OAK RIDGE National Laboratory

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WANDA-24
Fusion Energy Science

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U.S. DEPARTMENT OF ENERGY

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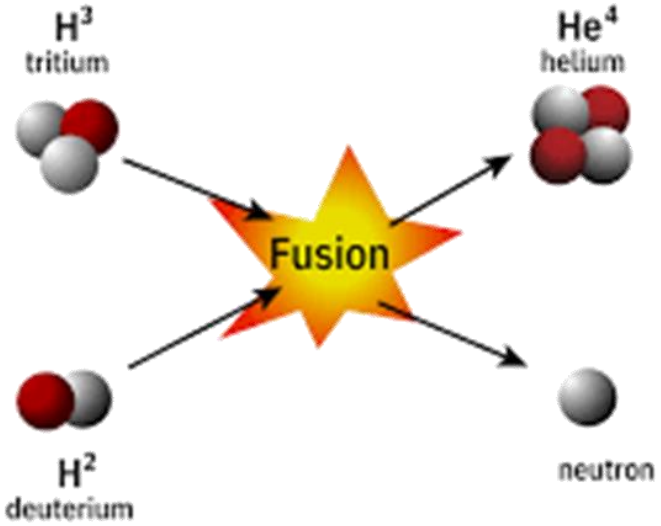
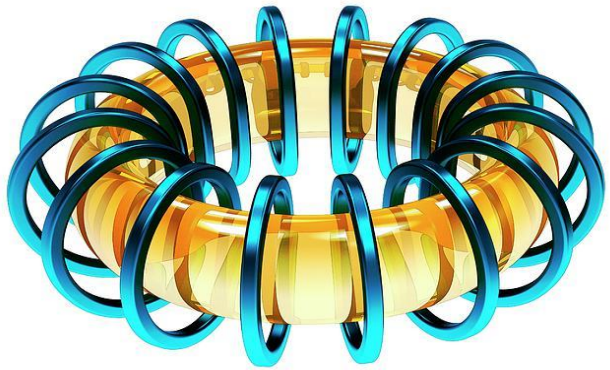
Nuclear Fusion

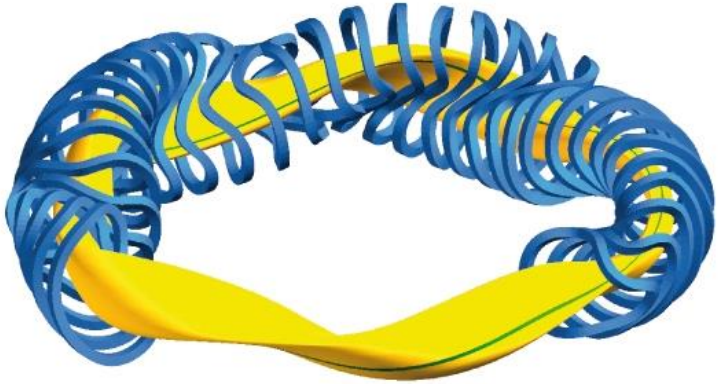
$$D + T \rightarrow \alpha + n(14.1MeV)$$

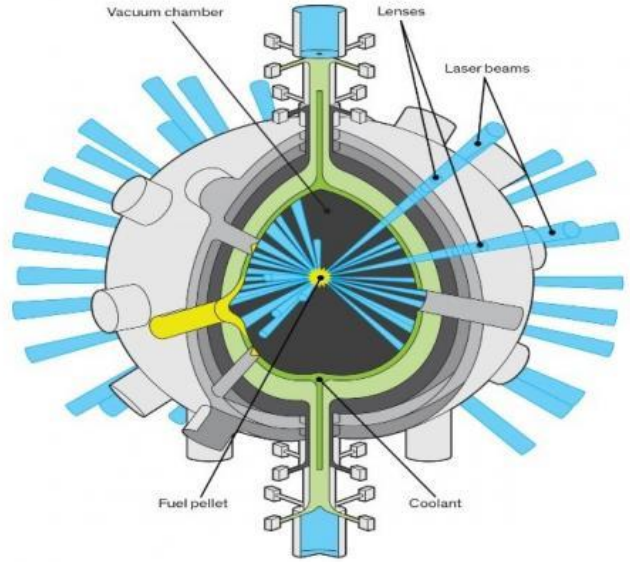
Magnetic confinement

Inertial confinement





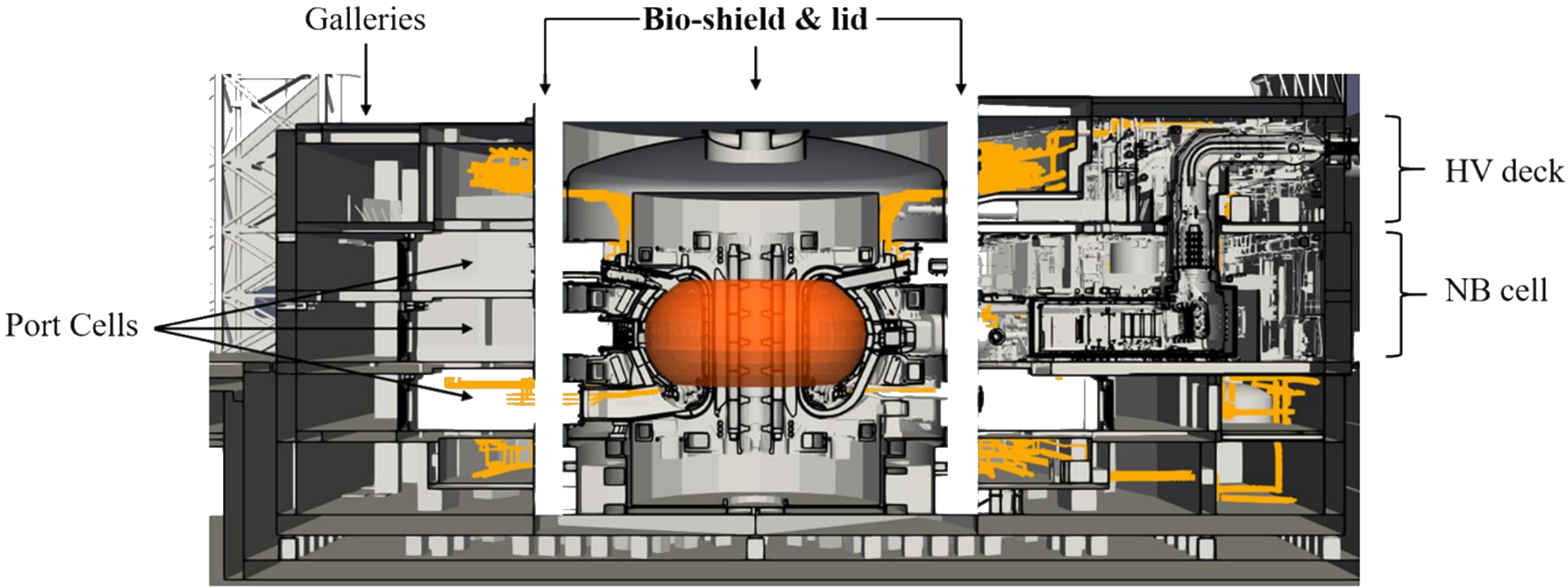




Neutron production: 3.5×10^{20} neutrons/sec/Gigawatt of fusion power.

Tritium breeding is essential for the fusion economy.
Tritium breeding ratio > 1.05.

Radiation Responses for Fusion (Tokamak example)



Tokamak materials

Plasma facing material: tungsten, boron

Blanket

- **Tritium breeding**
- **Energy conversion**
- **Shielding**

Divertor

- **Tungsten**

Vacuum vessel

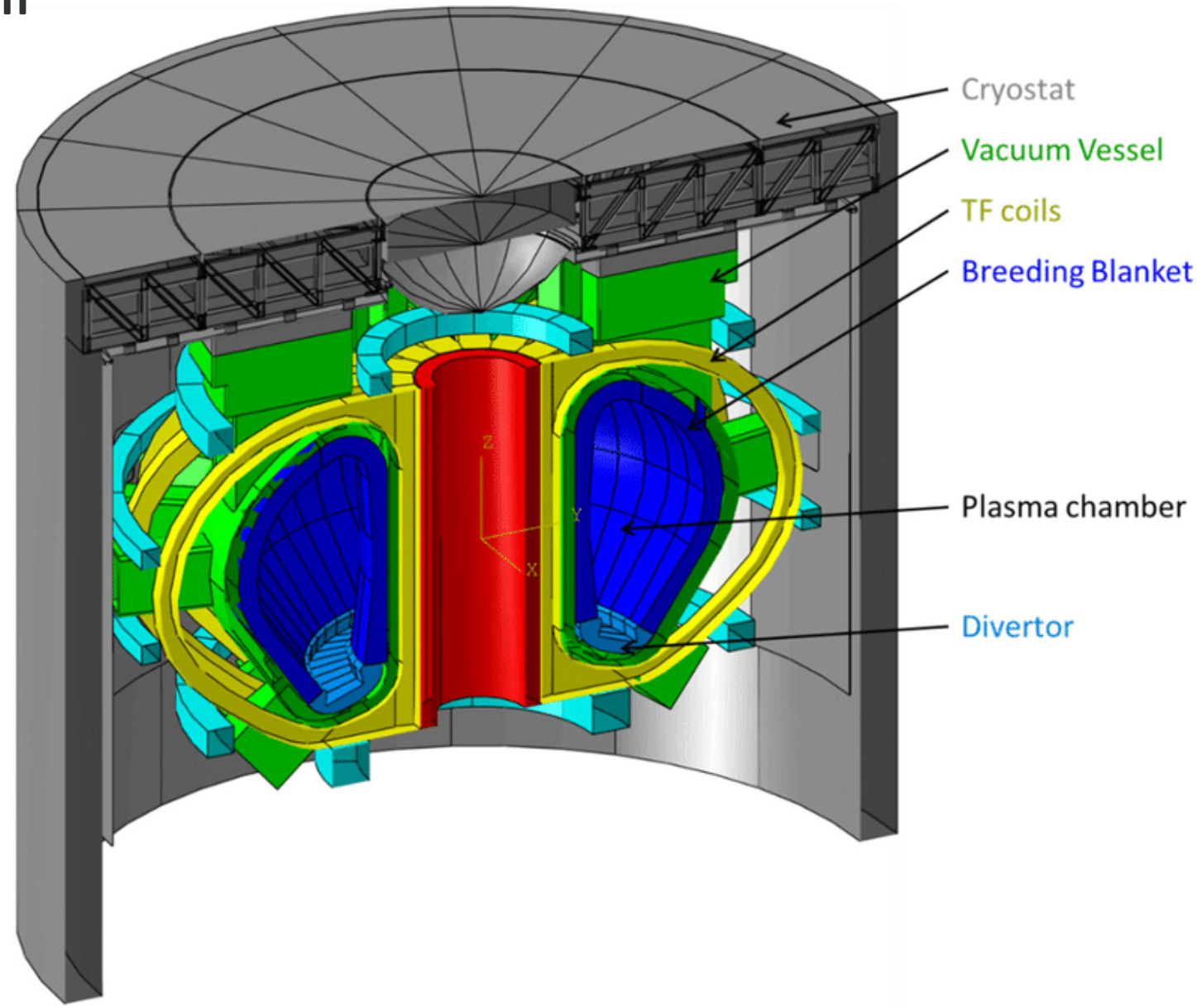
- **Steel**

Coils

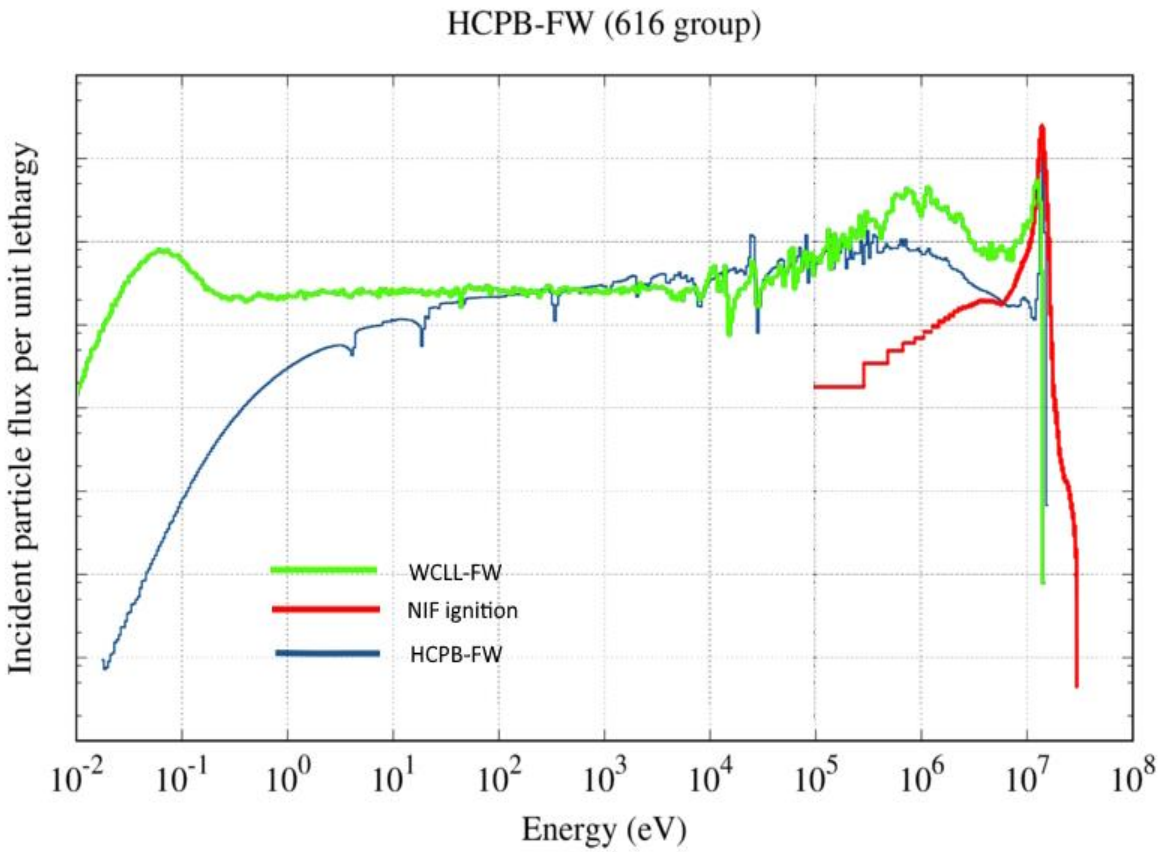
- **Niobium-Tin**
- **REBCO**

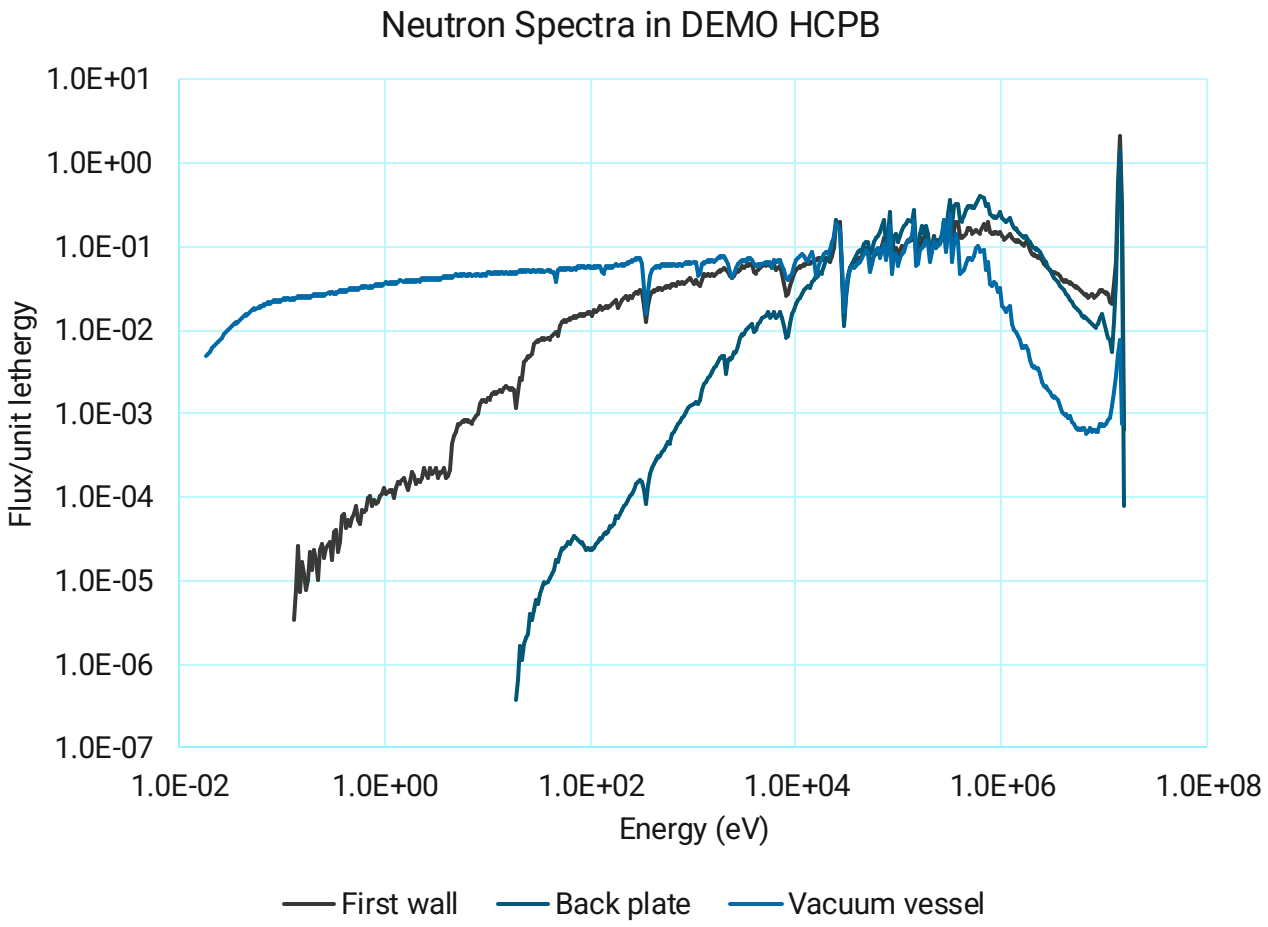
Cryostat and Thermal Shield

- **Steel**
- **Silver**



Neutron Spectra





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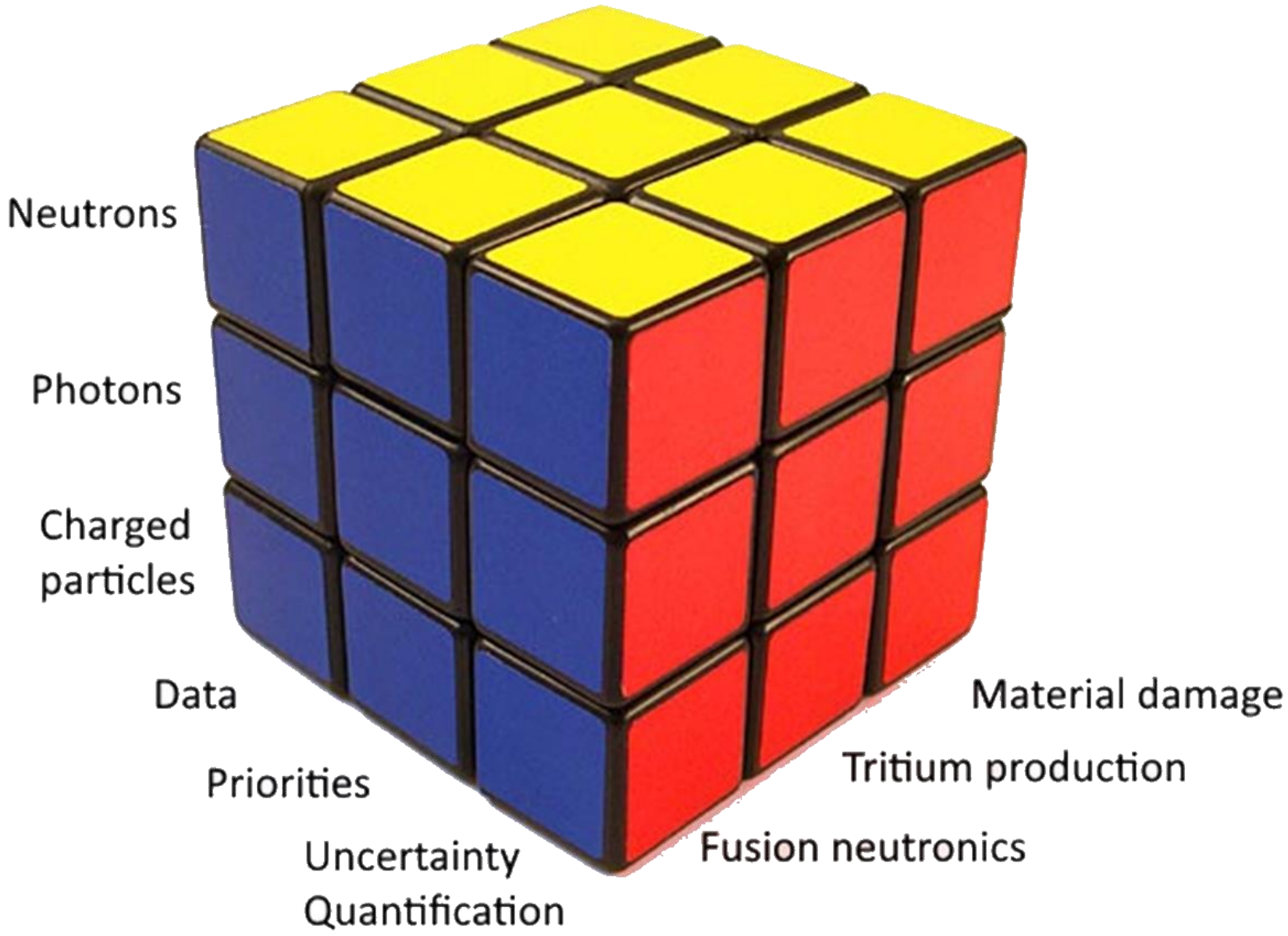

Neutrons
Photons
Charged particles
Data
Priorities
Uncertainty Quantification
Material damage
Tritium production
Fusion neutronics

Fusion Neutronics

8 recommendations:

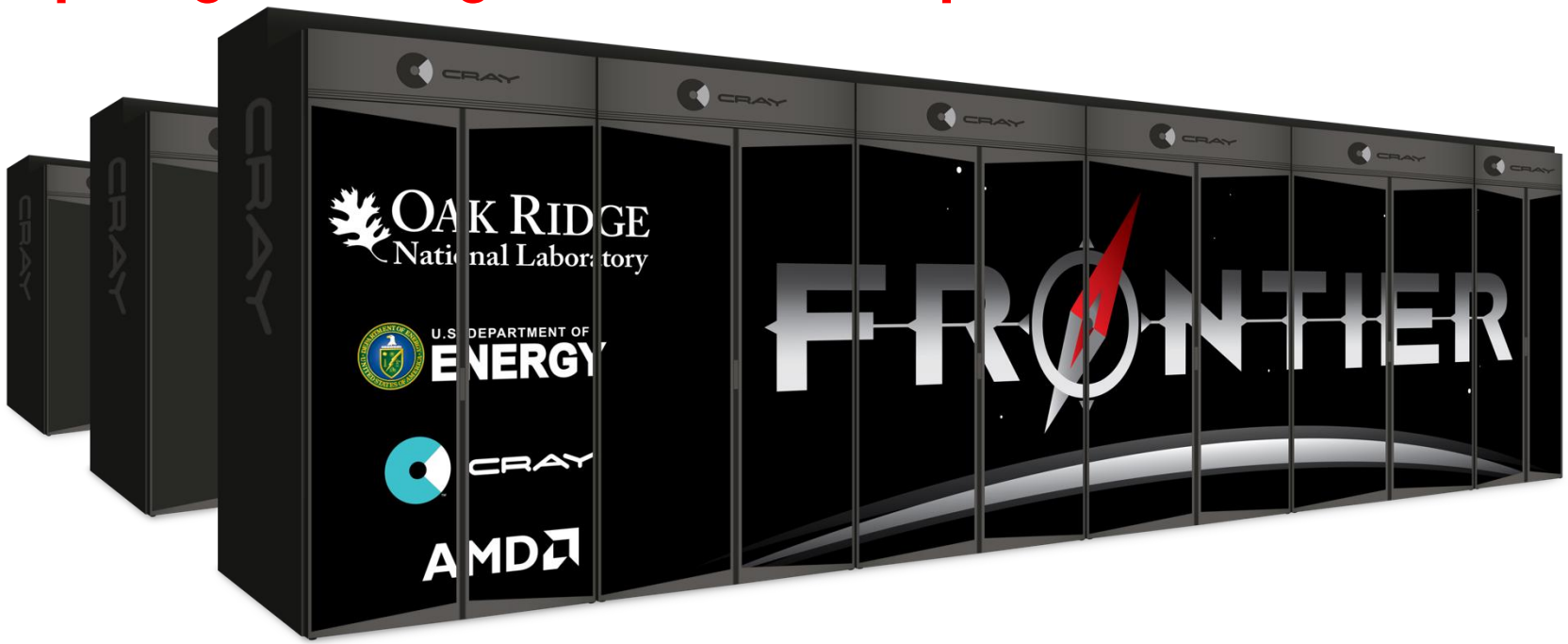
1. Sensitivity studies
2. Evaluations to prioritize specific nuclides
3. Benchmark experiments
4. Provide summary of existing fusion relevant integral experiments
5. **High fluence source**
6. Work force development
7. Fission/fusion information exchange
8. A repository of the facilities available for nuclear data measurements/experiments should be created.

SHINE Technologies has demonstrated clearly visible Cherenkov radiation

Tritium Production

5 recommendations

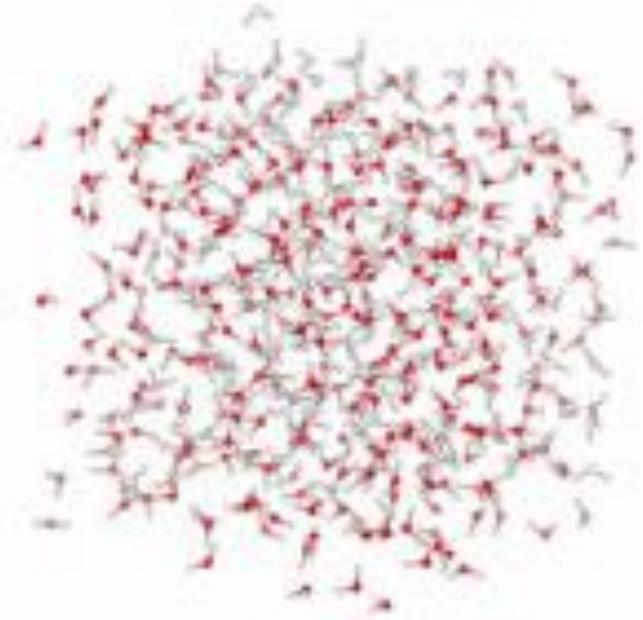
1. Narrow down the specific nuclear data inventory for breeder, multiplier and structural material
2. Assess data and predictions for tritium production
3. Build a path to integral benchmarks
4. Data exchange between fusion, defense and nuclear data communities
5. **High performance computing including software development**



Material Damage

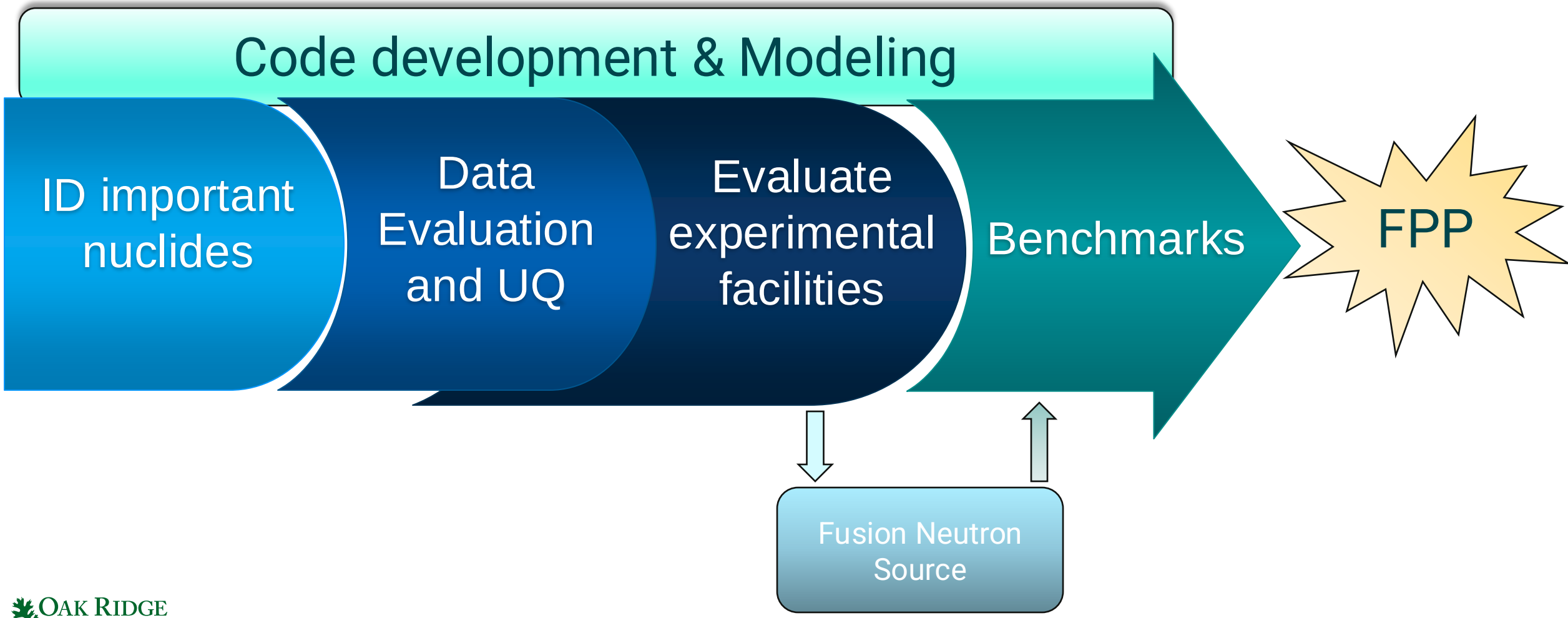
7 recommendations

1. **Bridge transport and molecular dynamics**
2. Improve recoil distributions
3. Recoil distribution sanity checks
4. Scoping studies to prioritize material damage data
5. Uncertainty Quantification
6. Switch to arc-dpa metric
7. Improve means to report issues to evaluators



Summary

Discussion



Further slides

Fusion and Fission