CHANGING WHAT'S POSSIBLE

Centrifugal Mirror Fusion Experiment

BETHE Kickoff Virtual Workshop
Aug. 11–12, 2020

C. A. Romero-Talamás, University of Maryland, Baltimore County

A. B. Hassam, I. Abel, B. Beaudoin, T. Koeth, University of Maryland, College Park

U.S. DEPARTMENT OF ENERGY

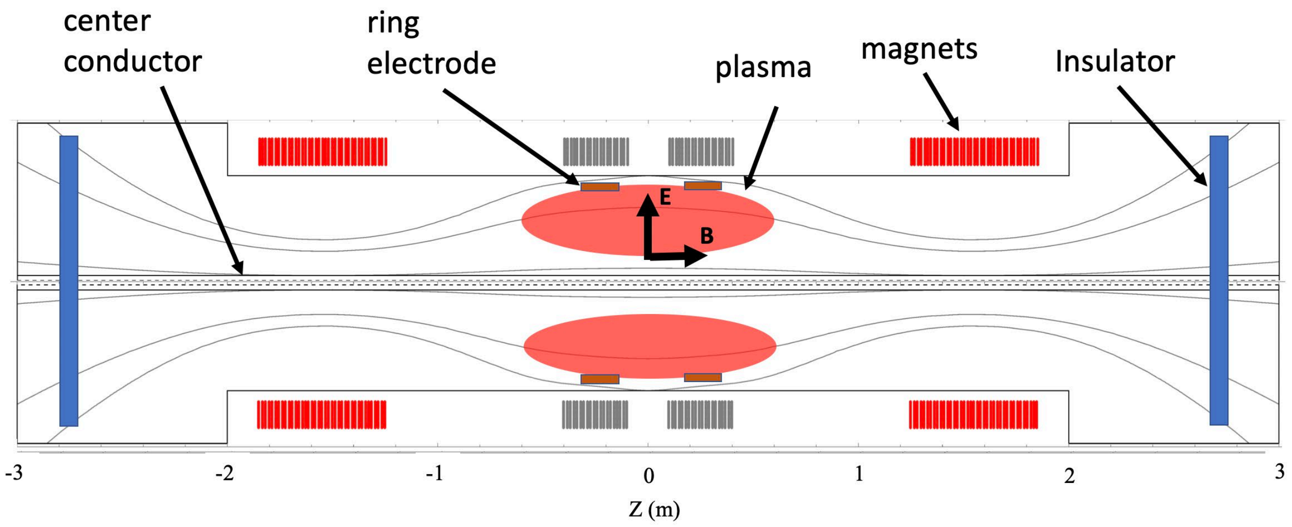
Team members and roles

- **Carlos A. Romero-Talamás**, PI, UMBC/UMD Associate Professor, Mechanical Engineering.
  - Engineering Design, Experiment Design, Spectroscopy, B-dot probes.
- **Adil B. Hassam**, co-PI, UMD, Prof. Physics.
  - Lead Theory, Numerical Simulations, Comp. Support Teams Interface.
- **Ian Abel**, co-PI, UMD
  - Theory Support, Numerical Simulations, Support Teams Interface
- **Brian L. Beaudoin**, co-PI, UMD, Research Prof. at Inst. for Res. Appl. Physics
  - DAQ, High-speed imaging, Experimental Support, Safety.
- **Timothy Koeth**, co-PI, UMD
  Asst. Professor, Materials Science.
  - Insulator Design, Neutron Detectors, HV Design System, Safety.
- **John Ball**, Ugrad/Grad. Student, UMD
  - Insulator Design, Neutron Detectors, HV Design.
- **Nathan Eschbach**, Grad. Student, UMBC
  - Experiment Design, Magnets, B-dot probes, UHV.
- **Zachary Short**, Grad. Student, UMD
  - Spectroscopy, IDS
- **Postdoc** (TBD): Experiment Support, Data Analysis.

All team members will contribute to publications and outreach

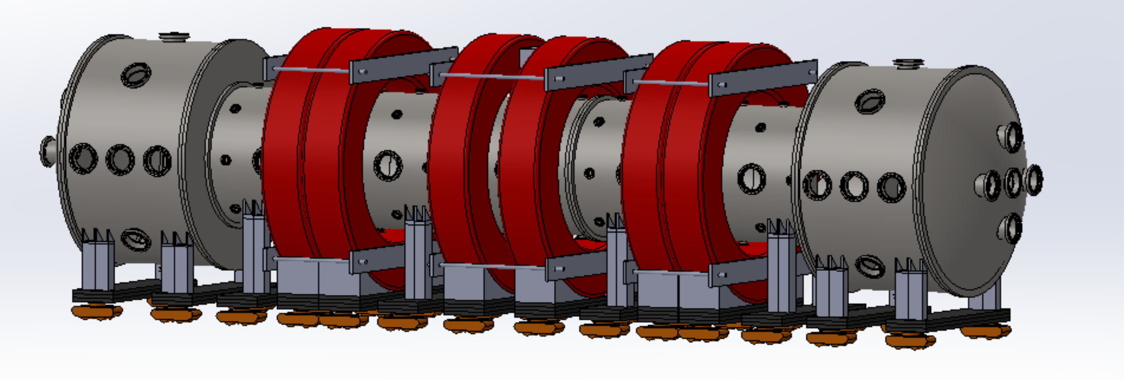
High-level motivation and goals of the project

- ***Motivation***:
  - *Deliver a simple magnetic configuration that can scale to viable fusion power source.*
  - *Innovative mirror configuration that suppresses loss-cone losses and stabilizes MHD instabilities, while allowing access to energy breakeven.*
- ***Goals***:
  - *CMFX aims for T > 0.5 keV and nTτ > 10^{17} with H-H and D-D plasmas.*
  - *High plasma impedance to sustain high T and high rotation velocity.*
  - *Stable plasma duration 15 – 100 ms.*



Major tasks (and technical risks), milestones, and desired project outcomes

- Engineering design for high mirror ratio, high voltage, and long pulse capacitor banks.
  - 100 kV transmission line.
  - 3 T mirror coils.
  - UHV system.
  - Neutron shielding for D-D plasmas.
- Design of insulator and plasma-facing surfaces.
  - UHV compatible insulators/metals.
  - High heat/particle load at insulators and electrodes.
- Diagnostics
  - Density: Interferometer
  - Ti: IDS, Te: TS (ONRL)
  - Impurity: spectrometer.
  - DD Neutrons: ^{3}He, plastic scint.
  - Stability, momentum: B-dot, diamagnetic loops.



Key techno-economic metrics of the project

- Demonstration of long confinement times in a small, high-β plasma configuration. Expected to produce confinement times of up to ~100ms.
- Demonstrate efficient coupling of high-voltages to a plasma.
  - HV gear for rotation off-the-shelf (up to ~ 1 MV).
  - Plasma impedance increases with confinement time. *In theory, no additional heating required.*
- Demonstrate acceptable Plasma-Material interactions => low power losses, low upkeep costs.
- Demonstrate confinement with low mirror ratio => accessible with conventional SC magnets.