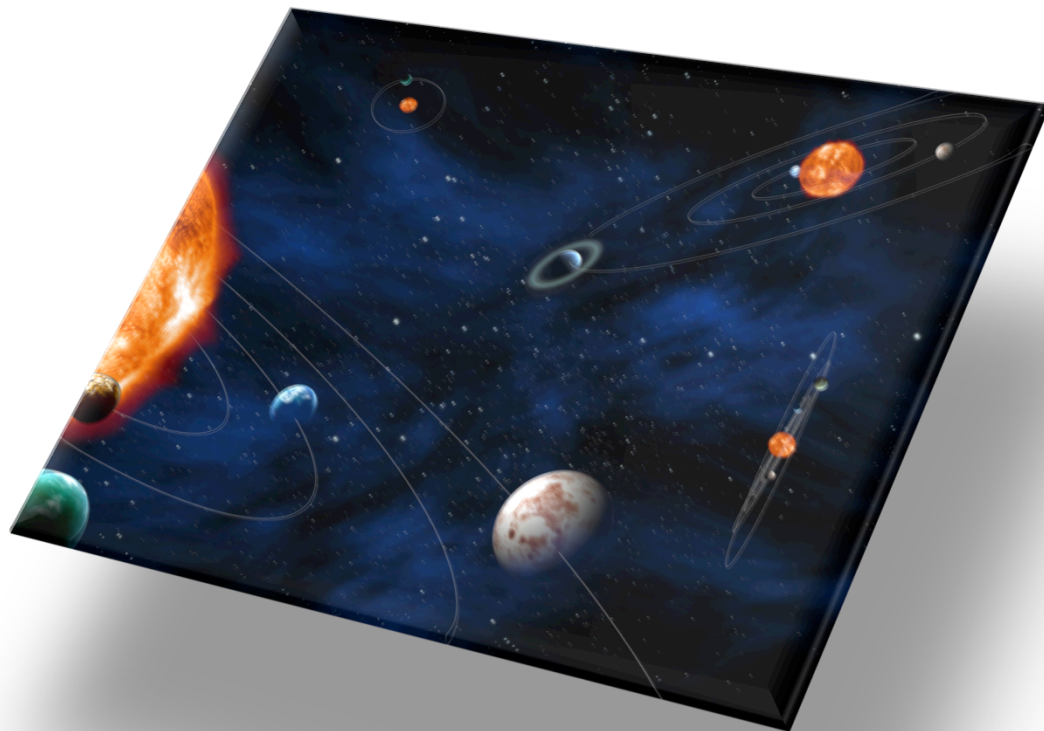


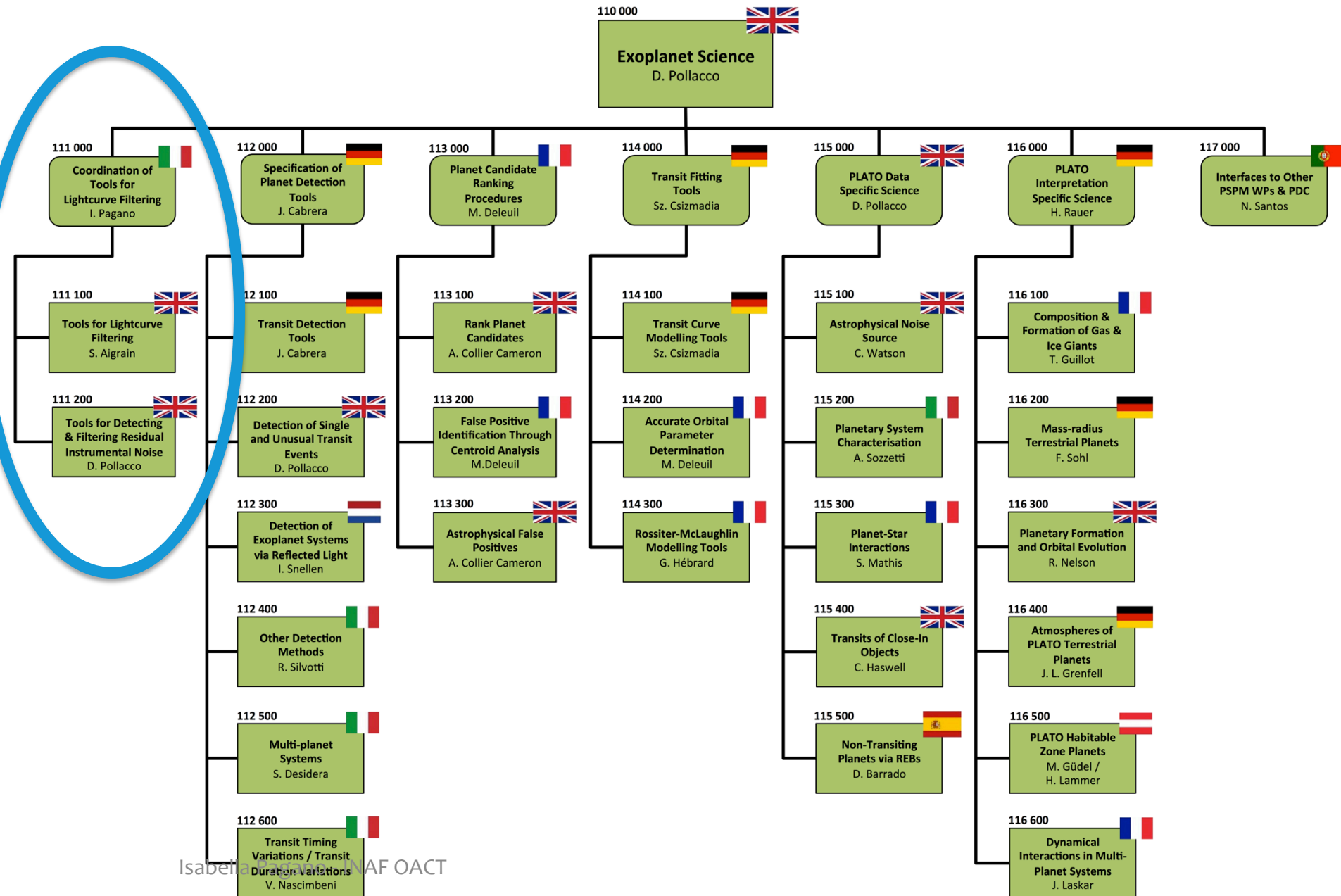
# Stellar activity and rotation in view of exoplanet transit detection and characterization

## Introduction



*Prepared by:* Isabella Pagano

*Event:* PLATO PSM - WP 120 Meeting, 23-24 May 2016



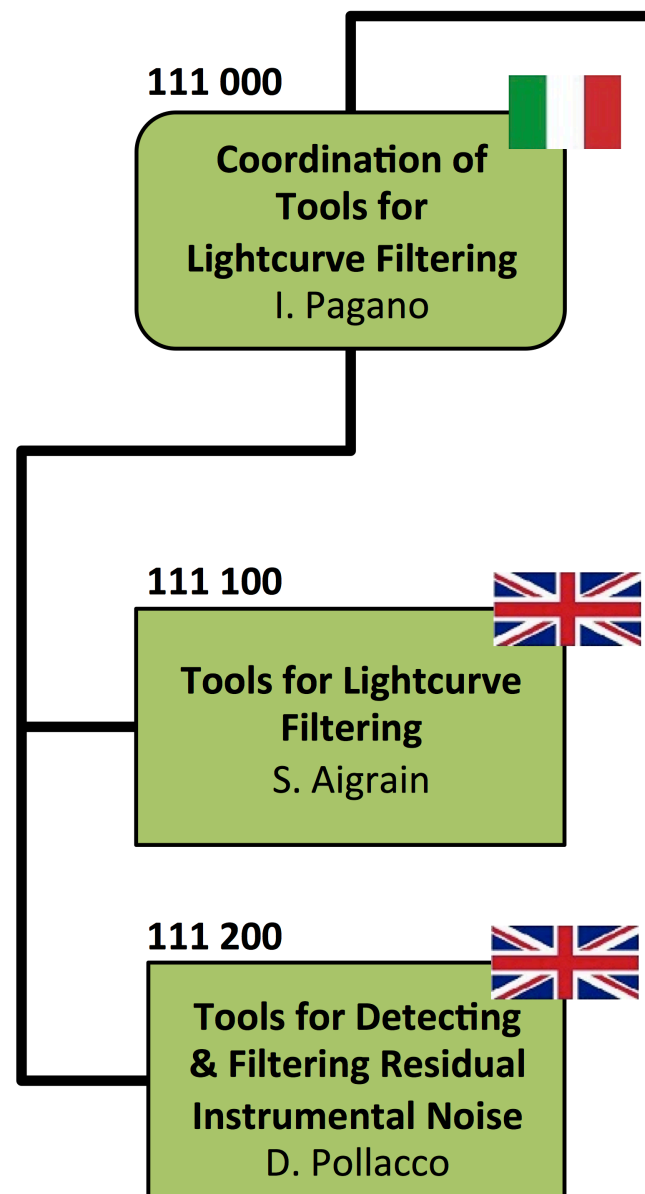
# Involved People

## WP110000

- **INAF**: I. Pagano, G. Scandariato, D. Sicilia
- **Oxford Univ.:** S. Aigrain, H. Parviainen
- **Warwick Univ.:** D. Pollacco, F. Faedi, D. Brown

## Interfaces with:

- **WP112000** “Specification of planet detection tools” (J. Cabrera)
- **WP 123000** “Stellar Activity and Rotation” (N. Lanza)
- ..... ??





# From the WPD document

**Tools for Lightcurve  
Filtering**  
S. Aigrain

**Key Personnel:** S. Aigrain; 1 postdoc (Oxford)

## Objectives:

To understand and minimize the impact of stellar noise on transit detection with PLATO through the evaluation and development (as necessary) of light curve filtering algorithms

## Tasks:

1. Continued evaluation of scientific literature (including unpublished works from CoRoT and K2)
2. Development and testing of algorithms for different types of variability

## Input:

1. Scientific literature
2. PLATO Red book
3. Current PLATO performance estimation
4. Publicly available Kepler and K2 data
5. Simulated PLATO data

## Dependencies:

1. PLATO End-to-End Simulator

## Output:

1. Understanding of impact of stellar noise on PLATO transit photometry
2. Scientific specifications for noise handling algorithms

## Deliverables:

1. Report on WP activity
2. Algorithm(s) for implementation by PDC

## Milestones:

07/2017: Delivery of Initial Set of scientific specifications

07/2018: Review and scientific validation implementation of algorithms done in the PDC.

12/2018 – 12/2023: Cyclic updates on the scientific specifications in compliance with the PDC development plan



# From the WPD document

**Key Personnel:** D. Pollacco; F. Faedi (Warwick)

**Tools for Detecting  
& Filtering Residual  
Instrumental Noise**  
D. Pollacco

## Objectives:

To simulate the effect of systematic noise arising in the PLATO instrument itself and its effects on transit detection. To adapt and optimize mitigation techniques outlined earlier. This WP will also produce test data to be used by other exoplanet WPs for benchmarking the PDC Exoplanet software.

## Tasks:

1. Optimization of algorithms via the analysis of light-curves residuals after de-trending.
2. Develop and assessment of algorithms for different types of systematic noise sources.
3. Develop test data to be used in benchmarking (and testing) the PDC exoplanet software.

## Input:

1. Scientific literature
2. PLATO Red book
3. Current PLATO performance estimation
4. CoRoT and Kepler datasets

## Dependencies:

Exchange of information and coordination with WP 112 and WP 114, PLATO End-to-End Simulator

## Output:

Mitigation of the effects of residual instrumental noise on PLATO photometry. For example residuals correlation with colour, magnitude, time scale of observation. Test for the optimal de-trending technique.

## Deliverables:

1. Report on status and tests of algorithms
2. Report on bench mark datasets

## Milestones:

03/2017: Results from the use of Kepler data to assess the algorithm performance for PLATO

07/2017: Production of specification for bench mark and identification of existing and synthetic datasets

07/2017: Delivery of Initial Set of scientific specifications

07/2018: Review and scientific validation implementation of algorithms done in the PDC.

12/2018 – 12/2023: Cyclic updates on the scientific specifications in compliance with the PDC development plan

# From the WPD document

**Key Personnel:** I. Pagano; A. F. Lanza (INAF-Catania); S. Aigrain (Oxford); F. Faedi (Warwick)

## Objectives:

To coordinate work packages looking at noise sources (both astrophysical and instrumental) in the PLATO photometry. To deliver algorithms and specifications to reduce the impact of noise on transit detection and modelling.

## Tasks:

1. Continue the evaluation of scientific literature on this topic (including new works from CoRoT and Kepler)
2. Assessment of algorithm descriptions and their requirements
3. Methods to test the implemented algorithms

## Input:

1. Scientific literature
2. PLATO Red book
3. Current PLATO performance estimation
4. Simulated PLATO data

## Dependencies:

WP 111 100, WP 111 200, PLATO End-to-End Simulator

## Output:

1. Understanding of stellar noise on PLATO photometry and its impact on transit detection and modelling in collaboration with WP 112 000 and 114 000
2. Transfer of information through WP 117 000

## Deliverables:

1. Reports on algorithms and specifications.
2. Reports on tests performed as algorithms and their implementation evolve.

## Milestones:

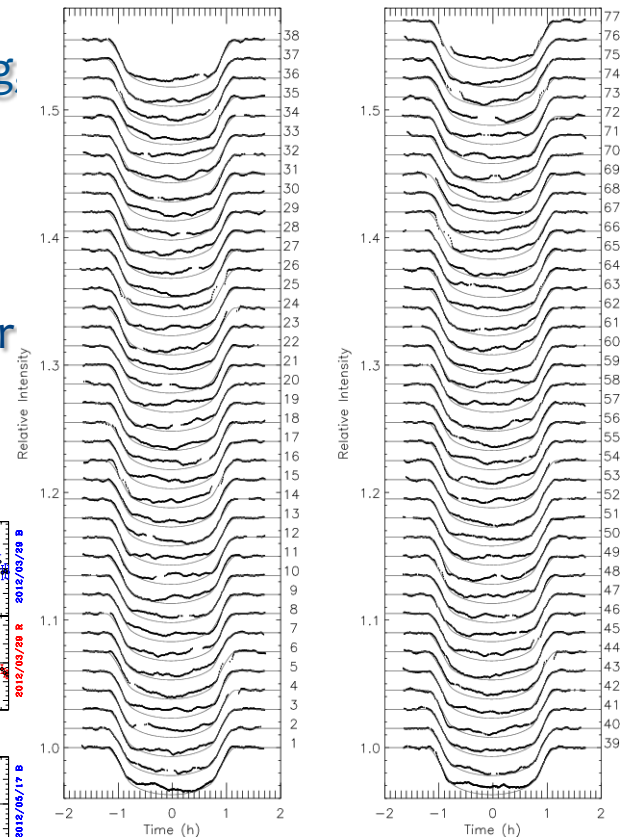
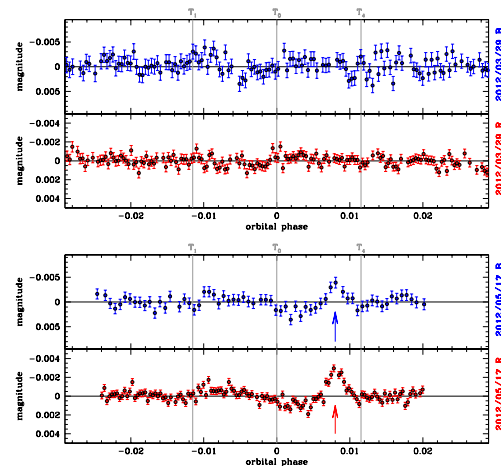
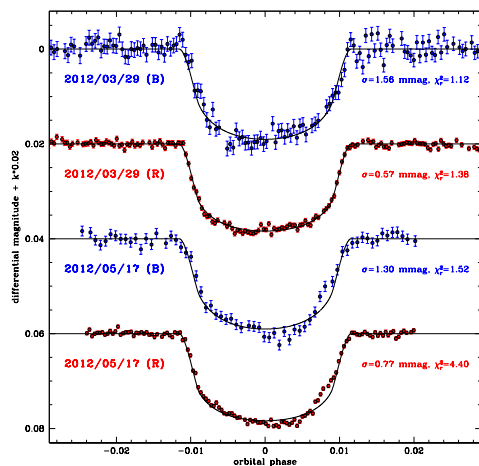
07/2017: Delivery of Initial Set of scientific specifications to the PDC

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# Stellar Activity as main source of noise

- Activity is the main noise for planet (detection)/characterization:
  - It alters transit depth, duration and timing
  - possible wrong radius estimation;
  - possible errors on the characterization of the atmosphere;
  - Possible perturbation on TTV (relevant for mass estimation on multiple planetary systems)



77 transits of **CoRoT-2b** in front of its spotted host star (Silva-Valio et al. 2010, A&A 510, A25)

**GJ 1214:** 2 transits measured by LBC@LBT simultaneously in B and R  
 ~1.5 months apart (Nascimbeni et al. 2015, A&A 579, A113)



# WP111000 ↔ WP120000

- "Mitigation of stellar activity in transit search: lesson learned from CoRoT, Kepler and K2" – Suzanne Aigrain
- Discussion