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Properties of a Clean and Economic Boron Laser Fusion Reactor

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Fusion reactions of protons with the boron isotope 11 (HB11) were considered as extremely difficult and impossible for a power reactor. This changed by several orders of magnitudes using picosecond (ps) lasers with powers >petawatt (PW) igniting fusion in a non-thermal way by direct conversion of laser energy into ultrahigh acceleration of plasma blocks [1]. The HB11 reaction produces primarily only clean helium without nuclear radiation problem. The design of a new kind [2] of a fusion power reactor, (see Fig. 19 of Ref. [3]) contains a reaction unit in the center of the reactor sphere with a cylindrical solid stoichimetric hydrogen-11born fuel (see Fig. 10 of Ref. [3]). The unit is charged at about -1.4 Megavolt within the reactor sphere and the fusion reaction is generated end on at the fuel cylinder by a 30 kJ laser pulse of ps duration. The 2.9 MeV helium (alpha particles) convert their energy into electricity when moving against the wall of the reactor. At a one Hertz operation rate, the current of 780 Amps is converted into ac three-phase electricity resulting in power generation on a profitable level [3].

The fusion reaction in the cylindrical fuel is trapped by a magnetic field by a 4.5 kilotesla magnetic field for one nanosecond. The trapping field is generated for one nanosecond by the capacitor laser driving device following Fujioka et al. [4]. The conditions for sufficient magnetic trapping of the HB11 reaction for binary reactions in a fuel cylinder of 1 and of 0.2 mm diameter are confirmed by hydrodynamics [2][3] and extended to experimentally confirmed avalanche reactions [5]. Results on physical solutions are reported focusing on direct drive ignition conditions and the theory of avalanche reactions by elastic nuclear collisions [6]. This was elaborated on block ignition by laser pulses of >30kJ-ps producing >GJ energy in the 2.9 MeV alphas. It is estimated that the available 10PW-ps pulses per minute [7] are developed within reasonable time to the 30PW-ps laser pulses for one Hz operation for the new reactor type.

[1] H. Hora, G.H. Miley, et al. Energy & Environmental Science 3, 479-486 (2010); H. Hora, et al. IEEE Transact. Plasma Science 42, 640 (2014).

[2] P. Lalousis, et al. Laser & Particle Beams 32, 409 (2014); H. Hora & G.J. Kirchhoff, International Patent PCT/EP2014/003281.

[3] Heinrich Hora, et al. SPIE Proceedings 9515, 951518 (2015).

[4] S. Fujioka et al. Scientific Reports 3,1170 (2013).

[5] A. Picciotto et al. Phys. Rev. X4, 031030 (2014); H. Hora, G. Korn, etal. Laser and Particle Beams. 33, 607 (2015).

[6] Shalom Eliezer, H. Hora, G. Korn et al. Physics Plasmas 23, 050704 (2016).

[7] T.R. Ditmire, 2 nd Conf.HPLSE Suzhou/CN 15 March 2016 paper C-12.

Eligible for student paper award?

No

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