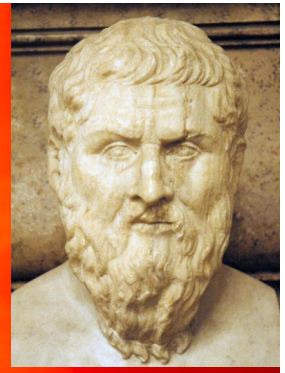


***PLA**netary **T**ransits*
***and O**scillations of stars*

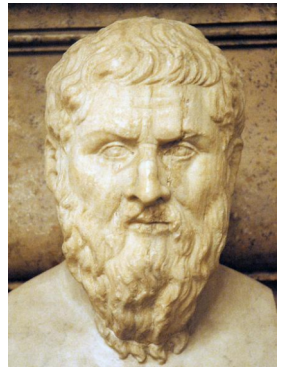
http://www.oact.inaf.it/plato/PPLC/Home.html

PLATO

Claude CATALA
Observatoire de Paris, LESIA

Meeting of the Data Analysis System
Cambridge May 27&28, 2010

Status of the mission



PLATO was selected in Feb 2010 for a definition phase, together with Solar Orbiter and Euclid

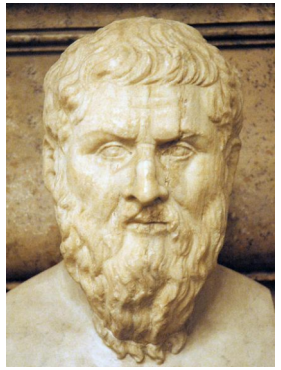
Definition phase:

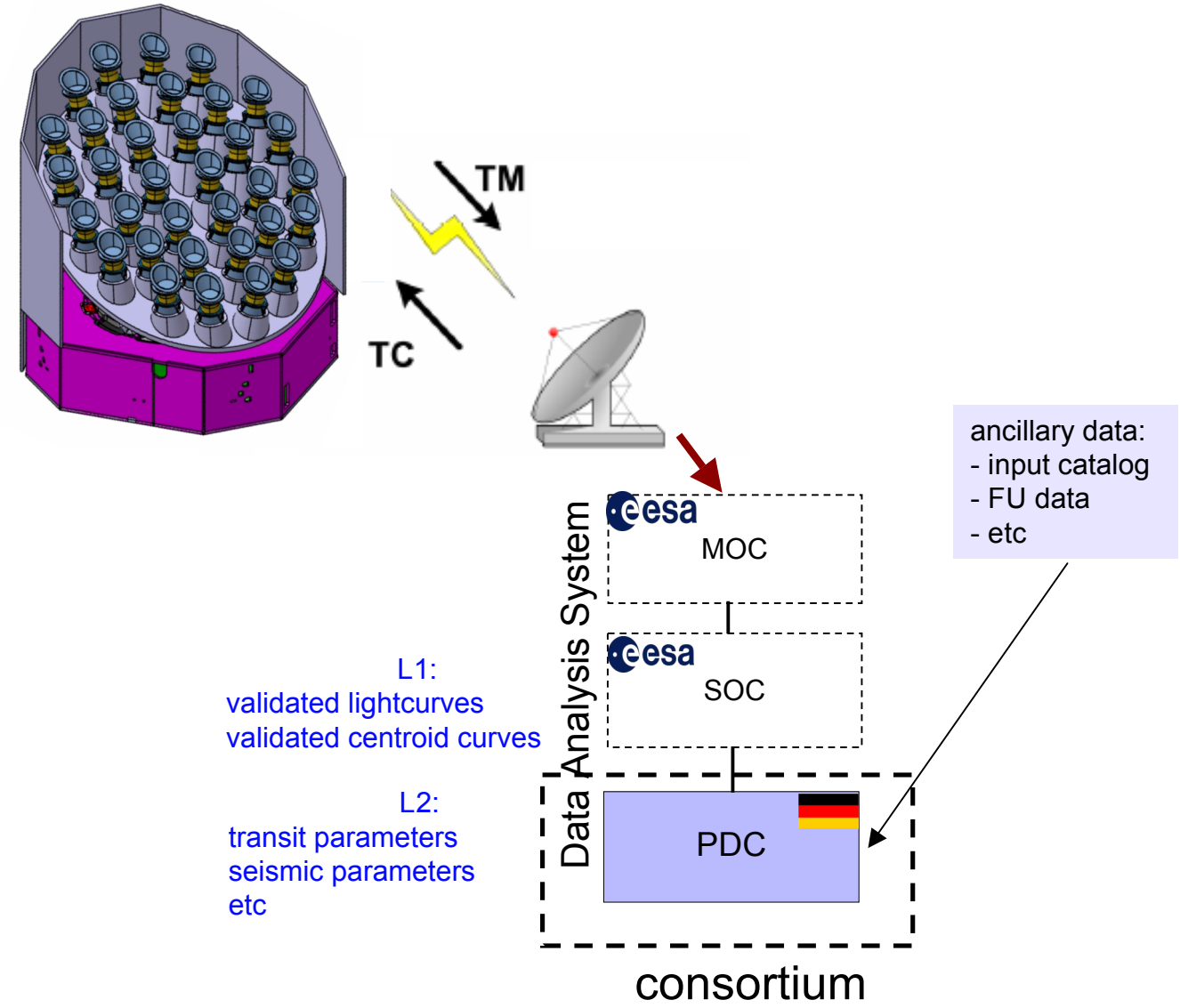
1. Phase A until June 2011
2. Down-selection in June 2011 : two missions out of three will remain
3. Phase B1 until Dec. 2011

ESA will issue an AO for constituting a PLATO consortium in mid-June 2010

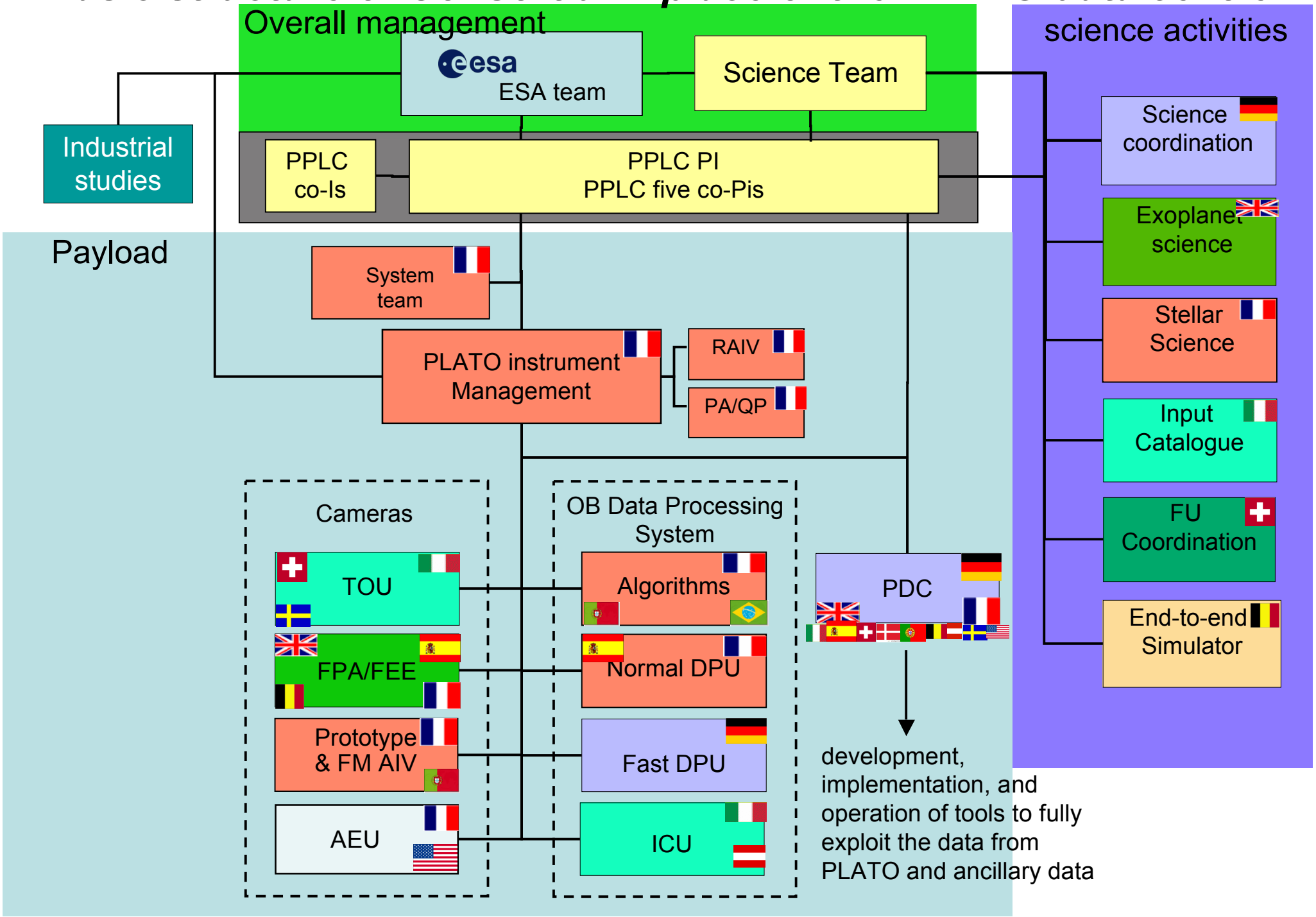
Answer to the AO expected around Sep. 15, 2010

The Data Analysis System and the PLATO Data Centre: what is it?

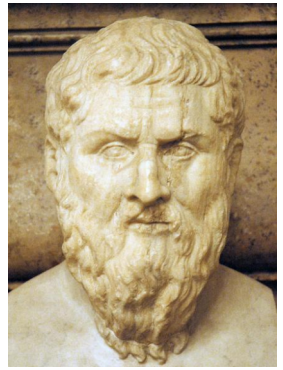




Basic structure of Consortium: place of the PLATO data centre

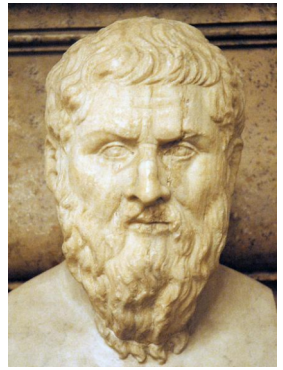


Goals of the meeting



1. Identify all tasks related to the PLATO Data Centre in the more general context of the Data Analysis System
2. Establish to first order the Work Breakdown Structure, and distribution of responsibilities
3. Prepare the answer to the AO, for all issues related to PDC
4. Prepare Phase-A work
5. Discuss further steps: phase-B1, phase-C, etc.

Science Objectives of PLATO

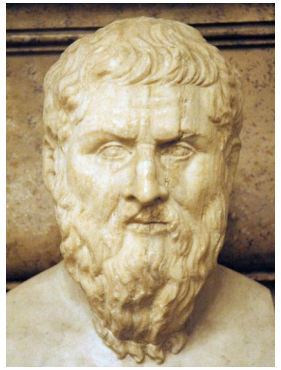


Search for and characterization of transiting exoplanets, using combination of ultra-high precision space photometry and groundbased radial velocity follow-up observations:

1. Study of exoplanets of all kinds, including earth analogs, i.e. terrestrial planets in the habitable zone of solar-type stars
2. Provide full characterization of the planet host stars (radii, masses, ages) through seismic analysis and other data, from which planet radii, masses and ages will be determined
3. Identification of transiting planets around brightest solar type stars, including in their habitable zone, which will become privileged targets of future characterization work
4. Search for transiting planets around dM stars up to a few tens of parsecs at various orbital periods and with all physical sizes, in a significant fraction of the sky
5. Seismic studies of bright stars of all types

PLATO target samples

Main focus of PLATO:
Bright and nearby stars !!



PLATO…
is watching you !

> 20,000 **bright** (~ $m_V \leq 11$)

cool dwarfs/subgiants (>F5V&IV):

exoplanet transits
AND
seismic analysis of their host stars
AND
ultra-high precision RV follow-up

noise < $2.7\ 10^{-5}$ in 1hr
for 3 years

>1,000 very **bright**

($m_V \leq 8$)

cool dwarfs/subgiants

for 3 years

exoplanets

around bright and nearby stars

>3,000 very **bright**

($m_V \leq 8$)

cool dwarfs/subgiants

for >5 months

> 5,000 (3 years) + 5,000 (5 months) nearby M-dwarfs

($m_V \leq 15$-16) noise < $8.\ 10^{-4}$ in 1hr

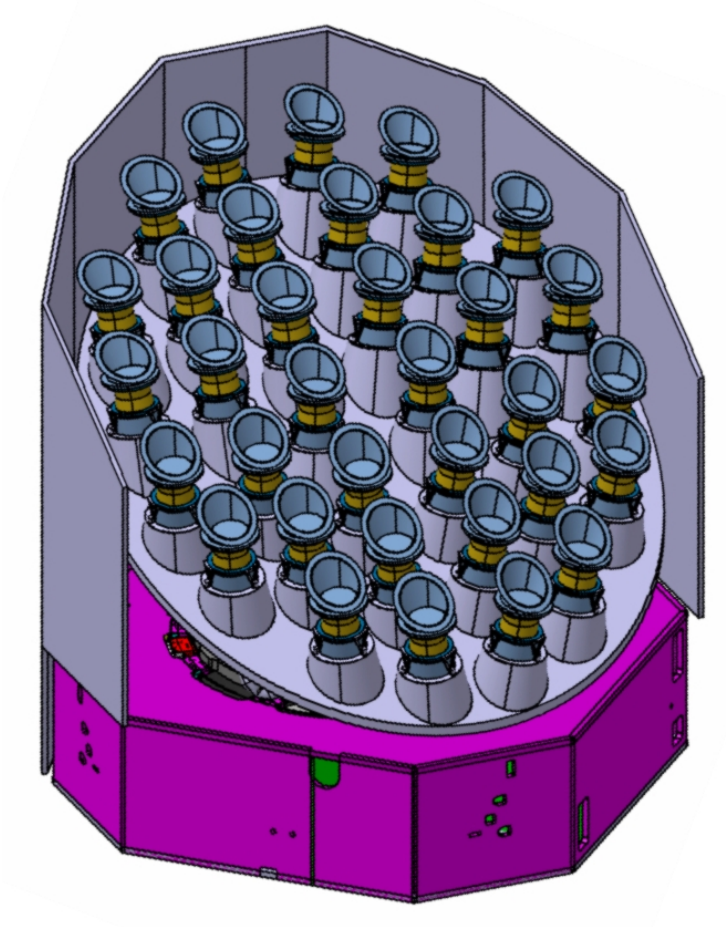
> 250,000 cool dwarfs/subgiants (~ $m_V \leq 13$)

exoplanet transits + RV follow-up

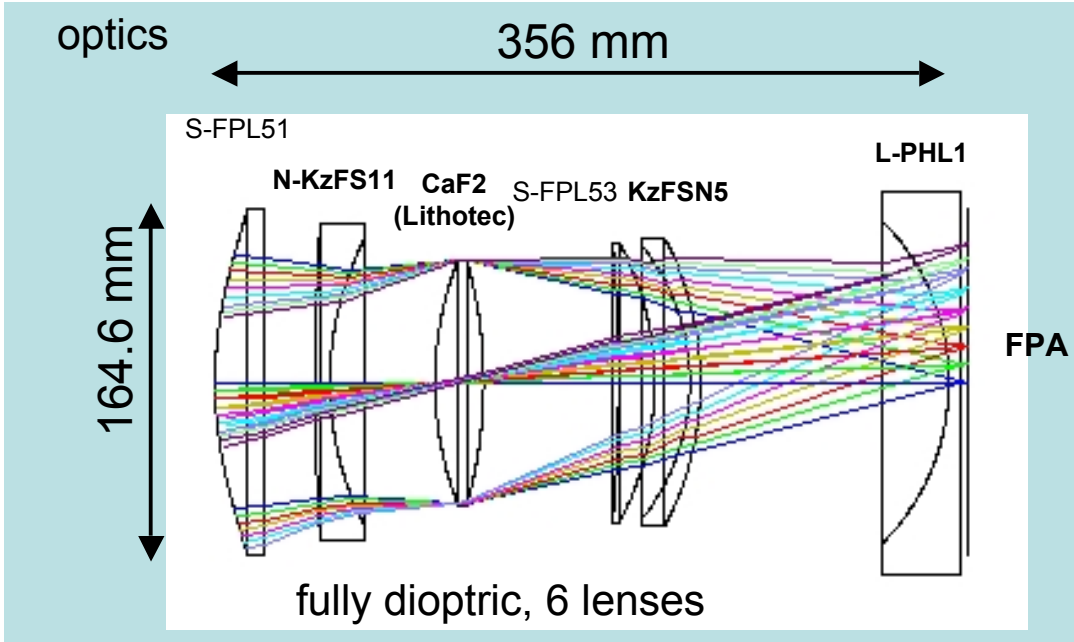
noise < 8.10^{-5} in 1hr for 3 years

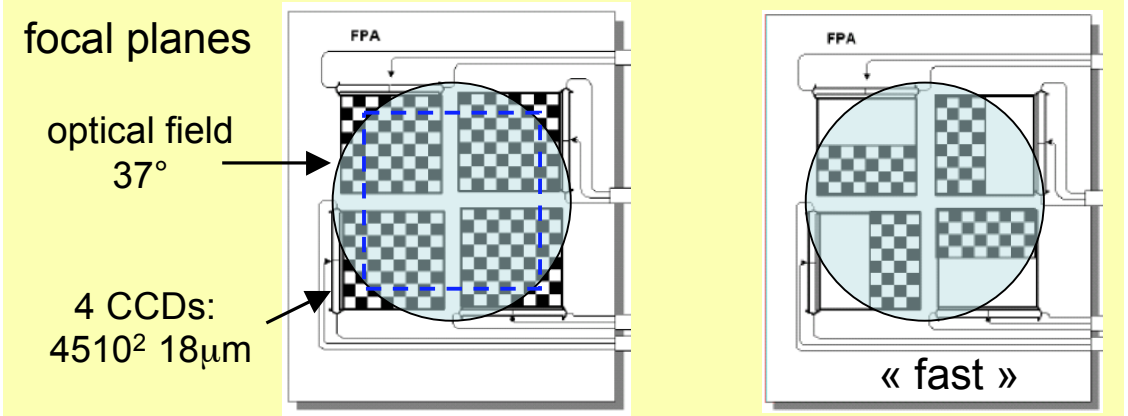
Instrumental Concept

Very wide field + large collecting area :
multi-instrument approach



New design
- 32 « normal » cameras : cadence 25 sec
- 2 « fast » cameras : cadence 2.5 sec
- pupil 120 mm
- huge dynamical range: $4 \leq m_V \leq 16$!!





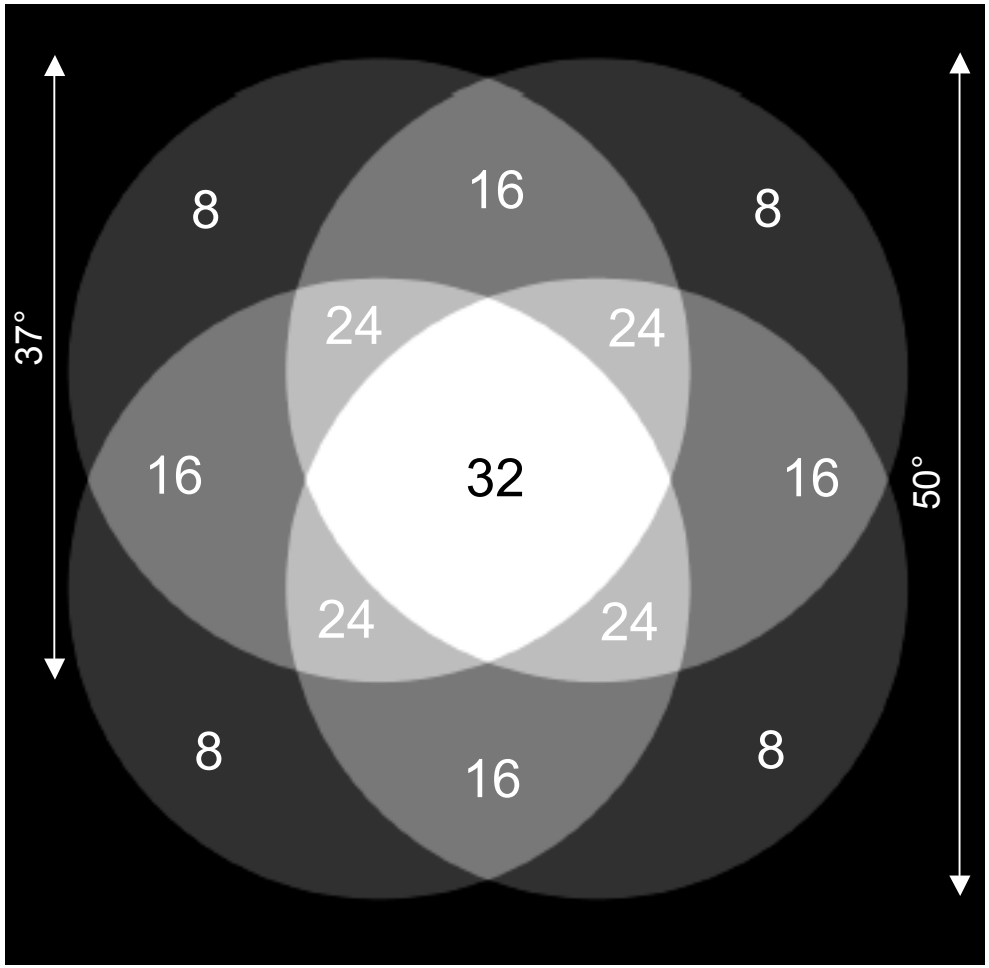
larger CCD than YB concept C --> wider field

field increased by more than 25% !

Orbit around L2 Lagrangian point, 6-year nominal lifetime

Concept of overlapping line of sight

4 groups of 8 cameras with offset lines of sight
baseline offset = 0.35 x field diameter (*k=0.35*)

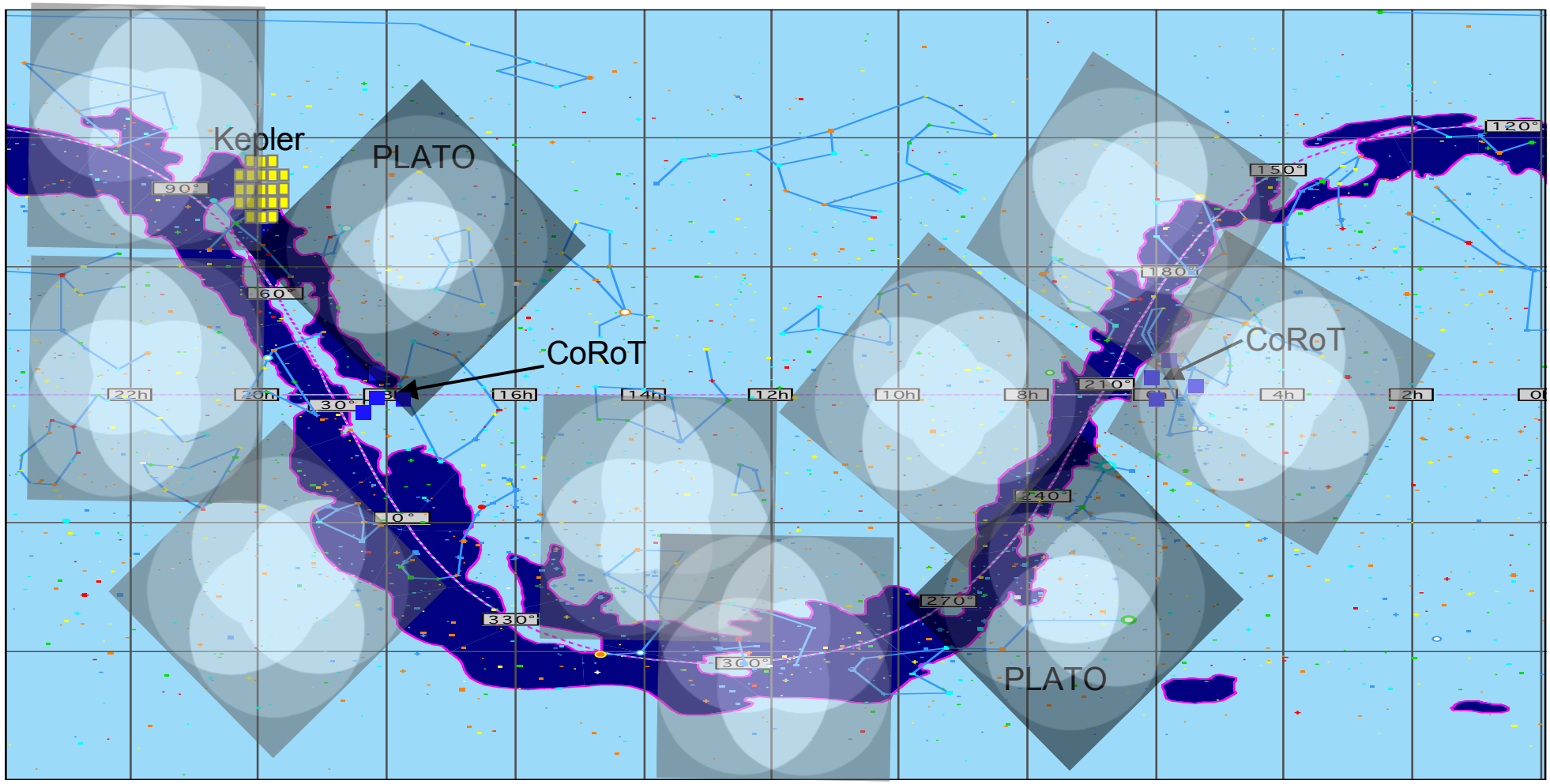


Optimization of number of stars at given noise level
AND of number of stars at given magnitude

Sky coverage

Observation strategy:

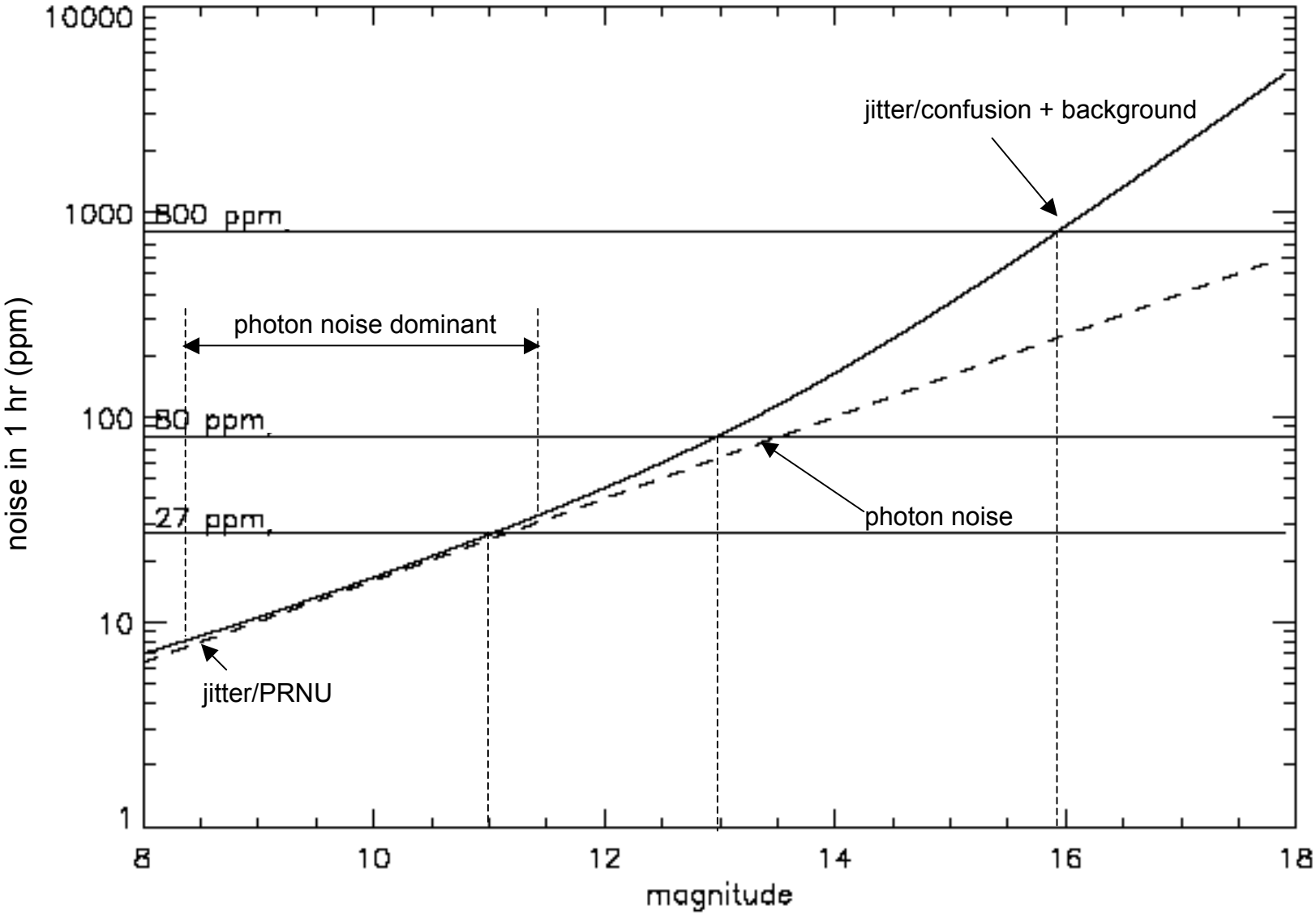
1. two long pointings : 3 years or 2 years
2. « step&stare » phase (1 or 2 years) : *N* fields 2-5 months each



>50% of the sky !

Expected noise level

noise calculated for 32 cameras



Performances of the long pointing phases

as a function of noise level

↓

	PLATO (4360 deg^2)		Kepler (100 deg^2)	
noise level (ppm/√hr)	nb of cool dwarfs & subgiants	m_V	nb of cool dwarfs & subgiants	m_V
27	22,000 spec 20,000	9.6 - 10.9	1,300	11.2
80	330,000 spec 250,000	11.6 - 12.7	25,000	13.6
	1,290 spec 1,000	8	30	8
	58,490	11	1,300	11

↑

as a function of magnitude

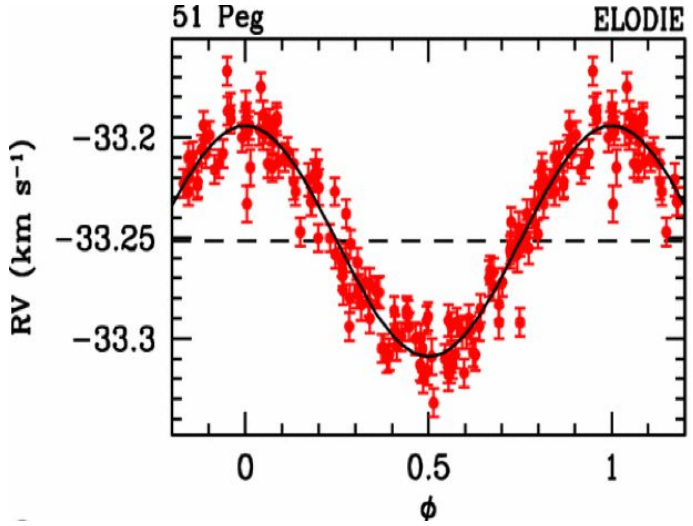
noise of 800 ppm/√hr is reached down to
- mag 15 (1 group)
- mag 16 (4 groups)

entirely dominated by background and jitter/confusion

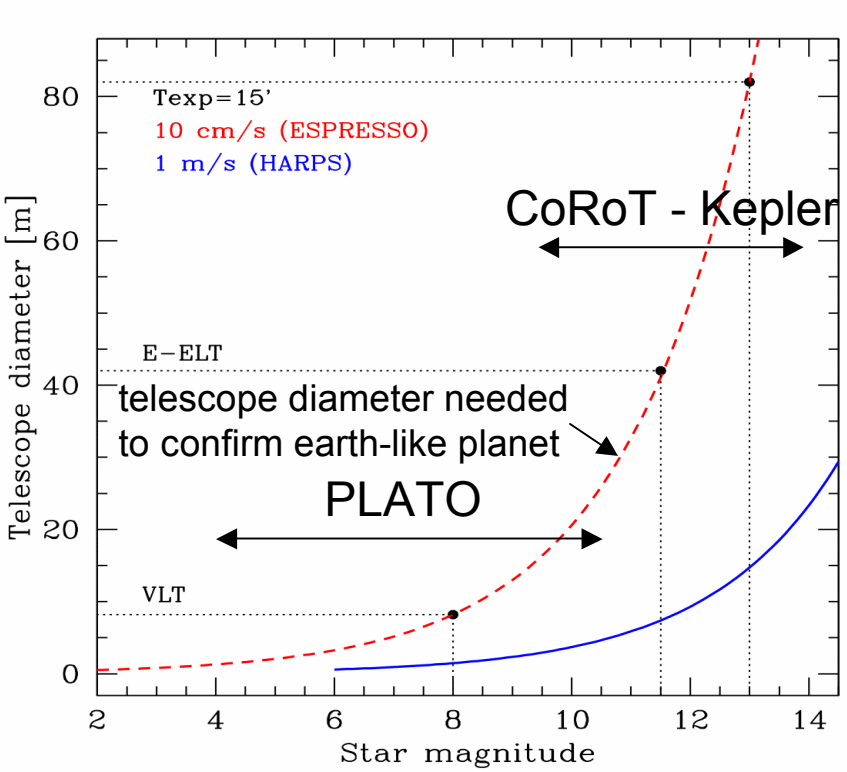
→ search for habitable planets around M-dwarfs

Groundbased follow-up

- Vigorous follow-up needed
- Most important aspect = radial velocity monitoring
  ⇒ planet confirmation and mass measurement



Planet	Distance (AU)	RV Amp. (m/s)
Jupiter	1	28.4
Neptune	0.1	4.8
Neptune	1	1.5
SuperEarth	0.1	1.4
SuperEarth	1	0.5
Earth	1	0.1

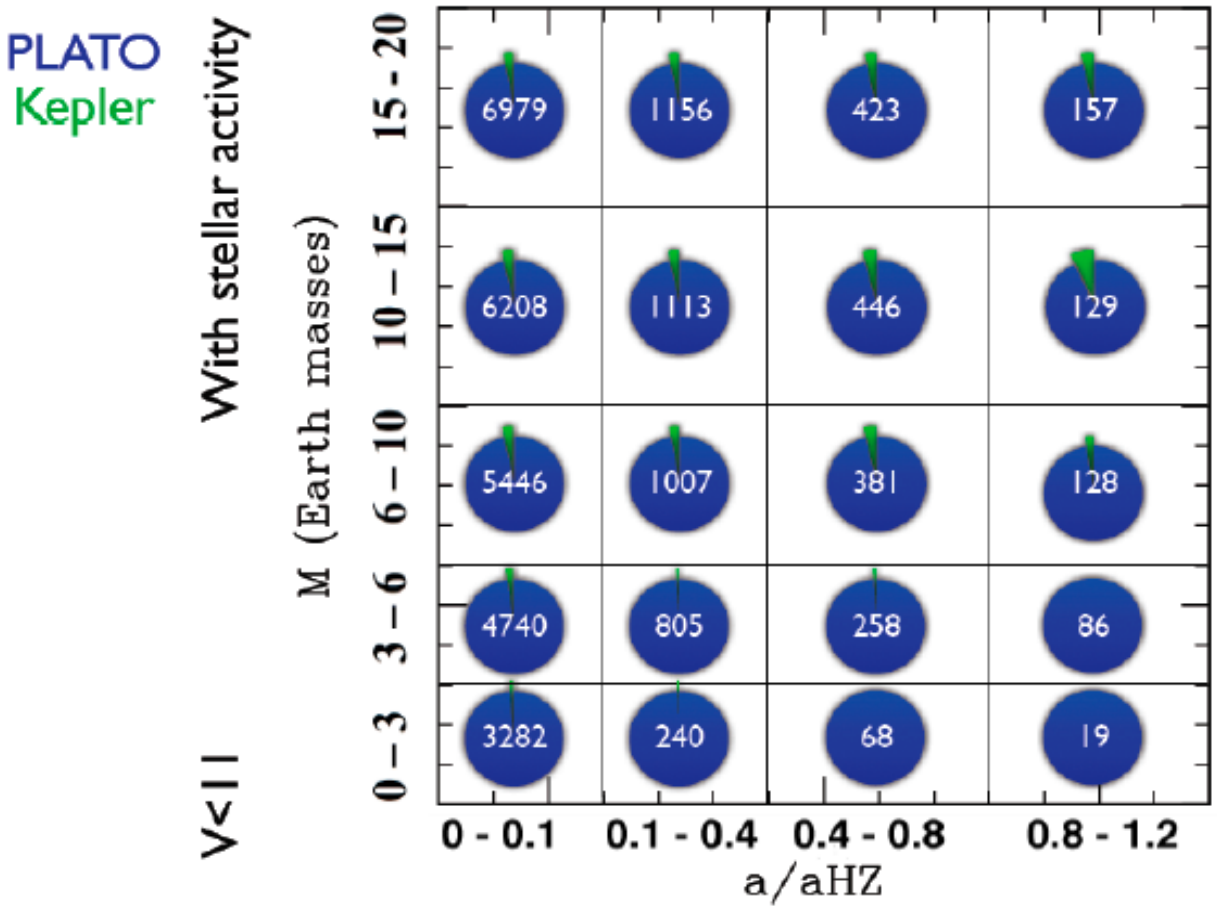


- stellar intrinsic « noise »:
  oscillations, granulation, activity
- need to apply proper averaging technique
- time consuming
- in practice limited to bright stars

Scientific Impact

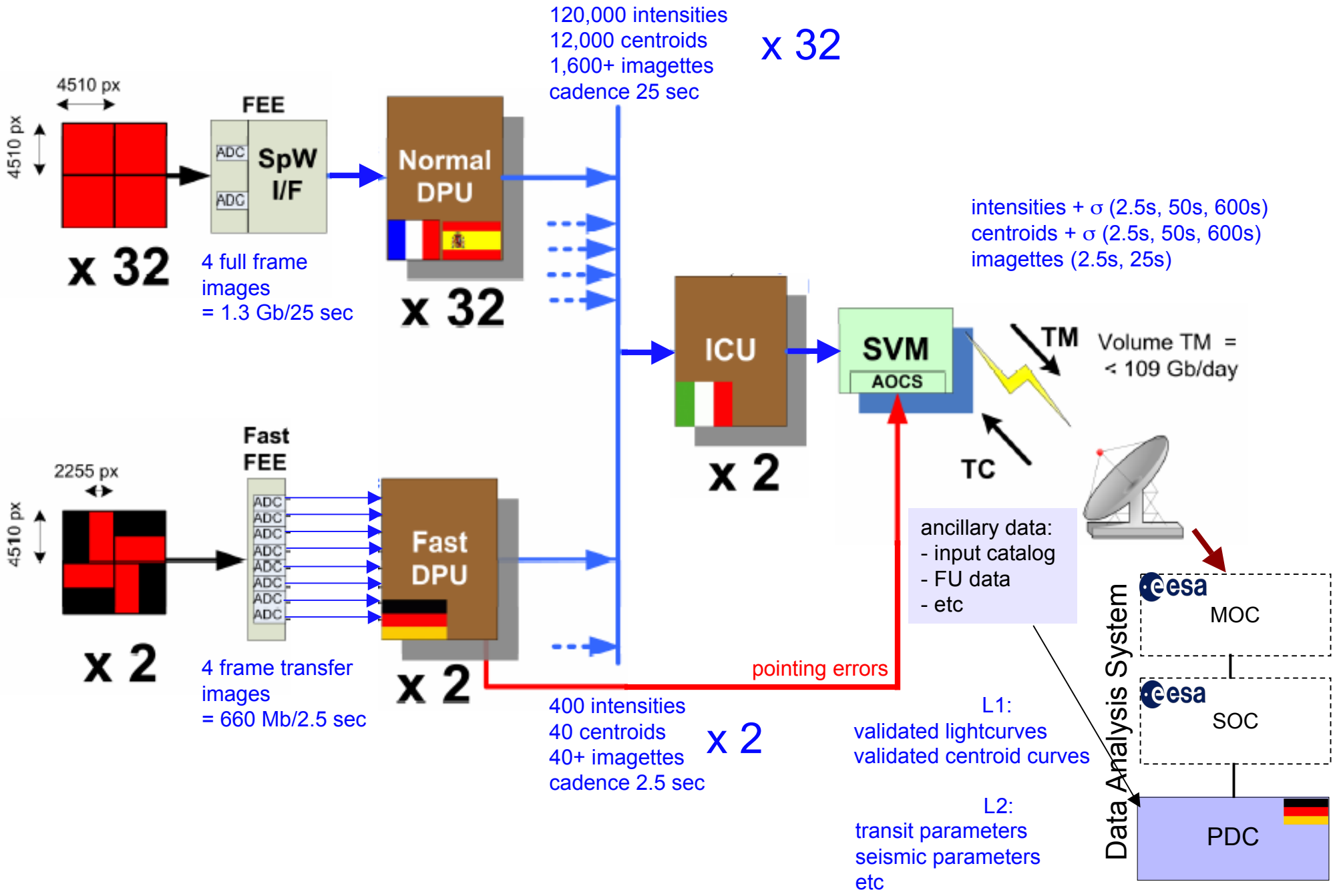
Expected number of detected transiting planets by PLATO and Kepler:

- ***each star has one and only one planet in each cell***
- ***planet is detected if a transit signal AND a radial velocity signal are measured***
- ***intrinsic stellar « noise » is taken into account***



The lower right corner (telluric planets in the HZ), not covered by Kepler because of the overwhelming difficulty of FU observations, will be explored by PLATO thanks to its focus on bright stars

Data Processing System



PLATO Payload Consortium: Science activities and PDC