§23. Particle Transport Study on CHS with Tracer-Encapsulated Solid Pellet Injection

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For an accurate measurement of the particle transport, the concept of tracer-encapsulated solid pellet (TESPEL) has been proposed.1) The idea is to observe behavior of tracer particles deposited locally by the injected TESPEL. The TESPEL consists of polystyrene (polymer: $-CH(C_6H_5)CH_2-$) as an outer shell (diameter 300 μm, wall thickness 50 μm) and LiH as an inner core (a crystal of 50 μm size). The TESPEL production technique is described in detail in 2). The pellet is accelerated by a pulse of He gas to the velocity of 300 m/s and injected into the plasma.

The target plasma of CHS is heated by the 1 MW NBI, which is also used as a neutral beam source for the CXRS spectroscopy of the Li ions.

The light emission from the pellet is observed by two photomultipliers (with H_α and Li I (or Li II) filters) having a 10 μs time resolution. Furthermore, two CCD cameras are also equipped for recording the images of the pellet cloud in H_α and Li I (or Li II) light. A sample CCD image made with Li II filter is presented in Fig. 1. It is seen from the photo that the pellet reaches the central region of the plasma. The strong emission of Li^+ ions is localized within the area of a few centimeters. Photomultiplier signals of H_α and Li II show that at first H_α appears for about 500 μs and then Li II emits for a short period of about 50 μs. This indicates clearly the local deposition of the tracer particles in the core region.

After being fully ionized, Li^{+3} ions form a toroidal annular domain, which then diffuse in radial direction. The diffusion is measured by observing the Li III light (λ=449.9 nm) originated from CXRS with neutral hydrogen of the NBI. For that, an array of photomultipliers with spatial resolution of up to 7 mm and time resolution of up to 10 μs is set up at the location of the neutral beam. In order to subtract the background Li III light from the peripheral plasma, an identical set of photomultipliers was installed at the neighboring port. The resulted signals are shown in Fig. 2. The major peak is attributed to the pellet ablation phase, whereas the long time (τ~20 ms) decay has, obviously, diffusive behavior. The time delay Δt between the Li III rises is about 9 ms for the distance Δr of 8 cm.

The first results obtained on CHS have shown that this method will be a useful technique for studying the local particle transport.

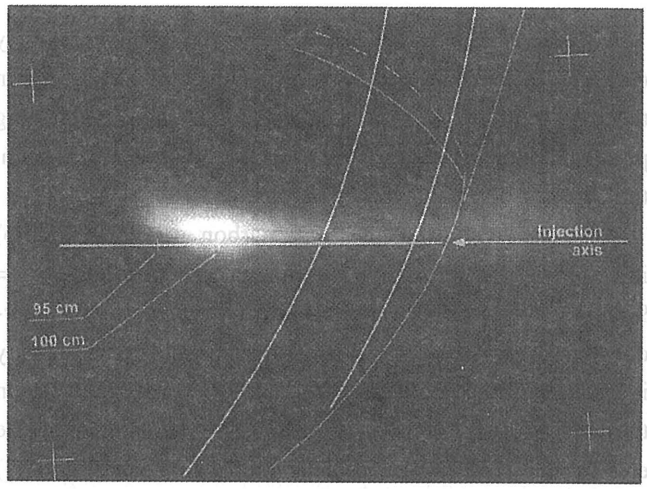

Fig. 1. CCD image of the pellet cloud in Li II light overlapped with geometry contours. Two values of major radius are shown (R_{ax}=92.1 cm).

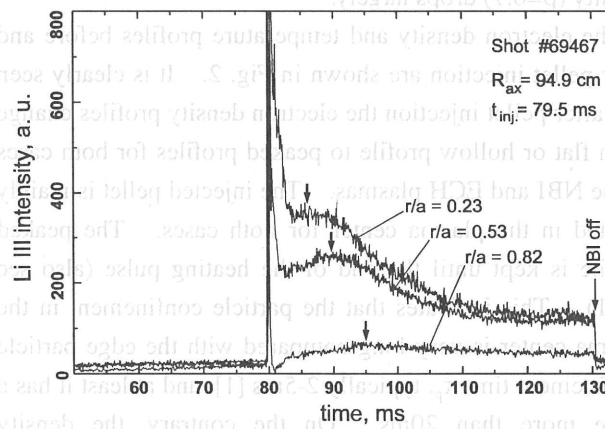

Fig. 2. Signals of Li III CXRS intensity at different radii. Three arrows indicate the moments of maximal intensity.

Reference
1) S. Sudo, J. of Plasma and Fusion Research, **69**, (1993) 1349.
2) K. Khlopenkov, S. Sudo, Rev. Sci. Inst. (in press).