

PLENARY SESSIONS

MONDAY, AUGUST 18, 2008

MONDAY MORNING PLENARY SESSION 9:00am

1AP - Monday Plenary Sessions 9:00am - 10:00am

9:00am

1AP01 - Superconducting Detectors Come of Age, or Ready to Leave the Lab

H. Moseley, Goddard Space Flight Center

Cryogenically cooled superconducting detectors have become essential tools for a wide range of measurement applications, ranging from quantum limited heterodyne detection in the millimeter range to direct searches for dark matter with superconducting phonon detectors operating at 20 mK. Superconducting detectors have several fundamental and practical advantages which have resulted in their rapid adoption by experimenters. Their excellent performance arises in part from reductions in noise resulting from their low operating temperatures, but unique superconducting properties provide a wide range of mechanisms for detection. For example, the steep dependence of resistance with temperature on the superconductor/normal transition provides a sensitive thermometer for calorimetric and bolometric applications. Parametric changes in the properties of superconducting resonators provides a mechanism for high sensitivity detection of submillimeter photons. From a practical point of view, the use of superconducting detectors has grown rapidly because many of these devices couple well to SQUID amplifiers, which are easily integrated with the detectors. These SQUID-based amplifiers and multiplexers have matured with the detectors; they are convenient to use, and have excellent noise performance. The first generation of fully integrated large scale superconducting detection systems are now being deployed. Improved understanding of the operation of these detectors, combined with rapidly improving fabrication techniques, is quickly expanding the capability of these detectors. I will review the development and application of superconductor-based detectors, the ultimate limits to their performance, and consider prospects for their future applications. Continued advances promise to enable important new measurements in physics, and with appropriate advances in cryogenic infrastructure, may result in the use of these detectors in everyday monitoring applications.

TUESDAY, AUGUST 19, 2008

TUESDAY MORNING PLENARY SESSION 8:30am

2AP - Tuesday Plenary Session 8:30am - 9:30am

8:30am

2AP01 - Zero-Emission Aircraft: A Potential Application for HTS Superconductors (*)

C. Luongo, P. Masson, Florida State University; T. Nam, D. Mavris, Georgia Institute of Technology; M. Waters, Dave Hall Engineering

The sharp increase in the cost of fuel tied with a relentless growth in air traffic will foster the development of revolutionary new aircraft technologies over the next 25 years. Zero-emission aircraft will have to be developed in response to heightened environmental concerns. There is an intense push in the industry to ultimately develop an all-electric aircraft, with fuel cells being considered as the prime generation source for aircraft propulsion. Towards that end, there is a great need to develop ultra-compact and light electric motors and actuators suitable for airborne applications. HTS superconductors are destined to fulfill the need to achieve the very high power and torque densities required in airborne electric propulsion. This paper will present and review the challenges to develop all-electric aircraft propulsion. In particular, we will show how aircraft design philosophy needs to be re-formulated for electric propulsion, and what are the technology benchmarks that superconducting devices have to achieve in order to be a feasible option on an airborne platform. We will also review the work of our team over the last 5 years to developing system design models for all-electric aircraft. In parallel with those efforts, concepts have been developed for ultra-compact superconducting electric motors. Some of these concepts are transitioning to proof-of-principle experiments. In the end it is shown that HTS superconductors can achieve the required power/torque densities for airborne applications and that once energy conversion devices (e.g., fuel cell) reach adequate power densities, all-electric aircraft can soon follow. The aircraft industry, and other transportation applications, could potentially be a major market for HTS superconductors.

WEDNESDAY, AUGUST 20, 2008

**WEDNESDAY MORNING PLENARY SESSION
8:30am**

3AP - Wednesday Plenary Session 8:30am - 9:30am

8:30am

3AP01 - 7 Tesla and Beyond - A Review of High Field Superconducting Cyclotrons and Synchrocyclotrons: Present Status, Key Applications, and Future Prospects

T.A. Antaya, Massachusetts Institute of Technology

Cyclotrons are now in their 8th decade of use, and superconducting cyclotrons are in their 3rd decade. Resistive magnet based cyclotrons operate at around 1-3 Tesla, and the superconducting cyclotrons operate at field levels of about 3-5T. Circular resonant particle accelerators in general have an inverse scaling of radius with increasing field for a given energy, and this translates into nearly an inverse volume scaling with increasing field in the nearly spherical superconducting cyclotrons. One can exploit this compactness to make very powerful but small cyclotrons, as was done for heavy ion nuclear science, or exploit the low overall power levels (magnet, rf, cryogenics) of these compact cyclotrons to make a very efficient particle accelerator- for example ACCEL's PBRT cyclotrons. Recent advances in all aspects of superconducting cyclotrons (beam dynamics, engineering and supporting technologies) have made the step up to even higher field levels of 7-10 T possible, and this results in remarkable compactness and efficiency, that will, as a consequence, have significant impact in all applications in which cyclotrons are employed. We will first present the high field cyclotrons, followed by their key technology issues, and then discuss the emerging applications in radiotherapy, PET, radiation sources and strategic nuclear materials detection. In addition, high field weak focusing cyclotrons can now be built that are better characterized as being portable devices rather than as accelerator systems, and these set new standards for transportability. Several highly mobile systems based on such devices, the applications that they enable, and their present status of development, which is moving forward rapidly, will be discussed.

THURSDAY, AUGUST 21, 2008

**THURSDAY MORNING PLENARY SESSION
8:30am**

4AP - Thursday Plenary Session 8:30am - 9:30am

8:30am

4AP01 - New Superconductors in Applications; Some Practical Aspects

J.W. Bray, GE Global Research;

The first blush of success in the search for a new superconductor is usually a high transition temperature, T_c . However, all power applications of superconductors and most other applications requires good current carrying capacity, usually characterized by I_c , within substantial magnetic fields, usually characterized by H_c . Furthermore, a number of other characteristics must be satisfied before commercial success can be obtained, such as acceptable cost, mechanical strength, stabilizers, and appropriate insulation materials. I will examine a number of superconductors, starting with the workhorse NbTi, and look at the long road to success for the successful commercialization of a new superconductor.

FRIDAY, AUGUST 22, 2008

**FRIDAY MORNING PLENARY SESSION
8:30am**

5AP - Friday Plenary Sessions 8:30am - 9:30am

8:30am

5AP01 - Recent Events in Applied Superconductivity in China

S.T. Wu, ITER Organization/ASIPP

With strong support from Chinese government bodies such as the National High Technology Research and Development Program of China (863 programs) and the National Basic Research Program of China (973 programs), the field of applied superconductivity in China has been developed in different areas. Especially in the fusion application area, the first fully-superconducting tokamak, EAST (Experimental Advanced Superconducting Tokamak), has been successfully constructed and commissioned in the last two years. Based on the requirement from the ITER project, high performance Bi-2223 HTc tape, and Nb3Sn and NbTi strands have been developed as well. In the area of HTc applications for electric power systems, R&D has been focused on Superconducting Magnetic Energy Storage (SMES), Superconducting Fault Current Limiters (SFCL) and MRI. A 1MJ/500kVA SMES and a saturated iron-core type 35kV/90MVA FCL have been built and their integration into transmission networks demonstrated. A 45 T hybrid high magnet facility has been approved recently by the Chinese government. Finally a 100 km/h HTS Maglev test line has been proposed. In this paper, the recent progresses in applied superconductivity in China are reported.