Star Wars: Episode II: Return of Python

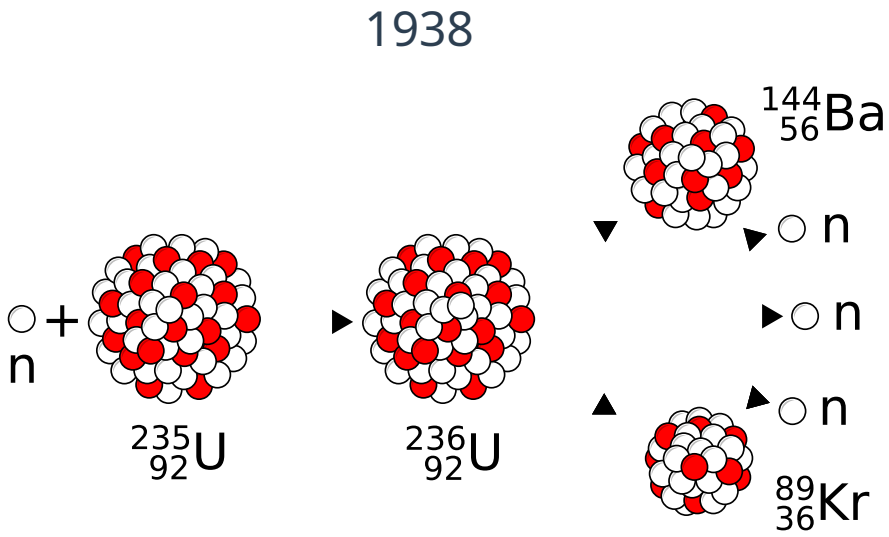
PyCon India 2025

Shakthi Kannan
@shakthimaan

Who am I?

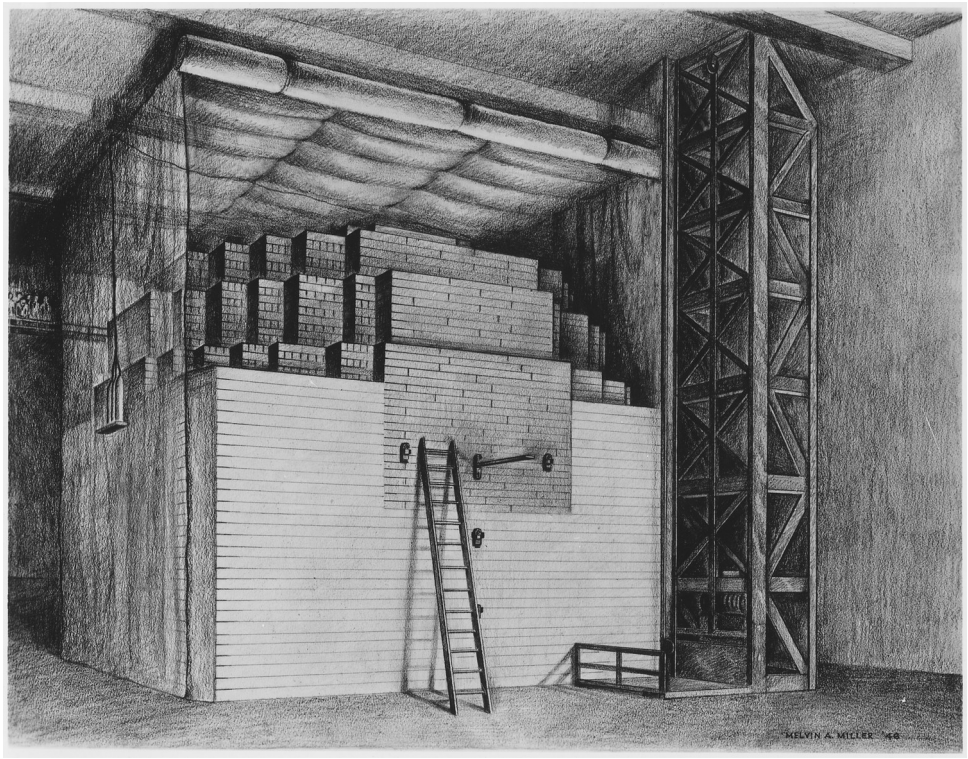
- Free Software enthusiast
- Book: “i want 2 do project. tell me wat 2 do.”
  - Google Summer of Code (GSoC)
  - KDE, Mozilla, User groups
- MOOC: Foundations in Free/Libre and Open Source Software
- Community: Chennai Linux User’s Group (ILUGC), GNU Emacs
- DeepTech R&D (IITM, UCBerkeley, UChicago, UCambridge)
- Online: @shakthimaan
- MS (IT), Rochester Institute of Technology

Nuclear Fission



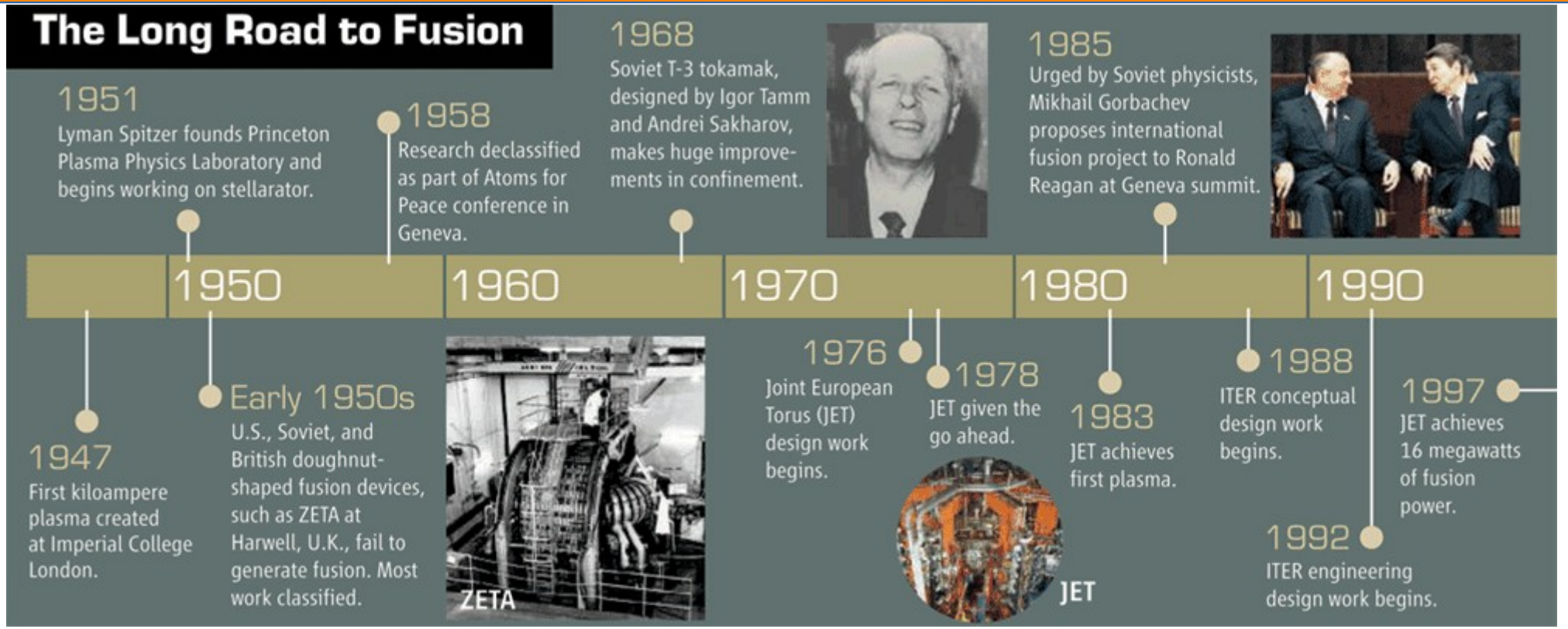
Sources:

- https://en.wikipedia.org/wiki/Discovery_of_nuclear_fission
- https://en.wikipedia.org/wiki/Chicago_Pile-1



Chicago Pile-1

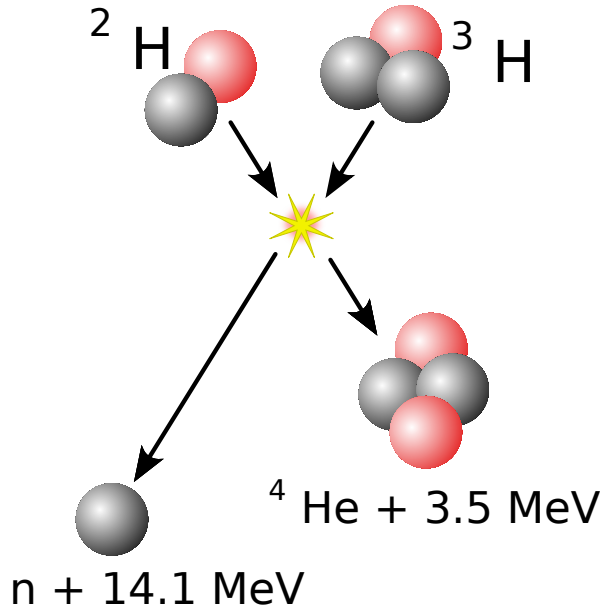
Nuclear Fusion



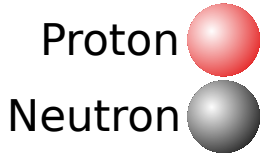
Source: https://www.linkedin.com/pulse/nuclear-fusion-ever-feasible-practical-affordable-jim/

Nuclear Fusion

- Fusion is clean energy
- Safe nuclear power with sufficient fuel
- Plasma confinement
  - Gravity, magnetic, inertia
  - Stellarator
  - Tokamak
  - Magnetic mirror
  - Spheromak



Sources:
https://en.wikipedia.org/wiki/Nuclear_fusion
https://suli.pppl.gov/2023/course/Moser_SULI_tokamak_2023.pdf



In the News

MIT News
ON CAMPUS AND AROUND THE WORLD

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Study: Fusion energy could play a major role in the global response to climate change

Experts in energy systems modeling and fusion technology explore the future role of fusion at various costs and carbon constraints.

Nancy W. Stauffer | MIT Energy Initiative
October 24, 2024

US energy chief tells BBC nuclear fusion will soon power the world

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UKAEA develops 3D printing for fusion components

Monday, 28 July 2025

Lawrence Livermore National Laboratory

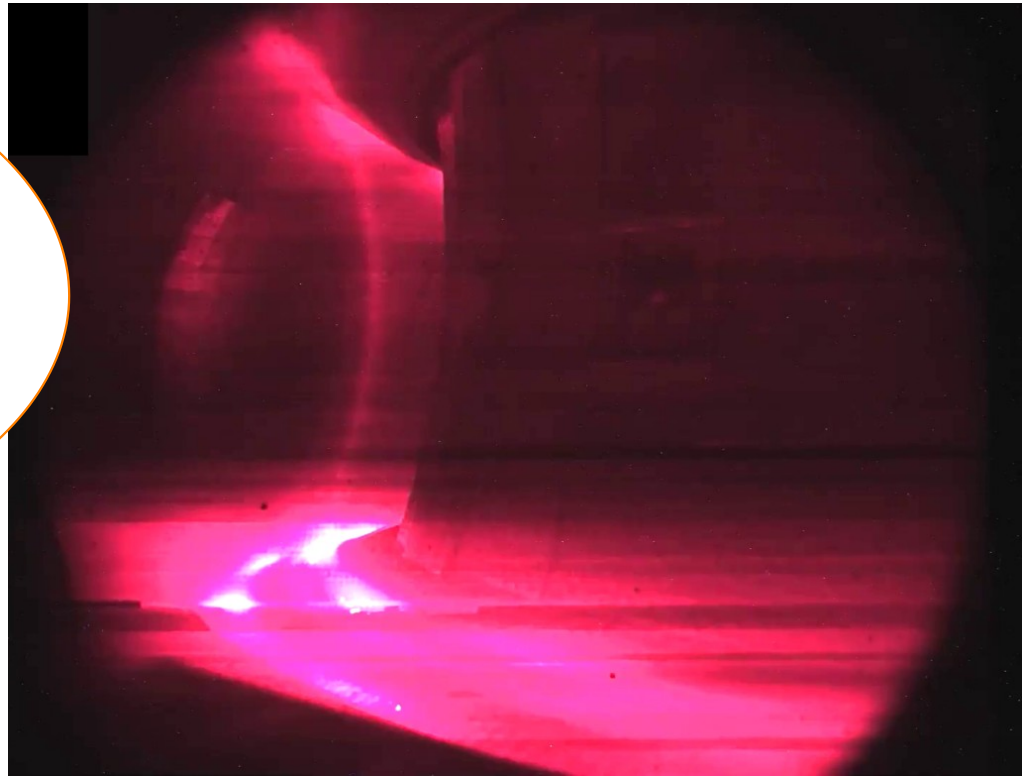
LLNL Pushes Frontier of Fusion Target Design with AI

4-Aug-2025 12:30 PM EDT, by Lawrence Livermore National Laboratory

13 Shares

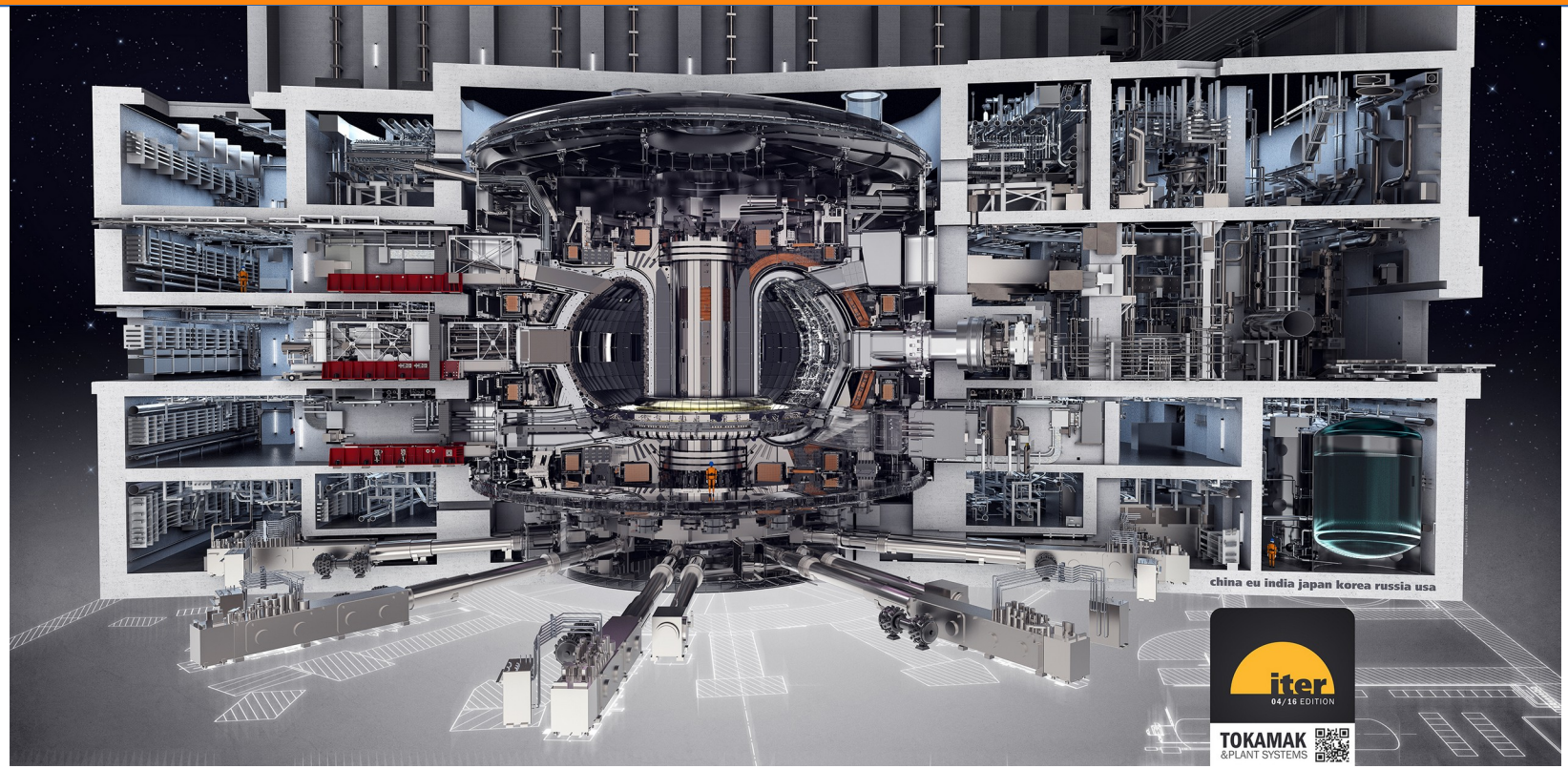
Commissariat à l'énergie atomique et aux énergies alternatives (CEA)

"West has achieved a new key technological milestone by maintaining hydrogen plasma for more than twenty minutes through the injection of 2MW of heating power." ~ Anne-Isabelle Etienvre, Director of Fundamental Research, CEA



Source: https://www.cea.fr/english/Pages/News/nuclear-fusion-west-beats-the-world-record-for-plasma-duration.aspx

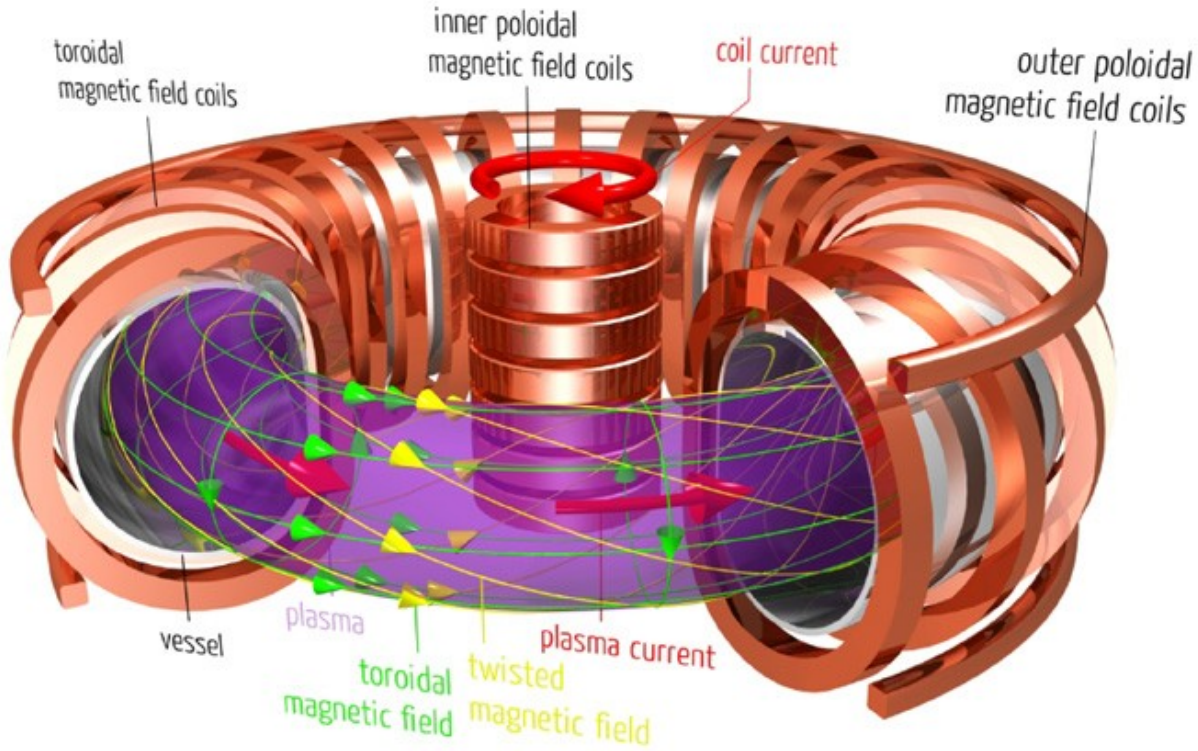
International Thermonuclear Experimental Reactor (ITER)



Source: https://en.wikipedia.org/wiki/ITER

Tokamak

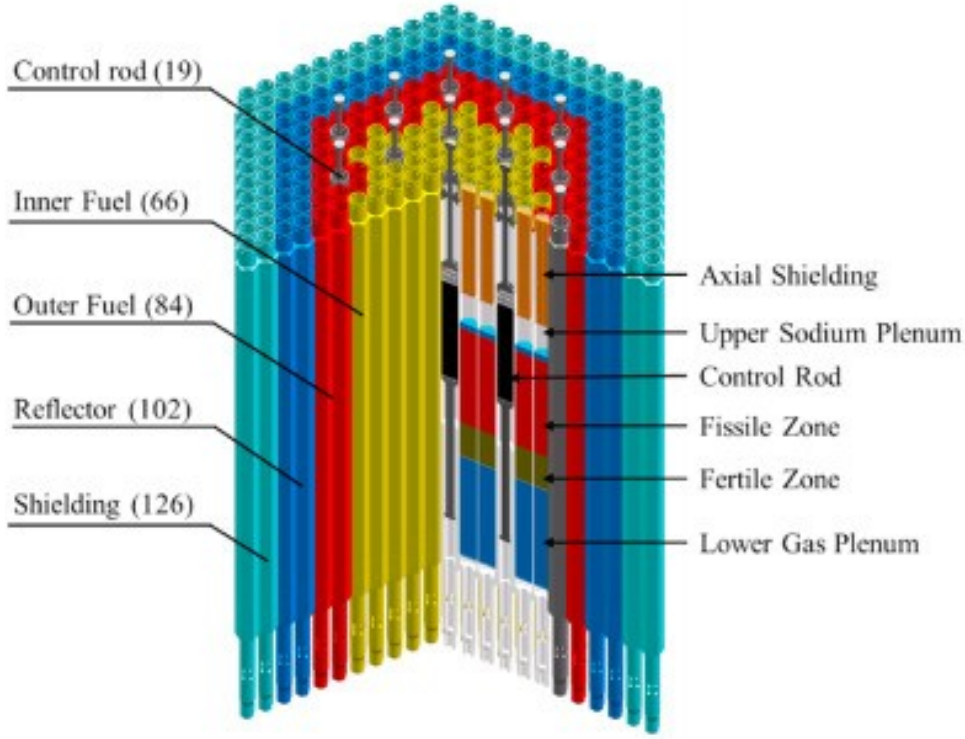
- Toroidal magnetic confinement
- Poloidal coils shape the plasma
- Plasma shape affect stability
- Particles along field lines



Source: https://physics.stackexchange.com/questions/333151/how-many-times-does-plasma-do-a-full-loop-tokamak-before-fusion

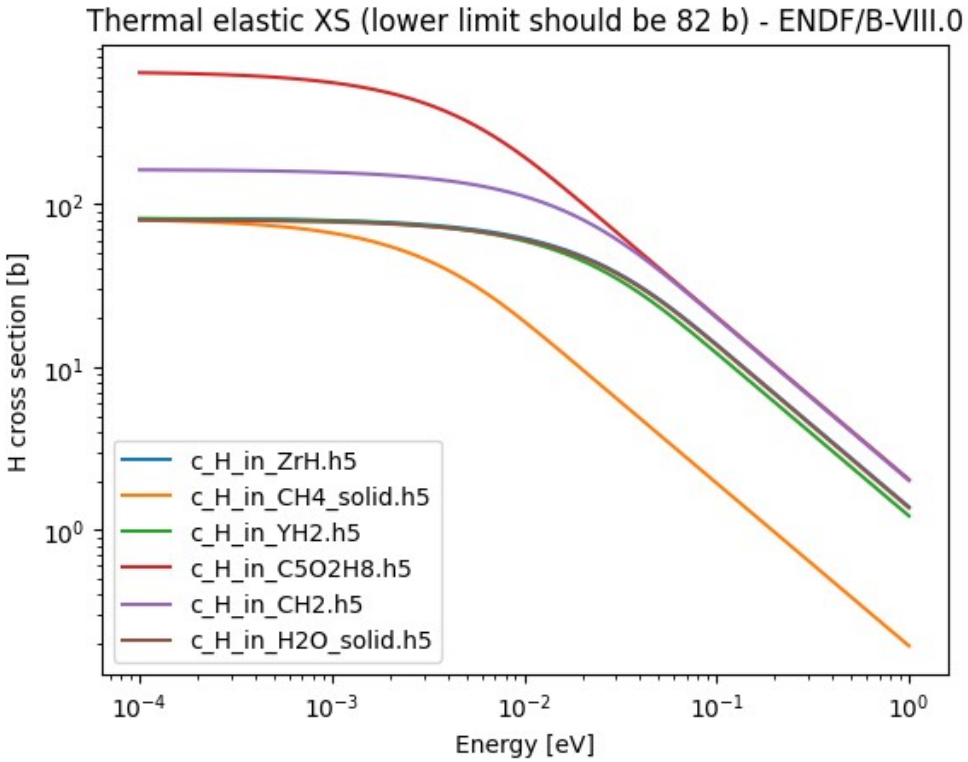
OpenMC

- Open Source Monte Carlo neutron and photon simulation transport code.
- Computational Reactor Physics Group at MIT
- Hybrid MPI and OpenMP programming model
- Python: 66.9% C++: 32.3%
- MIT/X License



Source: https://www.sciencedirect.com/science/article/pii/S173857332100557X

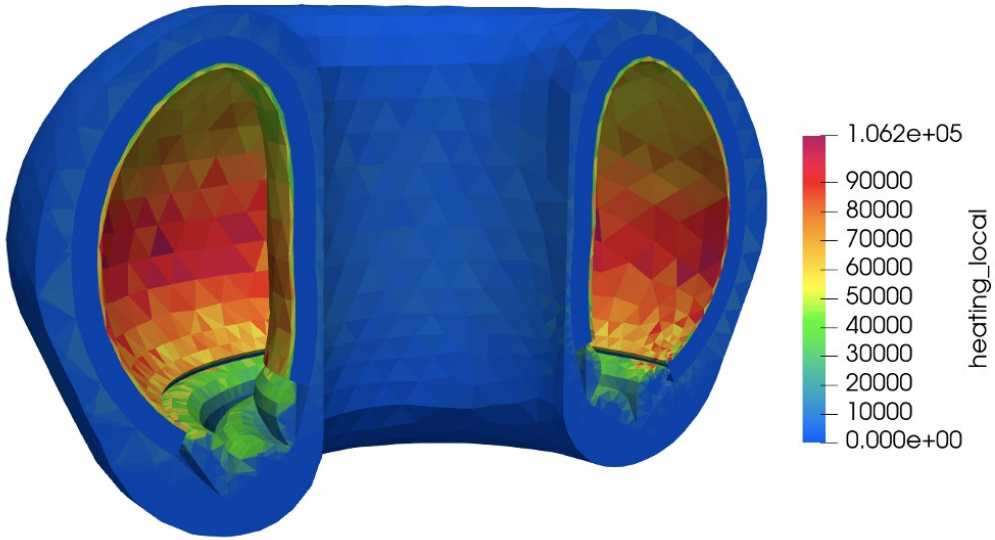
PR#3233 Error in thermal elastic data

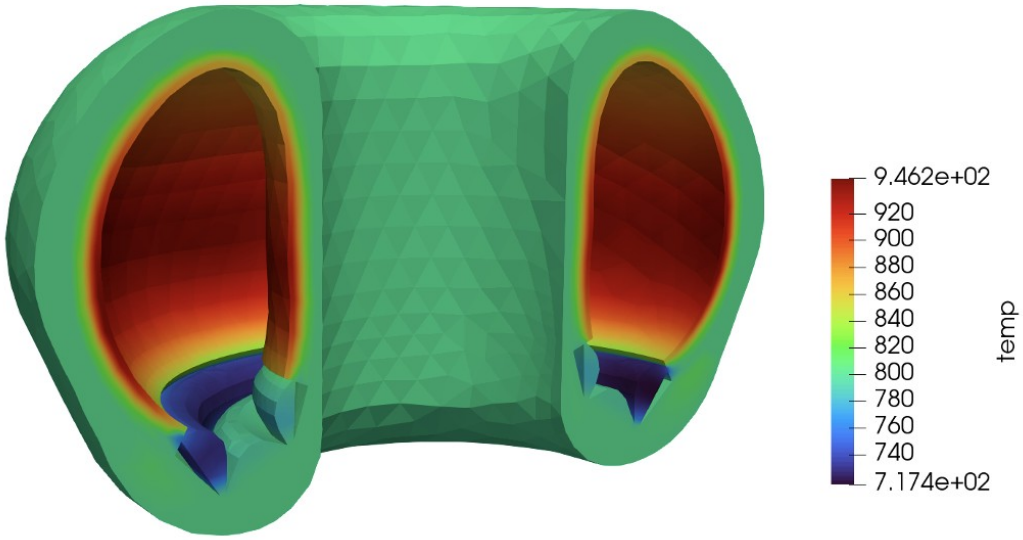


"This on itself is not an OpenMC bug, but, more likely proof that we (the thermal scattering evaluators) are horrible, horrible people, but, let's try to fix the issue in OpenMC." ~ Jose Ignacio Marquez Damian

Source: https://openmc.discourse.group/t/polyethylene-hdpe-cross-section-for-neutron-moderation/3019/10

DAGMC Tokamak

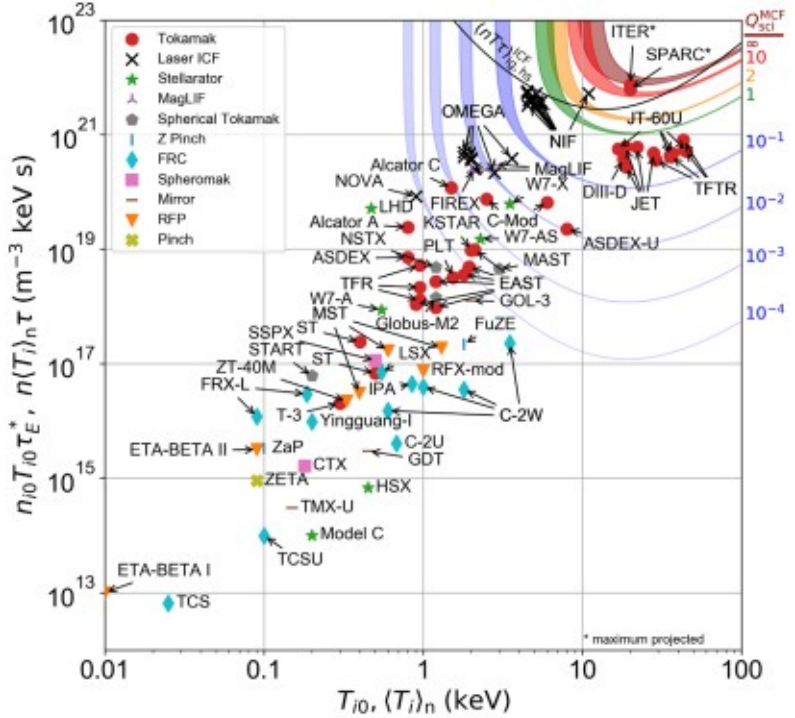




Source: https://cardinal.cels.anl.gov/tutorials/tokamak.html

Challenges

- Maintaining magentic confinement
- High temperature requirements
- Materials degradation
- High Capital Expenditure
- Long development time
- Radioactive waste
- Public perception
- Alternative renewable energy
- Political and economic reasons



Source: Samuel E. Wurzel, Scott C. Hsu. *Progress toward fusion energy breakeven and gain as measured against the Lawson criterion*. Physics of Plasmas.

“There is no place for dogma in science. The scientist is free, and must be free to ask any question, to doubt any assertion, to seek for evidence, to correct any errors.”

~ J. Robert Oppenheimer