06pC02

高繰り返しレーザー核融合と燃料ターゲットインジェクション
Hi-repetition Laser Fusion and its Target Injection

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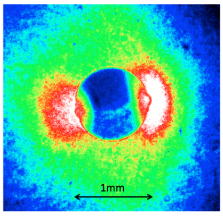
High-rep. rate fusion using fast heating of a compactly imploded CD core[1]: A 4J/0.4-ns output of a laser-diode-pumped high-repetition laser HAMA[2] is divided into four beams, two of which counter-illuminate double-deuterated polystyrene foils separated by 100 μm for implosion. The remaining two beams, compressed to 110 fs for fast heating, illuminate the same paths. The heating pulses heat the imploded core, emitting x-ray radiations >20 eV, and yielding some 10^3 thermal neutrons[2].

Laser engagement of 1-Hz-injected pellets, channel borings, and neutrons[3]: CD bead pellets, after free-falling for a distance of 18 cm at 1 Hz, are engaged in flight by two counter short pulse laser beams from HAMA[2]. The snapshot of a flying pellet at the instance of engagement by using a 2ω harmonic laser probe is in Fig. 1. The laser energy on the pellet, pulse duration, and wavelength are 0.63 J per beam, 104 fs, and 811 nm, respectively. The irradiated pellets produce 2.45 MeV DD neutrons with a yield of $9.5 \times 10^4/4\pi$ sr/shot at maximum.

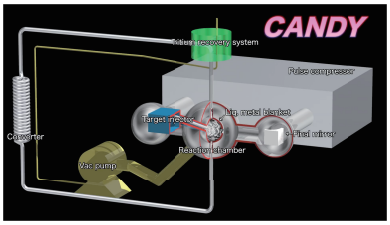
CANDY Concept: The zeroth goal is to construct an unified experimental machine CANDY, as in Fig. 2. DT cryogenic fuel pellet is injected at 10 Hz, to which the counter implosion beams are engaged, followed coaxially by the fast heating beams. A liquid Pb-Li blanket is to catch some mount of neutrons and radiations.

To construct CANDY using a kJ DPSSL driver in the fast-ignition scheme, we pursue the fast ignition and the high repetition laser implosion. We succeed in the continuous target injection and engagement.



Snapshot of a flying pellet engagement by laser probe.

Neutron yield	DT	5×10^{12}/shot
	DD	5×10^{10}/shot
Implosion laser	Energy	2 kJ/shot
	Wavelength	500 nm
	Repetition rate	10 Hz
Heating laser	Energy	2 kJ/shot
	Wavelength	1000 nm
Gain	DT	0.007 [190 W]
	DD	1.5×10^{-5} [0.3 W]



Conceptual Design of CANDY.

[1] Kitagawa Y *et al.* 2012 *Phys. Rev. Lett.* **108** 155001
[2] Mori Y *et al.* 2013 *Nucl. Fusion* **53** 073011
[3] Komeda O *et al.* 2013 *Scientific Reports* 6 September