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Low velocity ion slowing down in a demixing binary ionic mixture

Claude Deutsch[1], Daniel Leger[2] and Bekbolat Yashev[3]
[1] *Université Paris-Sud, LPGP (UMR-CNRS 8578, Bât. 210, F-91405 ORSAY, France*
[2] *Université Valenciennes-Hainaut Cambresis,Lab. MECAN, F 59313 MONTHOUY, France*
[3] *Kazakh National University, Department of Physics,Tole Bi 91, 4800012 ALMATY, Kazakkstan.*

We consider ion projectile slowing down at low velocity $V_p \leq V_{the}$, target thermal electron velocity, in a strongly coupled (Gamma~60) and demixing hydrogen-helium ionic mixture of astrophysical concern. It is investigated in terms of quasi-static and critical charge-charge structure factor for each ion species out of the HNC-scheme. Non-polarizable as well as polarizable partially degenerate electron background are given attention. The given low velocity ion slowing down turns negative in the presence of long wavelength and low frequency hydrodynamic modes, signalling a critical demixtion. This superelastic process thus documents an energy transfer from the target ion plasma to incoming ion projectile.

P54.

The production of advanced fast ignition cone geometries for fusion studies

C. Spindloe
Scitech Precision Ltd, Rutherford Appleton Laboratory, Harwell Science and Innovation Campus, Chilton, Didcot, Oxon, UK
Contact: Christopher.spindloe@scitechprecision.com

The recently launched HiPER (**High Power** laser **Energy Research** facility) project is a European initiative to offer a credible way to demonstrate the possibility of opening up Inertial Fusion Energy as a commercial process for energy generation. One baseline target design includes cone geometries and there are significant technical and scientific challenges in the production of these cones to the required specification in the required numbers for the facility. There are also a large number of research projects that are investigating cone performance and are re-designing the cone to have novel features and specifications. We review the production of a number of different geometries and also the ability to mass produce such items.

P-55.

Ignition and burn in contaminated DT fuel at high densities

John Pasley
University of York and STFC Central Laser Facility, U.K.

Radiation hydrodynamics simulations have been performed to quantify the effect of contamination upon the ignition threshold in DT at high densities. A detailed thermonuclear burn model, with multi-group multispecies ions, is incorporated alongside a multigroup diffusion approximation for thermal radiation transport. The code used is the research version of the HYADES 1D code [1].
Acceptable levels of contamination are identified for a range of contaminant ion species. A range of different contaminant spatial distribution within the fuel are explored: i) in which the contamination is uniformly distributed throughout the fuel ii) in which the impurity ions are confined to the hotspot, or iii) where contamination is restricted to a particular region of the hotspot (either centrally, near the surface, or at an intermediate location). Initially the fuel has a constant density with the hot-spot located centrally. The overall radius of the fuel is chosen to be sufficiently large that it has no significant effect upon the success or failure of ignition. The evolution of the system is then simulated until ignition either establishes widespread thermonuclear burning, or a failure to ignite is observed. The critical ρr for ignition is found by iteration on the hot-spot radius.
We show that varying the spatial distribution of the contaminant within the ignition spot has little effect, so long

as the total mass of contaminant is held the same. As expected, high-Z contamination is far more detrimental than that by low-Z ions. Discussion of the findings in the context of re-entrant cone-guided fast ignition is presented, in addition to a theoretical interpretation of the results.

Reference

[1] contact Larsen@casinc.com

P-56.

Laser fusion energy from p-^{7}Li with minimized radioactivity

M. Ghoranneviss[1], B. Malekynia[1], H. Hora[2], G.H. Miley[3], A. H. Sari[1,4]

[1]*Plasma Physics Research Center, Science and Research Campus, Islamic Azad University (IAU), Tehran, Iran.*

[2]*Department of Theoretical Physics, University of New South Wales, Sydney 2052, Australia*

[3]*Department of Nuclear, Plasma and Radiological Engineering, University of Illinois, Urbana, IL 61801, USA*

[4] *Faculty of Engineering, Kingston University, London SW15 3DW, UK*

The observed anomaly of PW-ps laser interaction opened the possibility of the side-on ignition of solid DT [1] and the updating led to encouraging results [2] for DT laser fusion within comparably compact reactors in the future. The new possibility of side-on laser ignition of p-^{11}B with negligible radioactivity encouraged to study the fusion of solid state p-^{7}Li fuel which again turns out to be only about ten times more difficult than the side-on ignition of solid deuterium-tritium using petawatt-picosecond laser pulses very close to the case of p-^{11}B [2-5]. It was interesting to check another candidate for a safe, low cost and comparably clean nuclear power generation from the reaction of p-^{7}Li fuel. The result for p-^{7}Li under the simplified and pessimistic conditions are reported. Updated cross sections of the nuclear reaction are included. We derived that the threshold for the side-on ignition for the energy-flux density with an ignition temperature is merged into a constant value of 2.5×10^{9} J/cm^{2} and 69 keV, respectively. It can be concluded that this result of not too much higher difficulty for the clean fusion energy generation than for DT fuel can be stated with certainty. This does not depend on minor modifications and corrections from further studies of numerous details to be gained in further studies. One modification may be due to the fact that the ignition temperatures for all the considered fuel are above the energy loss by bremsstrahlung as known since the computations for DT [1] and as it was repeatedly confirmed in the present treatments. However, this emission was based on thermal equilibrium functions with the fusion cross sections averaged over a Boltzmann distribution of the electron velocity. The side-on ignition is a process in a shock front with energy production from the ions and the generated alpha particles. It may well be that the Boltzmann distribution is strongly disturbed and only details with the PIC method or what was gained from the "peripheric ignition" may lead to more detailed evaluations apart from several more parameters to be studied. A distinguishing is necessary between the double layer processes defined by internal electric fields in plasmas known form the genuine two-fluid computations determining the TNSA and between physically different skin-layer mechanisms which are optically determined by dielectrically increased blocks or skin depths. We have studied the change of the results when using the collective stopping power in contrast to the usually used binary collision stopping of the Bethe-Bloch theory. In contrast to the cases with DT with a strong dependence on the stopping power model with changes of the temperature of the ignition threshold by few keV, a similar difference for p-^{7}Li is again by a few keV but this is comparably small in view the rather high ignition temperature of 69 keV.

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