

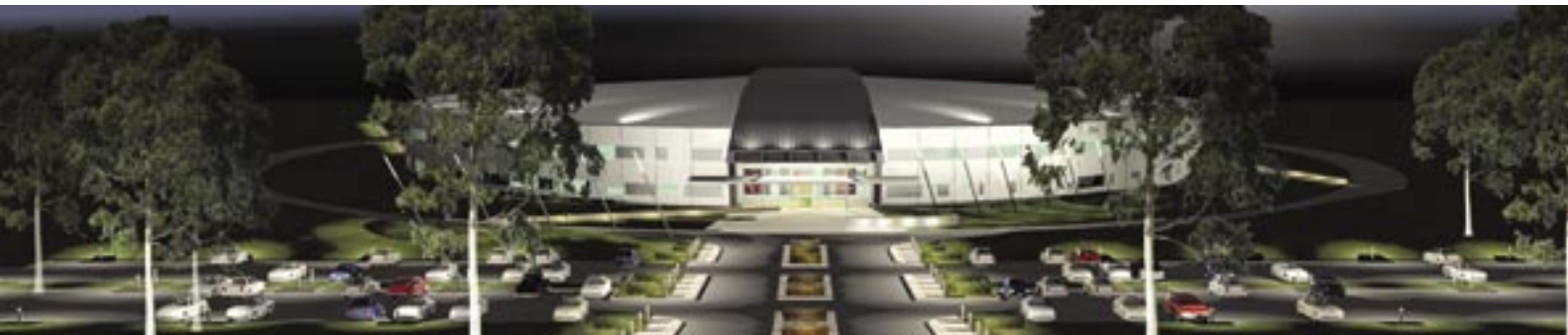


The Diamond Booster

Diamond synchrotron is the largest UK-funded scientific facility to be built for over 30 years. It will produce ultra-violet and X-ray beams of exceptional brightness, allowing pioneering experiments to be carried out which probe deep into the basic structure of matter and materials. The facility will comprise a 3 GeV electron storage ring, injected from a 100 MeV linac through a full energy booster synchrotron, and an initial complement of seven beamlines.

Danfysik is an important supplier to Diamond with a delivery of 44 ready-to-install Booster Girder Assemblies containing different combinations of laminated dipole, quadrupole, sextupole and corrector magnets. Included in the Danfysik delivery is full mechanical, electrical and magnetic testing of the individual magnetic elements, as well as vacuum tests to ensure UHV compatibility. The magnets and vacuum components are mounted and accurately aligned on the girders, complete with all services and interlock connections ready. Hence, the Girder assemblies delivered on the Diamond site are ready for immediate installation in the booster ring.

The assemblies will also include the UHV vacuum vessel running through the magnet gaps, Beam Position Monitors, bellows, flanges and all necessary vacuum pumps and instrumentation.



Progress at Australian Synchrotron Project

Danfysik is presently constructing the complete 3.0Gev full energy Injection System for the Australian Synchrotron Project in Melbourne. The contract with ASP is for a turn-key delivery, which include the 100MeV Linac, the Booster Ring and the Booster to Storage Ring Beam Transport Line. The Booster Synchrotron, 130m of circumference, makes use of a combined function magnet lattice.

The manufacture and testing of the magnets and power supplies are to be completed by spring 2005. In order to minimize the installation and alignment work on-site the Booster Elements will be assembled on support girders in the Danfysik factory before shipment.

Preparation for the installation work in Melbourne will start in spring 2005 and during summer the girder assemblies and other equipment will be installed. The late summer is foreseen for control system installation and pre-operational testing. Beam Commissioning is scheduled to begin by the beginning of fall and is expected to complete in the beginning of 2006, as contractually agreed with ASP.



Last year we experienced an increasing demand for our magnet, power supply, current transducer, and accelerator technology. A number of new synchrotron light sources are under construction in different continents, and most of them involve Danfysik and Oxford Danfysik with significant contributions. In the medical field our electronics and transducer products are increasingly sought by MRI manufacturers and, as you will find described in this newsletter, our synchrotron accelerator technology is now also being applied in the most advanced cancer therapy, Particle Therapy.

Over the last year our production facilities and our number of employees grew by almost 1/3. With a total of more than 160 well qualified and determined staff members we are well prepared for the continuing increase in demand that we experience from our valued customers.

All customer projects, small and big, require good project management to address the issues that are critical for success, - namely design, performance, on-time delivery, and quality. We are doing our utmost to ensure that our project engineers are well trained and have efficient tools for quality project management. All projects will benefit from our more than 40 years of experience in managing accelerator construction projects.

We look forward to another year of collaborating with and working for you, our customer.

Bjarne Roger Nielsen, CEO

Racetrack Microtron for Willy Wien at BESSY

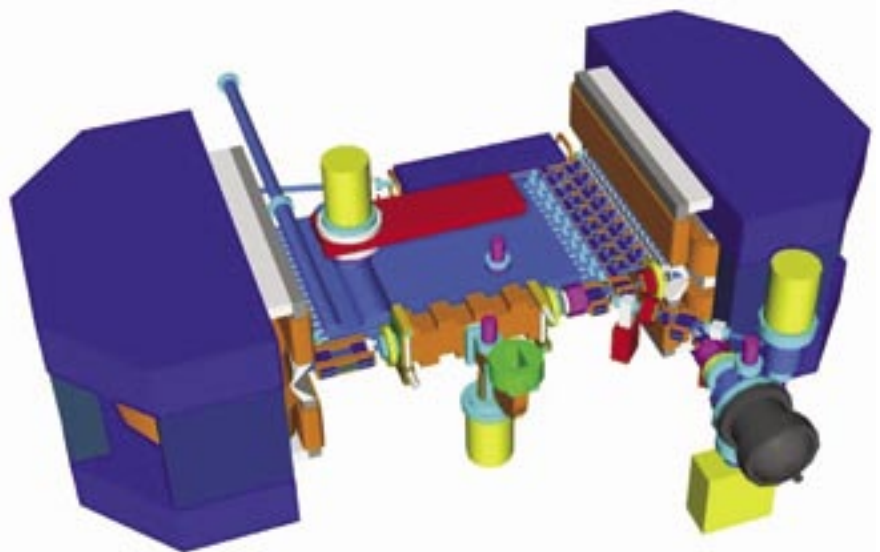
Danfysik is presently constructing a 100 MeV Racetrack Microtron (RTM) for the PTB Metrology Light Source called the Willy Wien Laboratory, situated next door to the BESSY II Synchrotron in Berlin, Germany. Danfysik received the order in October 2004 and will deliver the RTM fully commissioned in spring 2006.

The RTM is ideally suited as an electron source for boosters and storage rings in that it delivers a high electron beam current together with a low emittance and low energy spread, called high brightness, which maximizes the injection performance. The foot print of the RTM is as small as 2.5x2.5 meters and the total weight only 7.5 tons.

The main beam parameters are shown in the table below. The RTM is easily upgradeable to 1 kHz repetition frequency and can also be equipped with a single bunch gun.

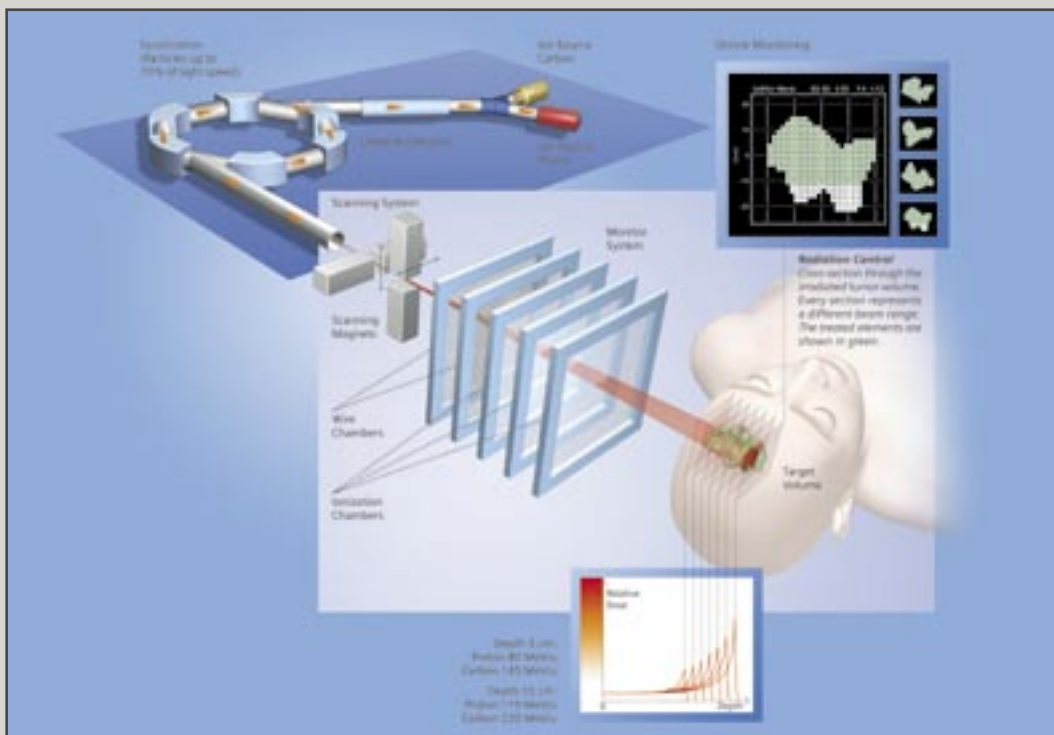
Main parameters of the Danfysik Racetrack Microtron for the PTB metrology light source WWL

General parameters:	
Repetition rate	10 Hz
Emittance	0.1 mm mrad
Energy spread	100 keV
Output beam energy	100 MeV
Current	10 mA



The RTM is designed with state of the art technology and some new features are:

- A full metal vacuum system to help shield high radiation sources.
- Ion pumps for UHV performance with turbo pumps restricted to roughing use, only.
- High stability RF system with solid-state modulators for klystron as well as for the electron gun.
- EPICS control system developed by BESSY.
- Remote control positioning of linac and main magnet.
- Extensive diagnostics for full control of the accelerator.
- Modular and independent sub-systems throughout the accelerator.



Danfysik joins Siemens on Particle Therapy

Danfysik and Siemens Medical Solutions have entered into a cooperation contract for Particle Therapy solutions. Danfysik will provide the complete accelerator complex from the ion source to the beam delivery point, and Siemens will provide the treatment control and planning, patient handling, diagnostics, etc., and will be the interface to the hospital, the doctors, and the operating personnel.

With Particle Therapy, accelerated ions are used as a very precise and efficient means of radiotherapy. Ions, such as protons and carbon ions (up to 250 and 430 MeV/amu, respectively), penetrate the human tissue and deliver very high energy doses at the end of their tracks, in the so-called Bragg peak region. The shape and sharpness of the Bragg peak allow dose levels that are lethal to the cells in the cancer tumour while sparing the surrounding tissue. With energy scanning, which is possible only in synchrotron based systems, the tumour is treated layer by layer, which in conjunction with magnetic scanning, allows the tumour to be treated exactly over its entire three dimensional shape. The radiobiological efficiency of carbon ions is factors larger than that of protons, and hence, for carbon ions, the complete treatment can be performed with much fewer therapy sessions than with protons. With particle therapy, radiation treatment can be carried out in an efficient way on tumours without affecting nearby vital organs, the central nervous system, etc.

The accelerator system consists of two ECR ion sources with an inflector magnet, followed by an RFQ accelerator and a drift tube linac. The final particle energy is achieved in the synchrotron which has a circumference of approximately 60 m, and the beam is delivered through a high energy beam transport line to three or four beam delivery sites with fixed beam position or gantry, followed by the transversal magnet scanning system. A robotic couch places the patient in the precise treatment position, defined by data from the integrated X-ray imaging and CT scanning systems.

More information can be found on www.siemens.com/medical or by contacting Lars Anthon, la@danfysik.dk



New transducer joins the 867 family

As customers may have noticed on our homepage, we have recently added a 200A transducer to the popular 867 family.

The new sensor has the same high accuracy as the other 867 family members, and can even be offered with offset adjustment.

Customers world wide have shown great interest in the new 200A transducer, and "orders have already exceeded all expectations", says product manager Allan de Neergaard.

Description, technical specifications and outline drawings of all our current transducers are available at www.danfysik.com

Oxford Danfysik a leading supplier of monochromators

Oxford Danfysik is currently assembling 7 double crystal monochromators destined for Diamond Light Source and SOLEIL.

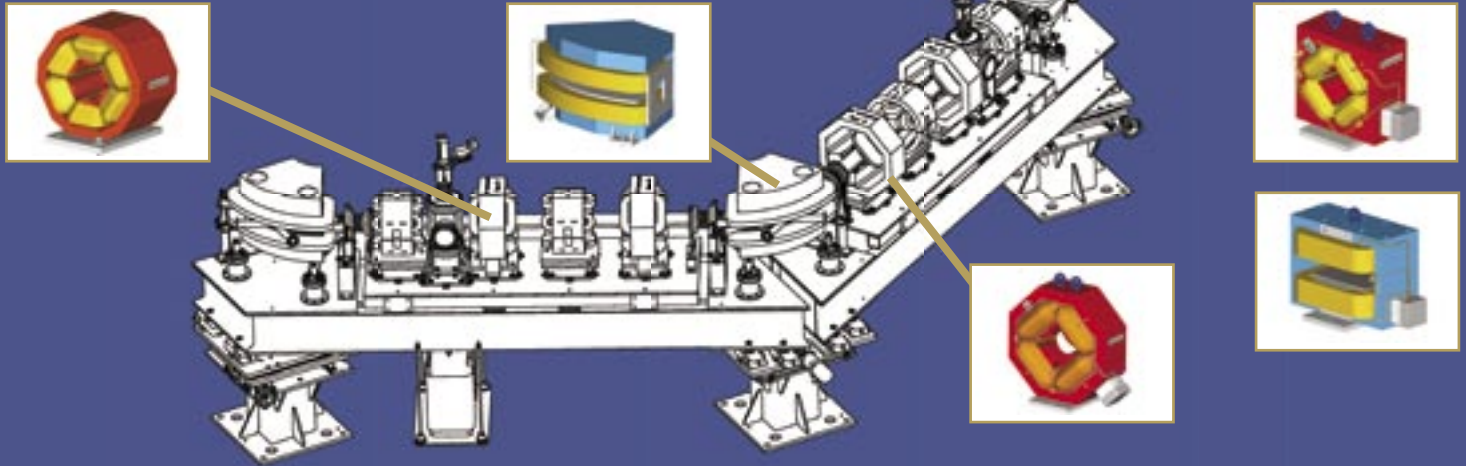
Each monochromator incorporates a significantly upgraded Bragg axis rotation stage and novel features in the crystal cage designed to further enhance their very high stability and repeatability. The first 3 systems are key components of the three complete MX beamlines being constructed by the company for the DLS.

There is complete flexibility in cooling options and crystal configurations and the 7 systems in build include indirect cryogenically cooled crystal sets with additional water stabilisation circuits, indirect water cooled crystal sets, multiple crystal sets and sagittally bent second crystal. To complete the range of options, the recently installed crystal cage upgrade on the wiggler at BL 5.02 at the ALS incorporated a direct cryogenically cooled first crystal. The DLS monochromators are being provided with full EPICS control systems.



One of the DCMs for the DLS fully assembled in the cleanroom in Oxford

Preparation for the 4th Generation Light Source



The fourth generation light source (4GLS) is a new synchrotron radiation facility proposed for the United Kingdom designed to complement the ESRF and Diamond by providing state-of-the-art radiation in the low energy photon regime – from the far-infrared to the extreme ultraviolet.

In preparation for 4GLS an Energy Recovery Linac Prototype (ERLP) is being constructed at the Daresbury Laboratory.

For the ERLP, a single circuit race-track electron accelerator, Danfysik has been awarded the contract to deliver 39 magnets needed for the facility.

The delivery of these high performance magnets include 3D magnetic field calculations and field documentation.

The new generation of high performance and cost effective power supplies

The System 7000 and System 9000 are the new generation of power supplies from Danfysik.

Whereas System 9000 is a range of unipolar power supplies consisting of more than 100 different versions up to 10kW, the System 7000 is a 1.5kW true bipolar power supply, of which more than 500 units are already sold to major laboratories worldwide.

The two new systems, like all power supplies from Danfysik, incorporate the well-known Danfysik Ultrastab precision current transducers to secure the stability of the output current.

Both System 7000 and System 9000 are housed in a very compact 19" wide, 3U chassis to fulfil our customer's needs for a compact design with specifications superior to available standard products on the market.





10.5 meters long Electromagnetic Elliptical Undulator for the SOLEIL Synchrotron

In March 2004 Danfysik was awarded the contract to design and manufacture the large Elliptical Electromagnetic Undulator HU640, that will be the photon source for the High Resolution Spectroscopy Beamline at the French SOLEIL Synchrotron.

The horizontal and vertical field components are produced by three sets of coils in a special arrangement, allowing production of all kinds of light polarization on a fixed girder structure.

As the magnetic field at this undulator is created without use of iron, the field quality is dominated by the accuracy of the coil winding. All coils of a type therefore have to be identical within narrow tolerances, and also their accurate position in the undulator is essential for the performance of the device.

The undulator will be delivered to SOLEIL Synchrotron by summer 2005.



High Speed Detectors

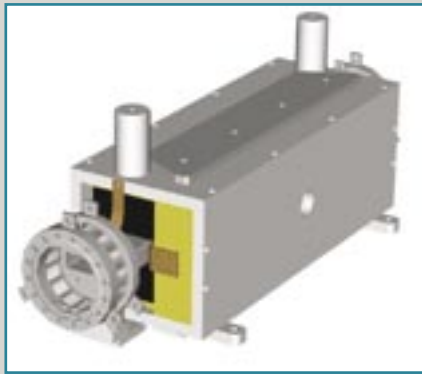
Two variants of Avalanche Photo Diode detectors have just been launched by Oxford Danfysik.

The common detector head offers count rates up to 100 MHz with pulse pair time resolution of 5.6 ns and high photon efficiency – 45% at 12 keV. The detector head can be paired with two variants of electronics which offer different control options. The APD PLUS incorporates electronics designed and developed at the ESRF while the APD PRIM is based on Peter Siddons design in use at the NSLS Brookhaven.

The addition of these high count rate detectors further expands Oxford Danfysik's extensive range – there are now 11 product ranges including ionisation chambers, scintillations counters, crystal analysers and beam diagnostics and over 50 variants.

More information can be found on www.oxford-danfysik.com or by contacting Oxford Danfysik.

Fast Magnets systems for Diamond



Danfysik is the selected supplier of all the fast magnets as the septum and kicker magnets for injection and extraction processes at the Diamond Light Source, UK. The scope of supply includes design, manufacture and testing of all systems operating at up to 5 Hz, and the magnet pulsers. The Storage Ring Injection Kickers incorporate ceramic vacuum chambers.

All septum magnets are 'out of vacuum' types with a thin walled vacuum pipe and a current carrying septum. In the booster ring both Injection and Extraction septa are needed, whereas the Storage Ring only needs an Injection septum.

The lengths of the magnets vary from 0.3 m up to 1.7m and the peak current is as high as 15kAmp. Current pulses are full sine shape with 400µs period. The septum thickness is 3 mm for all magnets, which is sufficient to get a low leakage field seen by the orbiting beam.

Kicker magnets for Injection and Extraction in the booster are both 'ferrite in vacuum' type, with a low inductive C-shaped yoke. Special attention is given to the current feed troughs to ensure low induction. The rise/fall times for both kickers are 150 ns and flat top length is 380 ns. The PFN voltages needed to drive the magnets are 1.5 kV for the Injection kicker and 38 kV for the Extraction Kicker.

Four Kickers are used to produce a fast local bump of up to 17 mm in the 8 m long injection straight at Diamond storage ring. The free aperture in the ceramic vacuum chamber is 23x80 mm while the magnet aperture is 37x95 mm. The peak current needed is 5700 Amp to get 160mT in the gap. The four kickers have an inductance mechanism, in order to tune them to perform identically.



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Successful In-Vacuum Insertion Devices

As mentioned in the last issue of News, Danfysik was awarded the contract for design, manufacture and delivery of an in-vacuum undulator for Swiss Light Source.

SLS has now installed the undulator and comment; "It is working perfectly!"

We are looking forward to delivering another in-vacuum undulator for SOLEIL at the end of 2005.

Danfysik has also recently designed and constructed a special quasi periodic undulator for the Free Electron Laser project FELICE at FOM in the Netherlands. With this special undulator it is possible to adjust the step taper through a double carriage solution.



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