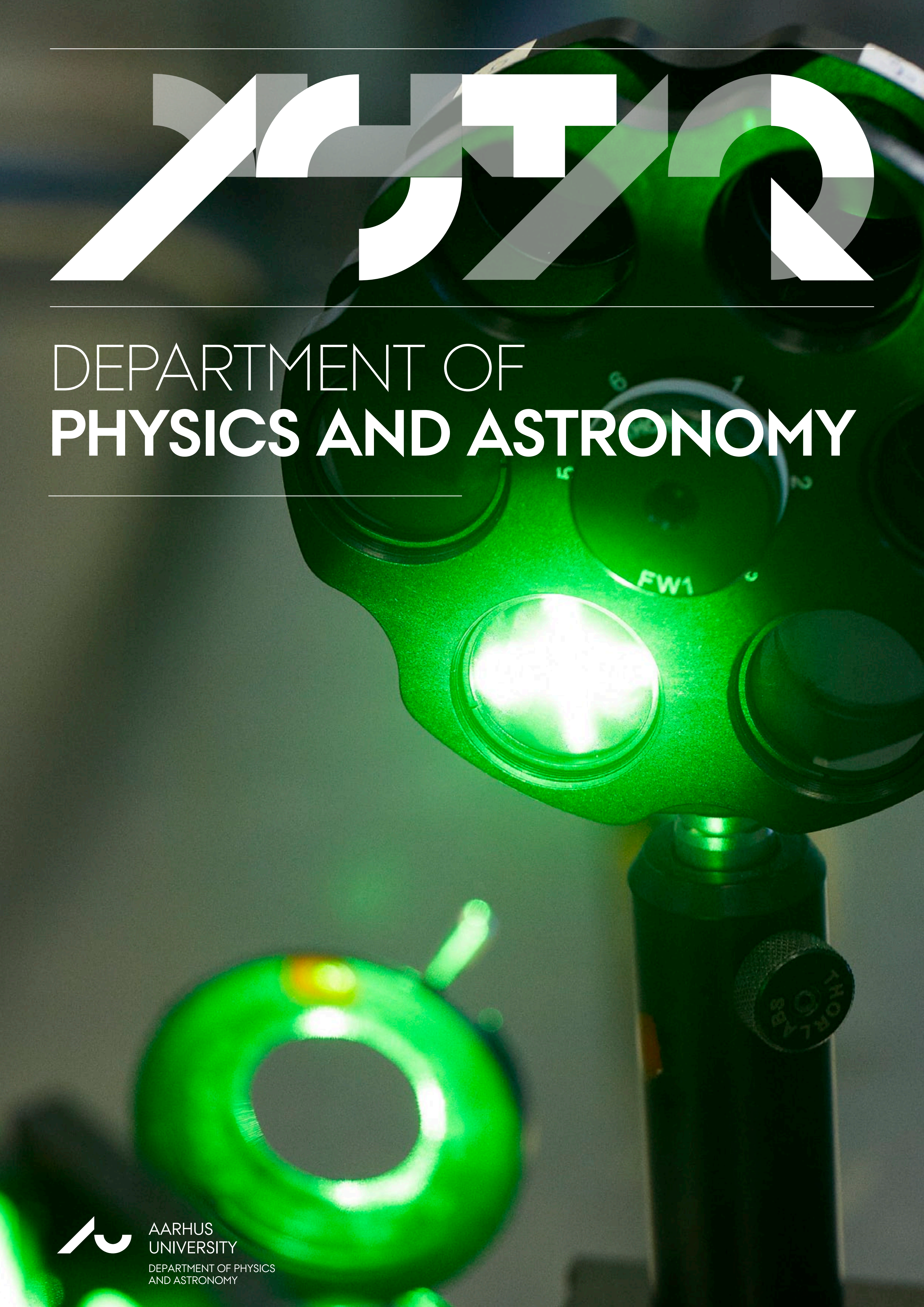
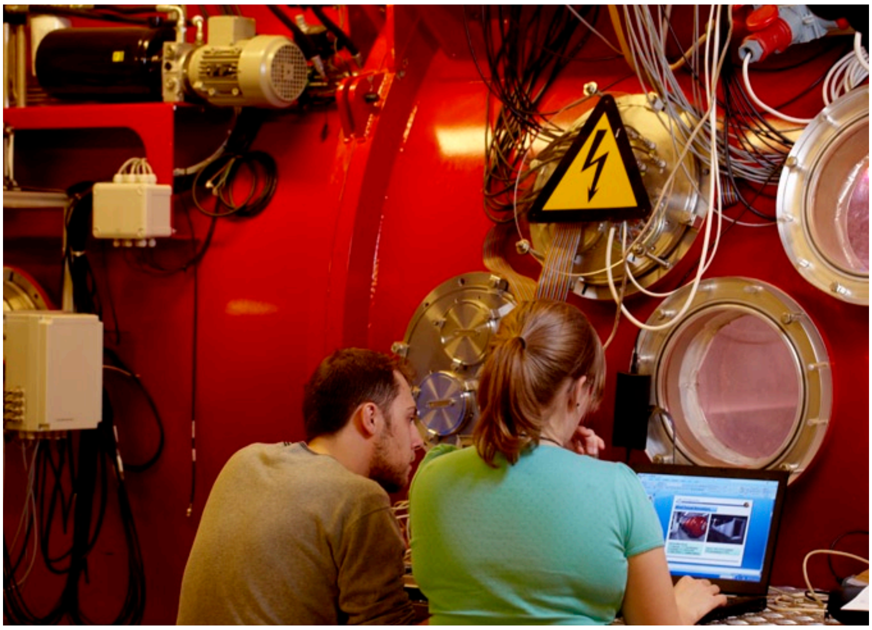
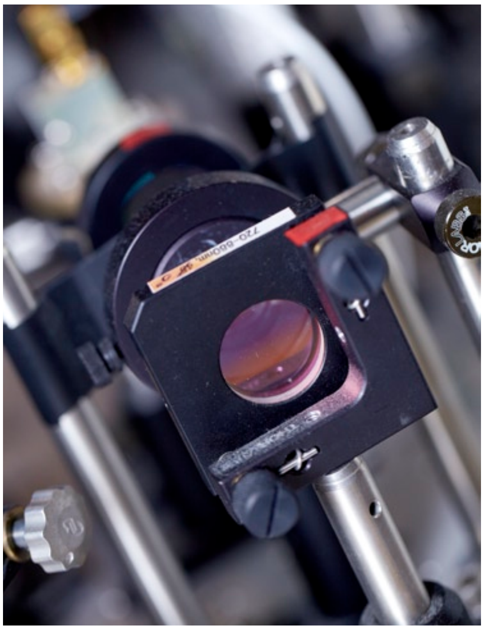


DEPARTMENT OF
PHYSICS AND ASTRONOMY

AARHUS
UNIVERSITY
DEPARTMENT OF PHYSICS
AND ASTRONOMY





DEPARTMENT OF **PHYSICS AND ASTRONOMY**

The Department of Physics and Astronomy (IFA), Aarhus University is known for top international research, the development of new research talents and sublime teaching with inspiration directly from cutting edge research. We work closely with many different companies, where we contribute with knowledge sharing and participate in research and development projects.

The research that supports these activities, spans many disciplines ranging from the nuclear physics, solar cell research to astrophysics. It is based on fundamental theories as well as advanced experiments. In our research we always strive to find the deepest relationships and a fundamental understanding. In recent years we have studied the role of quantum physics in such diverse issues as quantum computing and biological macro systems, where the outcome of complex biological processes appear to be determined by individual quantum states.

The Department cooperates with several foreign institutions. CERN (the European Organisation for Nuclear Research) has played a special role in this regard for many years and we are currently at the threshold of new findings with measurements that compare the properties of matter and antimatter.

CERN has had great importance for IFA on front line accelerator research and the department's dual-purpose storing ring ASTRID is a good example of how knowledge has been transferred from foreign institutions. Partly as a result of this, IFA today has Denmark's largest accelerator expertise.

Right now we are faced with a new departmental structure in Science and Technology and are looking into opportunities for cooperation across departmental boundaries. The Department also has a long tradition of interdisciplinary research, for example iNano (the Interdisciplinary Nanoscience Centre) developed from the IFA in 2002. Recently, the Centre for Science Studies has become an integral part of IFA.

We want to help to solve some of society's fundamental challenges here and now, for example within energy and the climate. But perhaps most importantly, we generate knowledge for the future. If new discoveries on the fundamental level are to be achieved, we are obviously a part of this – who else?

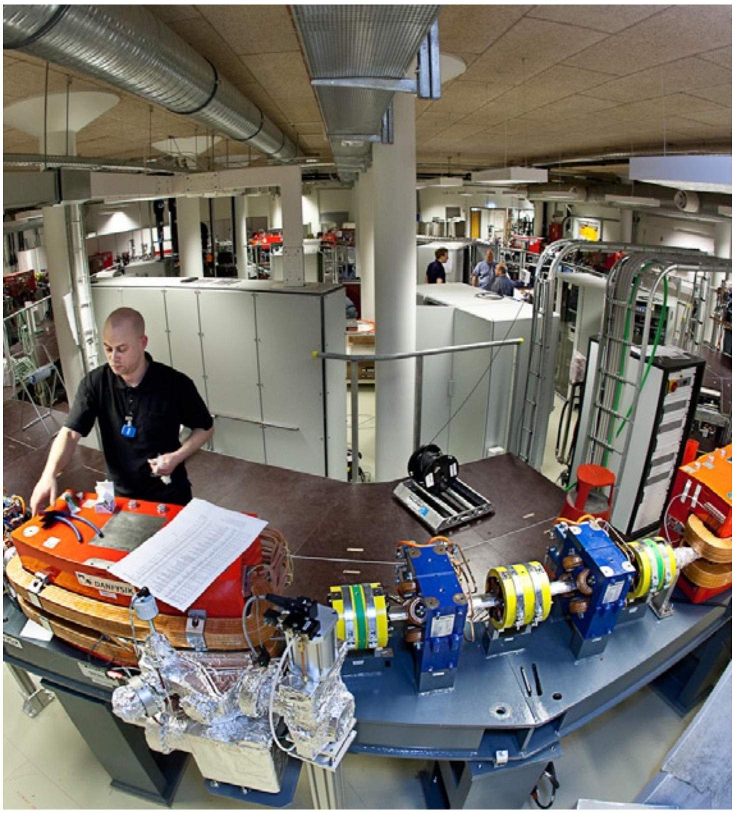
Our cutting edge research has often generated useful spin-off. By building experimental facilities for studying the planet Mars, which has attracted widespread attention both in the media and the research world, we now have an apparatus which is pertinent in an industrial context.

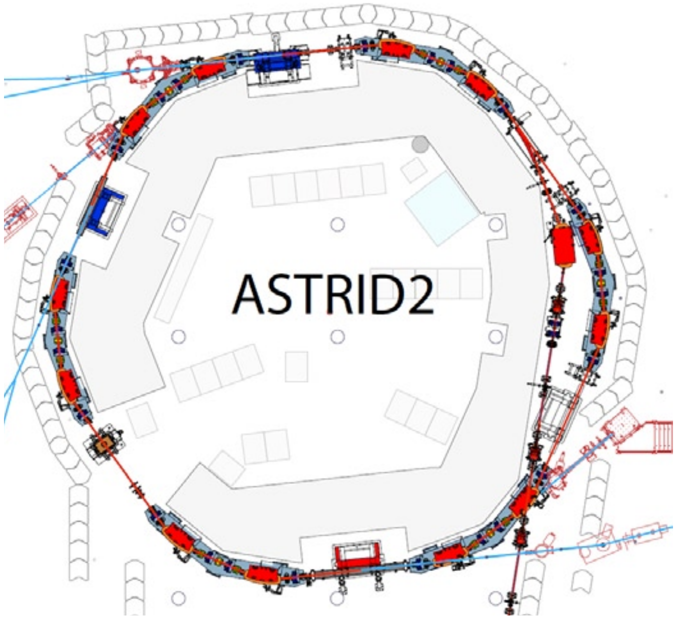
On the following pages we will show examples from the dynamic environment at the department. You will meet PhD students as well as established researchers with some examples of their research. Additionally, you will find factual information about our programmes and the department in numbers.

If you are considering studying at IFA, let the following quote from a student's letter enter into your considerations: '... *last but not least, we have a really cool study environment!*'

I hope the information will be useful to you.

Yours faithfully
Lars Henrik Andersen, Professor and Head of Department





THE HEAVY LADIES IN THE BASEMENT

Our knowledge about the nature around us, especially at the microscopic level, is based on the use of a variety of instruments especially invented by physicists. One type of instrument is the so-called accelerator; these are machines that can accelerate atomic particles to velocities close to the speed of light. The biggest accelerator, the world has seen, was built at CERN (the European Organisation for Nuclear Research) in Geneva, where a ring-shaped accelerator of nearly 30 km in circumference was built 50 metres below ground. Here the elementary particles, nature's tiniest building blocks and the forces between them, are studied.

Not known to many, in the large cellars under the Department of Physics and Astronomy at Aarhus University there is a somewhat smaller but still substantial version of an accelerator. Well, actually two, as the eldest, which under the name of ASTRID was commissioned in the early 90s, has now got a sister, ASTRID2 which has a circumference of 46 metres! Sheer size alone is an indication of the department's central role as *the accelerator laboratory* in Denmark. Dr. Scient Søren Pape Moller has built both, although not alone, and his research is now focused on developing the enormous apparatus at ISA, the Institute for Storage Ring Facilities, Aarhus University.

'Such an accelerator is not something you can buy anywhere in the world, but through the years, IFA has acquired the expertise to design, build/buy, install and commission the many components that are needed' says Søren Pape Møller.

'Our job is to build accelerators and get them to function. We are constantly expanding our research facility and additionally we have involved ourselves in accelerator projects elsewhere. Accelerators are also used widely within industry and health. For instance, up to half of all cancer patients today get radiation therapy, where cancer cells are killed by shooting X-ray beams, or as something new, charged particles on the tumour. For several years researchers at IFA have actively worked on various aspects of radiotherapy, and IFA is now actively participating in the Danish initiative to get the first Danish proton medical particle accelerator to Aarhus. Finally, we must also mention the Danish-Swedish initiative to build the European Spallation Source – the world's most intense neutron source, in Lund, Sweden. In this facility, for an estimated 10 billion DKK, a very intense proton accelerator is used to produce the world's most intense neutron beams to study future materials.'

It started at CERN, and for several years staff at IFA have performed experiments at the giant research facility within several fields. But the expansion of accelerator facilities at IFA positions Aarhus in a central role. Since the department's expansion in the early 1960s, accelerators have played a very significant role in experimental research. This trend was particularly augmented in the early 1990s when ASTRID (dual- purpose storage ring) was taken into operation. This 40 m long accelerator was, as something innovative, designed with two purposes: firstly to accelerate and store ions for studies particularly within atomic physics, and secondly to store electrons, which emit very intense electromagnetic radiation, synchrotron radiation, with wavelengths from the visible region to the X-ray range, 1-200 nanometres. The use of ions in ASTRID was something completely new and resulted in many significant research results. A smaller storage ring, ELISA was subsequently invented, and ions, specifically heavy molecular ions, are studied in ELISA today.

Today ASTRID is therefore only used as a synchrotron radiation source and more than 100 scientists from around the world use ASTRID annually. She is now an aging lady, and shortly before Christmas 2009, Aarhus University received a grant of 37 million DKK to build a new, very brilliant synchrotron radiation source, ASTRID2.

'The commissioning of the ASTRID2 accelerator is ongoing summer 2012 with final completion at the end of 2013. ASTRID will not be "buried" with the construction of ASTRID2 as ASTRID, as an essential element, will function as a pre-accelerator in the new facility. The new machine is expected to provide IFA and AU with very good opportunities for cutting edge research in physics, materials, Nano science etc. Although accelerators at IFA are built for research purposes, the unique situation of accelerators available at the university results in exceptional opportunities for students at all levels' says Søren Pape Møller.

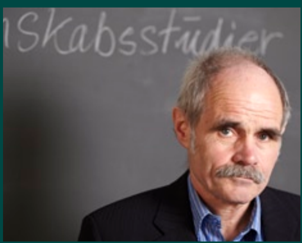
ASTRID2

Large circular accelerators, synchrotrons, now produce very intense electromagnetic radiation, photons from the infrared part of the spectrum up to the soft X-ray range. This synchrotron radiation has for years evolved into one of the most universal probes for the understanding of atoms, molecules and solids. Again, IFA is at the forefront, as the new synchrotron accelerator ASTRID2 is expected to be 'the ultimate source of radiation'.

CENTRE FOR **SCIENCE STUDIES**

Why is it so difficult to convert climate science to climate policy? How did Denmark end up being amongst the leaders in wind power? What is the relationship between basic and applied research? What role has science played in the development of modern Denmark? These are some of the questions that researchers at the Centre for Science Studies are interested in.

Helge Kragh, professor of science history:



'When the faculty or department need to show the world that science is also a cultural activity, it is people like us who say something credible. We do not engage in science as such, the substance of the history of science and philosophy is something that lies between the humanities and natural science. Our objects are those who carry out scientific research. We reflect on the existing science, its origins and its cognitive and social consequences.'

Hanne Andersen, associate professor, Director of the Centre for Science Studies:

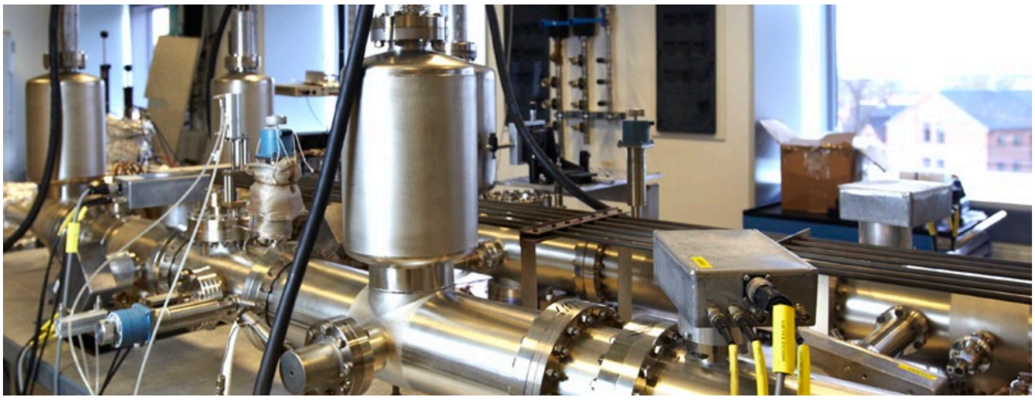
'Our role is to provide a meta-perspective on what science and engineering are, which roles they play in society and how they have evolved through the ages. It is mandatory in all programmes to have a course in philosophy of science. It gives a broader perspective on what your profession is, where it has come from, how it develops, and which characteristics it has. What does it mean to be a scholar? What does it mean to do research and how is this knowledge applied in our society? What are the ethical issues surrounding what we do? It provides the students with the ability to come out and work in a broader context than just the academic'.

In today's knowledge society, scientific knowledge and innovation represent an important foundation for growth and welfare. At the same time, links between science, technology and the society they are part of have become increasingly complex and changeable. Many of the scientists and engineers who in the future will be responsible for generating new knowledge and its application, need to have strong skills; not just in science but also in the ability to analyse the complex relationships that scientific knowledge produces and is used in.

The Centre for Science Studies is an interdisciplinary department which deals with theoretical, historical and social studies of science and engineering sciences and their interaction with society and culture now and throughout history. The department's staff typically has a background in both science and history, philosophy or communication for example. In research as well as in teaching, the department's hallmark is a tight coupling between detailed studies of scientific developments and historical/philosophical reflection.

The department's research has its main focus on the 20th and 21st century scientific development and includes for example studies of experimental mathematics, computer simulation in climate science, collaboration in interdisciplinary research groups, news coverage of new scientific fields or the exploration of Greenland during the Cold War. Part of the department's research concentrates on larger projects with associated PhD students and postdocs. The department has, for example, with support from the Carlsberg Foundation conducted a major research project on science in Denmark; this laid the foundation for the award-winning multi-volume work *Dansk Naturvidenskabs Historie.*

An important part of the department's work, through tailor-made courses in all fields of study, is to enable future graduates from science and technical schoolings to be in a position to reflect on their own subject's uniqueness, its development and its social function in a systematic and efficient way. Moreover, the department provides a wide range of specialised courses such as courses in history of methematics which are designed for teaching in high schools, courses in research communication in which graduate students receive training in communicating their expertise to various groups of recipients, or courses for future researchers on good scientific practice and the research system's many facets. The department also offers a master programme in science studies, which admits students with a BSc degree in science.



Benedikte Klærke

SMALL STEPS **TOWARDS REALISATION**

Although it is not what concerns us in everyday life, physics and astronomy also deal with where we came from and all new knowledge is a small step towards this realisation. Since Benedikte Klærke had physics in the seventh grade, she was captivated by the idea that fundamentally one can discover how the world works. It is this interest that still drives her as a PhD student.

'We go way down, as far as anyone can, it is pure basic research. Why are these molecules found in the interstellar medium and why are they important? What conditions must be met before a star or a planet can be formed?' reflects Benedikte Klærke.

'My project deals with a group of molecules that occur in car exhausts, but – and more interesting for us - also in the interstellar medium. The interstellar medium consists of gas and dust clouds that fill the space between the stars in our galaxy. The molecules are of interest for several reasons: they have long been suspected of leading to a family of absorption bands in the visible region of the electromagnetic spectrum, this has been known since the 1920's, but they have still not been ascribed to a particular family of molecules. In addition, it has been suggested that they may act as a catalyst for the formation of molecular hydrogen, which is the most common molecule in the interstellar medium.'

Benedikte Klærke's PhD project started as a continuation of her bachelor project. She had a good experience in her group, good guidance and an exciting and challenging environment where there was a ample opportunity to acquire new and useful skills as well as to work with exciting and inspiring people. Her focus lies in interstellar space, but her daily life consists of laboratory experiments:

'To identify the molecules in the spectra that astronomers measure in their observatories, it is necessary to have appropriate laboratory- absorption spectra. It is therefore important to try to restore the conditions, which are often extreme, in the interstellar medium. Among other things, the density of molecules is very low so the molecules in the laboratory must be bought into the gas phase in order to avoid interactions between them. This allows the laboratory data to be compared to the interstellar spectra. The identification of these molecules is very important, but more important is a deeper characterisation to understand the importance and function of molecules in the interstellar medium.'

Her theoretical and practical work as a researcher has also clarified her mind with regard to the future:

'For those who have the desire, there are jobs as a scientist in the future, but I also want to see how what I have learned can be put into practice in either education, business or the healing system. One is well positioned, both theoretically and practically with a PhD Degree from the IFA on your CV. The degree obviously leads your thoughts to a career in academia, but the many tools that I have received can very well be used in the private sector for example. A day in the laboratory offers many technical challenges and diagnosing and troubleshooting are now second nature. Through the courses we have been offered one can learn much more than the specific subject – for example academic English, communication and project management. I have also benefited greatly from the teaching of the younger students which I am also a part of!'

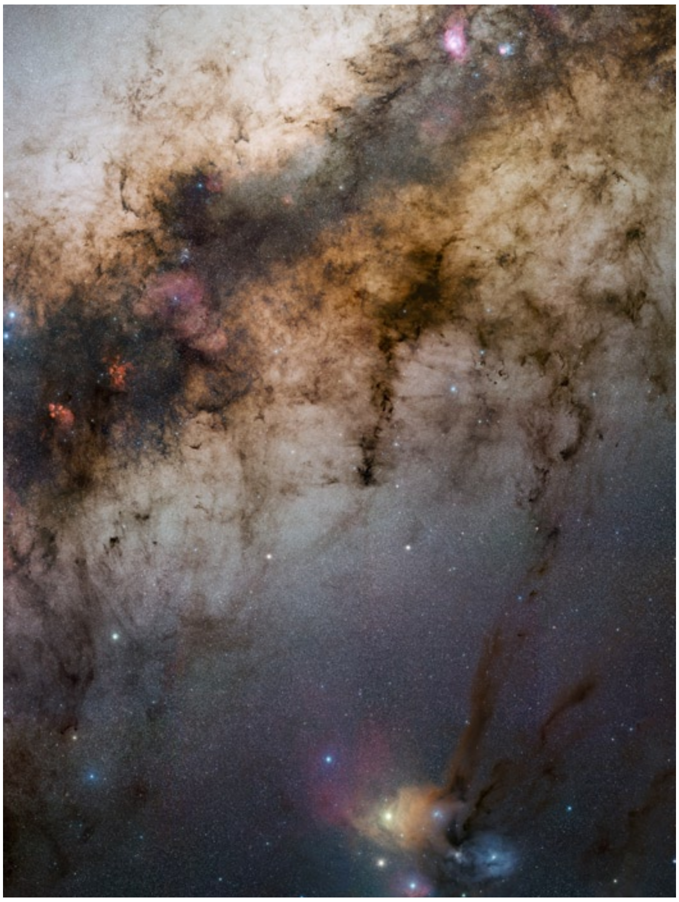


Photo: NASA

THE MILKY WAY HAS MOVED CLOSER

Detailed studies of stars and planets in the universe are achieved via observations with the most modern telescopes and space probes. At Aarhus University researchers work with both observations and calculations by computer models, and within a short time there has been a scientific revolution in data quality which has shown researchers that many of their theoretical models must be revised. But one result has really made people take note: the discovery of Kepler 22b, the first planet outside of our own solar system, where surface conditions would in principle allow life of the same kind that we know from Earth.

'We found a world where conditions on the surface are such that we in the earthly sense would survive,' says associate professor of astronomy Hans Kjeldsen. 'For a long time we have had radio antennas directed towards the planets, in case they decided to send a signal. It is very fascinating, and not silly; researchers discuss how we could communicate with intelligent civilisations! We have heard nothing from out there, but we have gone from knowing nothing to being able to measure the actual conditions. The next step is to see whether there is any biological activity. It won't happen tomorrow, but we have plenty of time'.

In March 2009, America launched the Kepler satellite whose goal it was to make very accurate measurements of the brightness of thousands of stars. The purpose of these light measurements is to reveal the existence of planets which in their orbits pass in front of their stars and shade a small portion of its luminous surface. In this way, the Kepler satellite has found a host of new planets orbiting around stars other than the Sun.

Since 2009, Aarhus astronomers through a unique collaboration with NASA, have had access to data from the Kepler satellite, and from 2012, the astronomers will use a new telescope which Aarhus University in collaboration with Copenhagen University and Instituto de Astrofisica de Canarias in Spain have developed at the Teide Observatory on Tenerife. The telescope will be operated by remote control from Aarhus University, and will in the coming years be used extensively by researchers and students to uncover new details about planets and stars.

Starquakes and asteroseismology

Since the launch of Kepler astronomers around the world have used the measurements to look for starquakes on the surface of a variety of stars that Kepler observes. By measuring the periodic light variations from starquakes, astronomers can determine which physical conditions prevail deep inside the stars through a type of exami-

Hans Kjeldsen

NEW OBSERVATORY ON TENERIFE

The geographical location and the clear, calm air at the top of Mount Teide provide the perfect conditions for an observatory. Aarhus University in collaboration with the University of Copenhagen and Instituto de Astrofisica de Canarias in Spain have established a new telescope which is to be controlled remotely from the University of Aarhus. Via webcam, one can already follow the conditions on the sunny island and online connectivity means the results from the telescope can be read back in the laboratory.

THE KEPLER SATELLITE - A VERY ACCURATE LIGHT METRE

The Kepler satellite observes, virtually uninterrupted, the same area in the sky around the constellations of Swan and Lyra, and is probably one of the American space agency, NASA's most successful missions. The mission will continue in the following years and is expected to provide new measurements until at least 2016 and maybe longer.

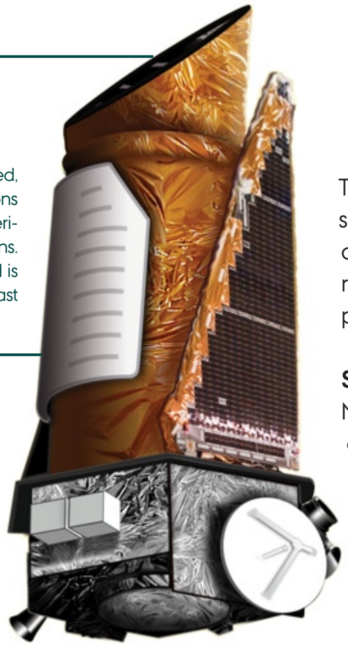


Illustration: NASA

nation which is called asteroseismology. The asteroseismic studies of Kepler's measurements are led by researchers at Aarhus University and via the Kepler Asteroseismic Science Operations Centre (KASOC) at the Department of Physics and Astronomy; the measurements from the satellite are distributed to 540 researchers at over 100 institutions in 30 countries all over the world.

In the past two years it has been possible to uncover more and more details about the internal structure and development of the stars. Kepler's measurements show us the stars in a novel way and allow for thorough investigations which before the satellite was sent up, had been impossible to achieve. Among the important findings which asteroseismology has resulted in is new knowledge about how the so-called giant stars rotate internally.

Giant stars internal rotation

When stars get old, they evolve into so-called giant stars, which can be 5 to 100 times larger than our own star the Sun, a phase our own Sun will reach in just over 5 billion years.

It has long been known that the stars rotate, but ordinary findings only indicate something about the rotation of the star's surface. Observations of Sun-quakes, analysed among other places in Aarhus, have shown that the Sun's interior rotates at roughly the same speed as the surface. But this will change once it becomes a giant star. When a star evolves into a giant star, it happens because the core collapses whilst the outer part of the star inflates itself to many times its original size. Just as an ice-skater spins faster when she wraps her arms around her body, a star's interior will also rotate faster when the core contracts.

The new results show that the inner part of giant stars rotates so fast that it manages to turn ten times while the surface only rotates once. This is an example of how scientists' theories and calculations can be observed in practice with Kepler's unique measurements.

Starquakes and planets

Measurements of starquakes not only provides information on rotation inside the star. Researchers also measure how big the star's diameter is, what its mass is, and not least how old the star is. By combining Kepler's measurements of the new planets with information from starquakes and asteroseismology, astronomers can build a more complete picture of the new planetary systems and their properties. It is for example possible to calculate what the conditions are on the surface of the detected planets.

The future – is there any life out there?

In the coming years, astronomers will find many more planets and many of the newly discovered planets will be subjected to detailed studies, where one hopes to reveal the precise conditions of the surfaces and determine the properties of the atmosphere that surrounds most of the planets one finds.

Associate Professor Hans Kjeldsen concludes that with the new measurements we are facing completely new insights:

'The question of whether there are other worlds out there has been open for a few thousand years since the Greek Epicurus first expressed it. But there has never been a device that has been able to answer it. The Kepler satellite is the first man-made device that can find the places we need to investigate further in order to answer these fundamental questions: are there places that are habitable, and are they inhabited? '

Astronomers hope to find out which planets contain water and which planets have oxygen in their atmosphere. This will give the first indications of whether there could be biological processes on the planets. All these studies take place in a large international collaboration involving researchers and students from Aarhus University. Perhaps it will be one of the PhD students from the Aarhus group who will be the first in the world to find signs of extra-terrestrial life?

KEPLER-22B - THE FIRST PLACE THAT ALLOWS LIFE

Not long after the news about Keplers first planet, NASA – in collaboration with Aarhus researchers – revealed the discovery of the first planet outside of our own solar system, where surface conditions would in principle allow the kind of life we know from Earth. The planet - called Kepler-22b – orbits its parent star in 290 days, which is almost as long as it takes the Earth to orbit once around the Sun. The planet's surface temperature is calculated to be close to the Earth's surface temperature. The planet's diameter is slightly more than twice as large as the Earth's diameter, but the planet's precise mass is as yet unknown and therefore it is uncertain which atmosphere and surface is found on Kepler 22b. Within a few years, astronomers expect that Kepler's measurements will reveal the existence of planets the same size as Earth and with orbits the same length of Earth's orbit around the sun. The distance to Earth is 620 light years.

ANTIMATTER - **THE EVIL TWIN**

One of the biggest unanswered questions in physics is a deceptively simple one: "Why are we here?" The so-called "Big-Bang" theory of the origin of the universe holds that the universe flashed into existence in a burst of pure energy. Some of the energy (E) subsequently converted to mass (m) according to Einstein's famous equation $E = mc^2$, where c denotes the speed of light.

This leaves us with a paradox. When we use energy to create a particle of matter in the laboratory - this is, after all, the business of a particle accelerator laboratory like CERN - we always end up with a particle of *antimatter* as well. Antimatter is a kind of evil twin to normal matter. For each of the types of particles (electrons, protons, and neutrons) that make up the atoms and molecules in our world, there exists a corresponding type of *antiparticle*, which has the same mass but opposite charge. Matter and antimatter don't mix well - if an electron meets its antimatter counterpart, the *positron*, they annihilate in a burst of energy. Thus, a universe with equal amounts of matter and antimatter is not a stable situation. So why is there a universe at all, if some of the original energy converted to equal amounts of matter and antimatter? As far as we can observe today, the universe seems to contain only "normal" matter. What happened to the antimatter?

The mystery surrounding antimatter motivates an Aarhus-led experiment at the European Laboratory for Particle Physics, CERN, in Switzerland. The ALPHA (Antihydrogen Laser Physics Apparatus) experiment works with the simplest atom of antimatter, *antihydrogen*. Antihydrogen, the evil twin of Niels Bohr's hydrogen atom, consists of an *antiproton* and a positron. The antiprotons must be created in high-energy collisions using the CERN particle accelerators. Aarhus scientists have been pioneers in the study of antimatter since 2002, when our earlier experiment at CERN, called ATHENA, showed that it was possible to create atoms of antihydrogen in numbers sufficient to study them.

The question behind ALPHA's research is very simple: "Do matter and antimatter obey the same laws of physics?" Our current theory - the so-called Standard Model of particle and interactions - predicts *symmetry* between antimatter and matter; for example, nothing seems to prevent the existence of a universe that is made entirely of antimatter instead of matter. Yet our universe is made of matter; it's as if Nature took an abrupt right turn instead of a left turn, during the evolution of the universe, and we don't understand why. There are several ways to approach this quandary. One way is to look at high energy particle collisions in the giant Large Hadron Collider (LHC) machine at CERN. Perhaps there are new, as yet unobserved, physical phenomena at energies that we haven't been able to produce until now.

ALPHA's approach is very different. Here the structure of the antihydrogen atom is studied, so that it can be compared with the struture of hydrogen. The Standard Model predicts that they must behave identically - for example, they must absorb and emit the exact same colour (or frequency) of light. This comparison is very compelling, because physicists understand hydrogen very, very well. The hydrogen atom was the original test case for the development of the modern quantum theory, and experimentalists have been studying its spectrum for more than 100 years. Using stabilized lasers, the Nobel laureate Ted Hänsch can measure the frequency of a spectral line in hydrogen with a precision of a few parts in 10^{15}. The ultimate goal of the ALPHA collaboration is to make similarly precise measurements on antihydrogen. The idea is to see if some small difference between matter and antimatter might show up in these ultra-precise measurements. ALPHA is an international collaboration of about 40 scientists and students from 16 institutes in seven countries, and it has operated at CERN since 2006.

ALPHA is now the world leader in antihydrogen research and has been extensively covered by the world press. In recent years, the collaboration has demonstrated how to magnetically trap atoms of antihydrogen (2010) and store them for up to 1000 seconds (2011), and it has made the first ever measurement on the antihydrogen spectrum (2012). Antimatter is serious science - not just the stuff of science fiction tales like *Star Trek or Angels and Demons* - although the latter was actually inspired by our work!

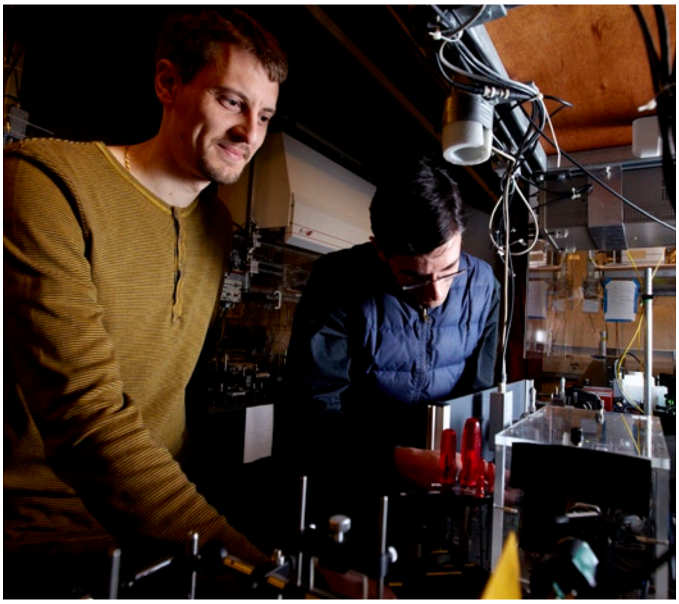
Jeffrey Hangst. Photo: CERN

A REAL BREAKTHROUGH

The physicist Jeffrey Hangst from Aarhus University, together with an international team of researchers from CERN has taken another giant step towards solving the riddle of antimatter – and thus the universe. The international research team led by Jeffrey Hangst created a sensation in 2002 by being the first research team to generate antimatter in the form of antihydrogen. In 2010 the team managed to capture and restrain the antihydrogen atoms for1000 seconds before they were annihilated by contact with ordinary matter. And now it is finally possible to perform measurements on the trapped antihydrogen atoms. Finally, because the whole purpose of creating and maintaining the antiatom was to be able to measure it and thereby study its properties compared to ordinary hydrogen. *"This is the greatest achievement in my career. This is what all the other results have prepared the ground for. They were the technical steps that were necessary for us to reach this one. One often hears about breakthrough results, and this is an important one of that type, this is a real breakthrough."*

EDUCATION AT IFA

Education is one of the department's main tasks. The Department provides Bachelor's, Master's and PhD degree programmes. Almost everyone who takes a Bachelor's degree in physics, continues on to a Master's degree programme, the majority at IFA. At IFA about 30 students yearly are awarded a Master's degree and about 10 earn a PhD degree.



Teaching at all levels is research based and the course offerings in the latter parts of the programme reflect the Department's research activities. The students perform independent research at a scientific level during their master degree thesis study and especially during the PhD programme, which is actually a research scientist education. Employment opportunities for MSc graduates and PhDs educated at IFA are numerous and very good.

Structure

The students are admitted from upper-secondary schools for the three-year Bachelor's degree. The Master's degree is obtained by the subsequent completion of the two-year graduate programme. The four-year PhD programme builds on the first year of the MSc. Alternatively, one can be accepted after completion of the Master's degree, in which case the PhD programme is three years.

Courses

IFA accommodates a Bachelor's degree programme in physics and three Master's programmes degrees: Physics, Astronomy and Science studies. A Bachelor's degree in physics also gives access to the technical Master's degree programme Optics and Electronics, which is partly studied at IFA.

Contents

On the **bachelor level**, the principal subjects of classical as well as the modern physics are studied. Content is international standard. A solid foundation in mathematics is built up and the student is introduced to solving physical problems through computer modelling and simulations. A considerable amount of laboratory work is included, as well as experimental and theoretical projects and philosophy of science. The student can customise and thereby influence their programme significantly.

The Master's programmes are individually planned two-year programmes. One can choose among a wide range of advanced courses, and the ratio between range and scope is guided extensively by the individual student's needs and interests. The thesis study, which represents the completion of the MSc programme, has a duration of six months to a full academic year. It is an independent experimental or theoretical study of one or more academic issues, and it is carried out under individual supervision. The aim of the thesis is to prepare the student to be able to plan, implement and report an investigation on a scientific level.

While enrolled in a Master's programme, students have the opportunity to apply for admission to the **PhD degree programme**. Admission usually takes place before the Master's degree thesis begins as the goals of the thesis are achieved during the PhD study programme. The beginning of this research training consists of a series of courses and the start of a research project. This project, which is the PhD programmes key element, may be theoretical and/or experimental.

Employment and career

There are extremely good business opportunities for MSc graduates and PhDs from IFA. There is virtually no unemployment. Physicists and astronomers find jobs in teaching for example at secondary schools, within research – both basic and applied research – where the latter is on an equal footing with civil engineers in private industry and hospitals.

DEPARTMENT OF PHYSICS AND ASTRONOMY
Aarhus University
Ny Munkegade 120
DK-8000 Aarhus C

E-mail: phys@au.dk
Phone: 8715 0000
Fax: 8612 0740

www.phys.au.dk

Department of Physics and Astronomy in numbers (2012):

- 14 professors og 35 associate professors and other researchers
- 46 postdocs
- 64 PhD-students + 24 iNANO-PhD-students
- 48 technical-administrative employees
- 125 enroll in the Bachelor programme
- 4 different Master's degree programmes
- 35 MSc graduates in 2011
- Ca. 300 publications

Research subjects:

- Accelerator mass spectrometry
- Astrophysics and cosmology
- Atomic- molecular- and optical physics
- Biophysics
- CERN-related physics
- Solid-state- and materials physics
- Subatomic physics
- Nano physics
- Surface physics
- Statistical physics
- Science studies

Research centers attached to the Department:

- AMS 14C Dating Centre
- CVS – Centre for Science Studies
- The Danish Mars Project
- DCSC – Danish Center for Scientific Computing
- iNANO – Interdisciplinary Nanoscience Center
- ISA – Institute for Storage Ring Facilities
- LTC – The Lundbeck Foundation Theoretical Center
- NICE – National Instrument center for CERN Experiments
- SAC – Stellar Astrophysics Centre