# A Neutral (Tritium) Beam Injector for Fuelling a Fusion Reactor

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During the operation of a fusion reactor, tritium is consumed by the fusion reactions and it will have to be continuously replenished. Gas injected from the outside of the reacting plasma will be ionized before it penetrates any significant way into the plasma, and well outside the main transport. The result is that the $T^+$ will be rapidly lost to the walls of the reactor, and it is very difficult to replenish the burnt fuel by simple gas injection. Techniques to overcome this fundamental difficulty, such as the injection of fast pellets of frozen D, T or DT, or supersonic gas jets have had only limited success as they do not significantly change the basic problem. The injection of a beam of, say, 100 keV $T^0$ is potentially an attractive way to deposit the required fuel inside the transport barrier where it is required, and the power from the injected beam will contribute to heating of the reacting plasma. This paper examines a possible design of $T^0$ injector which aims at minimizing the total $T_2$ inventory in the injector. The injector is based on standard positive ion acceleration and neutralization, but a novel design of split accelerator grids reduces substantially the $T_2$ flow into the ion source and minimizes the contamination of the ion source by the neutralizer gas. As a very high total equivalent current of $T^0$ has to be injected, a very high current of $T^+$ must be produced by the beam source(s) of the injector. This is achieved by using a single large ion source and accelerator using technology being developed for the ITER negative ion based injectors. This paper will outline the basic principles of the injector and give some calculated values for the $T^0$ injection rate, $T_2$ accumulation rate in the injector, and the overall efficiency of the injector.