GAUSS FUSION

Technology development: Successful cooperation between industry and research institutions

EU Fusion Forum

July 4th 2024

Richard Kembleton, Luca Pezzoni

GAUSS FUSION FOUNDERS

Already key industrial players in the fusion ecosystem today

ALSYMEX ALCEN [1]

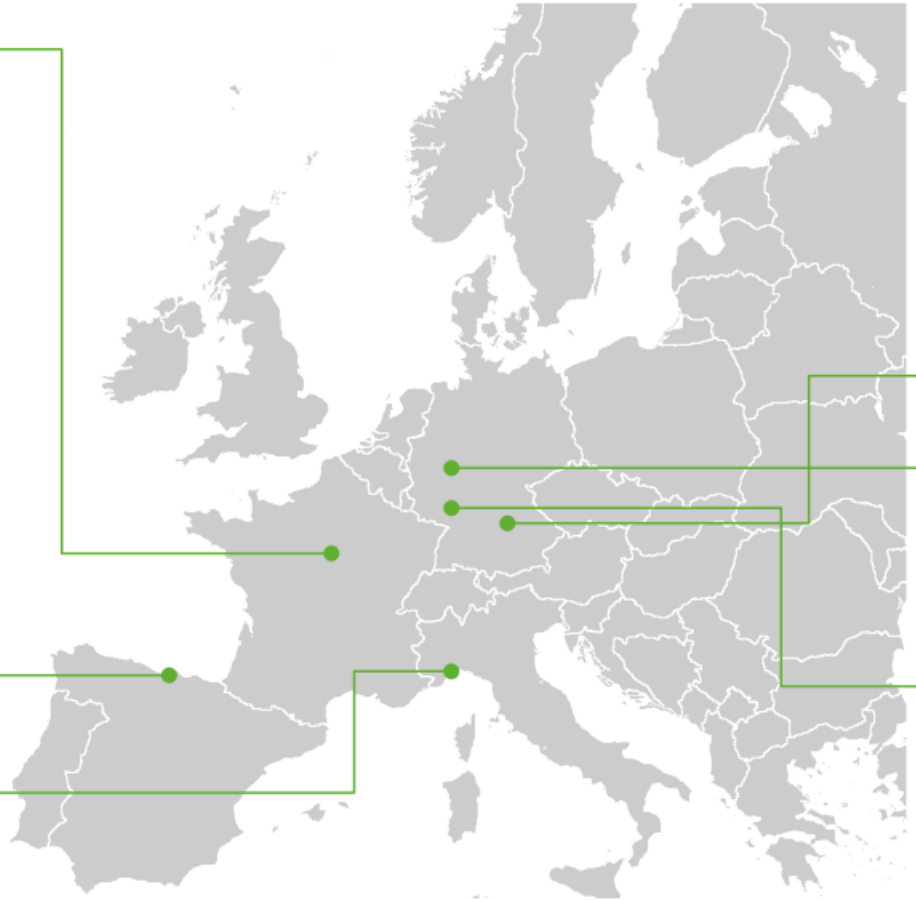
Paris, France
Instrumentation, heating systems

IDOM

Bilbao, Spain
Engineering, diagnostics

ASG SUPERCONDUCTORS [2]

Genoa, Italy
Superconducting magnets



research instruments

Bergisch-Gladbach, Germany
Cryotechnology, Diagnostics

GAUSS FUSION

Garching/Munich, Germany

BRUKER

Hanau, Germany
Superconductors

Note 1: Investment by Alsymex's shareholder Alcen
Note 2: Investment by ASG's shareholders Hofima and Luleo

GAUSS FUSION PARTNERSHIPS

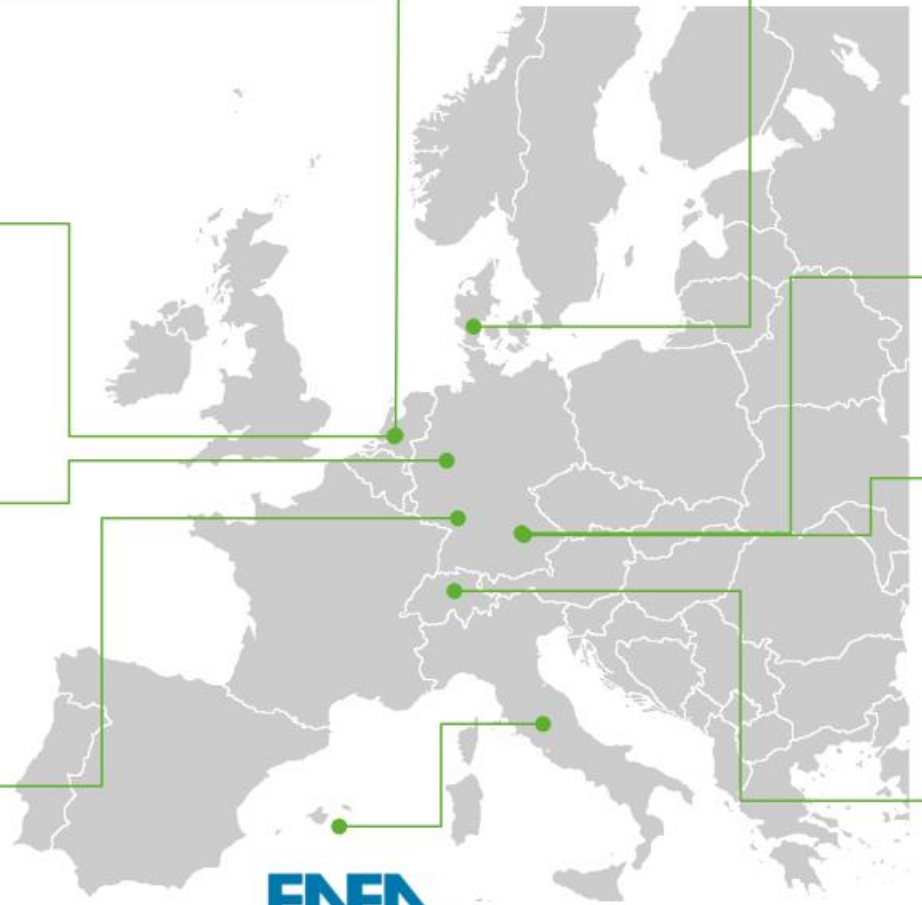
Key scientific partnerships in Europe

TU/e EINDHOVEN UNIVERSITY OF TECHNOLOGY
Eindhoven, Netherlands

DIFFER
Eindhoven, Netherlands

JÜLICH FORSCHUNGSZENTRUM
Jülich, Germany

KIT Karlsruher Institut für Technologie
Karlsruhe, Germany



ENEA
Rome, Italy

DTU Technical University of Denmark
Lyngby/Copenhagen, Denmark

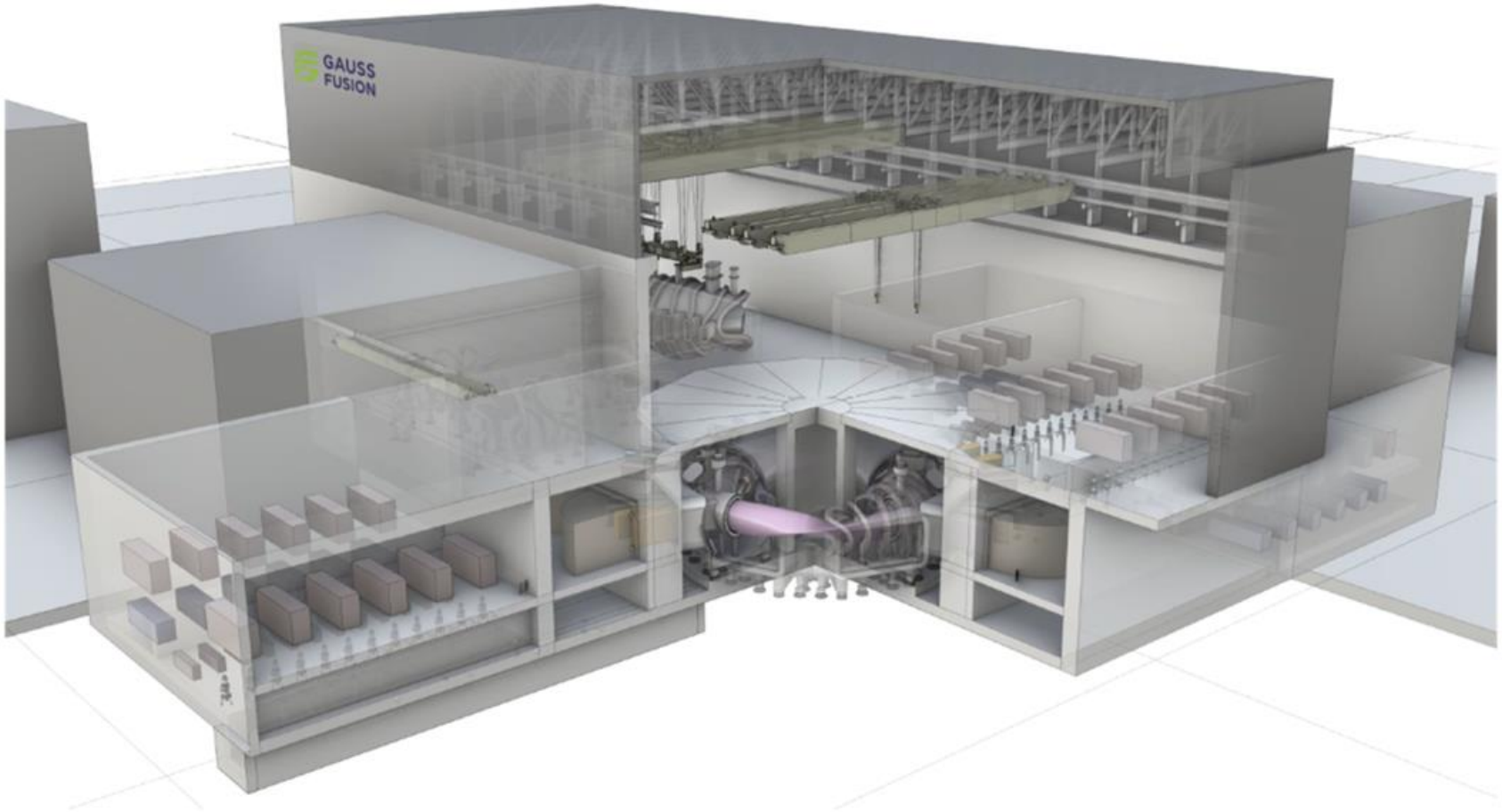
IPP Max-Planck-Institut für Plasmaphysik
Garching/Munich, Germany

Technische Universität München
Munich, Germany

CERN
Geneva, Switzerland

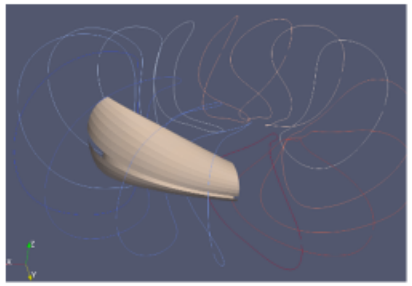
SNEAK PEEK INTO THE FUTURE

Gauss Fusion's Stellarator



STELLARATOR OPTIMISATION

Interlinked multi-fidelity, multi-scale optimisation problem



1. Having a good plasma physics scenario
2. Being able to build the magnets and handle the forces
3. Having sufficient plasma-coil distance to fit thermal shield, vacuum vessel, breeder blanket, first wall, divertor… with shielding for VV and magnets
4. Preserving remote maintenance access to the blanket and divertor

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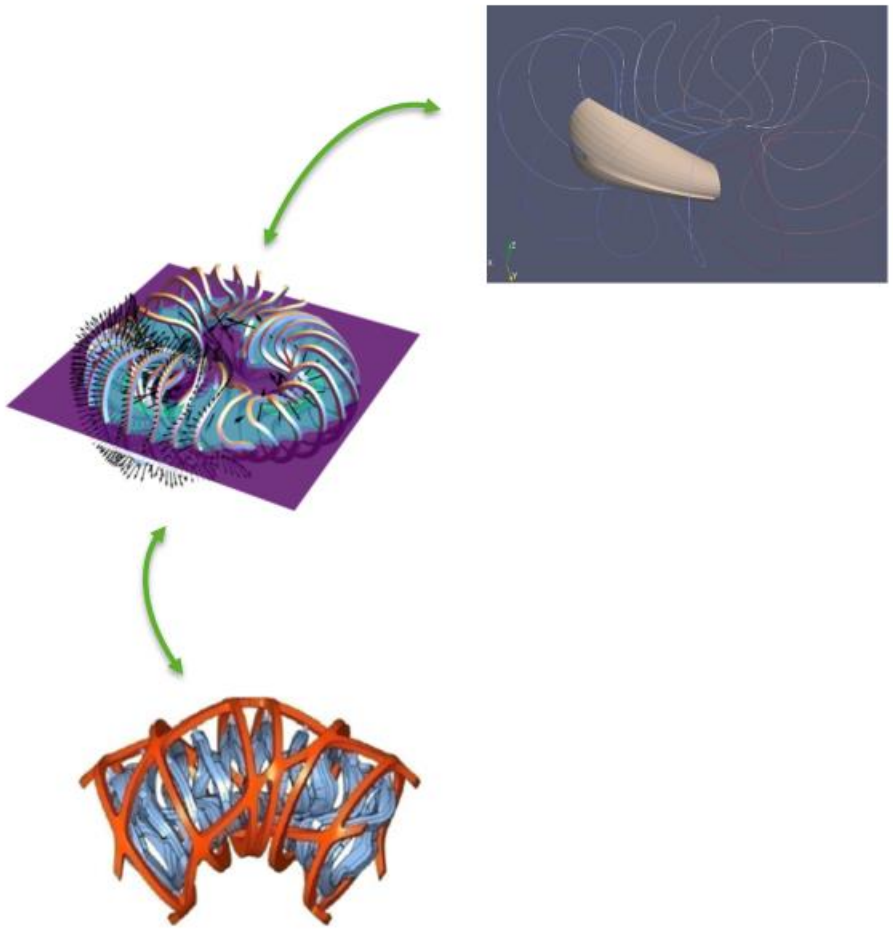

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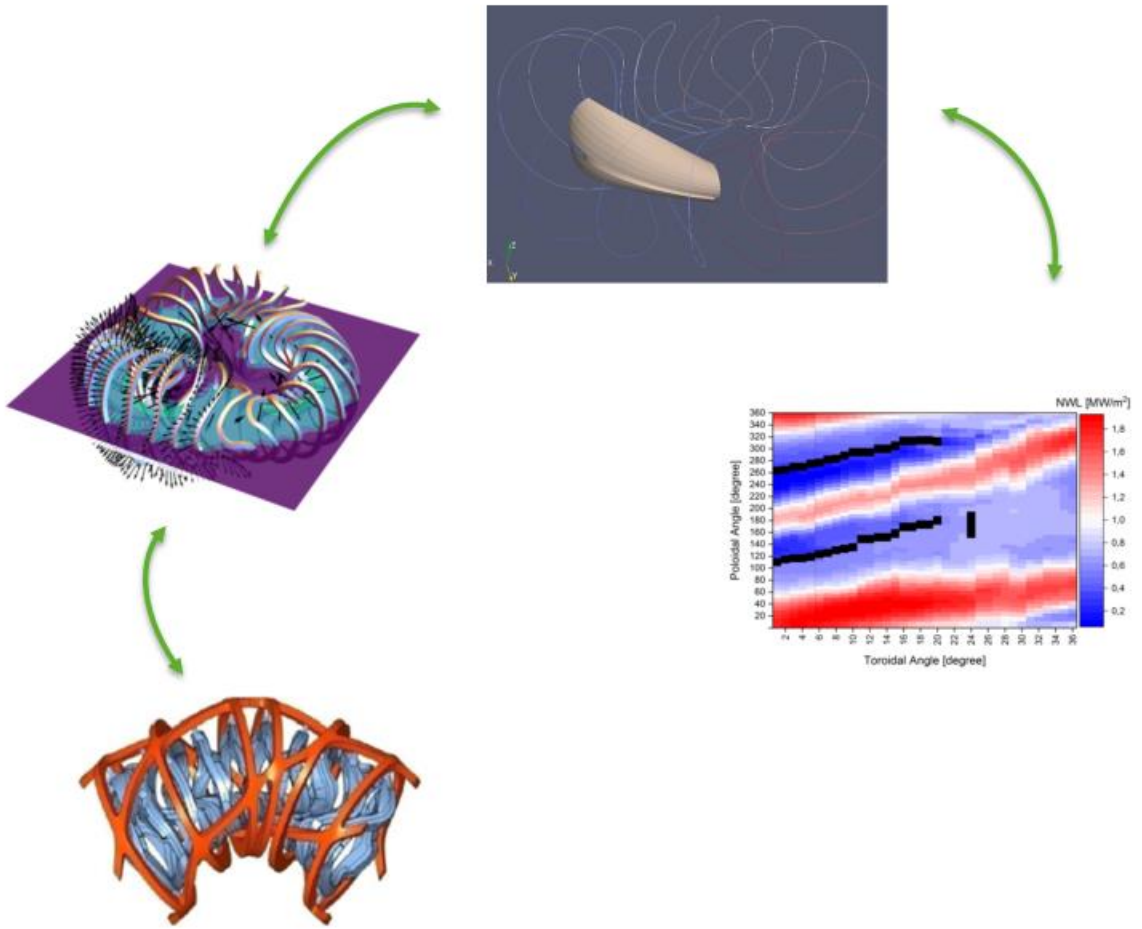

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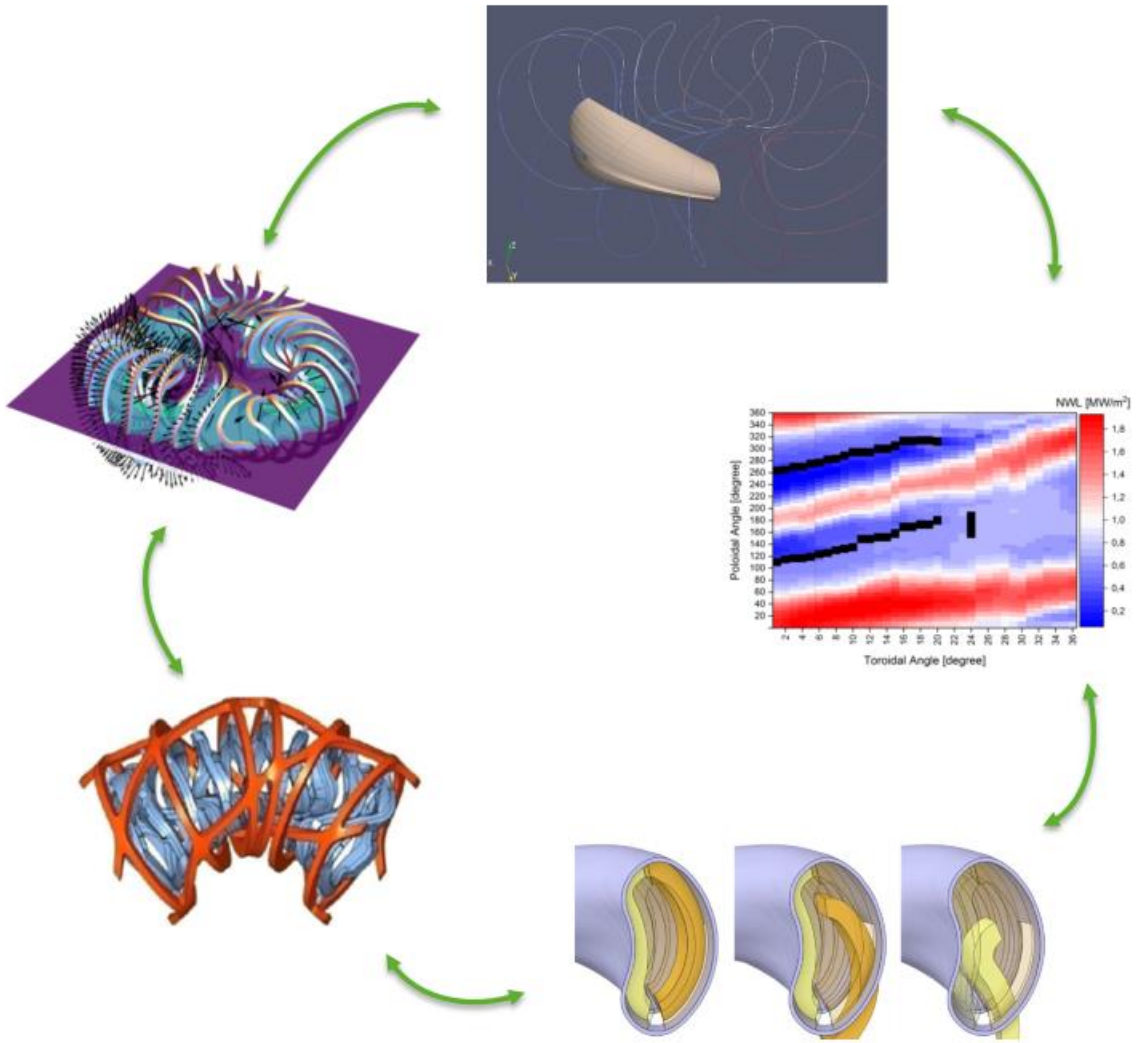
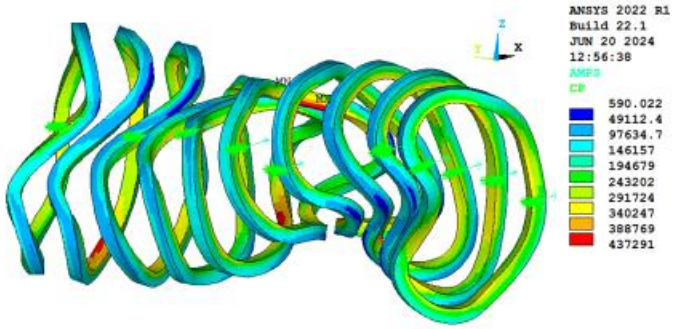
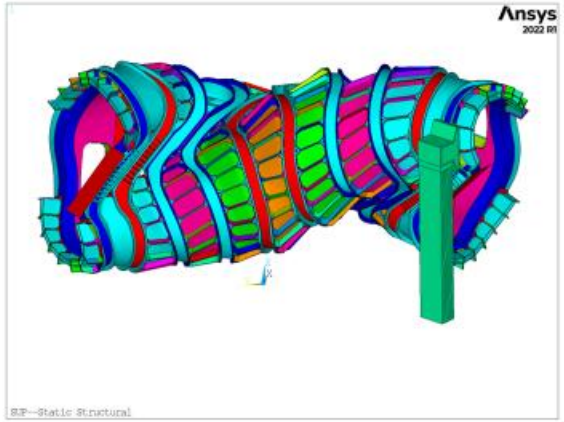
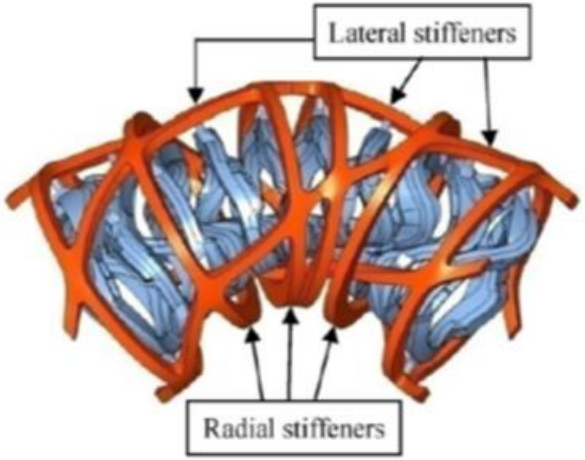


MAGNET STRUCTURES

Large forces require large structures







COOPERATION WITH PUBLIC SECTOR AND PRIVATE SECTOR

Expertise rests in many institutions

Coil shape optimisation

Research Institutes

Stellarator magnet optimisation with physics performance

Magnets approach

- Central management
- Concept development
- IP management
- Stellarator design integration

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TRL improvement

Collaboration with industry and institutes

High impact magnet technology development

- Supply contracts
- Design
- Testing

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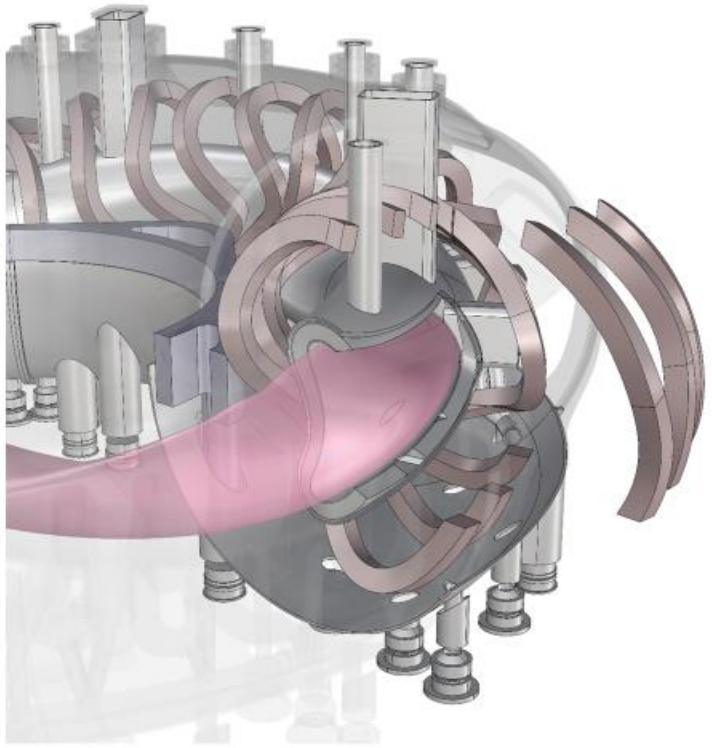
Industrial suppliers and collaborators

Stellarator magnet design optimisation, build and qualification

- Supply contracts
- Design

DEMOUNTABLE COIL CONCEPT

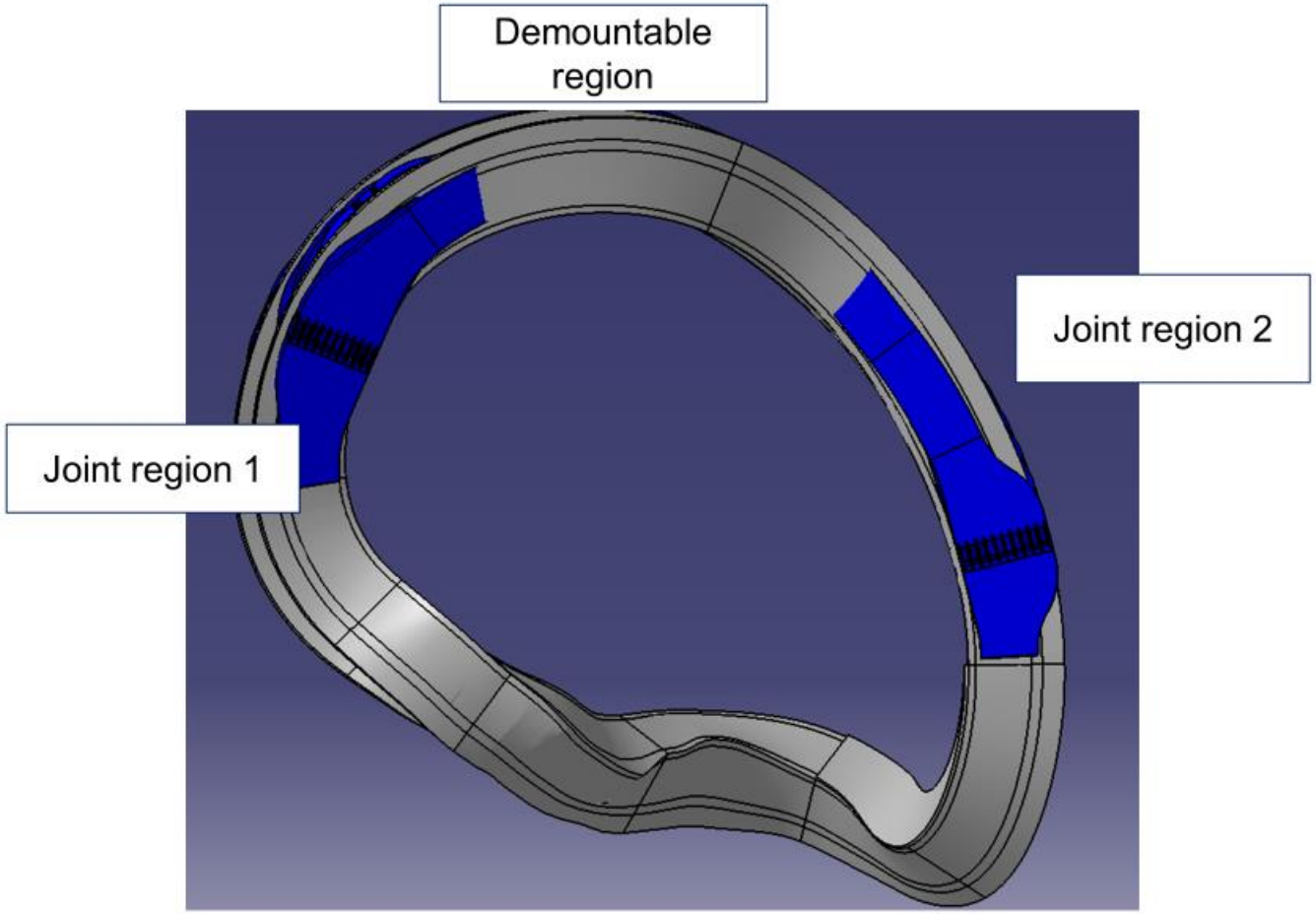
Engineering for manufacturing, assembly, and maintenance

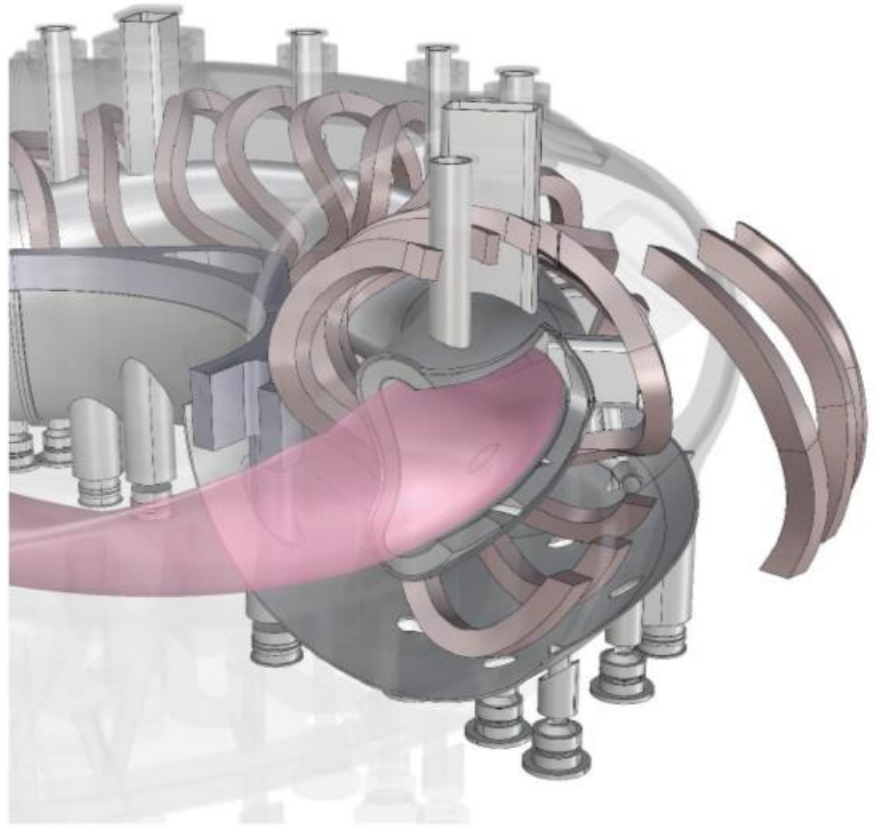


1. Large potential impact
2. Low TRL
3. BMBF grant for developing demountable coils
4. GFG lead, partners KIT and IPP
5. GFG working with shareholders (RI, Bruker) and collaborators (ASG, ENEA)

INTEGRATION OF JOINT CONCEPT IN COIL

Overview: Example of 3D Coil (Helias 5)





Stellarator optimisation (plasma-coils) has to include straight planar regions for joints as well as constraints on free-form centrelines (to be composed instead of arcs, even if not in same plane).

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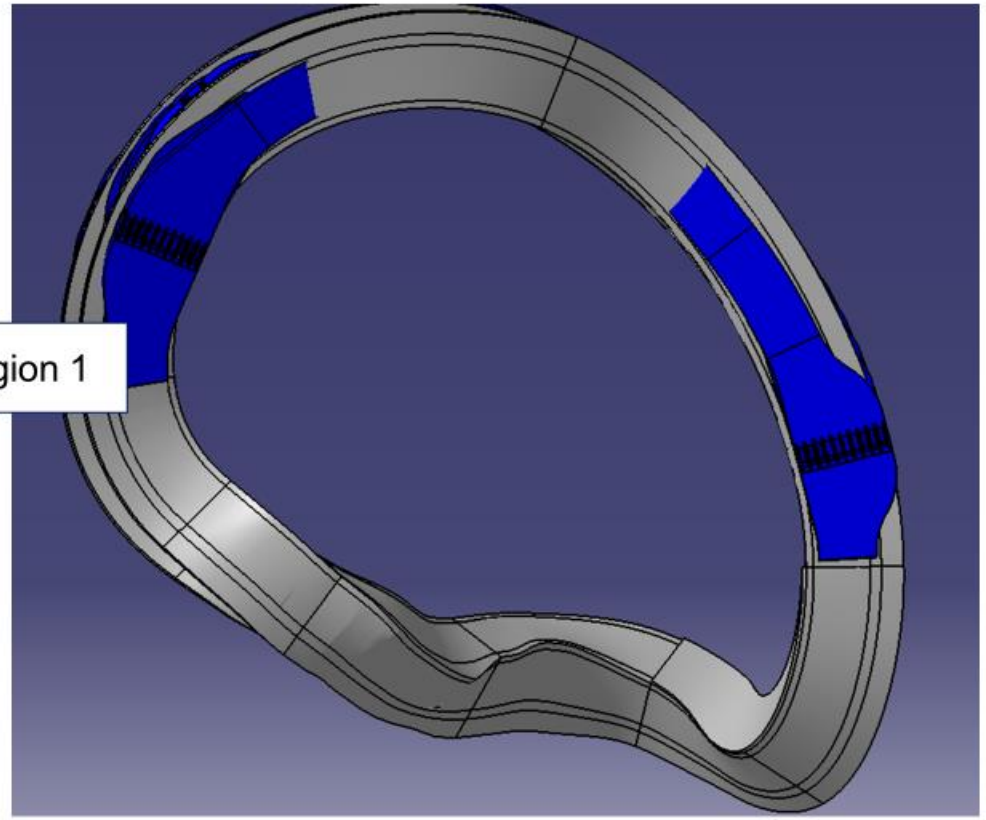

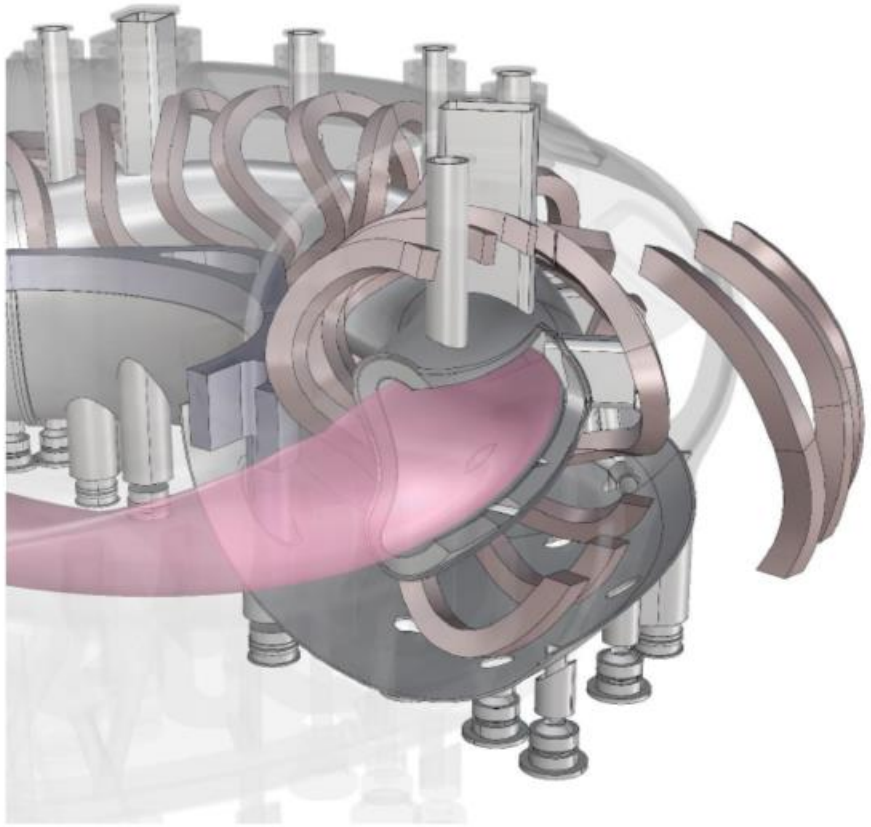

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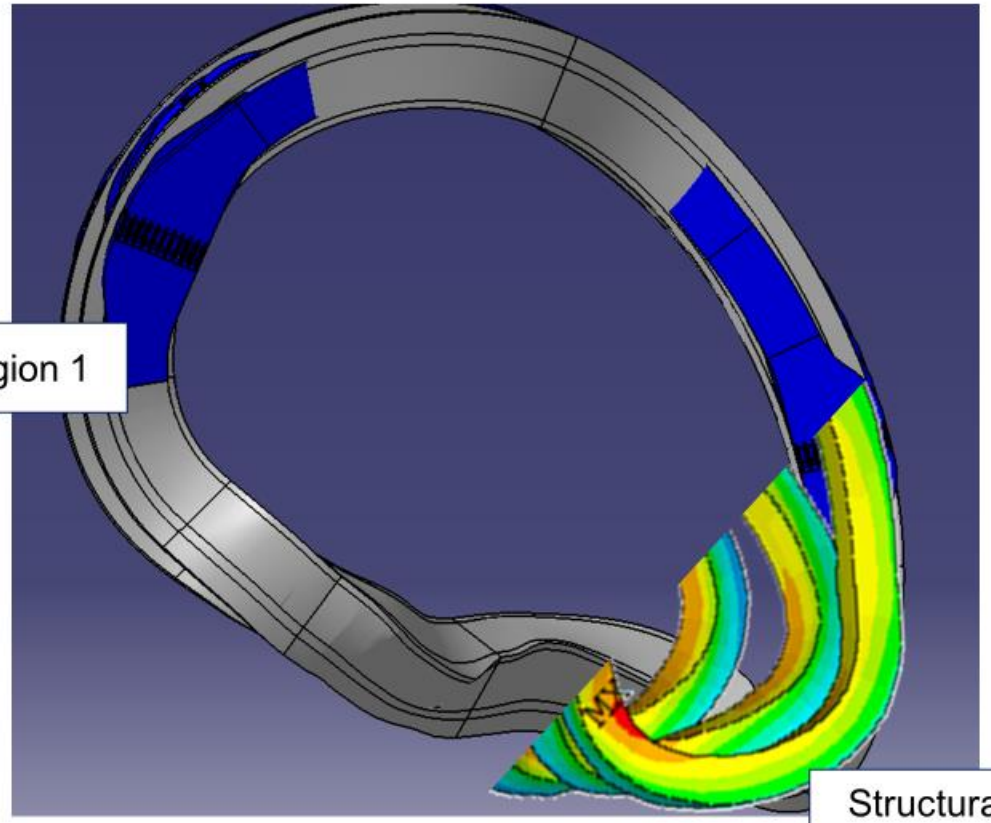
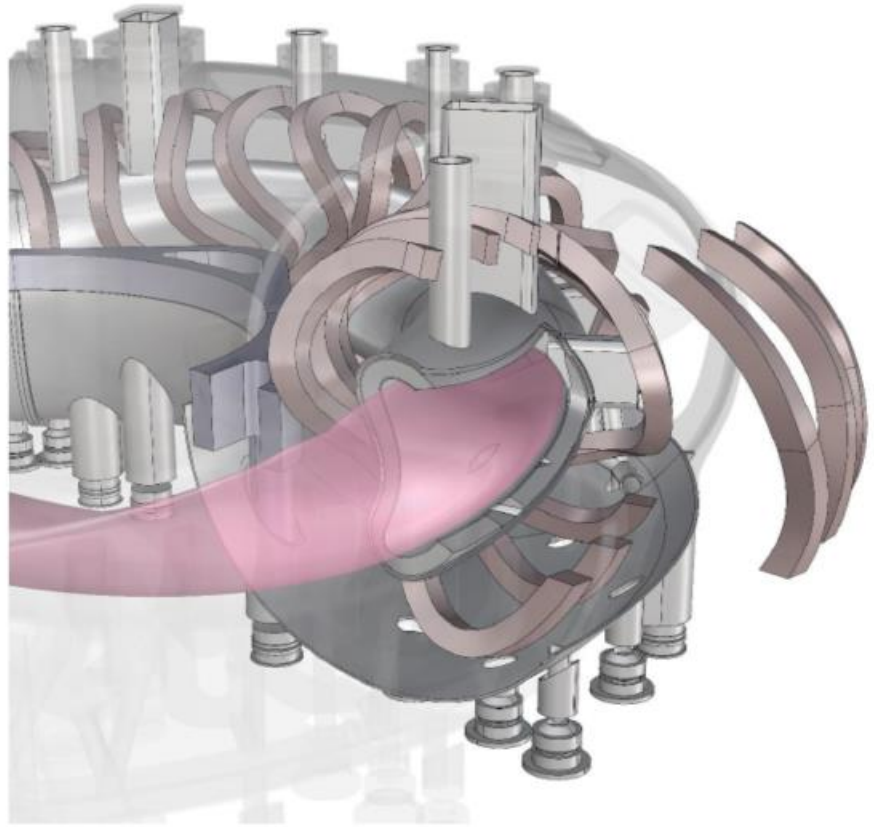


Structural design and analysis: RI



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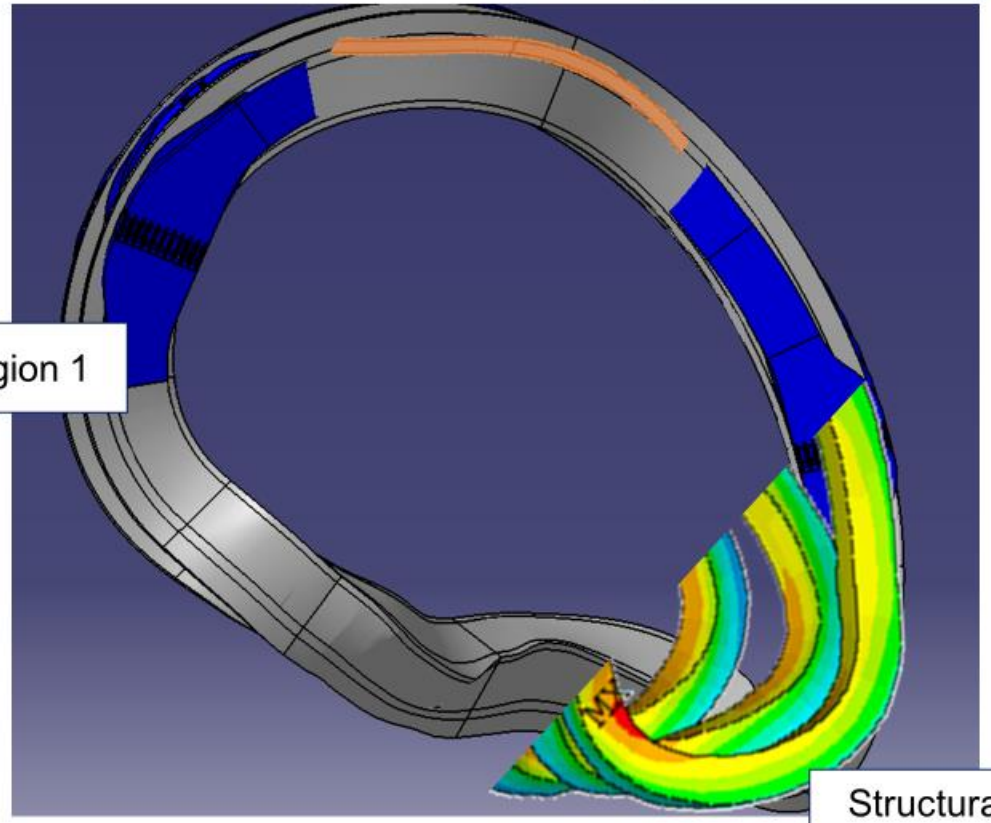
Conductor supply: ICAS



Joint region 1

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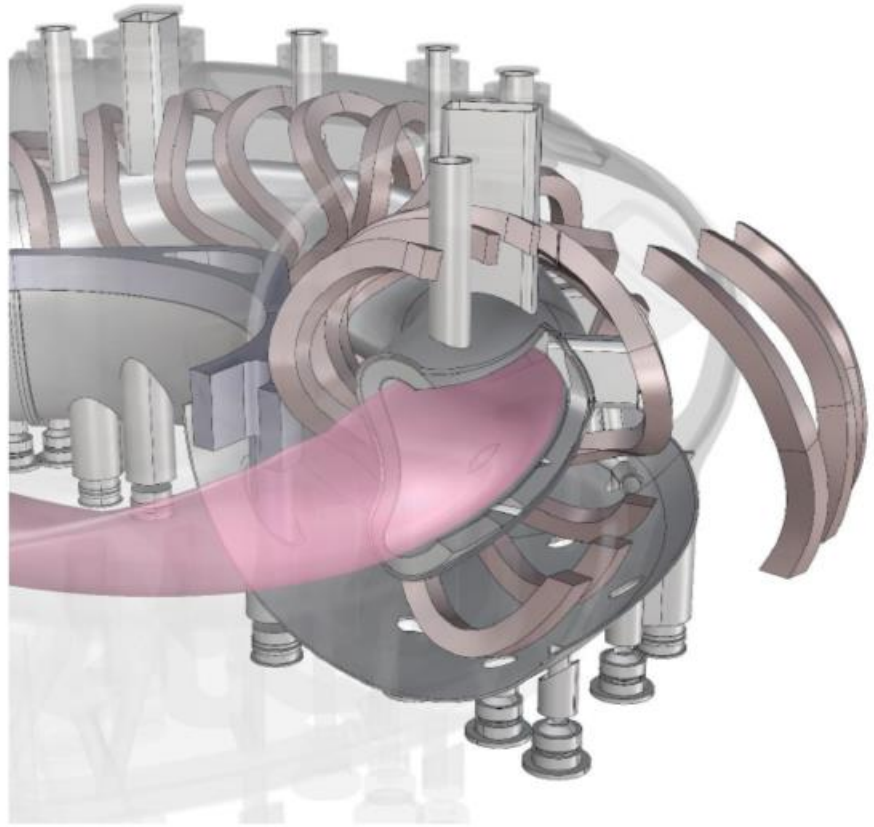

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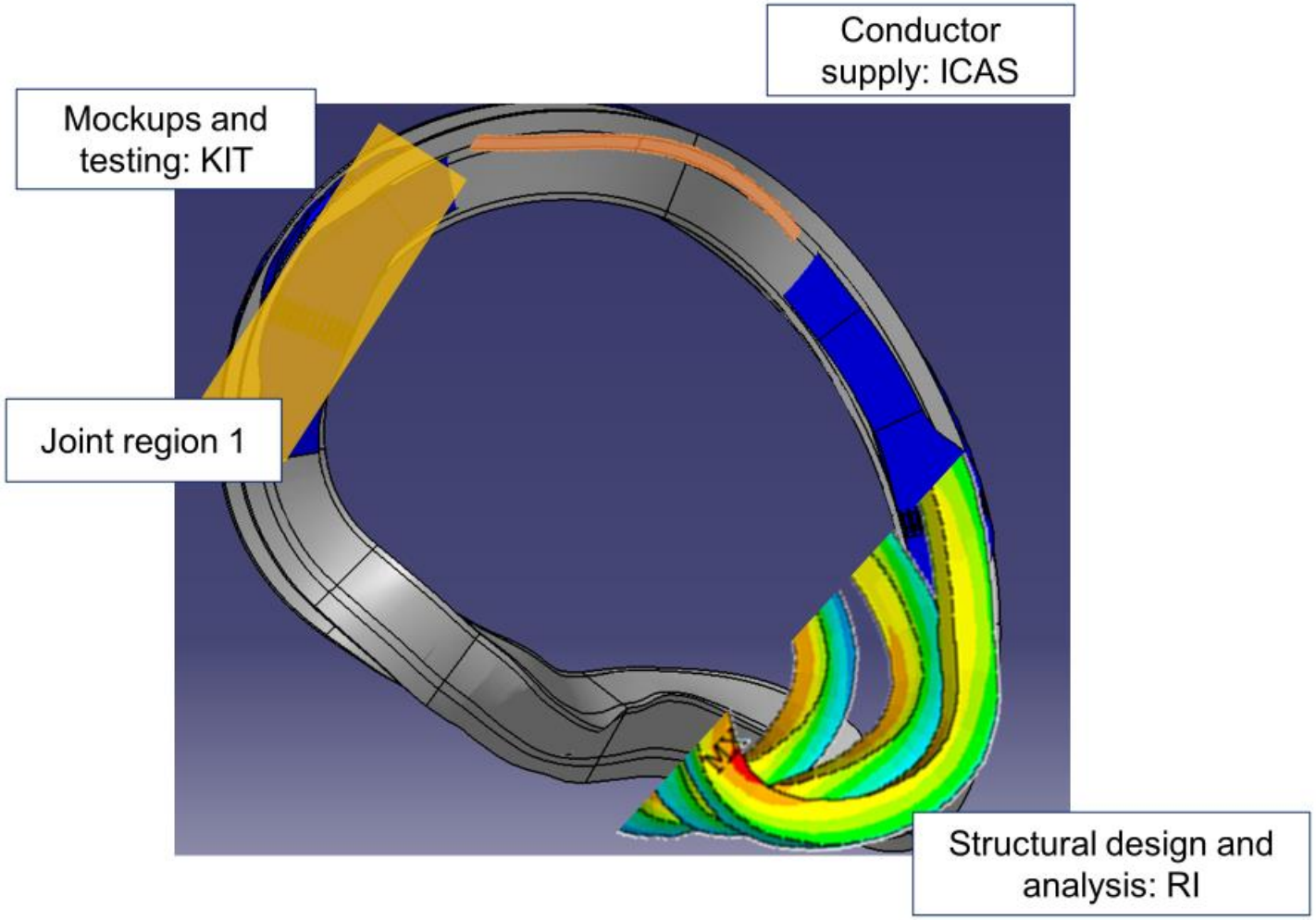

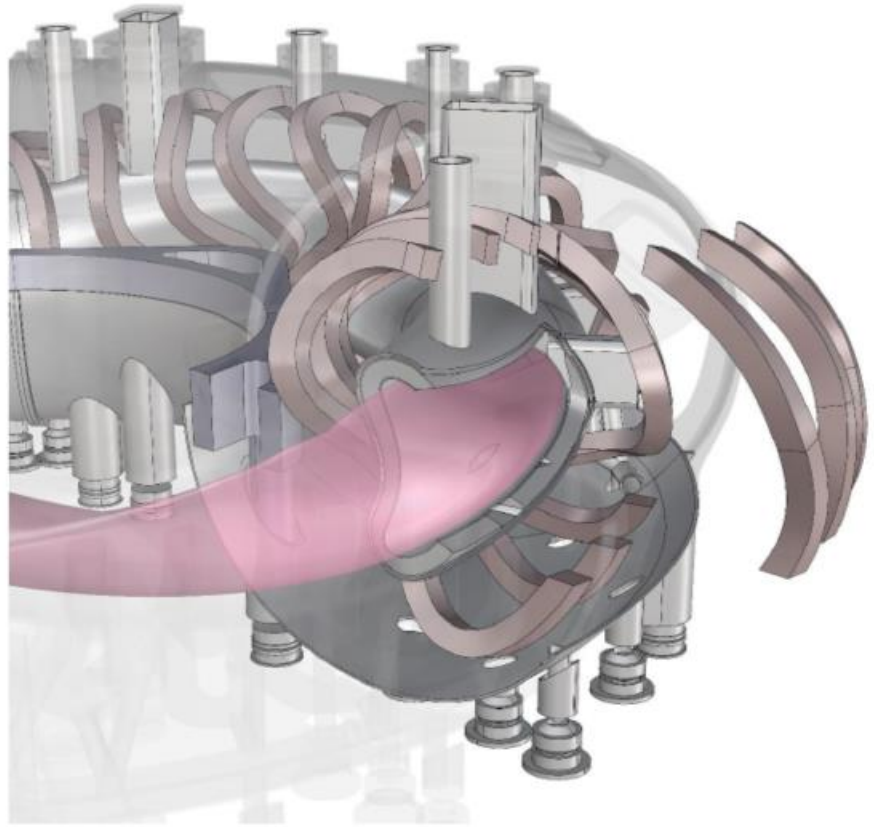

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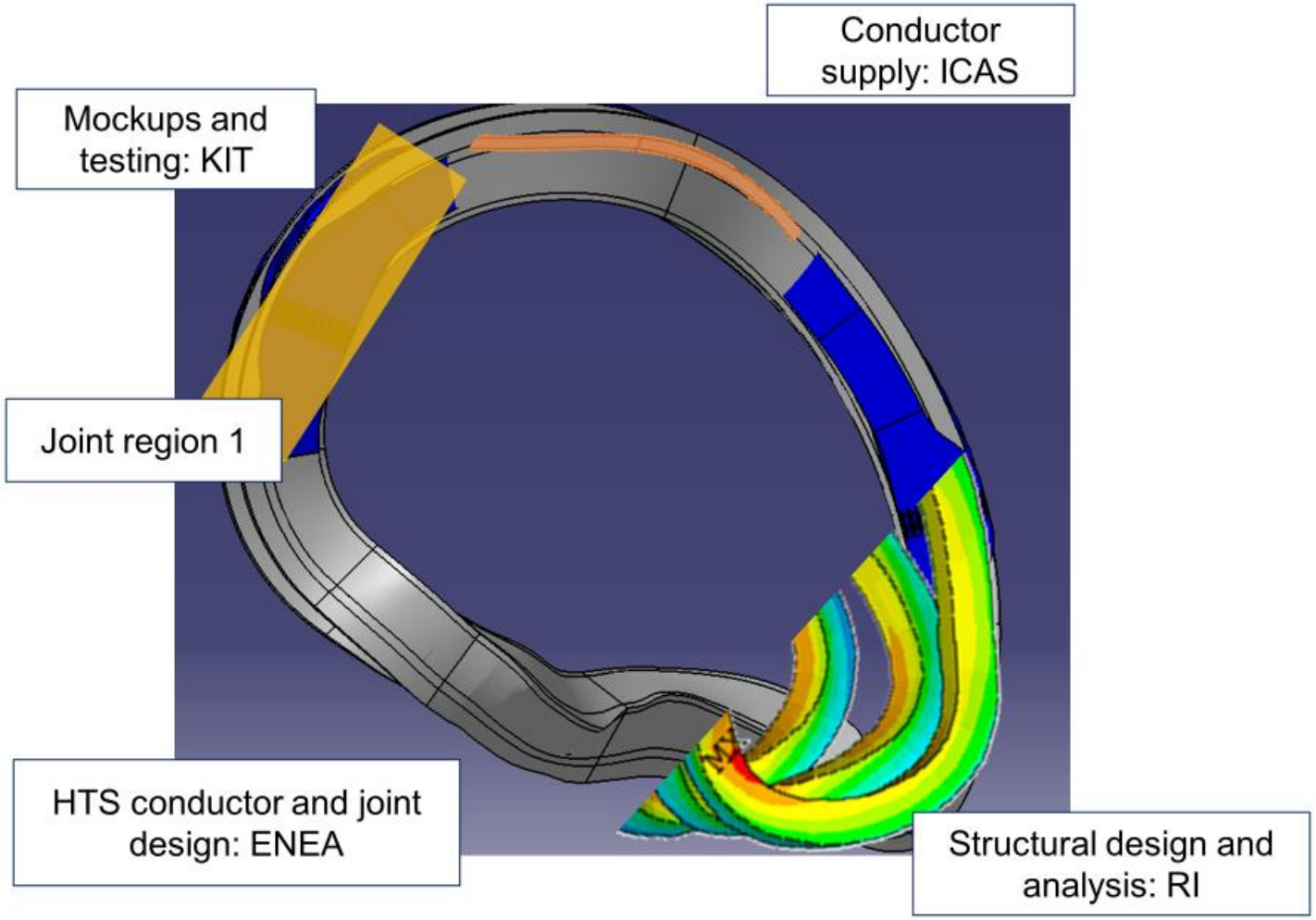

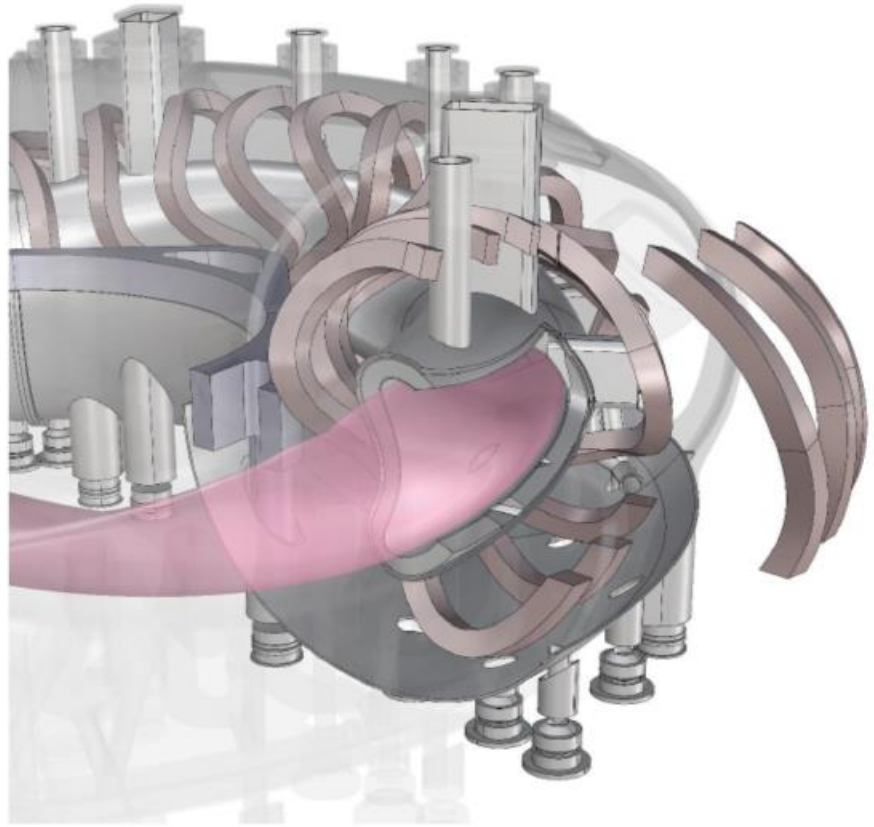

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INTEGRATED DESIGN

Stellarator Basic Machine Optimisation Project

Set of tools and embedded engineering know-how that will allow us to iterate from plasma to basic machine layout (coils, VV) satisfying main engineering requirements for a given FPP concept

Steps		
1	Plasma Configuration	Institutes
2	Plasma - Magnets	Institutes and GFG (plus partners)
3a	Magnet Structures, coils & conductors	Partners, collaborators (input of structural modelling expertise and coil manufacturing know-how) GFG➔ assessment of new technology TRL and risk of implementing in baseline (eg DCP)
3b	Vacuum Vessel Structure