Conquering turbulence in fusion plasmas:
The key to design unprecedented stellarator reactors

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The stellarator concept

Main processes that limit confinement:
- Undesired particle drifts
- Collisional diffusion
- Turbulence
The optimised stellarator concept

Main processes that limit confinement:

- Undesired particle drifts
- Collisional diffusion
- Turbulence
Turbulence is present everywhere!

Image credits: NASA/JPL-Caltech/SwRI/MSSS/Kevin M. Gill
Turbulence in fusion plasmas

Gyrokinetics:

Wendelstein 7-X, courtesy: IPP, 2016
Turbulence in fusion plasmas


Drift wave in a plasma, courtesy of J.H.E. Proll

Can we conquer plasma turbulence?
How are we planning to conquer it?
Identifying the driving gradients
Turbulence in stellarators depend strongly on the geometry!

Wendelstein 7-X  Helically symmetric experiment  Quasi-poloidal stellarator

Our simulations show:

Saturation model  Optimisation process

Fusion reactor
Summary and outlook

• The stellarator concept is a great candidate for future power plants.

• Plasma turbulence is still a complex challenge for stellarator devices.

• Linear physics is understood
• Non-linear interactions depend on geometry

• Understand saturation mechanisms that intervene in stellarator turbulence

• Identify their dependence on the geometry

• Create models to describe observed phenomena
• Further prediction of transport levels