Spotlight

On Alumn Tim Andreadis (1974)

For many college graduates, the journey ends far too quickly. The papers were completed, the presentations were delivered and the late night study sessions proved successful on exam day. However, academics, alone, don't always represent a well-rounded college experience. UMD Alumni, Tim Andreadis, learnt that college was full of learning experiences in, and outside, of class that he would talk about years after graduation day.

“At the university my experience included life in the dorms, athletics and academics,” said Andreadis. “Being called ‘Terp' even pejoratively, was a badge of honor.”

Tim Andreadis graduated from the University of Maryland with a Bachelors Degree in Physics, in 1974. As an undergrad he maintained a hectic schedule that forced him to interact with an eclectic group of people.

“I stayed in what was known as ‘the trailer,” Andreadis said. “This dormitory was populated with numerous colorful characters. We still keep in touch 30 years after graduation.”

In addition to physics, his daily routine required his attendance in English Literature, Russian History and practice, as a devoted member of the Maryland Fencing team. Many of his fondest memories were made as a part of a college athletic team. Tournaments against Duke, North Carolina and Clemson provide unforgettable trips down Tobacco Road.

After graduation, Andreadis worked for private industries and the federal government as a researcher. His background in Physics and Nuclear Engineering led him to his current position as the Head of the High Power Microwave (HPM) section at the Naval Research Laboratory. There, he carries out research that involves remotely altering the behavior of electronic systems. Through this position, he has had the honor of representing the United States to a NATO organization. In addition, it has allowed him to gain contacts from researchers world wide, offering experimental packages that have taken him to deserts, beaches, boats and airplanes.

As the head of the HPM, he remains in constant contact with professors and students of UMD. Currently, he is interacting with Drs. Victor Granastein, Steve Anlage and Agis Illiadis. His group also has an active cooperative education program which has led to employing several University of Maryland students.

“My job is to develop new research efforts, carry out research and monitor the research of those in my section,” Andreadis explained. “An important aspect of my work is developing new graduates into outstanding researchers.”

Andreadis received his Ph. D in Nuclear Engineering from UMD in 1981. It was in

Spotlight

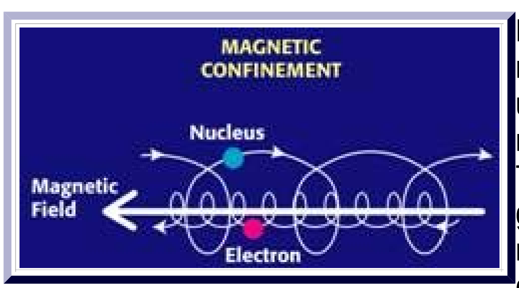
A SPINNING (PROTO) STAR AT UMD

By Adil Hassam

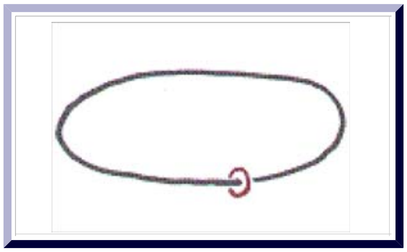
If a deuterium nucleus is slammed into a tritium nucleus,the nuclei can stick because of the attractive nuclear force that acts at short distances. This fusion takes work; the D and the T, isotopes of hydrogen, are both positive electrical charges and they repel. But there is a large payoff: the fused nucleus, Helium, is a more “compact”arrangement than the D and the T separately and there is a large energy release as the remaining neutronshoots off. The energy multiplication is 450:1.

This is fusion energy.

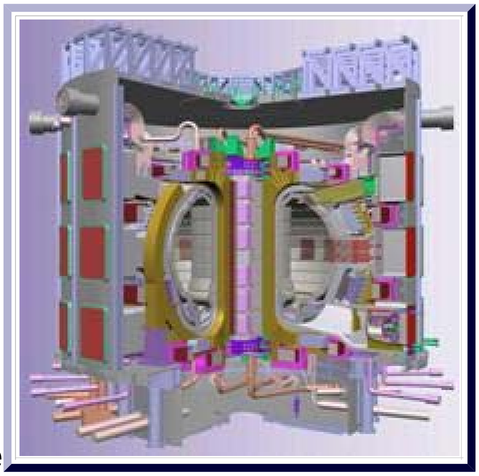
Proton-proton fusion powers the Sun and practically every star in the Universe. The difficulty with making a Star on Earth is the electrically repelling nuclei. In order for the D-T gas, contained in some “bottle”, to steadily generate energy, the gas has to be brought to a highenough temperature. In addition, the gas has to be dense enough and the internal heat has to be thermally well bottled so that enough reactions can occur to produce net energy. The needed temperature is easy to calculate – it is the electrical potential energy of repulsion that has to be overcome before the nuclear force kicks in. This translates to a temperature of 100,000,000 degrees, roughly the temperature at the center of the Sun. At that temperature, unless something was holding the D-T gas together, the gas would blow outwards in microseconds and cool off, shutting off all fusion. The Sun holds all the hydrogen in one place because of the self-gravitation, given its sheer size. Gravity is too weak a force for terrestrial sized systems.



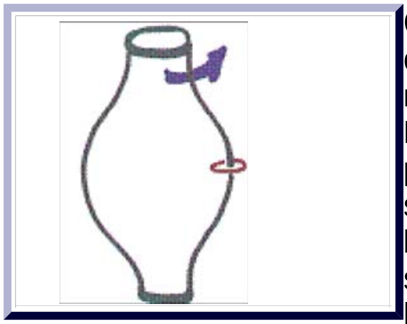
Luckily, we can use magnetic fields. A charged nucleus at a 100M-degree temperature, if unimpeded, will zip across a few meters in a microsecond. Put the same nucleus in a one Tesla magnetic field and the nucleus will simply gyrate around the field line with a radius of a few mm. We thus have containment – except for one detail: while the nucleus performs a tight circle about the magnetic field, it spirals unimpeded in the direction parallel to the field, much like a bead on a frictionless wire. For containment, one has to plug up the beads in the direction along the field.



At first glance, this should be simple: make the magnetic field lines a closed torus. This will create a containment bottle for a donut-shaped star. This turns out to be too simplistic: there are collective effects. A system of interacting charged particles self-generates charge separations, currents, and electromagnetic fields. The physics of this "plasma", the fourth state of matter, includes highly complex, nonlinear, collective dynamics. In particular, fusion grade plasmas are spontaneously turbulent and exhibit filamentary behaviour, resulting in heat losses that need to be controlled by ingenious means. To make a long story short, more coils and power systems need to be incorporated.



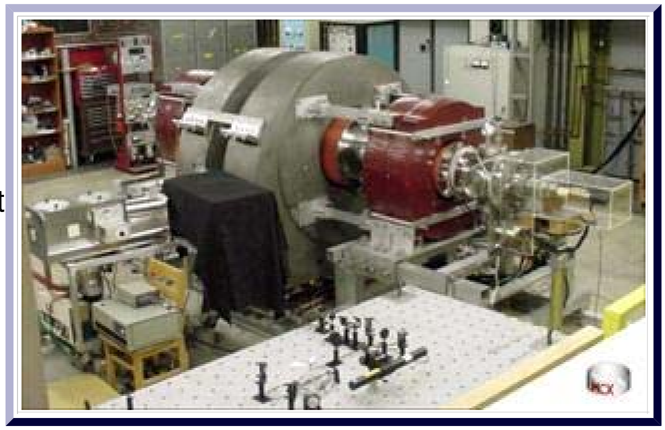
The resulting system is a "tokamak". A tokamak can meet the requirements of fusion but the collective effects, as governed by the laws of nature, demand that tokamaks have to be large, with challenging coil systems that make them technologically complex devices. To be sure, fusion energy output from tokamaks has advanced more than 100 billion-fold over the last 30 years. ITER ("The Way") is a planned international experiment. It will make a burning star, for the first time, with net energy production.



Can a tokamak be optimized? Are there other confinement configurations that might be better from a reactor design viewpoint? The Maryland idea for plasma containment is to spin the plasma. Imagine sliding beads on an electromagnetically spinning, "shaped coat-hanger" magnetic field line. As the beads spin, they gravitate (as it were) to the middle of the shaped field and stay there. Thus, even though the field lines are not closed, the plasma cannot escape. An "open" field line translates to simple coil systems, and potentially less expensive fusion power plants.

The Maryland Centrifugal Experiment (MCX) was commenced in 2000 and achieved "first plasma" in 2002. Plasma in a mirror-shaped magnetic field is made to rotate azimuthally. For effective centrifugal confinement, the rotation must be supersonic. By 2003, Professor Richard Ellis, the Project Director, had led his team to record speeds of greater than Mach 2. It is not sufficient simply to rotate the plasma; the rotation must be sheared. If not, the plasma could "splash" against the vessel and cool off rapidly. The MCX team has shown that the plasma is long-lived, much longer than if it had been splashy. In addition, they have recently measured rotation shear.

Velocity shear is a hot topic in fusion confinement physics. Tokamaks, for one, exhibit spontaneous “barriers” inside of which heat is very well insulated. These barriers are thought to be the result of velocity shear suppressing splashy, turbulent behaviour of the plasma. Thus, velocity shear laminarization in MCX is also of fundamental interest.



The road to a burning star is measured in decades – at UM, we have an exciting start.

For more information on Dr. Adil Hassam's research, click here.

Dr. Adil Hassam is a professor for the University of Maryland. He is a member of the Plasma Theory Physics group. Contact him at: hassam@plasma.umd.edu

Tel: 301.405.3401
1117 Physics Bldg.
University of Maryland
College Park, MD 20742

Contact the editor.
Contact the webmaster

graduate school that he formed relationships with several professors. In addition to their mentorship and excellent academic environment, the best discussions were held after the day was done and classes were over. Although he chose the route of Nuclear Engineering, his graduate research was heavily physics based. In fact, his physics background continues to be useful.

“My physics education has provided a broad base from which to build,” he said. “I enjoy developing concepts and applying them to problems.”

The university experience that Andreadis received from UMD has led him to an exciting and fulfilling career. Years later, he maintains a busy schedule by serving on the board of directors for his church and a private school. For current Physics students and recent graduates, the future remains undetermined. Dr. Andreadis provides advice that will ultimately guide anyone's journey.

“Make sure that you obtain a broad science background,” said Andreadis. “I would advise Physics students to obtain a strong computer background and to have a practical understanding of electronic circuits. Students should also look for opportunities to improve their public speaking skills. Good writing skills are also very important. Don't overlook the development of social skills.”

More importantly Andreadis demands “Don't stop learning.”

If you would like to contact Dr. Tim Andreadis, please send messages to the editor. She will be happy to pass along your questions or comments.

Tel: 301.405.3401
1117 Physics Bldg.
University of Maryland
College Park, MD 20742

Contact the editor.
Contact the webmaster.