REQUIREMENTS SPECIFICATION FOR THE NEUTRAL BEAM INJECTOR ON FAST

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This paper discusses the scientific and technical requirements for a Neutral Beam Injection system on the FAST Tokamak and describes a preliminary conceptual design of a suitable injector. FAST is being proposed as an European experiment in support to the operations on ITER and to the design of DEMO [1]. The specific mission of this relatively compact (R=1.82 m, a= 0.64 m) high magnetic field (7 up to 8.5 T) device is an integrated approach to a number of outstanding burning plasmas physics and operational issues with an emphasis on the impact of fast particles on turbulent transport. In this respect the inclusion of a NBI to complement the ICRH, LH and ECRH systems is of particular importance. The reference H-mode scenario in FAST features a single-null diverted, 6.5 MA of plasma current, 7.5 T of toroidal magnetic field and 30MW of total input power [1], with a central electron density of about 2.5 $10^{20}m^{-3}$. The main physics requirement for a beam on FAST is that the beam generated fast particles are to be super-Alfvenic and their pressure of the order of a few per cent of the magnetic pressure. In addition, the beam energy must be high enough to assure deep penetration in the dense FAST plasma and also drive preferentially electron heating to emulate alpha heating in a reactor. Momentum input and current drive capabilities are further important ingredients, for stability and advanced scenarios studies. To identify the most effective beam configuration that fulfils the FAST scientific requirements, an extensive scan of beam parameters (species, energy, geometry, divergence) has been performed by means of the NEMO/SPOT codes, simulating the interaction of the beam with the FAST H-mode plasma. A full scenario simulation has also been performed by using NEMO/SPOT coupled to the CRONOS transport code in order to assess the effect of the NBI in a self consistent way. The specifications for the beam converge towards a hydrogen/ deuterium beam with 0.7 -1 MeV of energy, 10 MW of input power, tangential injection and the possibility of vertical steering. Such scientific requirements set a series of technical challenges regarding the injector and the coupling of the injector to the FAST main chamber, these requirements are addressed in the paper. Finally a preliminary conceptual design of the injector is proposed.

[1] G. Calabrò et al, 2009, Nucl. Fusion **49,** 055002