ET-PP_INFRA-DEV_Annual_Meeting

Towards an engagement plan

WP7.2 Status of Activities

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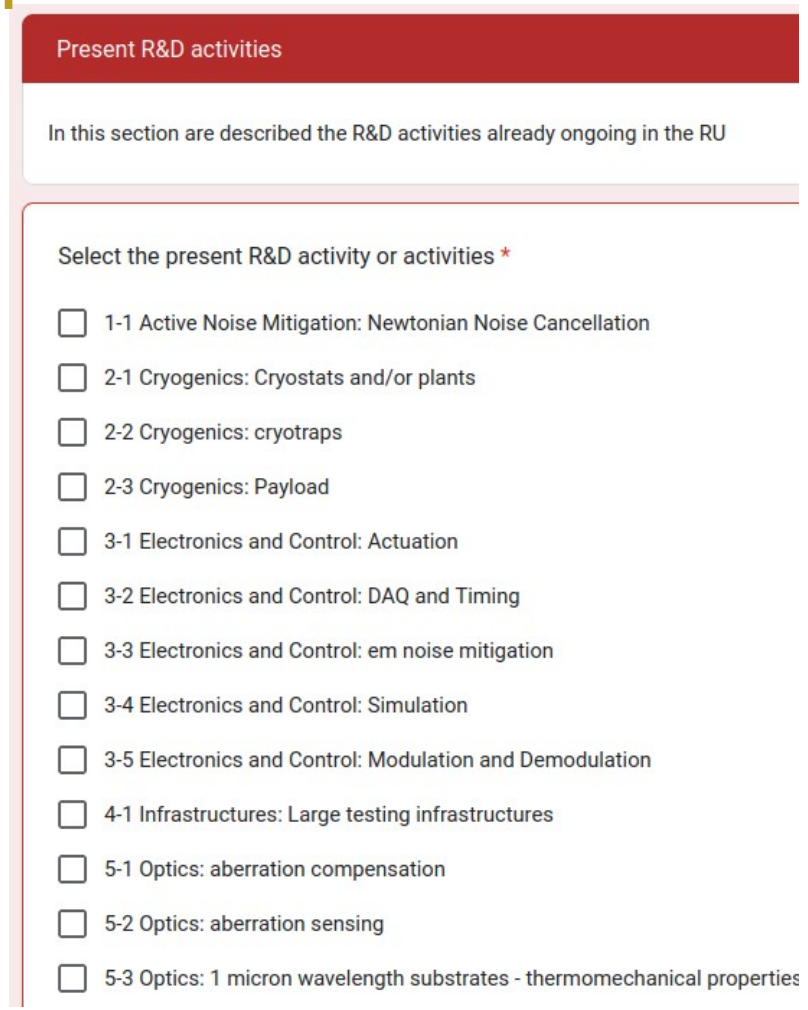
WP7.2: Towards an engagement plan

On the Collaboration side, a questionnaire will be issued this month for a survey of R&D activities in the different research units

- Survey on the present and future R&D activities in ET
  - R&D activities already ongoing in the RU
  - Future R&D
  - Maily collect information on founds and budgets



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Questions on industrial involvement have been added to the questionnaire in order to elaborate the gap analysis

- Present and future R&D activities - Industrial Engagement
  - Companies already engaged in the R&D activities
  - How important is to find other new industrial partners
  - Current ad future Technology Readiness Levels (TRL) of the R&D activities

Which companies are already engaged in the related R&D activities?
Please report the code of the R&D activity and possible specific associated technologies.
[e.g.: 10-3 - **Company1(UHV), Company2(Getter)**]

Your answer

- TRL 1 – basic principles observed
- TRL 2 – technology concept formulated
- TRL 3 – experimental proof of concept
- TRL 4 – technology validated in lab
- TRL 5 – technology validated in relevant environment (industrially relevant environment in the case of key enabling technologies)
- TRL 6 – technology demonstrated in relevant environment (industrially relevant environment in the case of key enabling technologies)
- TRL 7 – system prototype demonstration in operational environment
- TRL 8 – system complete and qualified
- TRL 9 – actual system proven in operational environment (competitive manufacturing in the case of key enabling technologies; or in space)

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- From the gap analysis, we create a plan for the coming years of the most effective engagement actions for each technological sector

- The Vacuum technological sector is used as a case study

WP7.2: Engagement plan

Structure of the document

1- Overview

The ET-PP project's industry engagement plan will be in place during the next 36 months of the project

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Structure of the document

2- Effective engagement actions

Some of the most effective actions to be used to identify companies that can collaborate on R&D activities for the ET project include:

- Mapping of the industrial landscape and scouting for interested companies
  - Face to face interaction with industry: interviews and visits to companies
- Industrial portal (a reference site for European industries with opportunities, events, etc.)
- Industrial surveys
- Funding instruments
- Event:
  - Big general events involving all the technological sectors
  - Technical events, such as thematic workshops for each technological sector or visits to Research Institutions (Ris)
  - Webinar

WP7.2: Engagement plan

Structure of the document

2- Effective engagement actions

A survey was sent out to the Industrial Liaison Officers (ILOs) of the different RIs they cover with the purpose of (see Task7.2-ILO_Questionnaire_report):

- To understand how ILOs in Europe engage with their industries in the R&D and C&O phases.
- To determine the tools that they make use of, and which ones work best.
- To learn about the degree of knowledge their industries have about the Einstein Telescope.
- To collect their views about the different initiatives which could be included in the ET-PP engagement plan.

  Moreover, they were asked what initiatives could be implemented at a European level in the ET industry engagement plan.

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3- Industrial gap analysis

- The objective of the gap analysis is to highlight any lack of technological readiness and industrial capabilities and competitiveness necessary for the ET project in the R&D and in the C&O phase.
- This analysis is here used to make clear which promotional initiatives and R&D collaborations with industry could be most useful to fill the possible gaps (engagement plan).
- Information to build the analysis are collected mainly through questionnaires and interviews with experts connected to the ET-PP project.

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3.1- Vacuum

1. Material and permeation/diffusion of hydrogen in steel
2. Internal coatings for water and bakeout
3. Structural design
4. Ion and getter pumps
5. Pipe production - welding – logistics
6. Metal cleaning systems
7. Quality control assessment (steel, welding, contamination)

For the vacuum sector, the most critical challenges include:

1. Material and permeation/diffusion of hydrogen in steel considering:
   Since the future Einstein Telescope needs a huge UHV vacuum system installed underground, mild steel could be used as an alternative to the stainless steel to reduce costs. One possibility is the use of ferritic stainless steel (AISI 400 series). Such steel has a low solubility and high diffusivity of hydrogen, which therefore escapes during cooling.
   - Hydrogen outgassing measurements: companies are engaged informally and effective engagement actions consist in directly contacting companies deemed interesting and further mapping of industrial landscape.
   - Pipe corrosion: outer anti-corrosion coatings. No companies already engaged.
2. Internal coatings for water and bakeout:
   One important aspect to consider is the minimization of water absorption of steel during exposure to air.
   - Vacuum pipe internal coating and water adsorption: the companies SAES is already engaged and involved in an activity to increase the pumping speed in the bakeout.
3. Structural design:
   In order to reduce the mass and cost of the structure, wall reinforcements or corrugated tubes could be used.
   - Construction of vacuum chambers using corrugated tube: there is an urgent need to find companies capable of producing this type of artefact.
4. Ion and getter pumps:
   A substantial R&D phase is expected for the design of the UHV pumps for ET evaluating the possibility of their positioning inside the tunnels.
   - Vacuum pumps engineering: Minimize the volume of the pumps. Research on getter material and pumping schemes. Companies already engaged are Saes and Agilent and there is the need of further industrial partners. Events could be the most effective promote actions.

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3.1- Vacuum

All this information is given in full in the document vacuum_challenges.pdf

5 Ion and getter pumps

The pumping system will consist of 240 pumping stations (5000 l/s effective rate) with 480 valves (DN250). To section the 10 km pipe of each interferometer arm into at least three segments (two at the end and one in the middle) and to be able to isolate the cryogenic traps at the ends of each arm, 72 DN1000 valves are required. The pressure measurement system involves approximately 200 RGAs (Residual Gas Analysis) and about 1000 gauges.
NEG pumps have large pumping capacities for H2 and H2O and are suitable for the steady-state operation. Auxiliary ion pumps should be installed to pump traces of noble gasses and methane. A substantial R&D phase is expected for the design of the UHV pumps for ET evaluating the possibility of their positioning inside the tunnels. Minimising or eliminating the volume of pumps by integrating getter materials into the pipe would allow the elimination of external appendages requiring only the passage of the power supply. The company involved in this application is SAES. For ion pump size reduction, the company involved is Agilent.

5.1 R&D issues for vacuum pumps

Vacuum pumps engineering

R&D ongoing	Minimize or cancel the volume of the pumps. Getter material and pumping schemes. investigations by CERN and KIT.
Companies already engaged:	Saes, Agilent
Other known partners to be engaged:	
Need of further industrial partners:	Yes
Effective promote actions:	Events

5.2 Production issues for vacuum pumps

Vacuum valves

Production issues	Yes. High vacuum valves cost 200K Euros.
Known suppliers	VAT

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4- Specific requirements

Take into account the duration for the ET-PP project, engagement actions should start very soon, hypothetically from September 2023 for the other 3 years of the project.

4.1- Vacuum

Agreement INFN - Nikhef - CERN on beam pipes with the objective of

- manufacturing, assembling and testing a pilot sector (on the Virgo baseline)
- writing the technical design report including cost estimations

➢ Engagement actions shall be expected to be taken relatively soon for this sector.

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4.1- Vacuum

- For what concern the construction of the vacuum chamber, in order to reduce the mass and cost of the structure, it is proposed to use the material in thin sheets a few millimetres thick with wall reinforcements or in the form of corrugated tubes, a sort of large bellows (see gap analysis).
- In this case, it is proposed to start in September with the mapping of the industrial landscape and the scouting for interested companies.

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5- Action plan

The action plan describes:

- Time for broad spectrum engagement activities (Big general events, ...)
- Time for targeted actions (mapping, workshops, ...)
- Prevision costs
- Schedule of engagement activities during the remaining time of the ET-PP project (still three years) is presented in the form of a Gantt chart

Vacuum

Project Start: ven, 9/1/2023

Display Week: 1

ago 28, 2023 | set 4, 2023 | set 11, 2023 | set 18, 2023 | set 25, 2023 | ott 2, 2023 | ott 9, 2023 | ott 16, 2023

TASK	ASSIGNED TO	PROGRESS	START	END
Structural design				
Corrugated tubes - mapping of the industrial landscape		15%	9/1/23	9/16/23
Corrugated tubes - scouting for interested companies		10%	9/16/23	10/1/23

Thank you