ELM Suppression and Pedestal Structure in I-Mode Plasmas on Alcator C-Mod

by

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S.B. Physics & Mathematics (2010)
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Submitted to the Department of Nuclear Science and Engineering
in partial fulfillment of the requirements for the degree of

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Abstract

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A dedication goes here maybe?

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Acknowledgements go here.

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1.1 PLASMAS FOR FUSION

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binding energy curve graphic to illustrate?

Fusion collectively refers to the class of nuclear reactions merging lighter nuclei into a single heavier element. While fusion reactions for elements lighter than iron are generally exothermic, the most common and readily attainable involve isotopes of hydrogen or helium, the most promising candidates for which are shown below.

$$^{2}\mathrm{D} + {}^{2}\mathrm{D} \rightarrow {}^{3}\mathrm{T} + \mathrm{p} + 4.03\ \mathrm{MeV} \tag{1}$$

$$^{2}\mathrm{D} + {}^{2}\mathrm{D} \rightarrow {}^{3}\mathrm{He} + \mathrm{n} + 3.27\ \mathrm{MeV} \tag{2}$$

$$^{2}\mathrm{D} + {}^{3}\mathrm{He} \rightarrow {}^{4}\mathrm{He} + \mathrm{p} + 18.3\ \mathrm{MeV} \tag{3}$$

$$^{2}\mathrm{D} + {}^{3}\mathrm{T} \rightarrow {}^{4}\mathrm{He} + \mathrm{n} + 17.6\ \mathrm{MeV} \tag{4}$$

Here D and T indicate nuclei of deuterium and tritium, two heavy isotopes of hydrogen (one proton plus one and two neutrons, respectively).

reaction cross-section graphic

Pure deuterium fuel (reactions shown in eqs. 1-2) is attractive from a research standpoint, due to the abundance and ease of use of deuterium. Deuterium is a stable nucleus, obviating the need for radiation safety on the fuel system, and is naturally occurring in relative abundance (approximately 1/6000 of hydrogen nuclei on earth are deuterium cite), allowing harvesting of deuterium fuel from seawater. However, pure-deuterium reactions suffer from low energy output per reaction ref cross-section graphic and a significantly lower reaction rate at feasible plasma conditions compared to other fuel options, setting high performance requirements for a putative DD-burning reactor.

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COLOPHON

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