Towards Euclid launch: status, thoughts and concerns from the primary science perspective (with some Italian flavour)

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Euclid Italy annual meeting

19-20 January 2023

Outline

1. Scientific validation of Euclid early products: are we ready for the real data?

2. Preparing for the scientific exploitation: DR1 Key Projects

Scientific validation (galaxy clustering)

- Clear request after Mission Key Point review (spring 2022). Led to involvement of the four core Science Coordinators to the GSSR.
- Consequently, we created a “Galaxy Clustering Validation Group”, including GC-SWG leads and (at least one of the leads of) OU MER, SIR, SPE, LE3.
- “Observational Systematics” WP of the GC-SWG (Monaco, Scarlata), working on characterising high-level systematics since a few years.
- One-week meeting organised in Trieste by Pigi in April 2022: critical issues emerged in various areas.
- Work now connected all along the spectroscopic pipeline.
- Led to writing and delivery to ESA of the ***“Scientific Validation Tests for the Euclid galaxy clustering-pipeline”*** document, delivered in fall 2022 for the GSRR.
- In fall 2022, meetings of the GC Validation Group intensified (every two weeks): listed open issues crucial for GC performance in all units along the pipeline.
- Decided to transform next annual galaxy clustering meeting in Milan (Feb 2022) which usually involved GC-SWG & LE3 into a joint SIR/SPE/LE3/SWG meeting.

First data “all-through” validation

- Identify processes to enable a fast way of looking at early data. Identify any gaps in the chain and what is needed to plug them
- Go through the systematics document, tie each proposed test to a requirement on data and on code.
- Identify any potential problems with data & calibration that are not currently included in the OU plans (e.g. cosmic rays)
- Make sure that deep data analysis includes all of the required subsamples and plans are in place to process these (e.g. wide-like visits)
- Design quick test of LE3 estimators? Test quality of clustering statistics on what cadence and how?
- **—> Develop alternative algorithms to compare spectral extraction and redshift measurement against OU-MER/SIR/SPE pipeline as end-2-end check of pipeline** (as, e.g., MaxLikelihood 2D approaches or HST Grizli)
- —> Evolve Validation group towards a “Tiger Team” gathering expertise to achieve this (also inheriting “Purity & Completeness” task force legacy)

Joint Galaxy Clustering meeting 2023
GC-SWG & OU SIR/SPE/LE3

February 20-24, 2023

Università Statale di Milano, Milan, Italy

Towards Euclid science: DR1 Key Projects

"…Key Projects (KPs) cover ***the science that Euclid is obliged to deliver to fulfil its original goals****. These are areas where coordination is crucial, to guarantee the maximum quality of the results and make sure the whole EC speaks with a single voice on specific, fundamental science issues. Typically, within a KP the* ***flagship paper(s) will typically present the top results of the analysis, with other supporting papers providing all extra technical information or additional tests…****"*

Pre-Launch Key Projects

	Pre-Launch Science Key Project Document	Ref.:	EUCL-UMI-PUB-8-001
		Issue:	1.6
		Date:	19/01/21
		Page:	1/65

Approved

Title:	Euclid Consortium pre-launch science Key Project document		
Date:	19/01/21	**Issue:**	2.0
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Custodian:	Luigi Guzzo		

Prepared by:		**Date :**	**Signature :**
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Endorsed by:			
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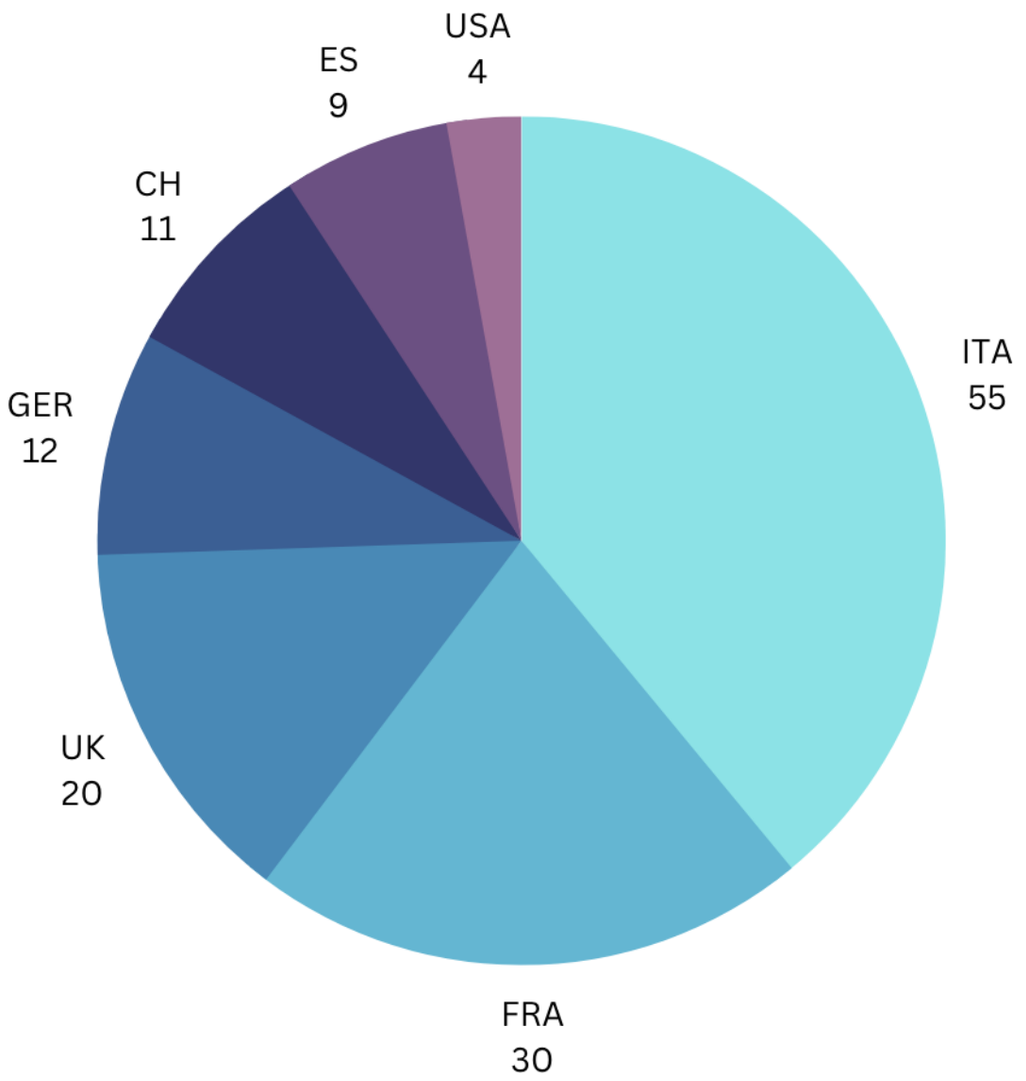
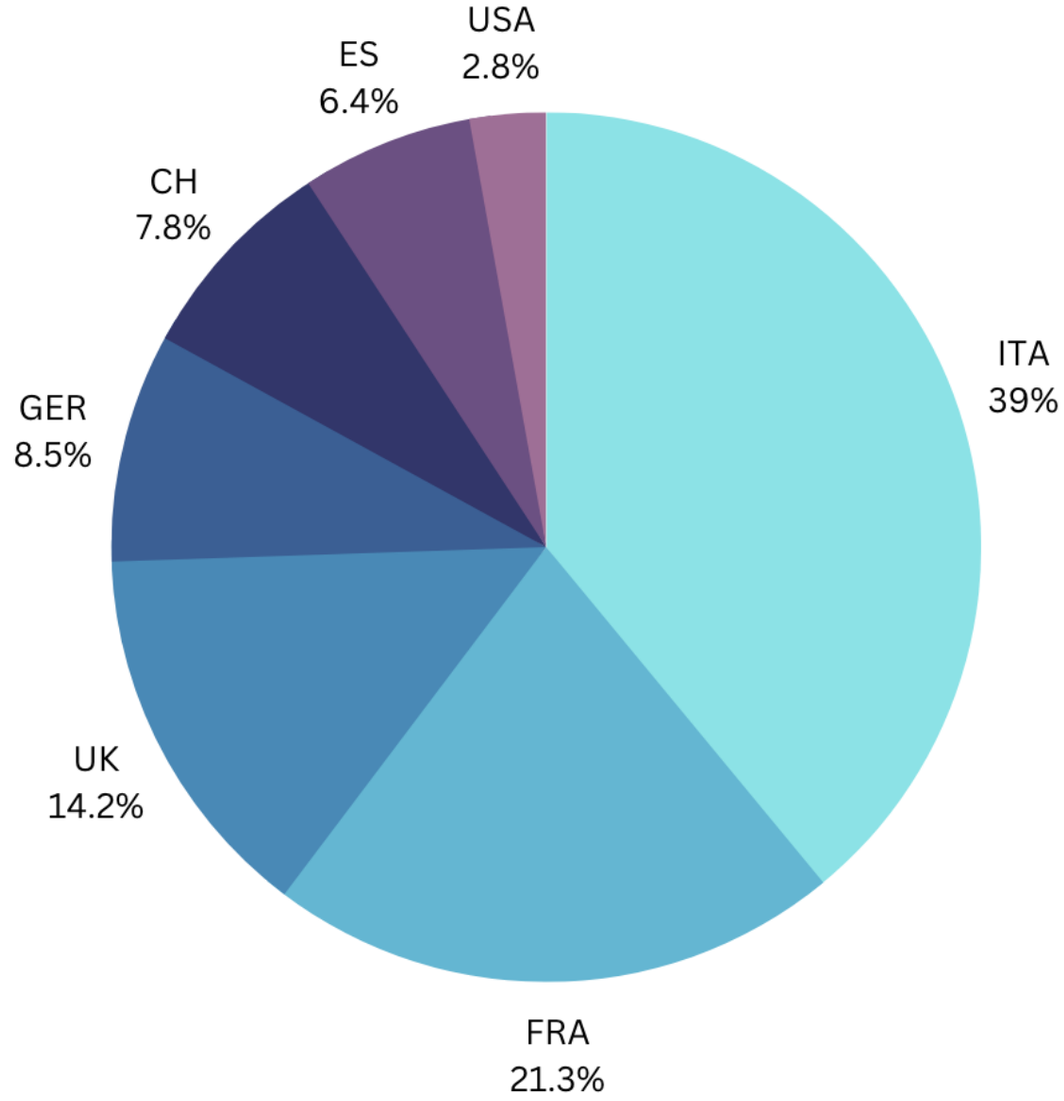
Authorised by:			
Yannick Mellier	ECL		

Pre-launch KP overview

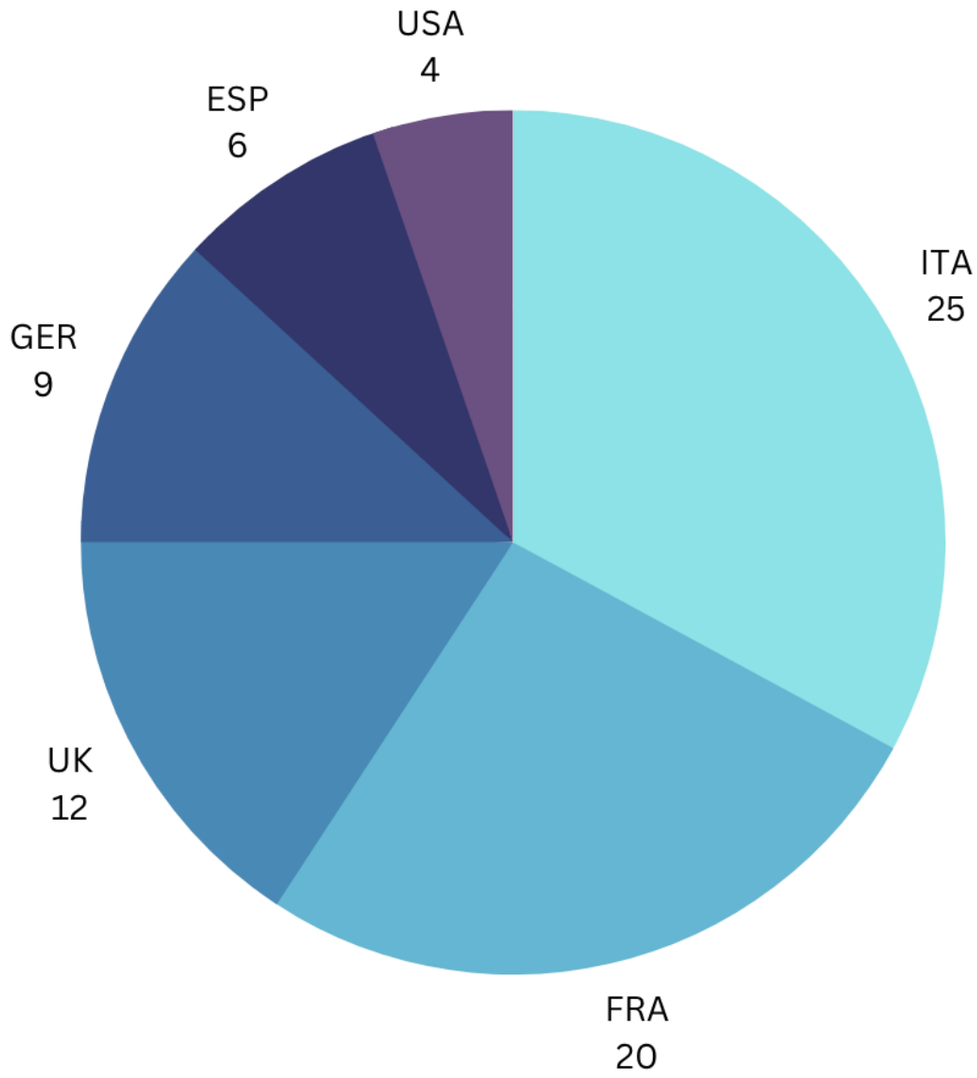
- Large numbers: **~50 projects**, **about 200 papers planned, 76 active**
- **A crucial exercise to fine-tune the science flow:**
  - Encouraged discussion within SWGs, share ideas and identify priorities (beyond early “wish-lists”)
  - Identified **overlaps** between SWG plans, suggesting new **interfaces and coordination structures** (e.g. “Covariance”), as well as natural **joint project areas** (involving ISTs)
- DR1 KPs are now at the horizon

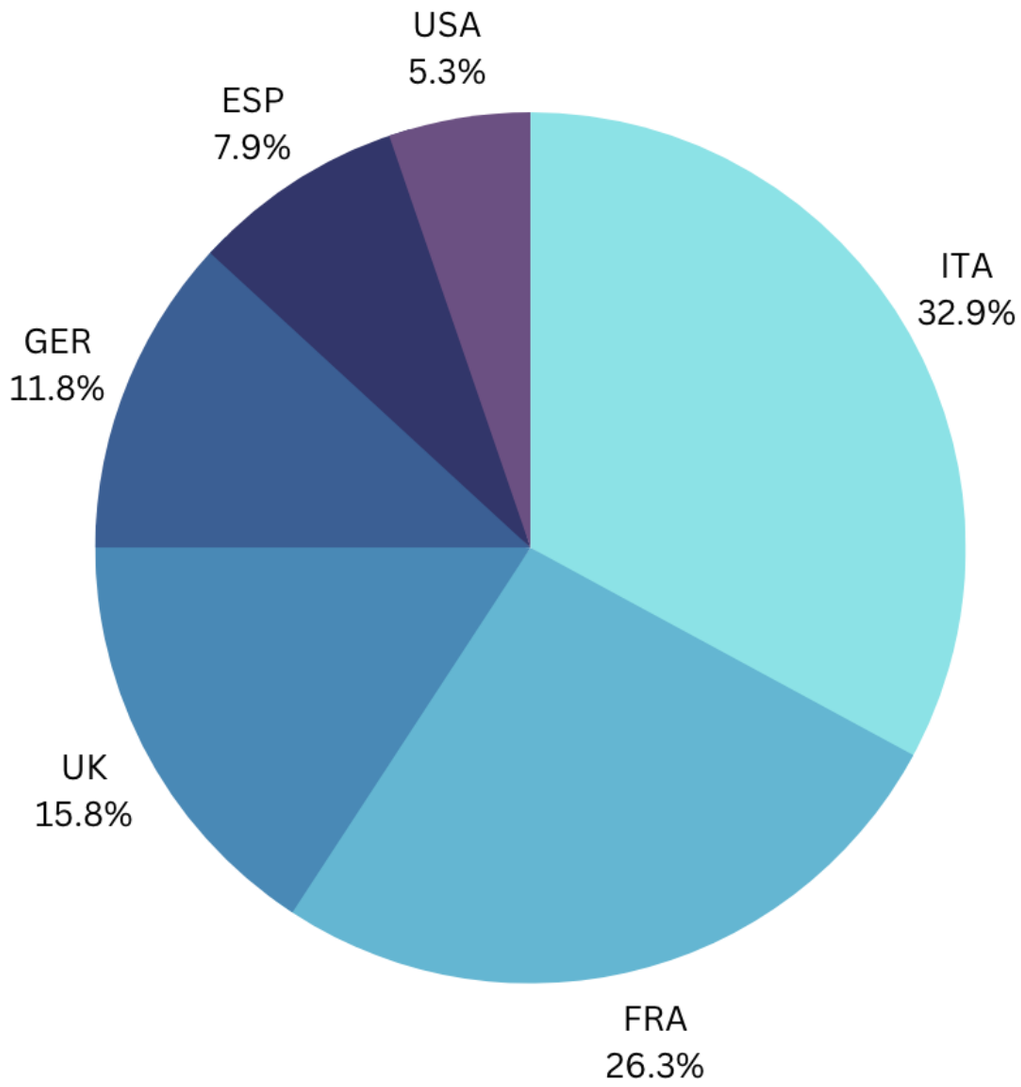
Pre-launch Key Projects:
KP coordinators by country (Jan 2023)





Pre-launch Key Projects:
paper leaders by country (Jan 2023)



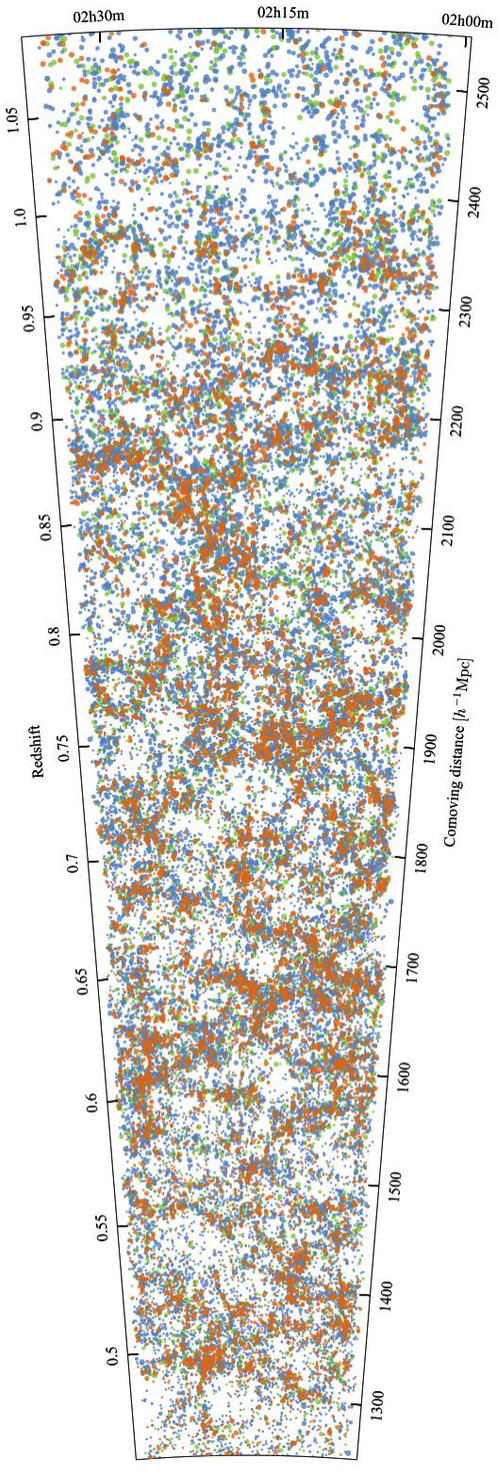


Towards Euclid science: DR1 Key Projects

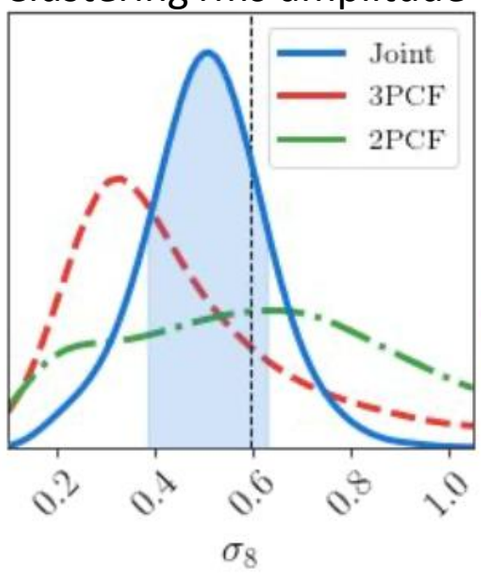
- Italian role clearly very strong in pre-launch KPs
- Being pre-launch, emphasis is on preparation, tools, simulations
- Pre-launch projects clearly more natural for some units (e.g. LE3 - algorithms, methods) —> post-launch will be different (e.g. no Flagship papers this round)
- Competition from countries with more tradition (and more flexible financing / hiring schemes…) will be higher
- Be ready to harvest
- Keep studying: focus on key questions / find new ones

VIPERS joint 2-point + 3-point constraints

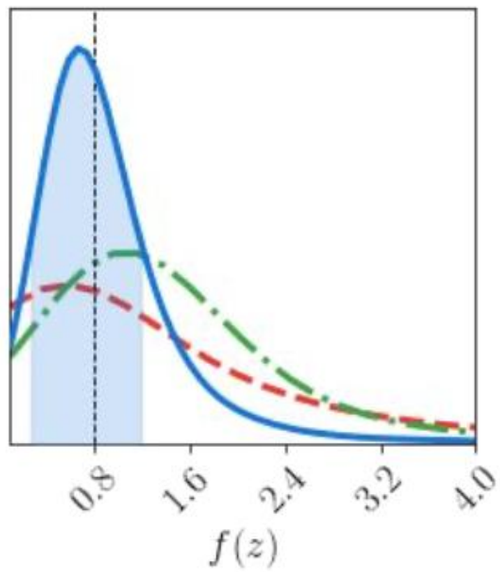
(Veropalumbo+ 2021, MNRAS, 507, 1184)



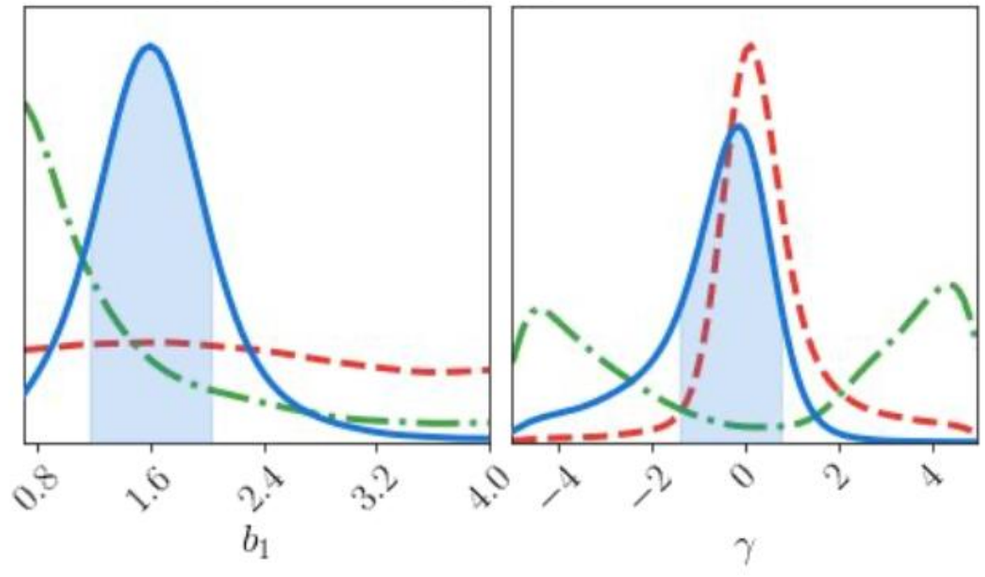
Clustering *rms* amplitude



Growth rate



Bias parameters (galaxy-DM connection)

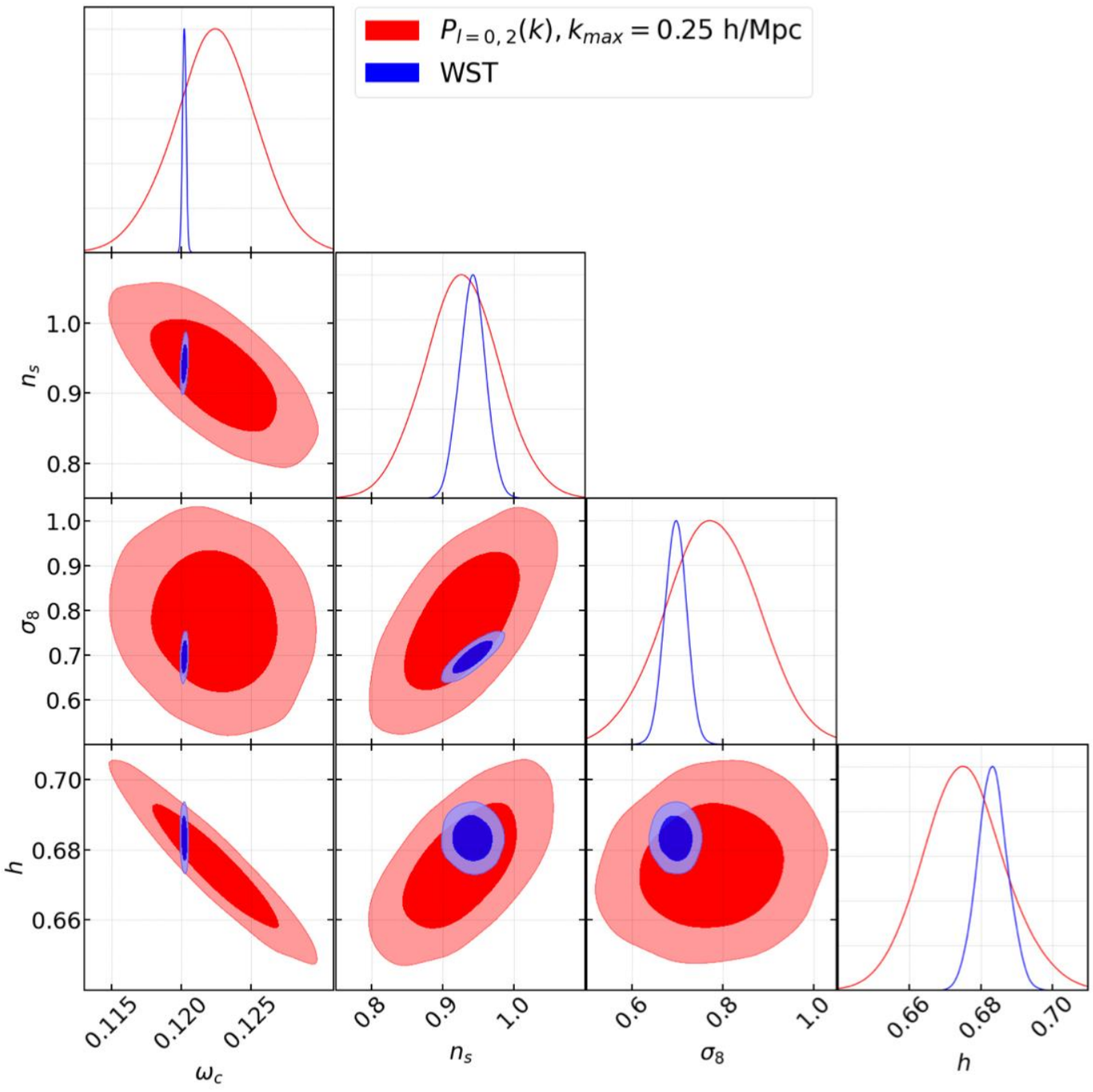


The importance of Standard Projects

- DR1 KPs will include “expected” science: what Euclid promised to deliver
- A KP Flagship paper from one of the DRs may well include Nobel prize discovery
- However, most exciting discoveries may well come from new bold ideas applied to the unprecedented Euclid data set: it is the history of surveys
- This is why, while delivering such an enormous amount of data, we need to be open-minded towards both new physics and analysis methods
- *Machine learning* is already becoming the name of the game: a lot of work needed, beyond “off the shelf” application of algorithms, but very exciting
- All such novel investigations will be developed within **Standard Projects**
- Success in developing such ideas will depend even more on our ability to engage (support) young scientists within our institutions through PhD and postdoctoral positions
- A current point of difficulty: the Science Project Portal

Example of advanced statistics: the Wavelet Scattering Transform

(Valogiannis & Dvorkin 2021, 2022)



- ★ Filter the galaxy field with appropriate wavelet kernel
- ★ Applied here to BOSS
- ★ see Cheng & Menard 2021 for pedagogical introduction
- ★ Caveat: needs many numerical simulation, covering variety of cosmologies, to perform likelihood

Summary

- There is no excuse anymore: pending issues ought to be tackled and solved
- Focus on these and be ready to identify problems, prepare alternatives, if needed (learn from history…)
- EC organisation unfortunately problematic in some areas (structure, IT infrastructure)
- Yet, a lot of (very competent) expertise exists in many areas and we shall get there
- Data are coming, DR1 Key Projects soon to be defined
- Italy is scientifically ready to exploit science in most of Euclid areas

- Needs concerted effort to get the best out of the data: get engaged in data work
- Needs continuing financial support as we had so far, to assure fresh forces to exploit science

END

DR1 Key Projects

DR1 Key Projects

From WPs to KPs: an example from the GC SWG of the large Italian contribution and potential

WP #	Work-package (and link to wiki page)	Leads	Input product	Output product	Notes	Priority	
			Papers (ITA?)				
WP1	Observational Systematics	**Pierluigi Monaco** (Oct 2019–), **Claudia Scarlata** (Apr 2020–) [Lado Samushia, Marco Scodeggio (Feb 2018–Sept 2019)]	11	**(5)**	Merging old "Sample Selection", "Mask/Slitless" and "Liaison with Sims" work-packages	High	—> KP-GC-2
WP2	Galaxy Clustering End-to-End	**Ben Granett** (June 2018–), **Sylvain de la Torre** (Apr 2020–), **Michele Moresco** (Apr 2020–)	6	**(3)**		High	—> KP-GC-1
WP3	Likelihood Fitting	**Julien Bel** (Jan 2021–), **Carmelita Carbone** (Jan 2021–) [Dida Markovic (Feb 2018–Jan 2021)]	5	**(2)**	matches old WP, link to IST:likelihood	High	—> KP-GC-6
WP4	Non-linear effects	**Martin Crocce** (Jan 2021–), **Zvonimir Vlah** (June 2020–)			includes old reconstruction WP, link to future IST:non-linear	Medium	
WP5	Higher-order stats	**Cris Porciani** (Jan 2021–), **Emiliano Sefusatti** (Jan 2021–)	8	**(5)**	matches old WP	Medium	—> KP-GC-5
WP6	Additional GC probes	**Florent Leclercq** (Jan 2021–), **Cora Uhlemann** (June 2020–) [Alkistis Pourtsidou (Feb 2018–Jan 2021) Adam Hawken (Feb 2018– Apr 2020)]			matches old "new probes" WP	Medium	
WP7	Photo-z clustering	**Stefano Camera and Isaac Tutusaus** (Jan 2019–) [Shirley Ho, Martin Crocce (Feb 2018–Dec 2018)]	8	**(4)**	matches old "photo-z" WP	Medium	—> KP-GC-7
WP8	Voids	**Nico Hamaus, Seshadri Nadathur, Alice Pisani** (Apr 2020–)			formerly "Voids sub-group" of WP6	Medium	
			3+5	**(1+2)**	BAO Reconstruction + Covariance		—> KP-GC-3 & KP-GC-8
		TOTAL:	46	**(22)**			

OU-LE3 Galaxy Clustering (Branchini): 3 KPs, 13 papers —> potentially, **up to 10** Italian lead

Inverting the “brain drain”

- …
- Success in developing new ideas to analyse the new data will depend even more on our ability to engage (support) young scientists within our institutions
- This means also being able to drain the best brains from all-over the world: would you come to Italy if you see one of INAF 50-page long announcements of “Assegni di Ricerca”??? (first you had to understand what we are looking for…)
- A current point of difficulty: the Science Project Portal

Science flow: from projects to publications

PDD

	Project Definition Document	**Ref.:** **Issue:** **Date:** **Page:**	 07/05/20 1/21

Title :	Euclid Consortium Standard and Key Project Definition Document		
Date:	07/05/20	**Issue:**	Version 1.1
Reference:			
Custodian:	Luigi Guzzo, Hendrik Hoekstra, Thomas Kitching, William Percival		

Authors :		**Date :**	**Signature :**
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Authorised by :			
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PPD

Euclid Consortium Publication Policy

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—> Please do read these documents!

Project Definition Document (PDD) Amendment

	PDD Pre-launch Amendment Document	Ref.: Update to PDD Issue: 1.1 Date: 29/01/21

Title:	Project Definition Document (PDD) pre-launch amendment document		
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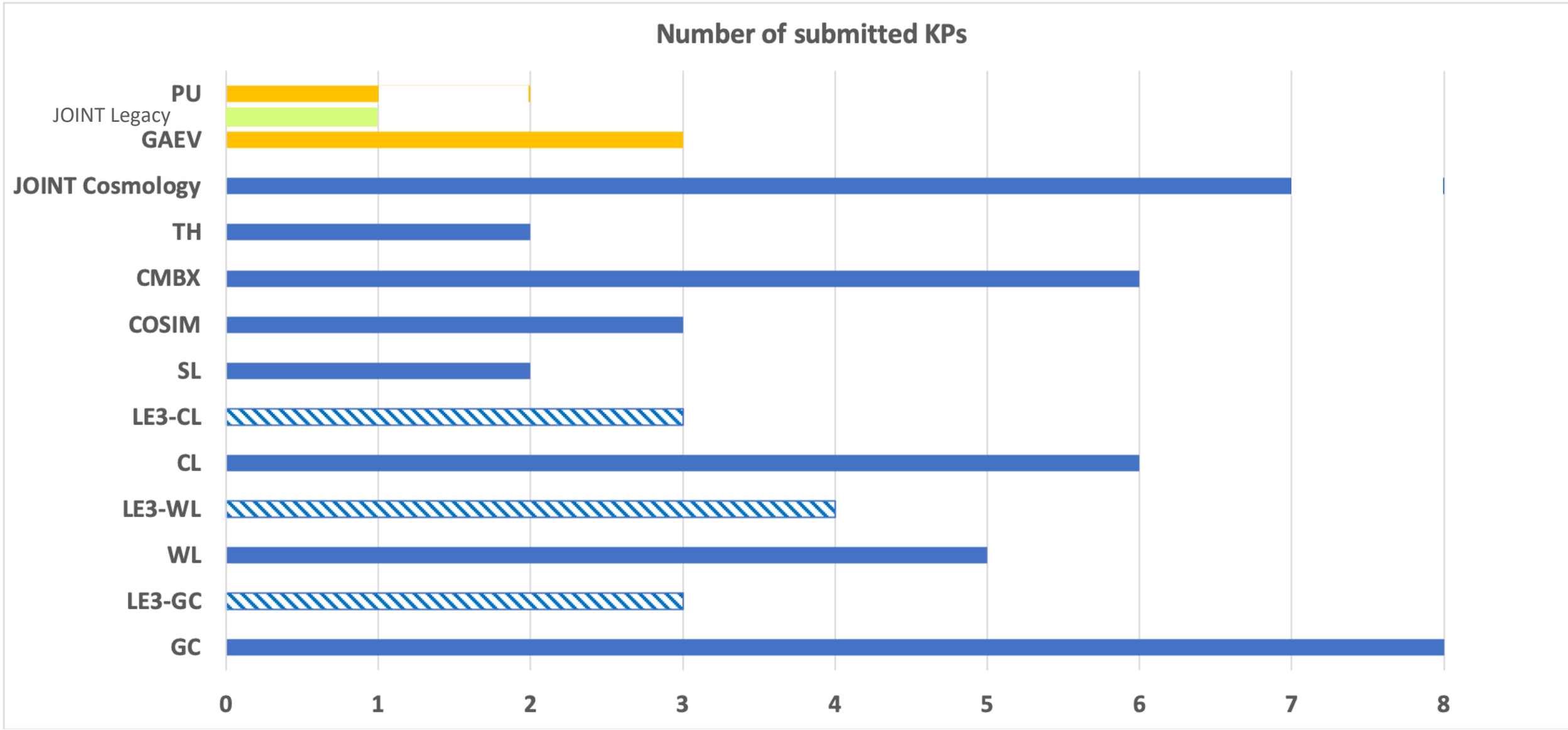
Approved by:			
	ECB	20/01/21	
Authorised by:			
Yannick Mellier	ECL		

—> Please do read these documents!

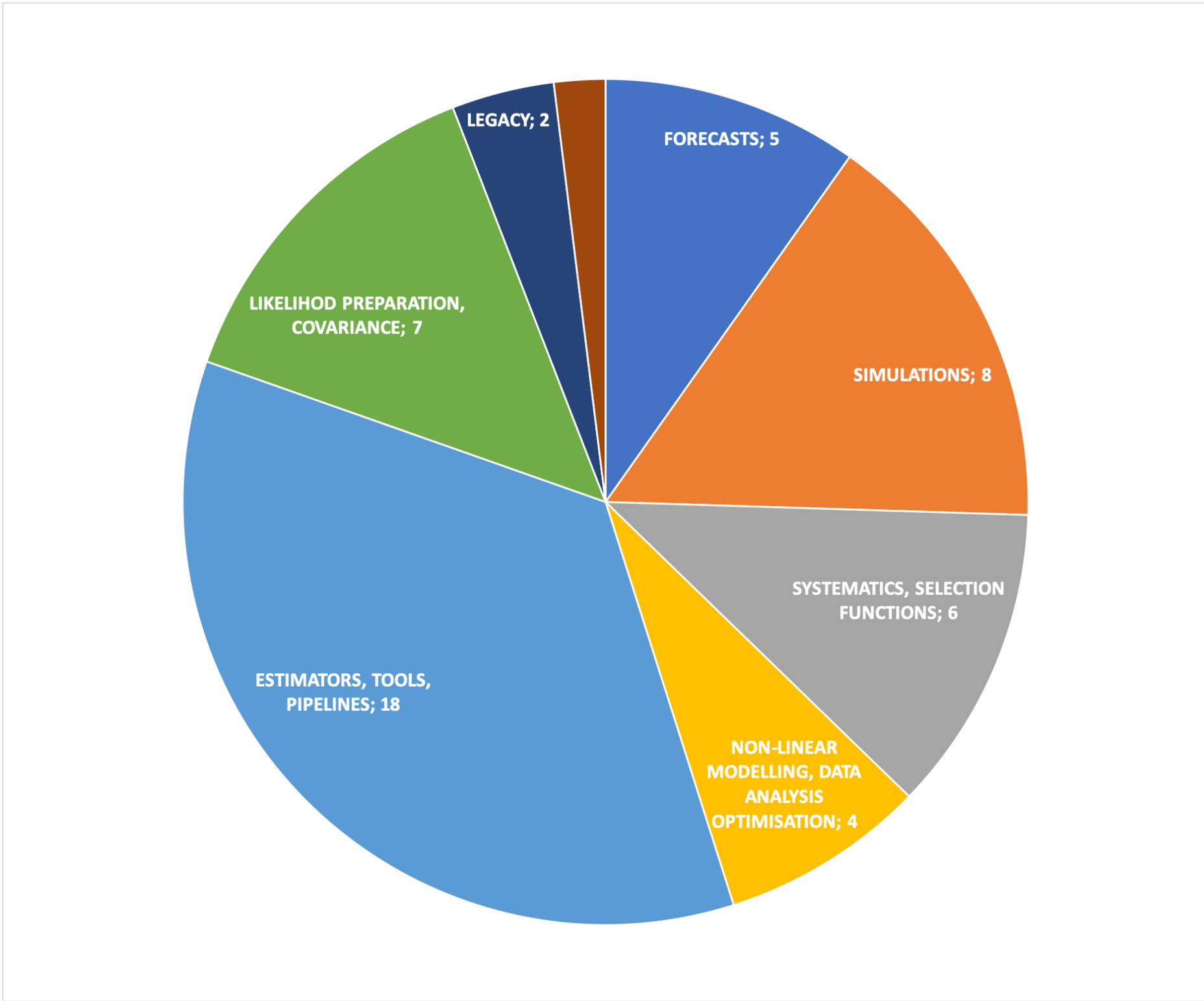
- Important achievement: fills “regulatory gaps” in PDD/PPD on how to coordinate KPs and papers therein
- Makes science project management structure clearer, defining a bottom-up process to identify responsibility: Work-Packages —> SWGs —> ECPG
- Clarifies role of ECEB sub-groups in evaluating “projects” (ECPGs) and “publications” (ECEB)
- Connects current SWG “preparatory” structure to “operative” post-launch mode
- Will be eventually merged into PDD, updating the relevant articles (and related PPD parts)

Pre-launch: (consolidated) # of Key Projects approved by ECB

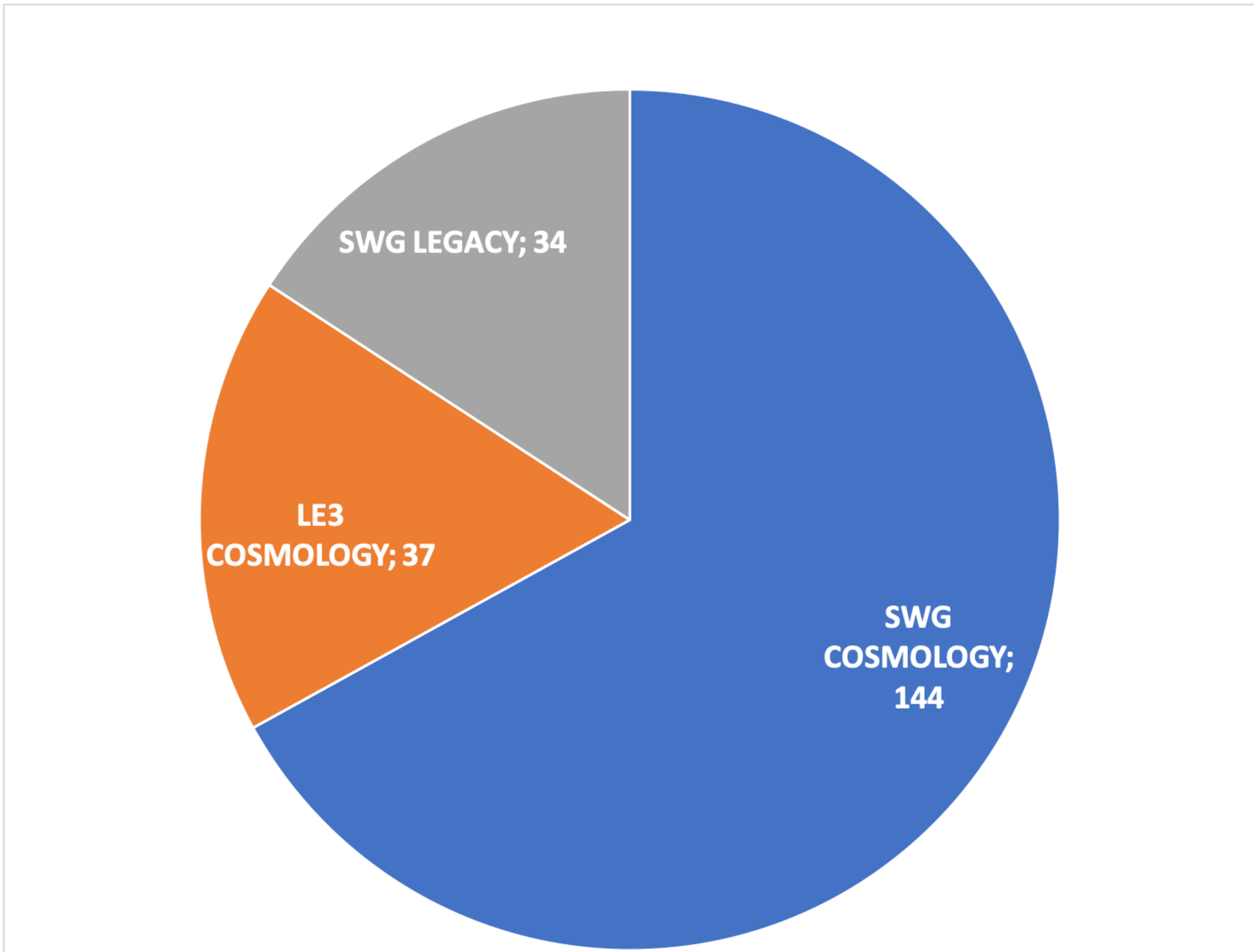


Total of 54 Key Projects listed

What kind of projects?



Cosmology vs. Legacy KP papers



Total of 215 (potential) papers!

Italian leadership / scientific strength