§31. Study of Neutral Beam Injection into CHS-qa

Nomura, I., Isobe, M., Matsuoka, K., Nishimura, S., Okamura, S., Suzuki, C.

As a post CHS plasma device, the design study of CHS-qa is now underway[1]. We studied the basic requirements for the neutral beam injection in CHS-qa. At present CHS has two NB injectors (NBI #1 and NBI #2) with positive ion sources. These NBIs will be also used for CHS-qa. Their characteristics are shown in table1. The NBI#2 has potentials both of off-axis injection and of increasing injection energy up to 50keV. We studied the contribution of neutral beam injection to CHS-qa using these parameter.

First we estimated the beam driven current using neoclassical formula developed by Okano[2]. This study is important from the view of current-driven MHD instability. We calculated in the case of tokamak, which has the same aspect ratio with the 2b32 configuration of CHS-qa. We assumed the plasma parameters are as $T = T(0)(1-s)$, $T_e(0) = 2.0$ keV, $T_i(0) = 1.5$ keV, $n = n(0)(1-0.8s+1.3s^2-1.5s^2)$, $n_e(0) = n_i(0) = 2.0\times10^{19}/m^3$, here s is the normalized toroidal flux. Results are shown in fig.1 as a parameter of the electron density. We assumed the absorbed beam power is constant, i.e. 1.5 MW which results in the maximum estimation of the beam driven current in the case of 2b32 configuration.

Because the plasma shape of CHS-qa is not symmetric with respect to the equational plane, the skew poloidal injection angle dependence on neutral beam deposition is expected. The beam deposition rate is calculated using HFREYA code[3] for 2b32 configuration of CHS-qa and with the present NB injectors parameter. We assumed the electron density and temperature profile as, $n_e(\rho)=n_e(0)(1-\rho^2)^{0.5}$, $n_e(0)= 6.0\times10^{19}/m^3$, and $T_e(\rho)=1.5(1-\rho^2)$ keV, respectively. Fig.2 and fig.3 show the asymmetric effects of neutral beam in the case of poloidally off-axis injection.

References

1.Okamura, S. *et al.* Proc. of 18th IAEA Fusion Energy Conf., Sorrento, IAEA-CN-77/ICP/16.

2.K.Okano, Nuclear Fusion 30(1990)423.

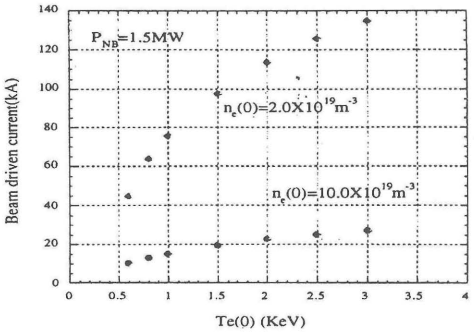

Fig.1. Beam driven current of CHS-qa.

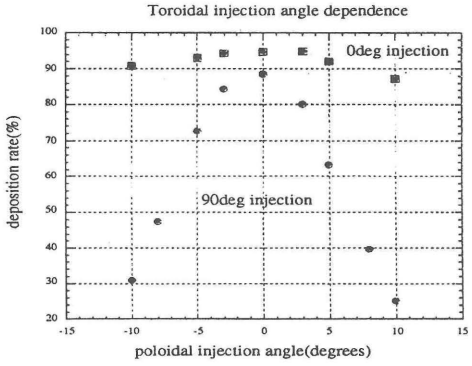

Fig.2. Dependence of poloidal injection angle on neutral beam deposition rate as a parameter of the toroidal beam injecting position.

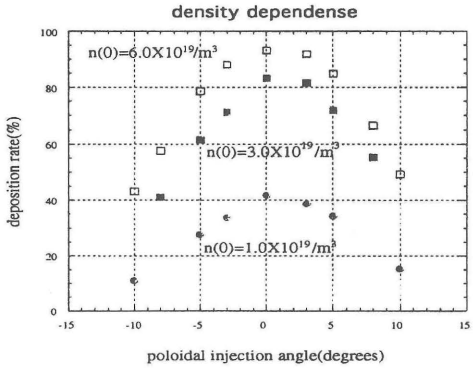

Fig.3. The poloidal injection angle dependence at 90 degrees beam injection.

	NBI#1	NBI#2
power(MW)	1	1
energy(kV)	40	30
focus points(mm)	3451	3700
beam emittance(rad)	18	20
port diameter(mm)	300	300
ion source diameter(mm)	240	300

Table 1. Characteristics of NBI.