DANFYSIK

NEWS 2010

A company in its best years

Every day in its forty-six year long life Danfysik has been serving the particle accelerator community with accelerator components, such as magnets, electrostatics, power supplies, insertion devices, beam instrumentation, and complete accelerator systems. As you will see from a quick scan through this newsletter, 2010 is not an exception.

New synchrotron light sources, like NSLS-II at Brookhaven National Laboratory and ASTRID2 at Aarhus University, are being constructed, and others like ALBA in Barcelona are completing the installation phase and starting commissioning. Furthermore, some laboratories, like the ESRF in Grenoble, presently go through an upgrade phase in order to further advance the performance and functionality of the facilities. At Danfysik, we are proud to be chosen as supplier of booster- and storage-ring magnets, injection and extraction elements, insertion devices and power supplies for these prestigious projects.

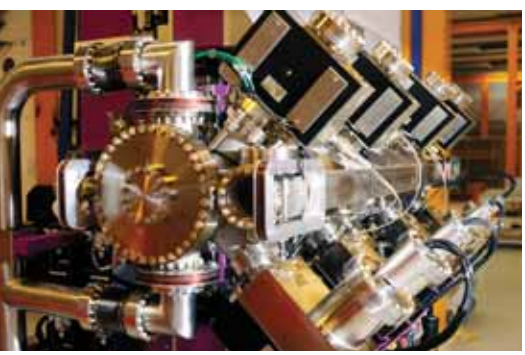
For the Diamond Light Source we have just completed the commissioning of a cryo-cooled in-vacuum permanent magnet undulator operating at temperatures down to 130 K, thereby allowing extraordinary high peak magnetic field and short period length. The cryo-undulator is scheduled to be inserted in the DLS ring later this year. Other insertion devices to be delivered this year include an undulator for the free electron laser project, FLARE, in Nijmegen, Holland, and a multi-pole wiggler magnet for Aarhus University, Denmark.

For particle accelerator laboratories, like TRIUMF in Canada and IUAC in New Delhi, we are providing a number of custom designed magnetic and electrostatic spectrometer devices, for new and advanced special projects under construction at both laboratories.

It is worthwhile noting that we have delivered demanding custom designed magnet power supplies for superconducting loads for experimental equipment both at RIKEN in Japan and at Jefferson Lab in Virginia USA, and the very compact 18 kilo-amp magnet power supply for the superconducting European Dipole, which is to be used at the world's next experimental fusion energy facility, ITER, in southern France.

The number of project highlights that we are bringing in this year's newsletter is indicative for the trust that our customers have in our team, our knowhow, our quality and our service. As a company "in its best years" we have provided accelerator equipment to hundreds of other sites over the years. We look forward to collaborating with our customers in many more projects in the future.

Bjarne Roger Nielsen
CEO

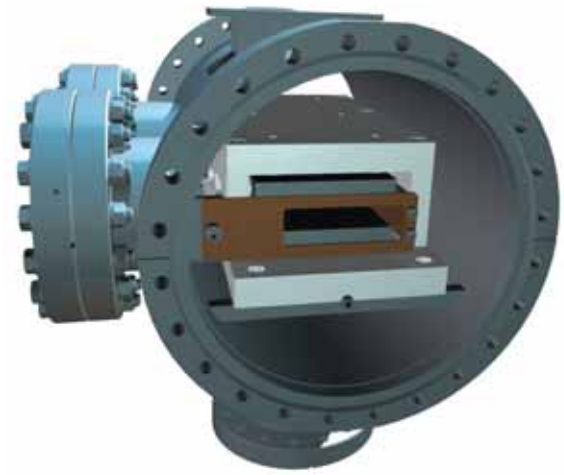


ASTRID2, a Danish state-of-the art Synchrotron Light Source

The ISA Institute for Storage Ring Facilities at Aarhus University in Denmark has been funded to build ASTRID2, a 46 meter storage ring which will be built adjacent to the existing light source ASTRID. Rather than having an electron beam which decays over time, ASTRID2 will be continually "topped up" from ASTRID, allowing an almost constant current. Beams are expected to circulate in 2011. "The low-emittance electron beam will generate synchrotron radiation of remarkable quality from the ultraviolet through to soft x-rays", says Søren Pape Møller, Director of the ISA.

Danfysik has been given the assignment to deliver all magnets on girders, including their main power supplies for the 580-MeV low-emittance synchrotron radiation storage ring. The main deflection magnets are solid-core C-shaped combined function sector magnets with dipole, quadrupole and sextupole fields, all with tight tolerances. Each of the six girders contains two deflection magnets, four quadrupole magnets, three sextupole magnets and two combined HxV steerers.

For injection and accumulation, three injection kicker magnets and one septum magnet are delivered along with their pulse generators. Also the beam transfer line from the existing ASTRID to ASTRID2 will be supplied by Danfysik and includes vertical and horizontal bend magnets, quadrupole magnets and steerers. The kicker is located 5/4 turn in advance of the septum magnet and hence kicks the beam twice. Although this scheme is the most relaxed for the kicker it requires 35kV to be driven due to the extremely short revolution time of 133 nanoseconds.



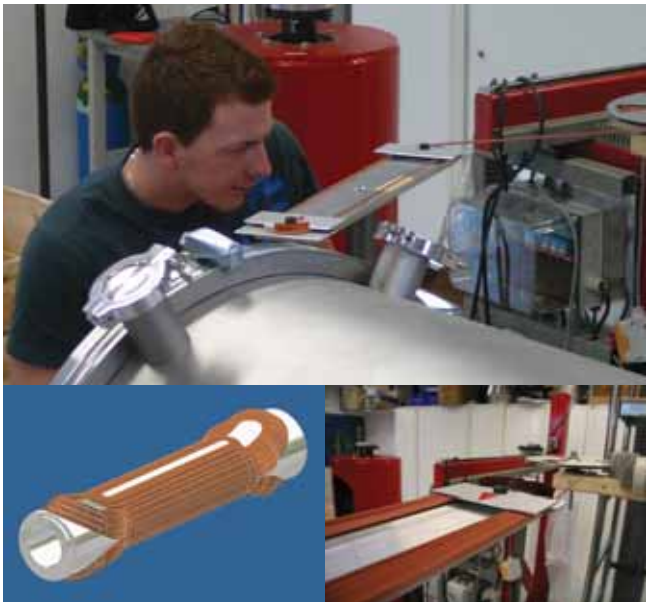
Danfysik Power Supplies at VECC

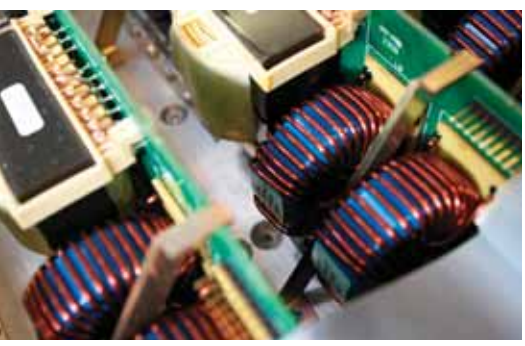
The Variable Energy Cyclotron Centre (VECC) in India developed the K-130 Room Temperature Cyclotron for light ions in the 70's. Subsequently this cyclotron accelerated heavy ions using ECR (14GHz) ion source. In 2007 VECC took up the program of up-grading the system to make the machine more reliable and user friendly. Danfysik actively participated in the program, delivering highly stable magnet power supplies for their beam line magnets.

VECC Director, Dr. Rakesh Kumar Bhandari is pleased with Danfysik participation and states: "Stability and availability of the ion beam on target has remarkably improved after the upgrade of the K-130 Cyclotron by introducing Danfysik highly stable magnet power supplies".

Developing a High Temperature Superconducting Dipole Magnet

Recent advances in the performance and availability of long-length high temperature superconducting (HTS) tapes have made these materials most interesting for high field magnets. Danfysik is exploring the technology as one of the industrial partners in the InnovAcc project, a partly government sponsored project, joining industry and academia. Danfysik has designed a test-sized, superconducting dipole magnet. Currently the coils are being fabricated and the magnet is being assembled at Danfysik. The HTS magnet consists of 18 coils with each 125 turns of HTS tape. Current densities of 340 A/mm2 can be achieved in the coils, yielding a magnetic field of 4.2 T in the good field region of 50 mm diameter. The homogeneity is modeled to be better than 7x10-4. The coil assembly and the enclosing yoke will be cooled with cryo coolers. The HTS tape is YBCO coated conductor.





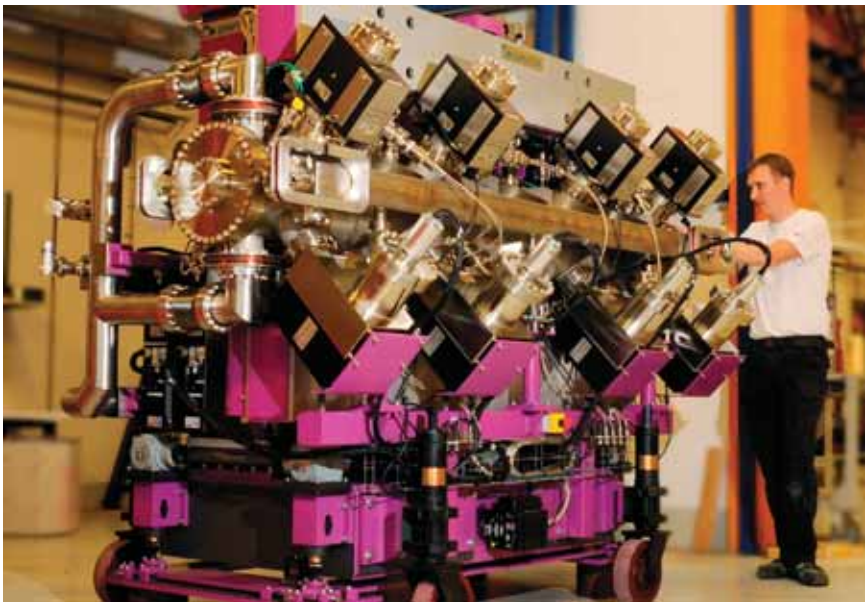
A busy year for Danfysik Insertion Device Group

Cryo-cooled Undulator for the Diamond Light Source

A new and demanding high performance insertion device has been designed, manufactured, tested and commissioned by Danfysik.

The device is an in-vacuum permanent magnet undulator, which can be cooled by a cryo-cooler down to 130K. The in-vacuum construction allows closure of the magnetic structures to a gap of only 4 mm, and consequently very small period lengths and high peak magnetic fields can be achieved.

When cooling the device to cryogenic temperatures the peak magnetic field is even higher because of the characteristics of the permanent magnetic material, thereby providing X-rays at higher energies.



The cryogenic permanent magnetic undulator (CPMU) is 2080 mm long with a period length of 17.7 mm and an effective K-value of 1.7 at a gap height of 5 mm. It was delivered to Diamond Light Source near Oxford in March 2010 and is scheduled to be inserted in the DLS storage ring later this year.

FEL Undulator for FLARE, Radboud University Holland

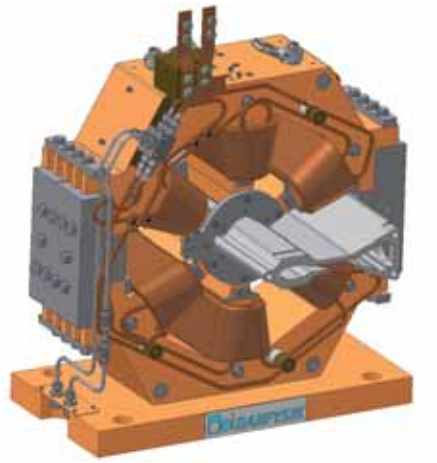
Danfysik is currently constructing a 4.5 meter long undulator for the FLARE Free Electron Laser project at Radboud University in Nijmegen, Holland. The undulator has 40 periods with a period length of 110mm. The gap is variable from 24mm to 300mm with a resolution of 2.5 microns. The undulator is designed with Sm_2Co_{17} magnets for better radiation hardness. The undulator is designed to be focusing with a 1% field increase at +/-10mm. At 24mm gap the effective field will be 0.47T and the effective K-value 3.4. Phase errors will be better than 5 degrees. The design of the undulator was approved early 2010, and the production is under way. The undulator will be delivered in autumn 2010.

Multi-pole Wiggler for ASTRID2

A 0.85 meter long multi-pole wiggler is the first insertion device to be installed in the new synchrotron ASTRID2 at Aarhus University in Denmark, and Danfysik is making the device for the facility. The wiggler has 7 periods with a period length of 116mm. The gap is variable from 12mm to 300mm with a resolution of 0.001mm. The wiggler is designed with NdFeB magnets for optimal field. The magnetic force of the wiggler will be approximately 3.5 ton. The K-value will be 21.7 at the minimum gap with a peak flux density of 2.003T. The wiggler is currently being designed, manufacturing starts in May 2010 and delivery will take place late 2010.

Sextupole Magnets for the NSLS-II Facility

NSLS-II, a state-of-the-art, 3GeV storage ring designed to deliver world leading brightness and flux is being constructed at the Brookhaven National Laboratory in New York. The facility will be able to produce x-rays up to 10,000 times brighter than those produced at the NSLS today. The electron beam which generates the radiation is stored in an accelerator ring with a circumference of approximately 800m, and included dipole, quadrupole, sextupole and corrector magnets.



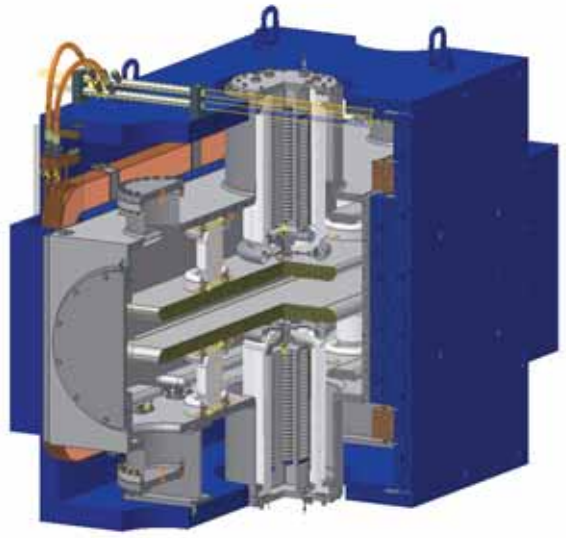
Danfysik has been awarded the contract to build 169 sextupole magnets for the NSLS-II Storage Ring. The specifications for the sextupoles request very narrow field tolerances pushing the boundaries of known technology, and the contract includes a detailed analysis of the magnetic field using 3D magnetic and mechanical modelling, providing a full harmonic analysis of the magnetic field. Also, the magnets will be magnetically measured in our test shop in Denmark. The magnetic measurements will cover determination of the integrated field harmonics, mapping to be performed with a rotating coil system.

Wien Filter Separators for the TRIUMF Beam Line

TRIUMF in Canada is making a major upgrade rebuilding its muon spin spectroscopy facility. For the M9A beam line Danfysik last year delivered a kicker system. For the rebuilding of the facilities 20 meters long M20 beamline, some high performance components are also needed. Danfysik was awarded the contract to build a kicker system and two wien filter particle separators for M20.

The purpose of the fast bipolar electrostatic beam kicker is to rapidly deflect the moun beam into one of the two entrance ports of a septum magnet. The main parameters of the kicker system are an electrical field of 7kV/cm, transition time 200 nanoseconds.

The two wien filter particle separators (electric/magnetic cross fields, please see figure) have two purposes: Separating the desired muons from unwanted particles and, in the process, rotating their spins. Very careful design and manufacture is utilized to meet the high performance requirements of the separators.



Main parameters of the wien filters are 43.8kV/cm electrical field, 0.05T electrical field and effective length 1500mm.

18,000 Amp Power Supply for the ITER European Dipole

Danfysik recently delivered an 18kA Power Supply to EPFL in Switzerland. It will be used to power a large superconducting coil, the European Dipole (EDIPO). This coil will produce a magnetic field of 12.5T in a large rectangular bore of about 100x150mm. The magnet will be the core element of a new facility dedicated to the qualification tests and the quality assurance tests of the superconducting cables for the ITER project.

Specification for 18 kA Power Supply

Nominal output current:	18kA
Max. output voltage:	±10V
Max. output ripple voltage:	50mVpp
Current drift stability:	100ppm (8 hours)
Remote control:	Ethernet
Dump circuit:	22.5 MJ
Topology:	4 x 6 pulsed thyristor- bridge with passive LCR-filter

High Field Electrostatic Deflector successfully tested

Danfysik has been the main supplier of accelerator components to the Hybrid Recoil Mass Analyzer (HYRA) at the Inter-University Accelerator Centre IUAC in New Delhi, India. HYRA is planned to be a unique combination of recoil mass spectrometer (RMS) and gas-filled separator (GFS), and the High Field Electrostatic Deflector is one of the key components for the project. The large Electrostatic Deflector has been successfully tested at Danfysik factory, and is now being installed at the IUAC site.

The main parameters of the ED are as follows:

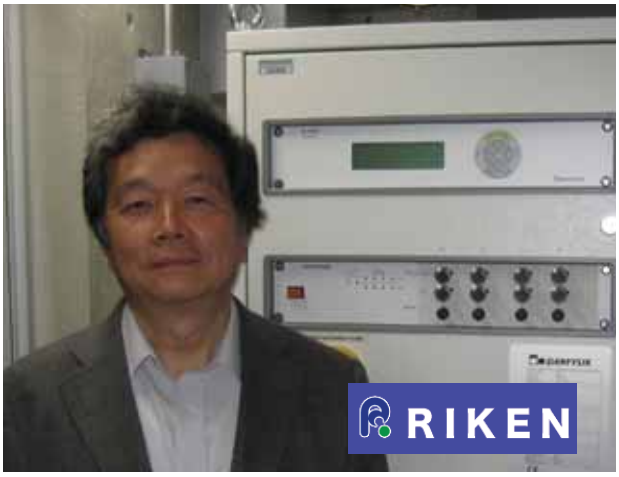
Radius:	6 m
Bending angle:	20°
Electrode gap:	120 mm
Max. voltage:	+/-300 kV
Max. field:	50 kV/cm

Ultra Stable Power Supply for 1GHz NMR system at Riken, Japan

RIKEN Systems and Structural Biology Center, Yokohama Institute, researches connections between proteins and diseases laying the groundwork for individualized medical care.

The enhanced Danfysik System 8500 performs a critical task by providing ultra-stable (sub ppm range) DC current to RIKEN's high temperature superconducting nuclear magnetic resonance experiments.

Next phase of the project is, supported by the Japan Science and Technology Agency, to develop a NMR spectrometer that operates at resonance frequencies beyond 1 GHz and magnetic field strength in excess of 23.5 T.



Dr. Hideaki Maeda, Director, NMR Core Technology Facility says: "The world class ultra-stable power supply from Danfysik improves the resolution of our experimental results by more than one order and enables us to conduct our research in an entirely new way."

News from our Customer Service Team

The Danfysik Service & Test Department offers a range of service solutions and profound technical know how which enables us to focus on our customers' individual needs and to ensure flexible assistance. Every customer repair inquiry is tracked and managed through our automated RMA system in order to resolve your problem quickly and efficiently. Our team has recently been strengthened by Merete Krogsgaard and Bjarke Nielsen.

Merete Krogsgaard joined the Danfysik Service & Test Department in September 2009 as Customer Service Coordinator. Merete has a broad experience in customer service, sales and marketing from various industries. Merete will take care of service requests and order handling. Merete speaks and writes fluently German, English, French and Danish.

Bjarke Nielsen, who joined the Service & Test Team in February 2010, has returned to Danfysik as Service & Test Engineer after 2 years of absence. Bjarke is specialized in automated test setups and a skilled Lab View programmer. An automated Lab View system with our newly developed Ultraprecision I/V Converter and an Ultraprecision Voltage Reference will ensure consistent high quality and stability.