Annotated Bibliography

1. Tokamak devices

L.A. Artsimovich 1972 *Nucl. Fusion* **12** 215

This paper is a survey of tokamak function and design. It starts with the general idea of what a tokamak is and how it confines plasma and then breaks it down to the details. First the paper details the movement of single particles in a tokamak and then reviews the theoretical work on equilibrium, transport coefficients and plasma stability. The design of the various Tokamak devices is described, as are the methods of plasma diagnostics employed with them. Finally, main experimental results are summarized and compared with theory.

The theoretical model used in the paper assumes perfect toroidal symmetry in the magnetic field causing particles to take a perfect- mathematically clean spiral around the reactor. The need for the spiral comes from the ExB drift of the plasma particles that would cause them to leave containment if their direction was not constantly changed. The paper continues with explaining the parameters needed to maintain plasma stability. It sums them up in the "q" factor which is a measure of how well fusion is sustained. It is dependent on confinement time, temperature, and plasma density.

I need to dig into the math a bit more to really understand what is going on. But, at face I understand conceptually how a tokamak contains plasma- it's basically a magnetic bottle donut. The q parameter makes sense though. The plasma density and temperature define the rate of fusion, and the containment time is how long the fusion lasted.

2. The fundamental parameter space of controlled thermonuclear fusion

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This paper gave a framework to compare multiple approaches to fusion by outlining the parameters for all of them. The three approaches are magnetic confinement fusion, inertial confinement fusion, and magnetized target fusion. The parameters for each type of fusion differ because of the different set ups, but they all operate under the same basic principles.

The basic parameter to measure fusion is Qfus, the fusion energy production rate, which is dependent on the rate of fusion and energy released per reaction. This is further broken down into ion density, fusion cross section, and temperature. It's like the tokamak devices paper; defining the basic, but it explains how these parameters apply to the other fusion approaches as well.

Magnetic confinement fusion is what tokamaks (and stellarators) do, make a magnetic bottle to contain the plasma while heating it. Inertial confinement fusion is setting up a pellet of fusion fuel and shooing it with lasers, so it implodes and fuses. Magnetic target fusion is a combination of the two that created a magnetic bottle to contain plasma and then squeezing it to get the temperature and density needed for fusion.