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対向高速点火方式レーザー核融合の開発の現状

Counter-illumination fast ignition fusion:present status

北川米喜 [1], 森芳孝 [1], 石井勝弘 [1], 花山良平 [1], 西村靖彦 [1,2], 中山師生 [1], 関根尊史 [3], 栗田隆史 [3], 佐藤仲弘 [3], 竹内康樹 [3], 加藤義則 [3], 栗田典夫 [3], 川嶋利幸 [3], 米田修 [4], 葛谷孝史 [4], 辻慎二 [4], 大木島純 [4], 日置辰視 [5], 元廣友美 [5], 東博純 [6], 砂原淳 [7], 千徳靖彦 [8], 三浦永祐 [9], 岩本晃史 [10], 坂上仁志 [10]

KITAGAWA Yoneyoshi[1], MORI Yoshitaka[1], ISHII Katsuhiro[1], HANAYAMA Ryohei[1], NISHIMURA Yasuhiko[1,2], NAKAYAMA Suisei[1], SEKINE Takafumi[3], KURITA Takashi[3], SATO Nakahiro[3], TAKEUCHI Yasuki[3], KATO Yoshinori[3], KURITA Yoshinori[3], KAWASHIMA Toshiyuki[3], KOMEDA Osamu[4], KUZUYA Takafumi[4], TSUJI Shinji[4], OKIJIMA Jun[4], HIOKI Tatsumi[5], MOTOHIRO Tatsuyoshi[5], AZUMA Hirozumi[6], SUNAHARA Atsushi[7], SENTOKU Yasuhiko[8], MIURA Eisuke[9], IWAMOTO Akifumi[10], SAKAGAMI Hitoshi[10]

光産業創成大学院大学 [1], TTDC[2], 浜松ホトニクス株式会社 [3], トヨタ自動車株式会社 [4], 名大未来社会創造機構 [5], Aichi synchrotron[6], レーザー総研 [7], 阪大レーザー研 [8], 産総研 [9], 核融合研 [10]

GPI[1], TTDC[2], HPK[3], TMC[4], Nagoya Univ.[5], Aichi synchrotron[6], ILT[7], ILE, Osaka Univ.[8], AIST[9], NIFS[10]

The counterbeam fast-heating can effectively heat the core due to the Weibel instability between the counter hot electron currents. It is demonstrated by the CD double foil target [1], followed by the shell target [2]. The instability deposits hot electrons in the imploded core plasmas [see Fig. 1] and even in a solid beads [3, see Fig. 2].

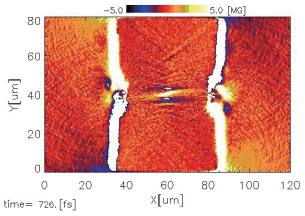

Fig. 1: 2DPIC: B-field due to counterbeam Weibel instability.

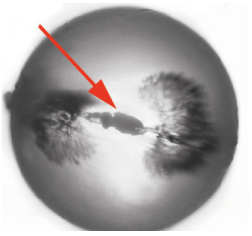

Fig. 2: Weibel instability inside the two-side irradiated CD bead, shown by the red arrow.

We propose a scheme that directly heats the imploded core by energetic ions driven by an ultraintense laser LFEX [4, see Fig.3]. A spherical deuterated polystyrene (C_8D_8 or CD) shell was polarly imploded by two counterbeams of a GEKKO XII (GXII) green laser. LFEX is focused onto the naked core from the side, vertical to the GXII axis. Illuminating LFEX to the core as close as possible shows us that both the hot electrons and energetic ions play main roles in core heating. The hot electrons heat the whole core, but the ions heat locally the surface of the core. In fact, DD beam-fusion neutrons with the yield of 5×10^8 n/4π sr are observed.

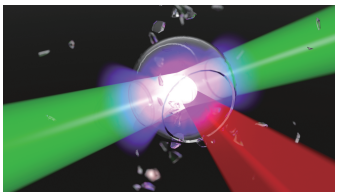

Fig. 3: LFEX directly heats the ions in the counter imploded core.

The above counter beam scheme results lead us to the preparation for the Mini reactor CANDY using high-rep. 4 kJ lasers. Two beams counter implode the cryogenic fuel shell to a dense core, which the remaining two counter short pulse lasers in the same axis heat in order to make a DT fusion. This will start in 5 to 10 years.

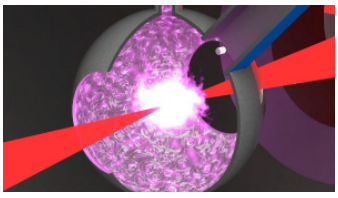

Fig. 4: Mini reactor CANDY.

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[2] Y. Mori et al., *Phys. Rev. Lett.* **117**, 055001 (2016).
[3] O. Komeda et al., *Scientific Reports* **3**, 2561(2013).
[4] Y. Kitagawa et al., *Phys. Rev. Lett.* **114**, 195002 (2015)