
Contribution ID: **8** Type: **not specified**

# Polarized Fusion, its Implications and Plans for Direct Measurements in a Tokamak Plasma

*Wednesday 28 September 2016 15:05 (35 minutes)*

We have carried out calculations demonstrating the benefits of having spin polarized fuel in future tokamak fusion reactors and the viability of testing spin polarized fuel in current tokamaks. The cross section for D-T (deuterium-tritium) fusion is increased by 50% when the nuclei spins are parallel to the tokamak guide field. In future magnetic confinement fusion reactor power plants the increased reactivity of using spin polarized fuel would lessen the engineering requirements (magnetic field, plasma current, major radius) on those reactors or increase their power output for the same engineering parameters. Of particular concern for future reactors is any degradation over time in capability of the various components due to prolonged high neutron fluence from the D-T reactions; using spin polarized fuel could mitigate the consequences of moderate degradation. For instance, using fuel that is completely spin polarized could yield an increase in reactivity to make up for a 13% loss in toroidal magnetic field. On the other hand, with fixed engineering parameters, complete spin polarization of the fuel would yield a 75% increase in power output due to non-linear stabilization of heat transport at the higher pressures. An outstanding question for the future viability of spin polarized fuel in magnetic confinement reactors is whether the spin polarized fuel can retain its polarization through injection into the plasma and then through the energy containment period. We have carried out simulations that show that introducing spin polarized D and He3 pellets in high performance discharges in the DIII-D tokamak will produce measurable levels of fusion products, whose poloidal distribution and quantity can be unique to the spin states of the fuel, and can then be used as an indicator of the retention of polarization through the fusion process. Ongoing research at Jefferson Lab, University of Virginia, and General Atomics is focused on refining existing methods and technology to prepare spin polarized fuels for injection into burning plasma scenarios in order to verify these results in existing tokamaks

**Author:** SANDORFI, Andrew (Jefferson Lab)

**Presenter:** SMITH, Sterling (General Atomics)

**Session Classification:** Plenary

**Track Classification:** A. Nuclear