

Neutron Capture in a Plasma Environment

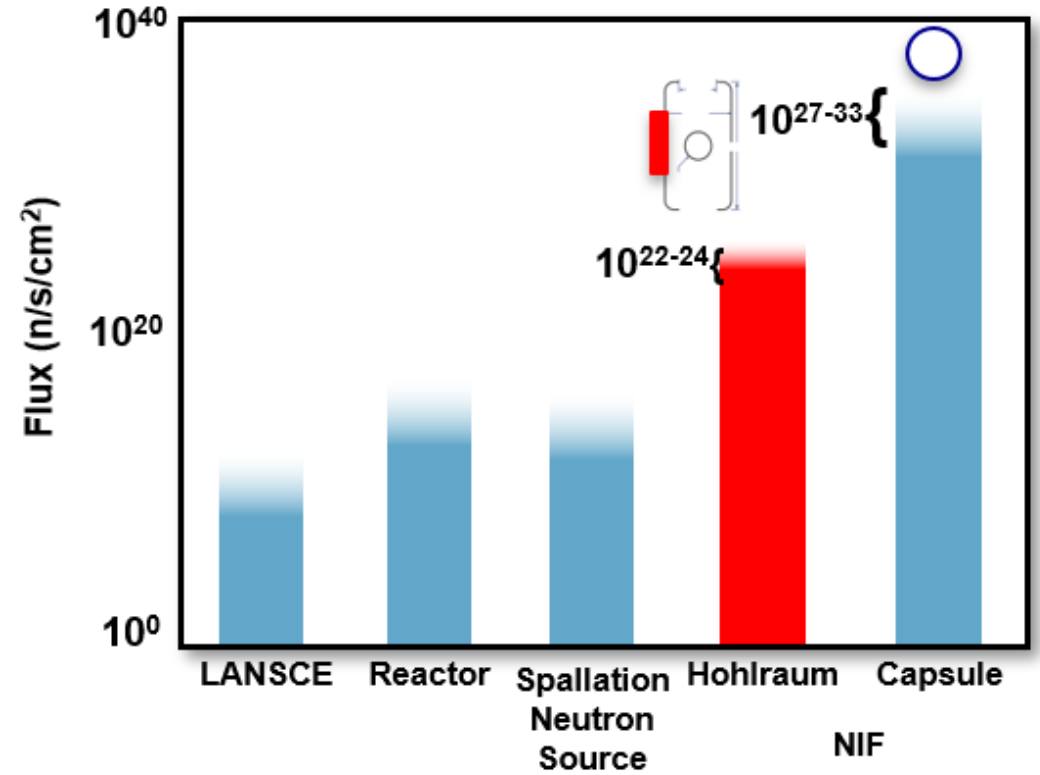
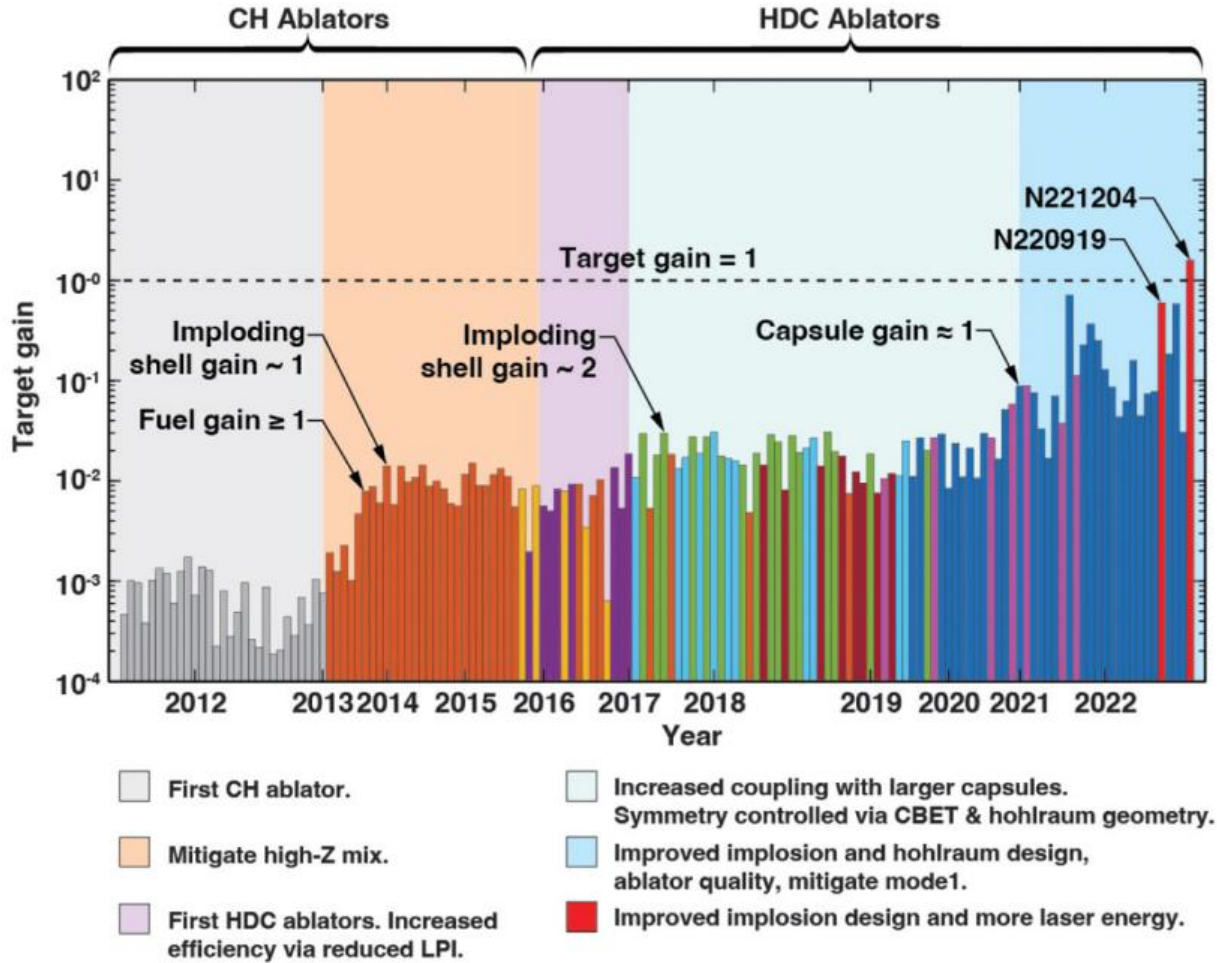
(Developing Nuclear Physics Platforms on ICF/IFE facilities)

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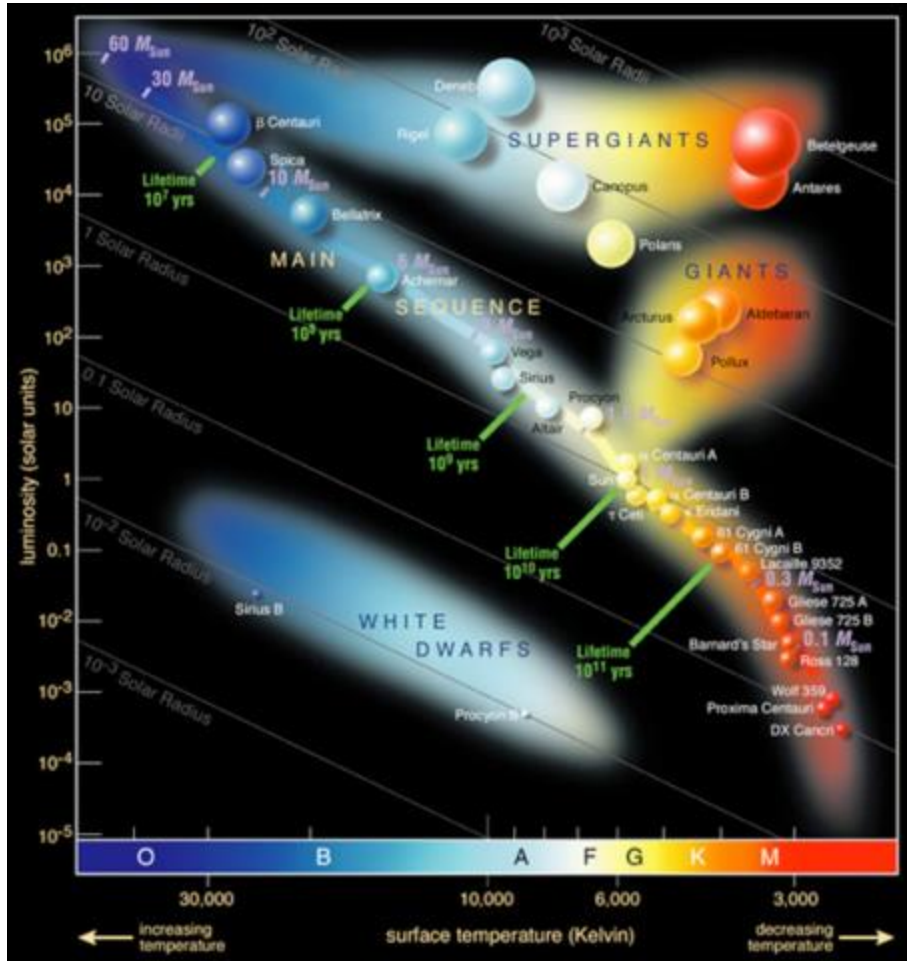
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NIF as neutron source



Estimates of neutron fluxes at different facilities

Stellar Nucleosynthesis



Hertzsprung-Russell diagram

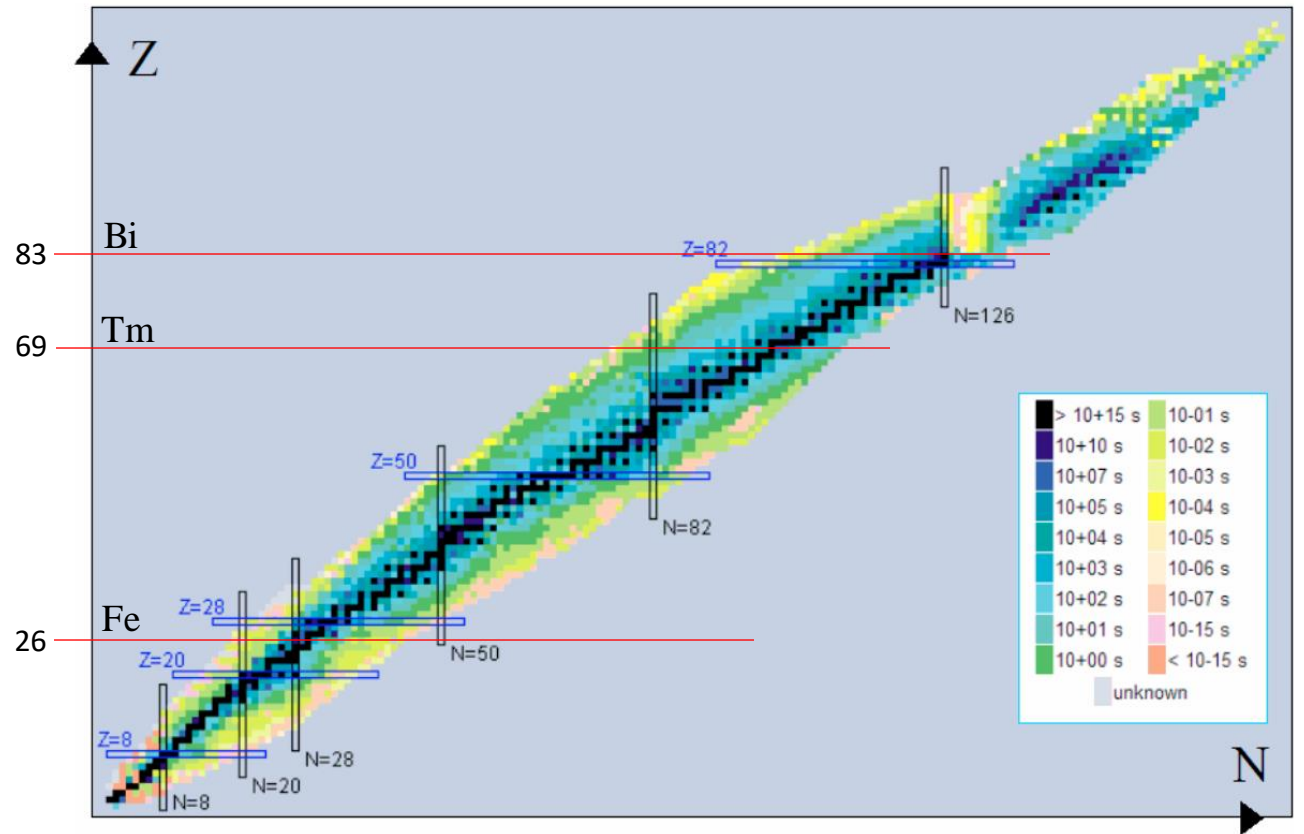
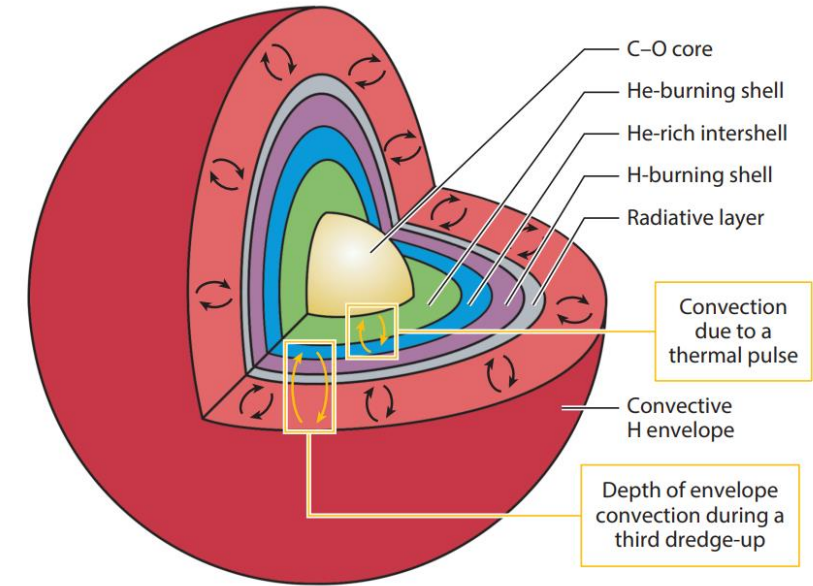
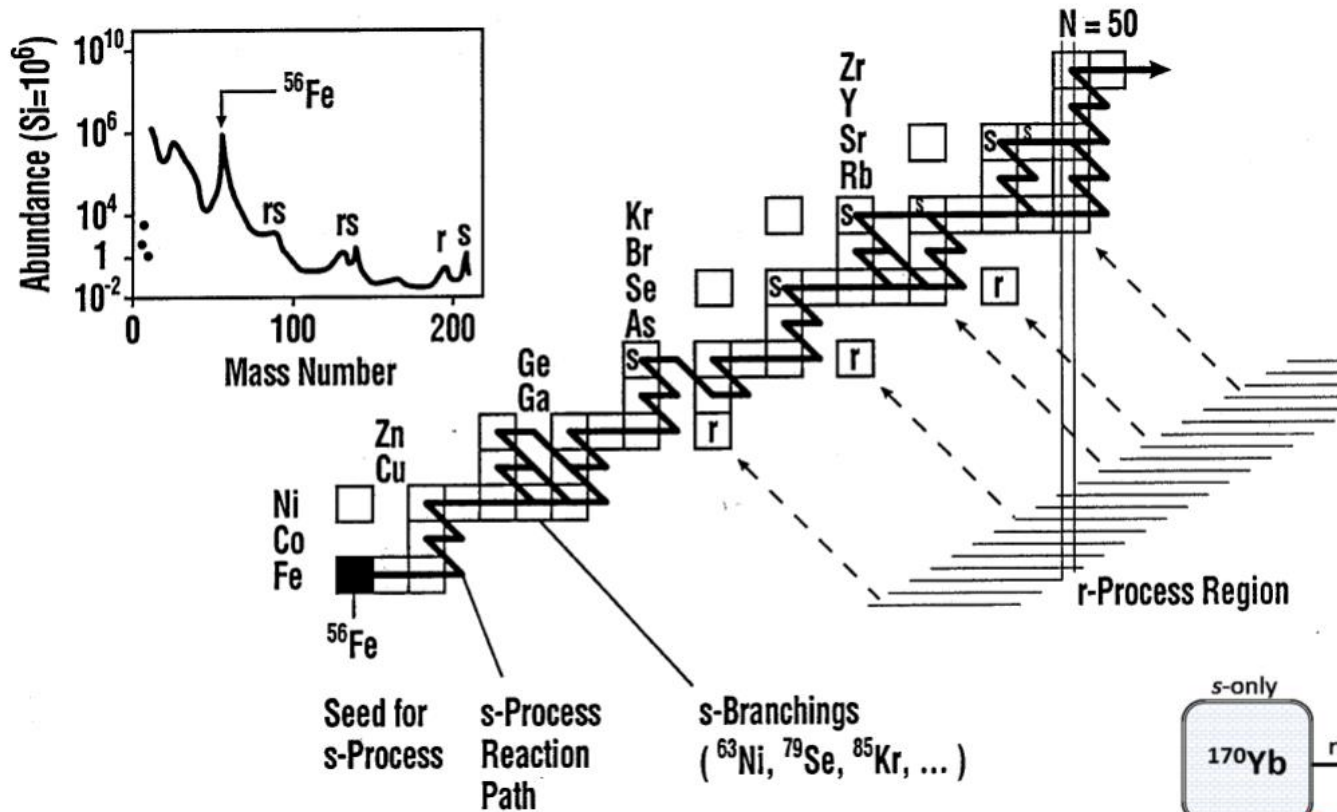


Chart of nuclides

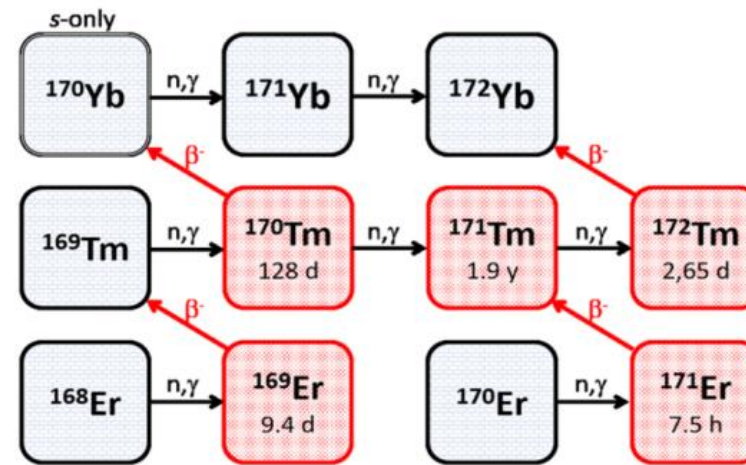
s process and branch point nuclei

nyplasma



AGB star with 1 – 4 M_⊙

Neutron capture processes for the formation of nuclei between Fe and the actinides



Branching scheme at A ~ 170

Radiochemistry on the NIF

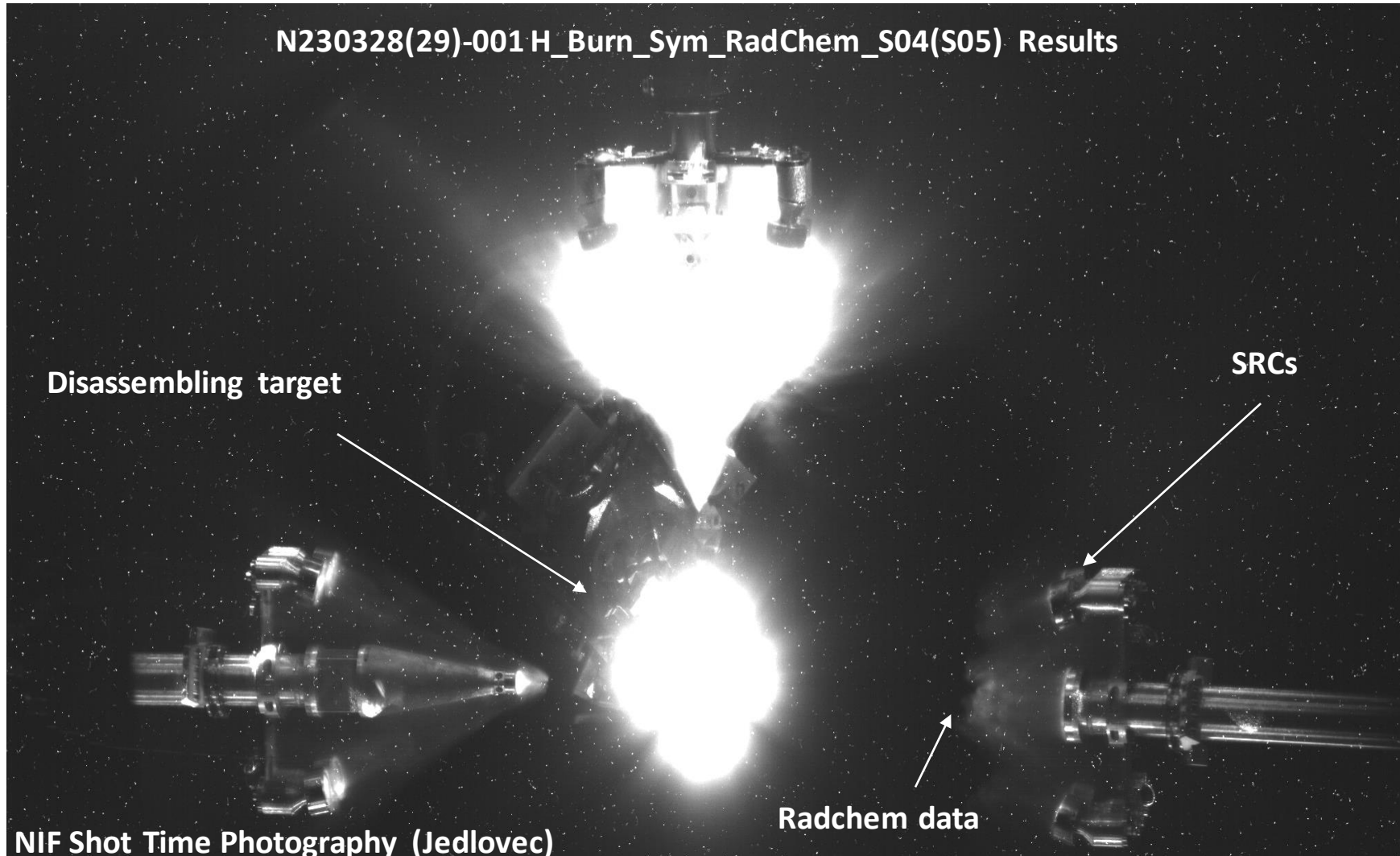
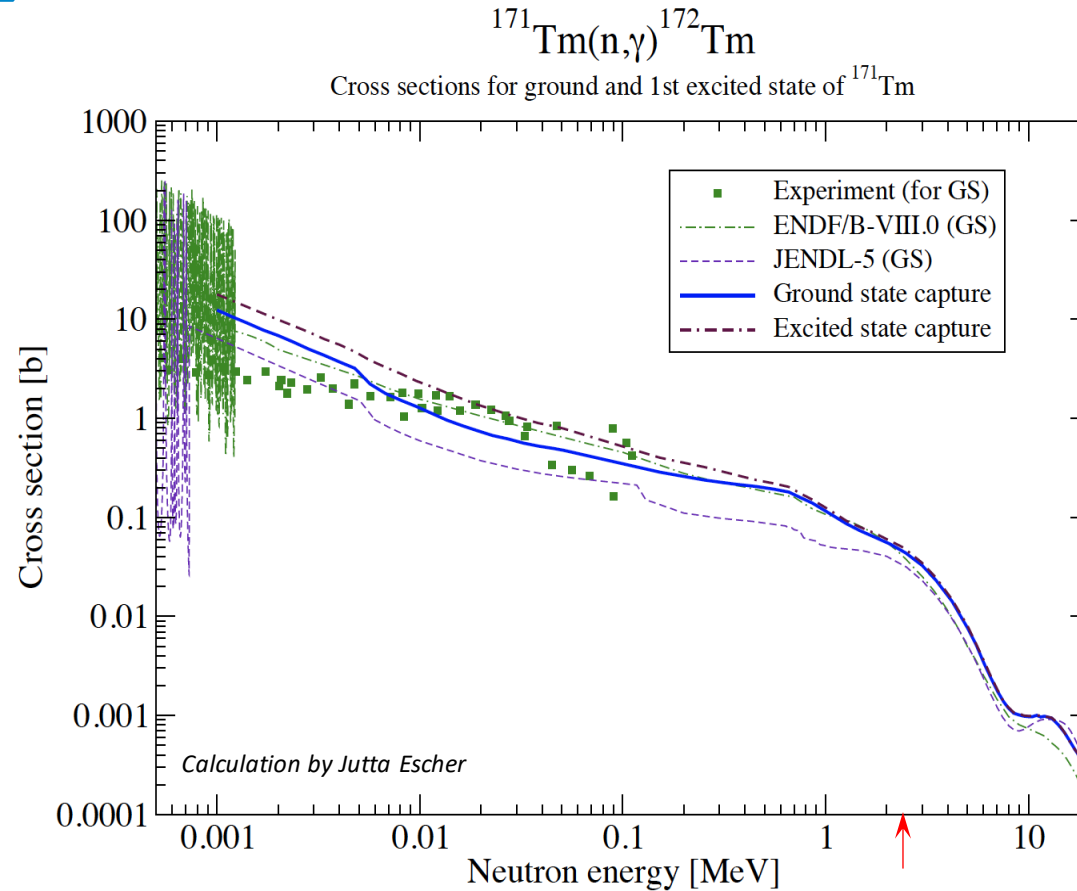


Image from NIF shot N230328 in which a symcap was doped with Y91, Tm171 and Eu152

$^{171}\text{Tm}(n,\gamma)^{172}\text{Tm}$



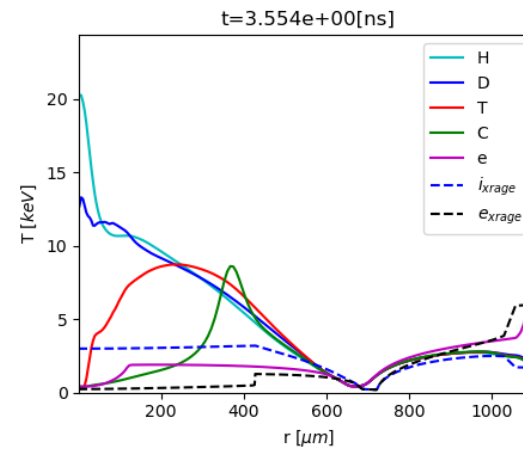
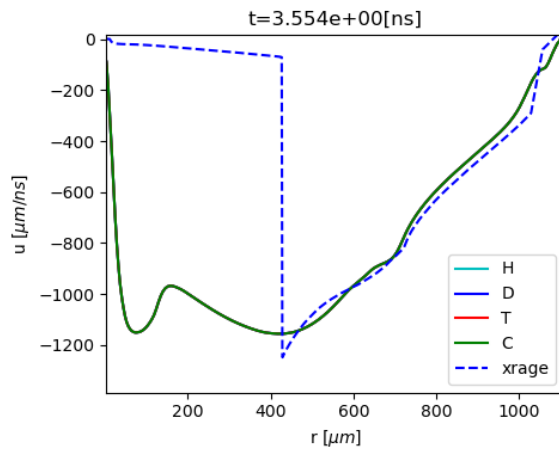
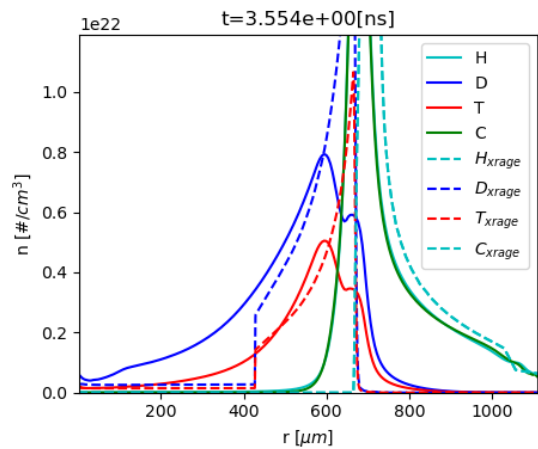
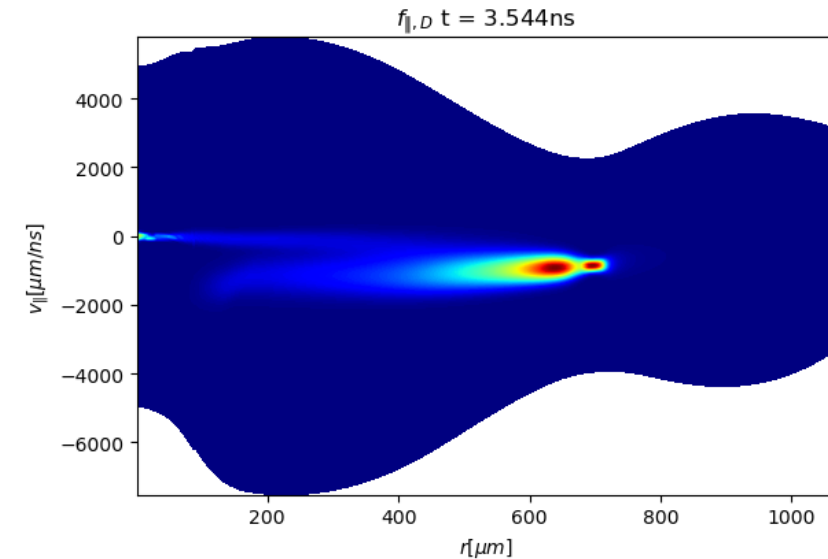
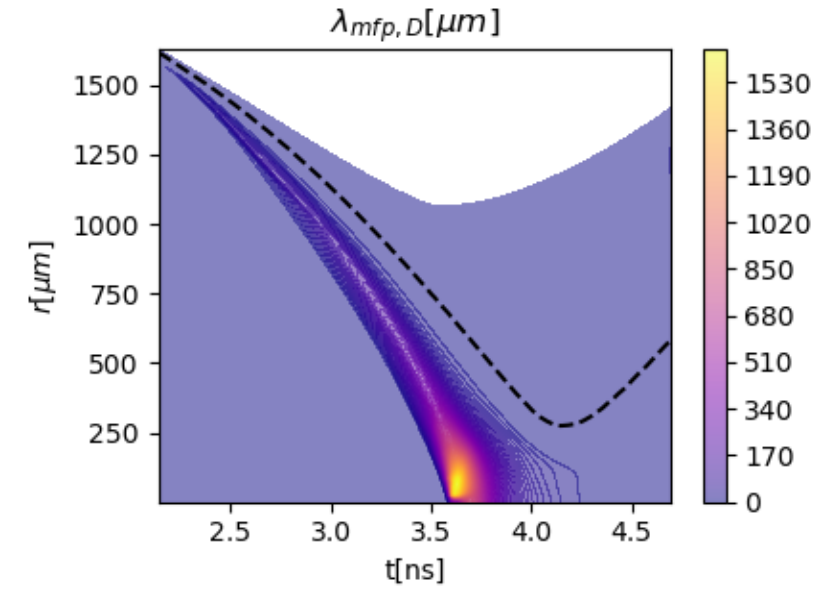
- NIF produces a large neutron flux to measure capture cross sections at a range of energies
- NIF produces a hot plasma which populates nuclear excited states

Simulation Tools - iFP



$n\gamma$ plasma

- Capabilities:
 - 1D in space and 2V in velocity
 - Kinetic ions
 - Kinetic (fluid) electrons with Ampère equation (Ohm's law) for electric field
 - Multigroup thermal radiation transport with TOPS opacity
 - Langdon inverse Bremsstrahlung laser absorption model
 - Nonlinearly implicit solver (step over stiff but dynamically irrelevant time scales)
 - Adaptive phase-space grid (span ICF spatial and velocity scales)
- Applications:
 - Exploding pushers
 - Post shock breakout NIF cryo implosion capsule
 - Modeling of exploding foils



iFP simulations by Will Taitano

Research Topics/Challenges

1. *Transport of high Z dopants in capsules*
2. *Characterization/Optimization of radchem diagnostics*
3. *Nuclear-Plasma interactions and populating excited states*
4. *Nuclear Physics theory*
5. *Neutron moderation in capsules and generation of <1 MeV high neutron flux*