Advanced Mechanics and Materials for Detectors and Accelerators – Co-Innovation (AMMDA-CI)

31 March 2020

HELSINKI INSTITUTE OF PHYSICS

UNIVERSITY OF HELSINKI

CERN

Introduction

- AMMDA-CI is a co-innovation proposal as a followup of the AMMDA co-creation project started in 05/2019
- AMMDA-CI is a 2 year research project including 5 academia and 5 industry partners with an overall volume of approx. 3m Euros (approx. 70% funded by Business Finland)
- It contains 5 industry projects, 4 supporting academia research workpackages and one pure research work package
- Every partner has to make an online application – there is a joint action plan (20 pages)

Goals of AMMDA-CI

- Clear synergy between some of the needs for the future detector mechanics and the future colliders such as CLIC.
  - low mass mechanics
  - ultra-high precision machining and assembly
  - novel materials and their related manufacturing technologies
- These needs require academia work together with industry in order to develop and validate materials and/or manufacturing methods.
- AMMDA-CI is the first research project by F3ME following the co-creation project AMMDA

F3ME

Finnish Materials, Mechanics & Manufacturing Ecosystem for Big Science projects

- Framework organization for planning and executing industry activation projects (e.g. AMMDA-CI and followups)
- Situated within Helsinki Institute of Physics (HIP) technology programme under Accelerator Technology Project

=> Easy access to academia partners within HIP

Structure of AMMDA-CI

WP1: Project coordination

WP2: Macro composite printing

WP3: Extreme straigthness metrology device for composite profile protrusion

WP4: Ultra high precision manufacturing

WP5: Metal hybrid manufacturing

WP6: CERN collaboration impact for Finnish SMEs

WP1 Project coordination

- WP leader UH
- Organize central events such as Kick-off, mid-term and final workshop
- Coordination of budget and reporting
- Actively conduct dissemination of public results.
- Assist companies with their individual projects and providing linking between the industry projects and the relevant academia work packages as well as CERN.
- Analyse relevant collaboration opportunities with other mechanics and materials field projects at and related to CERN.

WP2 Macro composite printing

- WP leader: UH
- Industrial partners: 3Dstep, Origo enineering and Exel
- Academia partners: UH and Aalto University
- 3Dstep develops composite printing technology based on robotic arms (opens up possibilities in multi embedded component printing and printing on top of existing structures of any dimension)
  - Researching of compatible radiation hard materials
  - Researching of printing on / repairing components
- One hot topic is biocomposites such as wood

WP3 Extreme straigthness metrology device for composite profile protrusion

- WP leader: Mikes
- Industrial partners: Exel
- Academia partners: UH and Mikes
- Future HEP detectors will face challenges of extreme precision and stiffness combined with minimal material budget. Extreme straight profiles are currently used and performance is limited by what precision industry is able to manufacture.
- Exel composites already manufactured profiles for CMS and is in the reace for the manufacturing the profiles for the upgrade.
- The task is to develop a metrological system for process optimisation allowing for protruding of long profles with 10 um accuracy over 3 m

WP4 Ultra high precision manufacturing

- WP leader: Karelia University of Applied Science
- Industrial partners: TH tools and Huawei
- Academia partners: UH and Mikes
- TH Tools is interested in adding ultra-high precision manufacturing capabilities to their portfolio and are ready to invest in a new manufacturing line. Karelia University is the only entity in Finland possessing a machine with the required capabilities and they previously conducted extensive research in this field.
- Huawei is specifically interested in optically transparent materials for their camera development
- Research in order to further enhance the (optical) surface quality of resulting parts could be achieved through advance surface treatments and polishing methods. New and emerging options include: Magnetorheological finishing (MRF), Fluid Jet finishing, Plasma treatment or femto second lasering.

WP5 Metal hybrid manufacturing

- WP leader: Aalto University
- Industrial partners: Premetec and Origo Engineering
- Academia partners: UH, University of Oulu and Aalto university
- Premetec wants to explore the possibilities of 3D priting in their manufacturing workflow
- The objective of WP5 is to identify and strengthen the benefits of an industrial hybrid manufacturing methodology including subtractive as well as additive manufacturing (AM) techniques combined in metal manufacturing and tool making.
- Advanced manufacturing and optimisation of processes
- Metal printing on / repairing existing components

WP6 CERN collaboration impact for Finnish SMEs

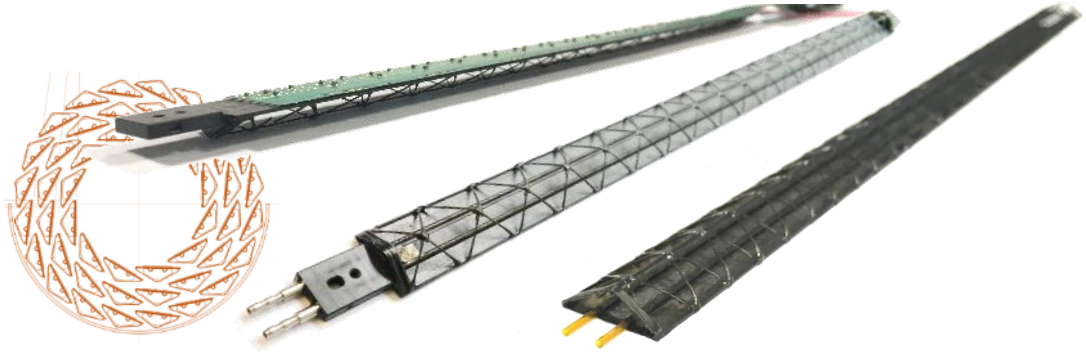
- WP leader UH
- Goal: Analyse and improve the collaboration and industrial return for SMEs stemming from national participation in CERN research and development activities.
- Although preliminary research has been conducted in the past few years on how different collaboration platforms, e.g. the CERN Open Hardware License would foster this kind of approach no standard indicators are in use
- How CERN or other BS projects could improve their attractivity in industries eyes?
- What is the role of public funding in industrial activation in BS projects?
- Industrial motivation and limiting factors, questionnaire and interview surveys.

AMMDA-CI schedule

- Final draft review by Business Finland is ongoing – Feedback coming Friday
- Submission (hopefully) of ALL partners before easter
- Minimum of 8 weeks for evaluation of proposal
- Project start possibly in August or September
- Project duration 24 months

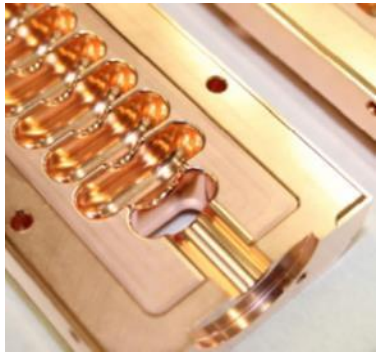
Extra slides

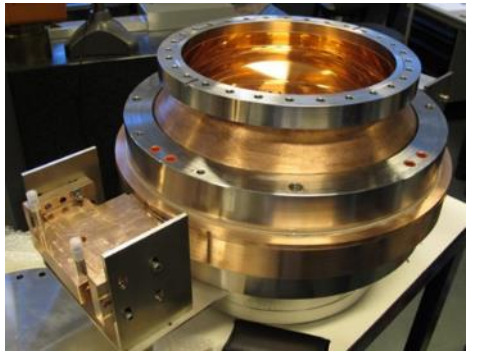
Technology: Detectors



- Detectors for High Energy Physics face constantly technological challenges on their track to meet unprecedented precision requirements at ever-growing measurement event rates.
- For the mechanics, this translates into competing requirements on minimum space use, complex geometries, low mass, precise operating temperature, high precision and high stability
- CERN seeks to stay at the forefront of key technologies enabling new detector projects by launching dedicated R&D studies and fostering external collaboration.
- CERN is also seeking for collaborations for its next major R&D programs on experimental technologies for particle detectors (https://ep-dep.web.cern.ch/rd-experimental-technologies).

Technology: Accelerators





- The **C**ompact **LI**near **C**ollider (CLIC) is in a phase of industrializing their main components, such as the accelerating structures and related RF components
- Focus of the pure R&D aspect of the project is shifting more and more towards building up industrial collaborations and probing for manufacturing capabilities within industry
- CLIC represents a clear need for R&D in the area of Ultra-high precision manufacturing for particle accelerator technology. This implies novel machining technologies, assembly and joining technologies as well as related material technology
- http://clic-study.web.cern.ch/