Scientific Programme for the visit to Prof. Javier Honrubia, Universidad Politecnica de Madrid, Spain
Prof. Dimitri Batani

I spent 3 days in Madrid (12 / 14 December 2011) visiting Prof. J.Honrubia.

We have worked together on the interpretation of experimental data obtained during an experiment at the Rutherford Appleton laboratory., using the Vulcan laser (see for instance L. Volpe, D. Batani, B. Vauzour, et al. “Proton radiography of laser-driven imploding target in cylindrical geometry” Physics of Plasmas, 18, 012704 (2011)), for which the group of Javier Honrubia has contributed to the analysis of data and to numerical simulations.
The experiment concerned the propagation of fast electrons in a compressed cylindrical target. The analysis has shown that magnetic fields generated in the target due to the resistivity gradients may act to collimate the fast electron current (F. Perez, J. Honrubia, D. Batani, et al. “Magnetically Guided Fast Electrons in Cylindrically Compressed Matter” PHYSICAL REVIEW LETTERS, 107, 065004 (2011))

During the visit we discussed about:

1) the comparison of collective effects (induced by the strong self-generated electric and magnetic fields associated to fast electron propagation in the material) and stopping power effects (collisions) in determining the energy loss of fast electrons in the target material.
2) The need of including degeneracy and correlation effects in the stopping power
3) The heating induced by fast electrons in the background material

We have observed modification of the fast electron distribution during propagation. In the experiment, fast electrons were generated in a Ni-foil of one side of the foam cylinder and propagate up to a Cu foil to the rear side. Ni and Cu K-a emission were used as diagnostics of the electron source and of fast electron propagation. Substantially resistive electric fields decelerated all electrons in the same way. Collisions were instead mainly affecting low energy electrons. This was producing an asymmetry I the fats electron distribution and could affect the generation of K-a photons (which is preferentially produced by electrons with energies just above the K-ionization energy).
Electric and collisional effects had opposite trends: as the foam was compressed it increased its density but also its ionization and electrical conductivity. Therefore, electric stopping was decreased as collisional stopping was increased for foams of lower initial density, both effects were decreased.
The two effects were in our experimental conditions comparable. The experimentally observed variation of Cu K-a yield were therefore the results of two competing effects qualitatively tending to balance each other.

The energy losses resulted in a substantial heating of the background material with respect to the value, which could be obtained by implosion-compression only. Being averaged over the whole fast electron density distribution and over a range of plasma parameters (different densities and temperatures were present at different radial and axial position in the implodes plasma due to the non-uniformity of laser irradiation), our measurements did not provide enough sensitivity to discriminate among (slightly) different stopping power models.

Work is continuing in order to finalize the evaluation of all such effects and write a paper.

Detail of expenses:
Hotel (2 nights) 181.96 €
Airplane Ticket 76.97 €
Local Travels (Taxi, Metro) 33 €
Meals 55 €
Total 346.93 €