## **REPETITIVE GYROTRON OPERATION FOR ITER**

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Figure 1: Waveforms of the beam current of the 800kW/600sec/20-30min intervals during 8days repetitive operation.

*repetitive operation.* by the ion pump interlock. At the day 7 and the day 8, there was small vacuum leakage from the transmission line, which terminates the couple of shots by the pressure interlock of the transmission line. By excluding these shots, the total shots are 88 shots. The successful 600 s shots are 72 shots. Therefore, the gyrotron reliability is measured as 82%.

The recovery test is also performed. For example, when the operation is stopped at 7.2 sec by the over current protection for the beam current, the next shot is started 72 sec after the interlock and successfully continued to the end of the pulse (600 sec). The 72 sec interval time is determined by the power supply system. The detailed analysis for the 88 shots will be shown in the presentation.

[1] A. Kasugai et al., Nucl. Fusion, 48, 2008, 054009

[2] K. Sakamoto et al., Nat. Phys., 3 , 2007, pp 411-414

The heart of the ITER EC system is the gyrotrons, which are to provide 1MW long pulse operation (between 500 and 3,000sec) with an electrical reliability of  $\geq$ 50%. Long pulse operation has already been demonstrated in ref [1] and [2]. The basic requirement of ITER (1MW power generation with 50%) electrical efficiency and 500 sec pulse length for scenario 2 flat top) is already satisfied in 2006 as shown in ref [1] and [2]. However, there is not enough experience of high power and long pulse operation. Especially, the pulse length of 500 sec is longer than the present tokamak ECH system that is less than 30 sec. It is important to show ITER equivalent long pulse operation is possible for a cyclic tokamak operation.

The repetitive operation corresponding to ITER is performed 8 successive days except the weekend. The pulse width is 600 sec and the interval is 20-30 min. The output power is 800 kW. The electrical efficiency including depressed collector is 53-57%. The waveforms of the beam current during 8 days operation are shown in Figure 1. As shown in the figure, there are two weekends without the operation. The total shots are 117 shot. The first two shots in the morning and first day after the weekend are dedicated to the conditioning of the gyrotron, that means the operation was stopped by the ion pump interlock. At the day 7 and the