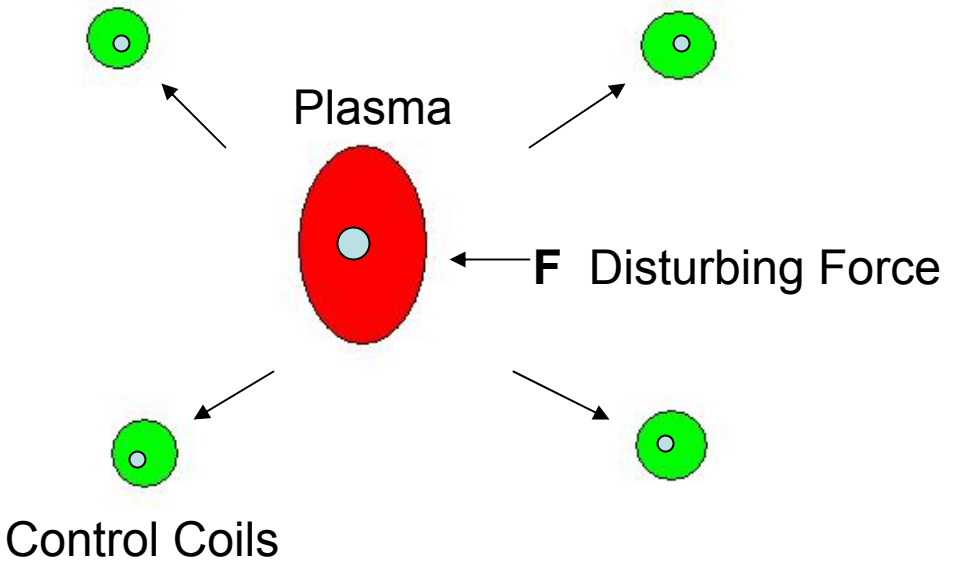
Disruption Control

Why disruptions are bad.

- Heat and damage surface that makes contact with the plasma.
- Induces high currents to flow in the containment vessel near where the plasma crashes.
- Creates unnecessary high forces due to induced magnetic fields.

Feedback Control

Unstable Mass-Spring-Dashpot System



High Z gas

- Plasma Fusion can be stopped quickly by the introduction of a high Z gas.
- This gas will radiate the thermal energy of the Plasma as visible light absorbed over the large surface area in the reactor.
- Krypton works well in this application.

Current Fast Valve Pros

- Operate at pressures up to 2000 psi.
- Impact used to overcome pressure force.
- 30 amp capacitor discharge given to a solenoid to operate the valve.
- High repeatability, up to 20 Hz.
- Currently used to inject frozen Deuterium fuel pellets at up to 1900m/s.

Schematic of current Fast Valve

Figure removed due to copyright reasons. See Fig. 1 in Milora, et al. (1986).

Current Fast Valve Cons

- The current valve is only 4mm in diameter.
- Time is taken to accelerate the striking mass 2mm before colliding with the plug.
- The valve begins to open 1.75 ms after being energized.
- The valve takes another 1.8 ms to fully open.

How a mass driver works

- A High Voltage pulse is sent to the coil.
- A current is induced in the conductive armature.
- The resultant magnetic fields repel.
- Demo is 300v, 5J

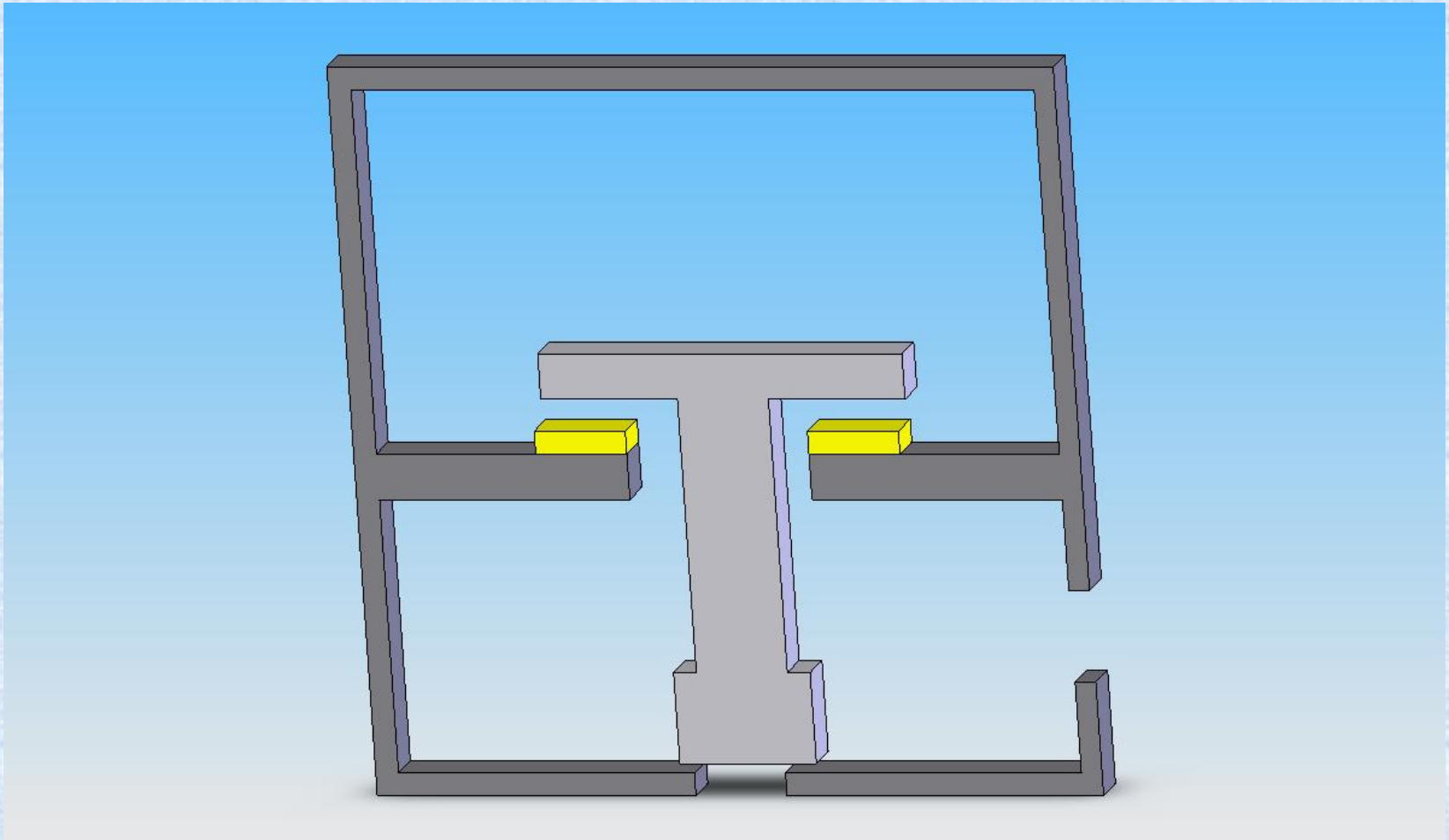
Full sized model

- A coil of 12 gauge magnet wire at the base receives a 16000v, 12 KJ pulse from the capacitors.
- A current is induced in the .08Kg aluminum ring.
- The ring is accelerated along the guide tube towards the energy dissipater.

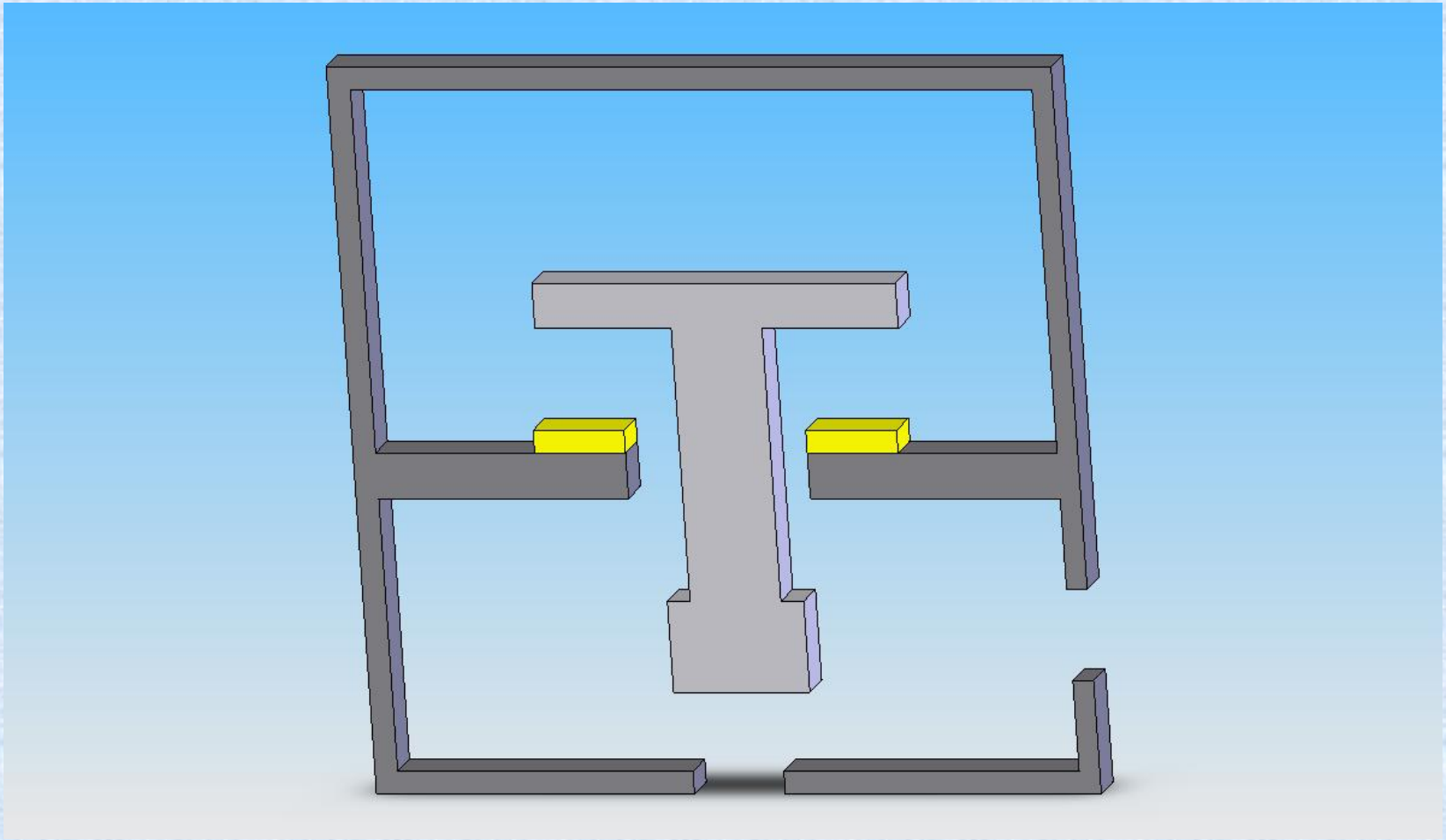
Math

- The electric discharge lasts approximately .1ms and peaks around 200 MWatts then gradually rings down.
- The ring is accelerated to 300m/s (1000ft/s). Kinetic energy is 3600J.
- Acceleration is 3,000,000m/s^2. Force is 240,000N(60,000lbs) Plenty to open a large high pressure valve.

Proposed design cross section



Action



This new valve could cut the opening time by a factor of 10.

Reference:

Milora, S. L., Combs, S. K., & Foust, C. R. Fast-opening magnetic valve for high-pressure gas injection and applications to hydrogen pellet fueling systems. *Review of Scientific Instruments* (57), 2356 (1986).