

# Technical Note

## Studies of Plasmas Produced by a Focussed TEA CO<sub>2</sub> Laser

By G. A. HILL, D. J. JAMES and S. A. RAMSDEN

THE AIM OF THIS WORK was to study the expansion of a gas breakdown plasma using our "home made" streak camera. Previous studies have used laser pulses less than 100 ns in duration. In our case the TEA (tetraethylammonium) CO<sub>2</sub> laser generated appreciable amplitudes lasting several hundred nanoseconds; in this case a separate interaction process occurs during the laser pulse and a change in mechanism of expansion is observed. The laser was a helical geometric transverse excited CO<sub>2</sub> laser 2 m by 2.5 cm pumped with a two-stage Marx-generator giving about 20 J in a 60-kV transient voltage pulse. The output is shown in Fig. 1.

The pulse focused by a 5 cm focal length mirror in Argon at 400 tor produced gas breakdown: a streak photograph of the expanding plasma is shown in Fig. 1 in time registration with the laser pulse.

A breakdown plasma appears at the lens focus 100 ns after the pulse begins and a nearly unidirectional expansion with an initial velocity of  $\sim 10^7$  cm/s is observed to move in a direction opposite to that of the incident laser beam. After 600 ns the plasma has decelerated to zero velocity which implies a much cooler plasma. At this stage radiation penetrates deep into the focal zone due to the lower absorption properties of the cooler plasma; a second plasma is generated nearer the focus which is coincident with the second peak in the laser beam intensity profile. A uniform expansion at  $\sim 6 \times 10^5$  cm/s occurs in both directions and remains constant for  $\sim 500$  ns.

The second plasma is observed to be a filament separate from the main body of the plasma. (A photograph could be shown but it proved inconvenient to superimpose such a photograph on the one shown in Fig. 1.) The nature and properties of this interesting effect are being studied. The initial expansion can be explained using a radiation-driven shock wave theory; this mechanism was first proposed by S. A. Ramsden and P. Savic (*Nature*, vol. 203, 1217 (1964)). Good agreement is found between the predicted and measured values for the expansion velocity.

A contribution submitted on May 9, 1972, by George H. Lunn for the authors, G. A. Hill, D. J. James and Prof. S. A. Ramsden, Dept. of Applied Physics, The University of Hull, Hull, HU6 7RX, England.

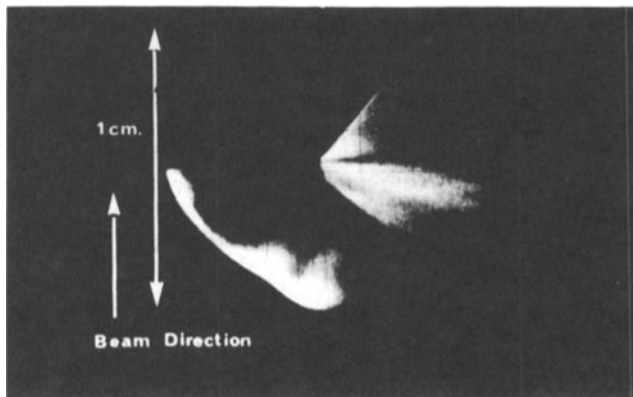
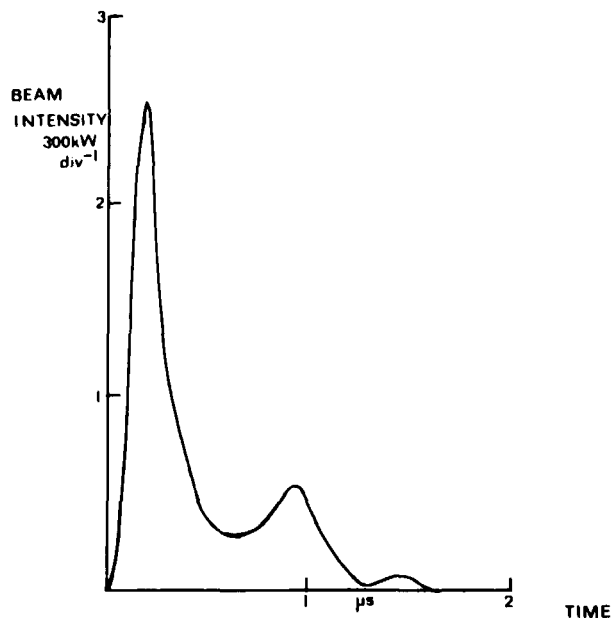


Figure 1

## Association of High Speed Photography Spring Conference—27-28 March 1972

By GEORGE H LUNN, *Vice Chairman*

ON THE INVITATION OF Dr E R Wooding the association met at the Royal Holloway College, Egham, Surrey with the permission of the Head of the Physics Department, Professor S Tolansky, FRS. The College is unusual for two main reasons, it was originally for "young ladies" and its main building is a twice life-size copy of the Chateau du Chambord. Its founder was named Holloway, a 19th Century industrialist who took a keen interest in female welfare, hence this college and the London prison for females also carrying his name. The conference was housed in a hall of residence, Kingswood Hall, situated close to the Thames by Runnymede, the hall was previously a private house

which has had a wing of bedrooms added and proved to be a most pleasant and compact venue. More than 80 members attended and listened to 10 varied papers, commencing with lunch, an afternoon session, a dinner, bed, breakfast, morning session, lunch and ending with an afternoon visit to a number of physics experiments in the College.

### Opening Session

At the opening session, members were welcomed by Prof. Tolansky who then delighted them with his entertaining and provocative lecture on "Optical Illusions" before handing the meeting back to the Association Chairman, Mr R J North.

Mr J S McVeagh of RARDE, Fort Halstead spoke on "The Use of the Low Speed Imacon Camera for Terminal Ballistics." The camera has been used in two modes, as a

Submitted 9 May 1972 by George H Lunn, Vice-Chairman, Association for High Speed Photography, 57 Whitelock Rd, Basingstoke, Hants, England.