



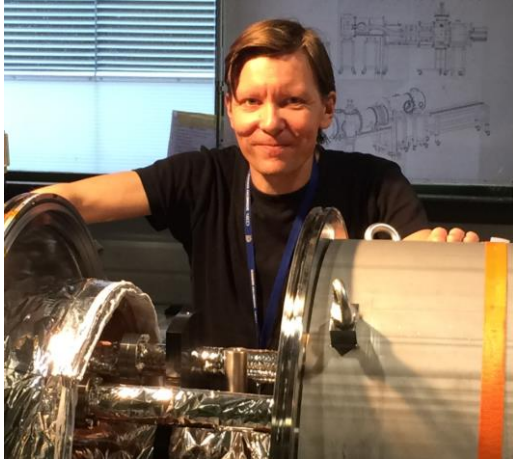
# Mechanical engineering of accelerator components

Antti Kolehmainen EN-MME  
Mikko Barinoff EP-DT  
Taneli Mutanen TE-MSc

Finnish High-School Students visits program

# WHO WE ARE

**Antti**



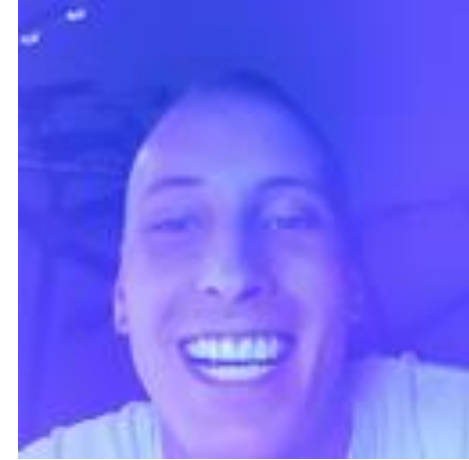
- Mechanical designer in Engineering Department
- BSc in engineering 2004, Jyväskylä
- CERN since 2012
- 10 years in industry prior to CERN

**Mikko**

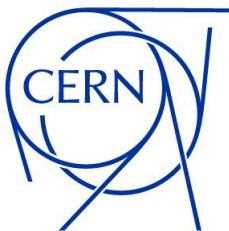


- Mechanical engineer in the Experimental Physics department
- MSc in mechanical engineering 2021, Aalto university
- At CERN since 2019

**Taneli**



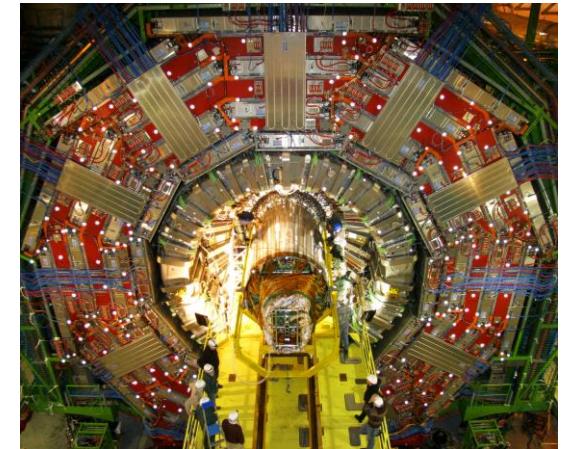
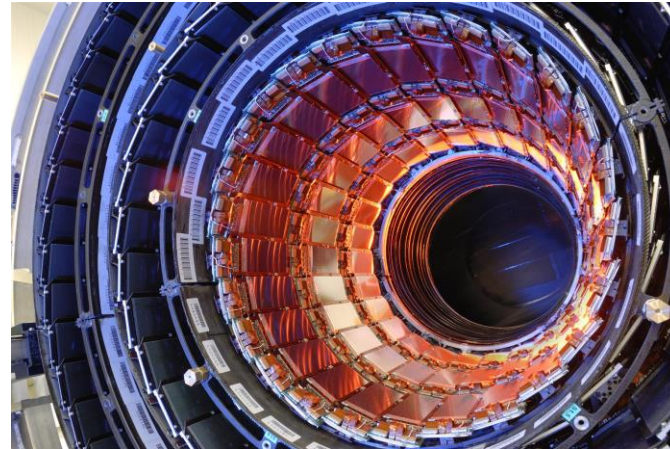
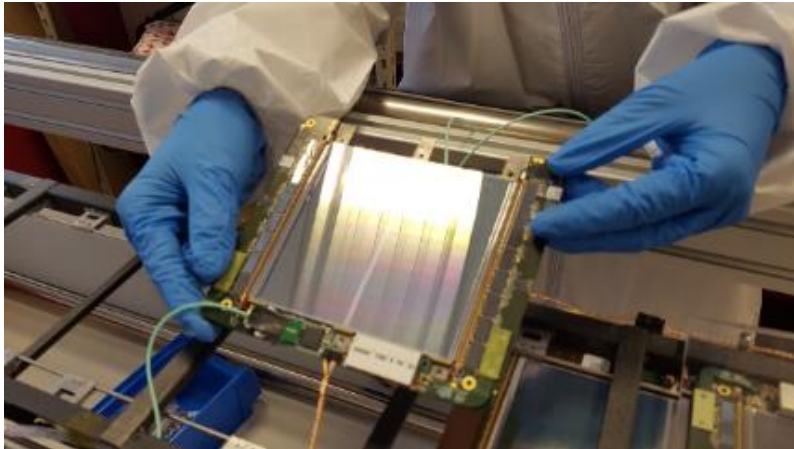
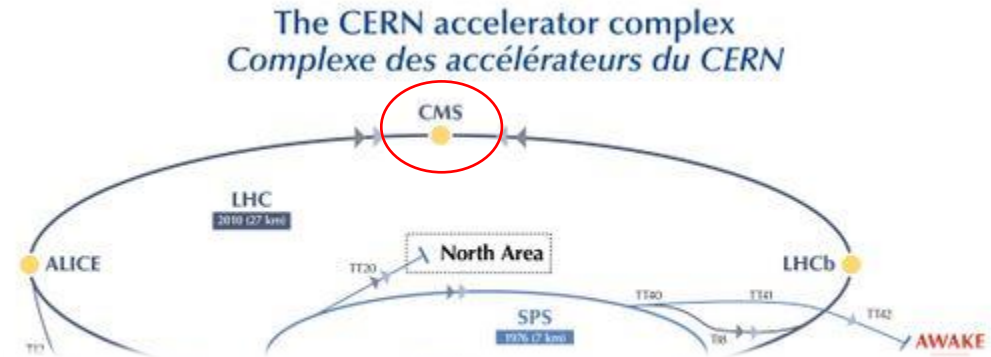
- Micromechanic in the Technology Department
- Micromechanics 2021, Finnish School Of Watchmaking
- At CERN since 2022



# WHAT WE DO?

## Mikko

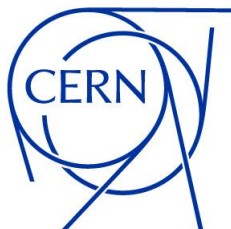
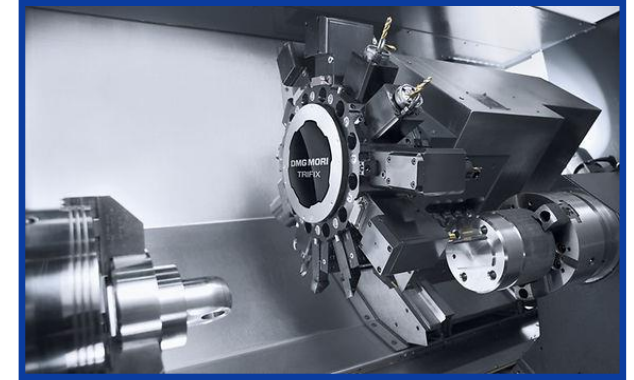
- Mechanical design & construction work for the Phase-2 upgrade of the CMS Tracker
- Tasks vary from high precision micromechanics to heavy handling equipment



# WHAT WE DO?

## Taneli

- Manufacturing of prototype components for superconductive accelerator magnets and other projects
- TE-MS-C-specialist in machining
- Programming and operating computer programmable manufacturing robots
- Manufacturing related consultation to help engineers and designers
- 2D&3D Mechanical design of components

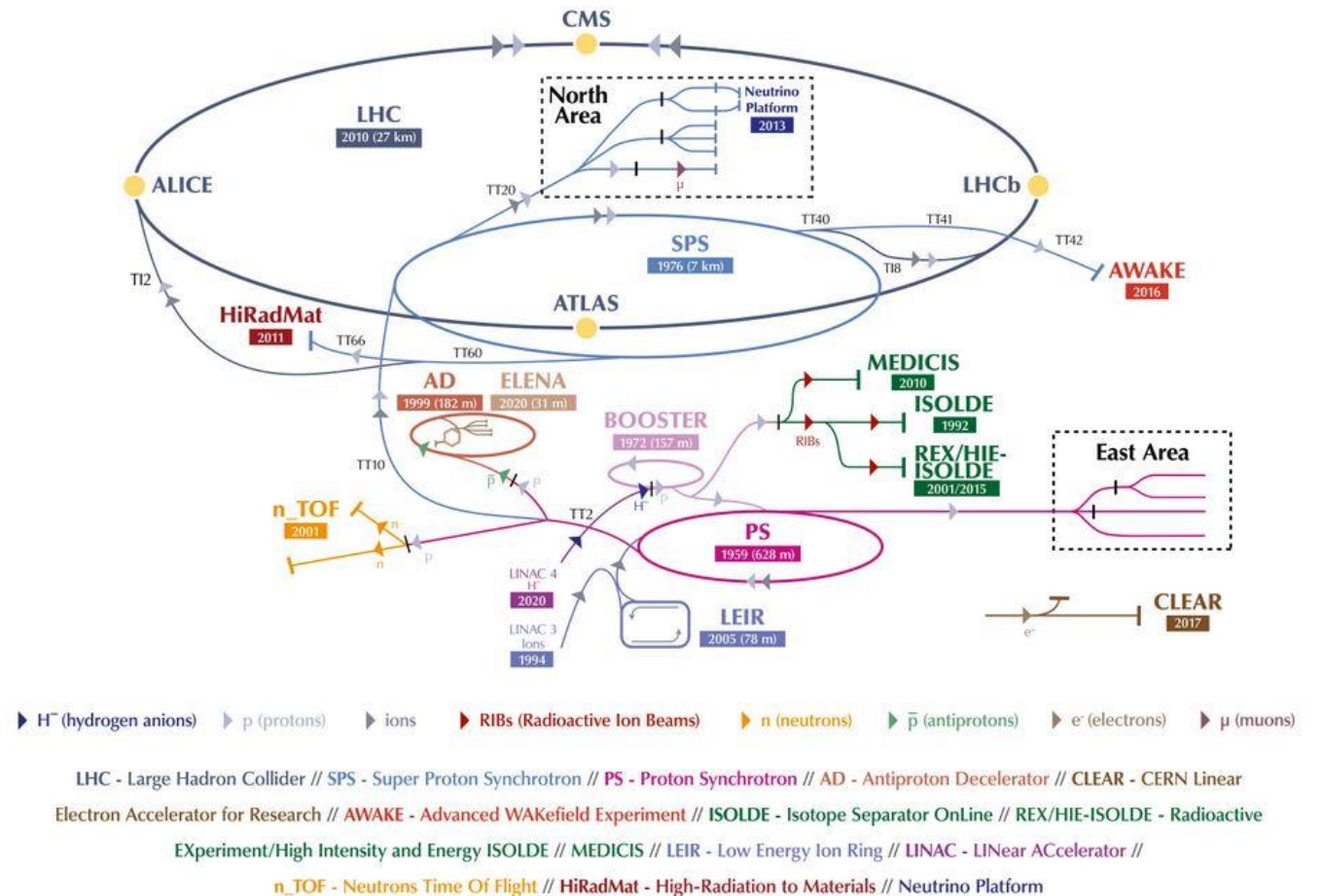


# WHAT WE DO?

## Antti

- Mechanical design of components for the accelerator complex
- EN-MME – specialist in mechanical engineering supporting other groups
- Small tasks
- Larger design projects
- 3D & 2D
- Calculations
- Fabrication follow-up
- Installation
- Pre-studies for future accelerators

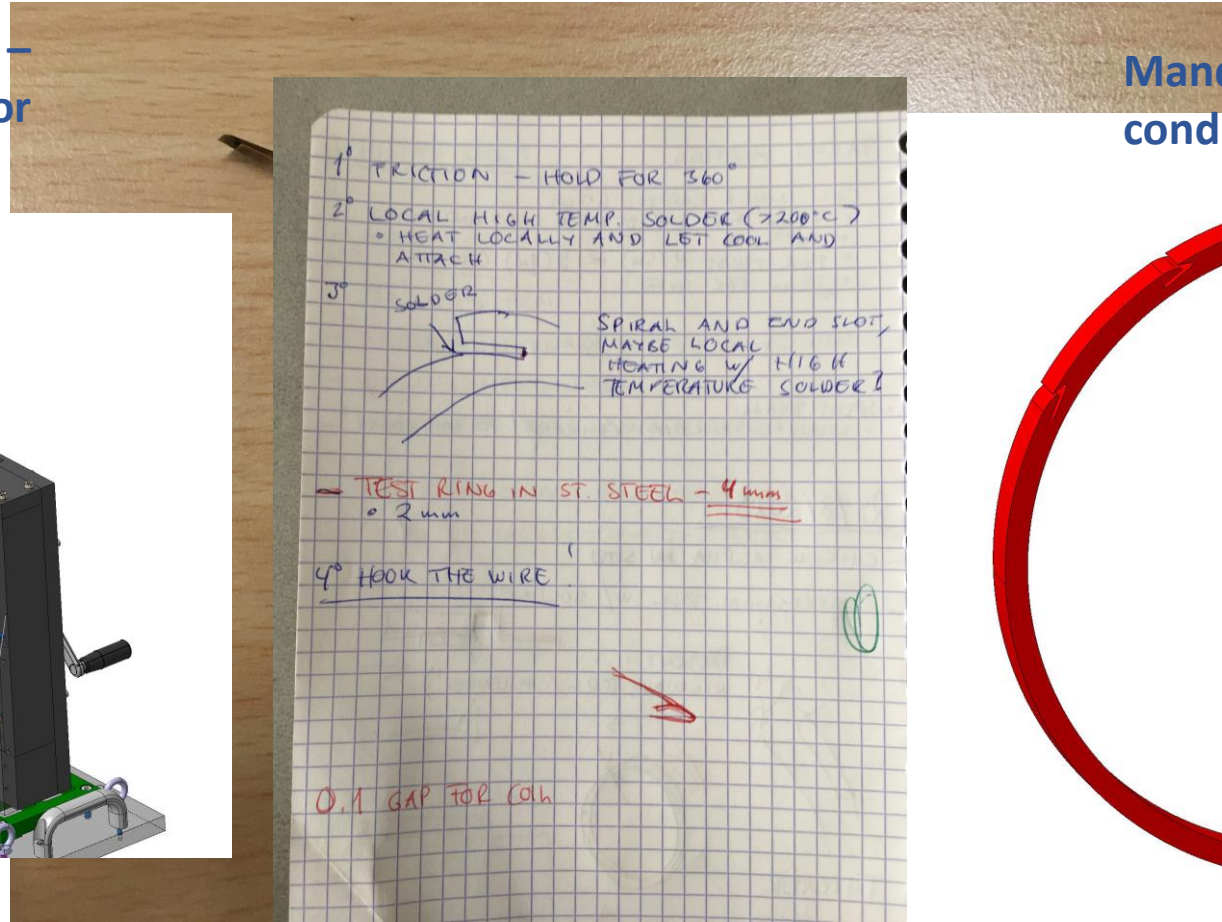
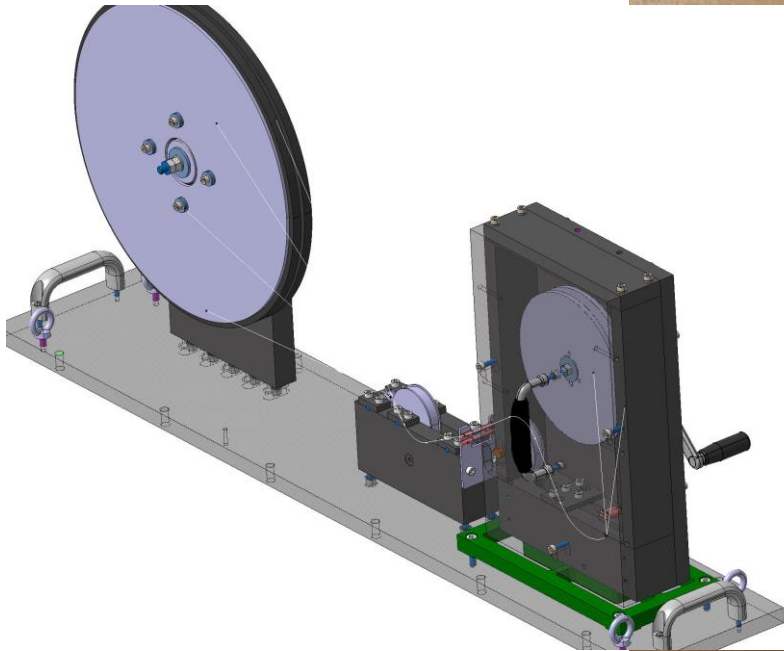
The CERN accelerator complex  
*Complexe des accélérateurs du CERN*



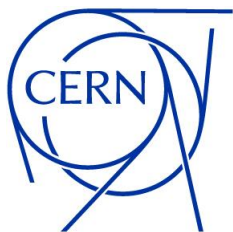
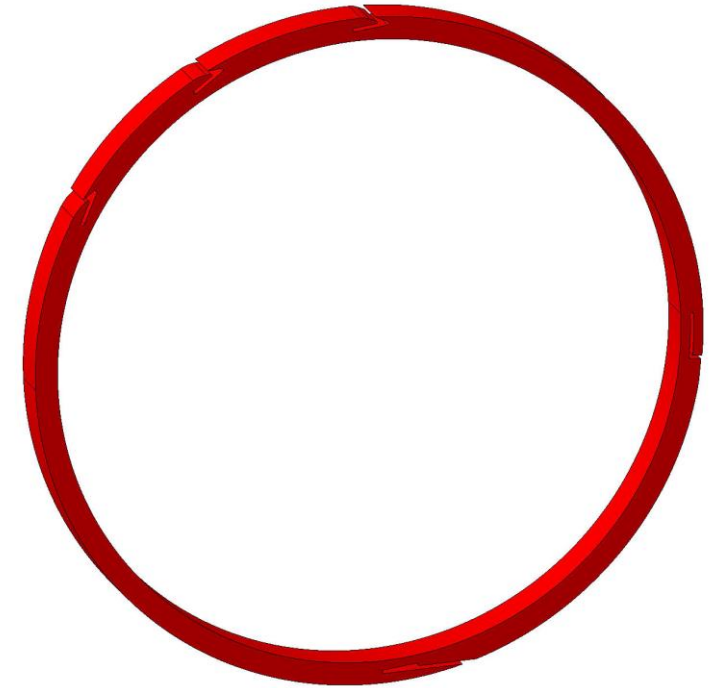
# DESIGN ENGINEERING

## Small tasks

Pancake coil winding tool –  
how to attached conductor  
rapidly?



Mandrel to test coil  
conductor attaching



*Context*

*Discussion -> notes*

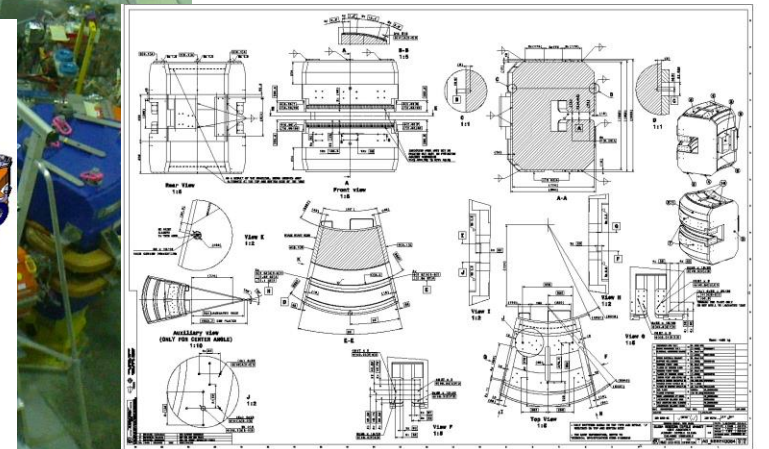
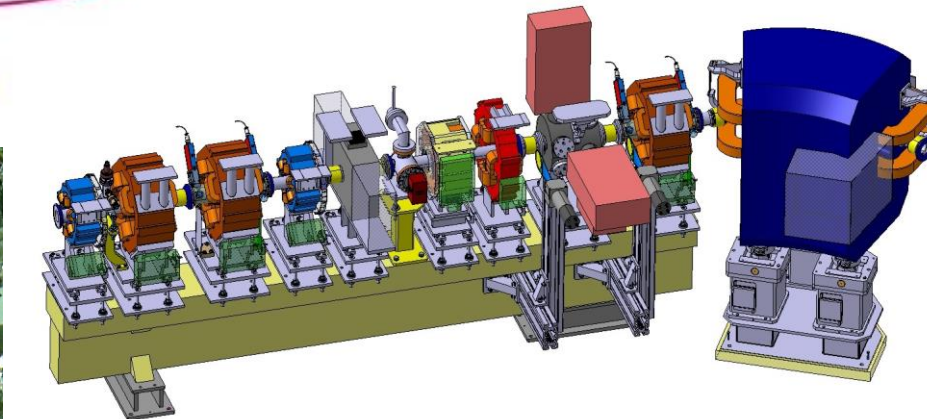
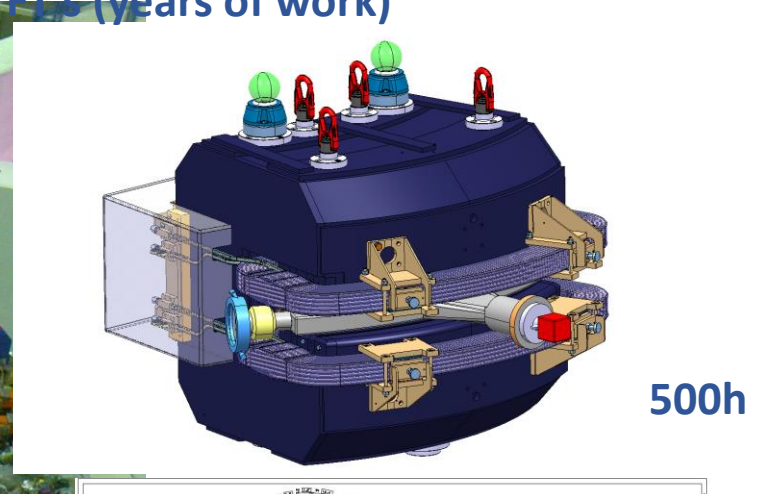
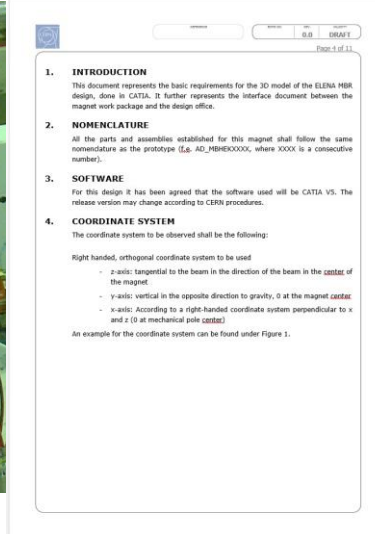
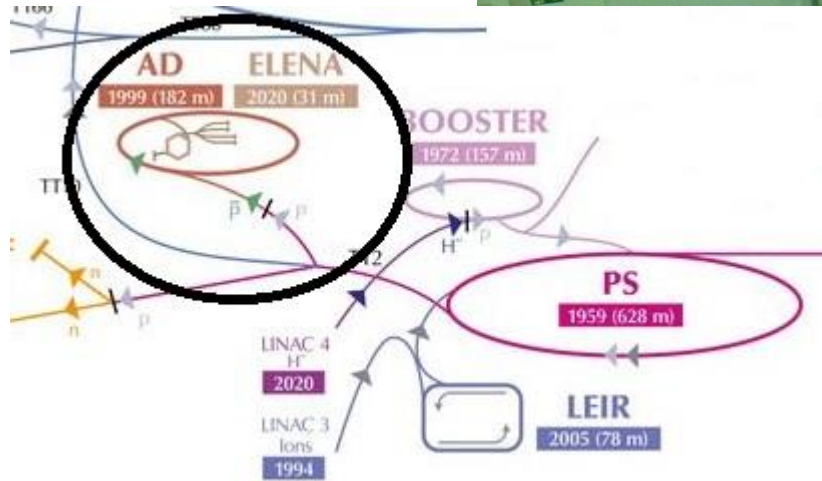
*Two hours to release for production*

# DESIGN ENGINEERING

## Large projects

Improve antimatter research by better antiproton capture – new decelerator ELENA

Design of ELENA machine components  
15 FT's (years of work)

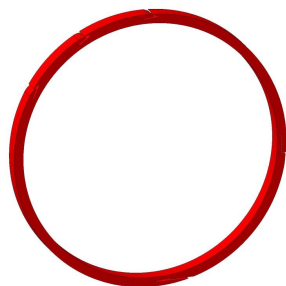
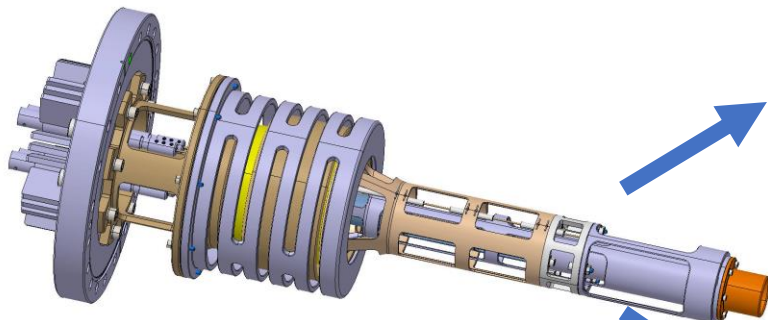
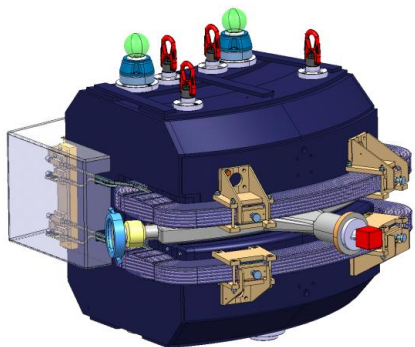


Context

Specifications, simplified models, schedules

3D models, manufacturing drawings, calculations, instructions...

# PRODUCTION



## Production outside CERN

- Specialist manufacturing
- Capacity
- Specific technologies

- Specifications
- Tendering
- Committees
- Signed contract

## Production at CERN workshop

- Follow-up of all steps
- Technology mastered by CERN
- Available capacity
- Rapid delivery

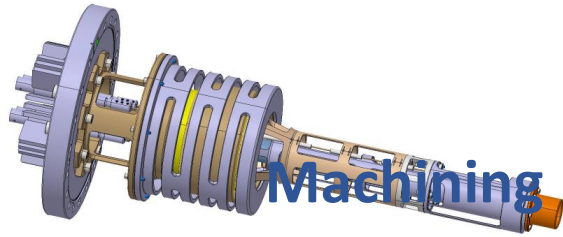
- Job request
- Documents(drawing)
- Budget





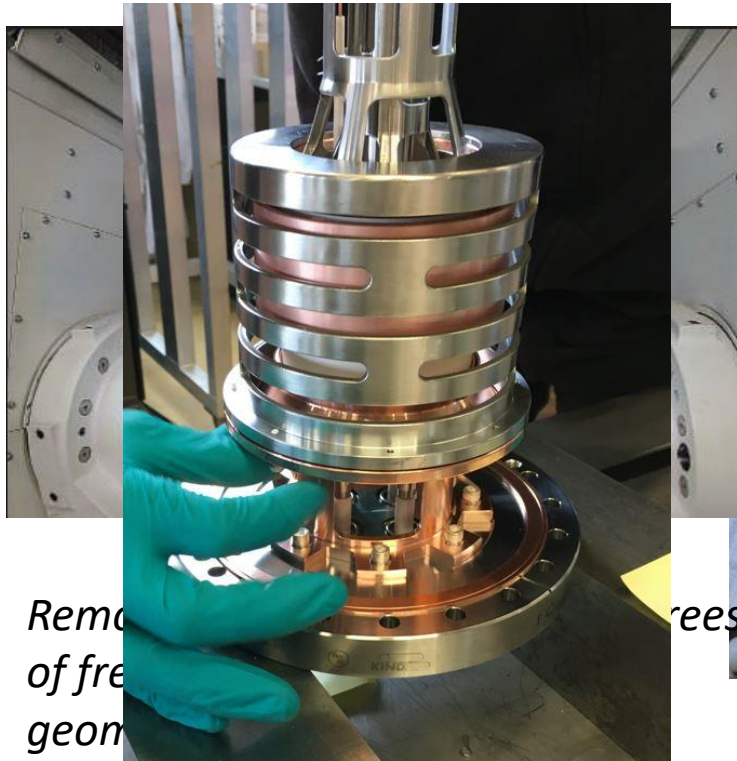
Electron gun to produce electron beam

# PRODUCTION



Joining

Forming



Removal of fre...  
geom...



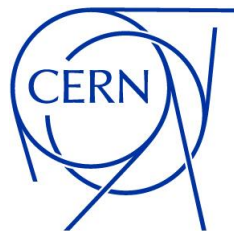
Welding – melt pieces locally to join them

Brazing – melt material between pieces to join them

Bonding – adhesive for different materials



Roll, bend, stamp, draw sheets



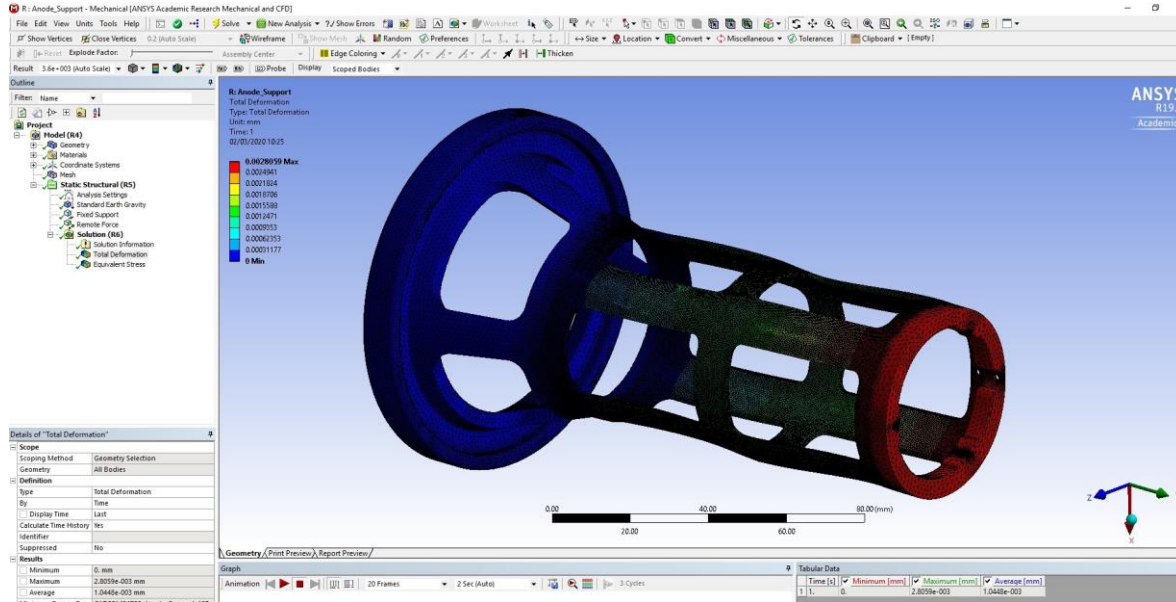
**Also subcontracting and assembly in clean room!**

# SERVICES

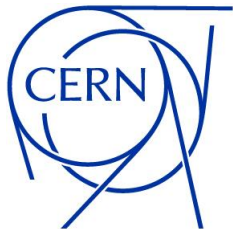
## EN-MME Group

### Calculations

*To guarantee safe operations over the component lifetime*



- *Safe (working) environment*
- *Material loss*
- *Calculation confirmed requirements must be followed in practice!*



### Measurements

*To proof required quality*



- *Geometry*
- *Raw material*
- *Mechanical measurements of produced components*

# EDUCATION & PR

## CERN – Lapin AMK collaboration

Until 2025 for now

2023: Timo

2019: Henrik, Jussi

2018: Katariina, Martti

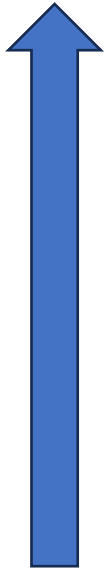
2017: Jani, Eero

2016: Jani, Jari

2015: Ville, Jarkko

2014: Samuel

***Established***



## Finnish High School Student Presentations

***Engineering presentations  
since 2014***

Experimental physics requires engineering!

An international organisation requires people from many domains!

Finns are involved in all CERN activities!



# PHYSICS vs ENGINEERING

## The challenge



*Physics(Formula) ≠ Engineering(Real object)  
→ Results in agreed compromise*



**THANK YOU FOR YOUR ATTENTION!  
YOUR QUESTIONS?**

**!/?**

