

Space-related Education on the Kiruna Space Campus, Sweden

The town of Kiruna lies approximately 140 kilometres above the Arctic Circle in northern Sweden. The high latitude makes Kiruna an attractive base for international space-related projects of many kinds. A space research institute was first created in Kiruna in the 1950's. During the last decade, there has been a rapid expansion in the area of space-related education at university level, which has its foundations on the local expertise in space science and engineering. Through cooperation with the Swedish Space Corporation students in Kiruna are offered the opportunity to participate in rocket and balloon launches as part of their education.

The two most northern universities in Sweden, Luleå University of Technology and Umeå University have formed a joint Department of Space Science located on the Kiruna Space Campus together with the Swedish Institute of Space Physics. The department is responsible for programmes covering a wide spectrum, practically oriented and more theoretical, leading to degrees in Space Engineering. In addition it runs space-related summer courses. Key features in the department's educational activities are close contact between research and education, hands-on experience and international co-operation. In addition the Swedish National Graduate School in Space Technology, hosted by Luleå University of Technology is located on the Kiruna Space Campus. The most recent development regarding space education on the campus has been the award by the European Commission of funding for an Erasmus Mundus Master Course, which is a cooperative project between Luleå University of Technology and five other European universities. The course will take two years for students to complete, following the guidelines of the Bologna process. It is expected that about 100 students, from Sweden and abroad, will take the programme and all of the students participating will spend time taking courses in Kiruna at the Department of Space Science.

Space research and industry

The largest research organization in Kiruna is the Swedish Institute of Space Physics, which carries out research in experimental space and atmospheric physics. Measurements are made from the ground, with balloons, and from satellites. Probably the most well-known space centre in Kiruna is Esrange, a space facility belonging to the Swedish Space Corporation. Esrange has its own satellite station, and facilities for launching sounding rockets and stratospheric balloons. Close to Esrange is the European Space Agency satellite station at Salmijärvi. The headquarters of the European Incoherent Scatter Scientific Association (EISCAT) are located

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*Swedish Institute of Space
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Picture: IRF*



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She is also the International Space University contact person in Kiruna.

in Kiruna. EISCAT is an international scientific association using radars to conduct research on the middle and upper atmosphere, the ionosphere, the aurora and meteors.

Space education in Kiruna

For many years students have been carrying out their PhD studies in space physics at the Swedish Institute of Space Physics in Kiruna. More recently the Swedish National Graduate School in Space Technology, hosted by Luleå University of Technology has been established on the Kiruna Space Campus. Space-related education has also been extended to the undergraduate level and there is currently a three-year undergraduate programme in Space Engineering run in its entirety in Kiruna by the University of Umeå in collaboration with the Swedish Institute of Space Physics. The three-year



*Bengt Hultqvist
Observatory photographed
by Jörgen Hedin.*

Space Engineering Programme leads to a Bachelor's degree in space engineering. An indication of the quality of the programmes is given by the fact that graduating students have been successful in obtaining jobs in the space and electronics industries in Sweden and abroad. In 1999 a fourth year was added to the existing three-year programme giving students the possibility to study to the level of a Masters degree. This fourth year can also act as a stepping stone for those who would like to continue on to read for a PhD in space engineering. The fourth year was initially aimed at Swedish-speaking students however international students are now invited to participate and the courses are run in English. In addition Luleå University of Technology runs an education leading to a Master's degree in Space Engineering. This education takes four and a half years to complete and students take courses both in Luleå on the university's main campus and in Kiruna.

On an international level, the Swedish Institute of Space Physics is an affiliate campus of the International Space University, which has its headquarters in Strasbourg. Students from Kiruna have

been active participants in the International Space University summer sessions in recent years. Umeå University has run an international 3-week summer course in Space Science and Technology for 2 years and will expand its summer programme this year with a new 3-week course in Manned Space Flight. These courses are currently free of tuition charges for all students attending, as is the case in fact with all of the programmes described in this paper. Earlier this year the European Commission awarded funding for an Erasmus Mundus Master Course, SpaceMaster, which is a cooperative project between the Luleå University of Technology and five other European universities. The course, which starts in the autumn of this year, will take two years for students to complete, following the guidelines of the Bologna process. It is expected that about 100 students, from Sweden and abroad, will enroll and all of the students participating will spend time taking courses in Kiruna at the Department of Space Science as well as at one or more of the other participating European universities.

Space education in Kiruna has now extended even down to High School level. An independent school runs a very popular 3-year high school programme specialising in space science and technology. In a joint project between this school, the local state-run High School in Kiruna and the Department of Space Science an astronomical observatory has been constructed in the vicinity of Kiruna's town centre. On 19 February 2004 the Bengt Hultqvist Observatory, as it is called, was inaugurated and is now used by both high school pupils and university students. The observatory is shown in figure 1.

Collaborative projects

There is a unique relationship between the Department of Space Science and the local centres of space expertise in Kiruna which has given students studying on the campus the opportunity to participate in space projects during their studies. Students have the possibility to participate in REXUS (Rocket EXperiment for University Students) rocket projects and the BEXUS (Balloon EXperiment for University Students) balloon projects in which the students build experiments that have been launched on rockets and balloons respectively from ESRANGE by the Swedish Space Corporation. They have also had the opportunity to participate in satellite projects. Students had some participation in the Munin nanosatellite, a satellite built at the Swedish Institute of Space Physics which was launched in 2000 into a polar Earth-orbit to measure plasma particles. More recently students have participated in the European Space Agency SSETI project to build a satellite.