

#### §4. Evolution of Two Dimensional Radiation Profiles during RMP Assisted Detachment in LHD

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Radiation is an important loss channel from the plasma. The InfraRed imaging Video Bolometer (IRVB) provides a two dimensional measurement of the radiation from the plasma [1]. Detachment is a mode of operation whereby the localized particle flux to the divertor can be replaced with radiation, which is more uniformly absorbed by the walls and divertor, thereby decreasing the peak heat load on the divertor. The Large Helical Device (LHD) has a natural double null helical divertor with two helical X-points (HDX) that twist helically around the machine.

In LHD detachment can be achieved at lower density and maintained more easily by using an  $m/n=1/1$  magnetic island in the ergodic edge region [2]. This is caused by a change in the localization of the radiation from the HDX to the magnetic island X-point (MIX) and ultimately to the magnetic island O-point (MIO). In this report we show images of the evolution of the radiation pattern from a top viewing IRVB [3] and compare these images with the corresponding images from the three-dimensional edge carbon radiation predicted by the EMC3/EIRENE impurity transport code [2].

The results are shown in Figure 1. In the first pair of images (1a, 1b) before detachment the radiation is seen to be localized in the HDX, which make the X shaped pattern from the lower and upper X-point traces. In the next pair of figures (1c, 1d) the detachment is taking place and the radiation is almost completely from the MIX and the MIO on the outboard (bottom in figure) side. The change in the location predicted by the synthetic images from the EMC3/EIRENE code is well reflected in the experimental data, but the model overestimates the magnitude of the radiation by factor of 2 to 4.

- 1) B.J. Peterson, Rev. Sci. Instrum. **71**, 3696 (2000).
- 2) M. Kobayashi et al., Nucl. Fusion **53**, 093032 (2013).
- 3) S.N. Pandya et al. Plasma Fus. Res. **8**, 2402095 (2012).

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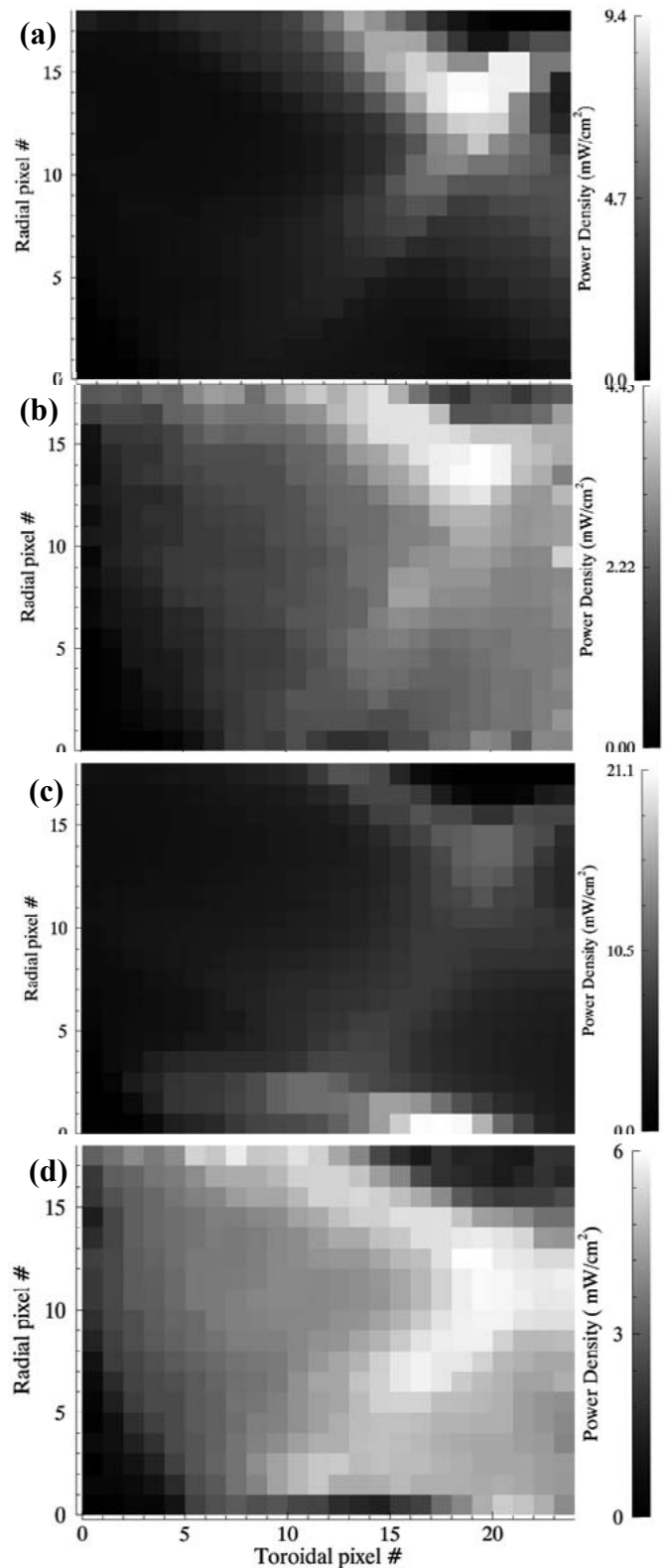


Fig. 1. Synthetic images of radiation from carbon radiation as predicted by EMC3/EIRENE at the upper port IRVB on LHD for densities of  $4.0$  (a),  $6.0$  (c)  $\times 10^{19}/\text{m}^3$  and corresponding experimental IRVB images (18 x 24 channels) of radiated power density from shot #115095 at line averaged densities of  $4.2$  (b) and  $6.0$  (d)  $\times 10^{19}/\text{m}^3$ .