



ACADEMIA AND INDUSTRY COLLABORATION AS A DRIVER FOR COMPETITIVENESS

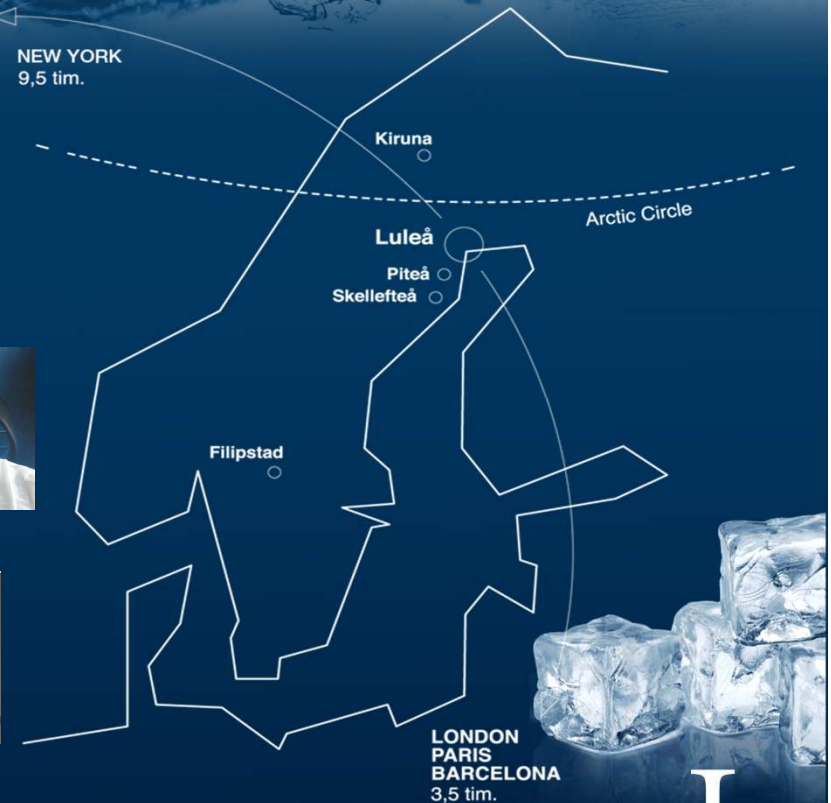
- THE CASE OF THE GRADUATE SCHOOL OF SPACE TECHNOLOGY

Marta-Lena Antti*, Anna Öhrwall Rönnbäck, Olle Norberg, Jonas Ekman
Luleå University of Technology (LTU)

**Coordinator Graduate School of Space Technology*

**Professor Engineering Materials*

- Started 2001.
- Round 3 started 2015, 18 PhD-students.
- Industry related and fundamental science projects.



LULEÅ
TEKNISKA
UNIVERSITET

GRADUATE SCHOOL OF SPACE TECHNOLOGY

42 PhDs, since start 2001!

- Collaboration industry/academy within research and innovation.
- Knowledge transfer.
- Cross-disciplinary.
- Networking.
- Industry new employees with PhD degree and an academic network.





ROUND 3:
6 RESEARCH SUBJECTS AT LTU. →
8 WOMEN, 11 MEN.
8 NATIONALITIES.

Throughput:

Round 1: 33 started. 27 PhDs.

Round 2: 15 started. 13 PhDs.

Round 3: 19 started. X PhDs (3 so far...).

Publications:

Round 1 + 2: > 250.

Round 3: 48 journal papers and 37 conference papers so far.

- Onboard Space Systems
- Atmospheric Science
- Engineering Materials
- Applied Physics
- Machine Elements
- Product Innovation



BOARD WITH EXTERNAL REPRESENTATIVES

- Close collaboration with the board since the start in 2001.
- Formed curriculum.
- Decides projects enrolled in graduate school.



BOARD-MEMBERS: PRESENT (AND FORMER MEMBERS)

IRF (Institute of Space Physics): Hans Nilsson (Lars Eliasson, Sheila Kirkwood, Ingrid Sandahl)

GKN Aerospace: Patrik Johansson (Hasse Nilsson)

SSC (Swedish Space Corporation): Lennart Poromaa (Anna Rathsman, Olle Norberg)

RUAG Space: Anders Larson (Tomas Thungren, Peter Möller)

SNSA (Swedish National Space Agency): Björn Lovén (Karin Holmquist, Robert Lundin)

LTU Faculty Dean: Roland Larsson (Björn Öhlander, Jan Johansson)

Head Dept. SRT*: Jonas Ekman

PhD-student representative: Tobias Roos (Rikard Ottemark)

***Computer Science, Electrical and Space Engineering, LTU**



JOINT COURSES

- Year 1:
 - Introduction to Space Technology
 - Space Environment
 - Radiative Transfer
- Year 2:
 - Project Management with Space Focus
 - Product Innovation
- Year 3:
 - Project Course
 - Programming
 - Personal Leadership

Statistical Analysis
Radiative Transfer
Research Methodology
Climate Physics
Data analysis
Monte Carlo Radiative Transfer
Inverse Theory





Product Innovation, 7.5 hp.

Anna Öhrwall Rönnbäck and Reza Emami



- What is the difference between **Invention** and **Innovation**?
- Entrepreneurship and Intrapreneurship?
- What is the “**product**” in your research project? (instrument, hardware, software, method, model, etc).
- Who are the **users**? Who are the **customers**?
- Interview companies, visits at companies, report writing identifying the product.
- Space Innovation Forums.
Meet large space companies and SMEs.



Project course, 7.5 hp

Marta-Lena Antti



ESA: “Fly you thesis”: 2018 parabolic flight campaign. *Pressure-Volume-Temperature Gauging Method for Electric Propulsion Systems*.
Validate (in microgravity) a new method for measuring remaining propellant in Xenon tanks. Method developed in collaboration with OHB Sweden.

Cantenna Satellite and Radar Unit:

Development / testing of integrated cantenna satellite and radar unit by using software-defined radios. Radar, Satellite simulator, Satellite ranging.



WORKSHOPS

Kiruna 2018 — *Academic writing*

Onsala 2017 — *Onsala Space Observatory*
+ visits to GKN, RUAG and Omnisys

Abisko 2016 — *Abisko Scientific Research Station*

Esrang 2015 — *Kick-off for Round 3*

2012 — Brändön, Luleå

2011 — Abisko

2010 - IRF, Kiruna

2009 — Esrange

2009 — Kick-off round 2 in Trollhättan / Göteborg

2008 — ESTEC, Holland

2007 — Abisko

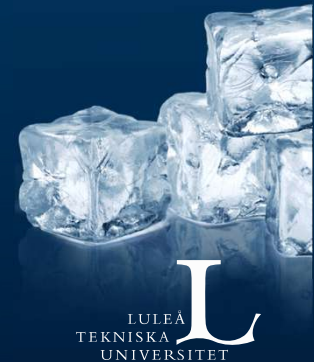
2006 - Esrange

2005 — Trollhättan (Rymdforum)

...

Rymdforums

Space Innovation Forums



SUPERVISORS

- Important role.
- Supervisors also from industry.
- PhD-students spend time at companies, meeting employees, understanding research questions.
- When enrolling new students, discussion with companies about research topics.



Rikard Slapak



Jana Mendrok



Mathis Milz



Lars-Göran Westerberg



Mattias Grahm



Javier Martin Torres



Thomas Kuhn



Maria-Paz Zorzano Mier



Jaap van de Beek



Marta-Lena Antti



Reza Emami



Anna Öhrwall Rönnbäck



Peter Törlind



Hans Nilsson



Eugenia Belova



Gabriella Stenberg



Johan Kero



Vinit Parida



Magnus Gustavsson



Ichiro Minami



Robert Person

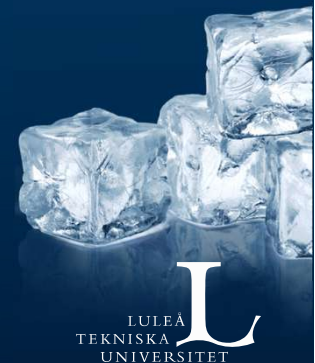


Peter Völger

FUNDING



- NRFP: National Program for Space Technology Research. Swedish National Space Agency for applied space research. Close collaboration with companies, the industrial partner send in the application.
- The RIT program, a regional space program for innovation and growth. LTU, IRF, SSC, GKN, OHB, EU regional funds, municipalities of Kiruna and Luleå, County of Norrbotten, a regional bank (Sparbanken).





INNOVATION SUPPORT

- Innovation support for PhD-students last 5 years through RIT (Space for Innovation and Growth). New innovative products / services delivered to the space sector by the PhD-projects.
- Innovation PhD-students. 8 projects, out of the 18, labelled as innovation projects.
- Product innovation course; study visits at companies, interviews, Space Innovation Forums, identifying products.
- Participating at e.g. Rymdforums, build network.
- Innovation post-docs. Could be the PhDs. Existing space companies or start-ups.



SUMMARY

- Graduate school strengthened space research and innovation in Sweden.
- Graduate school supports PhD-students.
- New types of funding.
- Board valuable.
- Increased space network created.
- Working for continuation as national graduate school.



Inauguration LTUs Centre of Excellence Space Technology, August 2018.

THANKS!

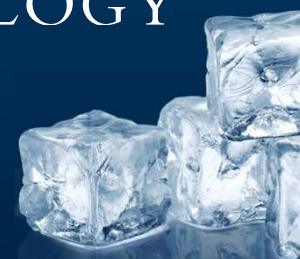
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Kiruna Space Campus



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