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PHY 482

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### Project Problem

I'm interested in researching tokamak fusion reactors for my project. A tokamak reactor is a toroidal fusion that uses a set of toroidal and poloidal electromagnets to contain plasma. Magnetic fields apply a force to charge particle perpendicular to the field making the toroidal magnets apply a poloidal force and the poloidal magnetic field apply a toroidal force. The combination of the two make a helical magnetic field that raps into itself to make a torus. This torus is the magnetic bottle that holds the plasma and gives all the charged particles in the plasma an infinite path to travel along.

In order to achieve fusion, the plasma needs to be heated up to millions of kelvin in order for the particles in the plasma to have enough energy to overcome the coulomb force between them. This is done by placing a solenoid in the middle of the tokamak reactor, through the doughnut hole if you will. This solenoid induces a current into the plasma which will then experience Ohmic heating and begin to fuse once it is hot enough.

There are many problems when it come to sustainable fusion, but many of them an engineering and materials problems. I'd like to investigate that some, but my main interest is in the physics and what all is happening inside the reactor. This will be a look into magnetic fields, MHD plasma response, and the statistical behavior of plasma.

### References:

L.A. Artsimovich 1972 Nucl. Fusion 12 215

J.D. Galambos et al 1995 Nucl. Fusion 35 551

M.J. Schaffer et al 2008 Nucl. Fusion 48 024004

R.C. Kalling et al. (2011). "Accelerating the numerical simulation of magnetic field lines in tokamaks using the GPU". Fusion Engineering and Design. Volume 86. Issue 4-5