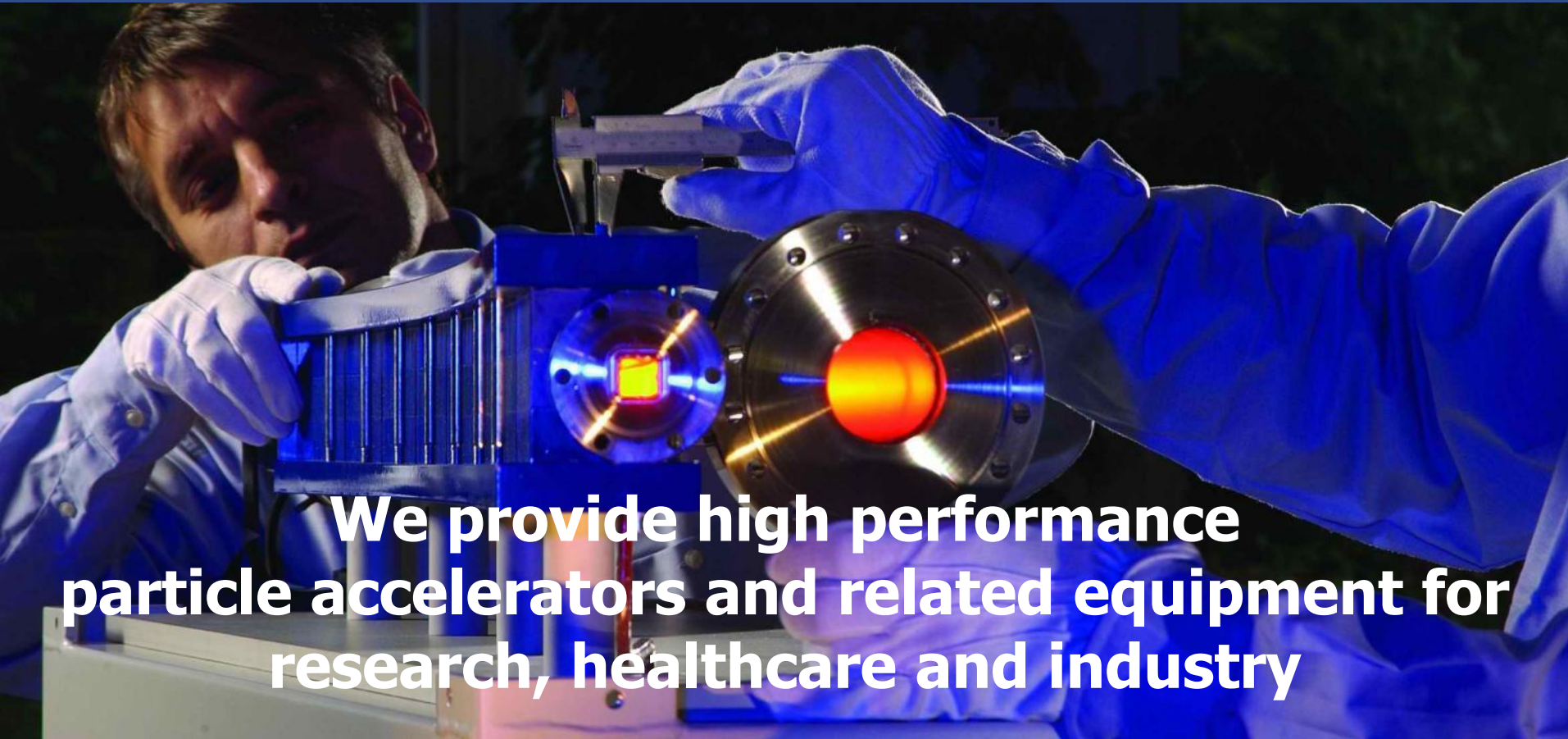




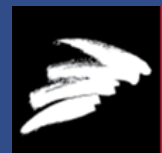
DANFYSIK

Michael Budde
Head of Physics Design group
Danfysik
Taastrup, Denmark

Accelerating Technology Business



**We provide high performance
particle accelerators and related equipment for
research, healthcare and industry**



DANFYSIK

Danfysik company history

- ❑ 1964 – Foundation of Danfysik

- ❑ 1964 – First power supplies
- ❑ 1967 – First ion accelerator system
- ❑ 1974 – First synchrotron magnet system
- ❑ 1995 – First insertion device

- ❑ Turnkey synchrotron systems
 - ❑ 1998 – Injection systems for ANKA, Karlsruhe, Germany
 - ❑ 2002 – Booster synchrotron for Canadian Light source
 - ❑ 2006 – Injection system and booster for Australian Synchrotron

- ❑ Particle Therapy accelerator systems – with Siemens
 - ❑ 2006 – Start of system development
 - ❑ 2011 – PartikelTherapie Zentrum, Marburg, Germany
 - ❑ 2012 – NRoCK, Kiel, Germany
 - ❑ 2014 – ShaPHIH, Shanghai, China

DANFYSIK products

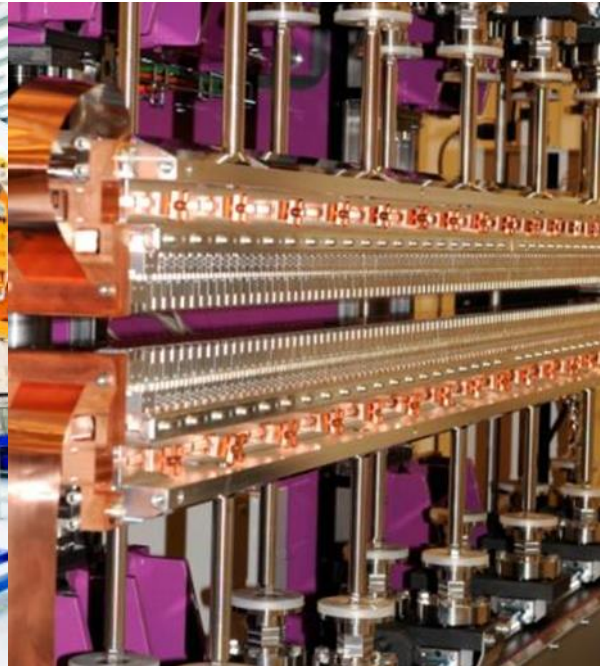
Power Supply Technology



- Magnet power supply design
- Magnet power supply production
- Magnet power supply test
- 10 A – 30000 A
- kW to MW
- 0.3 ppm – 100 ppm stability

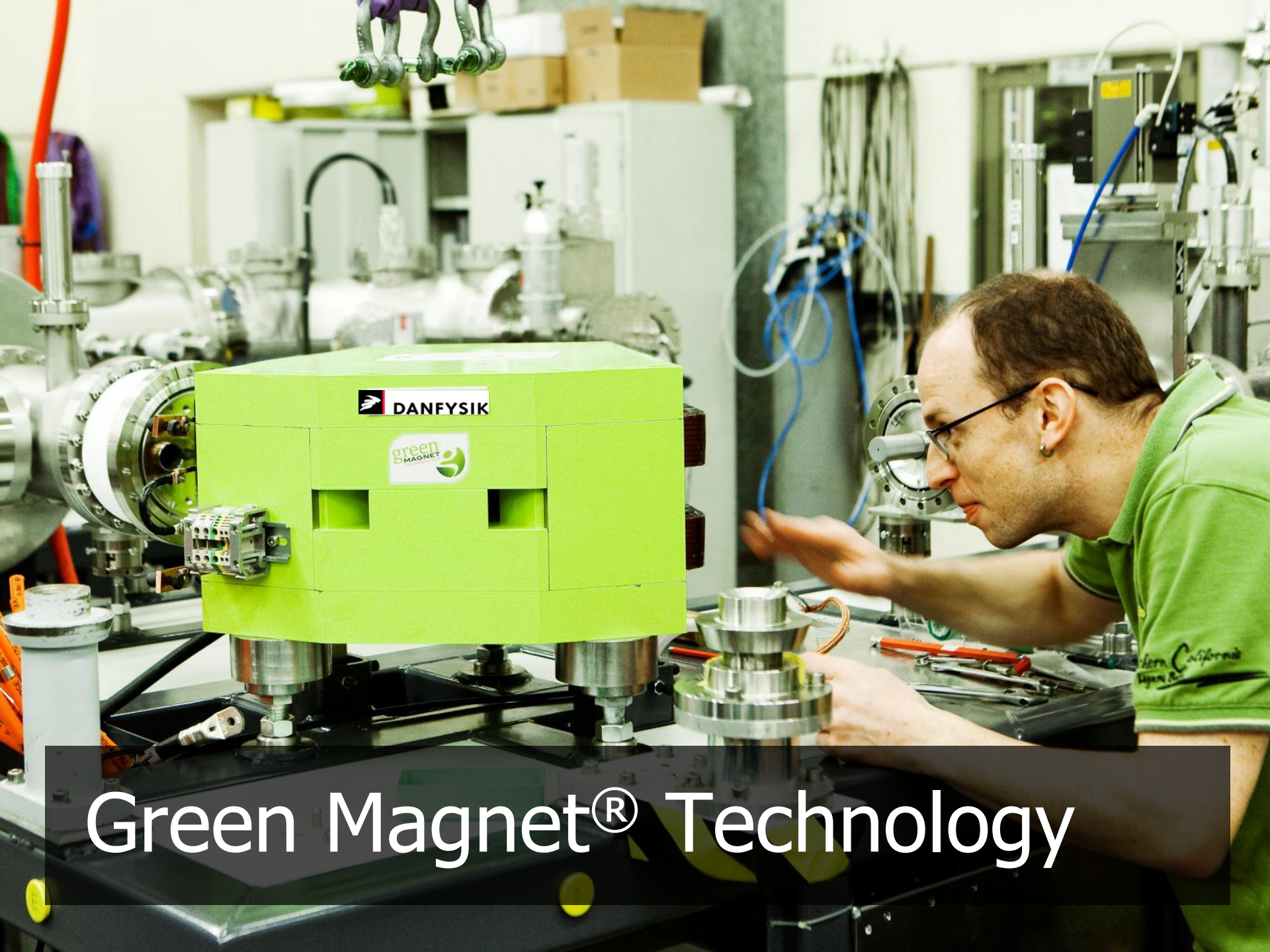
DANFYSIK products

Magnet Technology



- Beam optics design and magnet specification
- Magnet design
- Magnet production
- Magnet test

- Dipole
- Multipole
- Combined function
- Insertion devices

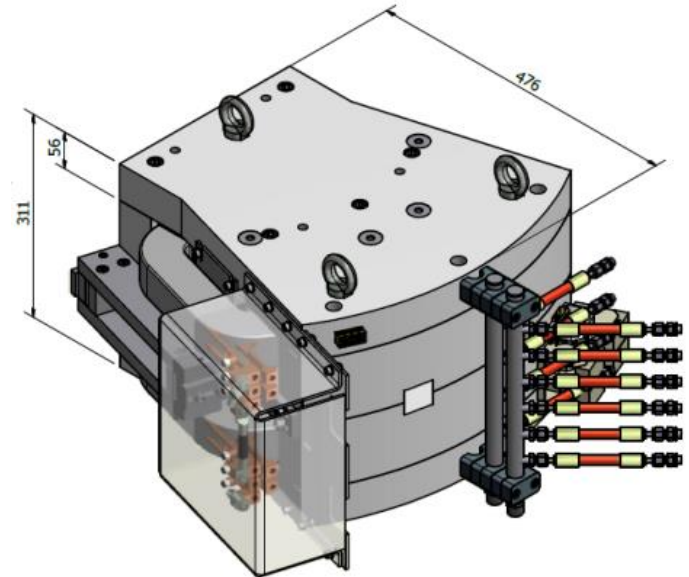


Green Magnet® Technology

GREEN MAGNETS®

Green Magnets project

- Collaboration with universities and other companies – supported by the Danish government
- Sustainable accelerator systems:
Minimum power consumption
- Reduction of total cost of ownership of magnet solutions
- Improve uptime of accelerator
- Use of permanent magnets
- New generation of highly efficient and reliable power supplies



DANFYSIK products

Accelerator Systems



Australian Synchrotron
Melbourne



PartikelTherapie Zentrum
Marburg

- Beam optics design
- System specification
- Installation
- Project management
- Commissioning

Particle Therapy accelerator projects

PTZ Uni-klinikum Giessen-Marburg, Marburg, Germany

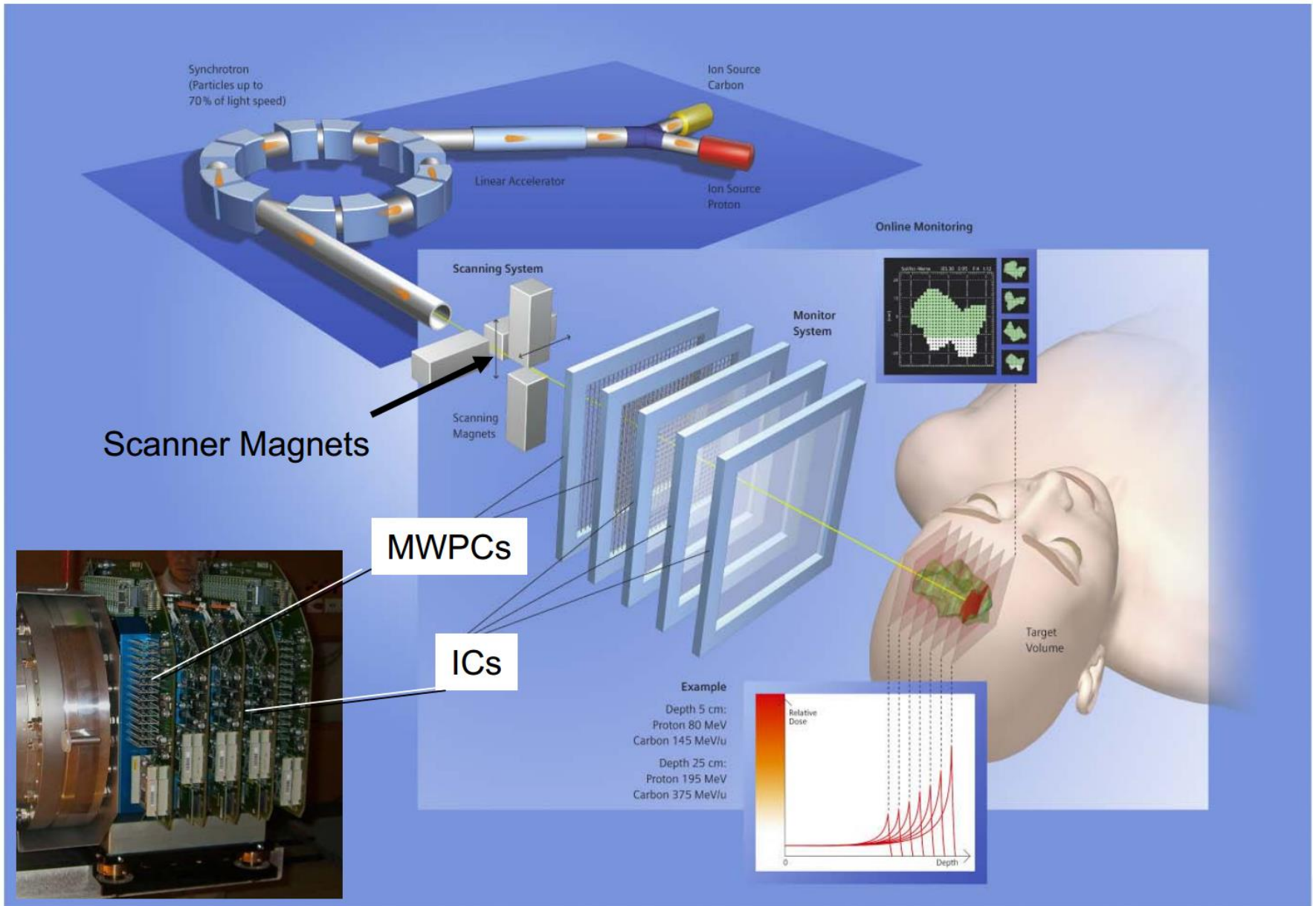


New name:
MIT:
Marburg IonenTherapie

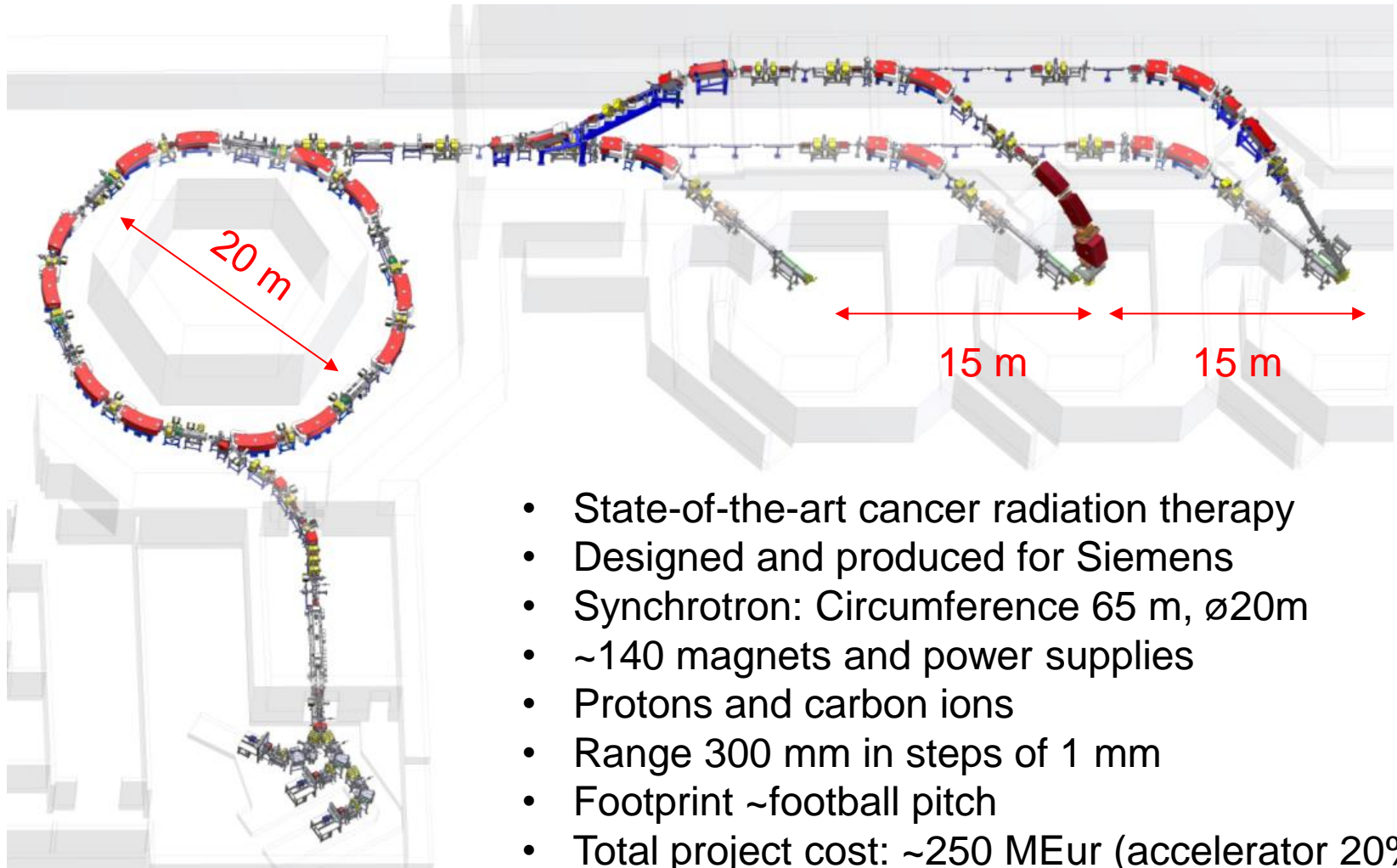
Shanghai Proton and Heavy Ion Hospital, Shanghai, China



Principle of Particle Therapy



Particle Therapy accelerator



- State-of-the-art cancer radiation therapy
- Designed and produced for Siemens
- Synchrotron: Circumference 65 m, \varnothing 20m
- ~140 magnets and power supplies
- Protons and carbon ions
- Range 300 mm in steps of 1 mm
- Footprint ~football pitch
- Total project cost: ~250 MEur (accelerator 20%)

Teknologisk Institut



DANISH
TECHNOLOGICAL
INSTITUTE

Danfysik's parent company since 2009

Teknologisk Institut



- Founded 1906 - "To support Danish industry, mainly small enterprises, by providing technical assistance in the form of teaching, advice, testing and technological research"

Today:

- ~1050 employees (Danfysik ~110 employees)
- 2 main campuses: Taastrup and Aarhus
- Revenue 2013: 144 MEur (Danfysik 19 MEur)

Building and construction



Business and industrial development



Chemistry and biotechnology



Energy and climate



Environment, working environment and health



Food and packaging



Industrial measurements and control



Industrial production and development



Meat industry solutions



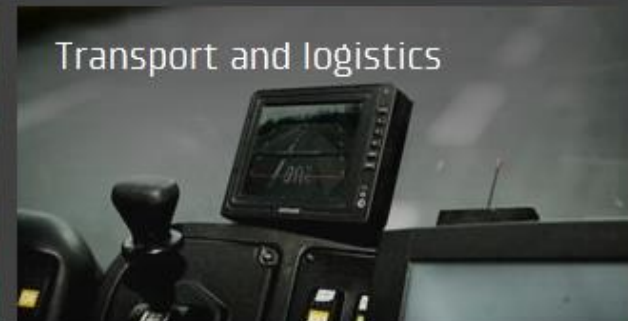
Productivity and management



Surfaces and microtechnology

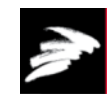


Transport and logistics



Teknologisk Institut

Main campus in Taastrup



DANFYSIK

Research and development at Danfysik

- Development is typically part of order execution (one-off's)
- Internal development projects
- Consultant services for costumers
- Participation in research networks (LA3NET, Green magnet)

R&D is divided into three groups:

- Mechanical and magnet design (14 engineers)
- Electronics design (13 engineers and 1 physicist)
- Physics design (7 physicists)

Research and development at Danfysik

Tasks of the Physics Design group:

- Beam optics design of accelerators and beamlines
- Specification of magnets and power supplies
- Specification of accelerator control systems
- Experts on magnet test methods and equipment
- Experts on insertion devices
- Experts on beam diagnostics
- Commissioning of accelerators
- Participation in research networks: LA3NET, Green magnet

Physics job opportunities

Danfysik's Physics Design: We're busy, but not hiring right now

Europe:

- Several big facilities: MAX IV, ESS, XFEL, FAIR, ITER
- New positions at universities - driven by retirement of staff
- Healthcare: Particle Therapy is becoming increasingly widespread.
- Industry: Medico, Energy, Finance, IT

Physicists are very attractive for high-tech industry because they:

- have good analytical skills
- are trained in solving tough problems - independently
- know basic science => can quickly learn new stuff
- often are advanced IT users (or programmers)
- have good language skills – due to research background

My career path

- Born 1971
- 1977-1990: Elementary school and gymnasium (high school)
- 1990-1998: Studied physics at Aarhus University, Denmark
PhD thesis: Experimental studies of H-related point defect in Si and Ge.
- 1998-2000: Research assistant professor, Vanderbilt University, Nashville, TN
Continuation of PhD work (with new techniques)
- 2000-2002: Research associate professor, Harvard University, Cambridge, MA
Quantum optics in ultracold atomic gases
- 2002-2007: Associate professor, Aarhus University, Denmark
Leader of Quantum Gas group, supervisor of PhD students
Lecturer in Atomic Physics and other courses
- 2007-2008 Accelerator physicist at Danfysik
- 2008-2012 Manager of System Architect group, Siemens Healthcare PT
- 2012-2014 Team leader of PT physicist group, Danfysik
- 2014- Head of Physics Design group, Danfysik

My career path

Key decisions:

- **After gymnasium:** Engineer or physicist? Decision driven by (lack of) mobility.
- **MSc → PhD:** PhD because I could - and liked being at Aarhus University
- **PhD → Post doc:** Wanted to become professor at Aarhus University
- **Post doc → Group leader:** Got the opportunity; my goal was in sight.
- **At age 36:** Very close to my long-term goal:
Realized that academic research didn't fulfill my expectations

Result:

- Experience in different fields of physics (good)
- International experience – worked in US for 4.5 years (good)
- Enjoyed the journey – most of the time (good)
- Had project management and group lead experience when I first applied in industry (good)
- Stayed in academia longer than necessary (not optimal)

No regrets!

Not direct career path – but I gained a lot of experience on the way

Recommendations

- Be spotted in the crowd:
 - Demonstrated relevant work experience is very important for first industry job.
 - Do something (relevant) that makes you stand out in the crowd.
- Which direction? Specialist, project management, line management
- Make yourself attractive by attending relevant courses
- Evaluate your goals and achievements regularly



DANFYSIK

Thank you for your attention