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Evaluation of beam-beam fusion reaction rate including localized beam profile in tolamak plasma

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Many D-D fusion reaction experiments have been performed in tokamaks and helicals. D-D fusion reaction rate is used to evaluate energetic particle confinement. In many studies, they use homogeniuos beam ions distribution to evaluate D-D fusion reaction rate and they dismiss localized effect. This is why experimental results are different from simulation results. In this study, we consider D-D fusion reaction rate between energetic beam ions with localized effect in tokamak. D-D fusion reaction is shown below.

$$\mathrm{D} + \mathrm{D} \rightarrow \mathrm{T}(1.01\mathrm{MeV}) + \mathrm{p}(3.03\mathrm{MeV})$$

$$\mathrm{D} + \mathrm{D} \rightarrow {}^{3}\mathrm{He}(0.82\mathrm{MeV}) + \mathrm{n}(2.45\mathrm{MeV})$$

We need NBI heating as an additional heating for self-ignition condition. We put energetic particles (deutriums) from NBI into the tokamak perpendicularly for the magnetic field , particles exchange their charges with bulk plasmas(deutriums) and they are locally trapped inside banana orbit by magnetic mirror effect. They distributed in a weak magnetic field side on the torus. Because of this, inhomogenius distribution of D-D reaction rate between beam ions occurs. Then, we finally evaluate D-D reaction rate between beam ions with localized effect occurred in tokamak.

We use GNET code that solves five dimentional drift kinetic equation to evaluate D-D reaction rate.