Multidimensional Modelling of Cross-Beam Energy Transfer for Direct-Drive Inertial Confinement Fusion

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IMPERIAL

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List of Acronyms

ICF Inertial Confinement Fusion

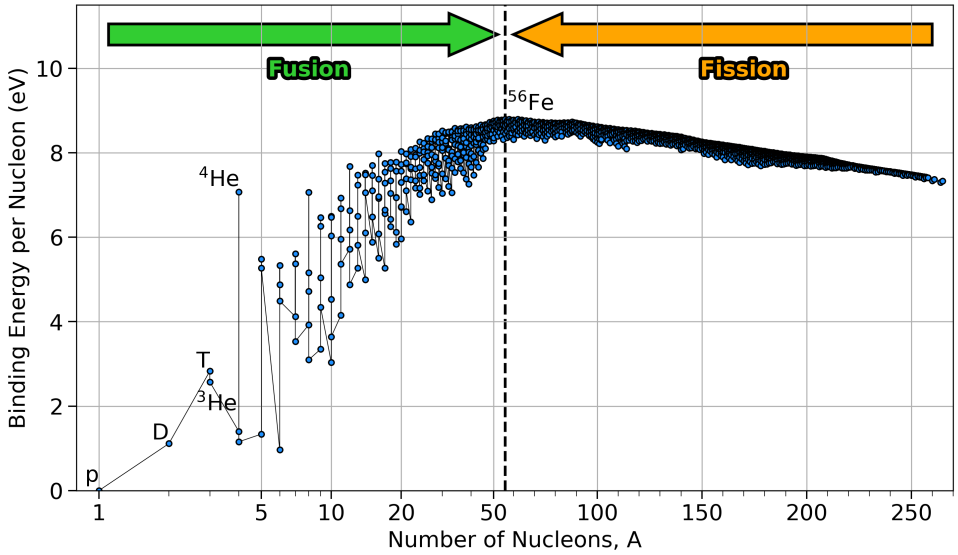

Figure 1.1: Binding energy per nucleon for common nuclear isotopes. Binding energy peaks close to iron, therefore energy is released for reactions which increase binding energy. ^{4}He has a particularly high binding energy and therefore fusion reactions which results in this isotope are strong candidates for fusion energy production.

1 Introduction

1.1 Nuclear Fusion

Say what fusion is and compare to fission and other energy sources. Give main reactions.

1.2 Inertial Confinement Fusion

Describe ICF vs MCF and MIF.

1.2.1 Ignition Requirements

Give Lawson and ICF version.

1.2.2 Central Hotspot Ignition

Describe ablation pressure, ignite small volume of fuel etc.

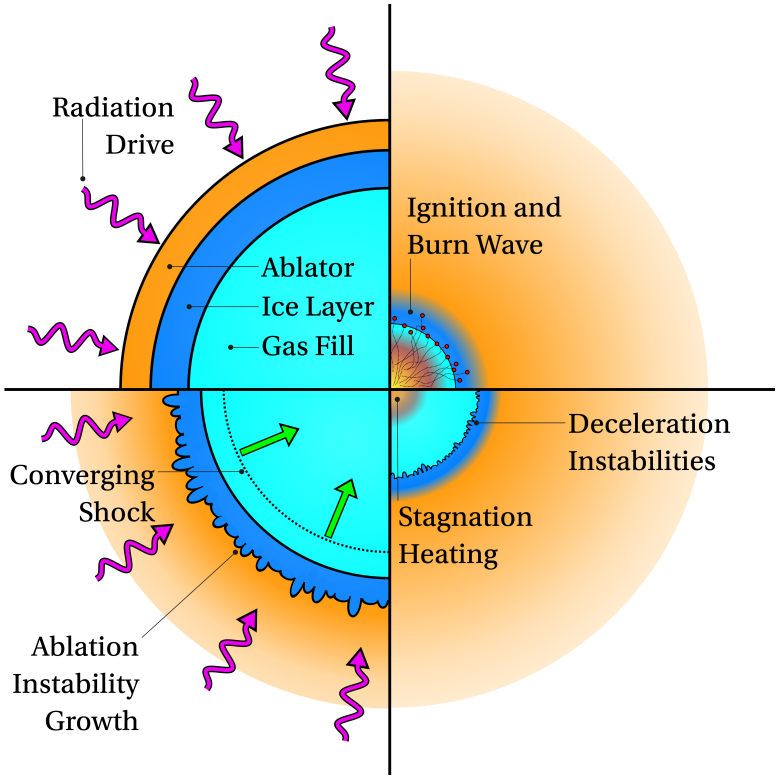

Figure 1.2: Key Stages of the central hotspot ignition Inertial Confinement Fusion (ICF) concept.

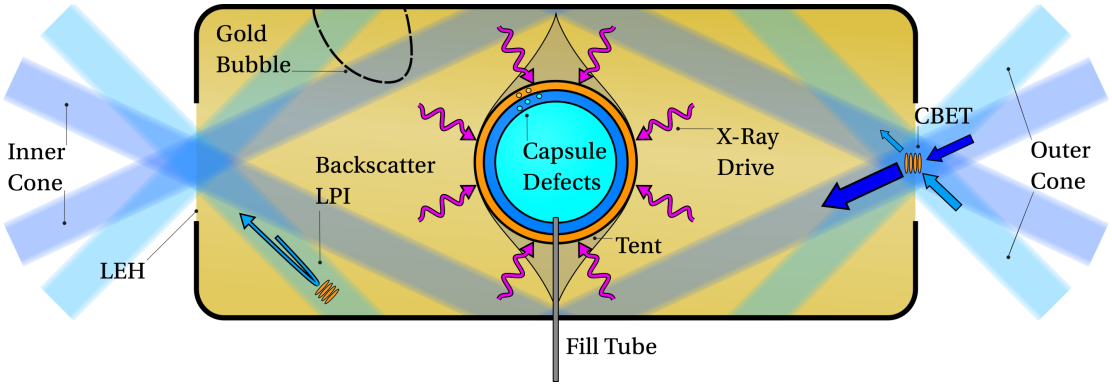

Figure 1.3: Schematic of the indirect-drive approach to ICF.

1.2.3 Alternative Approaches

Shock and fast ignition.

1.3 Current Experiments/ Main Approaches

Small intro on direct vs indirect.

1.3.1 Indirect Drive

Talk about all that jazz and give the diagram. Talk about NIF and ignition, gain etc.

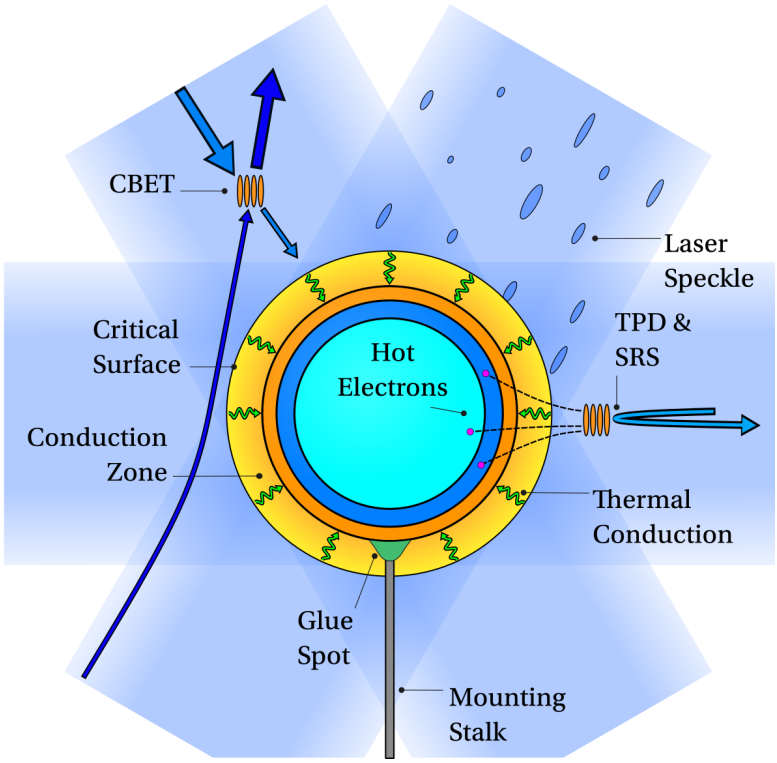

Figure 1.4: Schematic of the direct-drive approach to ICF.

1.3.2 Direct Drive

Say its the assumed version for IFE. Give a much more detailed anatomy of implosion, incl diagram. Talk about hydro-scaled ignition etc.

1.4 Laser Interaction with Plasmas

Understanding lasers is obviously crucial for Direct, indirect and hedp more generally.

1.4.1 Regime of interest

Want collisional absorption and to avoid LPIs. Therefore short wavelength, high power lasers, with limits to peak intensity. Balance between P_abl and high $I * lam^2$.

1.4.2 ICF Relevant LPIs

Damaging class of laser-plasma interactions for ICF. Give diagram of how they work micro-physically. Include direct drive LPI diagram. Introduce each in turn and say what they do for direct and indirect.

1.5 Objective of the work

LPIs are important for current experiments. Need to include models for them in integrated codes. Also, next gen lasers will eliminate LPIs hopefully with bandwidth, so need to under-

stand how they degrade current experiments to accurately extrapolate. Create laser module for CHIMERA, specifically capable of modelling LPIs, and then see what their effect is for direct-drive.

Appendices

Bibliography

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