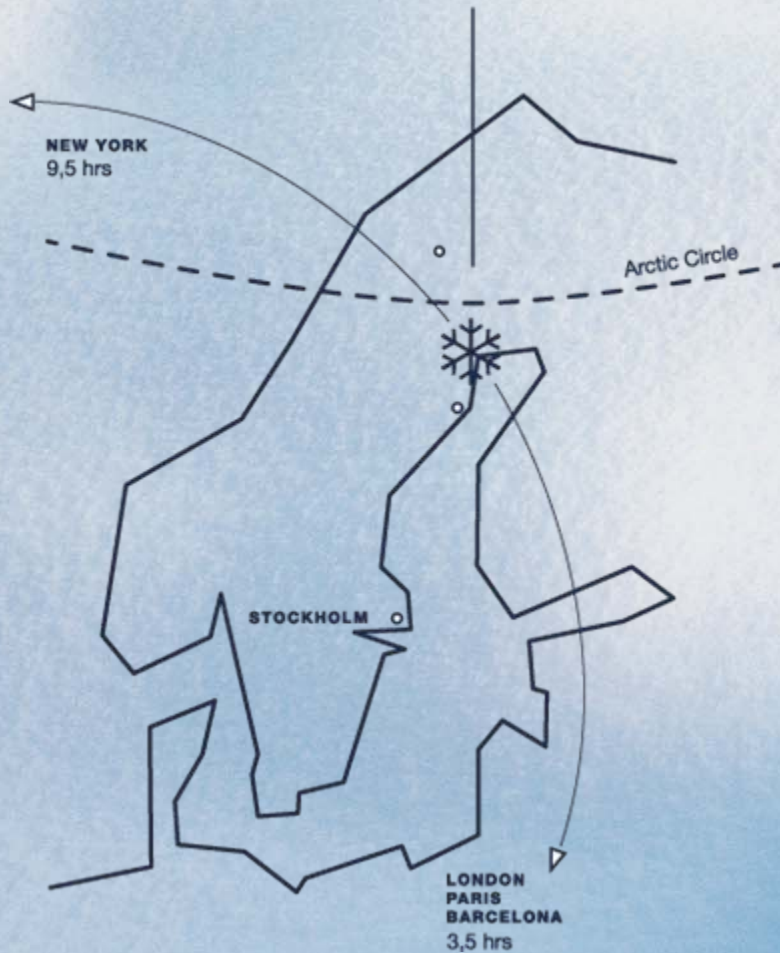


Luleå University of Technology



- Personnel:
1,400
- Students:
12,200
- Turnover:
EUR 106
million

Students 12,200

•MSc in engineering	2 400
•BSc in engineering	300
•Other programmes in engineering	500
•Business administration, economics and •social sciences	1 400
•Health sciences	1 200
•Interdisciplinary educations	200
•Music, media and drama	600
•Teacher education	1 000
•Single subject courses	4 600

•(about 600 exchange students are included in the total amount of students)

Programmes 09/10

Engineering – MSc programmes

- Architectural engineering
- Civil engineering
- Computer science and engineering
- Engineering physics and electrical engineering
- Industrial and management engineering
- Industrial design engineering
- Materials science and engineering
- Mechanical engineering
- Natural resources engineering
- Space engineering
- Sustainable energy engineering
- Sustainable process engineering
- Engineering (common entrance)

LULEÅ UNIVERSITY OF TECHNOLOGY

Department of Space Science = IRV



The northernmost University of Technology in Scandinavia
World-class research and education



Space activity in Kiruna

- Department of Space Science, IRV
- Swedish Institute of Space Physics, IRF
- Esrange, sounding rocket and balloonbase
- EISCAT, incoherent scattering radar
- ESA Salmijärvi satellite station



IRV

- IRV is a small department with about 20 persons
- Founded in Kiruna about 18 years ago



Educations at IRV

Civil engineering program in space technology 5 year,
2.5 year in Luleå
+ 2.5 year at IRV in Kiruna

Space Master Erasmus Mundus, 2 year,
LTU, Würzburg, Cranfield, Helsinki,
Paul Sabatier, Prague.

Doctoral studies, space physics,
space technology, and atmospheric
physics. LTU-IRF research school.



Why educations at IRV in Kiruna?

1. Space Environment, many space actors in Kiruna
2. Connect actors to our students at IRV
3. Guest lecturers, Degree projects, and EXUS, REXUS and BEXUS

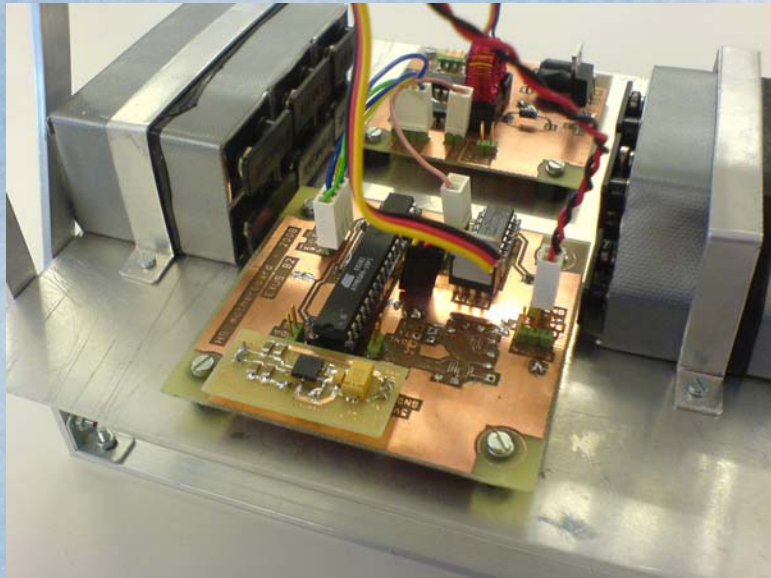


Above: smoke
trace after
REXUS 3 winter
2006

Student projects

'Hands-on experience'

- REXUS: Rocket Experiments for University Students
- BEXUS: Balloon Experiments for University Students
- Eurolaunch: Swedish Space Board and DLR in cooperation with ESA och SSC Esrange
- Our own balloons EXUS



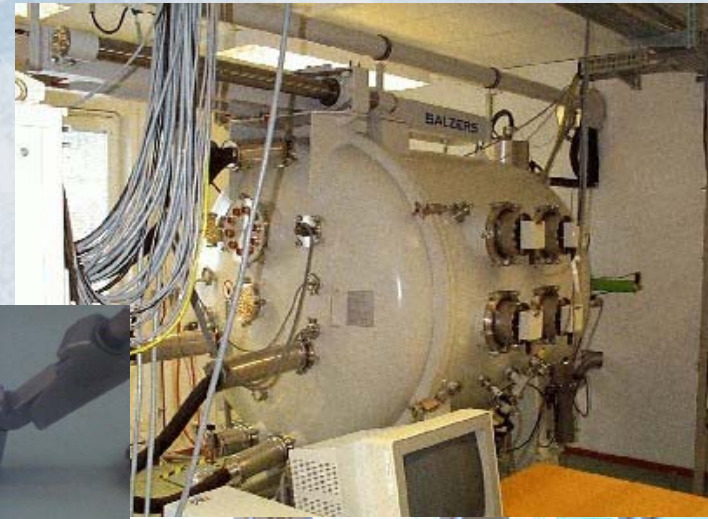
Student projects "Hands-on"

Our rooms support
student projects

Left: project lab,
Below: EXUS project room



Access to equipment



Here our students test their constructions in IRF's vacuum chamber.

Left: Our shaker equipment.



Structure of SpaceMaster

- Two years research-oriented Master course following the **Bologna concept**
- All teaching and textbooks in English (except at UPS during the second year where there will be a mixture of most French and some English)
- Double Master's Degrees from **two** European countries
- The first year is common for all students, starting in Würzburg and continuing in Kiruna
- 5 engineering and 3 science tracks during the second year

Erasmus Mundus Master Course in Space Science and Technology – SpaceMaster 120 ECTS



2005 – 2011, 2010-2016

- **Luleå University of Technology, Department of Space Science**
(Space Technology and Instrumentation, Atmospheric and Space Science)
- **Cranfield University, UK** (Dynamics and Control of Systems and Structures)
- **Czech Technical University, Prague, Czech Republic** (Space Automation and Control)
- **Aalto University, School of Science and Technology, Finland**
(Space Robotics and Automation)
- **Julius-Maximilian Universität Würzburg, Germany**
(Automation, Control and Communication of Space Robotics)
- **Université Paul Sabatier Toulouse, France**
(Space Technique and Instrumentation, Astrophysics, Space Science, Planetology)
- **The university of Tokyo, Graduate School of Science, Japan** (Earth and Planetary Science)
- **Utah State University, USA** (Mechanical and Aerospace Engineering)

**Master of Science and Technology with a
Major in Space Technology, 120 ECTS
Double MSc Degree**

The northernmost University of Technology in Scandinavia
World-class research and education



SpaceMaster, 120 ECTS

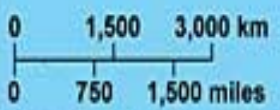
Semester 1 All students at JMUW
Core modules and optional modules in German language
30 ECTS

Semester 2 All students at LTU, Kiruna Space Campus
Core modules and optional modules in Swedish language
30 ECTS

**Semester 3 LTU- Kiruna Space Campus, JMUW, CU, CTU,
Aalto, UPS**
Core and optional modules
30 ECTS (15 ECTS – CU)

**Semester 4 LTU- Kiruna Space Campus, JMUW, CU, CTU,
Aalto, UPS, USU, UT**
Work on the Master Thesis
30 ECTS (45 ECTS – CU)

WORLD MAP



Space Master

Number of students (year 1, 2)

- Rond 1, 2005: 48(1) 39(2) 25 non-EU 14 EU 10 women
- Rond 2, 2006: 43(1) 42(2) 30 non-EU 12 EU 4 women
- Rond 3, 2007: 39(1) 33(2) 22 non-EU 11 EU 4 women
- Rond 4, 2008: 36(1) 33(2) 19 non-EU 13 EU 9 women
- Rond 5, 2009: 37(1) 36(2) 18 non-EU 18 EU 3 women

MSc Programme in Space Engineering 300 ECTS = 5 year

- 2 ½ year in Luleå: maths, physics and other basic courses
- 2 year space engineering and science courses in Kiruna, 10 – 15 students
- ½ year master degree projects, usually out in industry, space organisations, or other universities.

Courses in Kiruna 2010/2011

[F7004R Atmospheric Physics 7.5 hp](#)

[R7016R Space Flight Dynamics: Attitude Dynamics 7.5 hp](#)

[R7015R Space Flight Dynamics: Attitude Dynamics 7.5 hp](#)

[P7004R Degree Project Master in Space Technology 30.0 hp](#)

[R7012R Remote Sensing 7.5 hp](#)

[R0001R Introduction to Space Technology with Projects 7.5 hp](#)

[F7011R Climate Physics 7.5 hp](#)

[F7007R Cosmology 7.5 hp](#)

[F7002R Numerical Methods 7.5 hp](#)

[F7003R Optics and Radar Based Observational Technique 7.5 hp](#)

[F7010R Plasma Physics 7.5 hp](#)

[E7003R Space Electronics 7.5 hp](#)

[E7001R Space Electronics 7.5 hp](#)

[R7004R Spacecraft-Environment Interaction 7.5 hp](#)

[R7008R Space Vehicle Systems 7.5 hp](#)

[R7017R Space Physics 7.5 hp](#)

[R7013R Space Instruments 7.5 hp](#)

[F7001R Space Plasma Physics 7.5 hp](#)

[P7005R Space Technology Project 1 7.5 hp](#)

[P7006R Space Technology Project 2 7.5 hp](#)

[P7001R Space Technology Project II 15.0 hp](#)

[F7006R Solar Physics 7.5 hp](#)

[F7008R Solar System Physics 7.5 hp](#)

[E7002R Telecommunication Physics 7.5 hp](#)

Space Master students (in their first year master) and MSc in space engineering students (in their third year) both take the course

Spacecraft-Environment Interaction, 7.5 Credits = 5 week = 200 hours

containing an overview of space environment (neutral, plasma, particle/MMOD, and radiation)

and its interaction with the spacecraft, resulting in effects like drag, AO erosion, glow, sputtering, outgassing, contamination, charging, radiation damage, particle impacts, etc

- In the course the students shall do a 1 week practical using SPENVIS in groups of 1 or 2 students
- resulting in a written report
- that are corrected with Approved/Not Approved
- but have influence on the grade of the course for borderline cases

- The students choose an
- existing or planned s/c orbit based e.g. on TLE (two-line element) or
- an own invented orbit
- They are encouraged to choose an **interesting** orbit

Example of chosen satellites 2010:

- Chandra X-ray Observatory
a = 80787.981 km e = 0.801707 i = 28.4678°
- ESA Proba-2
a = 7096.95 km e = 0.00139 i = 98.31°
- ISS
n = 16.0506 rev/day e = 0.012536 i = 51.5908°
- Soyuz TMA
a = 6718.7 km e = 0.000009 i = 51.6373°
- Molnyia-1
p/a alt = 500 km / 40000 km i = 63.4°
- TOPEX/Poseidon
p/a alt = 1332 / 1342 km i = 66.04°

- ENVISAT
p/a alt = 780 km / 820 km i = 98.55°
- MetOp
n = 14.215 rev/day e=0.0001217 i = 98.7°
- RADCAL
p/a alt = 758 km / 887 km i = 89.52°
- Own invented Molniya
p/a alt = 600km / 40000 km i = 63.4°
- MOST
p/a alt = 826 km / 840 km i = 98.72°
- RADARSAT-I
p/a alt = 793 km / 821 km i = 98.58°
- STRV-1b (picosat.)
p/a alt = 300 km / 36 000 km i = 7.4°

Tasks for SPENVIS practical

- Choose orbit!
- Describe the mission!
- Characterize the environment the s/c is expected to meet in its various phases and estimate its importance for the s/c!
- Verify the above with data from SPENVIS!
Usually illustrated with diagrams from SPENVIS.

- Study specifically effects of the radiation environment:
- 1 How thick must a cover glass of a solar array be in order for 1 MeV electron equivalent fluence not to exceed a certain predefined value?
- 2 If a box contains a silicon device that can take 1.0 Mrad before it stops working, how thick must the wall of the box be?
- 3 What will the Single Event Upset rate be for four different memory chips? For three of them, the cross section is described by a Weibull function, where parameter values are given. For the fourth, experimental values are given when different monoenergetic ions are radiated towards the device. From that the parameters of the Weibull function are to be determined.

Experimental values:

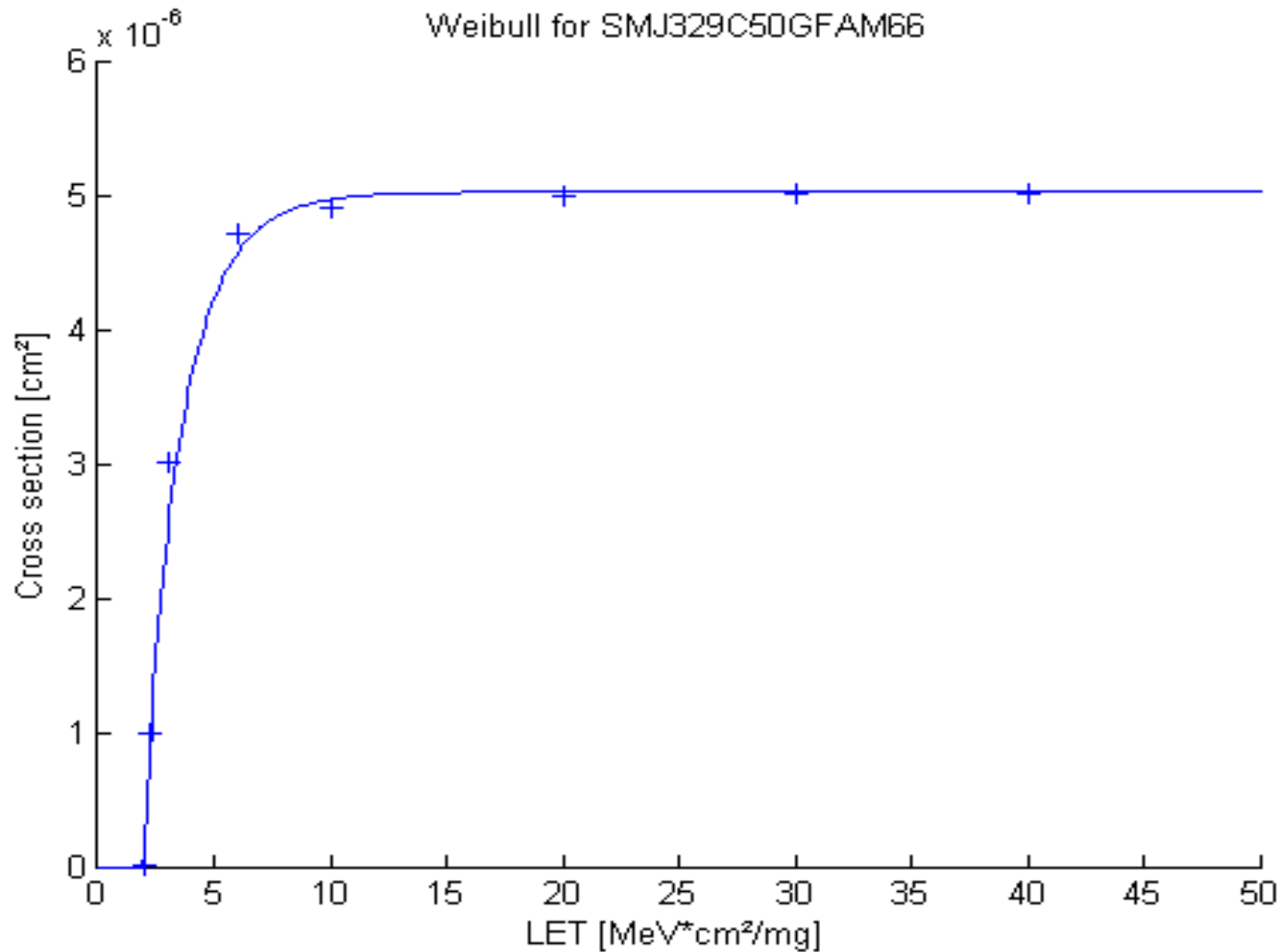
Ion	Energy of Beam [MeV]	Flux of particles [cm-2s-1]	Exposure Time [minutes]	Number of Flips
C-12	0.60	$25 \cdot 10^6$	5	8
C-12	0.72	$25 \cdot 10^6$	5	7497
C-12	9.6	$25 \cdot 10^6$	5	22514
O-16	4.8	$17 \cdot 10^6$	5	23986
Ar-40	20	$23 \cdot 10^6$	5	33810
Fe-56	56	$10 \cdot 10^6$	10	29991
Kr-84	84	$7 \cdot 10^6$	10	21022
Xe-131	786	$4 \cdot 10^6$	15	18043

Weibull function

$$\sigma(L) = 0 \quad , \quad L < L_0$$

$$\sigma(L) = C_s \left(1 - e^{-\left(\frac{L-L_0}{W}\right)^s} \right) , \quad L \geq L_0$$

should result in something like this:



having obtained the Heinrich flux from SPENVIS they finally shall obtain the SEU by integrating (MATLAB):

$$\frac{dU}{dt} = \int_0^{2\pi} \int_0^{\pi} \sin \theta \int_0^{\infty} \sigma(LET, \theta, \phi) \cdot \sum_{Z=1}^{92} h(LET) d(LET) d\theta d\phi$$

Experience of using SPENVIS as a pedagogical tool:

- Encourage *independent* seeking of information
- *Visualization* facilitates understanding, especially of 3-dim objects
- Students *motivated* by usage of "sharp" program used by space engineering community
- Suitable for students with different *backgrounds*
- *Speeds up learning*

Our home page:
www.ltu.se/irv

www.irf.se

www.ssc.se

Välkommen till Institutionen för Rymdvetenskap - SeaMonkey

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http://www.ltu.se/inst/irv

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Cookies | Anpassa | Lyssna | In English

LULEÅ TEKNISKA UNIVERSITET

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Ange söktext: Sökord Sök

Fler sökalternativ

Aktuellt

- Ny tjänst Lektorat/Professor i rymdteknik med inriktning mot elektronik, 28 feb.
- 2 Doktorandtjänster i atmosfärsvetenskap, 28 feb
- Astronomdagarna i Kiruna 21-23 sept, 2007.

Utbildning

- Ny kandidat rymdteknik startar hösten 2007
- Erasmus Mundus Space Master. Ett tvåårigt program tillsammans med 5 andra universitet.
- Magisterprogrammet i rymdteknik. Ett ettårigt program
- Civilingenjör Rymdteknik 300 Högskolepoäng. Studera i både Luleå och Kiruna.
- Studentprojekt REXUS BEXUS
- Examensjobb
- Dokument, schema och tentaperioder i Kiruna

Våra studenter berättar

- Civilingenjör i rymdteknik. Sofia Larson om sina studier
- I hjärtat av Europas rymdelit. Alexander Storm om sina studier

Forskning

- IRV SAT grupp

Rymdvetenskap

Välkommen till Institutionen för Rymdvetenskap

Ny utbildning se länk till vänster.

Institutionen för Rymdvetenskap bedriver utbildning och forskning inom områdena rymd och atmosfärsvetenskap.

Våra utbildningar, som ger grundläggande och fördjupade kunskaper i rymdteknik, satellitinstrument, rymdfysik, och atmosfärfysik, erbjuds både på Bachelor, Master, och PhD nivå.

En central del i våra grundutbildningar utgörs av instrumentprojekt där fysik och elektronikkunskaper sammanförs till en syntes i ett flygande experiment.

I ett ansökningsförfarande till rymdstyrelsen bedöms era projekt i konkurrens med andra universitets student projekt och kan eventuellt beredas plats på en flygning.

Forskningen fokuseras på användning av satellitinstrument för att studera jordens atmosfär.

Följ länkarna till vänster om du vill veta mer.

Relaterade länkar

- IRVs gamla Hemsida

Utskriftsvänlig version

Skapad av: Pierre Törnkvist 2006-12-22.
Senast ändrad: Hans Weber 2007-02-14

Studentwebben

Studentwebben. Portalen, fronter, schema, information om studiestart m.m.

Studentmedier

Studentmedier. Medier producerade av studenter vid LTU.

Alpina sektionen

Alpina sektionen. Vi kommer att ha transcieverträning 15 februari 10:30 och 14:30 i anslutning till alpinas J1B-session utanför B-huset.

Skidguide

Skidguide. Vi drar till fjällen. Möjligheterna till skidåkning är många vid LTU.

Studentidrotten

Stil. Studentidrotten i Luleå är en förening öppen för alla.

