

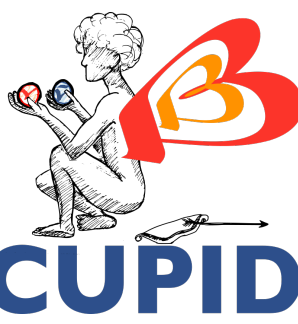
# International Collaboration and Division of Scope

Karsten Heeger  
Yale University

CUPID LBNL Project Review  
December 16-17, 2024



# CUPID Collaboration

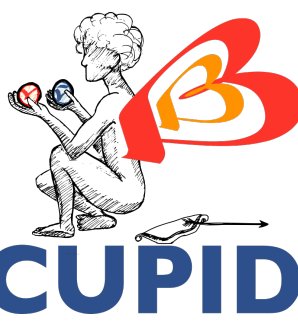


A strong, international collaboration builds on Italian-US partnership



May 2024

# US CUPID Groups

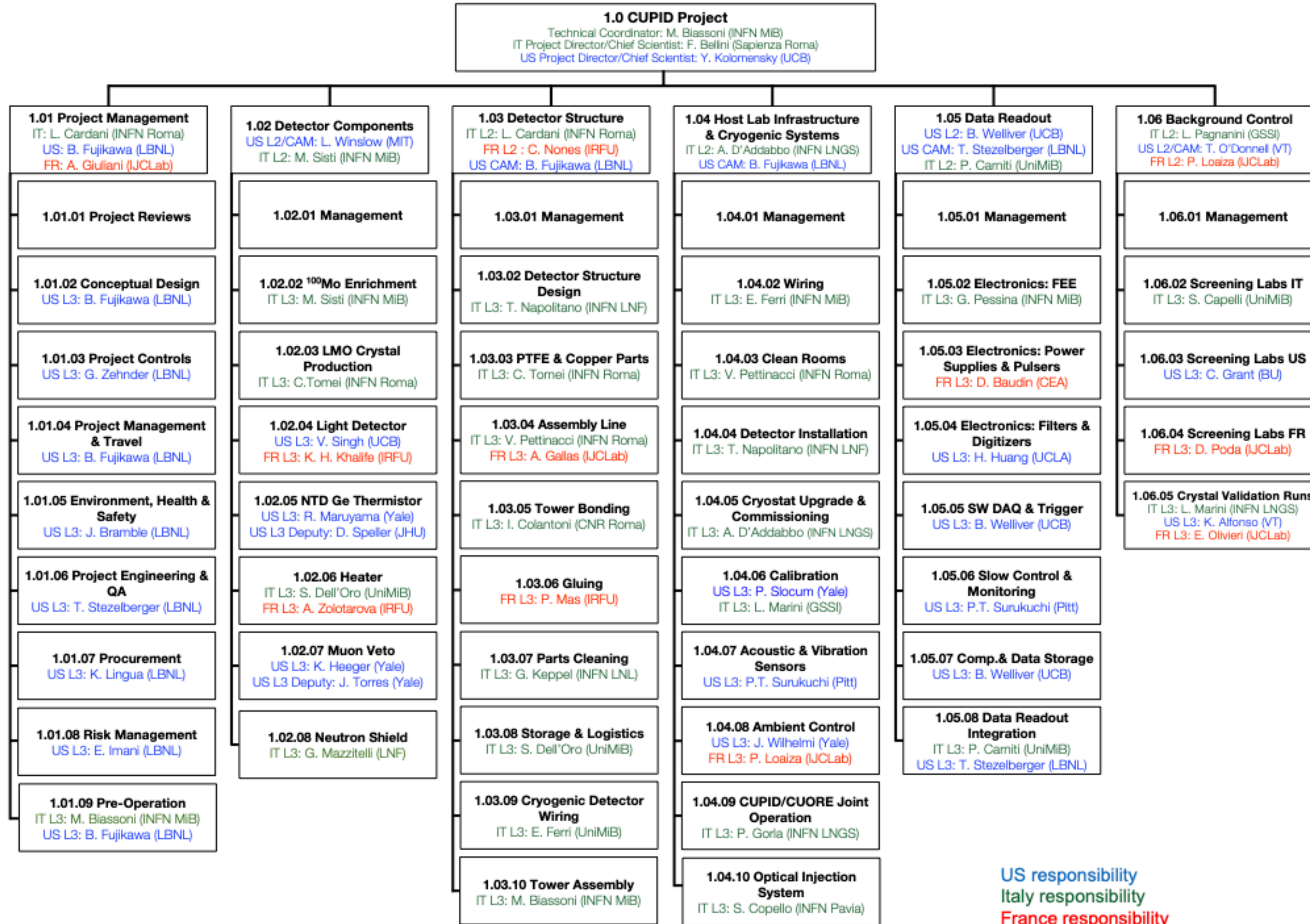
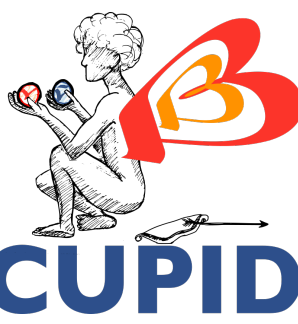


# International CUPID Collaboration



Italy and France are the major partners besides the US

# WBS Overview



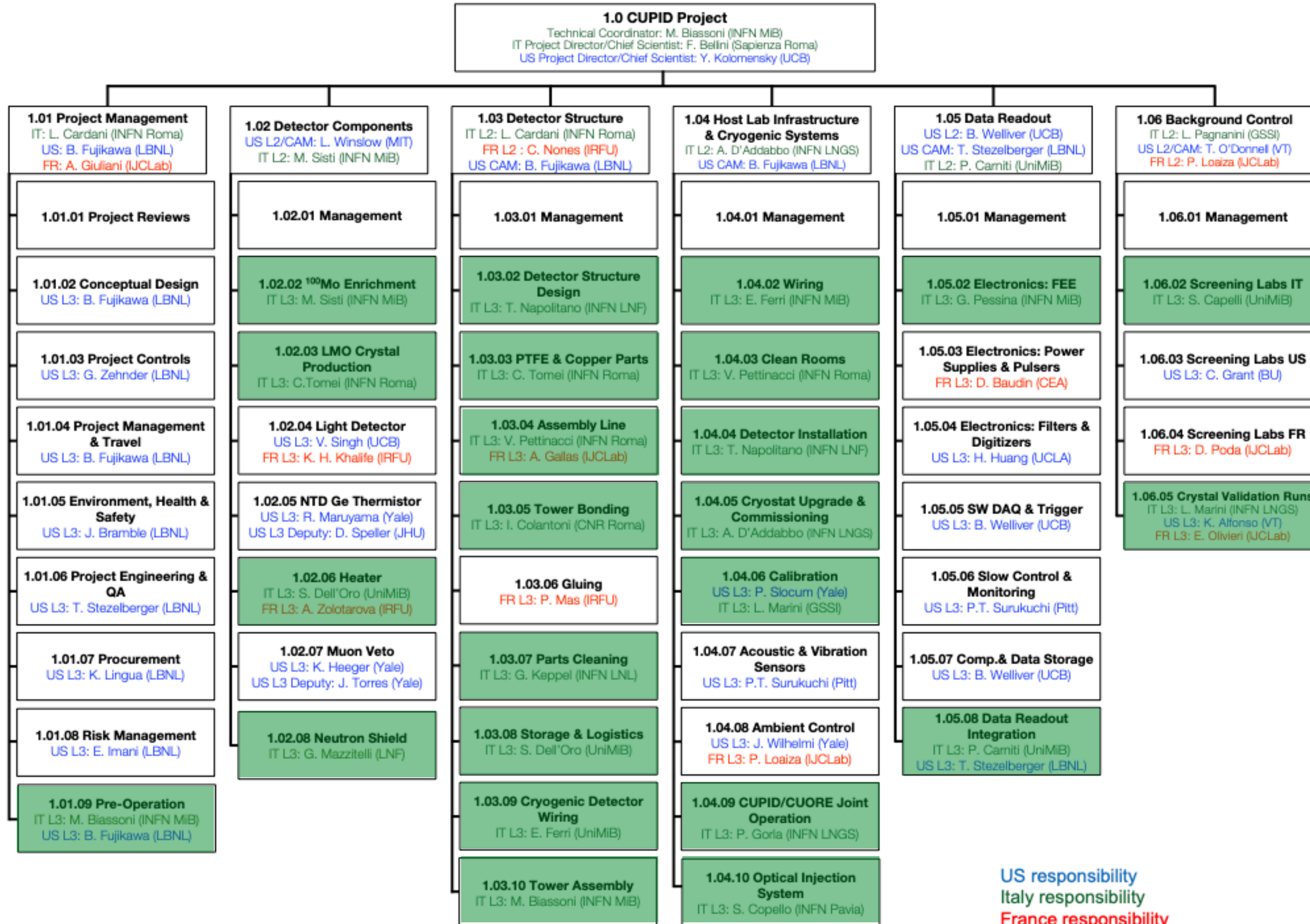
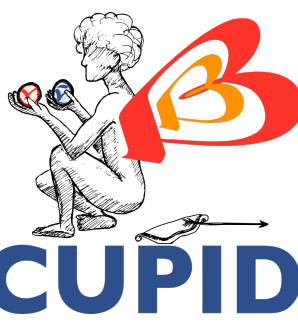
Color coding shows countries' responsibilities

Some WBS elements have Co-L3s

US responsibility  
 Italy responsibility  
 France responsibility

L3 first name: primary responsibility  
 L3 second name: secondary responsibility

# WBS Overview



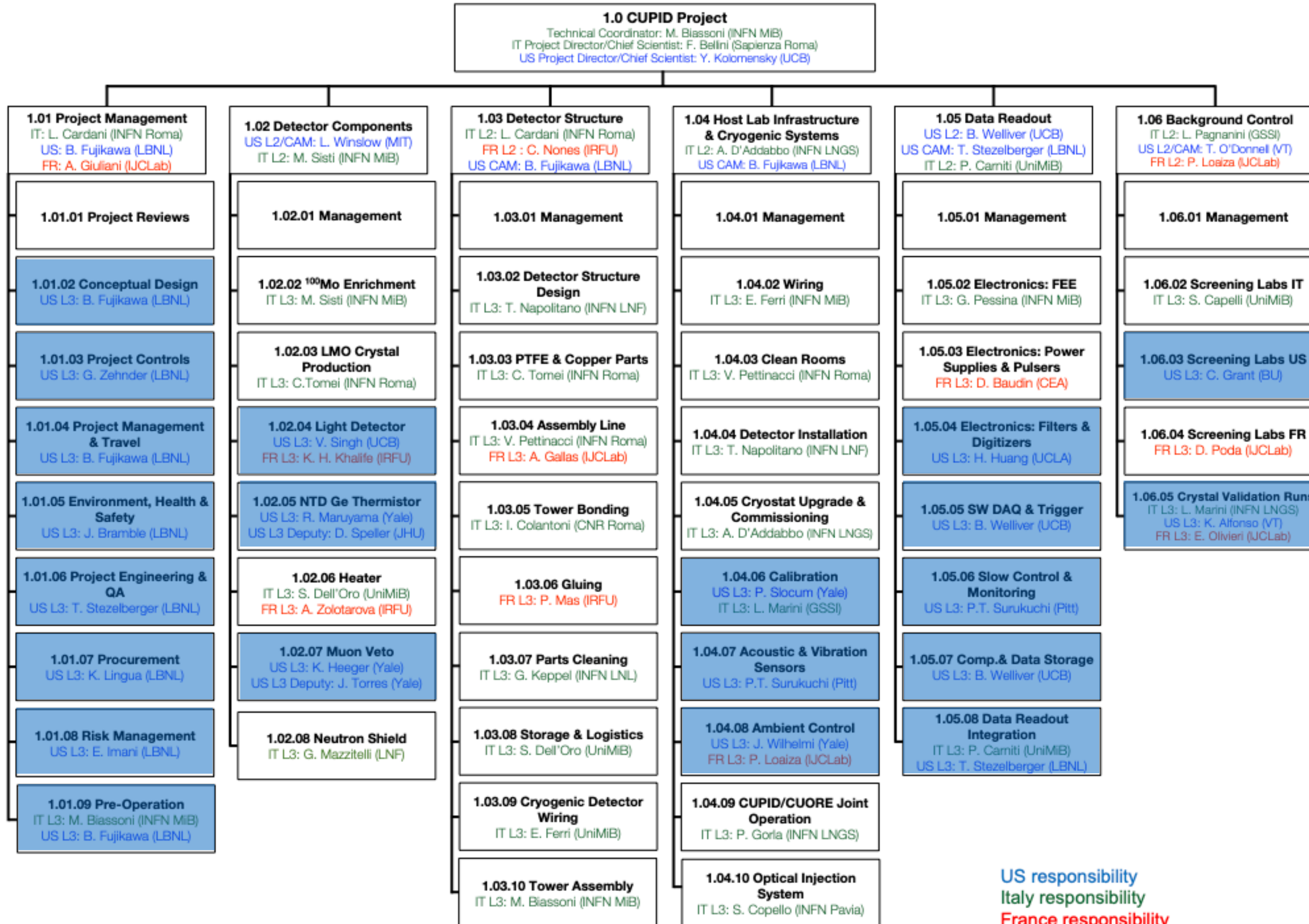
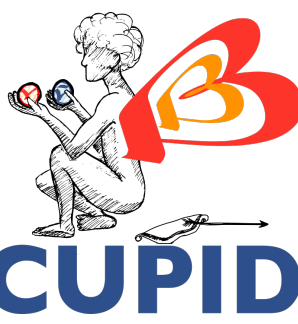
US responsibility  
 Italy responsibility  
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## Italy

- enrichment
- crystal production
- heaters
- electronics
- Neutron shield
- detector structure
- cryogenics
- assembly
- on-site logistics
- Background screening

# WBS Overview



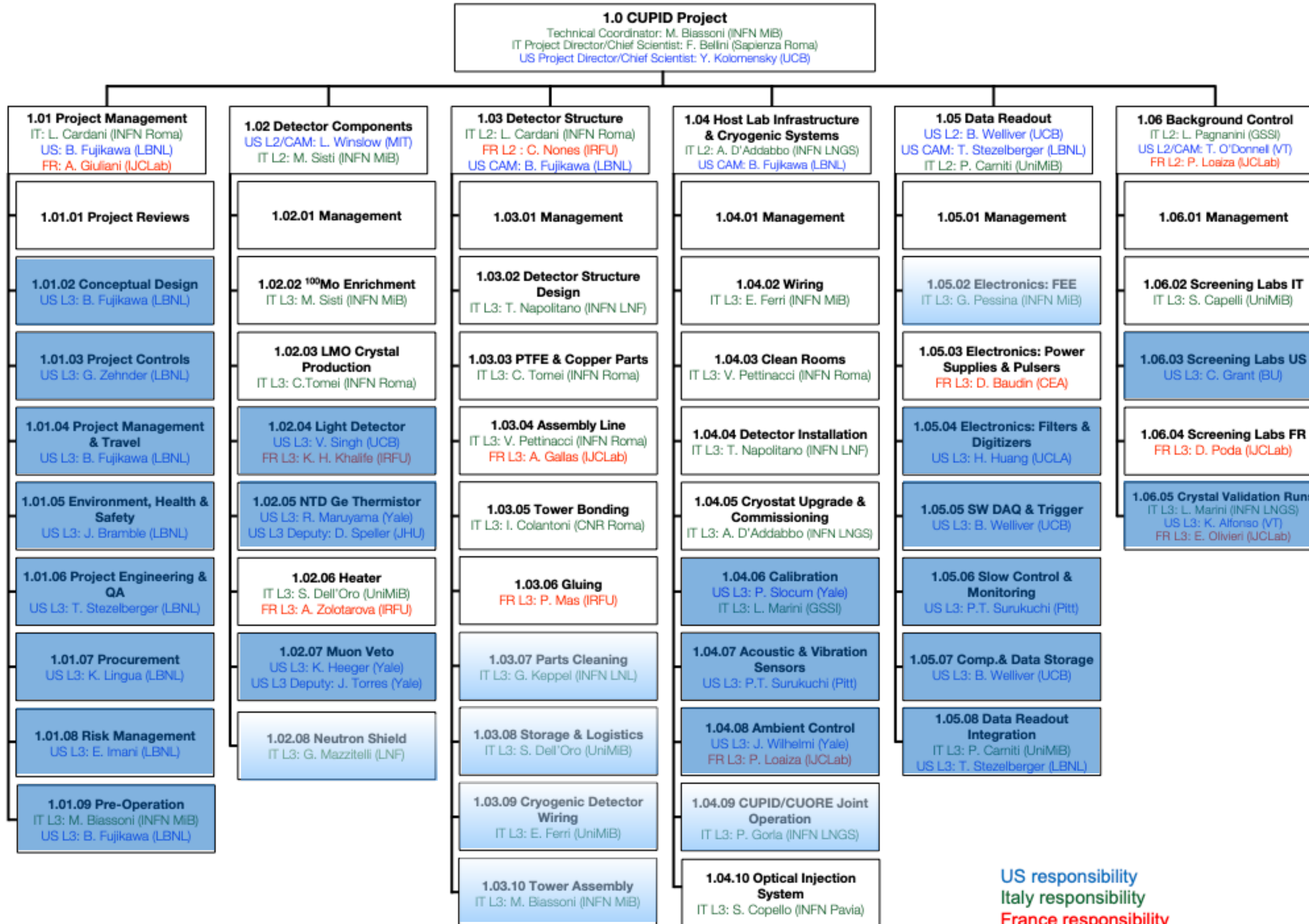
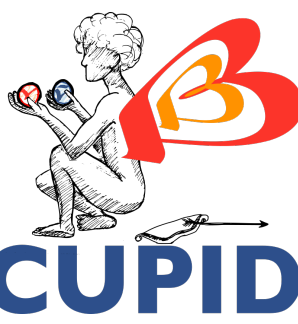
## US

- Project management
- Light detectors
- NTDs
- Muon veto
- calibration
- Sensors
- Slow control
- electronics
- data readout and DAQ
- Background screening

US responsibility  
 Italy responsibility  
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# WBS Overview



## US

- Project management
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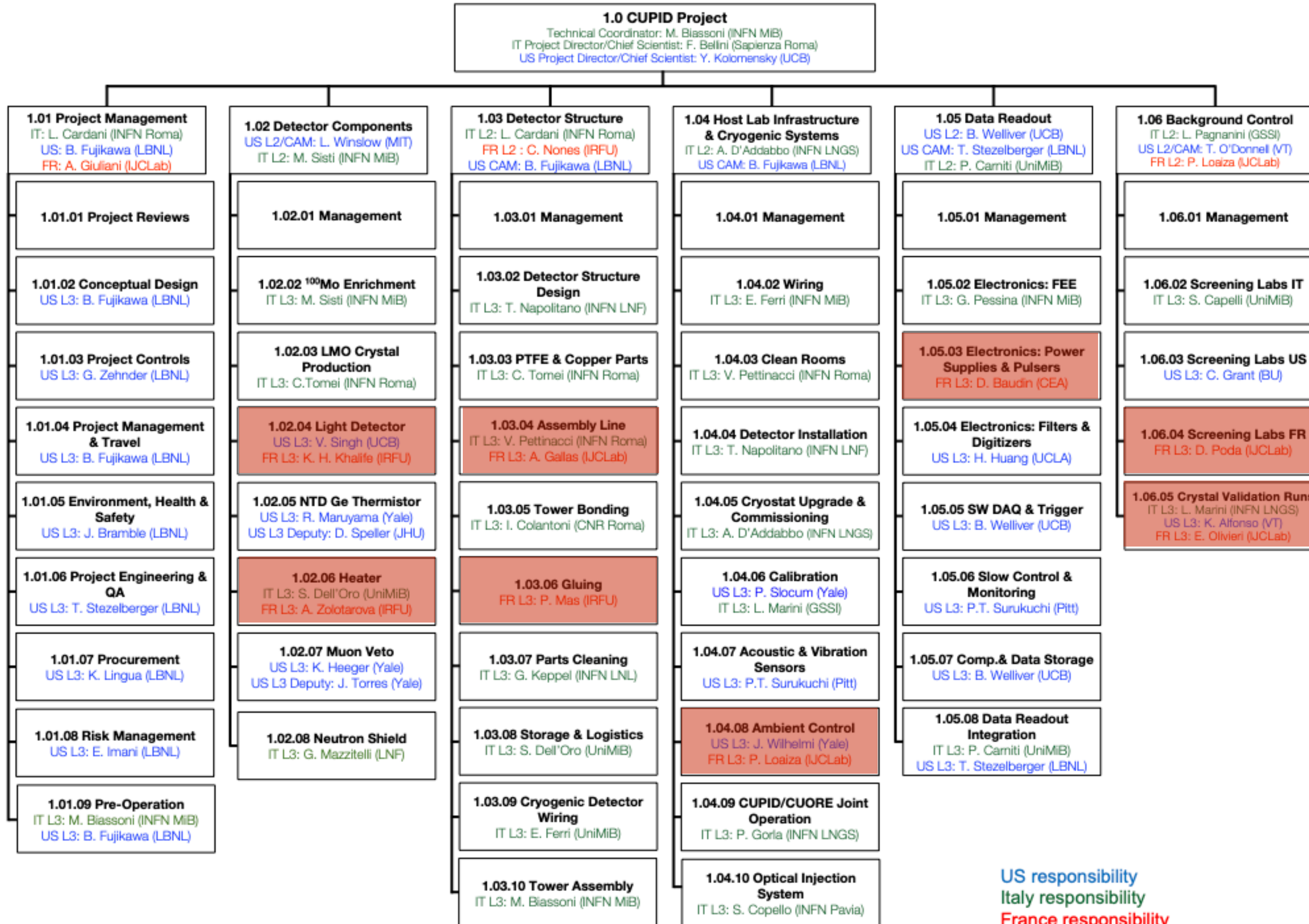
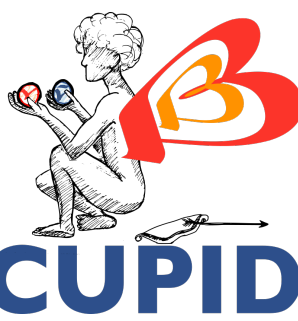
As part of scope swap, US contributes to:  
 1.02.08, 1.03.07, 1.03.08, 1.03.09  
 in Phase II:  
 1.03.10 1.04.09, 1.05.02

US responsibility  
 Italy responsibility  
 France responsibility

L3 first name: primary responsibility  
 L3 second name: secondary responsibility



# WBS Overview



## France

- light detectors
- heaters
- gluing
- Assembly line
- Background screening and projections

US responsibility  
 Italy responsibility  
 France responsibility

L3 first name: primary responsibility  
 L3 second name: secondary responsibility

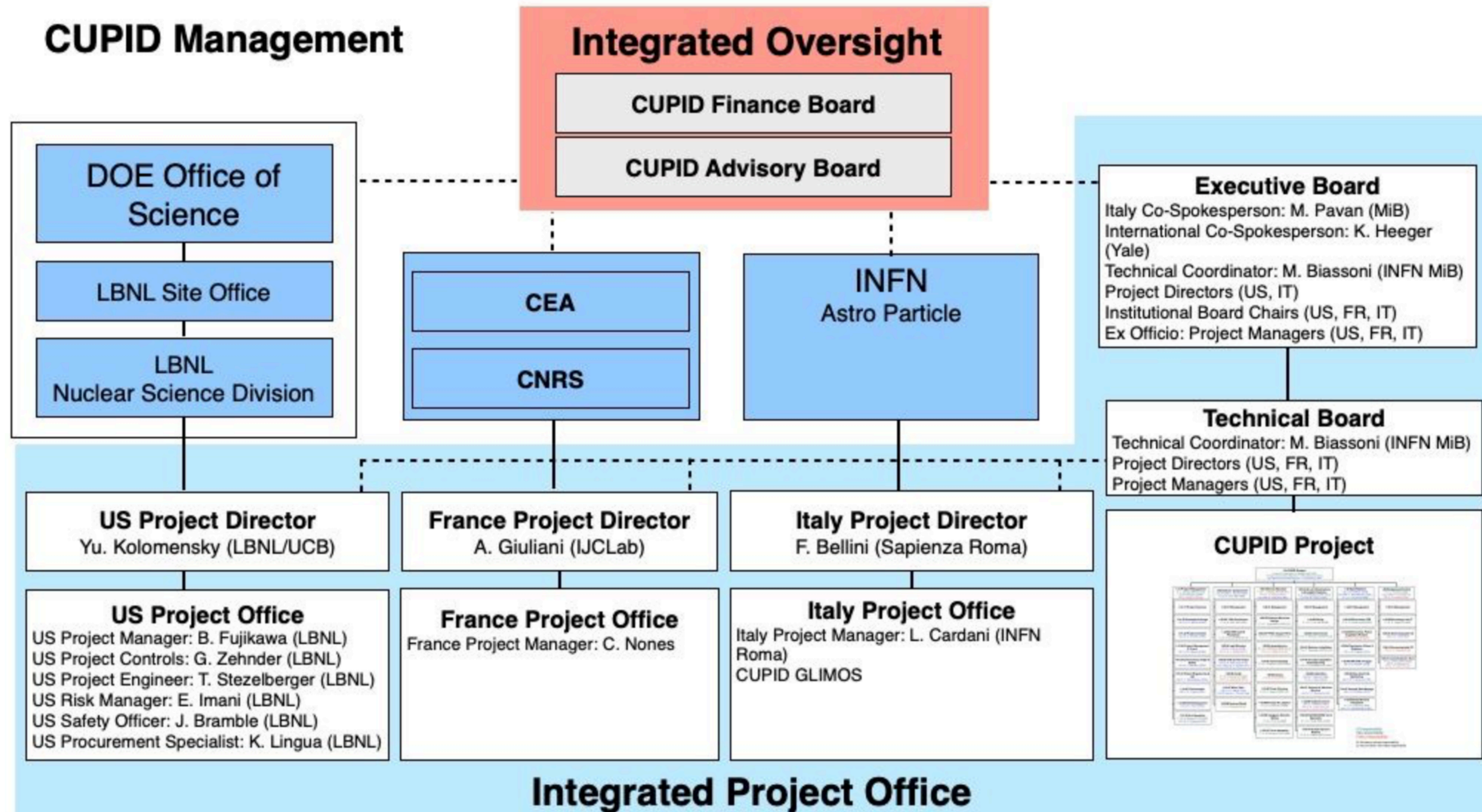
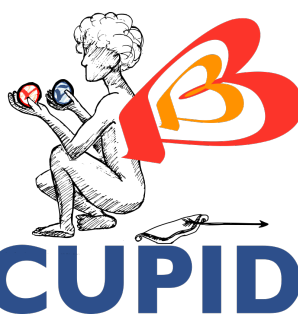
# Principles of Scope Division

- Project is coordinated between three major countries: **Italy**, **US** and **France**
- Scope and deliverables matched to the unique capabilities of the collaborating partners.
- **Italy**: host country; provides site, infrastructure, cryogenics and logistics; takes the lead in isotope and crystal procurement
- **US**: NTDs, electronics, muon veto, and half of light detectors, calibration, data readout and project management
- **France**: light detectors, gluing, and assembly
- Current scope split between Italy and the US is  $\sim 60/40$ , similar to the existing arrangement in CUORE. Will be defined in MOU.
- Scope swap between US and Italy to offset costs for major procurements like crystals (over course of full experiment including Stages I and II).
- Decouple dependencies between countries to the extent possible.

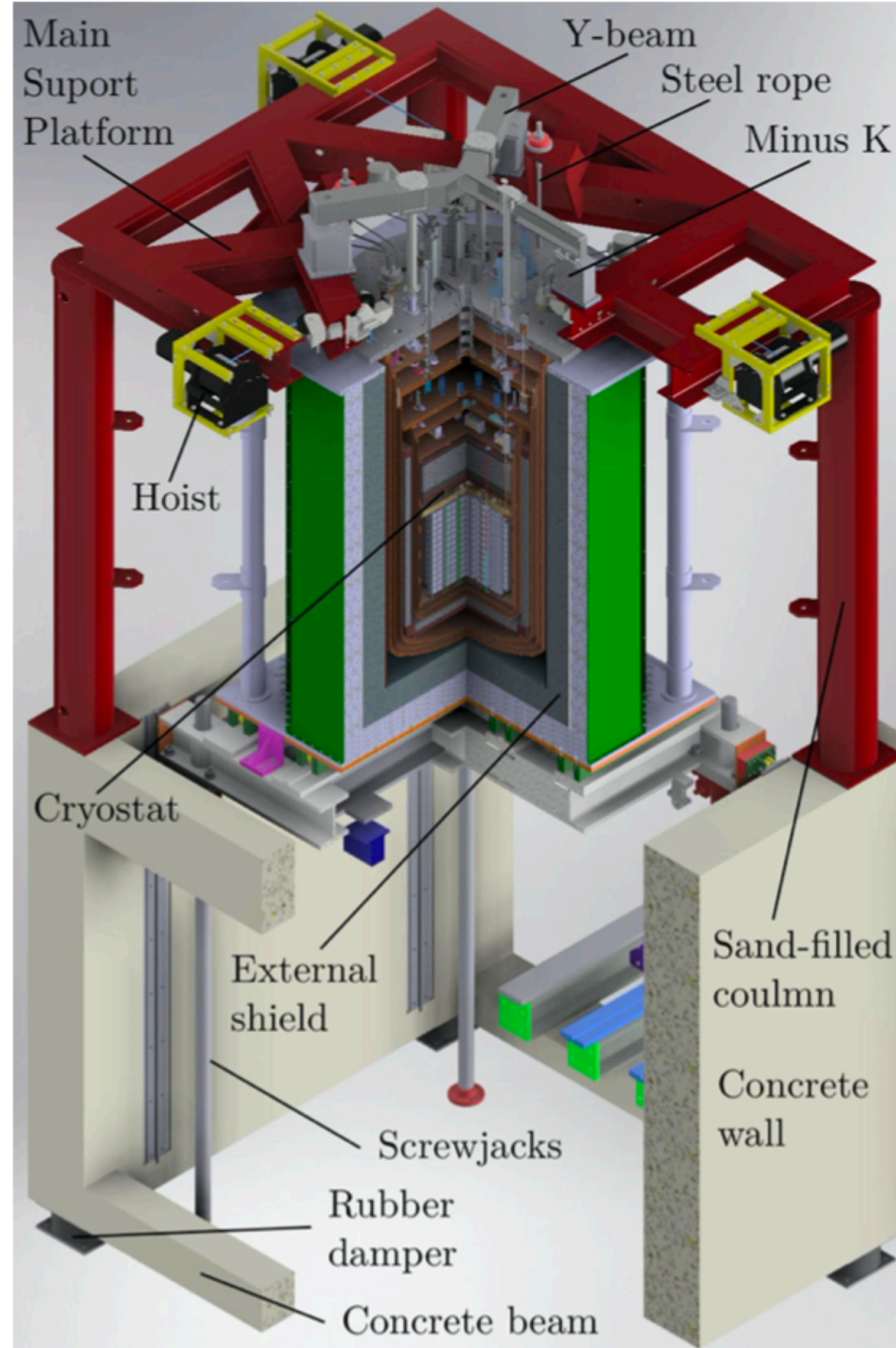
# Coordination and Deliverables

- Technical requirements are documented in **one technical reference document** (conceptual design report for the US) prepared by the entire collaboration
- Scope and **deliverables are well-defined** and matched to expertise.
- While collaboration and project are highly coordinated, scope split allows for asynchronous project reviews in each country and some limited flexibility in funding timeline.
- Project scope and timeline designed for **staged approach** to experiment.
- Contributions from all countries critical to realize Stage I of experiment.

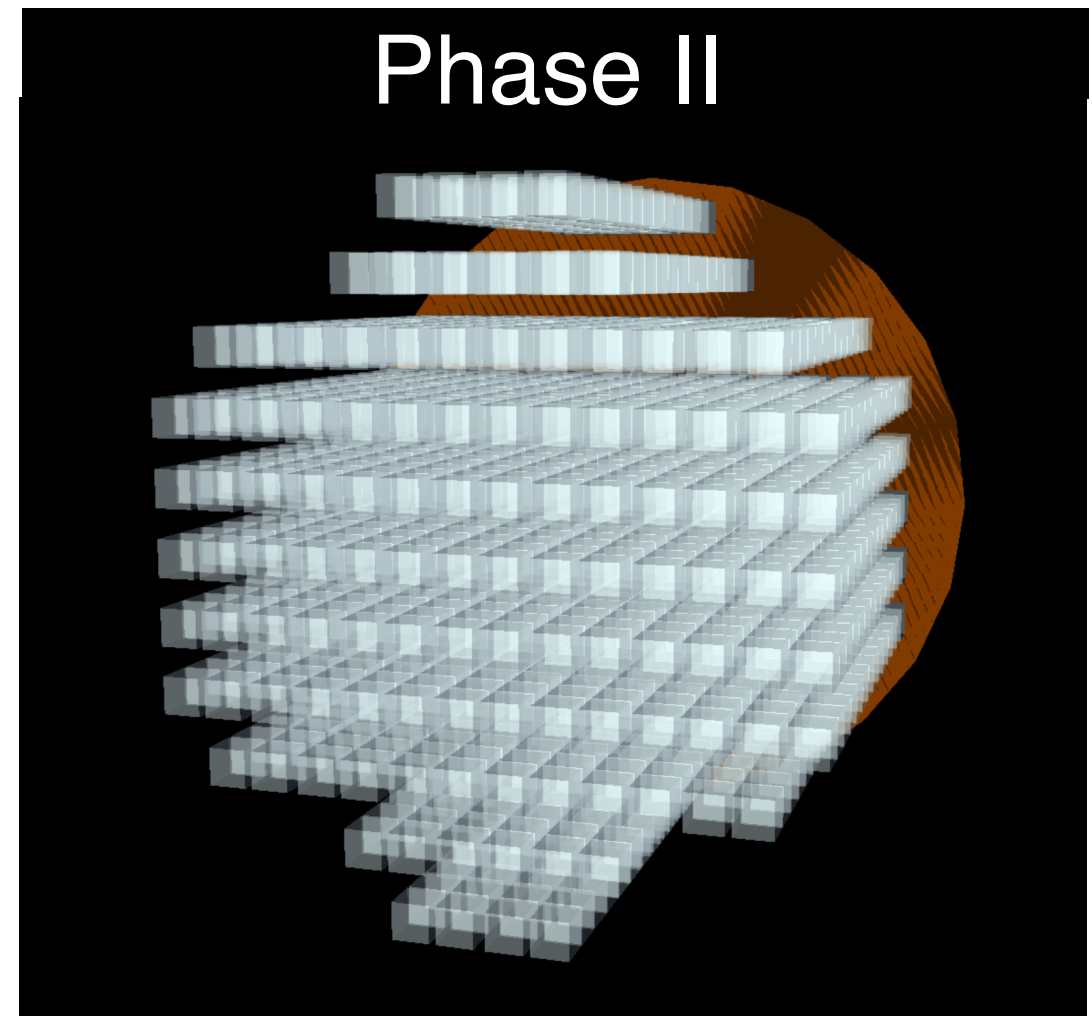
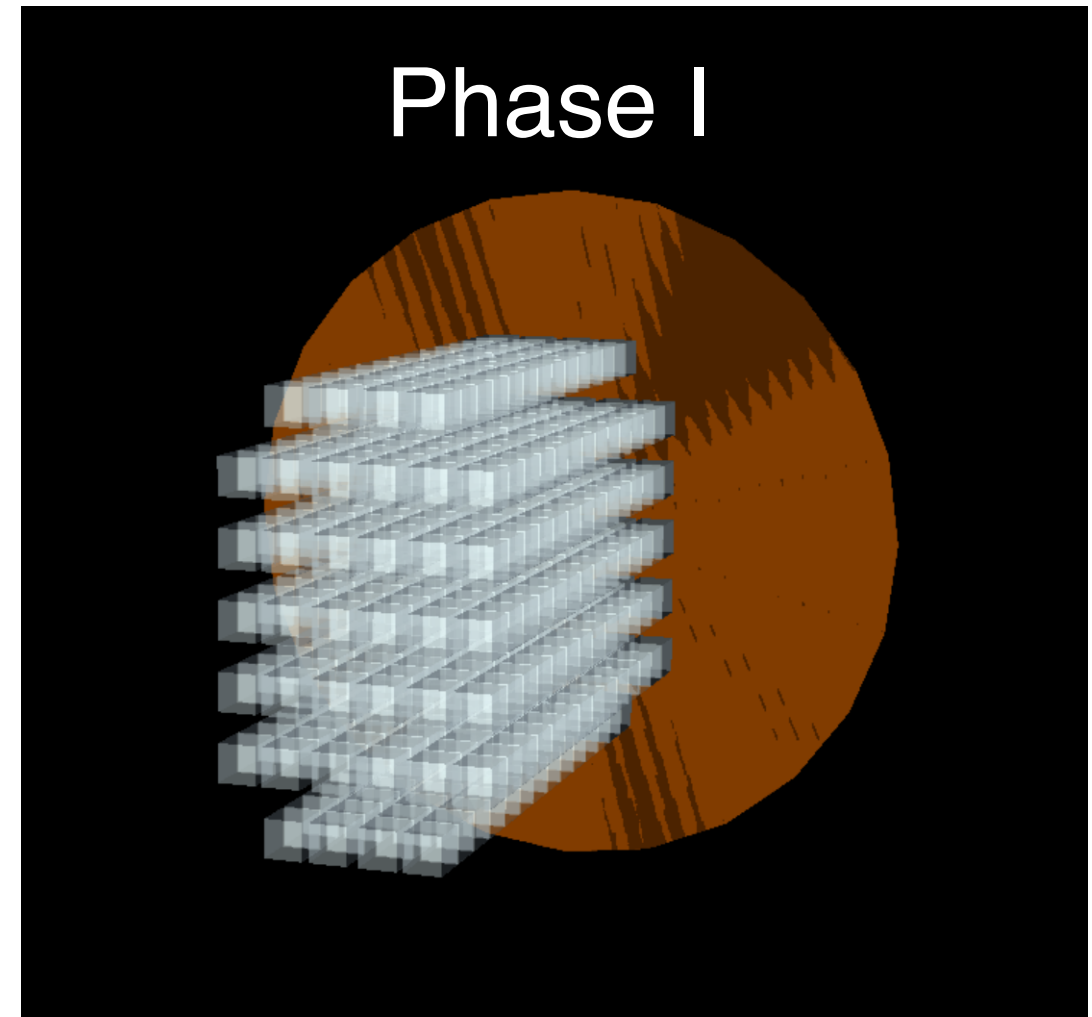
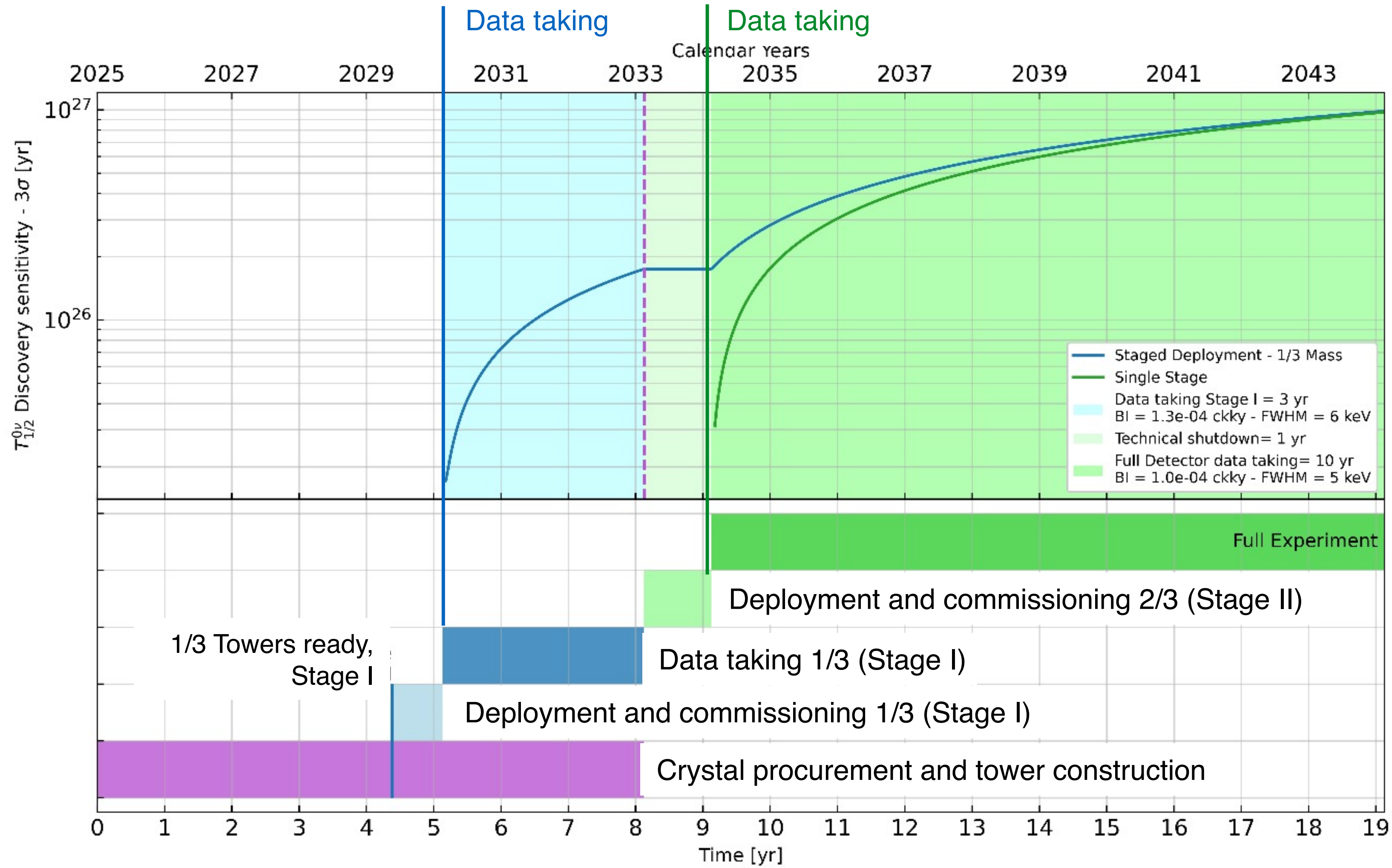
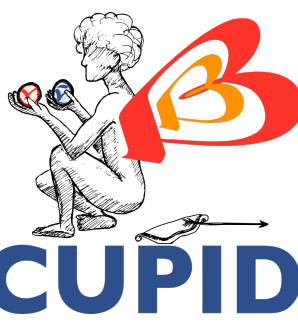
# Management of Scope, Scientific, Technical Decisions



# CUPID builds on existing infrastructure at LNGS



# Staged Deployment of CUPID



Detector configuration inside cryostat

# Reviews, Meetings, and Next Steps

- LBNL project review, December 16-17, 2024
- INFN President's review, spring 2025
  - waiting for next steps in the US and for first delivery/test of enriched crystals
  - important milestone for procurement of full set of enriched crystals
- International Double Beta Decay Summit
  - May 2025 (tentative)
  - Follows summits at LNGS and SNOLAB (2023)
- CUORE/CUPID collaboration meeting, LNGS, May 12-16, 2025

# Summary

- CUPID has an active and engaged collaboration with decades of experience from CUORE and bolometer program at LNGS.
- Scope and responsibilities well-defined and matched to experience of countries and institutions.
- Collaboration and project have mechanisms to collaborate and coordinate technical scope and deliverables.
- INFN set to take the lead as host country and in critical crystal procurement.
- US will make key contributions, critical to Stage I and the full experiment.