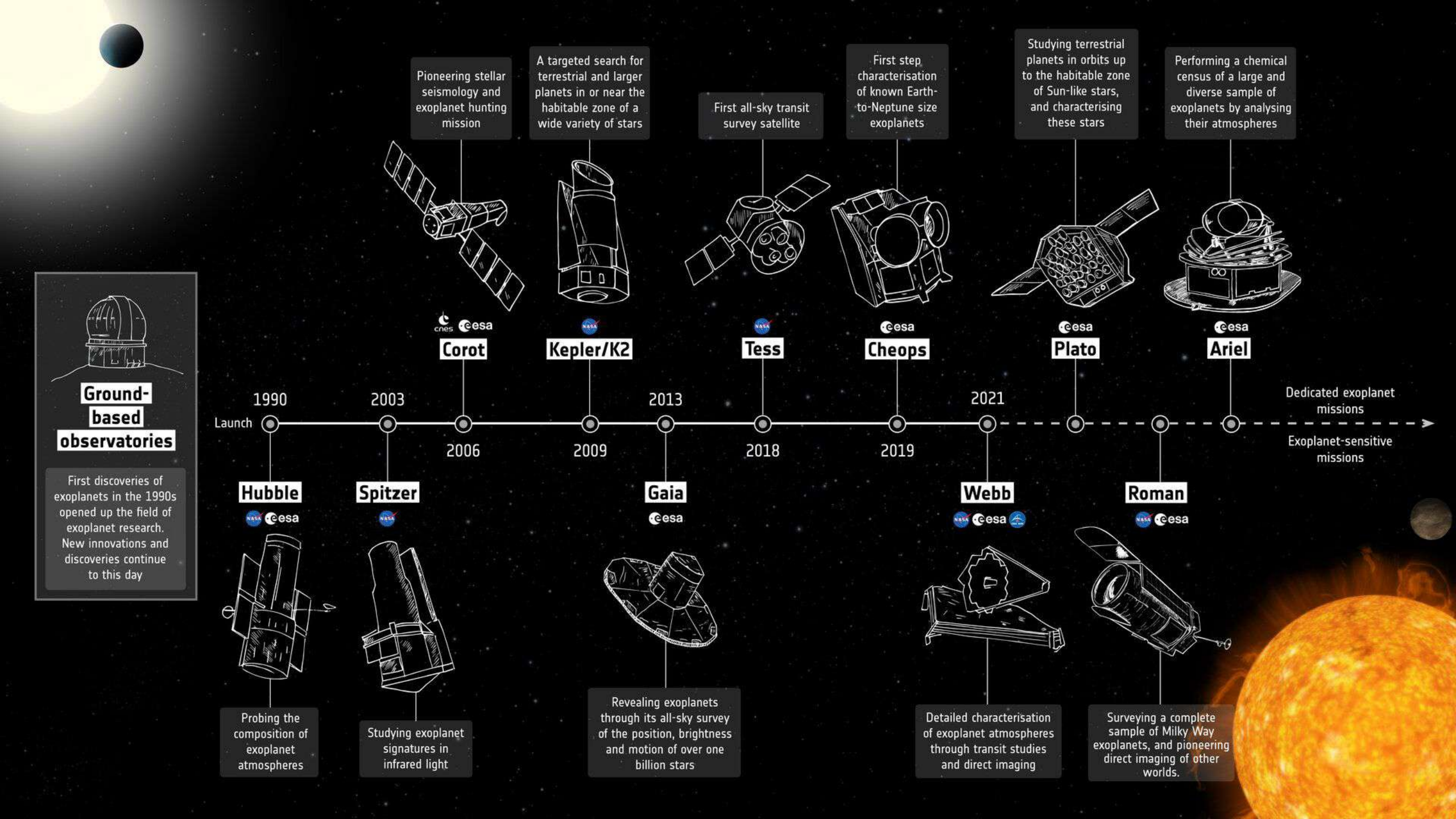
Contesto


Gioviani
Nettuniani
SuperTerre
Terre
exoplanet.eu, 2017-03-07
Planetary Mass*sin(i) (Mjup)
Year of Discovery (year)


Mass (M⊕)
Period (day)
Transit/TTV
RV
Imaging
Other

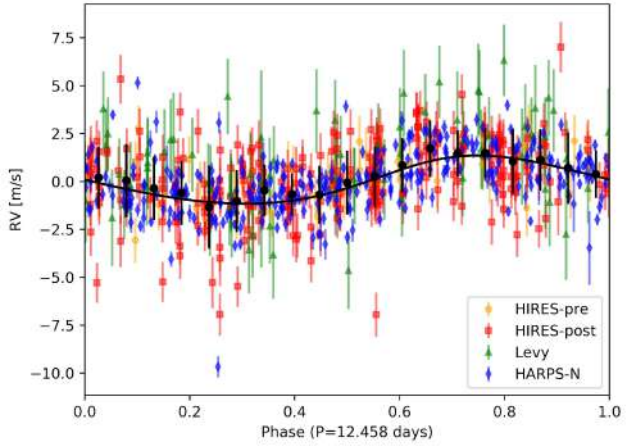
Contesto

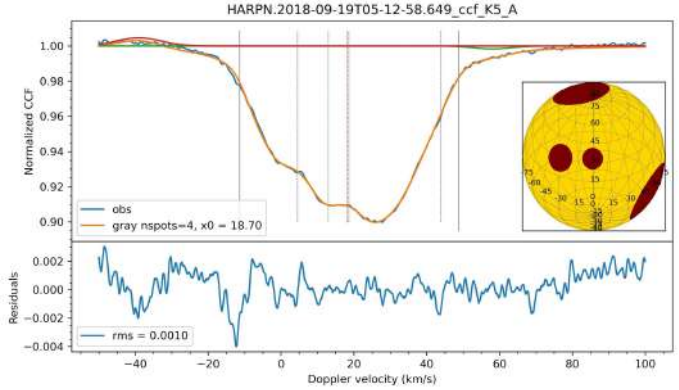
Serie temporali
Abitabilità
Conferenze
Collaborazioni nazionali
Progettazione
Densità
Sviluppi tecnologici
Temperatura
Osservazioni
Formazione planetaria
Python
Fisica
Atmosfere
Archivi
Raggio
Chimica
Statistica
Proposte osservative
Gravità
Modelli
Esperimenti di laboratorio
Interazione Stella - Pianeta
Proposte di calcolo
Tecnologia
Esopianeti
Biologia
Proposte di strumentazione
Collaborazioni internazionali
Massa
Pluto
Composizione chimica
Intelligenza artificiale
Geologia
Astronomia
Viaggi di lavoro
Curve di Luce
Strumentazione
Proposte di finanziamento
Informatica
Analisi numerica
Spettri
Attività stellare
Velocità radiale
Papers
Analisi e interpretazione dei dati
Simulazioni
Meeting di progetto
Irraggiamento
Pipeline
Transiti


Ground-based observatories
First discoveries of exoplanets in the 1990s opened up the field of exoplanet research. New innovations and discoveries continue to this day
Launch
1990
Hubble
Probing the composition of exoplanet atmospheres
2003
Spitzer
Studying exoplanet signatures in infrared light
2006
Corot
Pioneering stellar seismology and exoplanet hunting mission
2009
Kepler/K2
A targeted search for terrestrial and larger planets in or near the habitable zone of a wide variety of stars
2013
Gaia
Revealing exoplanets through its all-sky survey of the position, brightness and motion of over one billion stars
2018
Tess
First all-sky transit survey satellite
2019
Cheops
First step characterisation of known Earth-to-Neptune size exoplanets
2021
Webb
Detailed characterisation of exoplanet atmospheres through transit studies and direct imaging
Roman
Surveying a complete sample of Milky Way exoplanets, and pioneering direct imaging of other worlds.
Plato
Studying terrestrial planets in orbits up to the habitable zone of Sun-like stars, and characterising these stars
Ariel
Performing a chemical census of a large and diverse sample of exoplanets by analysing their atmospheres
Dedicated exoplanet missions
Exoplanet-sensitive missions

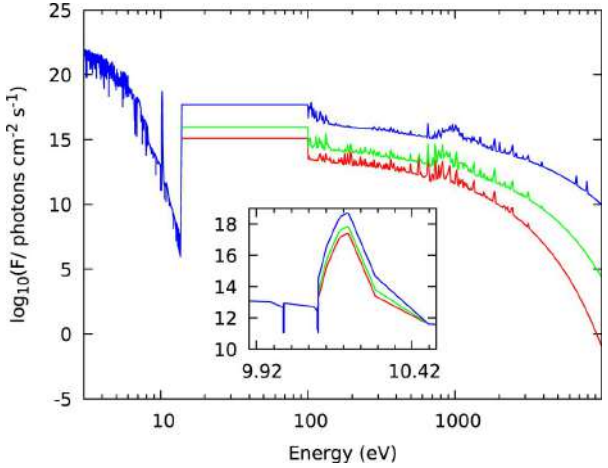
Di quali aspetti ci occupiamo

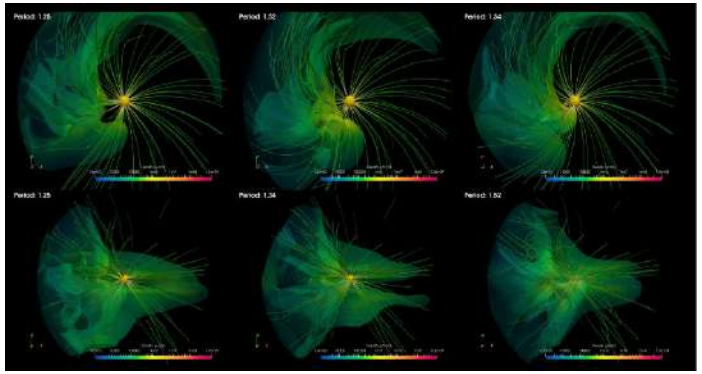
Scoperta e parametri fisici dei sistemi esoplanetari



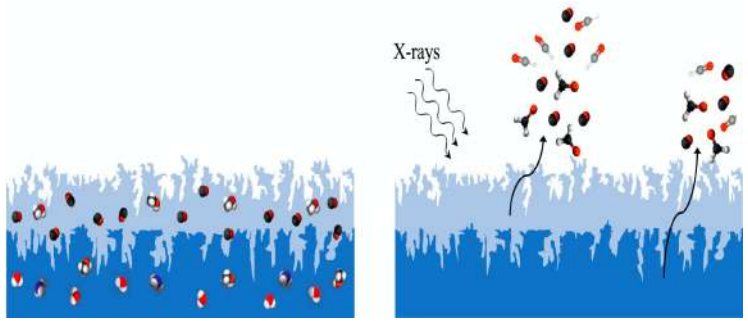


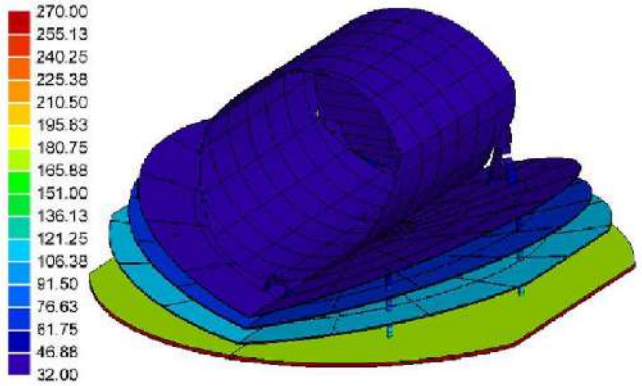
Atmosfere esoplanetarie e interazione stella-pianeta





Esperimenti di laboratorio e Tecnologie per strumentazione spaziale





EXOPA

Scoperta e parametri fisici dei sistemi esoplanetari

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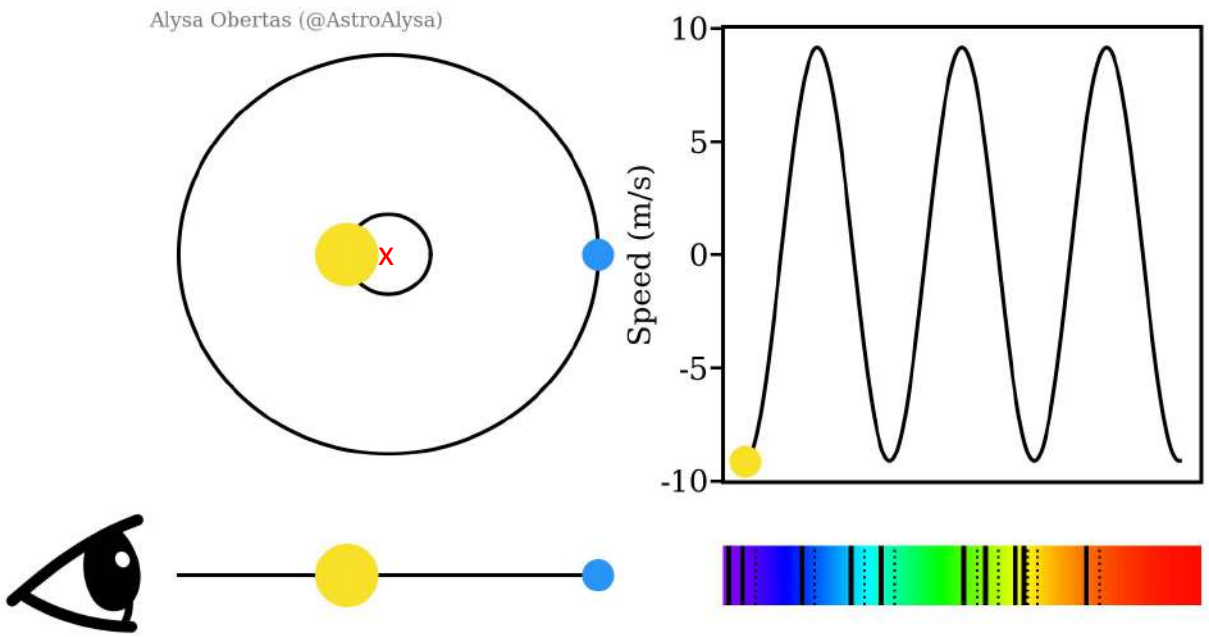
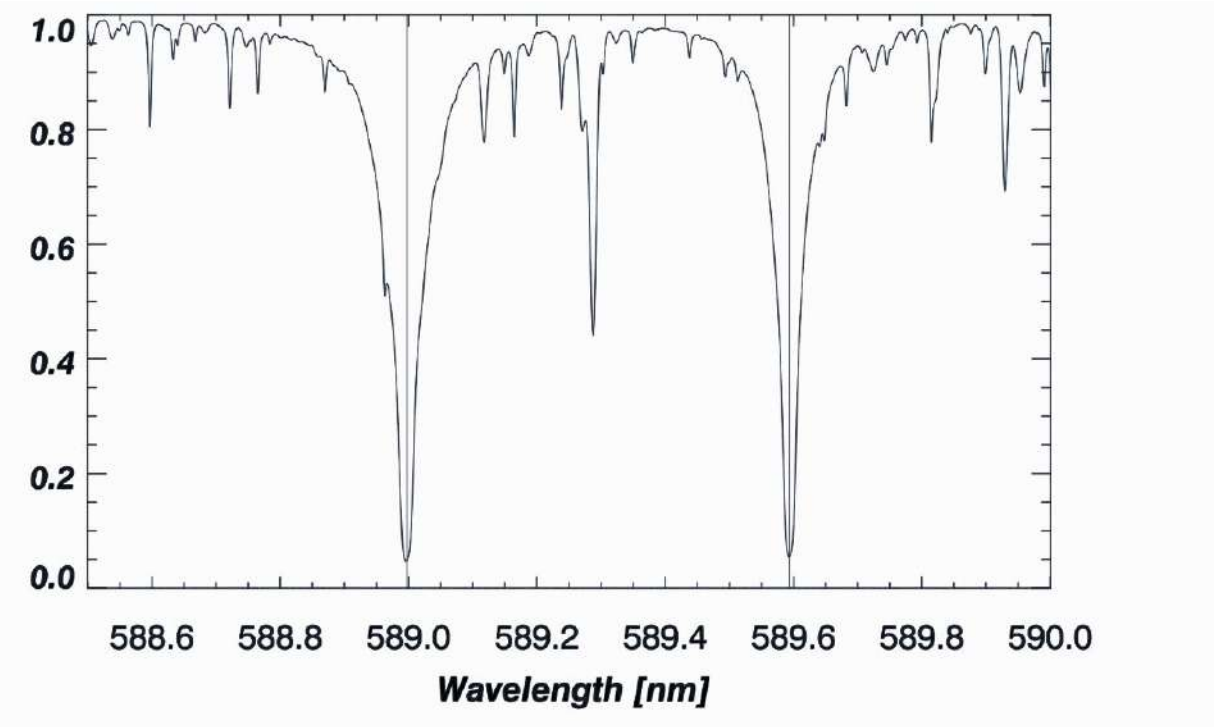
Problema scientifico

Trovare la massa del pianeta

Tecnica delle velocità radiali

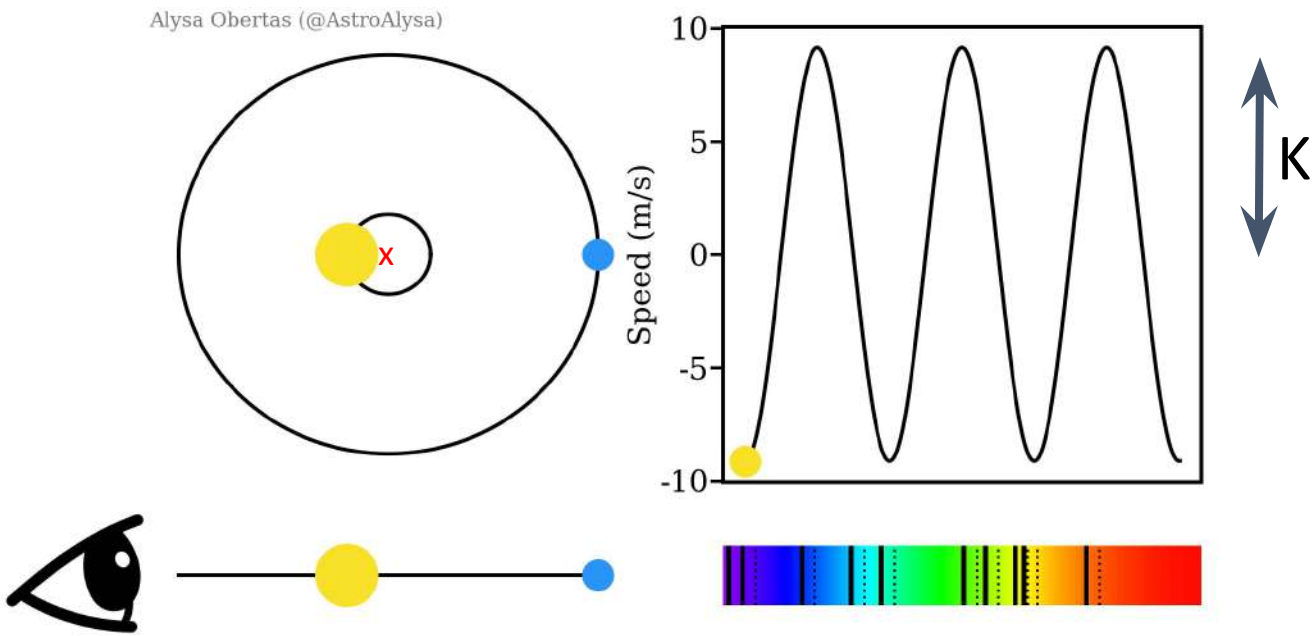




Problema scientifico

Trovare la massa del pianeta

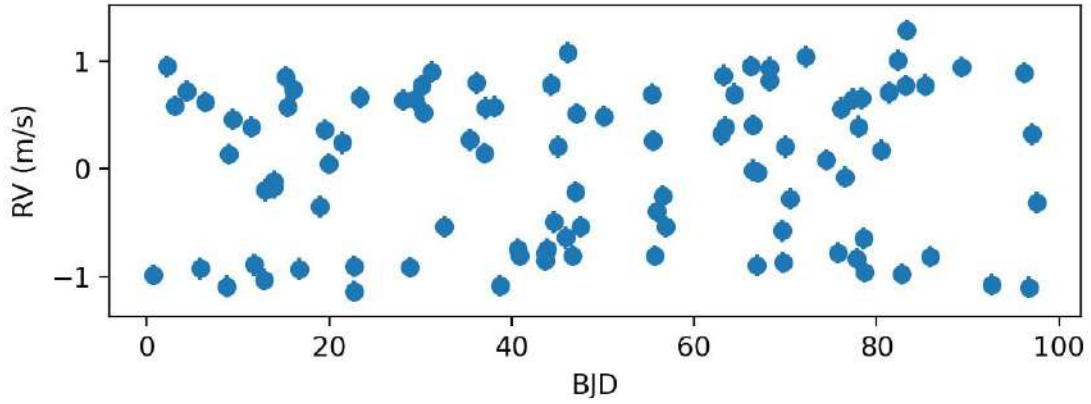
Tecnica delle velocità radiali



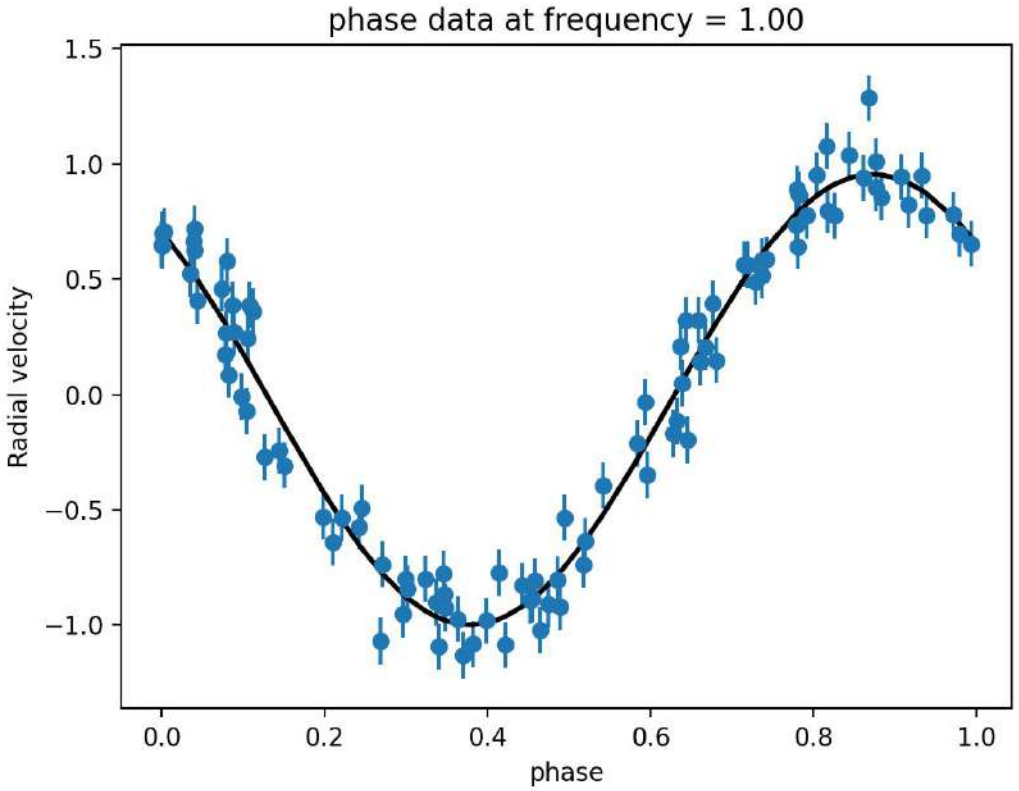
$$K = \left(\frac{2\pi G}{P}\right)^{\frac{1}{3}} \frac{M_p \sin i}{(M_* + M_p)^{\frac{2}{3}}} \frac{1}{\sqrt{1-e^2}}$$

Problema scientifico

Trovare la massa del pianeta



Tecnica delle velocità radiali



Come lo facciamo?

Proposal

Proposal Accettato!!

Raccolta dati

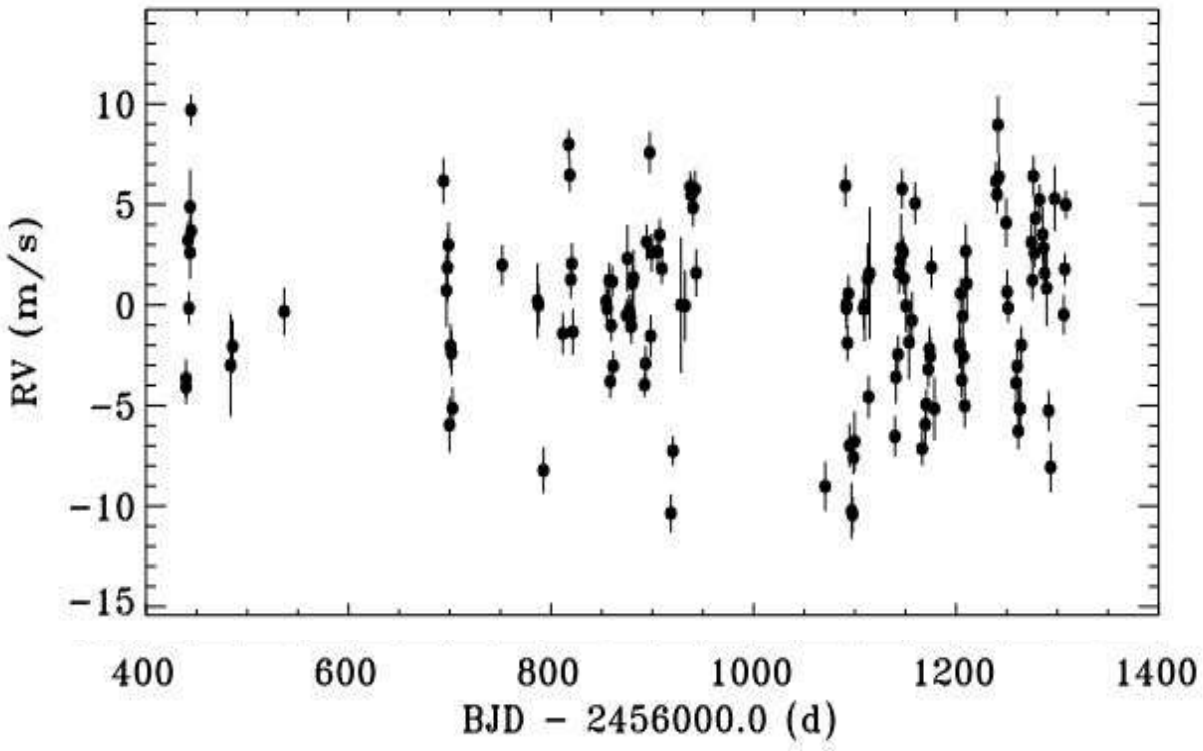
Recupero dai dati

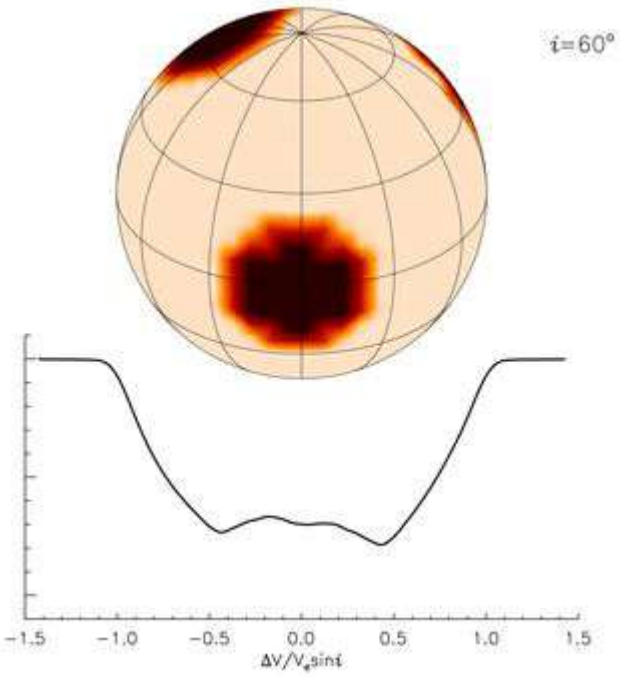
Come lo facciamo?

Analisi Dati

Serie Temporali di velocità radiali → Non solo pianeti all'interno del segnale RV

GJ 3998 (Affer et al. 2016)



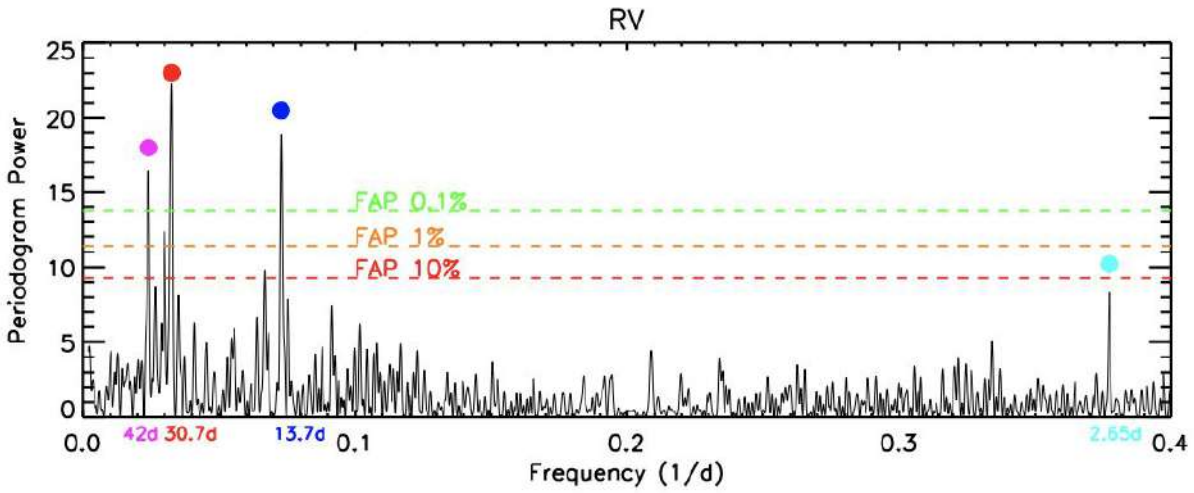


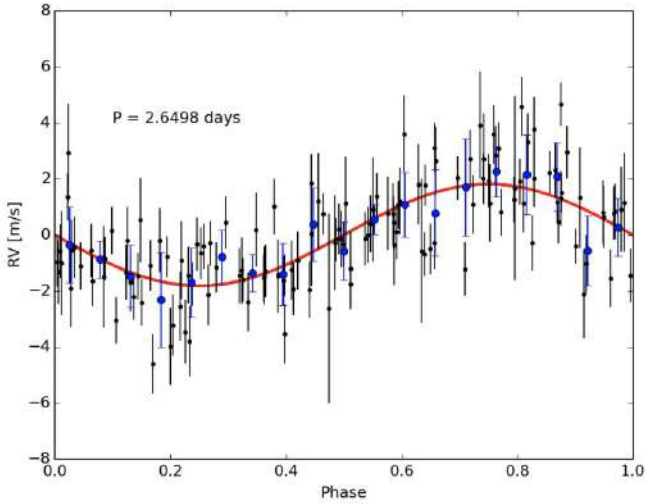
Come lo facciamo?

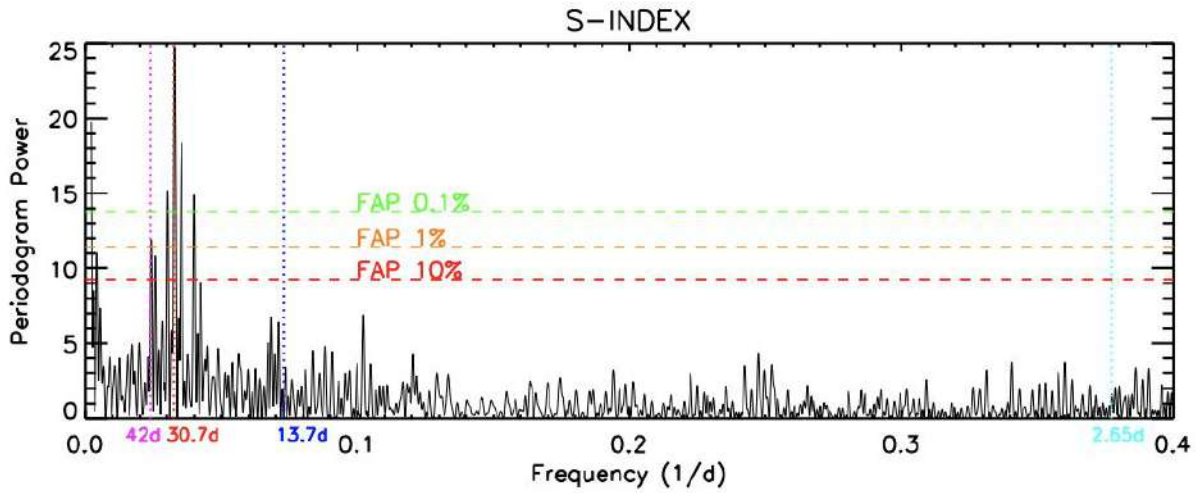
Analisi Dati

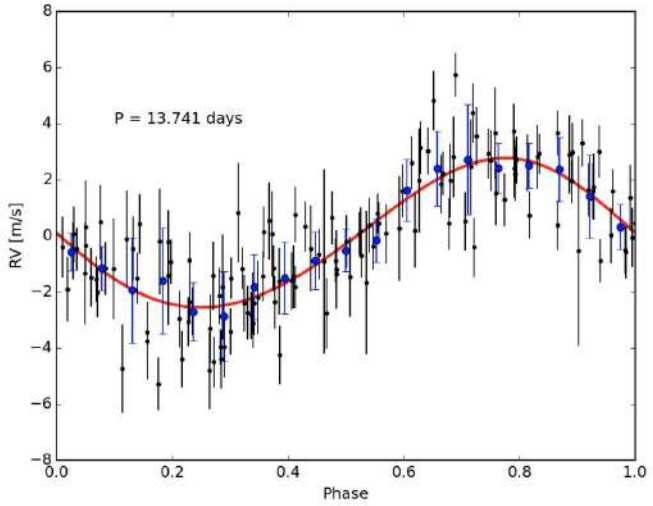
GJ 3998 (Affer et al. 2016)

- **Two-planets**
  - **13.7 d**
  - **2.65 d**
- **Two sinusoidal signals (stellar activity)**
  - **30.7 d**
  - **42.5 d**



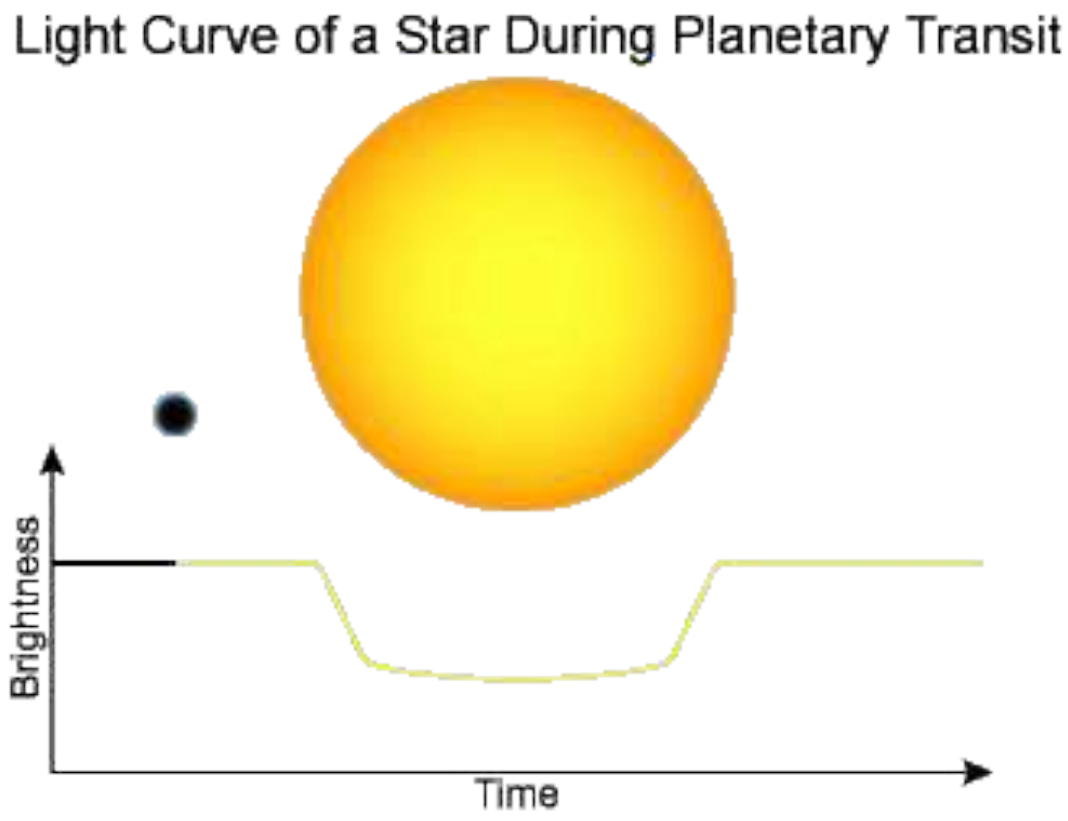






Come lo facciamo?

Analisi Dati



$$\delta = \frac{F_{out} - F_{in}}{F_{out}} \approx \left(\frac{R_p}{R_*}\right)^2$$

Quali risultati possiamo ottenere?

Tecnica delle velocità radiali

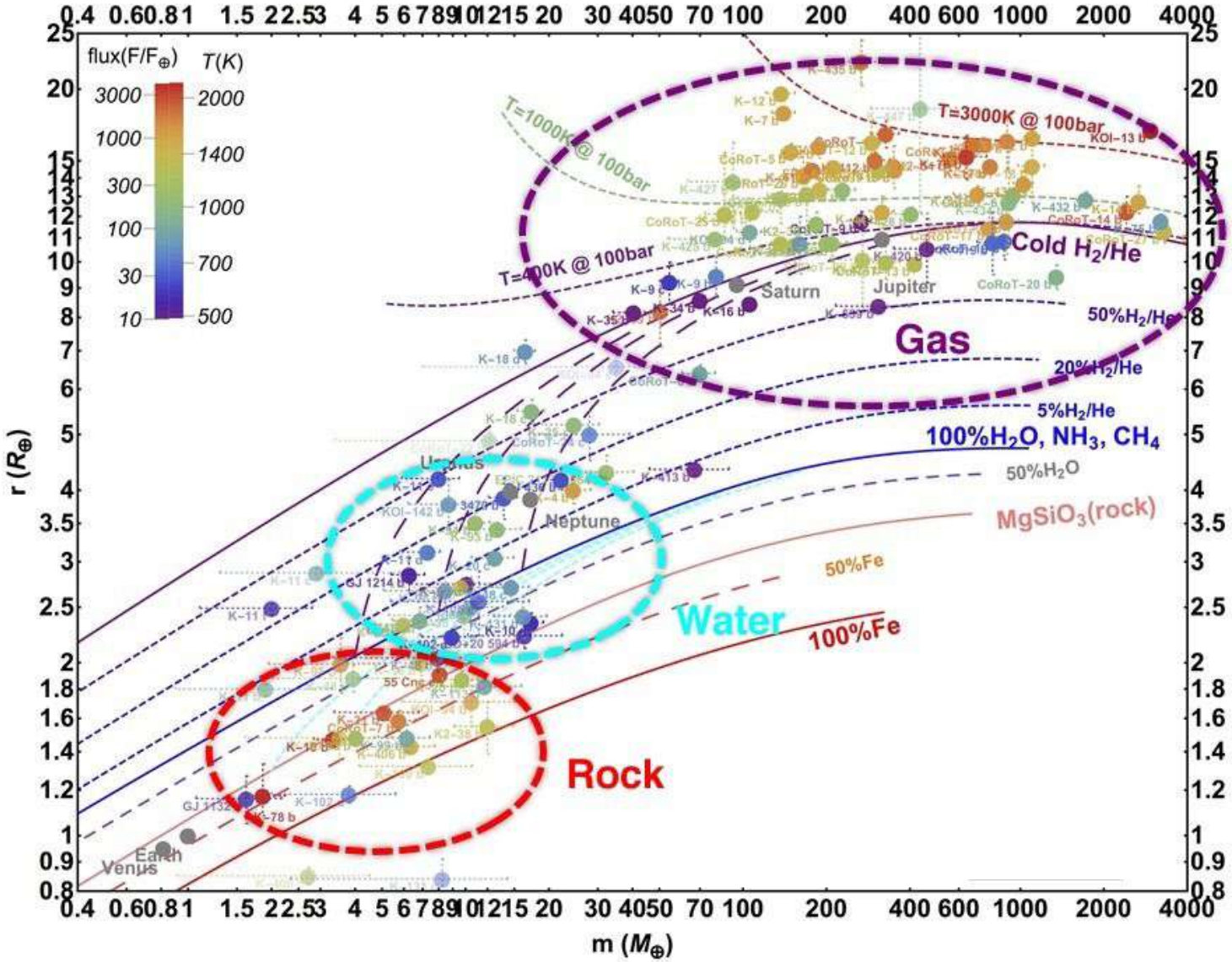
↓

Massa del pianeta

Metodo dei transiti

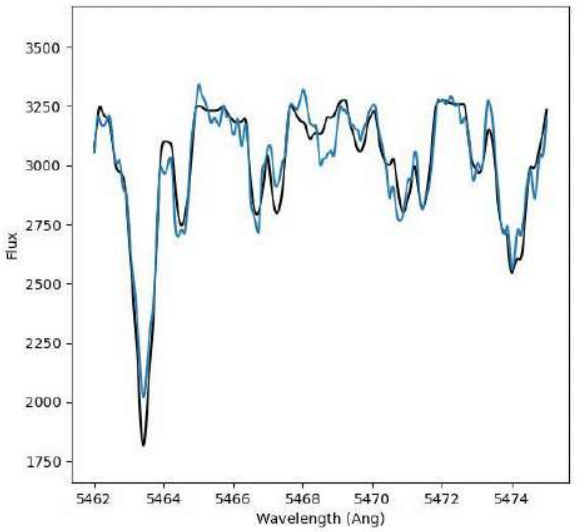
↓

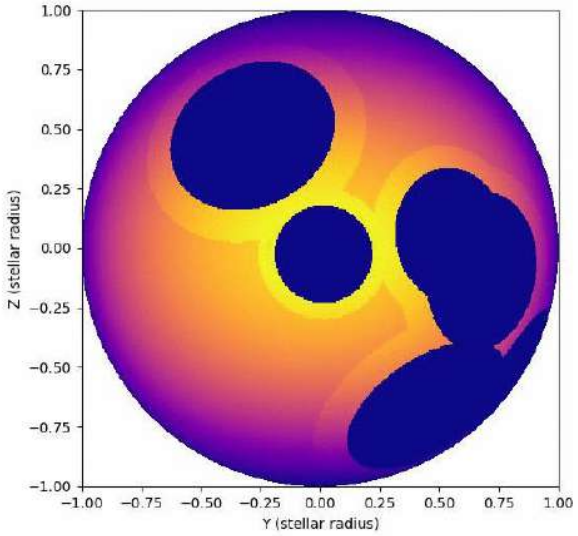
Raggio del pianeta



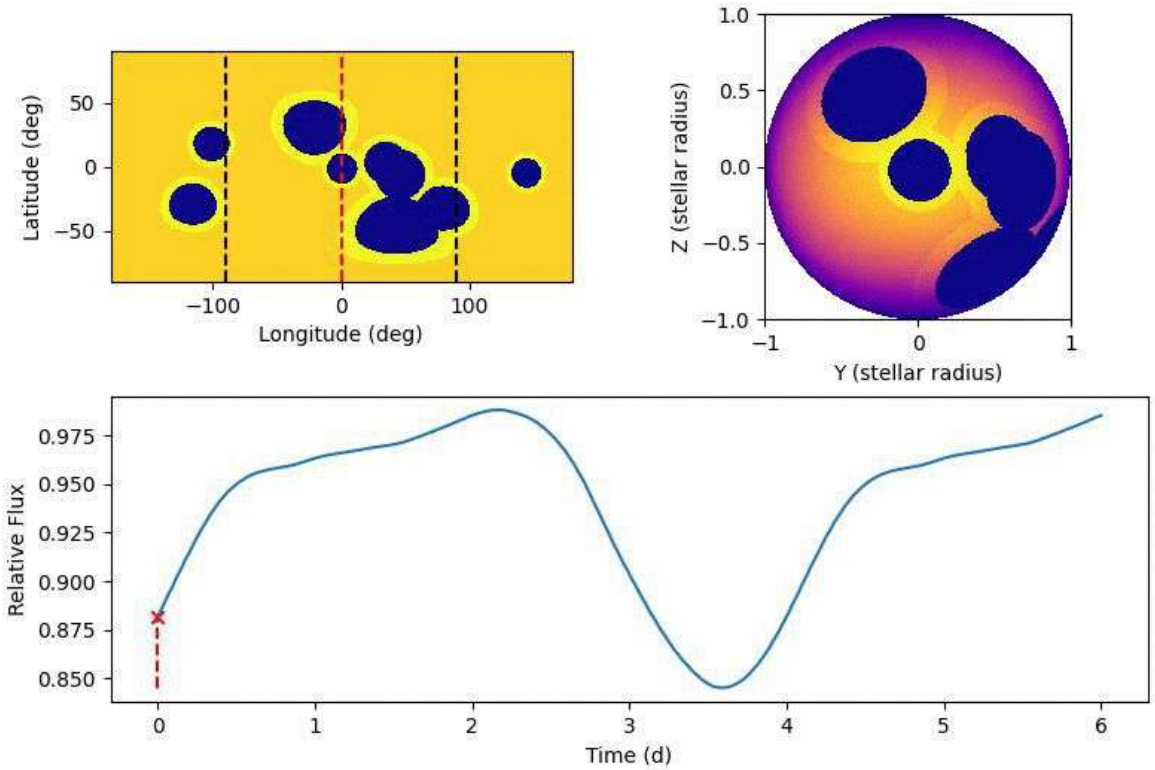
Attività stellare come risorsa

Impatto dell'attività stellare sulle misure di velocità radiale





Impatto dell'attività stellare sulle curve di luce



Progetti Nazionali ed Internazionali

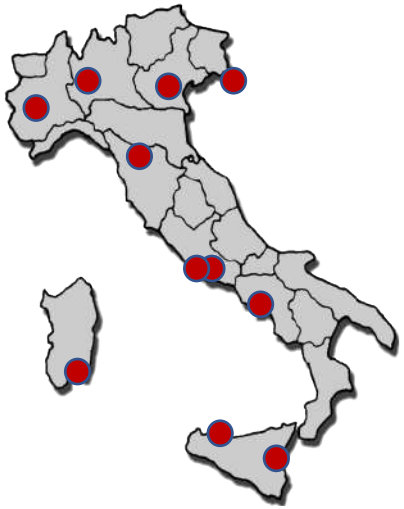
GAPS
GLOBAL ARCHITECTURE OF PLANETARY SYSTEMS

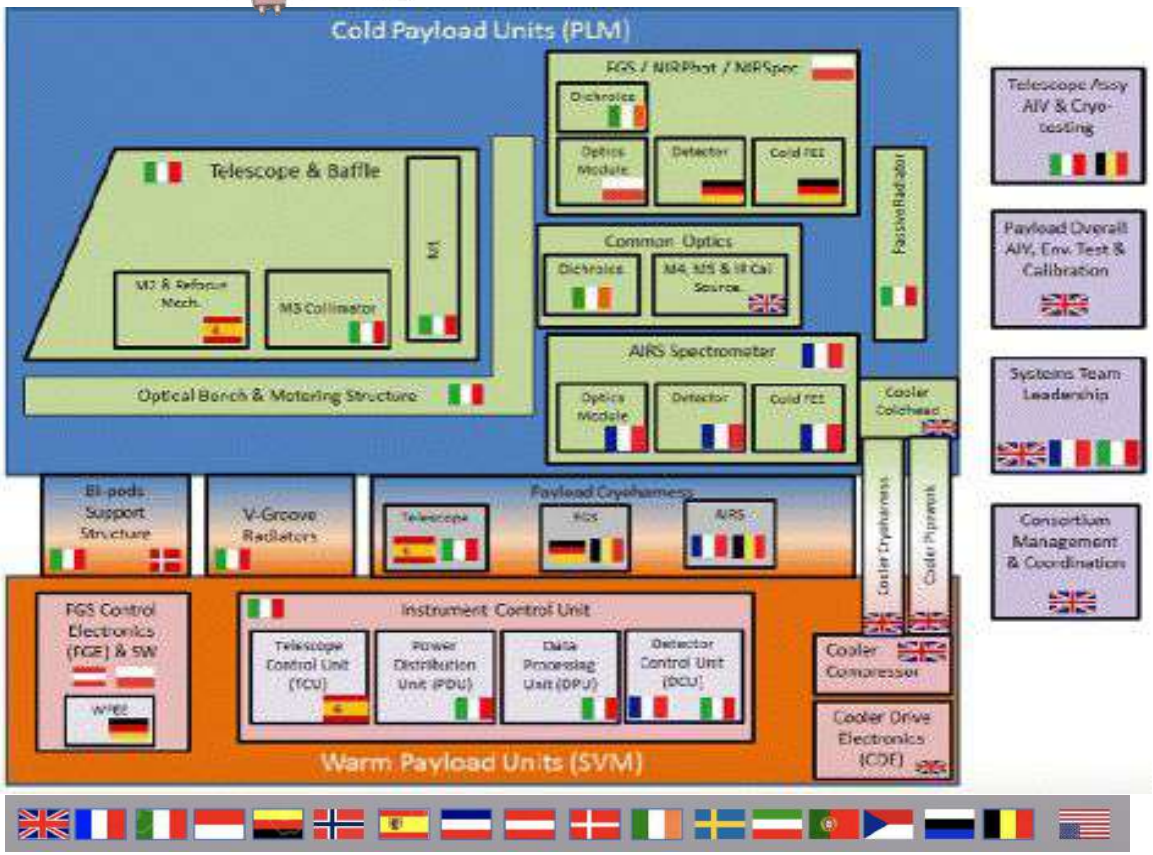
INAF
ISTITUTO NAZIONALE DI ASTROFISICA

Ariel

esa

ASI
Agenzia Spaziale Italiana





Ci divertiamo anche…. Ma vero vero!!!

Schiticchi OAPa

Scattata da Fabio Favata
Coordinatore Programma
Scientifico ESA
Ospite presso OAPa

Le attività del gruppo

Collaborazioni Internazionali
Gruppo di Esopianeti di UCL - Londra

Calendario ExoPa

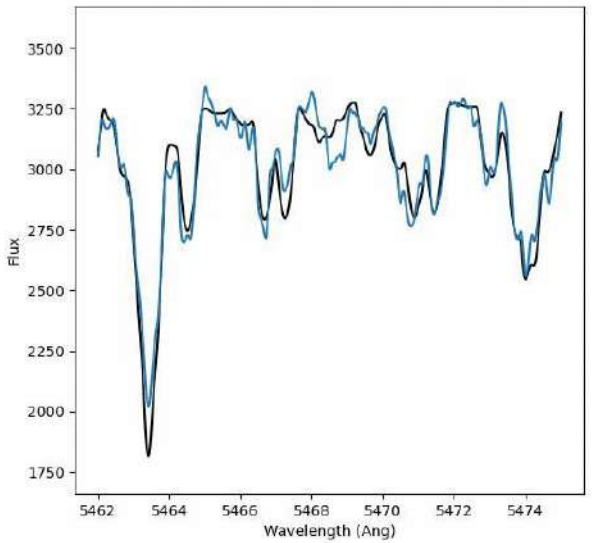
Famiglia ExoPa

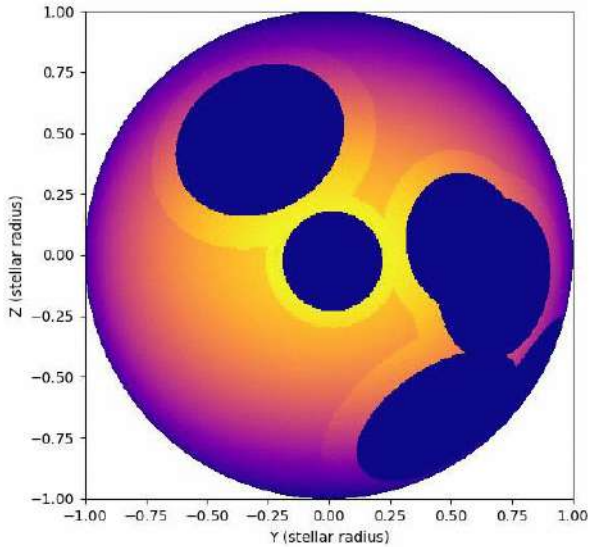
Cosa c'è ancora da fare?

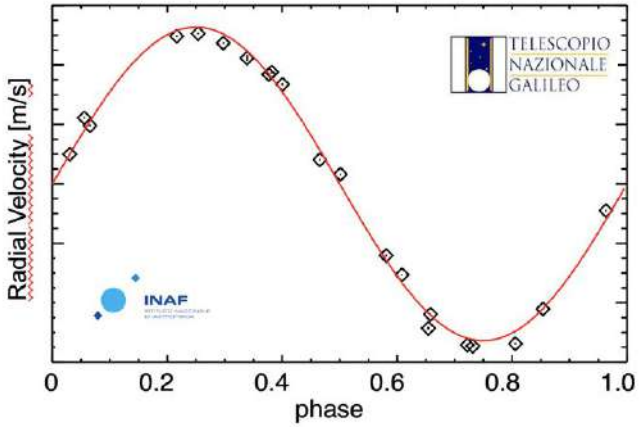
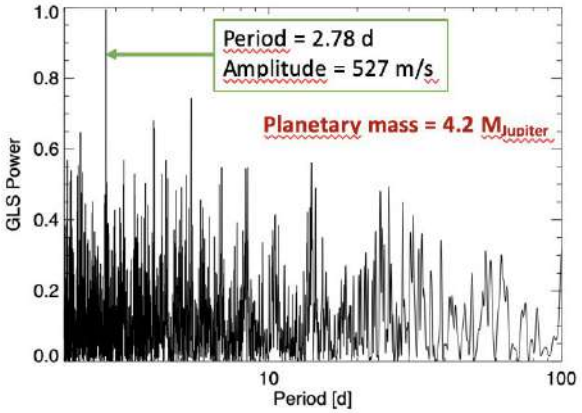
Possibili Tirocini o Argomenti di Tesi (Triennali o Magistrali)

- ***Temperature dependent spectral lines***

Selezione delle righe sensibili all'attività allo scopo di ottenere
- la ricostruzione della configurazione della superficie della stella
- l'ottimizzazione della capacità di scoprire pianeti di piccola massa





- ***Time series analysis of hot Jupiters host stars***

Analisi delle velocità radiali HARPS-N di pianeti giganti di corto periodo ottenute all'interno del programma GAPS
- Analisi delle frequenze di RV e indici di attività
- Fit RV per ottenere i parametri orbitali e la massa del pianeta