PROGRESS OF ITER EQUATORIAL ELECTRON CYCLOTRON LAUNCHER DESIGN FOR PHYSICS OPTIMIZATION AND TOWARD FINAL DESIGN

K. Takahashi[1], K. Kajiwara[1], Y. Oda[1], K. Sakamoto[1] and M. Henderson[2]

[1] *Japan Atomic Energy Agency, 801-1, Mukoyama, Naka, Ibaraki 311-0193 Japan*
[2] *ITER Organnization, St. Paul-lez-Durance, 13067 France*

Corresponding author: takahashi.koji@jaea.go.jp

An ITER EC equatorial launcher is required to inject a 170GHz, 20MW millimeter (mm) wave beam to plasma. The launcher should be capable of a toloidal steering of the beams ($20^o \leq \Theta_T \leq 40^o$) and it is performed by the combination of three movable mirrors. Twenty-four waveguide transmission lines with three miter bends in each line forming the dog-leg structure, in which high power RF waves were guided toward the mirrors[1]. The launcher design has been modified to a partial quasi-optical (QO) layout without changing the opening size of the blanket shield modules (BSMs) located in front, shown in Fig. 1, resulting some advantages such as a simpler configuration and a possible reduction of fabrication cost. The transmission efficiency of the mm wave beam on the QO layout is 99.5%, comparable to the reference design[1]. This modification also derives the reduction of heat load on the steering mirror to be one-third of the reference design, which relaxes the structure design.

The launcher injects the mm wave power to the direction of co-current drive and hence, a central heating with co-current drive can be demonstrated. This may lead to the excess peaking of current profile according to the physics analysis concerning to an electron cyclotron heating and current drive (EC H&CD)[2]. In order to perform the pure central heating of plasma with balancing the co- and counter current drive, the central beam row of the equatorial launcher has being flipped off, so that the toroidal injection angle of the 6.7MW-power become negative. In addition, the top and bottom beam row of the launcher has been poloidally tilted by 5º, so that the beams are deposited closer to the core plasma region. In order to perform this modification without degrading the propagation capability of the mm wave beam and increasing the peak heat load on the mirrors' surface, some part of the BSMs have been cut and the mirrors' shape have been modified. The position of both the steering and the fixed mirrors has also been shifted back to increase the space for the cooling pipes of the BSMs. The reasonable assembly and refurbishment of the BSMs' can be done with this modification. It is obtained that the degradation of the transmission efficiency of the beam is only 0.3% and the peak heat load on the mirror is equivalent to the reference design in this design modification. This degradation is allowable.

In this paper, the design progress of the ITER equatorial EC launcher is presented considering the results of mm-wave analysis, thermal, electromagnetic and nuclear analyses. The development of the launcher components is also described.

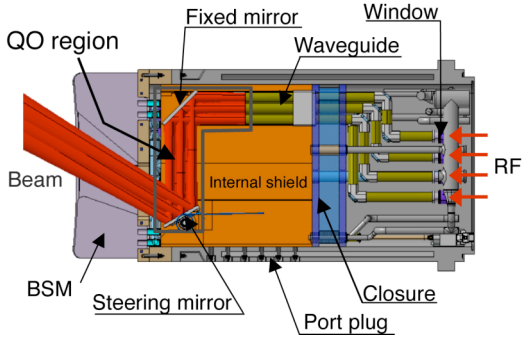

Figure 1: Cross section of ITER equatorial launcher. Quasi-Optical layout option (Present design).

[1] K. Takahashi, et al., Fusion Sci. Tech ,47 (2005) 1
[2] G. Ramponi, Nucl. Fusion 48 (2008) 054012