

CERN Courier Archive: 1975

A LOOK BACK TO CERN COURIER VOL. 15, MAY 1975, COMPILED BY PEGGIE RIMMER

SUPERCONDUCTING MAGNETS

A post-Frascati review



A coil of the huge superconducting magnet built at Argonne for the 12 ft bubble chamber, a pioneering application of superconductivity.

The Fifth International Conference on Magnet Technology was held from 21–25 April in Rome, having relocated from the Frascati Laboratory because of increasing attendance. Interest focused on the use of superconducting magnets in high-energy physics, where extreme requirements push the technology further than elsewhere.

Bubble chambers and spectrometers need high fields over large volumes. Pioneering work was done at the Argonne Laboratory where [in 1968] they built a magnet to give a 2 T field in the 12 ft bubble chamber. Another leader was the Omega spectrometer magnet at CERN, with a 1.8 T field in a 1.5 m aperture, achieved in 1973. High field, small volume magnets are required for detecting particles such as hyperons that live for around 10^{-10} s, to manoeuvre them after production to observe their interactions. At CERN, a very compact hyperon beam region was achieved with two short superconducting quadrupoles. Polarized proton targets also require high fields in small volumes to line up the proton spins while allowing the particles to emerge over as wide a range of angles as possible. The first to operate was at the late-lamented Cambridge Electron Accelerator in 1968.

The interest in pulsed magnets is higher peak fields, which would allow synchrotron energies to increase without increasing the machine size. The Fermilab proton synchrotron hopes to reach 500 GeV with 2.25 T fields from the conventional magnets around its 2 km diameter ring. If 4.5 T superconducting magnets could be used, the energy could reach 1 TeV in the same ring; magnets for such an “Energy Doubler” are under development.

Other applications were more prominent than at previous magnet conferences. This was particularly true of fusion research where recent advances coupled with the world



Nb_3Sn multi-filamentary conductors promise much higher fields and better temperature stability than NbTi. The wire on the left contains filaments that are revealed when the bronze matrix is etched away.

energy crisis have rekindled the desire to bring thermonuclear fusion reactions under control. Magnets for medical applications also drew a good deal of attention with various “medical beam lines” being developed at accelerators.

Practically all the magnets reported use niobium-titanium [NbTi] superconductor. However, NbTi does not retain its superconductivity much beyond current densities of 0.8 kA/mm or temperatures higher than about 5 K. Other materials offer higher field operation and temperature transitions. Niobium-tin [Nb_3Sn] can tolerate current densities of about 2 kA/mm, retaining superconductivity up to a temperature of 18 K. It is more difficult and expensive to work since it is very brittle, but during the past year Harwell/Rutherford has made solenoids using filamentary Nb_3Sn superconductor. But even after niobium-tin is mastered, there will still be challenges facing superconducting specialists.

● Compiled from texts on pp147–154.

AROUND CERN

Protecting the environment around CERN

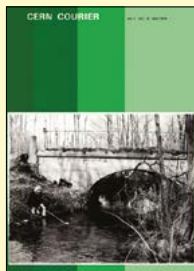


During the past year, samples of air, water, etc., have been taken around the CERN 400 GeV proton synchrotron site [SPS] to confirm that machine operation will not affect the environment from the point of view of radiation [see the cover thumbnail below].

This photograph was taken in the “Lion stream”, which crosses the Laboratory II site. The stream has to be temporarily rerouted for work on the beam-line to the North Experimental Area. The Franco-Swiss fishing Union was alerted and cleared 700 m of the stream of its population – a haul of 366 trout. The trout were stunned by an electrical fishing rod (a 350 V, 4 A device) and transported to safety further downstream.

● Compiled from texts on pp146 and 160.

Compiler's note



The use of magnets and particle accelerators in medicine is now widespread, and Fermilab did indeed upgrade the Main Ring to become the Tevatron, where the top quark was discovered in 1995. However, endeavours to generate power from nuclear fusion have been less successful, owing to horrendous engineering and technological difficulties in creating and confining the resulting plasma for longer than a few seconds. Collaborative research continues and the first plasma in the 35-nation ITER tokamak in the south of France, using Nb_3Sn superconductor technology, is foreseen for 2025.

The first operation of the high-luminosity LHC is also foreseen for 2025. It too will use Nb_3Sn superconducting magnets to achieve the necessary increase in performance over the present NbTi-based LHC magnets.



FAGOR

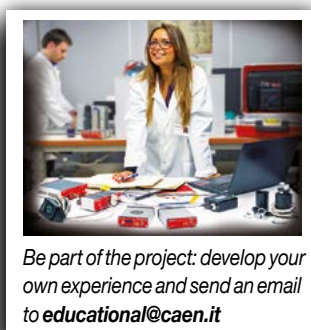
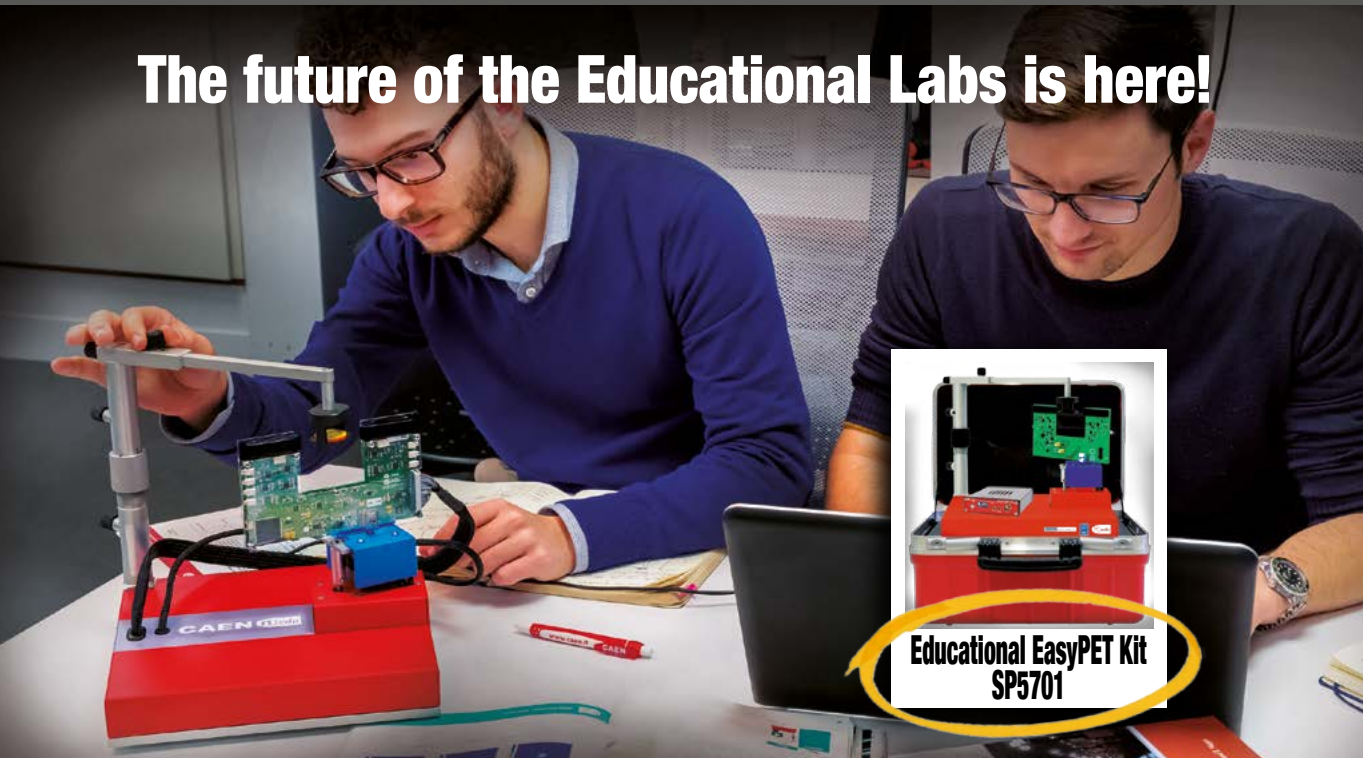


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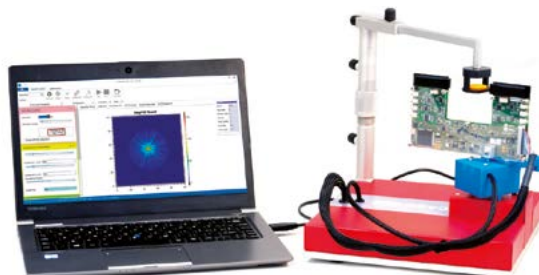
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CERN COURIER

VOLUME 58 NUMBER 4 MAY 2018

Contents

5	NEWS		
		• Baby MIND takes first steps • Majorana neutrinos remain elusive • Beams back in LHC for final phase of Run 2 • DESY sets out vision for the future • Flooded LHC data centre back in business • First hints of ultra-rare kaon decay • Antihydrogen spectroscopy enters precision era • Charm oscillations precisely measured by LHCb • ATLAS focuses on Higgs-boson decays to vector bosons • ALICE closes in on parton energy loss • CMS observes rarest Z boson decay mode	
15	SCIENCEWATCH		
17	ASTROWATCH		
18	FEATURES		
		Crab kicks for brighter collisions	
		Advanced radio-frequency crab cavities for the high-luminosity LHC upgrade	
26		The long march of niobium on copper	
		Niobium-copper accelerating towards their bulk-niobium counterparts	
31		Tales of TRIUMF	
		Founded 50 years ago, Canada's particle accelerator continues to drive discoveries in physics, medicine and materials science	



ns
ab cavities are under tests for the
.
copper
cavities are beginning to challenge
ts.

a's premier accelerator laboratory
in fundamental physics, nuclear
e.

37	FACES & PLACES
45	BOOKSHELF
48	RECRUITMENT
50	ARCHIVE

WELCOME

CERN Courier – digital edition

Welcome to the digital edition of the May 2018 issue of *CERN Courier*.

Radio-frequency cavities drive accelerators across the world, their weird and wonderful metallic structures sustaining strong electromagnetic fields that shunt charged particles to higher energies. Particle physicists have pioneered the development of the most powerful superconducting cavities, and CERN is at the core of this effort. Currently installed in the Super Proton Synchrotron for their first tests in a proton beam are two superconducting “crab” cavities, named for their ability to tilt proton bunches sideways to ensure maximum collision intensity. The technology is at the heart of the high-luminosity LHC upgrade and is based on cavities made entirely from niobium. But CERN is also making huge strides with advanced niobium-coated copper cavities. Once the pinnacle of radio-frequency technology at CERN, driving the upgraded Large Electron Positron collider during the 1990s, niobium–copper cavities are back and even beginning to challenge the performance of their bulk-niobium counterparts. Such developments underpin the recent energy upgrade of the radioactive-beam facility ISOLDE and are key to next-generation accelerators at CERN and elsewhere.

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