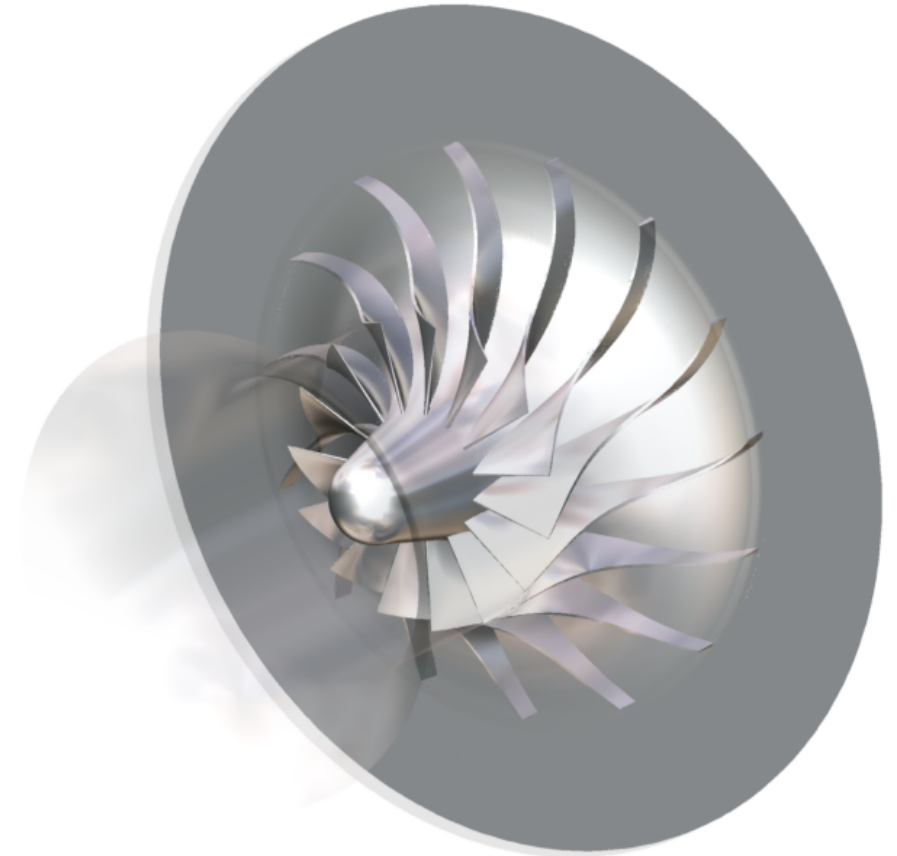


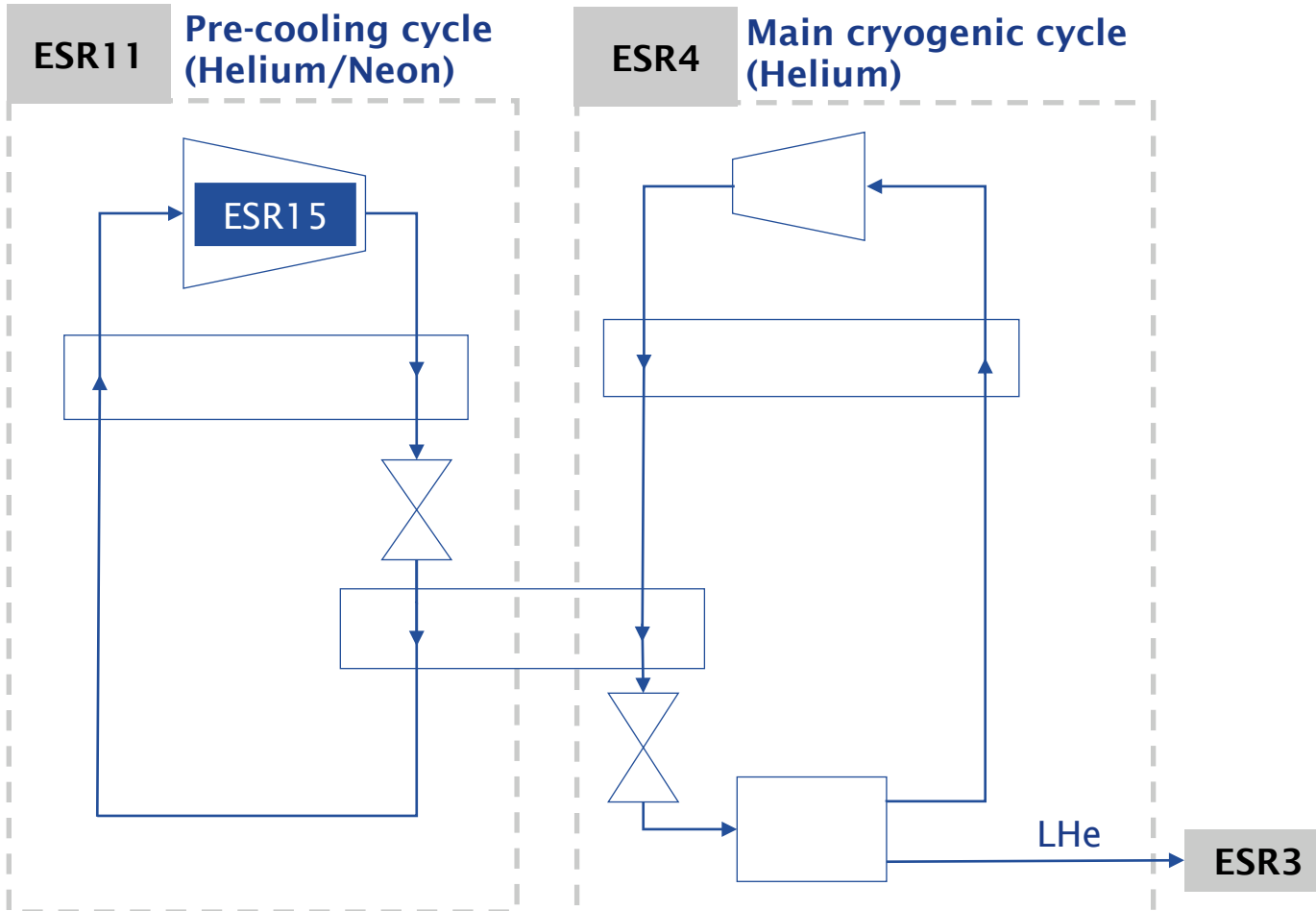
Mid-Term Review

10 December 2018, Brussels

Maxime, PODEUR
ESR15, WP4



- Background: MSc in Mechanical engineering from ISAE-SUPAERO and EPFL with specialisation, projects and internships in Turbomachinery
- Contract start date: 08/01/2018
- Host institute: University of Stuttgart
- EASITrain Supervisor: Prof. Tekn. Dr. Damian Vogt
- PhD Title: Reynolds number effect on compressor performance
- PhD University: University of Stuttgart
- Planned secondments:
 - 1. MAN Energy Solutions: Turbomachinery, October 2018 & September 2019, 2 periods of 4 to 6 weeks
 - 2. TU Dresden: Cryogenics, November 2019, 4 weeks



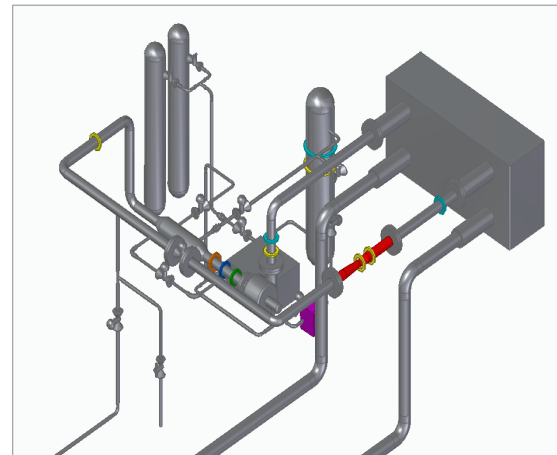
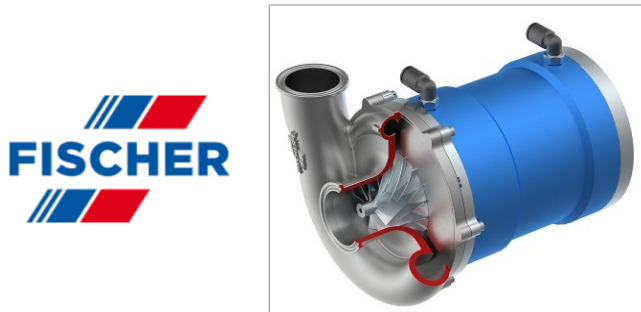
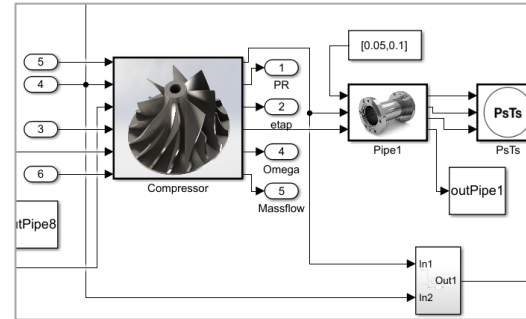
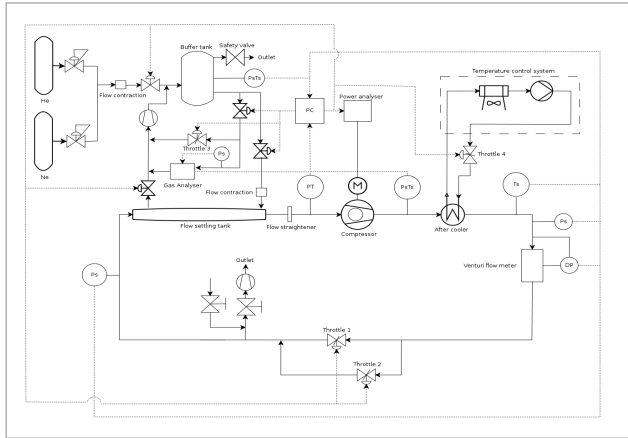
Role

Responsible for the turbocompressor design in the Helium pre-cooling cycle

Objective

- Give a possible design architecture for an agreed gas mixture with ESR11
- Give guidelines and answers to the difficulties of designing and manufacturing turbocompressors operating with light gases.

Test rig



Realized

- List of components
- CAD drawing
- Compressor manufacturer found
- P&ID
- Simulink model

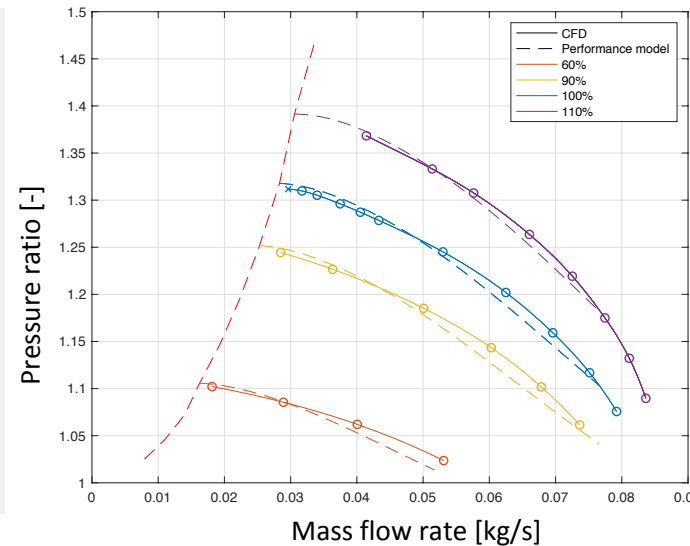
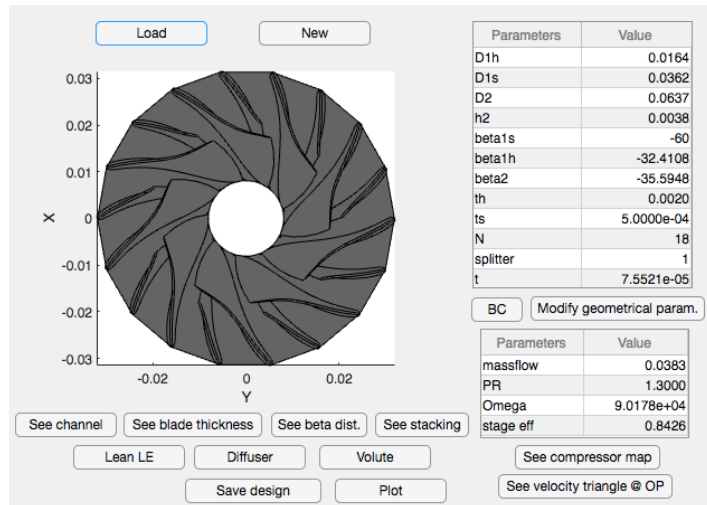
On-going

- Components procurement
- Compressor design

Next steps

- Data acquisition (in cooperation with ESR11)
- Test rig assembly

Models & Geometry generated



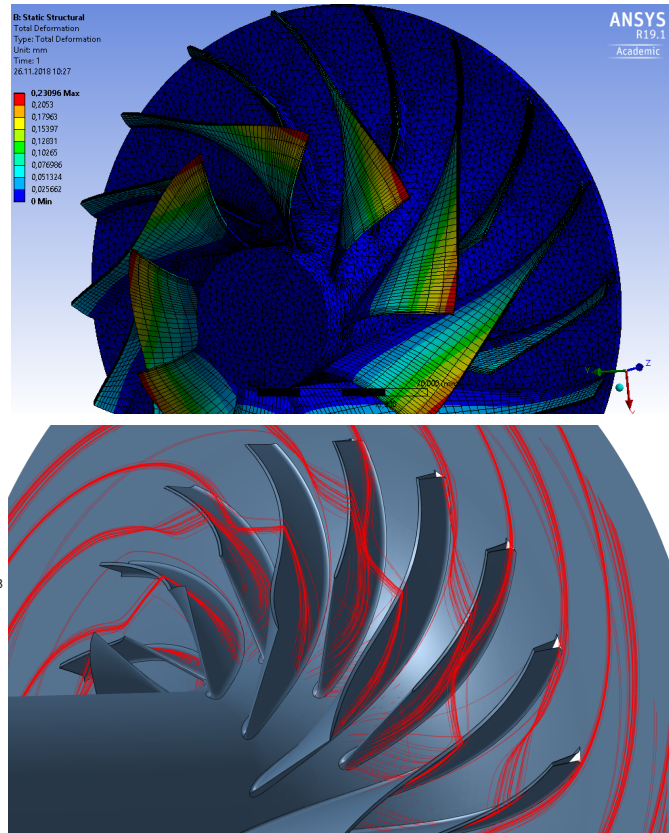
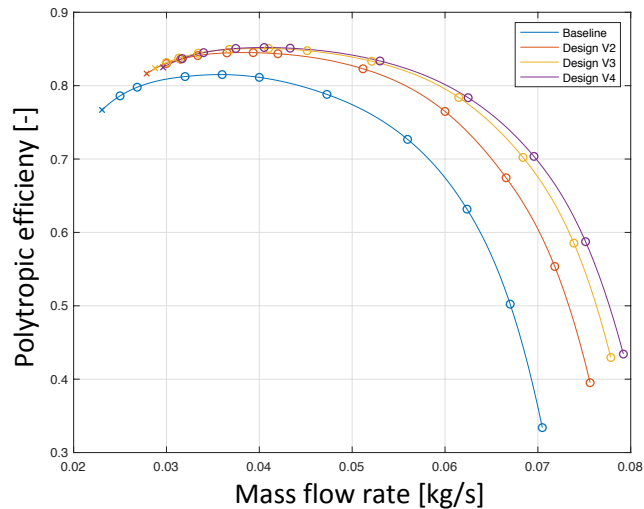
Realized

- Model development:
 - Performance evaluation model
 - Optimisation genetic algorithm
 - Blade modeller

On-going

- Continuous improvement of the models

Compressor design optimisation



Realized

- CFD parameterised study
- Aerodynamic optimisation validated with compressor manufacturer

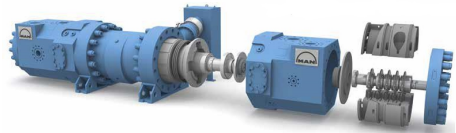
On-going

- Structural analysis (FEM)

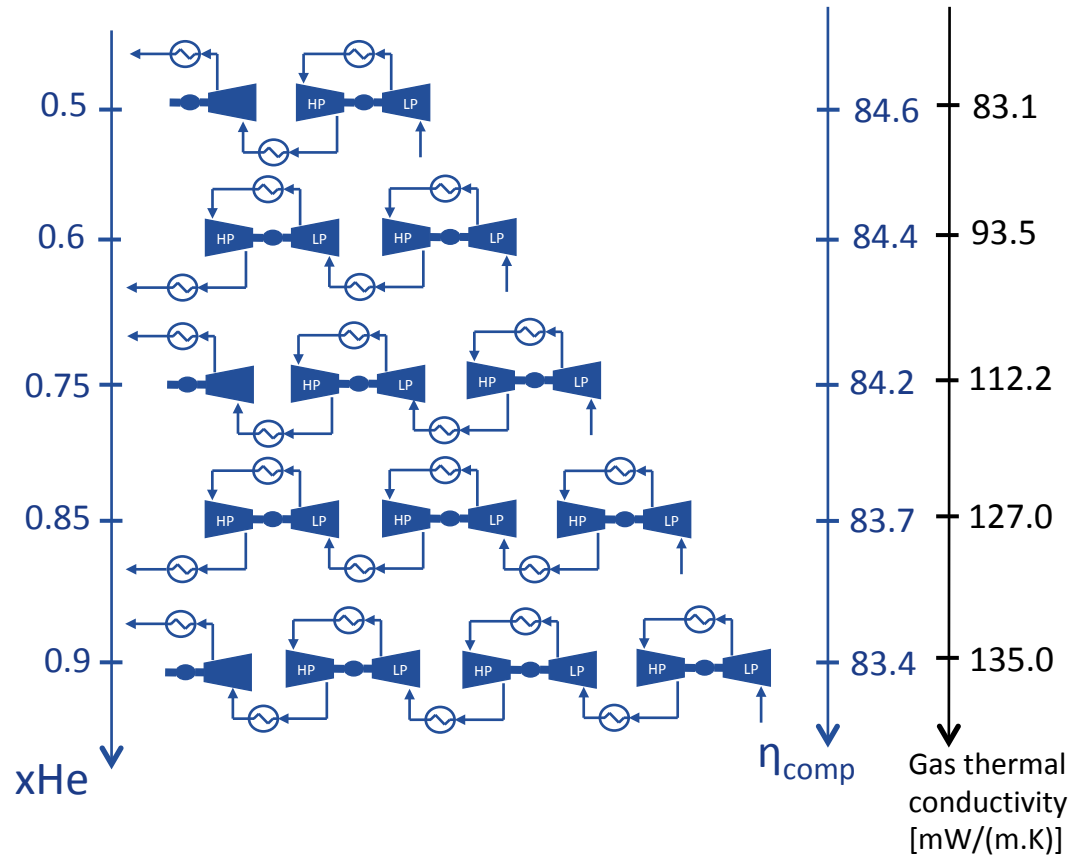
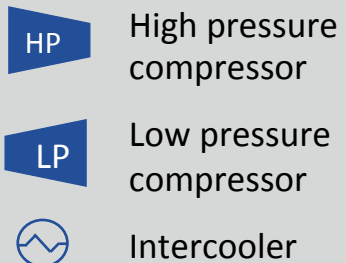
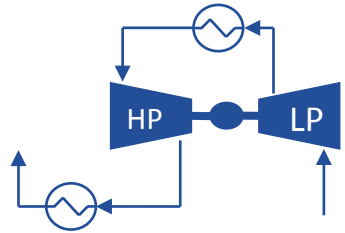
Next steps

- Compressor manufacturing & commissioning

Compressor architecture for the FCC



HOFIM™ (Image courtesy of MAN Energy Solutions)



Realized

- Preliminary compressor layout
- First estimation of performance and operation feasibility

On-going

- Iteration with ESR11 on gas mixture

Next steps

- Development of a new impeller in cooperation with MAN Energy Solutions

Training

- German classes
- EASISchool 1: September 2018, Vienna (Austria)
- Up Coming:
 - Cryogenic school (ECC): September 2019, Dresden
 - EASISchool 2: July 2019 (France), EASISchool 3: August 2020 (Italy)

Conferences

- 2018: FCC week
- 2019: Turbo Expo & FCC week
- 2020: Turbo Expo, International Cryogenic Engineering Conference (ICEC) & FCC week

Attended EASITrain events

- Kick off meeting at CERN: March 2018, Geneva (Switzerland)
- Project presentation during the FCC week: April 2018, Amsterdam (Netherlands)

Outreach activities

- Sharing FCC articles on social media has proven to be particularly effective
- Up coming: Videos relative to test rig commissioning and operation to be published on social media

Dissemination activities

- Journal publication in 2019
- Presentation at Turbo Expo 2020: London (United Kingdom)
- Presentation at International Cryogenic Engineering Conference (ICEC) 2020

Networking activities

- In my field of research: colleagues at institute, partnership and secondments with companies, conferences
- In cryogenics and particle accelerator physics: FCC week, WP meetings, trainings

Other: Master thesis supervision

Impact of my research on science and society

- **Cryogenics:** More efficient cooling cycles, suggest a disruptive approach to cryogenic cycle architecture
- **Turbomachinery:** Better understanding of Reynolds number effect on compressor performance
- **Society:** Help make superconductivity more affordable and accessible for more applications than today

Impact that being a MSC fellowship has on me and on my career

- What have I learned from this experience
 - A new language: German
 - Opportunity to work with people from different backgrounds and working in other fields of research
 - Understand the objective and constraints of industry and research institutes
- How will this experience help me direct my career to the paths I am interested in?
 - Acquire knowledge and experience in Turbomachinery research
 - Build a strong network with experienced people from industry and research institutes
- What have I enjoyed the most during this experience?
 - Close collaboration between university and industry
 - Participation to a group project with a large, challenging and concrete objective

Mid-Term Review

10 December 2018, Brussels

**Thank you for your
attention**

