The state-of-the art synchrotron light source, ASTRID2, will be used for research within medicine, molecular and cell biology, nanotechnology, new materials and atomic and molecular physics. This world class infrastructure will provide near laser-like beam quality, with tuneable wavelengths from the ultraviolet to the X-ray.

ASTRID2: the new Danish light source

The long-standing accelerator expertise at Aarhus University has meant that all aspects of the brilliant new light source, ASTRID2, have been designed and constructed by the staff of the Department of Physics and Astronomy. Likewise the complex and challenging task to build novel experimental instrumentation for beam lines and experimental stations is being met locally.

International Research

Synchrotron radiation is one of the best tools of today for investigating and understanding nature at the microscopic level. The brilliance of the light from ASTRID2 will allow new science to be performed in which we can, for example, examine drug action; probe new means of fabricating electronics and examine the properties of exotic metals, nanowires and biological molecules. The facility serves a wide community of scientists from both Denmark and internationally, acting as a powerful catalyst for EU and worldwide collaboration.

Design Technology

The main advantages of synchrotron radiation from a storage ring as a flash of radiation with only 9.5 ns between each flash of light, so fast that to the human eye the light emitted appears to be constant.

The electromagnetic spectrum is the entire range of wavelengths (or frequencies) of electromagnetic radiation, from the longest radio waves used, for example, for telecommunication, to gamma rays which are used in positron emission tomography (PET) and cancer radiation therapy. Visible light is only a small part of the spectrum.

Development of the ASTRID2 machine is based on technological innovations and forms a solid basis for Denmark’s knowledge and knowhow in advanced accelerators, especially relevant for particle beam cancer therapy.

Funding

- 37 Mkr The National Programme for Research Infrastructures, the Danish Agency for Science, Technology and Innovation.
- 10 Mkr The Lundbeck Foundation, The Carlsberg Foundation.
- 12 Mkr Financing from Aarhus University.
- 20 Mkr Building work, Aarhus University.
- ~100 Mkr The existing ASTRID accelerator.

History

1928: Aarhus University founded.
1933: The first Physics Department opens at Aarhus University.
1938: First large accelerator is built, the “high voltage platform”.
1974: Physics Department moves into the current buildings.
1991: Inauguration of the ASTRID accelerator.
2009-2013: ASTRID2 is built; inauguration in 2012.

Beam lines

The instrumentation required to guide photons from the synchrotron storage ring to an experimental station is called a beam line. Typically consisting of mirrors and a grating so that a specific energy of photons can be selected, a beam line focuses the light onto or through a sample under investigation.

The Electromagnetic Spectrum

The Electromagnetic Spectrum consists of all forms of electromagnetic radiation. These include radio waves, microwaves, infrared radiation, visible light, ultra violet light, X-rays, and gamma rays. Each form of electromagnetic radiation is a different wavelength or frequency, and these wavelengths and frequencies are ordered by increasing energy.

The region of the electromagnetic spectrum detected by the human eye is called visible light. Visible light is only a small part of the spectrum.

The polarisation of the radiation emitted from a bending magnet is linear in the plane of the electron orbit. Above and below the plane the radiation is elliptically polarised. The degree of polarisation is dependent on both the viewing angle and the wavelength of the radiation.

Brightness of synchrotron radiation from ASTRID2

Conventional sources such as incandescent bulbs or neon lights produce polychromatic light that means the light is made of many different wavelengths. The result is that the light is only dimly recognizable as a flash of radiation with only 9.5 ns between each flash of light, so fast that to the human eye the light emitted appears to be constant.

The main advantages of synchrotron radiation from a storage ring as a flash of radiation with only 9.5 ns between each flash of light, so fast that to the human eye the light emitted appears to be constant.