Going With the Flow: Using Star Power to Better Understand Fusion

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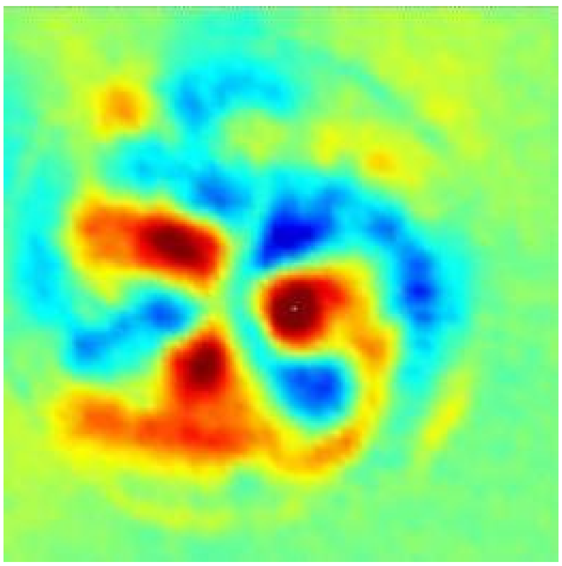

Above is a false color image taken from a fast imaging camera that shows the "plasma weather patterns" that form and propagate in Controlled Shear Decorrelation Experiments (CSDX). The motion and dynamics of these types of structures will be studied as part of the work in the new Center for Momentum Transport and Flow Organization in Plasmas and Magnetofluids at UC San Diego.

(PhysOrg.com) -- UC San Diego researchers are using "star" power to help ignite the field of fusion, which is being looked at as a future reliable green energy source. Under a new $5.8 million five-year grant from the U.S. Department of Energy, UCSD will host and lead the new Center for Momentum Transport and Flow Organization in Plasmas and

Magnetofluids, which will bring together astrophysical and magnetic fusion theorists, experimentalists and computationalists from multiple institutions.

The Center, led by George Tynan, a UCSD Mechanical and Aerospace Engineering professor and researcher for the UCSD Center for Energy Research, will also include collaborators from Princeton University, University of Wisconsin at Madison, the University of Colorado at Boulder, UC Irvine, Massachusetts Institute of Technology, UC Santa Cruz, University of Leeds and New York University.

Center researchers will focus on fundamental studies of turbulent transport and organization in fusion and astrophysical plasmas. In doing this, they will directly examine the link between turbulent momentum transport and large scale flow self-organization using newly developed diagnostic and data analysis techniques to investigate and critically test emerging theoretical and computational models. The new Center will also host an annual winter school for graduate students, postdoctoral researchers and scientists interested in this research topic. Web-based seminars and presentations will be provided and archived for future reference.

Studying how large-scale flows are generated and dissipated in natural systems like stars may help unlock some of the mysteries behind how fusion works, Tynan said.

“We are interested in identifying and understanding the common elements between fusion experiments, rotating stars and accretion disks. How do these systems develop organized flows and how do they dissipate or get rid of the energy associated with the flows?” he said. “Answering these questions can allow us to gain a better understanding of the overall behavior of these systems. For example, in order for stars and planets to for the disk has to get rid of some of the rotational energy."

The recognition of this commonality between flow generation and organization astrophysical and fusion systems came from Pat Diamond, a UCSD physics professor and member of the Center for Astrophysics and Space Science and Co-PI for this new Center. Currently, the leading candidate for producing controlled thermonuclear fusion power is a device called the tokomak, a magnetic confinement device that produces a toroidal magnetic field for confining plasma.

"One of the interesting about a tokomak is the plasma spins continuously, converting thermal energy to rotational energy," Diamond said. "The spin of a tokomak is good for energy confinement. It inhibits the plasma from locking on to the wall and causing unpleasant stabilities. By understanding these momentum transport processes through this new Center we may be able to optimize and control this spontaneous rotation."

One of the ultimate goals of the new Center is to help design better, smaller and cheaper fusion systems, Tynan said. He said this research could also contribute to the development of ITER, the world's first experimental fusion reactor being built in France.

"It's important that the plasma in the ITER device spins at a rapid enough rate— because this spinning increases the thermal insulation of the plasma, so you can get a hotter reaction in the center, and also allows you to raise the maximum pressure at which the plasma can operate before you have instability." Tynan said. "Achieving an adequate amount of this rotation in ITER is therefore important. Right now we don't really understand what causes the rotation in the first place so it's very difficult to predict with enough confidence what's going to happen in this new experiment. By working together in this new Center, we hope to be able to understand that problem enough so we can make an estimate of what might happen in this new experiment. We may then better know what the fusion power production in ITER will be.

“Over the last 10 years or more, we have been focused in this field on how to keep heat in a fusion system, largely ignoring the role that flow and flow organization plays,” Tynan added. “Now we have realized that the heat transport problem is intimately coupled to the flow organization problem. We saw that there was an opportunity to study this problem that has been neglected.”

Provided by University of California - San Diego (news : web)

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