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Book Review

Title:	***Physics of Inertial Fusion: Beam Plasma Interaction, Hydrodynamics, Hot Dense Matter***
Author:	Stafano Atzeni and Jürgen Meyer-ter-Vehn
Publisher:	Clarendon Press
Year:	2004
Pages:	458
ISBN:	0198562640

This book has several remarkable highlights summarized on laser produced plasmas and particle beam driven fusion energy. In contrast to the usual books, the nuclear fusion reactions are presented with very detailed experience, including pycnonuclear reactions, spin polarization, and mentioning the 25 orders of magnitude less probable weak force pp-reaction than DT. There is a rather comprehensive collection of the conditions of confinement, spherical implosion, ignition burn, and gain. Hydrodynamics is based on a one fluid model, not Schlüter's space charge quasi-neutral two-fluid model nor the genuine two-fluid treatment. Hohlraum targets are covered and the fast ignition (FI) contains the forte of the authors' own achievements though the entire problems shown experimentally or theoretically (Mulser *et al*., 2004) are not discussed nor the new aspects on FI known before finishing the book (Hora, 2004). The 36 pages for the entire physics of (laser- and particle-) beam-target interaction are used to sketch at least the most important aspects.

Of incommensurable value is the Foreword by Ray Kidder. It summarizes in an unique way the history of ICF with respect to laser fusion for energy against the border line to weapons research and how the steps of declassification happened including most of the crucial worldwide achievements and landmarks for inertial fusion energy. "The basic principles of high yield-to-weights nuclear weapon design had largely been learnt and put into practice in 1962, but the intriguing challenge of 'pure fusion' remained." Kidder confirms that it was the opinion on experiments after 1972 that preheat by hot electrons was limiting the progress. Unfortunately it was not known before the 1980s that only an insufficiently small amount of hot electrons were available for preheat, the most were held back by double layer effects (Eliezer *et al*., 1989).

American textbooks on electrodynamics mostly are missing the essential structure of Maxwell's theory—an exception is e.g., in Edward Ramberg's translation of Arnold Sommerfeld's "Electrodynamics"—as can be seen in D. Jackson's bestselling book which is structured from electrostatics in the style before 1864 (Maxwell). Jackson in the later editions only put Maxwell's equations on the first few pages falling from the sky followed by a pre-Maxwellian treatise. For the reviewed book, it would be necessary that it needs to make understandable to the reader where the Vlasov equation (11.13) or the wave equation (11.1) comes from. For the laser waves in plasmas their dielectric response is essential, correctly given in Eq. (11.9) but the subsequent formula for the absorption Eq. (11.34) is a low-density approximation only, invalid at or above the critical density. This limit even was not mentioned while the mechanisms at the critical density are essential at laser plasma interaction. This is the reason why e.g. in (11.48) the essential dielectric effects in plasmas with the dielectric swelling of E_l over its vacuum value for the expression of the nonlinear (ponderomotive) force was not explained. Nevertheless, it should be acknowledged that this book is a rare exception by mentioning the nonlinear force formulation while most of similar books are not mentioning this fact at all.

Another important point how the book very positively differs from others is that it elaborates the volume ignition about which both authors have worked well mentioning the work of Caruso and Fraley of 1974 where first approximations of optical re-absorption was included. The later success with inclusion of the self-heat follows the work of Basko only. One may understand that the authors joined the field after 1980 only, why they did not mention the first publication on volume ignition by the second reviewer (1978) nor the crucial work by John Wheeler, R. Krikpatrick, S. Colgate, K. Lackner, Xian-tu He, J.-M. Martinez-Val, and others.

It is positive that the authors mention the discrepancies about the stopping power of ions based on the important first measurement of much shorter lengths than expected by Hoffman *et al*. (1990). The explanation of a factor 35 of difference well is repeated in the known preliminary way

while the difference between binary and collective interaction still has to be clarified (Deutsch, 2004).

This book summarizes the authors' views and their long years detailed work in this field well acknowledging several side links form discussions with colleagues, but this is not the complete view in this field. It is therefore limited though it has to be acknowledged what enormous effort has been invested by the authors for producing this very respectable book.

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