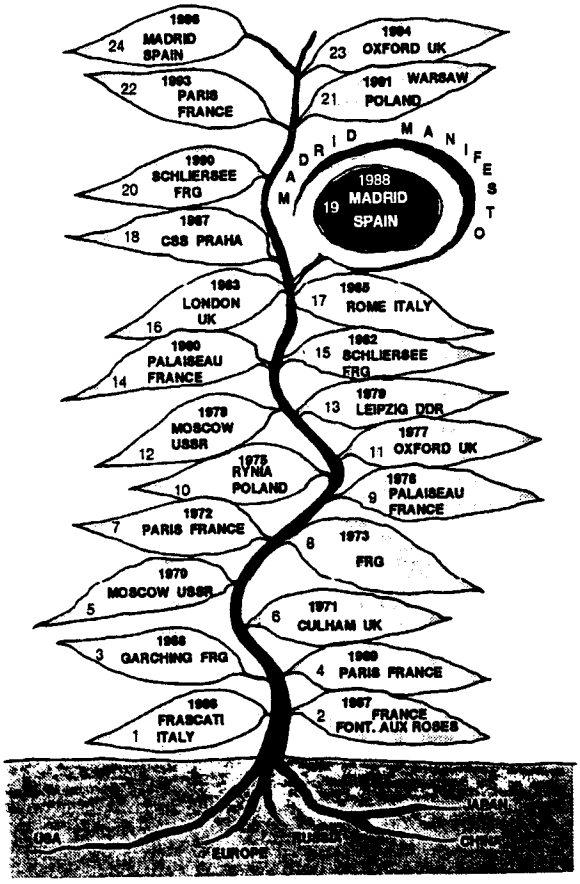
24th ECLIM

24th EUROPEAN CONFERENCE ON LASER INTERACTION WITH MATTER

Madrid (SPAIN) June 3-7, 1996

THE TREE OF ECLIM



TECHNICAL PROGRAMME

&

BOOK OF ABSTRACTS

XXIV ECLIM - Madrid (Spain) 3-7 June 1996

PROPAGATION OF A SHORT LASER PULSE IN PREFORMED PLASMAS AT RELATIVISTIC INTENSITIES

M.Borghesi, A.J.MacKinnon, L.Barringer, L.Gizzi*, C.Meyer, O.Willi

The Blackett Laboratory, Imperial College of Science, Technology and Medicine, London (UK)
* TESRE-CNR, Bologna (Italy)

The study of the interaction of laser pulses at relativistic intensities with plasmas is relevant for a number of applications, such as particle acceleration by plasma waves[1] and the Fast Ignitor[2] scheme for Inertial Confinement Fusion. For the success of these schemes, the pulse has to propagate for distances larger than the Rayleigh length without considerable energy loss.

We report on an experimental study performed at the Rutherford Appleton Laboratory, using the Vulcan laser facility. A plasma was preformed from thin films by a 400 ps pulse at moderate irradiance. The interaction pulse (1-3 ps duration, 1.054 μm) was focused onto the plasma at irradiances above 10^{18} W/cm^2. The plasma conditions could be controlled by varying the irradiance of the heating pulse and the delay between the two pulses. The diagnostics included optical probing transverse to the laser propagation and optical spectroscopy.

Strong self-channelling of the pulse was observed when interacting with an underdense plasma with a peak density of around 5 10^{20} el/cc (half of the critical density for infrared). Intense, localised optical emission suggests the formation of channel structures of less than 5 μm in diameter, that extend longitudinally for hundreds of microns. Coalescence of several channels into a single channel was also observed in a number of occasions.

3D-PIC code[3] simulations, performed for similar experimental conditions, predict the formation of narrow channels, in which the laser light is kept confined due to the effect of large self-generated magnetic fields. Preliminary measurements of magnetic fields were also performed that seem to be consistent with the computational model.

---

[1] D.C.Eder, P.A.Amendt, S.C.Wilks, Phys.Rev. A 45, 6761 (1992)
[2] M.Tabak et al., Phys.Plasmas 1, 1621 (1994)
[3] A.Pukhov, J.Meyer-ter-Vehn, preprint (1996)