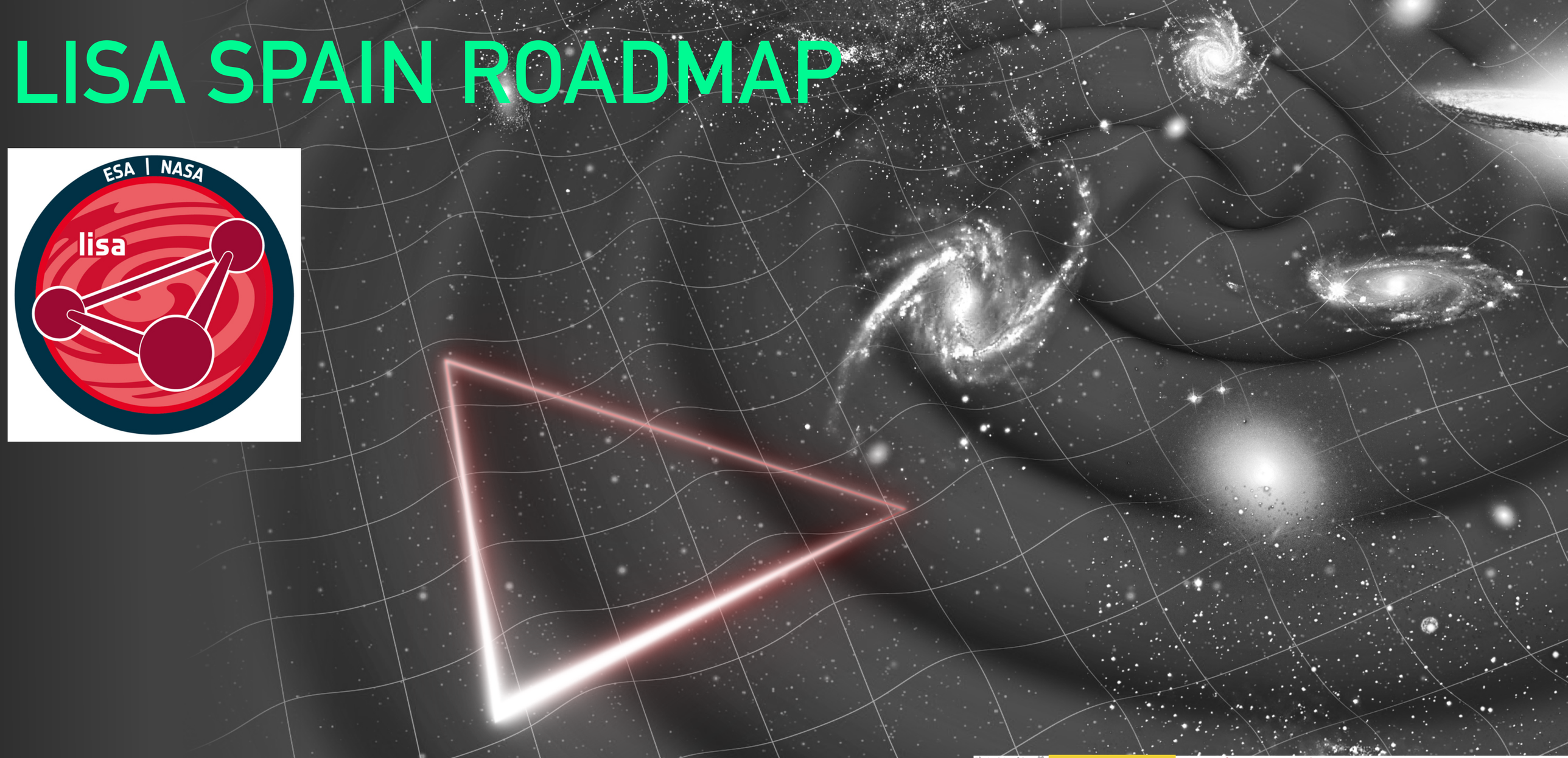
LISA SPAIN ROADMAP



LISA SPAIN MEETING 2024

CSIC

MINISTERIO DE CIENCIA, INNOVACIÓN Y UNIVERSIDADES

Institute of Space Sciences

IEEC

EXCELENCIA MARÍA DE MAEZTU

✦ Spanish Contribution to the LISA Ground Segment, as established in the Multi-Lateral Agreement (MLA) between ESA and member states:

Spain

- Be responsible for the development of 1 instance of the following pipelines of the DDPC:
  - Global Fit Pipeline;
- Be responsible for the deployment in Spain of 1 DCC and contribute to the system engineering work packages;
- Contribute to the software and data processing (contribution to other work packages than listed before) of the SGS and to the operations.

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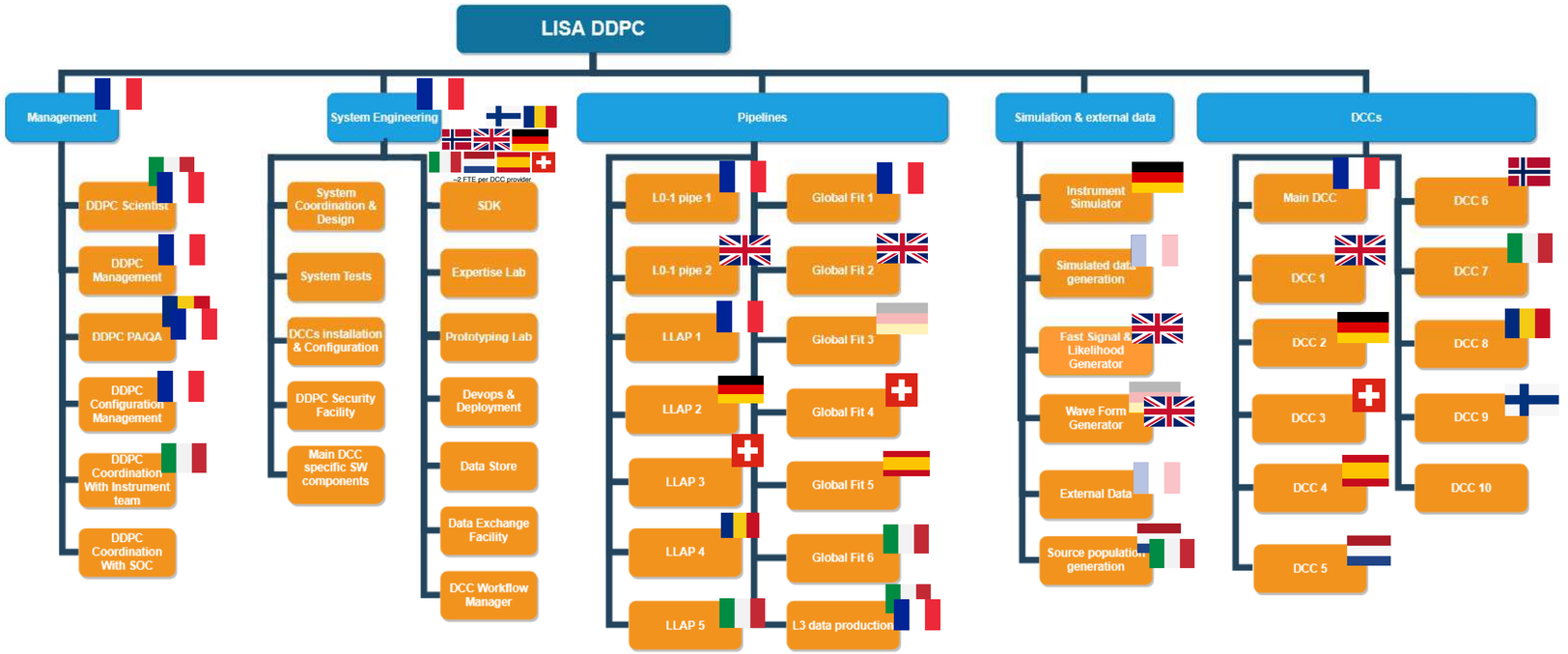
DDPC contribution status (07/03/2023)



LISA "boundary conditions"

Main Players

ESA (Lead)	NASA	ESA Member States / Consortium
▪ Mission Implementation Responsibility ▪ Mission Architect ▪ Space Segment ▪ Ground Segment ▪ Launcher ▪ Overall System Engineering ▪ Platform Hardware	▪ Partner to ESA ▪ Telescopes ▪ Laser Systems ▪ Charge Management Devices ▪ Science Data Processing ▪ Performance and Operations Support	▪ Instrument Hardware Contributions (Gravitational Reference Sensor System, Interferometric Detection System, Data and Diagnostics) ▪ Performance Test GSE ▪ Science Data Processing ▪ Performance and Operations Support

Main Instrumental Contributions

Gravitational Reference System	Interferometric Detection System	Instrument Testing GSE	Data and Diagnostics
▪ GRS Head (IT) ▪ GRS FEE (CH), FEE PCU (IT) ▪ GRS MCU (IT) ▪ CMD (NASA via ESA)	▪ Optical Bench (UK) ▪ ePMS (DE) ▪ IDS AIVT (FR) ▪ OB-MCU (NL) ▪ QPRs (NL+BE) ▪ BAM (BE) ▪ FSUA (CZ) ▪ PAAM (DE – TBC)		

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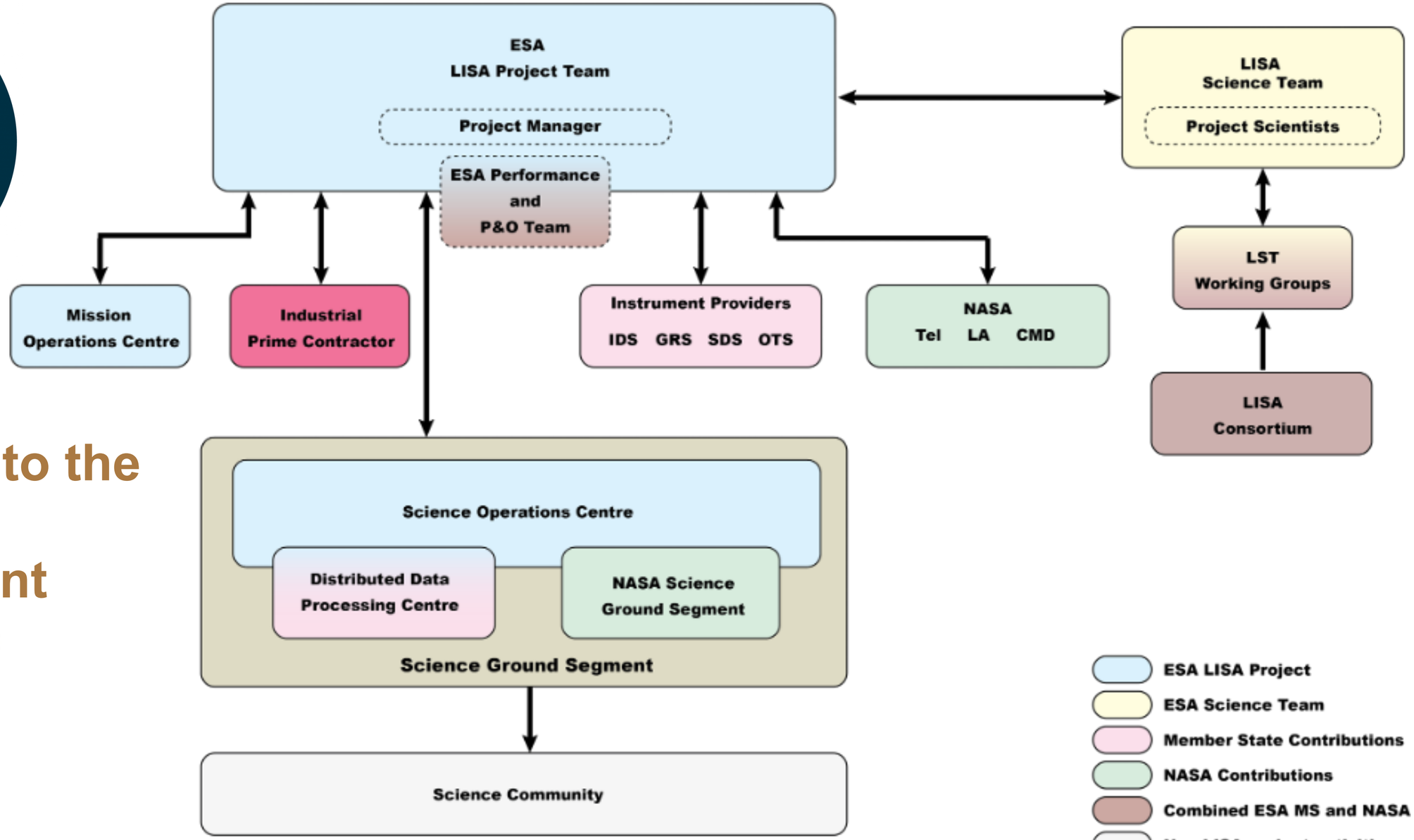
Instrument Testing GSE

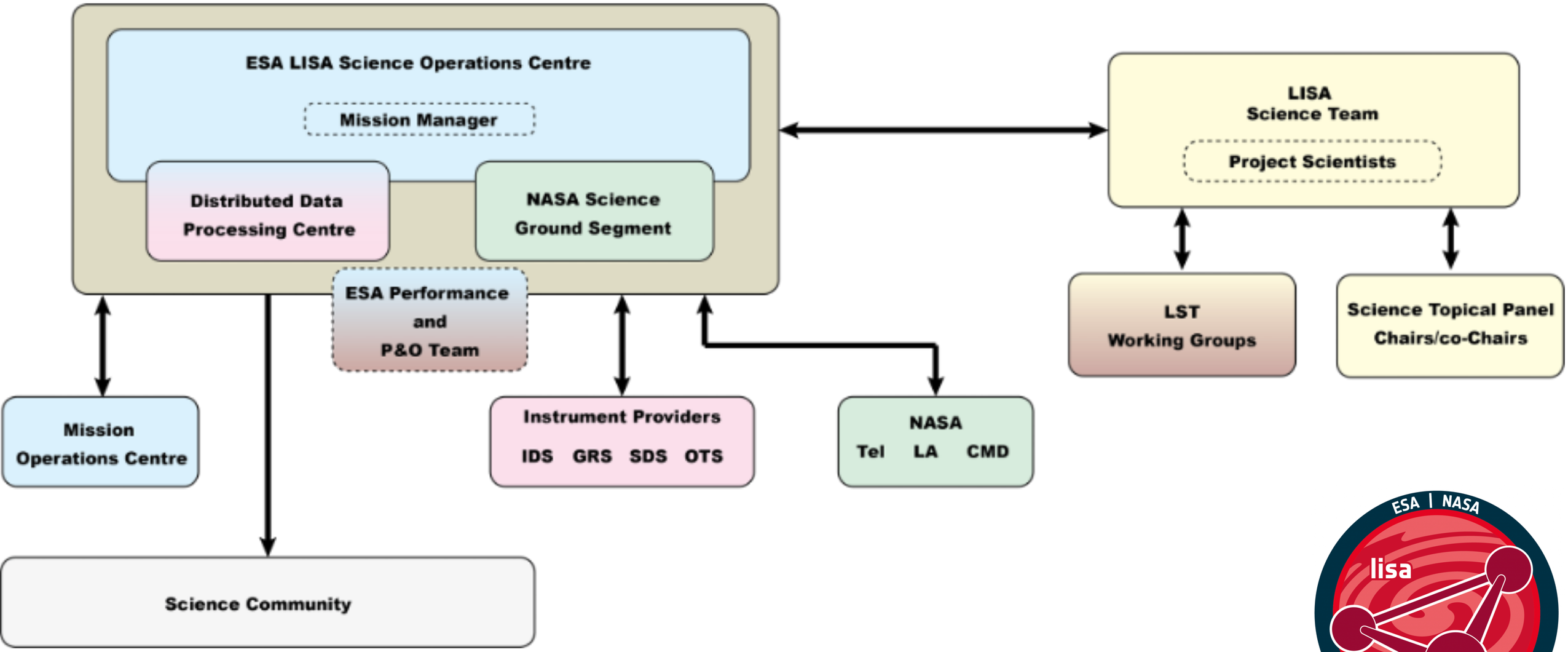
Data and Diagnostics

LISA Management Structure (Implementation Phase)



According to the Science Management Plan (SMP)

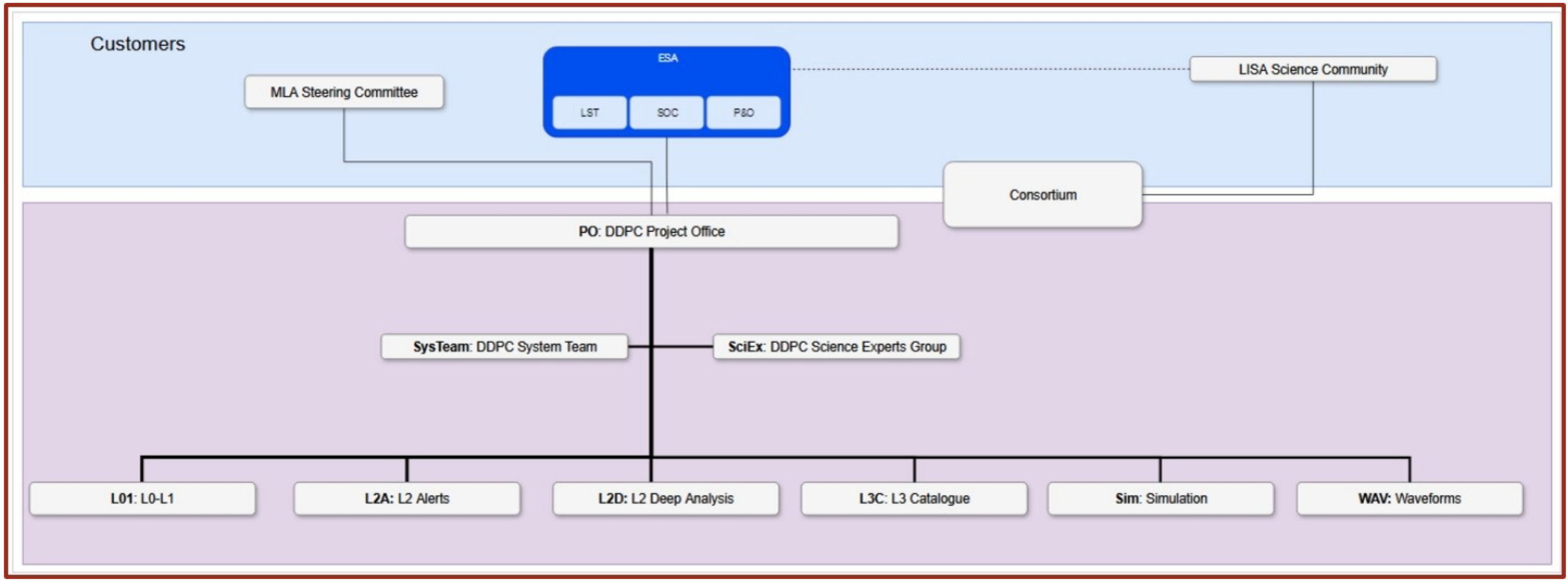
LISA Management Structure (Operations Phase)



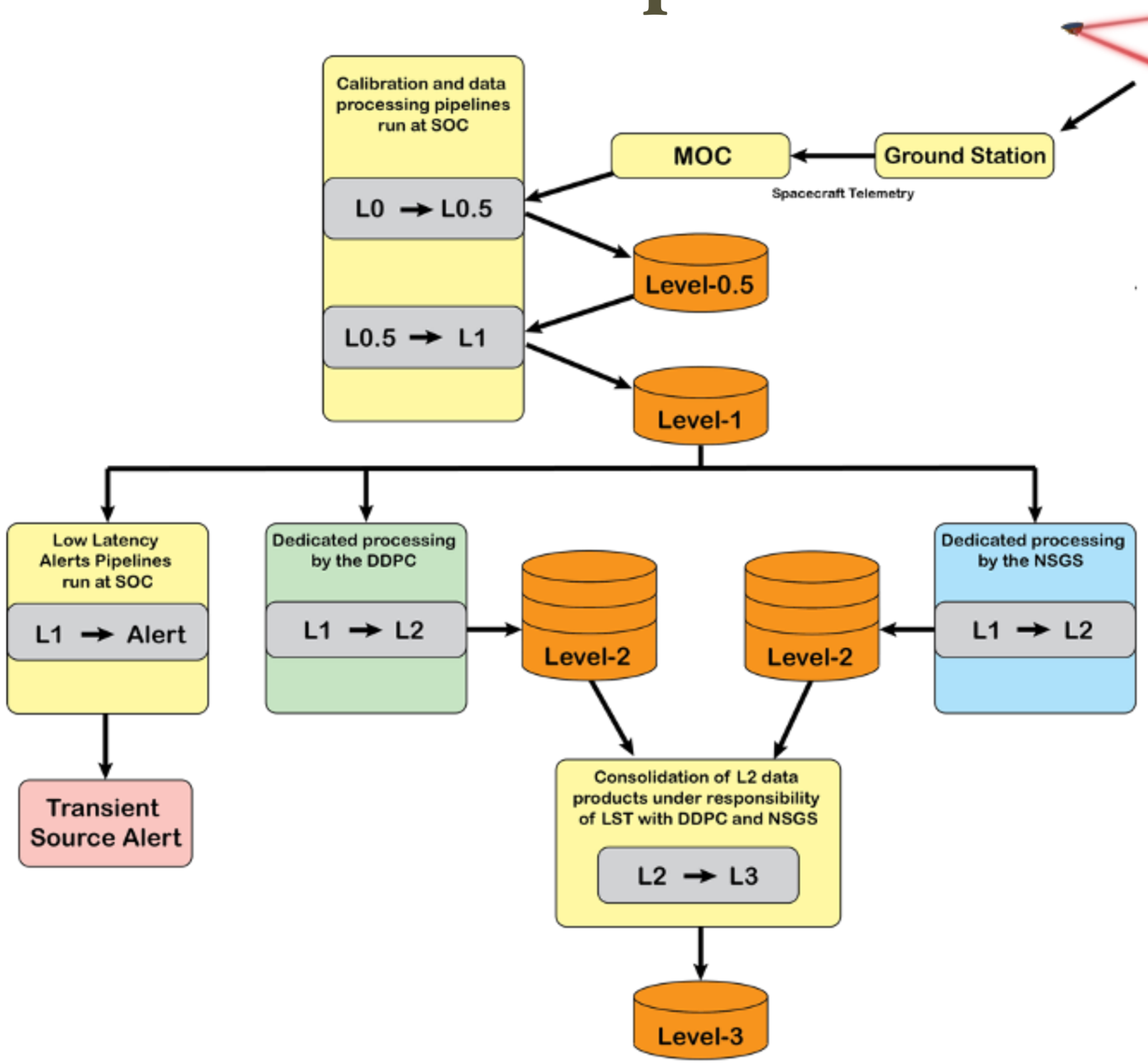
According to the Science Management Plan (SMP)

LISA Scientific Operations

✦DDPC Structure



LISA Scientific Operations



L0 Telemetry: unprocessed at full resolution
Time ordered and time-stamped to UTC

Level 0.5: Calibrated instrument data
Time ordered and time-stamped to UTC

Level 1: Time-Delay Interferometry (TDI) combinations
At a minimum, A, E, T, X, Y, Z, Sagnac

Level 2: Individual detected sources
Including posterior probability densities and waveforms

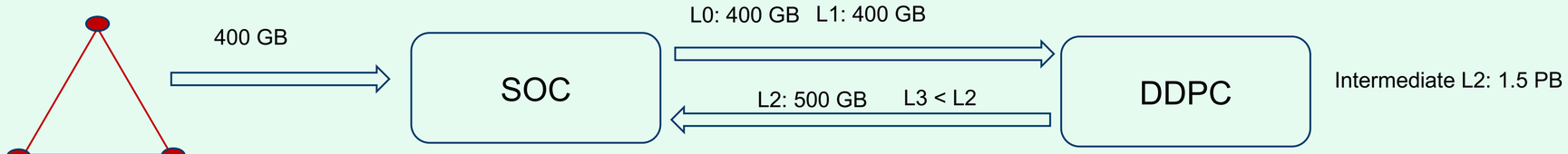
Alerts: Transient source alert
Including waveform, estimated masses, distance, and sky location

Level 3: Catalogue of detected sources
Includes the coherent merging of the L2 data products

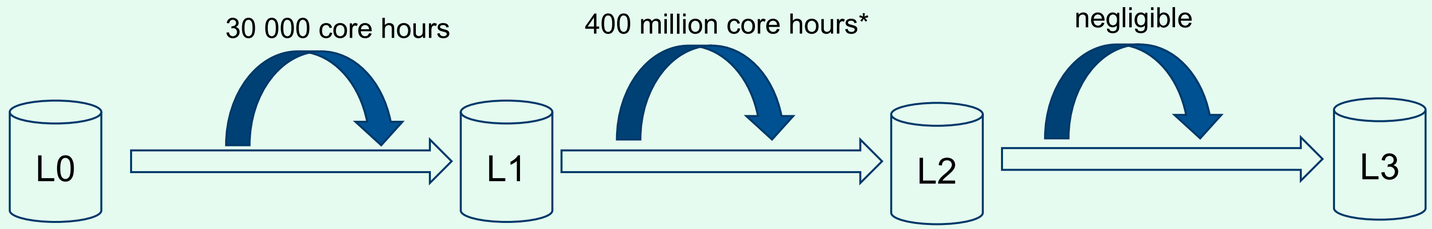
Development of a GFP prototype

Some numbers

Data size per year



Core hours per year



* Considering 2 global fit running in parallel
/!\ Carbon footprint

LISA Scientific Operations: LISA Data Challenges

- **Radler**
- single source type data set
- GB, MBHB, EMRI, SBBH, SGWB
- no artifacts 1 or 2 years
- TDI 1.5

- **Sangria**
- Mild Enchilada problem
- Population of GBs + MBHs
- No artifacts, 1 year
- TDI 1.5

- **Spritz**
- Single source type data
- GBs, MBHB
- Gaps, glitches, non-stat, ≲ 2yrs
- TDI 2.0

LISA Scientific Operations: LISA Data Challenges

- **Yorsh**
- **SBBH** ✅
- **EMRI,**
- no artifacts 1 or 2 years
- TDI 2.0

- **Sangria-HM**
- Extended Sangria (LDC2a)
- Population of GBs + MBHs
- No artifacts, 1 year
- TDI 2.0 (?)

- **Corpse Reviver/ Tequila Sunrise**
- Stochastic GW signals
- Gaps, glitches optional, non-stat, 1yrs
- TDI 2.0

LEGO-like data sets: Components are saved separately, can construct simple to complicated datasets.

LISA Scientific Operations: LISA Data Challenges

- **Mojito**
- Full enchilada: GBs, MBHBs, EMRIs, SBBH
- Artifacts optional 2 years
- Time iterative analysis,
- Alert pipeline

- **Long Island Iced Tea (Adios)**
- Full enchilada + SGWB
- all artifacts, 2 or 3 years
- Time iterative analysis, alert pipeline

Time critical

release

- **Aunt Roberta**
- Operational pipeline
- blind , most complete
- Live data
- Alerts

Time critical

release

Acknowledgements

Many Thanks for your attention!

✤ Work in LISA has been supported by contracts PID2019-106515GB-I00 and PID2022-137674NB-I00 (MCIN/AEI/10.13039/501100011033) and 2017-SGR-1469 and 2021-SGR-01529 (AGAUR, Generalitat de Catalunya). This work has been also partially supported by the program *Unidad de Excelencia María de Maeztu* CEX2020-001058-M (Spanish Ministry of Science and Innovation).