§26. Abrupt Intense Radiation from Divertor Plates

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We occasionally observe intense radiation from the divortor plates in LHD [1]. We happened to come to this observation in a course of examining what causes the collapses on *Te* (electron temperature) and *ne* (density) profiles obtained by Thomson scattering diagnostic (TS). An example is shown in Fig. 1. When *Te* and *ne* profiles collapse as shown in (A), the DC output of the avalanche photo diode (*DC_APD*), which is proportional to the radiation intensity integrated along the TS-light collection optics, becomes very large around the collapsed region (B). This collapsed region coincides well with the scattering region that has a divortor plate in background view scope, which leads us to suppose that the divertor plates emit so intense radiation that the TS data become invalid.

Figure 2 shows the time evolutions of the 5 *DC_APD* signals (bottom) from the polychromator#32 together with the cord-averaged plasma density *ne_bar*, the diamagnetic energy W_p, the bolometer signal P_{rad}, H-alpha, and total NBI power. The *DC_APD* rises rapidly around 1.3 s, 300ms after the start of NBI#3. Because of this rapidity, we call this phenomena AIR (Abrupt Intense Radiation). Crossing the AIR event, the *DC_APD* changed from 20 mV to 3 V. This 150 times increase in the *DC_APD*, compared with 2 times in P_{rad} at the same time, implies that the AIR is a very local phenomenon, supporting our assumption. The AIR shown in Fig.2 seems to well correlate with the rise in NBI. But this is not always the case. There seems to be a tendency that an AIR appears at the time when the diamagnetic signal W_p approaches its peak under an NB heating. From the energy-flow equation, $P_{heat}= dW/dt + P_{out} + P_{rad}$, where P_{heat} is heating power, P_{out} is the wall loading power carried by particles and P_{rad} is radiation loss from plasma, the above statement leads us to an assumption that the AIR appears when P_{out} or $\int P_{out}\, dt$ becomes large. This assumption is further supported by facts that the higher P_{rad} often reduces or suppresses an AIR.

Figure 3 (A) shows a time-integrated spectrum of the AIR measured by a fiber-multi-channel spectrometer. The 3073K black body radiation spectrum from a standard lamp measured by the same spectrometer is given in Fig. 3(B). They are fairly similar in shape.
Assuming that the AIR has a black body radiation spectrum, we can deduce the surface temperature that reproduces the observed relative signal intensities among the five *DC_APD* signals from a five-color polychromator. The result is shown in Fig. 4. The surface temperature abruptly rises up to 2000 K in a few ms.

We have yet no decisive explanation for the AIR. Possible interpretations are: (1) flake formation on the divertor surface; (2) vapor cloud formation in front of the divertor surface.

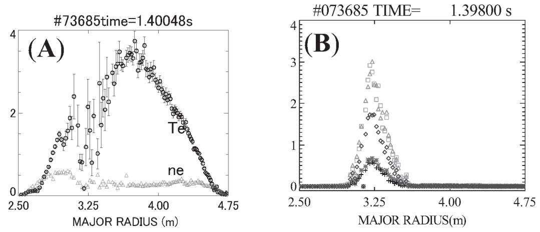

Fig. 1. (A) Collapsed *Te* and *ne* profiles. (B) Distribution of DC-outputs of APDs.

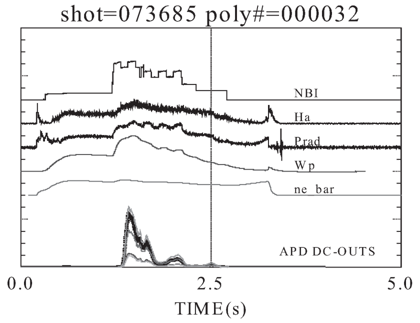

Fig. 2. Time evolutions of *DC_APD* together with the cord-averaged plasma density *ne_bar*, the diamagnetic energy *Wp*, the bolometer signal *Prad*, *H-alpha*, and total NBI power.

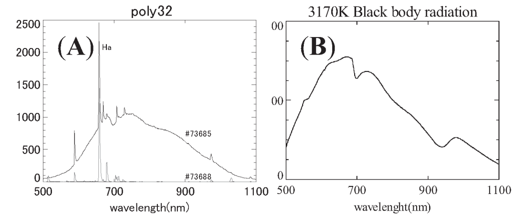

Fig. 3. (A) Time integrated multi-channel-spectrum of the light from the fiber connected to poly32 with/without AIR. (B) A 3170K BB radiation spectrum measured by the same spectrometer.

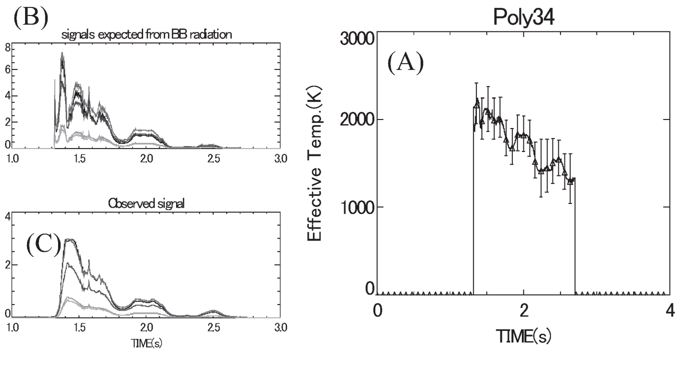

Fig. 4. (A) Deduced temperature evolution. (B). Calculated signal sizes from BB radiation of temperature shown in (A). (C): The observed signal size.

[1] K. Narihara, et al., Proc. of 17th Toki conference, p1-067.