Cold (<100K) Magnetized Plasma Thruster (CMPT)

What is the proposed concept?

The thesis is to study the electromagnetic acceleration of a low-temperature condensed plasma, *e*.g., a Bose-Einstein Condensates (BEC) plasma, in order to advance in-space propulsion technology for use in NASA missions. A BEC system is a highly correlated quantum system having long-range correlations that pass information around at the speed of light rather than the speed of sound. Whereby the development of a Cold (<100K) Magnetized Plasma Thruster (CMPT) would be a new class of electric propulsion (EP) thruster.

A superconductor is also a highly correlated quantum system having long-range correlation on the order of centimeters. This permits the formation of electron-electron (Cooper) pairs that conduct electricity with no resistance. The CMPT proposed in this study combines the long-range correlations from a cold (<100K) Type II superconductor to a fully ionized gas or plasma formed in proximity to the superconductor to produce a highly correlated system of cold plasma (<100K). Such a system is produced through the proximity effect known as a Josephson junction, wherein speed of light interactions allow a disturbance indenting the cold plasma on one side to cause the opposite side to immediately protrude. A Josephson junction is a well-known proximity effect between superconductors and other materials, including non-superconductive materials [e.g., 1].

A cold plasma system can be described with good accuracy as a macroscopic quantum system (MQS). By adding a magnetic field to the superconductor/MQS system, a MQS of Cold Magnetized Plasma (CMP) would be produced, where the ground quantum state of the MQS-CMP is a force-free, dipole-magnetized plasma. A higher energy quantum state of the MQS-CMP can then be induced by injecting space charge (a non-neutral pulse) into the cold magnetized superconductor/plasma system, where the additional energy is stored both capacitively (space charge) and inductively (currents). The higher energy quantum state of the MQS-CMP involves the internal storage of magnetic and electric energies that are not found in conventional EP drives, which are externally driven. This internal energy of the energized MQS-CMP can then be used to accelerate the coherent plasma to produce a Cold (<100K) Magnetized Plasma Thruster (CMPT).

What makes it exciting?

A highly correlated quantum system or MQS-CMP could generate combined thrust and Isp levels unheard of in other EP drives through the directed release of quantum state transition energy that is coherently (non-thermally) converted to thrust for a variety of space missions.

A CMPT is a cold plasma system. Whereby the need to radiate heat into space would be greatly reduced, lowering the mass of radiator systems needed by other EP systems.
The CMPT can be used for primary mission propulsion, opening up the solar system and making interstellar missions a reality. Whereby, a mission to MARS or beyond is possible in the near future using RTG power and arrays of CMPT. A future goal would be an interstellar mission to at least 0.10 c.

Is the concept unexplored?

The concept of using a MQS-CMP is Ground Breaking, as it has not been considered for space propulsion previously. Given that quantum states of matter has dark matter with direct gravitation implications [e.g., 3, 4], this study would open a new Science and Technology Area that could enable new propulsion concepts toward new missions in the future as yet to be foreseen.

Why is the concept credible and technically sound?

A MQS-CMP may have already been seen in a magnetically-coupled, Type II superconductor, voltage-discharge experiment [2], in which a flat discharge the sized of the superconductor emitter was formed when 500 kV was applied to a superconductor emitter that separated from the emitter and moved to the target electrode (grounded chamber wall) with great speed. A discussion with the author indicated that the flat discharge formed near the surface of the superconductor emitter, the diameter of the superconductor emitter and accelerated as a single body until hitting the grounded chamber wall, damaging the chamber wall surface. In addition, the flat discharge was believed to have been formed from the limited gases in the 1 Torr vacuum, noting that the cold superconductor emitter would act as a cold plate to condense the gases in the vacuum chamber, further enhanced by the applied voltage to lower the vacuum pressure from condensing the gases toward the superconductor emitter. Such a single body flat electric discharge has never before been seen, the one in this experiment indicates a possible BEC phenomenon.

Therefore, this exciting < TRL 1 technology is ready to take the next step toward providing a step forward in the development of new in-space electric propulsion systems. Ultimately, after more development and once proven in flight, it can be used first in incremental NASA small scale missions, but later enabling revolutionary new deep space exploratory capabilities beyond anything achievable by conventional electric propulsion systems.

Briefly, what do you plan to accomplish in the Phase I study.

Our initial Phase I effort will have two tasks, one experimental and one analytical:

1. Design and develop a CMPT for MQS-CMP acceleration and thrust at levels required for practical propulsion applications.
2. Conduct an engineering feasibility study for an orbit-maneuvering test to move a ~5,000 Kg mass including a modest 500 Kg of payload, a distance of at least 200,000 m.

References

1. Tinkham, M., *Introduction to Superconductivity,* 2nd Ed., Dover Publication, Inc., Mineola, NY, 2004.
2. Podkletnov, Evgeny and Giovanni Modanese, "Impulse Gravity Generation Based on Charged YBa2Cu3O7.x Superconductor with Composite Crystal Structure," arxiv.org, physics/0108005, (2001).
3. Hajdukovic, D.S., "Is dark matter an illusion created by the gravitational polarization of the quantum vacuum?" *Astrophys Space Sci* (2011) 334:215-218.
4. Maia, M. D., Capistrano, A. J. S. and Muller, D., **"Perturbations of Dark Matter Gravity," Int. J. Mod. Phys. D18 (2009) 1273-1289.**

Cold (<100K) Magnetized Plasma Thruster (CMPT)

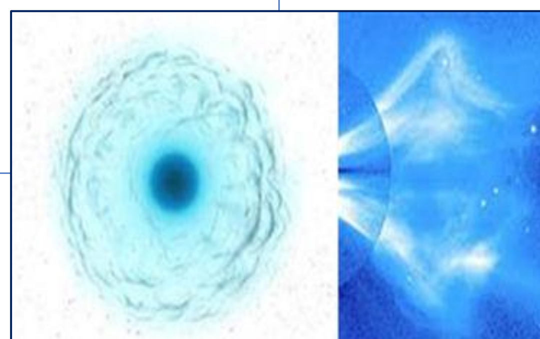
What is it?

CMPT

- A cold plasma electric propulsion device
- Consistent with Modern Physics
- <TRL 1, preliminary lab experiment

How can it be used?

The CMPT can potentially replace any in-space electric propulsion system, from reaction/attitude control to primary spacecraft propulsion.



Potential & Benefits

- The CMPT could generate combined thrust and Isp levels unheard of in other EP drives.
- Scalable electrically – powered propulsion.
- Potentially fast transit times for solar system and beyond.

Study Approach

1. Design and develop a CMPT for acceleration and thrust.
2. Conduct an engineering feasibility study for an orbit-maneuvering test.