**GENERAL**

**EDUCATION and OUTREACH**

**ON-GOING FLIGHT PROGRAM**

**FUTURE FLIGHT PROGRAM - ISSA PHASE I/II/III**

EXACT Investigators Present Results at LT-22

Two posters on the flight definition experiment Experiments Along Coexistence near Tricriticality (EXACT) were presented at the 22nd International Low Temperature Conference (LT-22) held in Helsinki in early August. Professor Norbert Mulders of the University of Delaware, one of the co-investigators on EXACT, presented his work on deriving the equations for the propagation of heat pulses in mixtures of helium-3 and helium-4. His poster was entitled "A Nonlinear Wave Equation for Second-Sound Propagation in 3He-4He Mixtures". Also at LT-22, EXACT's work on developing a nano-Kelvin resolution thermometer for the temperatures below 1K was presented by Dr. John Panek of JPL. His poster was entitled "A High-Resolution Thermometer for the Temperature Range 0.75-1.0 K".

**ISSUES AND CONCERNS**

**SCIENCE HIGHLIGHTS**

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Quantum tunneling across spin domains in a Bose-Einstein condensate.

**MIT Group Explores Boundary between Domains in a Condensate**

Wolfgang Ketterle of MIT reports that a paper titled "Quantum tunneling across Fire and ice – a good place to search for life?Jörn HelbertInstitute of Planetary ResearchDLRRutherfordstrasse 2, 12489 BerlinGERMANYjoern.helbert@dlr.de Creating a habitable environment is a complex process involving a wide variety of interacting processes. A prerequisite for any biological activity is an energy source. The terrestrial example of the black smokers shows how efficient geothermal processes are as an energy source.There is ample morphological evidence for continuous and episodic volcanic activity over the geological history of Mars. The youngest ages determined by the crater size-frequency measurements are about 2 Ma suggesting that the volcanoes are potentially still active today. While there is no direct evidence for volcanic activity the likelihood for localized hot spot activity or hydrothermal systems is very high.We have shown recently using thermo-physical modelispin domains in a Bose-Einstein condensate" was recently published in Physical Review Letters (Phys. Rev. Lett.ng that a morphologically identified glacial deposit on the northwestern flanks of Hecates Tholus contains very likely still a stagnant ice core. There are several units on Mars, especially on flanks of volcanic edifices, which based on morphological evidence may be glacial deposits and which are possibly still ice-cored. Combining these two findings provides an interesting option for a biological niche. Our modeling shows that variations in the climate and in the local internal heat flow due to ongoing volcanic activity can create a complex internal structure of these ice deposits. The ice deposits can effectively store volcanic gases. The enrichment of water ice with volcanic gases might form a nutrient rich environment which is protected by a dust cover and sealed by an enrichment of ice at the top. The implications for biological activity in these places deserve further attention. **83**, 661-665 (1999)). The authors D.M. Stamper-Kurn, H.-J. Miesner, A.P. Chikkatur, S. Inouye, J. Stenger, and W. Ketterle describe dynamics in a condensate consisting of two immiscible components. In case of two immiscible fluids, gravity tries to localize the heavier fluid below the lighter one. When the heavier one is placed on top of the lighter one, a metastable situation arises. The analogous situation was prepared by the MIT group in a spinor Bose-Einstein condensate, with a magnetic field gradient playing the role of gravity. For a sufficiently strong gradient, tunneling of one component through the other was observed and led to a stable equilibrium state. The observation of the tunneling rates provides a sensitive probe of the boundary existing between the two immiscible spin domains.

**UPCOMING EVENTS**