

Next Step Fusion

Specialized fusion supply chain company

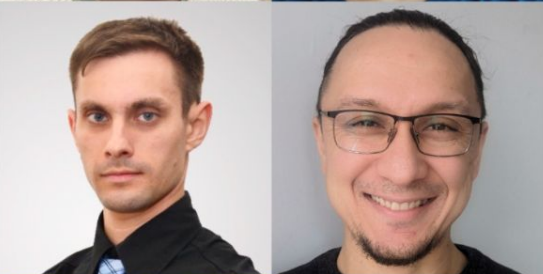
Team



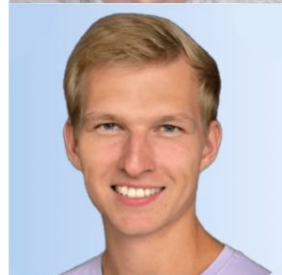
At Next Step Fusion, we believe recent and upcoming progress will soon launch the fusion energy industry, providing safe and affordable energy for humanity

Private EU company established in April 2023 in Luxembourg:

- **Unique, interdisciplinary team** of 20+ based in Luxembourg (HQ), Spain, and Portugal
- **Deep expertise in tokamaks** design, simulation, control, and diagnostics
- **Dedicated teams** for simulation software development and AI/ML
- **Vast experience** with ITER, KTM, T-10, T-15MD, COMPASS, DIII-D, ISTTOK, and TJ-II stellarator
- **Proven track record** in the public and private fusion sectors



NEXT STEP FUSION



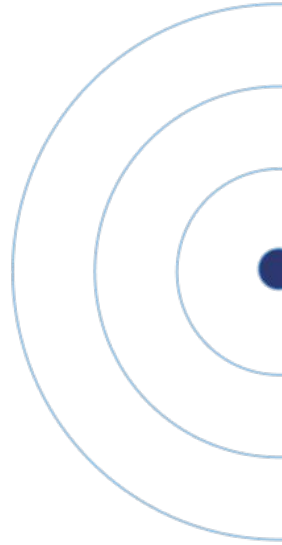




High-Quality Professional Solutions

Services and Products

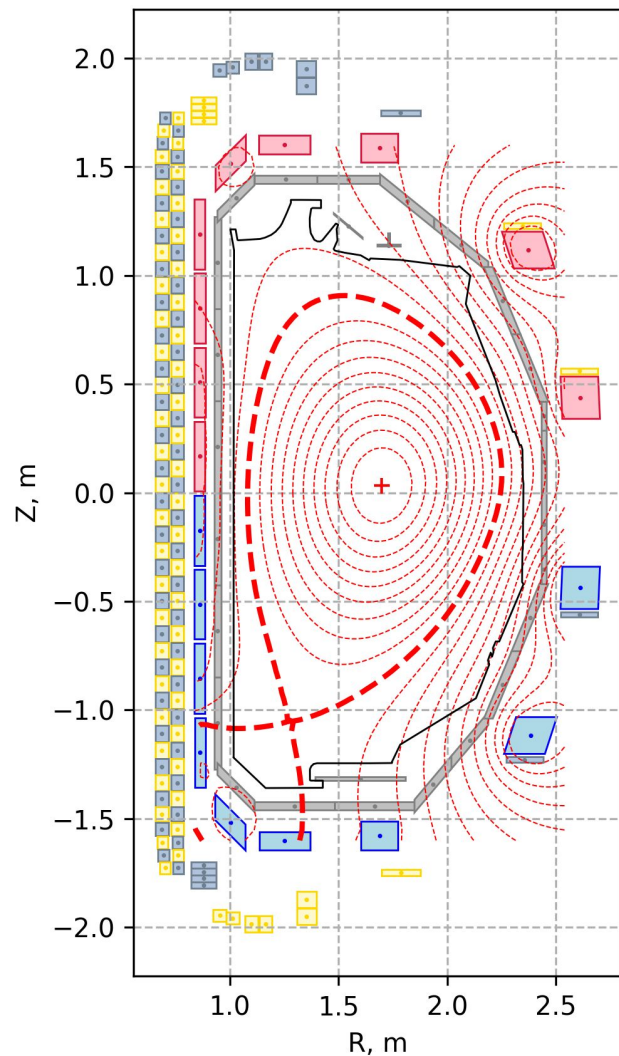
Tokamak Integrated Modeling



Tokamak Integrated Modeling

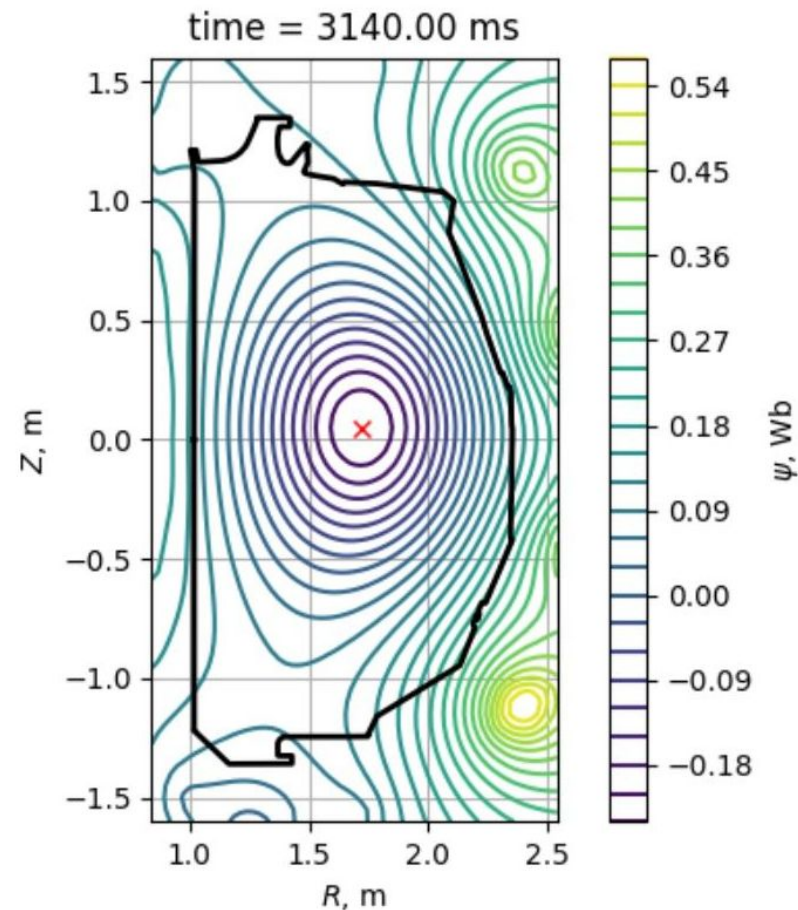
We provide **end-to-end multi-physics simulations** of tokamak systems to support design optimization, performance prediction, and scenario development:

- **NSFsim** – a Grad-Shafranov 2D solver with a 1D kinetic component, based on the renowned DINA simulation approach and modular architecture
- **Tokamak digital replica** for self-consistent modeling, built from the geometrical and electrical characteristics of the magnetic system and passive conducting structures
- **TGLF, TRAVIS, and other codes integrated** to support wide range of use cases



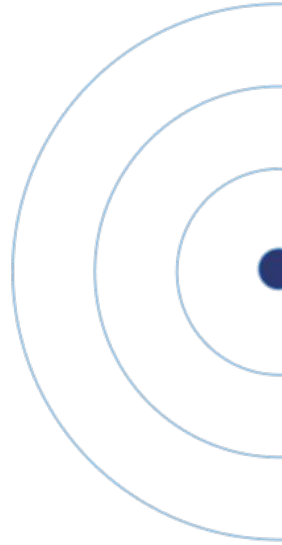
Advanced Tokamak Simulations

- **Feedforward simulations** of plasma equilibrium evolution
- **Discharge scenario development** to reliably achieve specific targets
- **Plasma-free calculations** to validate the 2D electromagnetic model
- **Inverse solver** to generate plasma parameter start points from defined inputs (e.g., for training ML models)
- **Disruption simulation (MD/VDE)** to safeguard device operations
- **Equilibrium reconstruction** with fixed or floating filaments



| | Supported | Coming soon |
|---------------------------|---|---|
| Equilibrium solver | <ul style="list-style-type: none"> ✓ Forward free-boundary equilibrium solver ✓ Flexible simulation scenarios ✓ Passive structures simulation ✓ Adaptive mesh | <ul style="list-style-type: none"> 🕒 Equilibrium reconstruction 🕒 Inverse task solver 🕒 Scenario development |
| Transport | <ul style="list-style-type: none"> ✓ 1D core transport solver ✓ GYRO-BOHM, MMM9 ✓ n/Tau impurity transport ✓ Integration with TGLF/TGLF NN | <ul style="list-style-type: none"> 🕒 SOL transport 🕒 Impurity transport |
| Heating and current drive | <ul style="list-style-type: none"> ✓ Parametric electron heating ✓ Parametric ion heating ✓ TRAVIS for ECRH heating | <ul style="list-style-type: none"> 🕒 ASCOT5 for NBI and fast particles 🕒 ICRH heating 🕒 LHCD |
| Control | <ul style="list-style-type: none"> ✓ Linear response controller for vertical stability ✓ Linear response controller for plasma density ✓ RZ position control | <ul style="list-style-type: none"> 🕒 Linear models generator |
| Synthetic diagnostics | <ul style="list-style-type: none"> ✓ Probs ✓ Loops | <ul style="list-style-type: none"> 🕒 ECE |
| Disruptions | <ul style="list-style-type: none"> ✓ VDE ✓ Halo and eddy currents | |
| MHD stability | <ul style="list-style-type: none"> ✓ VDE | <ul style="list-style-type: none"> 🕒 MISHKA for pedestal |
| Availability | <ul style="list-style-type: none"> ✓ Public web API – examples in the GitHub ✓ Professional simulations – contact us | |

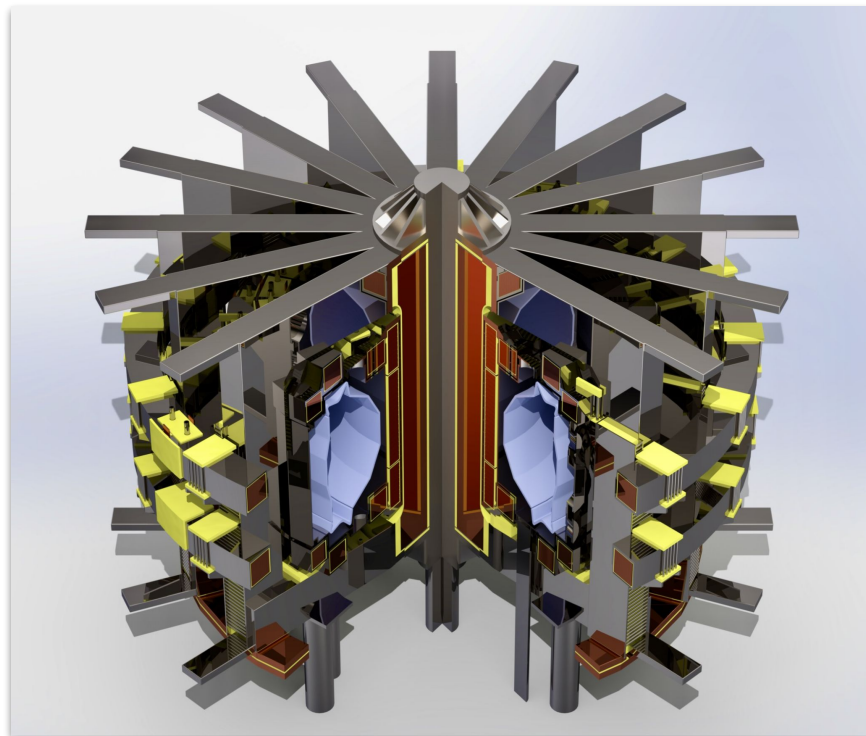
Tokamak Design Services



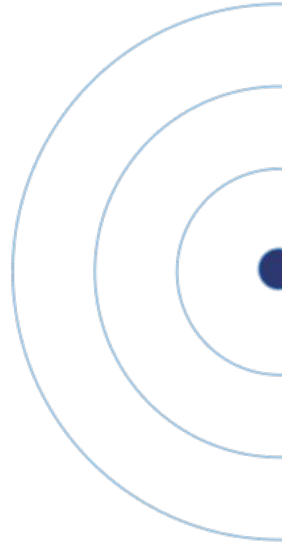
Tokamak Design Services

We provide **feasibility studies and design services** to support tokamak builders from day one, or even earlier:

- **Consulting** on using the tokamak concept for specific research or business matters
- **Tokamak feasibility study** with overall assessment and basic simulations within one to two months
- **Further design stages** include high-fidelity optimization of coils, vessel, transport, heating, fueling, loads, and many other aspects of future tokamak – delivering a fully validated design



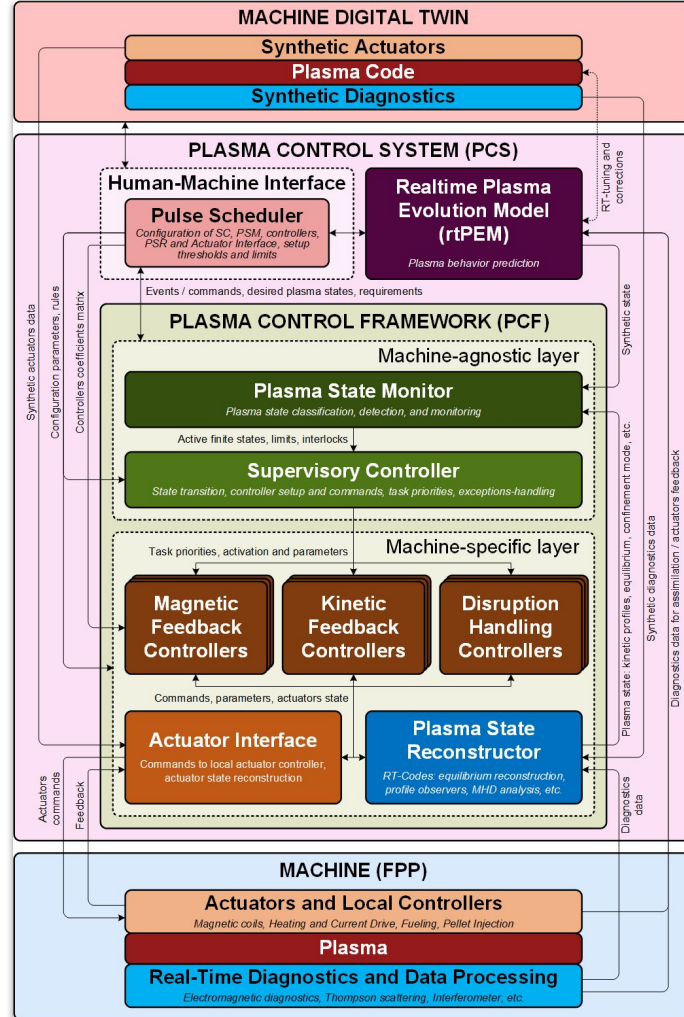
Tokamak Plasma Control



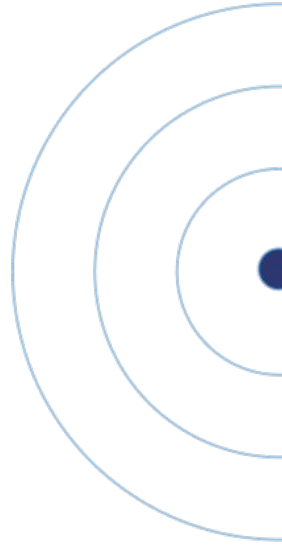
Tokamak Plasma Control

We develop **plasma control solutions** that combine conventional approaches with machine learning to provide the most robust and reliable real-time control of tokamaks:

- **Modern industrial PCS** for tokamaks, stellarators, and future power plants
- **Reinforcement-learning-based** controllers of plasma state, position, and other plasma parameters
- **NSFsim and its public API** for controller development and testing



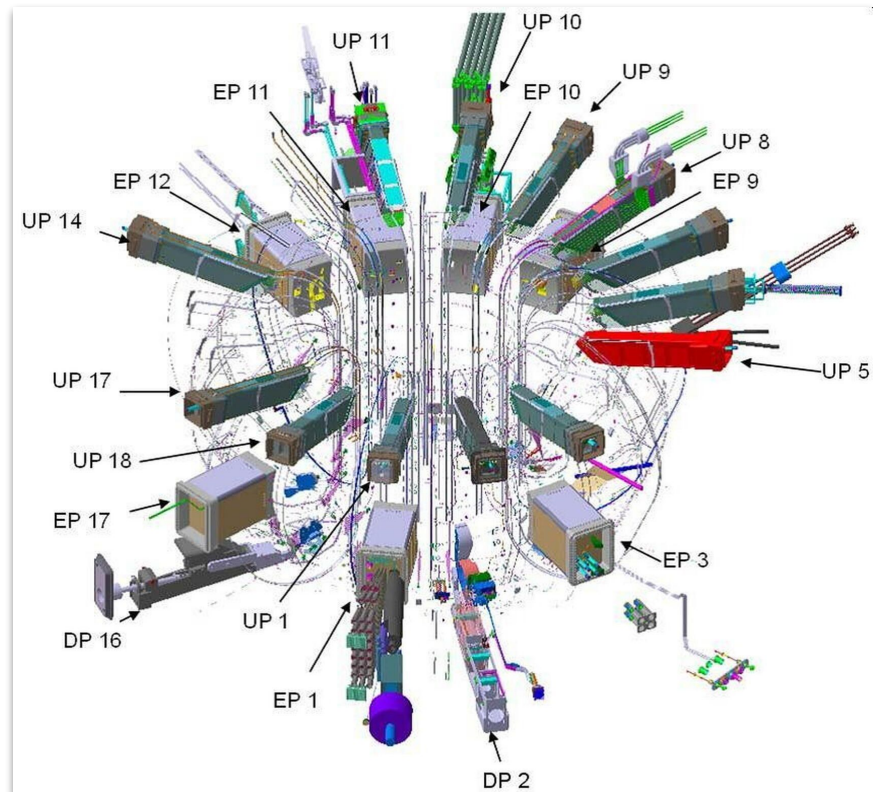
Integrated Diagnostics Solution for MCF Devices



Integrated Diagnostics Solution

We develop an **integrated set of diagnostics** for tokamaks, stellarators, and other MCF devices to address the following problems and market constraints:

- **Lack of standardization** in otherwise mature sensor solutions
- **High-neutron environments** require shielding, component durability, and system lifetime
- **Industrial operations** require robust, maintainable systems with 24/7 uptime
- **Fusion energy economics** require off-the-shelf, readily procurable solutions



Integrated Diagnostics Solution

We build **hardware, software, and a full supply chain** to enable fusion companies to move faster and more cost-effectively:

- **Modular port-plug-based unit** with multiple reactor-relevant sensors
- **Minimized footprint** within blanket and shielding structures
- **Hot-swappable** and available off the shelf
- **Unified data acquisition** and processing for all measurements
- **Physics-informed software** for real-time reconstruction of additional plasma parameters

real-time software

Plasma state

Comprehensive representation of plasma that enables flexible and reliable control.

Plasma parameters

Physics-informed real-time software and AI models that reconstruct all required plasma parameters.

Data acquisition

Holistic and reliable real-time data acquisition solution that enables software components.

Diagnostics

Customizable set of diagnostics enabling monitoring and redundant reconstruction of required plasma parameters.

Waveguides and mirrors

Standardized hardware consumables supplied during device's lifecycle.

Windows

Multiple vacuum windows fit into one port to minimize the diagnostics footprint requirements.

standardized hardware

Collaboration with UCSD and DIII-D



Collaboration with UCSD and DIII-D

In 2023, **we were the second private company** to join the DIII-D National Tokamak Facility as a user:

- **Huge support** from UCSD, DIII-D, and GA teams. Special thanks to Dmitri Orlov and Randall Clark!
- **Real-time plasma control module** has been integrated into the DIII-D PCS, tested with various ML models, and is available in the main branch
- **20+ discharges, 4 papers, several posters**, a few blog posts, and numerous mentions in LinkedIn
- **Still a lot of potential** collaboration topics: microwave diagnostics, synthetic diagnostics, and plasma parameter reconstruction, etc.



Next Step Fusion is

- Experienced specialized fusion supply chain company providing tokamak simulations, design, and plasma control services using NSFsim, [FusionTwin.io](https://fusiontwin.io), Plasma RL, and other tools for integrated tokamak modeling and control
- Developer of Integrated Diagnostics Solution for MCF devices that intends to address known problems and constraints, and enable fusion companies to move faster and cost-effectively
- Your fusion partner – we will be happy to see you among our friends, partners, and customers!





Follow us on [LinkedIn](#) or contact at info@nextfusion.org

Thank you!