

First meeting of the Suspension Division

February 8, 2021

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Einstein Telescope drafted governance

Subsequently adapted to technical and other needs

Executive board has created

- ISB Instrument science board
- OSB Observational science board
- SPB Site preparation board
- e-Infrastructures
- Internal Financial Board

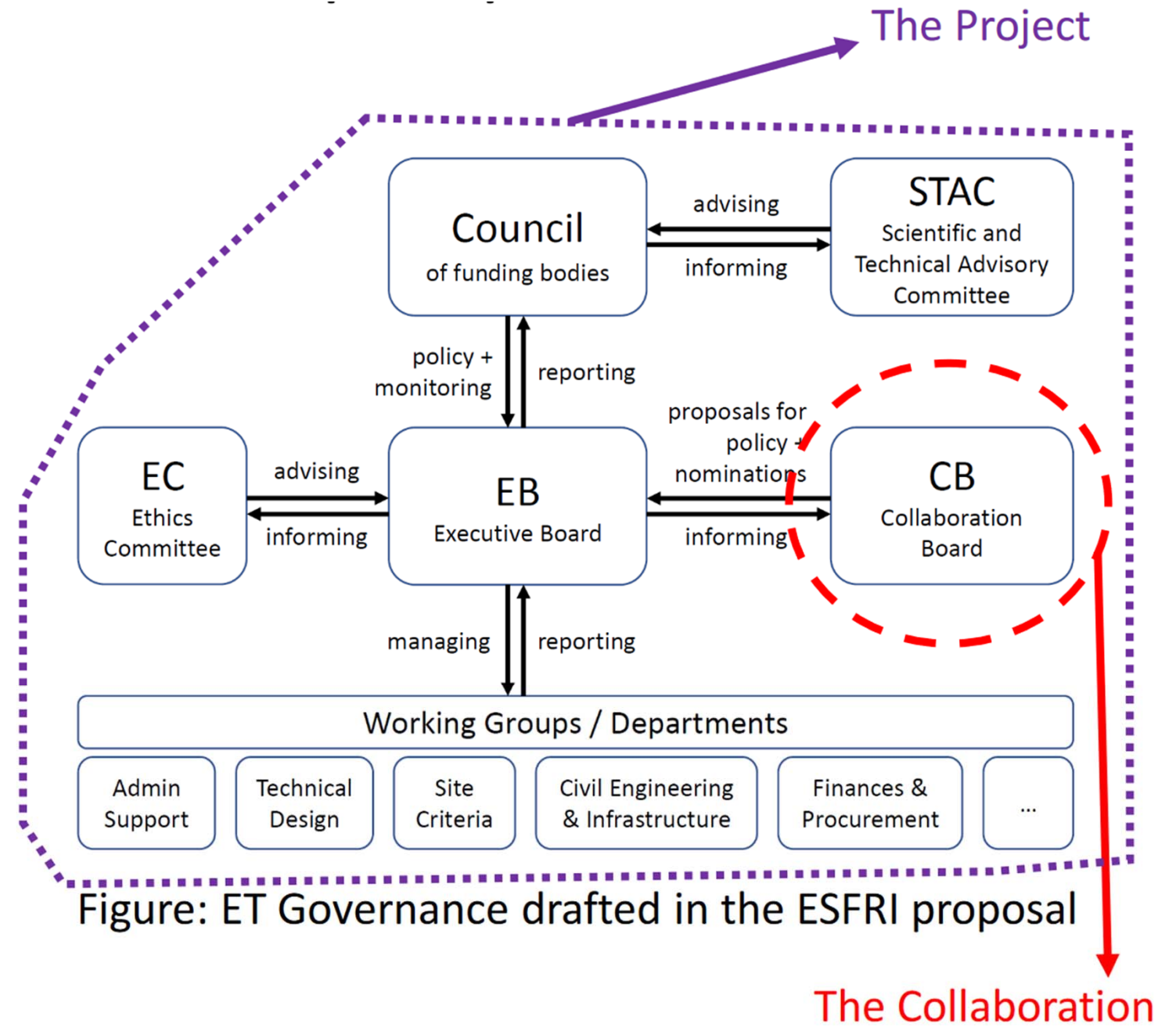
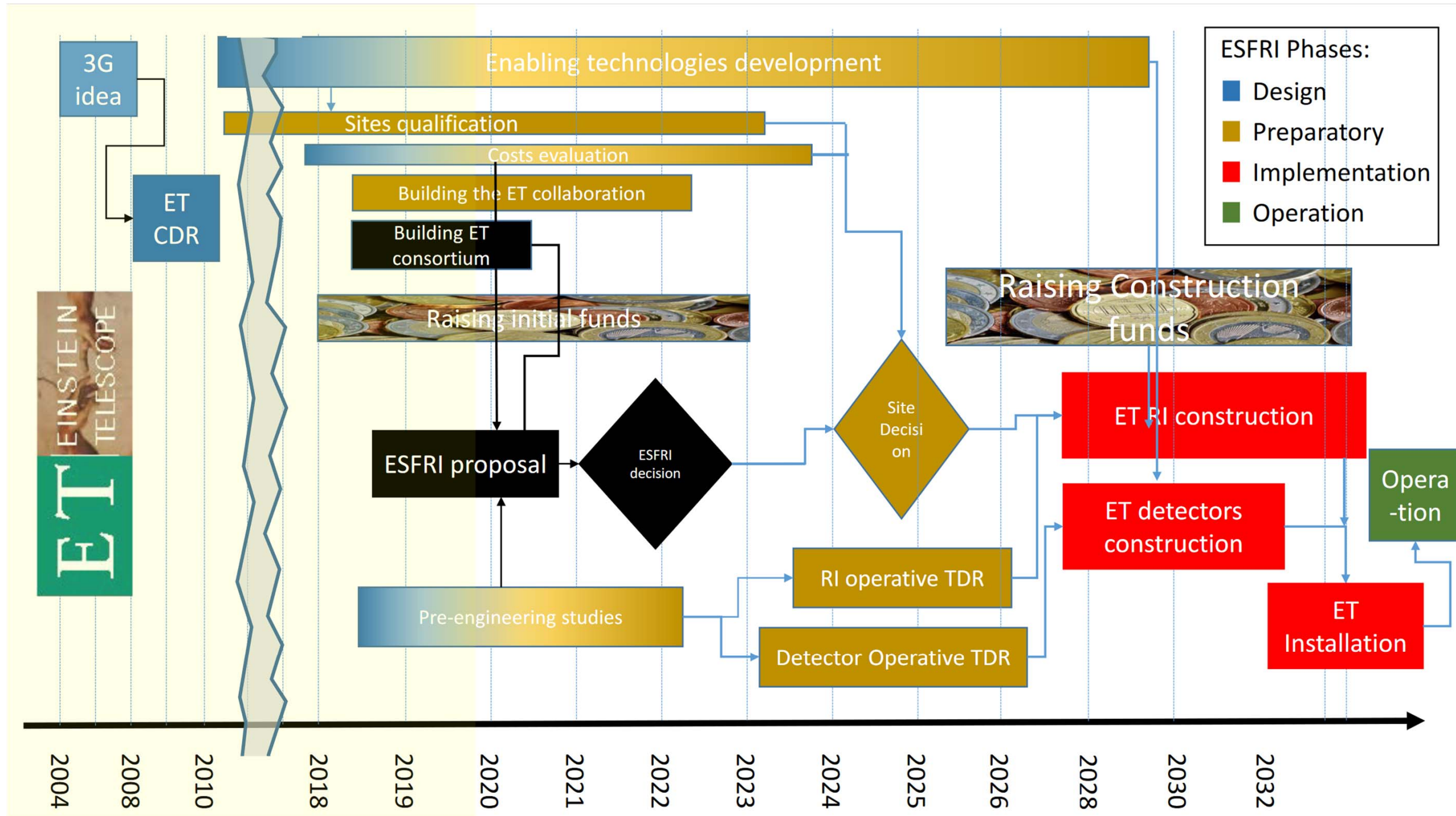


Figure: ET Governance drafted in the ESFRI proposal

Project Timeline



Mandate: <https://apps.et-gw.eu/tds/?content=3&r=17260>

The first objective of the team is to deliver the ET Technical Design Report (ET-TDR) of the infrastructure and of the detectors starting from the ET Conceptual Design Report (ET-CDR).

The ETTDR production will be an iterative process and will go through intermediate steps:

- **Q3 2022: Pre-engineering definition of the Research Infrastructure** (including an updated costs evaluation).
- **Q4 2022: Pre-engineering definition of the detector** (including an updated costs evaluation).

The level of detail of the design must be sufficient to allow the customization of the design for the two different sites, in order to prepare the site bids.

- **Q4 2025: RI operative TDR full engineering** (including costs evaluation).

This activity will probably be transferred to (or shared with) an external company.

- **Q2 2026: Detector operative TDR** (including costs evaluations).

The second objective of the whole team is to identify the missing technologies and suggest a plan for R&D activities. This must be a living plan, regularly updated.

- The first delivering of this plan is expected in **March 2021**.

Mandates

Mandate of the Division Chairs

In collaboration with the Steering Committee and the Work Package chairs, define the structure of the ET-TDR for the infrastructure and the detector, starting from the ET-CDR.

Joint responsibility for the overall design, to be discussed in regular meetings of the instrument science board.

Identify the missing parts/components of the design of the related systems

Allocate their design to the WP chairs, verify the consistency of the design and of the corresponding technical report.

Deliver reliable costs for the systems under design.

Highlight needs for R&D activity.

Coordinate the decision making process to select between alternative design options affecting work packages across divisions.

Mandate of the WP chairs

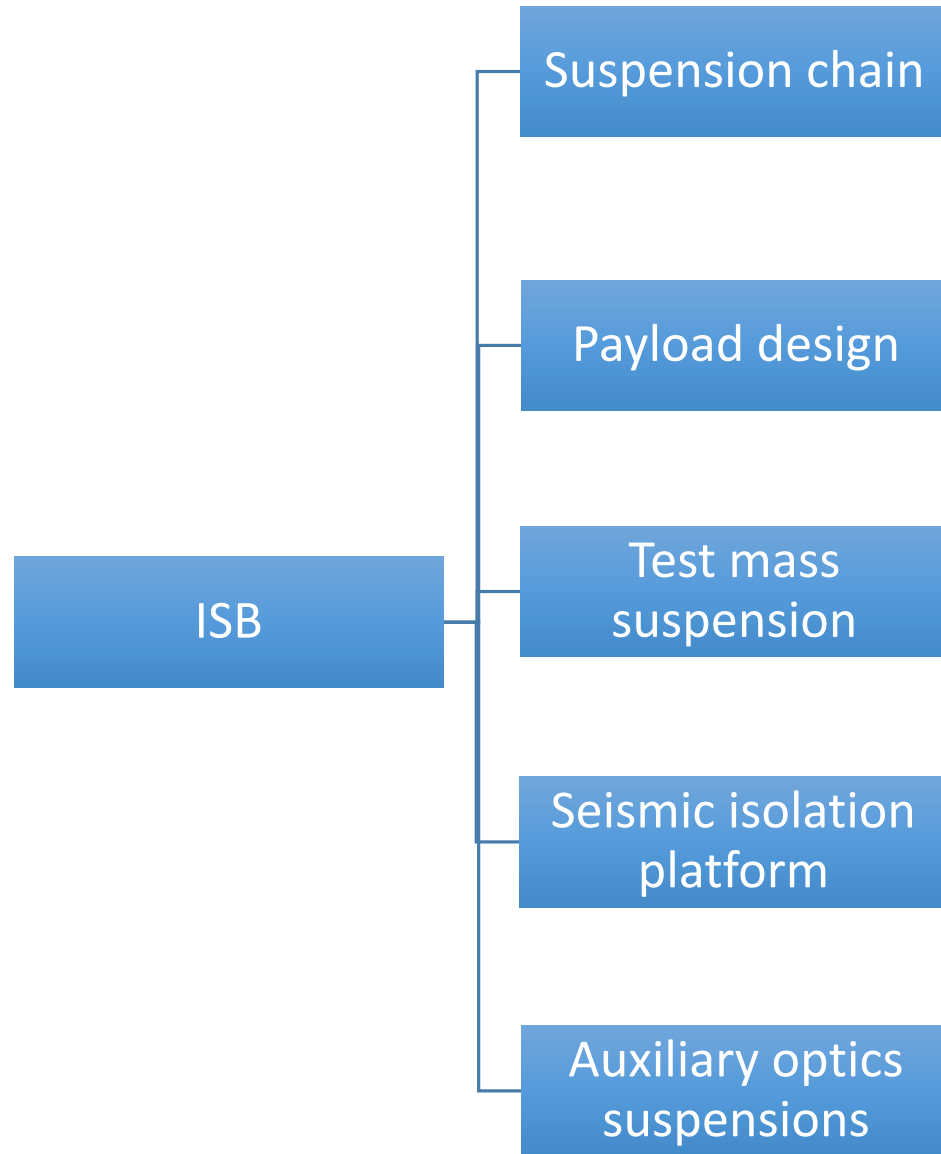
Design each individual subsystem according to the path paved by the ET-CDR and integrate it with updated or new solutions, coherent with the whole design.

Write the ET-TDR according to the structure agreed at project level.

WP chairs, in collaboration with the Division chairs, have to populate the two lower levels of the WBS (tasks and subtasks) identifying them both for the design phase and for the effective implementation phase.

Form if needed, a team of collaborators (tasks and subtasks responsible).

Suspension division organization



Work Package	Chairs	Institution	Country	Expertise
Suspension chain	Roberto Passaquieti	University of Pisa	IT	Seismic isolation expert, Environmental Monitoring subsystem manager in Virgo
	Oliver Gerberding	University of Hamburg	DE	Young researcher with background in LISA interferometry and active in interferometric inertial and position sensing.
Payload design	Paola Puppo	University of Rome, La Sapienza	IT	Expert in low thermal noise engineering design Chair of Parametric instability working group in Virgo.
	Jan Simon Hennig	University of Maastricht	NL	Young researcher with background in optics suspension design and interferometry
Test mass suspensions	Giles Hammond	University of Glasgow	UK	Expert in test mass suspension design and manufacturing. Chair of the LVK suspension working group.
	Flavio Travasso	University of Camerino	IT	Expert in test mass suspension design and manufacturing
Seismic isolation platform	Christophe Collette	University of Liege	BE	Expert in active vibration isolation systems and low frequency inertial sensors
	Alberto Gennai*	INFN Pisa	IT	Expert in seismic isolation systems controls
Auxiliary optics suspensions	Franco Frasconi	INFN Pisa	IT	Expert in seismic isolation
	Joris van Heijningen	University of Louvain	BE	Young researcher with background in seismic isolation systems. Active in low noise inertial sensors development

*Interim until replacement becomes available

Long term archive:

«The TDS» Technical Documentation System

Now called ET Documentation system

<https://apps.et-gw.eu/tds/>

Documents types are

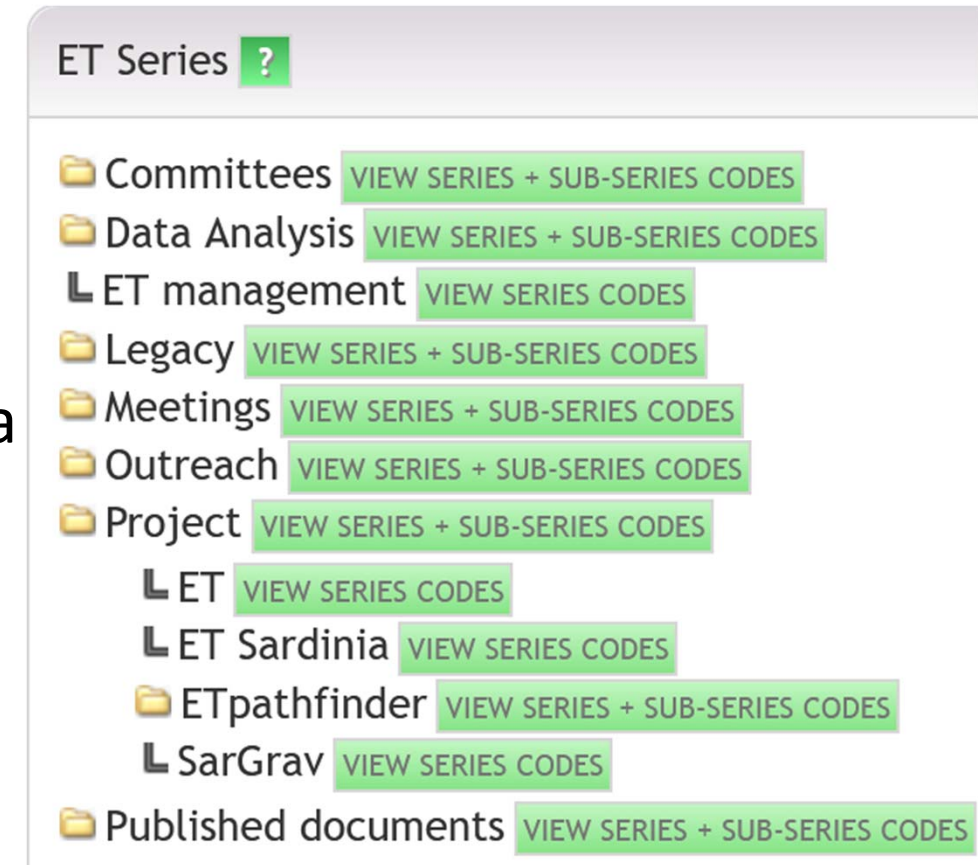
- Design
- Meeting minutes
- Official document
- Presentation
- Published article
- Scientific note
- Technical report

Retrieving documents by series

Document can belong to more than one series

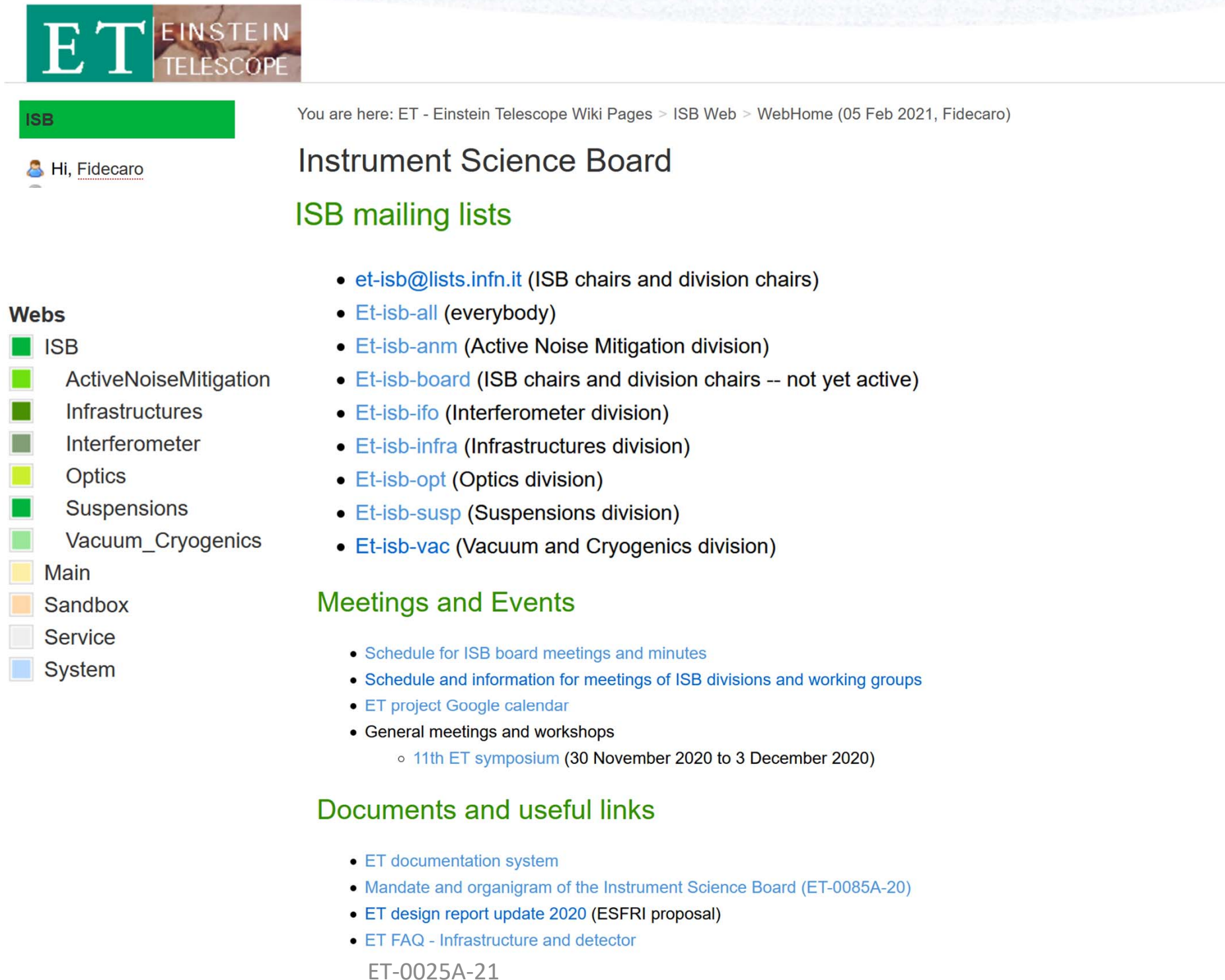
Add Suspensions series

- Mechanics
- Electronics
- Sensors
- Actuators
- Control
- Software and data
- R&D
- Specifications
- Design
- Validation



Wiki for work organization, pointers to documents and utilities

<https://wiki.et-gw.eu/>



The screenshot shows the 'Instrument Science Board' page on the Einstein Telescope Wiki. At the top left is the ET Einstein Telescope logo. Below it is a green bar with 'ISB' and a user profile for 'Fidecaro'. A breadcrumb trail reads: 'You are here: ET - Einstein Telescope Wiki Pages > ISB Web > WebHome (05 Feb 2021, Fidecaro)'. The main heading is 'Instrument Science Board', followed by a sub-heading 'ISB mailing lists'. A list of email lists includes: et-isb@lists.infn.it (ISB chairs and division chairs), Et-isb-all (everybody), Et-isb-anm (Active Noise Mitigation division), Et-isb-board (ISB chairs and division chairs -- not yet active), Et-isb-ifo (Interferometer division), Et-isb-infra (Infrastructures division), Et-isb-opt (Optics division), Et-isb-susp (Suspensions division), and Et-isb-vac (Vacuum and Cryogenics division). Below this is a 'Webs' sidebar with a tree view: ISB (selected), ActiveNoiseMitigation, Infrastructures, Interferometer, Optics, Suspensions, Vacuum_Cryogenics, Main, Sandbox, Service, and System. The 'Meetings and Events' section lists: Schedule for ISB board meetings and minutes, Schedule and information for meetings of ISB divisions and working groups, ET project Google calendar, and General meetings and workshops (including the 11th ET symposium from 30 November 2020 to 3 December 2020). The 'Documents and useful links' section lists: ET documentation system, Mandate and organigram of the Instrument Science Board (ET-0085A-20), ET design report update 2020 (ESFRI proposal), and ET FAQ - Infrastructure and detector (ET-0025A-21).

Gitlab for project versioning, code but not only, issue tracker, etc <https://gitlab.et-gw.eu/>

Slack-like: Mattermost

Web access: https://mattermost.et-gw.eu/signup_user_complete/?id=ssutei7pkjggif5xbim5pjh9ty

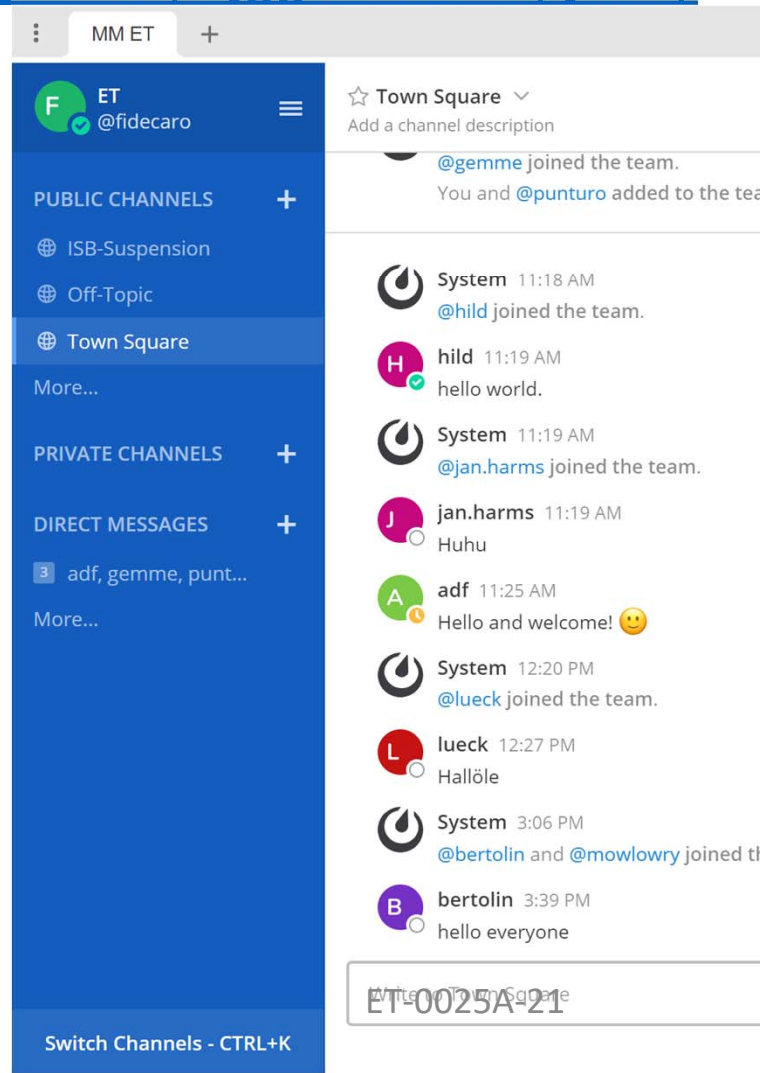
Sign in with Gitlab

Download here

<https://mattermost.org/>

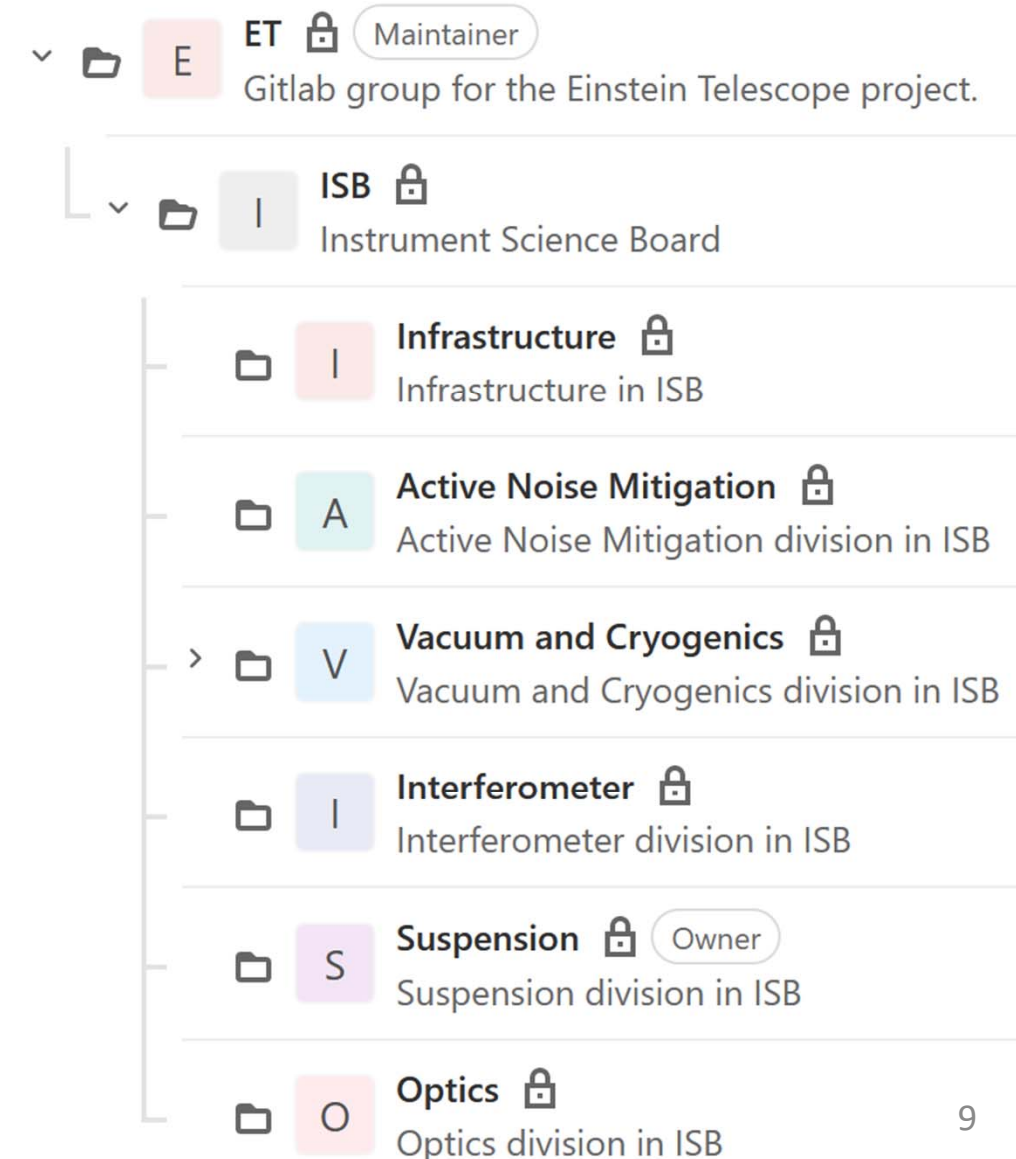
Server

<https://mattermost.et-gw.eu>



Groups

Your groups [Explore public groups](#)



Practical organization Teamwork

Meetings: need to find a good time for everyone for 1 / 2 hours

- Frequency: every two weeks
- Tools for meetings to be defined
- Dedicated workshop will be organized

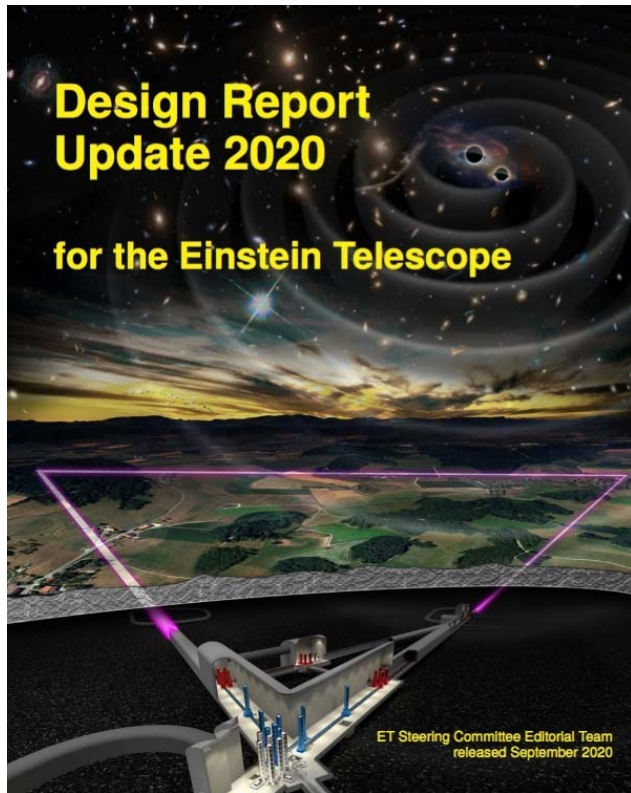
PROPOSALS WELCOME!

Our goal is to build a broad, inclusive and sustainable community for the success of ET!

Work packages

Co-chairs: Francesco Fidecaro, Alessandro Bertolini		WP co-chairs	Focus	Interfaces
WP1	Seismic isolation platform	Collette, Boschi*, Gennai*	mechanical design and design of controls using advanced seismic sensors	suspension chains, inter-platform global controls
WP2	Suspension chain	Passaquieti, Gerberding	design of standard filtering stages, interface stage between chain and payload and local controls for active damping of chain modes	seismic isolation platform, Payload design
WP3	Payload design	Puppo, Hennig	payload thermal noise engineered design for both ET-HF and ET-LF, design of mechanical interface with the cryocooler, design of mechanical interface with the last suspension stage, mirror and marionette local controls	suspension chain, test mass suspension stage, cryogenics, thermal compensation system
WP4	Test mass suspension	Hammond, Travasso	engineering design of fused silica (ET-HF) and crystalline silicon (ET-LF) suspension elements. Bonding technique selections. Manufacturing method selection. Fabrication.	Payload design
WP5	Auxiliary optics suspensions	Frasconi, van Heijningen	mechanical design of suspensions for IMC, optical benches, filter cavities mirrors, etc.	inter-platform global controls, interferometer global controls, scattered light mitigation

Defining a short list of urgent questions to be addressed/discussed in the first ET-ISB workshop



‘light’ means not radical changes; need to add/clarify what is missing for cost estimate and site selection by mid-2022

Light technical design

For developing the light technical design the following issues are a priority:

- **Cryo-payload conceptual scheme** We need to update the thermal noise model reconsidering the vertical dof contributions from both the test mass bouncing mode and the last seismic isolation stage. We should end up with a more refined and realistic conceptual design specifying: number of cryogenic suspension stages, need of vertical crystalline suspension elements, need of a cold vertical seismic isolation stage etc. Is a reaction chain needed? Choices made will have a direct impact on the cryogenic plant design, e.g. size of the cryostats, and then heat load etc.
- **Auxiliary suspensions** inventory of auxiliary optics and in-vacuum optical benches with corresponding in-band and RMS residual motion requirements is needed to proceed to conceptual design and cost estimate.

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Urgent questions

Defining a short list of urgent questions to be addressed/discussed in the first ET-ISB workshop

Longer term crucial aspects to be addressed in preparation of the Technical Design Report

Urgent questions

Before the complete design document we must address urgent issues following from the current design, for example:

- **Crystalline suspension stage for ET-LF** No production method and marionette/mirror interface design have been identified or selected. An intense R&D campaign is mandatory to inform the TDR.
- **Seismic attenuation platform** Combining the standard Virgo inverted pendulum scheme with a 6 DoF active isolation stage should be very beneficial in terms of residual RMS motion of the test masses and should allow reducing the size of the long attenuation chains. The new concept must be validated with extensive modeling and experimental investigation.
- **Low noise sensors** ET test masses residual motion requirements call for better sensors than those used in current detectors. Noise and dynamic range of inertial and displacement sensors should be specified by means of detailed simulations. Solutions should then be identified among the R&D programs currently ongoing, and by promoting new R&D initiatives.

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Urgent questions

Defining a short list of urgent questions to be addressed/discussed in the first ET-ISB workshop

Collecting ideas
for far future...

Research and development

In addition to the ET design effort, we will discuss and promote R+D for improved detectors, for example for future ET upgrades. The scope of this division includes work on:

- R&D activities will be promoted in the areas where requirements or specifications could not be met successfully in the initial ET implementation.
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- ?

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