HUN REN | Centre for Energy Research

HUN-REN Hungarian Research Network

HUN-REN Centre for Energy Research
Fusion Plasma Physics Laboratory

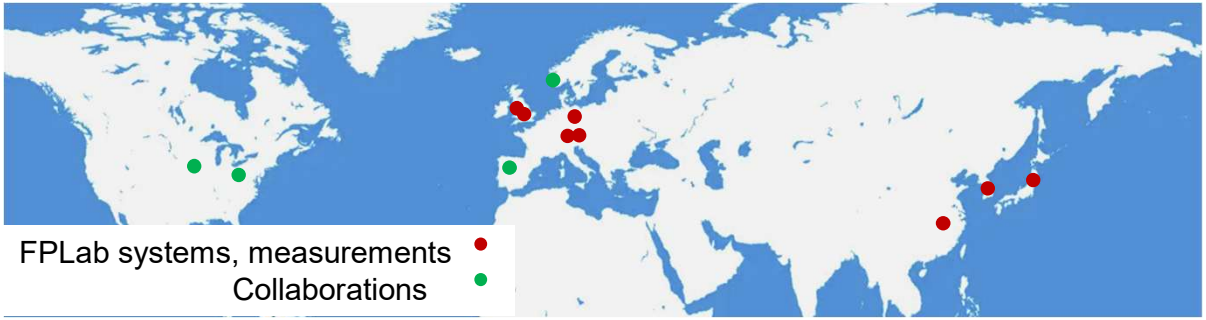
Physics informed neural networks for fusion plasma control

Balázs Molnár

Research. Innovation. Impact.

Fusion plasma physics laboratory (FPLab)

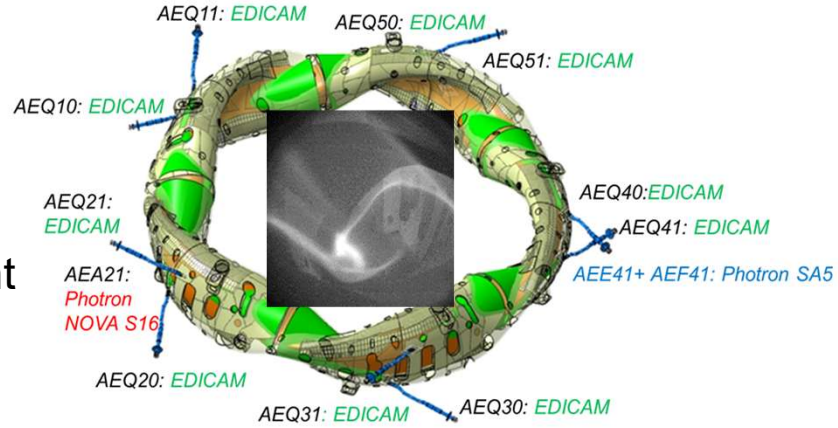
- Diagnostic developement, construction, installation and operation
- Plasma physics measurements, modeling, theory
- Publications in Nuclear Fusion, Rev, Sci. Instrum., Plasma Phys. Control. Fusion.



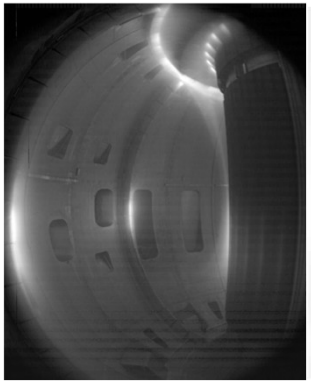
Video diagnostics:

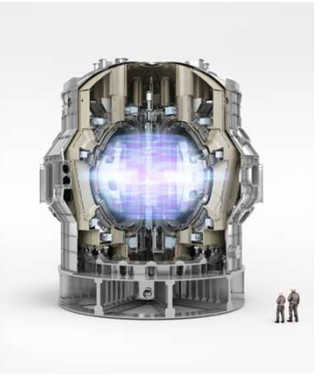
- Special camera development
- Overview diagnostic
- Turbulence measurement

Wendelstein 7-x (Germany)



JT-60SA (Japan)





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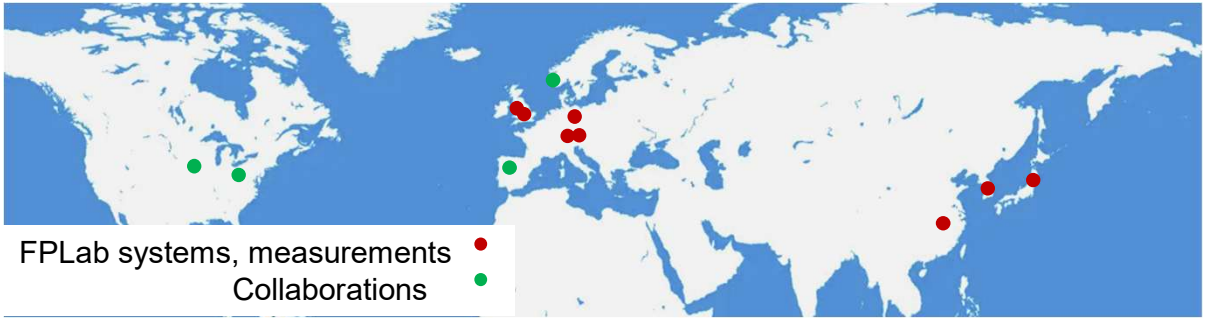
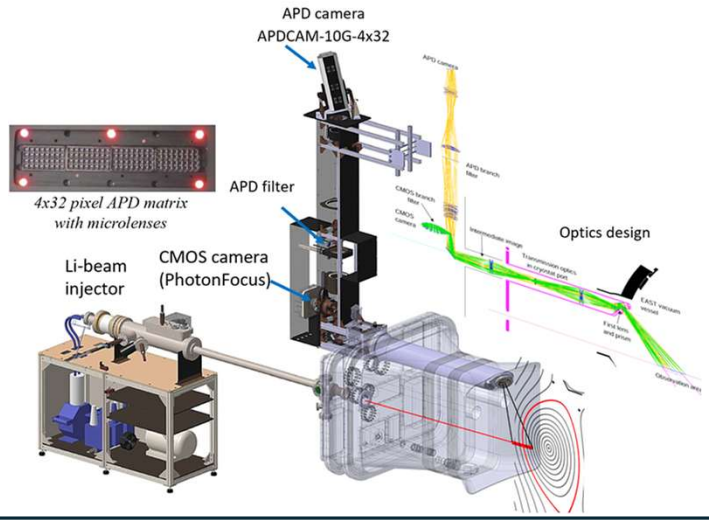
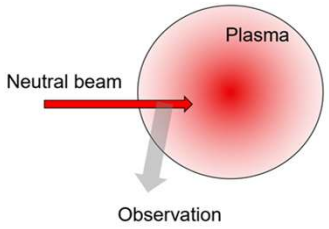


Beam Emission Spectroscopy

- Alkali beam injectors
- Optics and detectors
- Density profile and turbulence measurements

Wendelstein 7-x (Germany)





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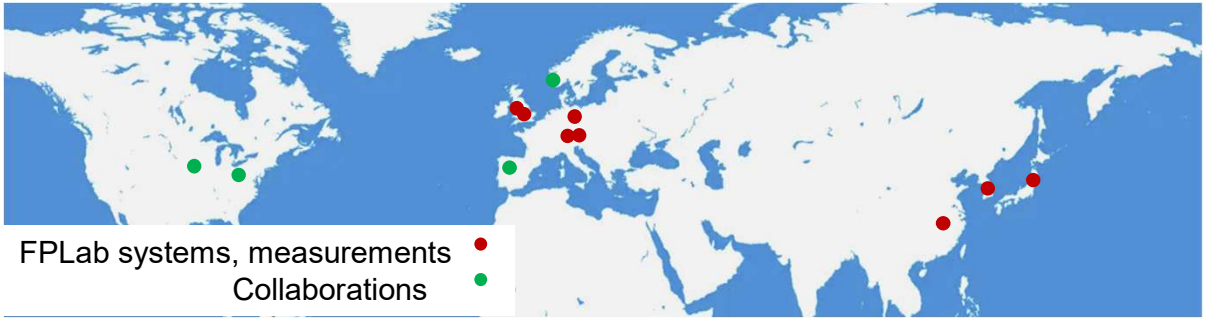


Disruption Mitigation System (DMS) development: Shattered cryogenic pellets

HUN-REN Centre for Energy Research (Budapest)

ITER DMS Support Laboratory

- Cryogenic technology, diagnostics, modeling
- Gas flow modelling and measurement

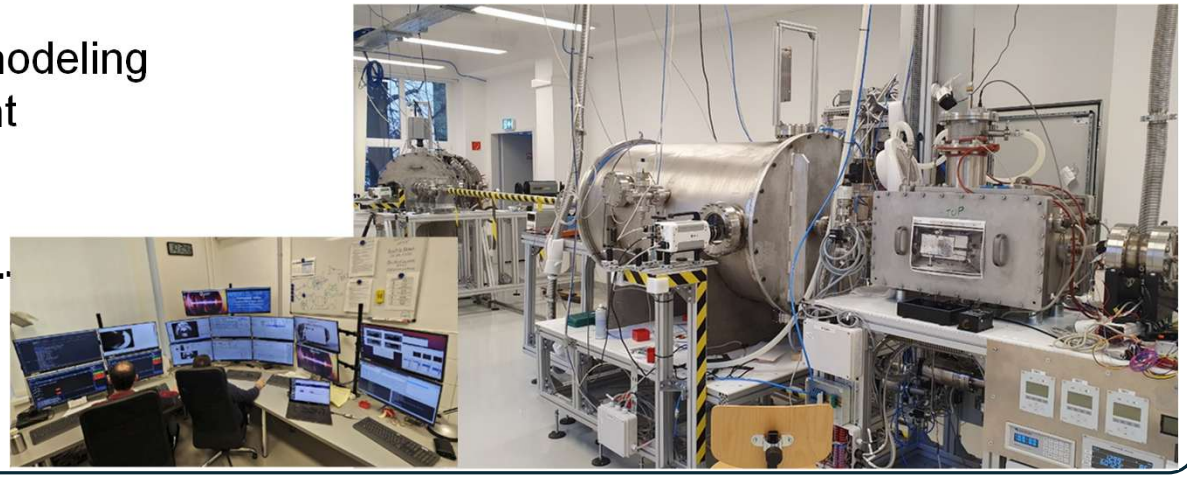
DMS fast shutter development

- Design and concept test of setup

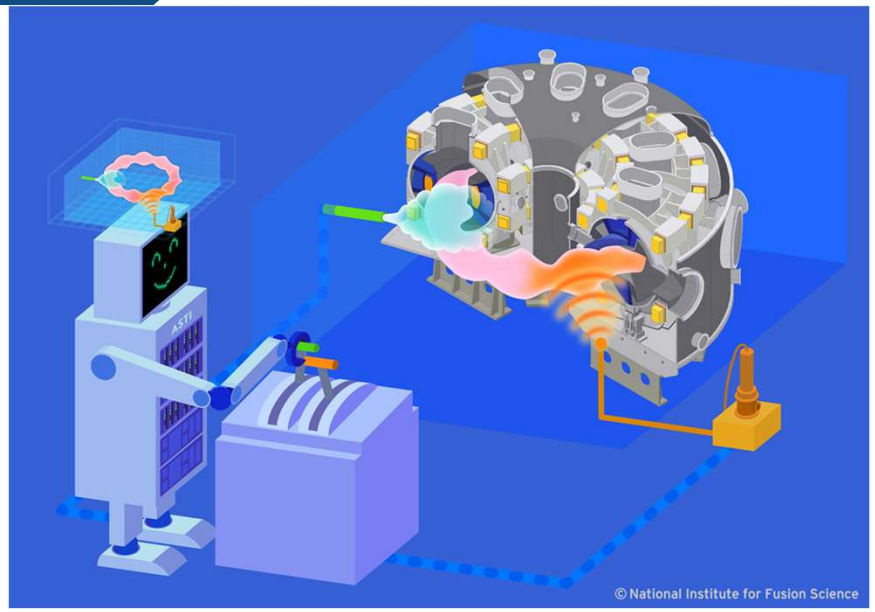
Optical Pellet Diagnostic prototype (2024-

- Real-time processing
- Rad-hard system

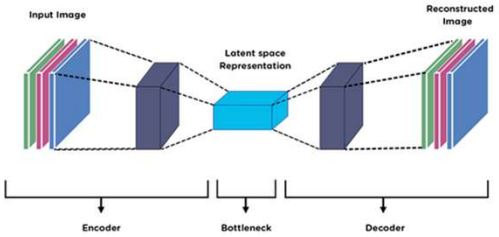
DMS launch unit prototype (2025-)

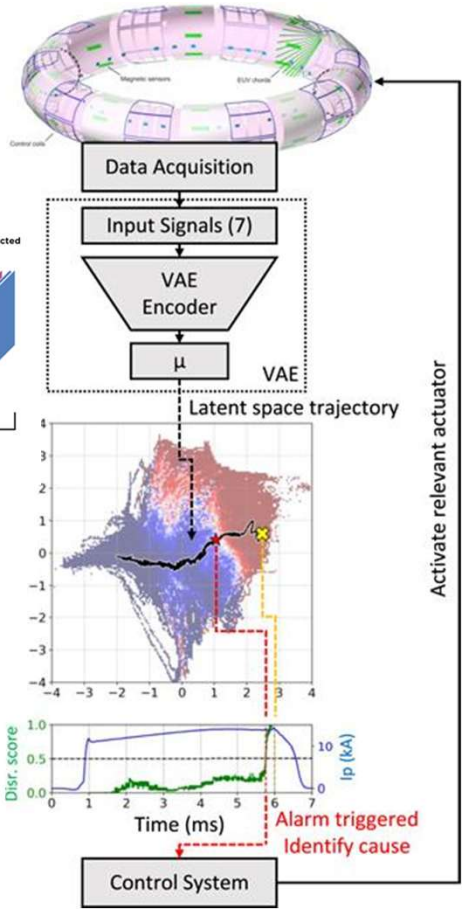


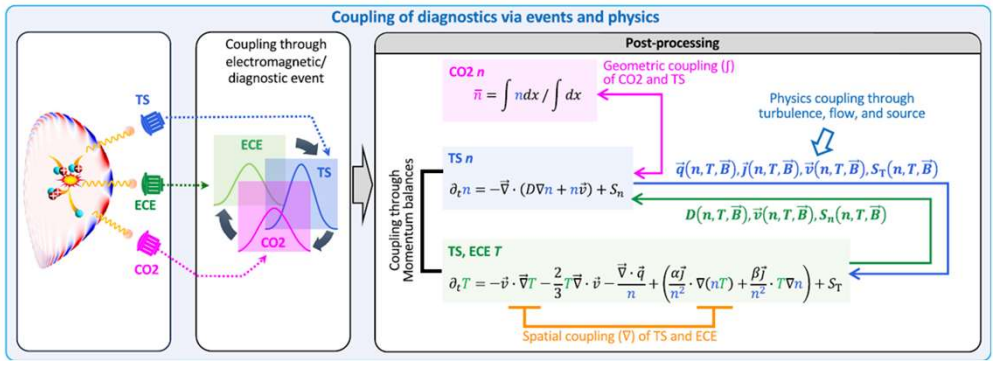
Digital twin for fusion



Low-dimensional representation-learning with autoencoders for controlling tokamaks







Multimodal approach and physics-informed neural networks

Digital twin for fusion

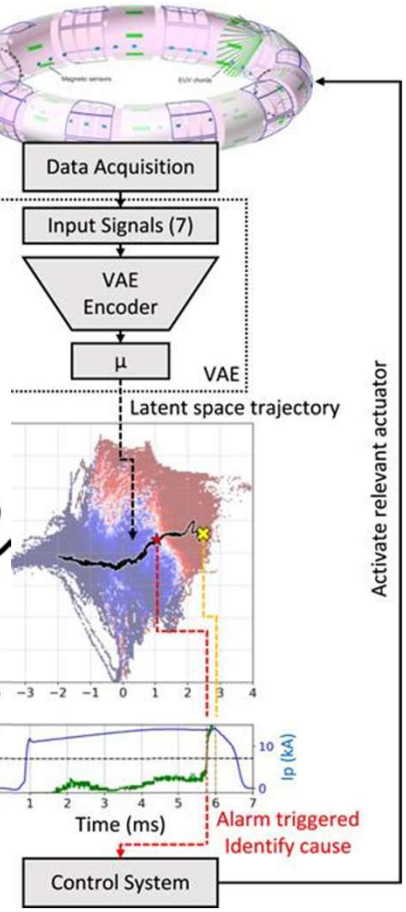
TensorFlow

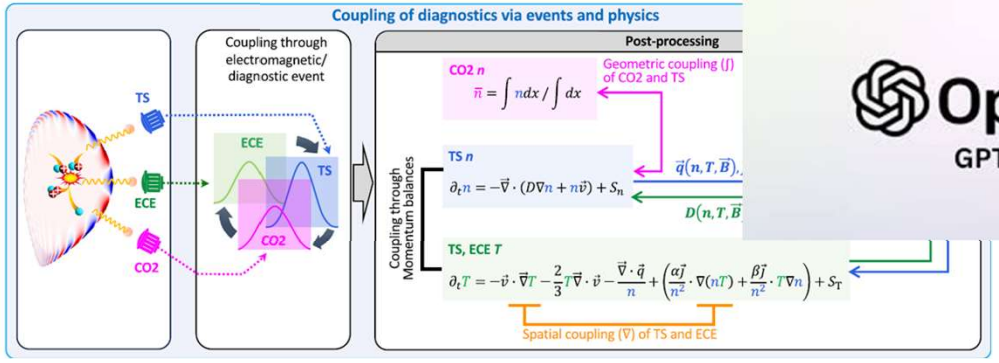
PYTHON

git

ONNX

scikit learn





OpenAI
GPT-OSS

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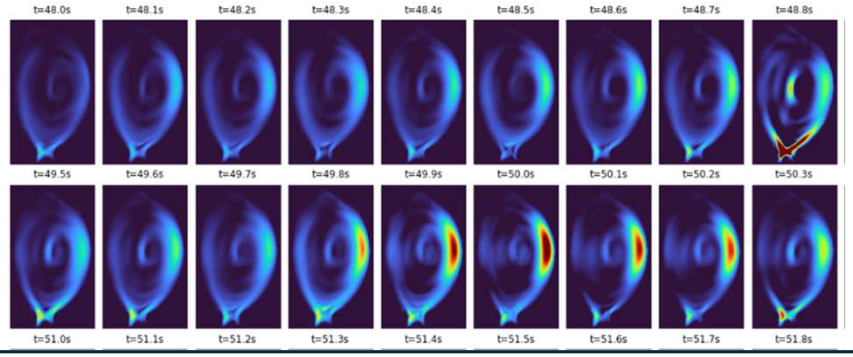
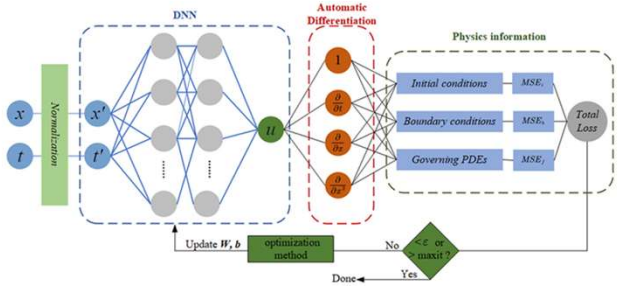
networks

Current research topics

„Bolometer tomography for real-time control”

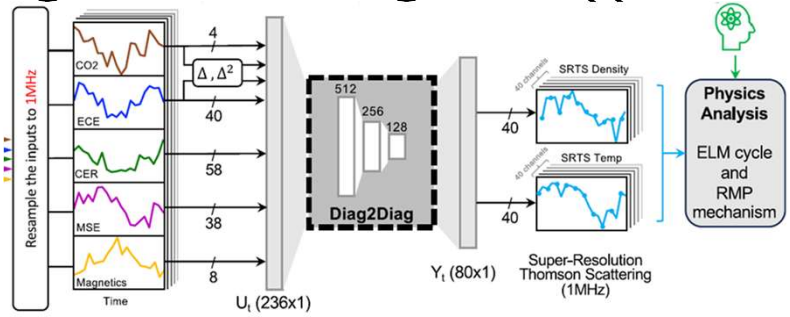


„Physics informed neural networks for beam emission spectroscopy”

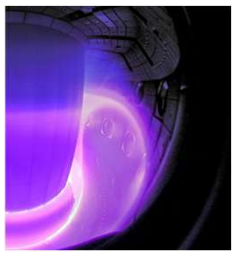


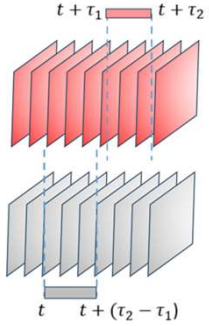
$$\lambda \frac{\partial^n u(x,t)}{\partial x^n} + f(x,t) = 0$$
$$u(0,t) = \varphi(0,t)$$
$$u(x,0) = g(x,0)$$

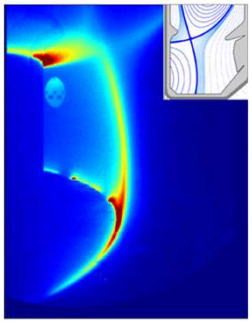
„Plasma control using representation learning with a multi-diagnostic approach”



„Advanced processing of fusion plasma video recordings using AI”







Contacts

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