From Barry Shelton

Science Research Council
APPLETON LABORATORY
ASTROPHYSICS RESEARCH DIVISION

Culham Laboratory, Abingdon, Oxon. OX14 3DB
Telephone: Abingdon 1840 or Oxford 41721 Telex No. 83159

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Dr G C Sudbury
Science Research Council
State House
High Holborn
London WC1R 4TA

Dear Dr Sudbury

PROPOSED CENTRAL LASER FACILITY

I was most grateful to receive a copy of the proposal to Council, and for an opportunity to comment on its astrophysical applications. In preparing a reply I have consulted with two of my colleagues, Dr B C Fawcett and Dr R W P McWhirter, both of whom have been involved with experiments using moderately-powered lasers. Some further comments by Dr McWhirter are also appended to this letter. Overall, I found the proposal of great interest and merit. However, I will try to confine my comments to three main points, and to keep these brief.

(1) There is a considerable astrophysical interest in the study of hot dense plasmas. Laser produced plasmas are close to steady-state in terms of ionisation balance and as such are the closest laboratory equivalent to date for the simulation of solar flares or other astronomical plasma in the region 10^7 to 10^8 °K. With the continuing advances in x-ray astronomy, it is likely that the astronomical interest in such high temperatures will increase. On the solar side, the forthcoming solar activity maximum in 1979 will lead to an intensification in the study of solar flares over the next decade. The physics of stellar (or solar) interiors is related to both the high temperature and high density aspects of laser-plasmas, but exploitation of the latter must await for a later stage than the factor of 10 compression envisaged initially in the present proposal. The following areas of study would be of direct astrophysical interest:-

(a) The creation of a hot plasma containing highly charged ions at close to steady-state ionisation enables experiments on energy-level structures, spectroscopy and collision rates to be carried out. This work, although primarily inspired by astrophysical needs is in effect basic atomic physics having a wider and more foundamental interest. It is an extension to higher temperatures of work at present carried out in this Laboratory.

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(b) Studies of the physics of very high density plasmas is of interest for the problems of stellar interiors. I know of no such work astrophysically motivated at present, but interest would increase as the degree of compression available begins to approach that required for stellar interior studies.

(c) Looking towards the future, it appears that it may be possible in highly-compressed plasmas to make direct measurements of nuclear reaction rates which are important in stellar interiors. Experimental rates are not otherwise available at such low energies.

(2) It is perhaps an historical accident due to the way in which this project has developed over the last few years, that the astrophysical interests have been neglected. This arises because of the assumption made throughout the proposal that the scientific users are the AEA and the Universities, while the technical facility would be provided by the AEA and the SRC. This excludes SRC scientific users in the Observatories or Appleton Laboratory, who have not been represented in the present studies. The additional interest from astrophysics would not be large in quantity, nor would it, I believe, have made any significant difference to the technical requirements as at present defined. However, I would hope that if the project goes ahead it would be possible to formally recognise this interest and to establish some communication channel between it and the project.

(3) Only one small mention is made in the proposal in Section 4.11 of an in-house physics programme associated directly with the project. I believe that a facility of this type can only work well and attract staff of the required quality if it is associated with worthwhile in-house research activity. Naturally, in the present financial climate this could not be large, but it is nevertheless important. It should be associated with the primary aim of the project (i.e the physics of hot dense plasmas, rather than the physics of lasers) and should include an SRC as well as an AEA element.

I hope you will find these comments of some help.

Yours sincerely

A H Gabriel

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