



# Fusion Research and Education at TU/e

Dutch Fusion Day – Josefine Proll

May 3, 2024

# Challenges of Fusion Reactors

High temperature

Magnetic Confinement

Turbulence Control

Heat-resistant materials

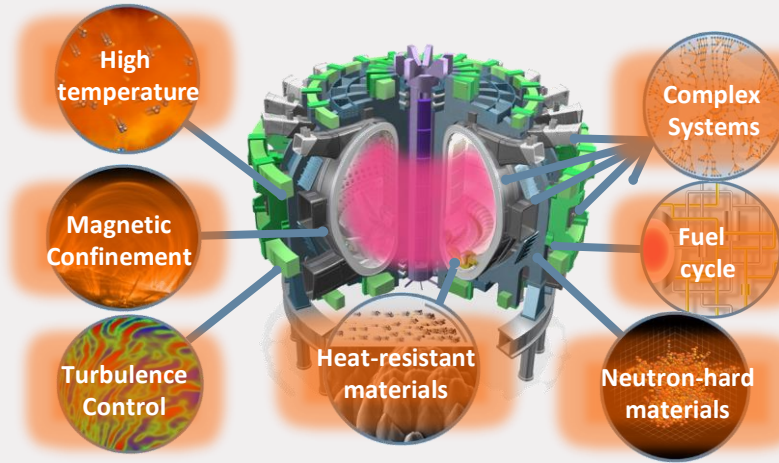
Complex Systems

Fuel cycle

Neutron-hard materials

*N.J. Lopes Cardozo – Lecture notes 3MF110 – TU/e*

# Activities at TU/e



## Heating systems

- Marion Matters (Electr. Eng.)

## Diagnostics (THz, ...)

- Roger Jaspers (Appl. Phys.)
- Idelfonso Tafur Monroy (EE)

## Modelling

- Barry Koren (Maths/Comp Sci)
- Michael Abdelmalik (Mech. Eng.)

## Turbulence studies

- Josefine Proll (Appl. Phys.)
- MJ Pueschel (DIFFER)

... and many more who supervised/collaborated on MSc and PhD projects

## Materials

- Hans van Dommelen (Mech. Eng.)
- Marc Geers (Mech. Eng.)
- Tom Morgan (Appl. Phys./DIFFER)

## Techno-economics of fusion

- Niek Lopes Cardozo (Appl. Phys.)

## Systems Engineering

- Felix Warmer (Appl. Phys)
- Pascal Etman (Mech. Eng.)

## Plasma control

- Marco de Baar (Mech. Eng.)
- Dinesh Krishnamoorthy (Mech. Eng.)
- Maarten Schoukens (Electr. Eng.)

EIRES –  
EINDHOVEN INSTITUTE FOR  
RENEWABLE ENERGY SYSTEMS

## Heating systems and current drive

- at high B field

## Diagnostics

- at high B field
- with adaptive optics?

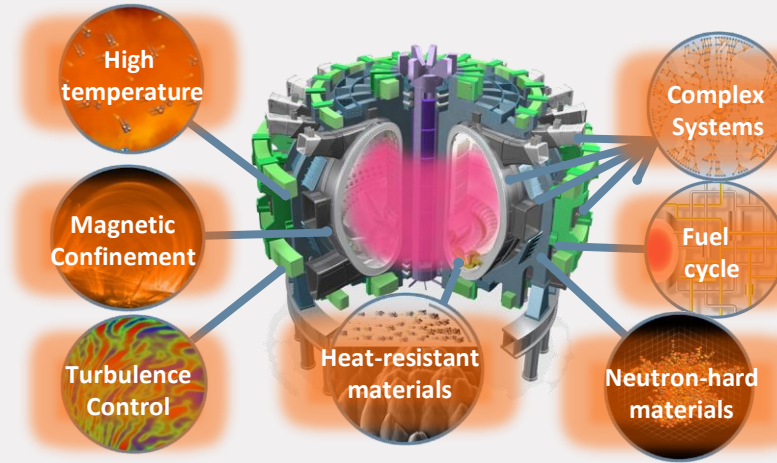
## Modelling

- Speeding up codes/replace with AI?
- Reduced models

## Turbulence studies

- Reduced models
- Use for optimization
- In the plasma edge

# Research Opportunities



## Materials

- Tritium breeding
- Blanket design

## Techno-economics of fusion

- Deployment
- Involve society

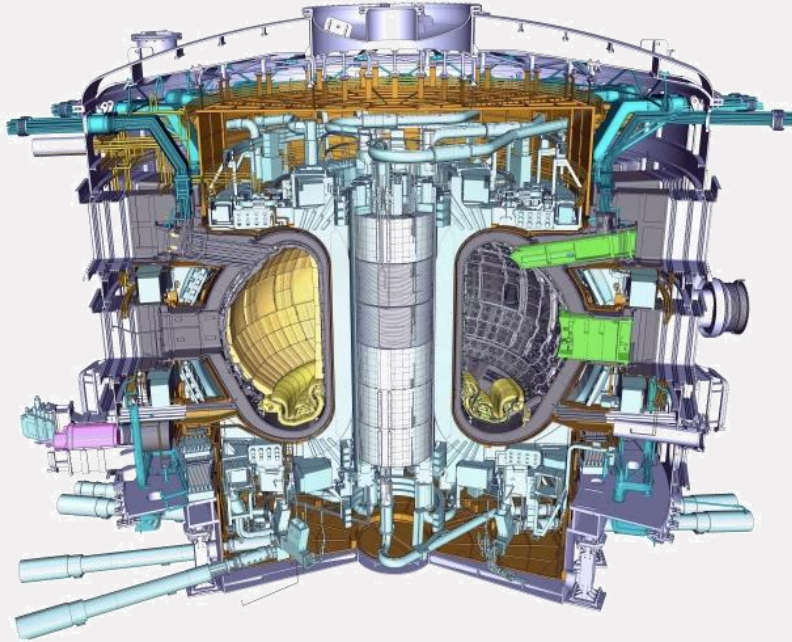
## Systems Engineering

- Digital twins
- Full reactor designs

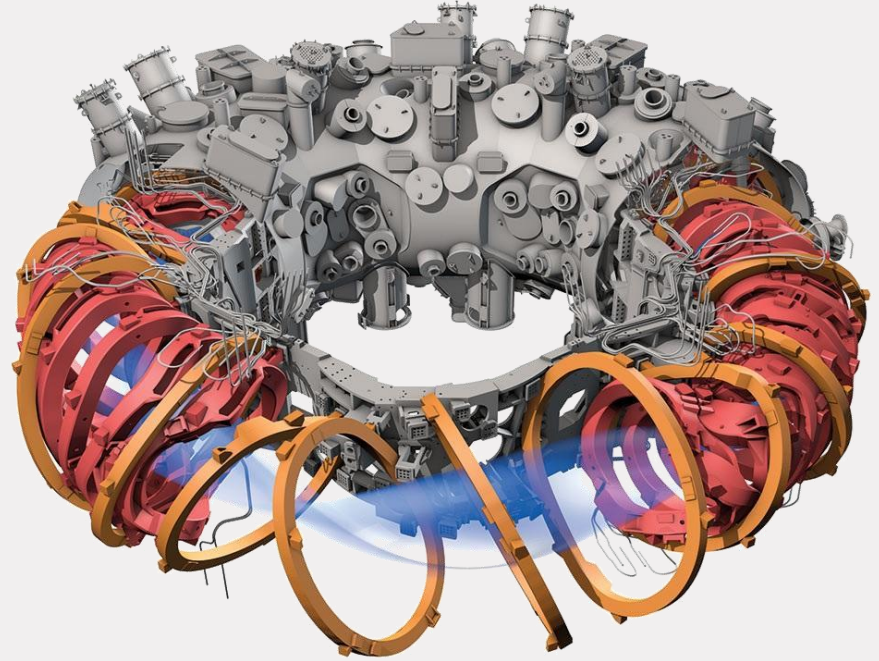
## Plasma control

- With fewer diagnostics
- Use of digital twin

## ITER – a tokamak

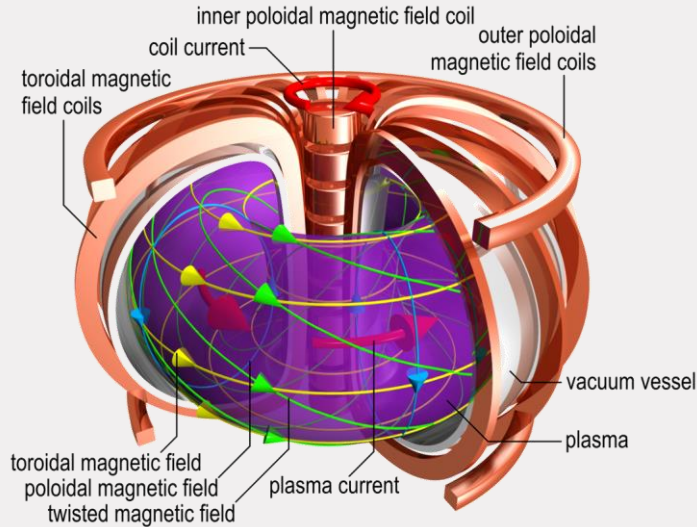


## Stellarators – the “star-bringers”

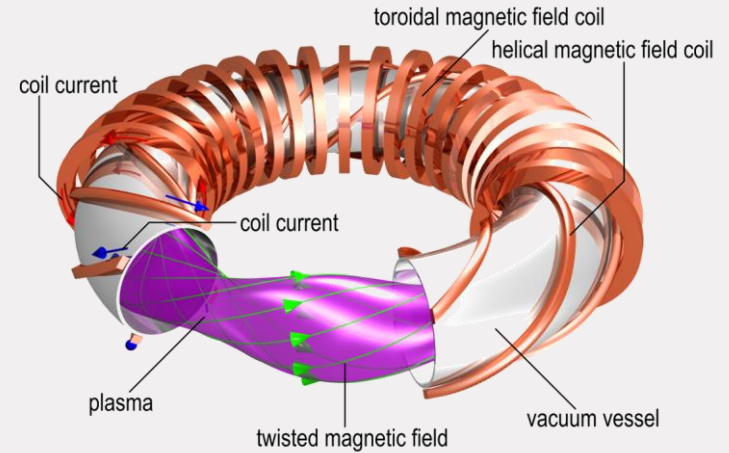


# Tokamaks were favoured over stellarators because of better confinement

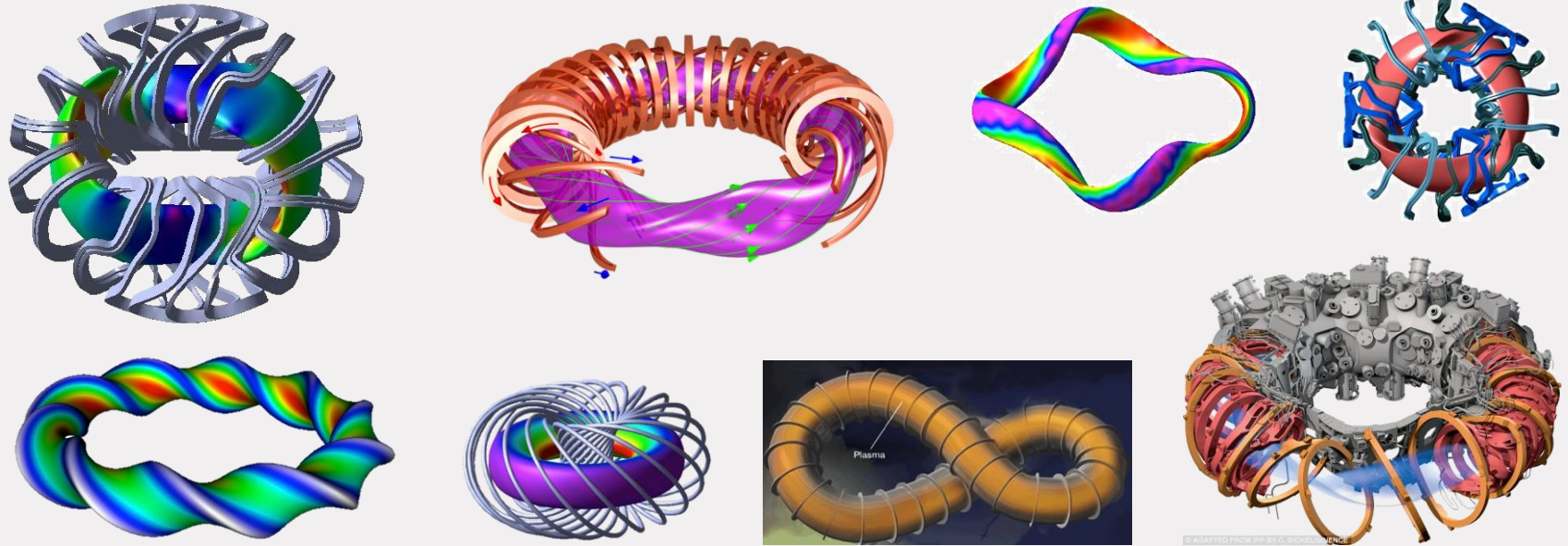
## Tokamak



## Stellarator



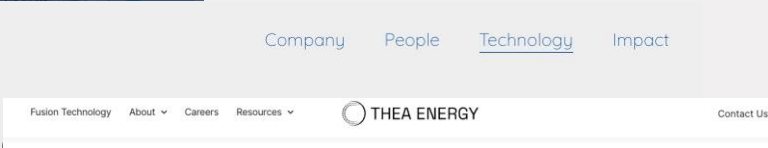
# We can optimise which shapes



... but not all are equally good

[MPI Plasma Physics, PPPL, D. Spong]

# Stellarators chosen by new fusion companies





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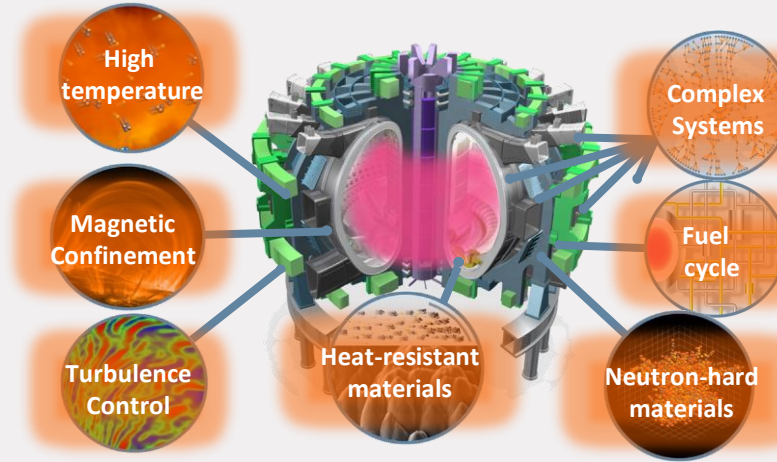
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All relevant and possible for tokamaks and stellarators alike!

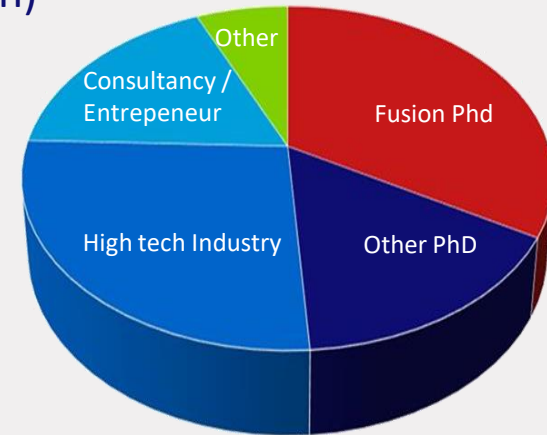
# MSc Nuclear Fusion @ TU/eindhoven

- Worldwide Unique, interdisciplinary 2 year's dedicated Fusion Master
- Top rated programme
- Links to (almost) all fusion labs worldwide (internships, projects)
- Also focus on generic skills and competence development



# MSc Nuclear Fusion @ TU/eindhoven

- Large contribution of students to our research (25 Msc. theses/year)
- Connection to various expertises & research programs via student projects
- Support by FuseNet (EU association on fusion education)
- Hands-on, excursions, masterclasses, science lunches
- Close collaborations with DIFFER, W7X, ITER
- Outflow: 40-45 % PhD, 25-30 % high tech industry



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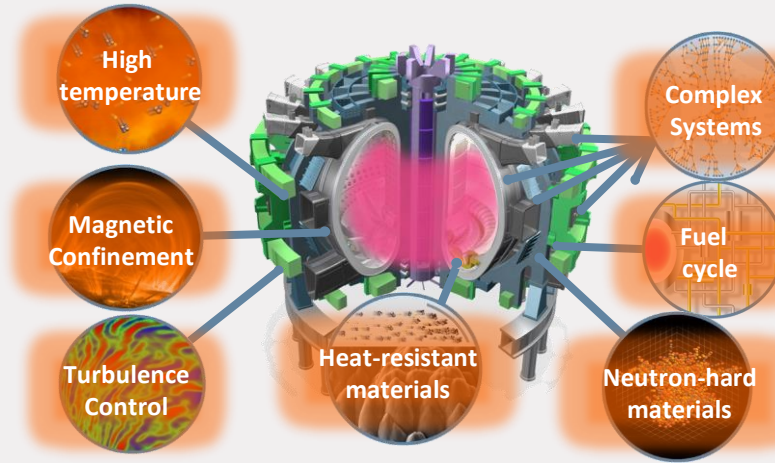
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