Gaia: prototipo ICT per progetti futuri (?)

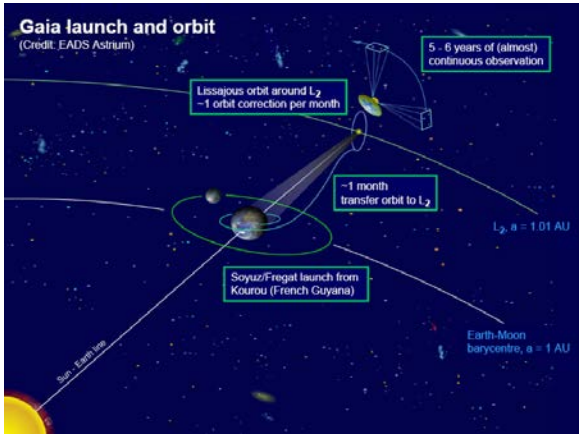
Parlando di requisiti e linee guida

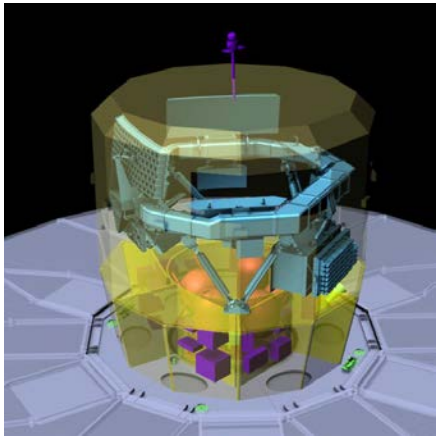
Mario G. Lattanzi (INAF-OATo)

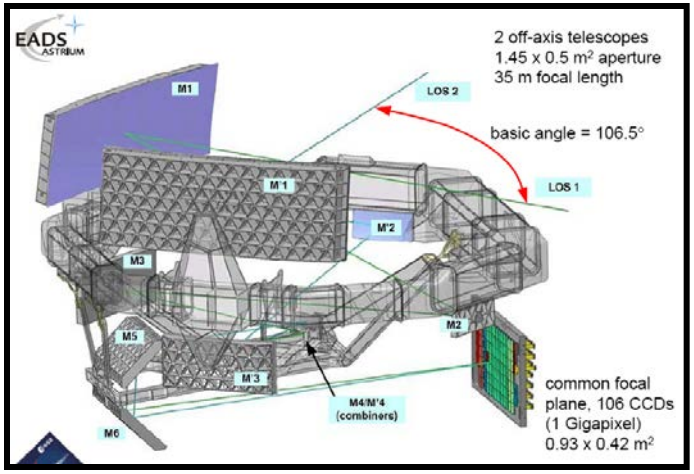
… e il fondamentale aiuto di Busonero, Morbidelli (OATo); Messineo, Mulone (Gaia DPCT @ ALTEC)

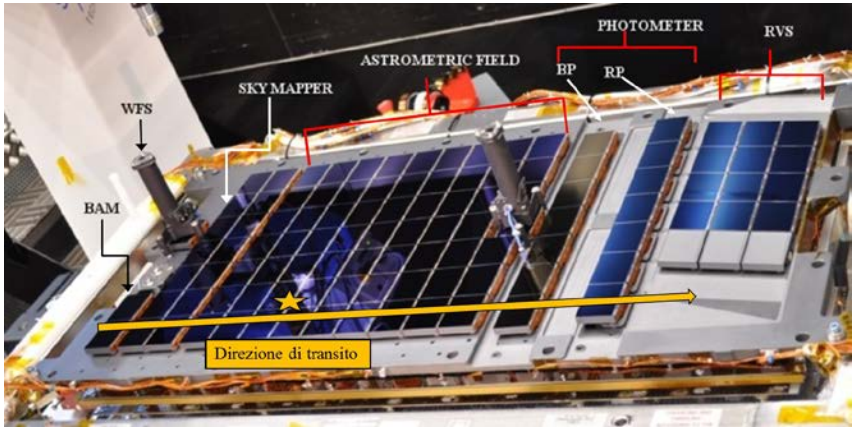
- **The Gaia mission is here!**

19 Dec 2013: Soyuz-Fregat launcher from CLG, French Guiana









- **Inizio Commisioning: around Jan 5, 2014.**

- **Fine formale del Commissioning ed inizio delle routine science operations: July 18, significantly longer than anticipated.**
  [Oggi siamo dunque, a 273 gg dal lancio, nel giorno 62 dall'inizio delle operazioni scientifiche.]

- Tutti i dati del BAM e dei 64 CCD del piano focale astrometrico vengono analizzati fin dall'inizio solo presso il DPCE (ESAC) ed il **DPCT** italiano, qui **tramite i sistemi BAM** ed **AIM di AVU.** Inoltre, parte dei risultati delle analisi e calibrazioni AVU vengono rimandati al MDB presso il DPCE @ ESAC.

- Piena ed efficace implementazione degli impegni Italiani come da art. 5 del Gaia MLA. Anzi, contributo al Commssioning molto maggiore di quanto previsto.

DPCT (@ ALTEC, To) a pieno regime.
Accumulati altre 50 TB di dati.

TABLE 1: Science performance predictions for a G2V star. The top half of the table shows the required performance (i.e. CDR numbers) and the bottom half shows the impact, as assessed by DPAC (TJP-017), of the extra noise due to the stray light from the Sun and night sky sources.

V magnitude	Astrometry (parallax)	Photometry (BP/RP integrated)	Spectroscopy (radial velocity)
CDR predictions			
6 to 12	5–14 μas	4 mmag	1 km s^{-1}
15	24 μas	4 mmag	3 km s^{-1}
16.5			13 km s^{-1}
20	290 μas	40 mmag	
Stray light impact (noise contribution only)			
6 to 12	5–14 μas	4 mmag	1 km s^{-1}
15	25 μas	5 mmag	13 km s^{-1}
16.5			
20	430 μas	60 (RP) – 80 (BP) mmag	

TABLE 2: Major non-compliances of the Gaia scientific instruments.

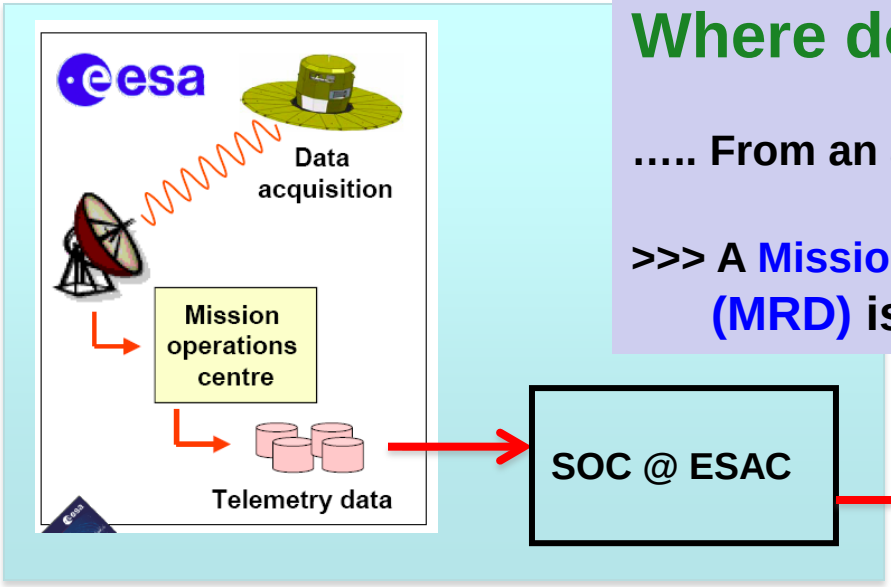
Non-compliance	MRD requirement	Comment
Continued contamination by out-gassing of water		
Basic angle stability	SCI-280	BAM measurements indicate an instability at the milli-arcsecond level over the spin period. These instabilities have been confirmed through ODAS using the method described in LL-106 (see also RA-012, for more information on the instability).
Basic Angle Monitor precision	SCI-290	A corrective action was taken after PLM TB/TV: extending the BAM window length to collect more flux per observation. However, SCI-290 will not be met by an approximate factor two, as explained in AMF-015.
Differential scan rate modulations		These may be indicative of differential focal length variations (FLS-024; FLS-031).
Stray light levels	SCI-700	Note: SCI-090 is not a requirement on background light level. Whether SCI-710 (BAM stray light) is met is not clear.
Science performance	SCI-250, SCI-460, SCI-570, SCI-620	Astrometry, photometry, RVS survey limit, and radial velocity accuracy, respectively

❑ Veniamo a noi

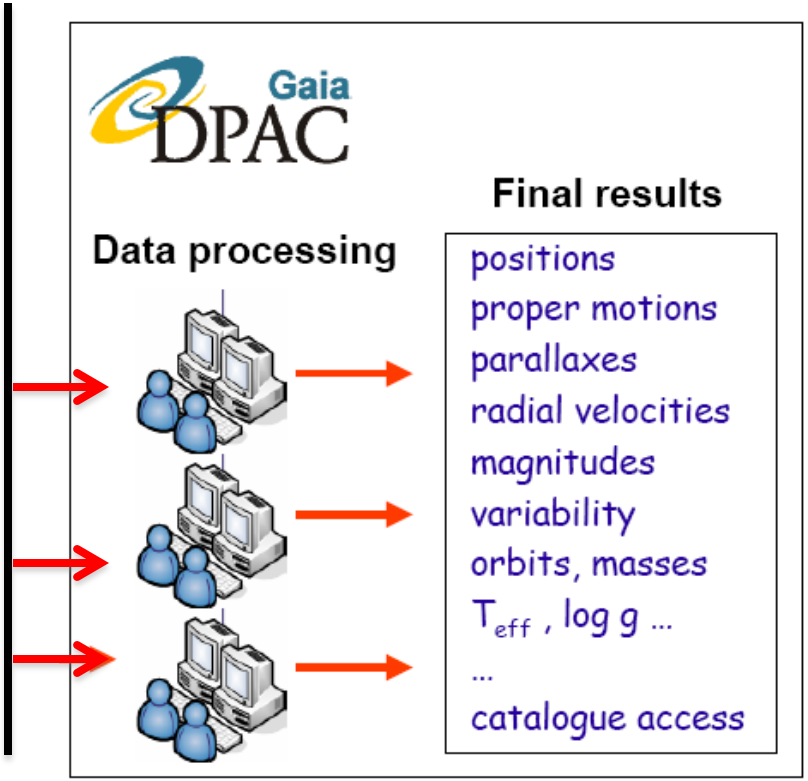
Where do we start from?

….. From an approved mission/project!

>>> A Mission/Project Requirement Document (MRD) is issued and maintained.



Housekeeping & payload data



Good and Bad about this approach (data processing and analysis)

Pro

- Development Platforms
- Common Protocols (e.g. transmission)
- Effcient Data Distribution
- Common programming language
- Common queries
- Cross-checks
- Libraries
- Move (some) data and (some) SW

Con

- Telemetry processing single point failure
- Common programming language
- Common queries (too generic)
- Libraries
- ….

Ideally the requirements specified in the MRD provide the terms of reference for:

①A full knowledge of the primary (raw) data (from satellite/environment and payload/instruments)

②The design and development of the Data Model

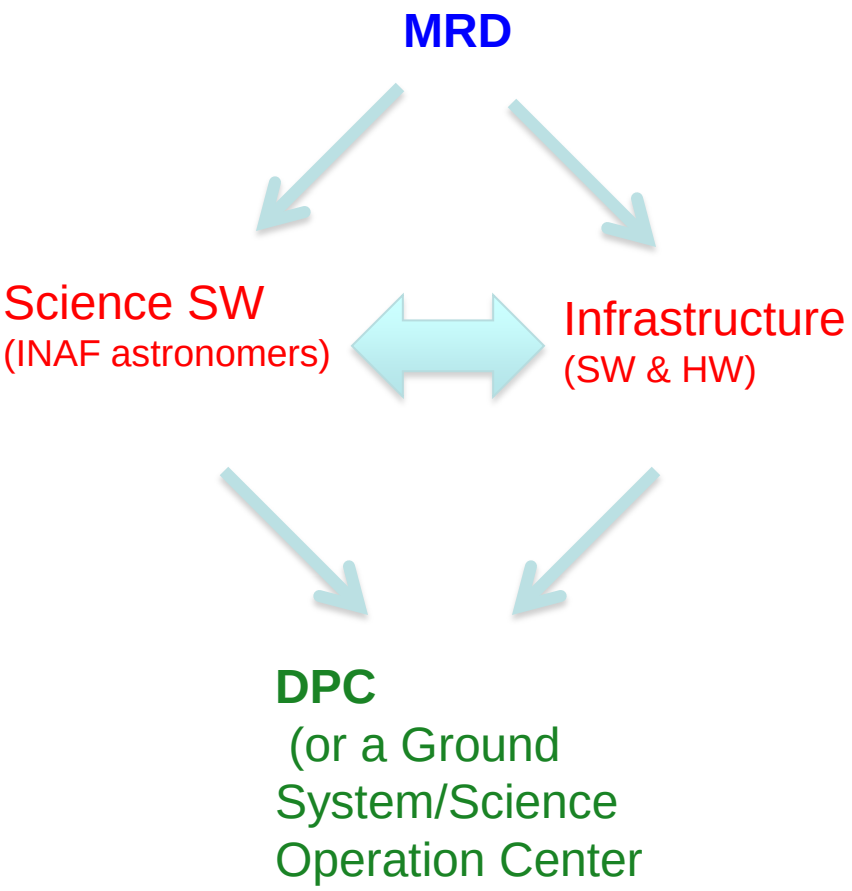
③The design and development of (science) Processing Paradigm(s) (e.g., need for HPC, pipeline vs off-line processing - DAAS, type of processing: top-down, recursive/iterative, data legacy….)

④The design and development of infrastructure: SW (including DBMS) and HW (Mission, or Main, DB) (e.g. MDB size, automatic processing, query levels, data legacy, fast, sustained and secure data transfers, mode of operation, overall size…)

- **2 and 3 above (mostly) for cost estimates (SW, HW & people)**

①Data legacy: make provisions for the unknown/unexpected or unanticipated use of data (detector ageing, selection function at survey mag limit, rare objects,…)

Schematically:



It is at this level that the scientists of the night sky (us!!) are required to have multidisciplinary abilities:

>> first within ourselves (INAF), then

>> must talk the language of ICT colleagues and that of SW and system engineers.

BUILD SYNERGYES

- Multidisciplinarity requires a high level of coordination starting from within our community (e,g, this meeting!): this is a must for INAF.

- SYNERGY with existing excellence within the ICCT world produce cost-effectiveness

- Base for future exploitation

- Base for ICCT progress, i.e., DPC's as ICCT research tools/laboratories (and not just because of their data content) → INAF direct involvement not necessary

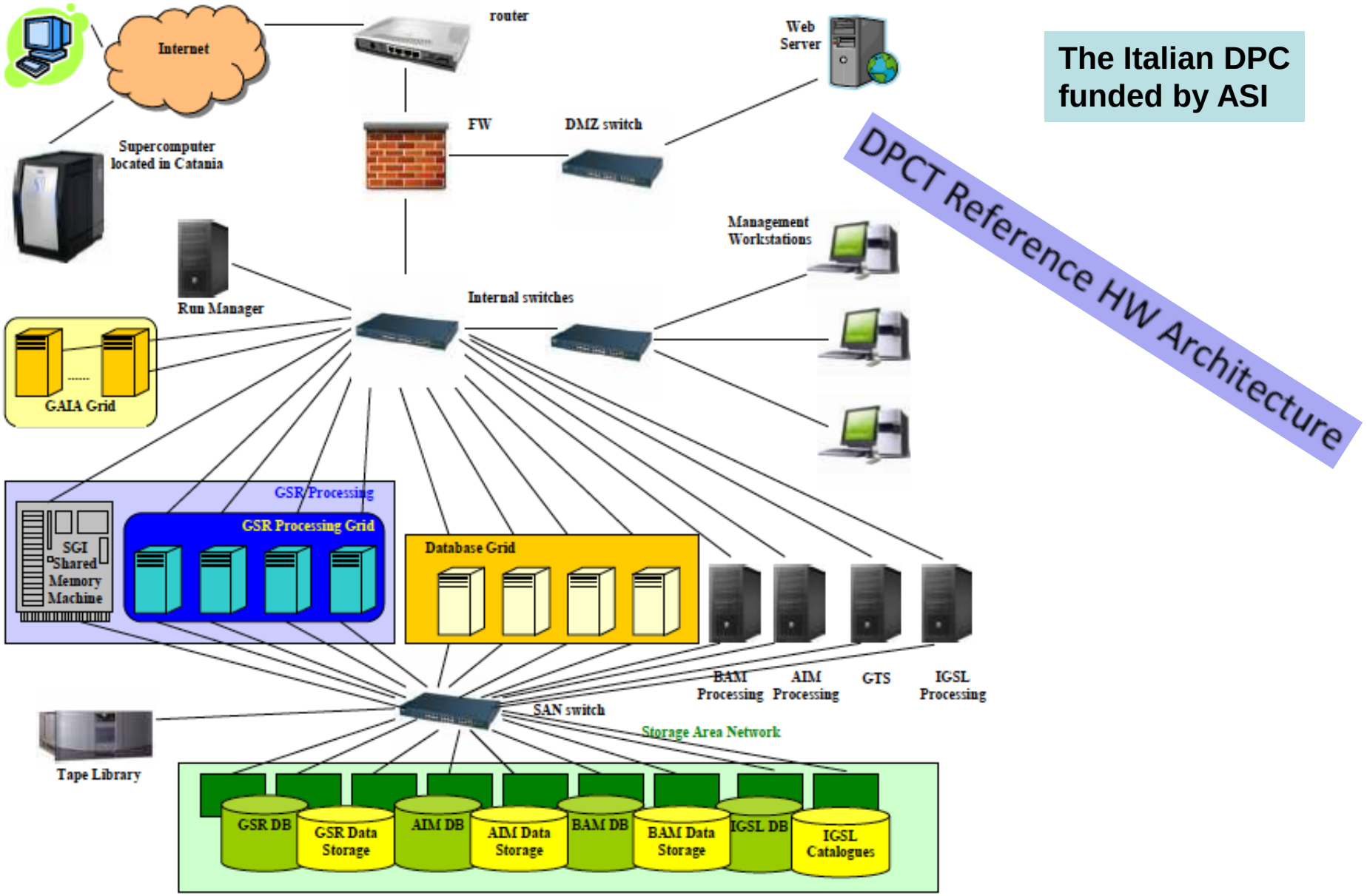
A rather radical statement:

We, as a community of scientists dedicated to unravel the misteries of the night sky, are in the business of building prototypes, if at all. Better, we design and build ‘’unique systems’’ that **challenge current knowledge**, **possibly influencing progress in the ICCT field.**

Of course we are indeed open to/interested in their possible re-use and/or transformation ;

However, the development into ‘products’ should never be our primary objective >>> foster developments yes, foster products no

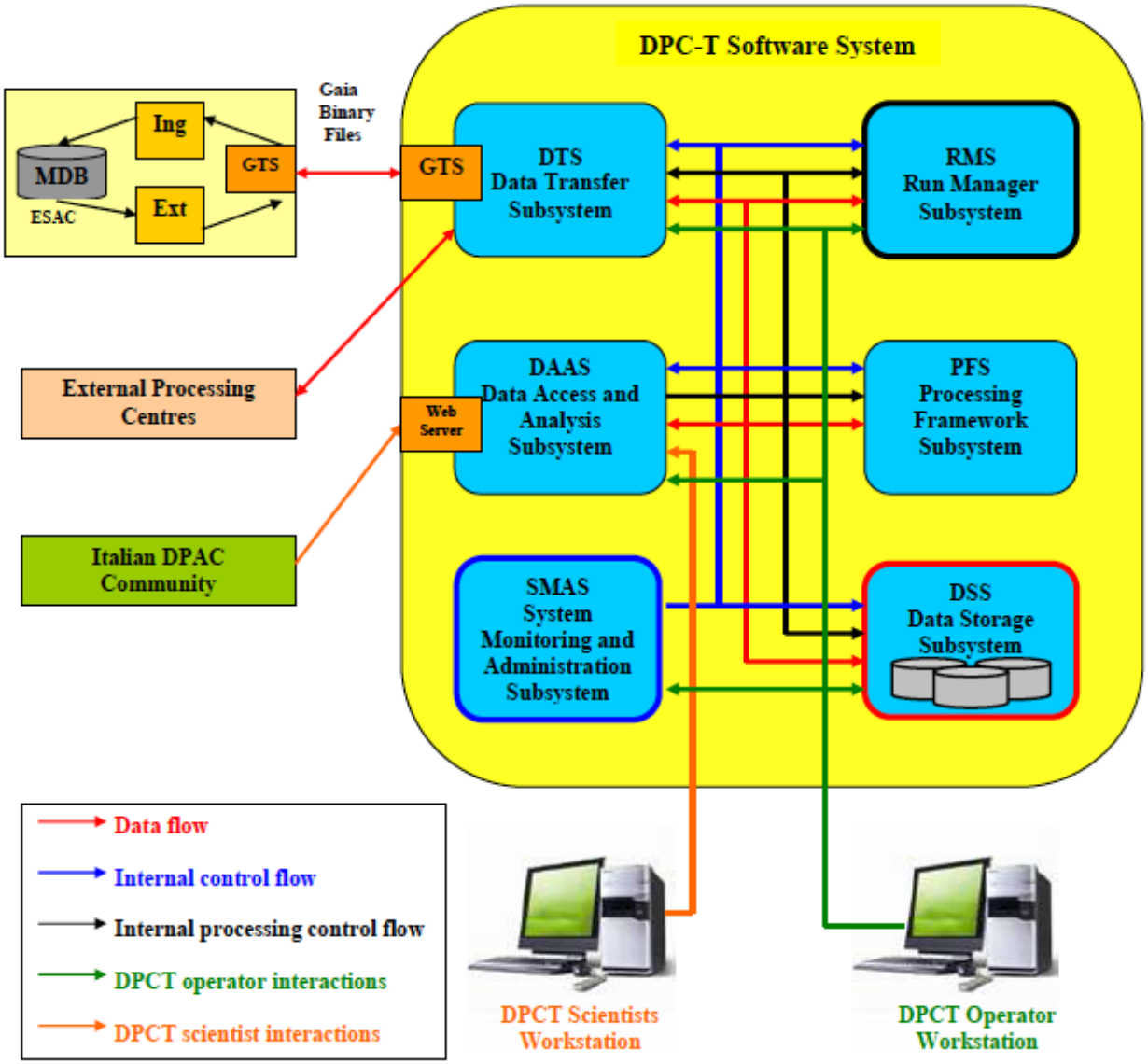
If we are not doing this,
then somebody else should be doing it!



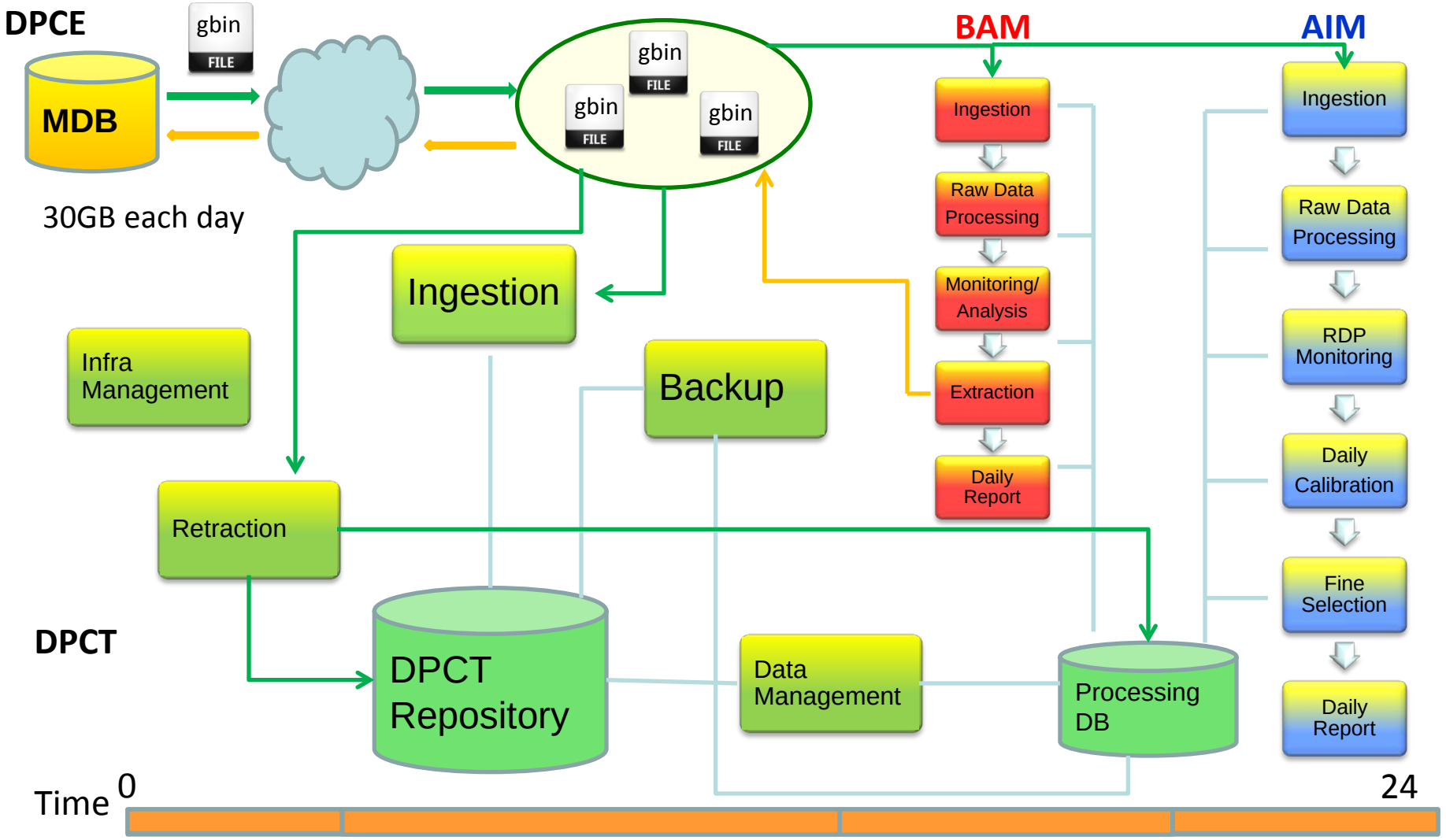
The Italian DPC funded by ASI

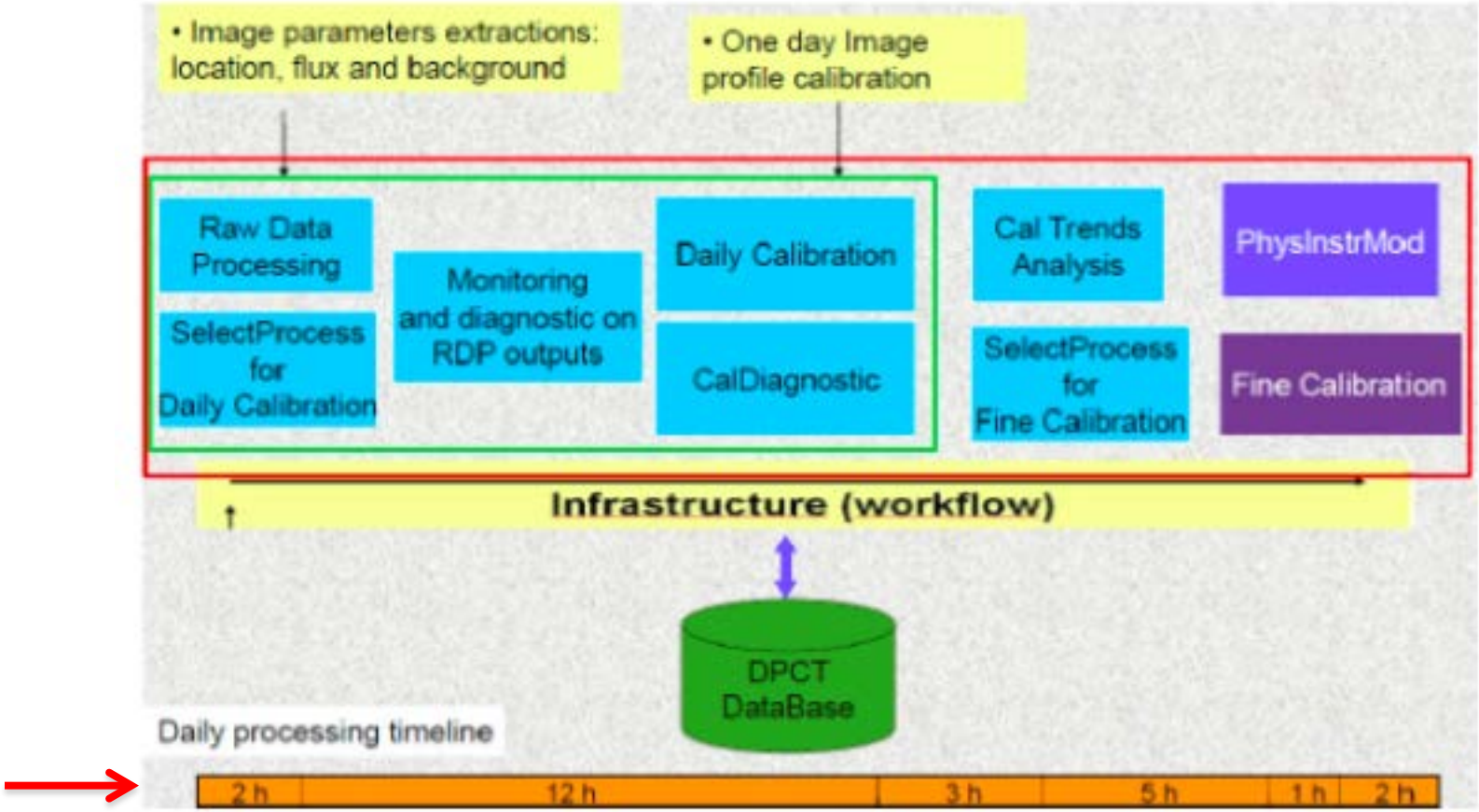
DPCT Reference HW Architecture

DPCT Infrastructure SW decomposition



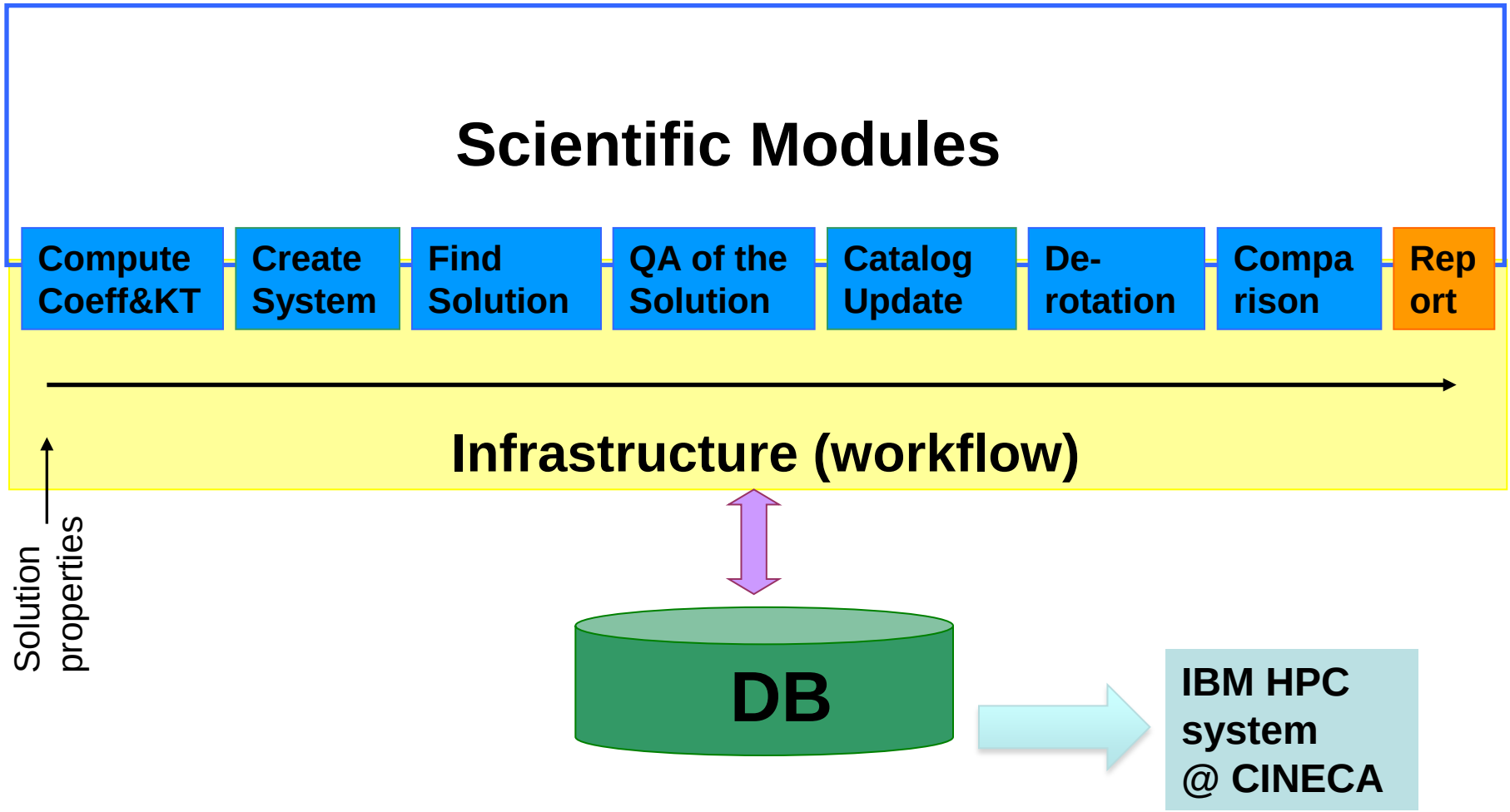
The Gaia daily pipelines at the DPCT @ ALTEC





Astrometric Instrument Model pipeline looking after the 64 CCD dedicated to astrometry (from Busonero, Lattanzi et al 2014, Proc. of SPIE Vol. 9150 91500K-1

Logical structure of the Gaia Sphere Reconstruction pipeline (NON DAILY)

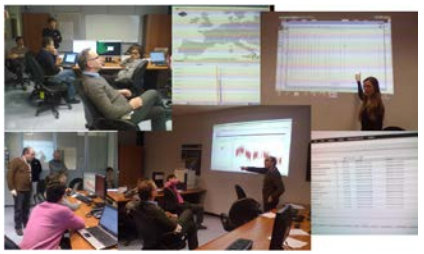


What is the message I'd like to leave here? The key issues when deleaning with far reaching missions/projects?

- System preservation: of both data & (re)processing capabilities (avoid the HIPPARCOS-Pleiades conundrum!!)

- Durability: maintenance (HW & SW) and sustainability (including financial)

- Multidisciplinary team working together (mostly at critical times): the all-in-one-place (or teams-proximity) model !!!



Data legacy: tens of years (50+?)

DPCT: raw data preservation & high performance query resolution on Main DB and recalibration capabilities

→ **IGSL**

→ **EUCLID (FGS, CCD's and cold electronics, SGS model)**

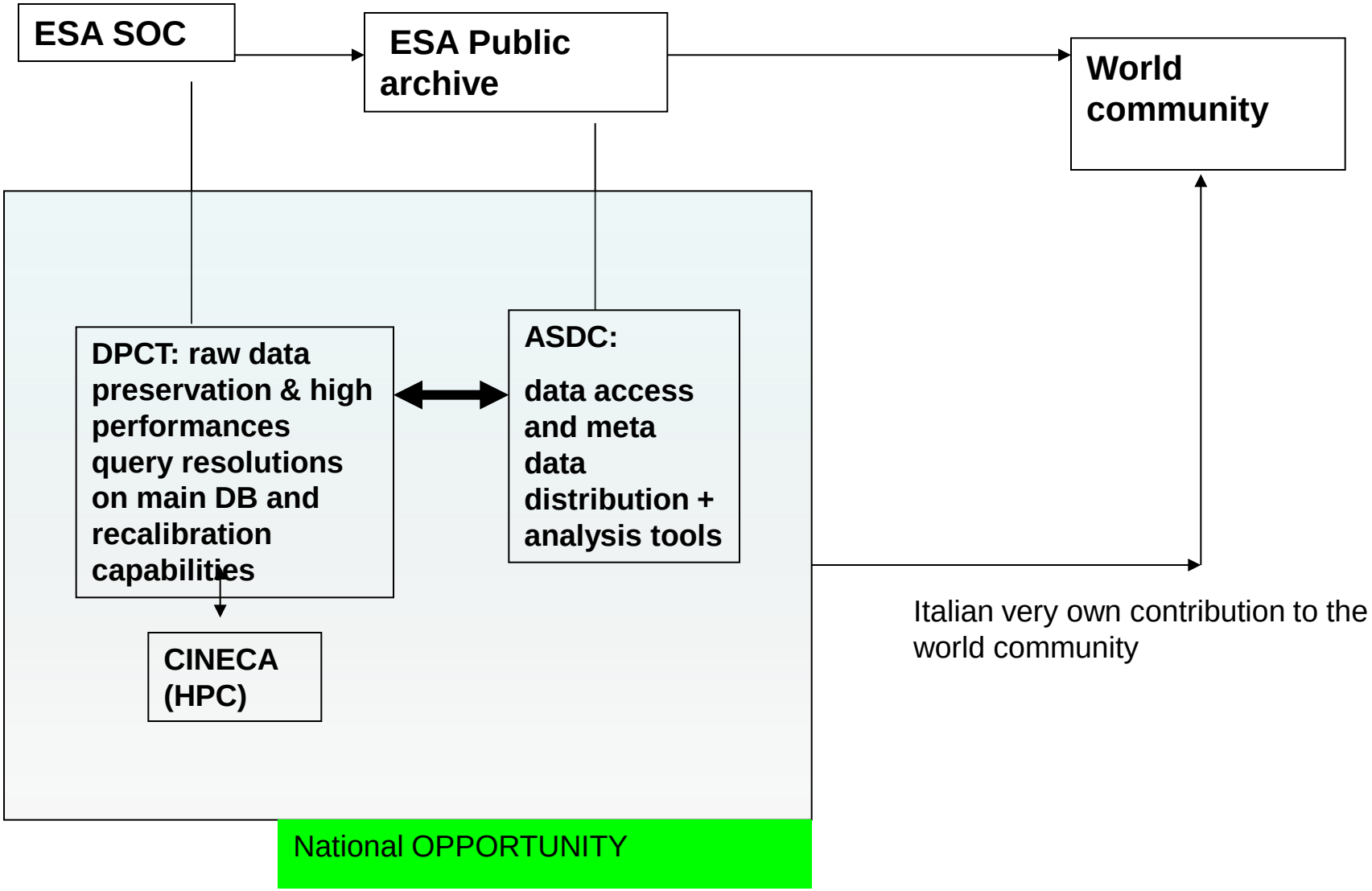
→ **SPHERE**

→ **METIS (SGS model)**

↓ **PLATO**

↓ **Other (e.g. SKA)**

- **Digital Space Lab for space science and space instrumentation**
- **Digital (deep) sky: Sopporto progettazione nuove missioni**
- **Modello per futuri SGS**


ESA SOC
ESA Public archive
World community
DPCT: raw data preservation & high performances query resolutions on main DB and recalibration capabilities
ASDC:
data access and meta data distribution + analysis tools
CINECA (HPC)
Italian very own contribution to the world community
National OPPORTUNITY

Dunque:

nel caso della missione Gaia e del DPC Italiano (DPCT) le scelte implentattive sono scaturite in modo naturale:

- **DBMS Oracle**
- **Partnership con componente industriale (with a mission!): ALTEC (To)**

E QUESTA E’ FATTA!

Grazie!!