

LETTERS TO THE EDITOR



COMMENT ON G. R. MAGELSSSEN'S REVIEW OF "INERTIAL CONFINEMENT FUSION" BY DUDERSTADT AND MOSES

Even though Magelssen¹ is quite critical in many parts of his review, he contradicts himself in the last two sentences by calling the book exceptionally good. Since not only Magelssen, but also the authors, Duderstadt and Moses, are newcomers to this field of research, because no important publication in the field of inertial fusion goes to their credit, I am not surprised that Magelssen has overlooked some gross errors and shortcomings of the book. The errors already come to light in the chapter on historical developments. There it says Bethe recognized in 1931 that nuclear fusion is a primary energy source in stars. Bethe may have recognized it, but the idea was published several years earlier by Atkinson and Houtermans.² Furthermore, the final theory of thermonuclear fusion reactions was not done by Fermi, Tuck, and Teller at Los Alamos in 1940, but rather published by Gamow and Teller in 1938 (Ref. 3). They corrected the simple one-dimensional tunnel effect theory by Atkinson and Houtermans, using the complete three-dimensional wave function. Bethe and von Weizsacker contributed by proposing the thermonuclear carbon cycle for main sequence stars. In addition to these historical errors, there are many others, a few of which I call to your attention. To begin, the book overlooks, or rather simply ignores, the work of almost every scientist who had laid the groundwork for ideas and for which the authors give credit to other scientists who rediscovered, or at best made improvements in, these ideas. The most important scientists unquoted are

1. J. C. Martin, from England, who initiated the modern electric pulse power technology
2. F. Ford, from Physics International, who built the first large electron beam machine and proposed its application for inertial fusion
3. J. G. Linhart, the originator of the fast liner inertial fusion concept
4. A. Mascke and R. Martin, who proposed heavy ion fusion using storage rings and Linacs
5. In presenting the important concept of the Marx generator, which was the basis of Martin's work, the book does not identify the inventor as Erwin Marx, but leaves it up to the reader to wonder if it was perhaps Karl Marx who invented the Marx generator.

In addition, it appears that Duderstadt and Moses are victims of the widely distributed Naval Research Laboratory (NRL) propaganda, which claims that NRL scientists had invented the magnetically insulated diode, which led to the

successful generation of intense ion beams. This idea was proposed in a paper I delivered in 1969 to the Enrico Fermi School in Physics⁴ and was also recognized as fact in a historical review on light ion fusion.⁵

In the chapter dealing with inertial confinement reactor concepts, credit is given to several scientists, including self-quotations by Duderstadt and Moses, for papers in which previously published microexplosion reactor concepts were rediscovered.⁶

In the chapter describing applications, the extensive work of the British Interplanetary Society (Project Daedalus) on thermonuclear microbomb rocket propulsion is completely ignored. Instead, the book brings the paper by Hyde et al., which is largely a rehash of much older published work.⁷

That the book is incomplete can be shown on several fronts. First, the interesting impact fusion concept is dealt with in one short paragraph, and the authors incorrectly believe that the best prospect for the required high velocities is by laser ablation acceleration. The credit for impact fusion is given to Peaslee, whose main contribution was that he had organized a meeting on this topic at Los Alamos in 1979. It also appears that Duderstadt and Moses are unaware of the fact that the idea of impact fusion is about as old as Nuckoll's high-density inertial fusion concept with the important difference that papers on impact fusion were already published in the early sixties, with Nuckoll's 1961 unpublished memorandum still unavailable for critical evaluation by the scientific community. Second, the important concept of magnetic inertial fusion targets fares no better. It is hardly mentioned but should have received large exposure because it is the only hope in the case that $\sim 10^3$ times solid density compression cannot be reached, as it is needed in Nuckoll's scheme. Third, on p. 21 the reader learns that with targets of a "classified nature" 100-fold compressions have been reached. No mention is made that some of these classified target designs can be found in the open literature⁸ or in papers I had published several years ago on black body radiation implosion targets.⁹ Finally, no mention is made of the important cannonball target concept advanced by Yabe and the Japanese school.

The omission of the first two concepts makes the book incomplete, but the omission of the last two concepts makes it to a large part obsolete because the direct bombardment concept has now been largely abandoned in favor of indirect bombardment by black body radiation through beam energy conversion into black body radiation. Because Magelssen does not mention this fact, it can only mean that either the U.S. Department of Energy (DOE) censors must have cut it out of his review, or that he has no access to classified concepts (which, however, are really not secret any more as some DOE officials try to make us believe).

In the area of light ion drivers, the authors have given great attention to a scheme by which ion beams are propagated in ionized plasma channels. To my knowledge, this

idea was first proposed by Yonas, but Duderstadt and Moses give the impression that it was invented by Ottinger et al. However, more recent experiments on such ion diodes show beam emittances as small as 0.5 deg, and therefore make it likely that ballistic focussing can be used, as I had proposed it many years ago.¹⁰

Fred Winterberg

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REFERENCES

1. G. R. MAGELSEN, *Nucl. Technol./Fusion*, **3**, 152 (1983).
2. R. ATKINSON and F. HOUTERMANS, *Z. Physik*, **54**, 656 (1928).
3. G. GAMOW and E. TELLER, *Phys. Rev.*, **53**, 608 (1938).
4. FRED WINTERBERG, *Physics of High Energy Density*, Academic Press, Inc., New York (1971).
5. B. M. SCHWARZSCHILD, *Physics Today*, **33**, 12, 21 (Dec. 1980).
6. M. MONSLER, "Reply to 'Comment on 'An Overview of Inertial Fusion Reactor Design,'" ' ' *Nucl. Technol./Fusion*, **2**, 430 (1982).
7. For references on thermonuclear bomb propulsion, see the historical review by A. MARTIN and A. BOND, *J. Brit. Interplanetary Soc.*, **32**, 283 (1979).
8. See, for example, S. L. BOGOLYUBSKII et al., *JETP Lett.*, **24**, 182 (1976).
9. FRED WINTERBERG, *Nature*, **286**, 364 (1980); see also FRED WINTERBERG, *Z. Physik A*, **296**, 3 (1980).
10. FRED WINTERBERG, *Nature*, **251**, 44 (1974); see also FRED WINTERBERG, *Plasma Phys.*, **17**, 69 (1975).