A Testbed for Space Systems Testing in Northern Sweden

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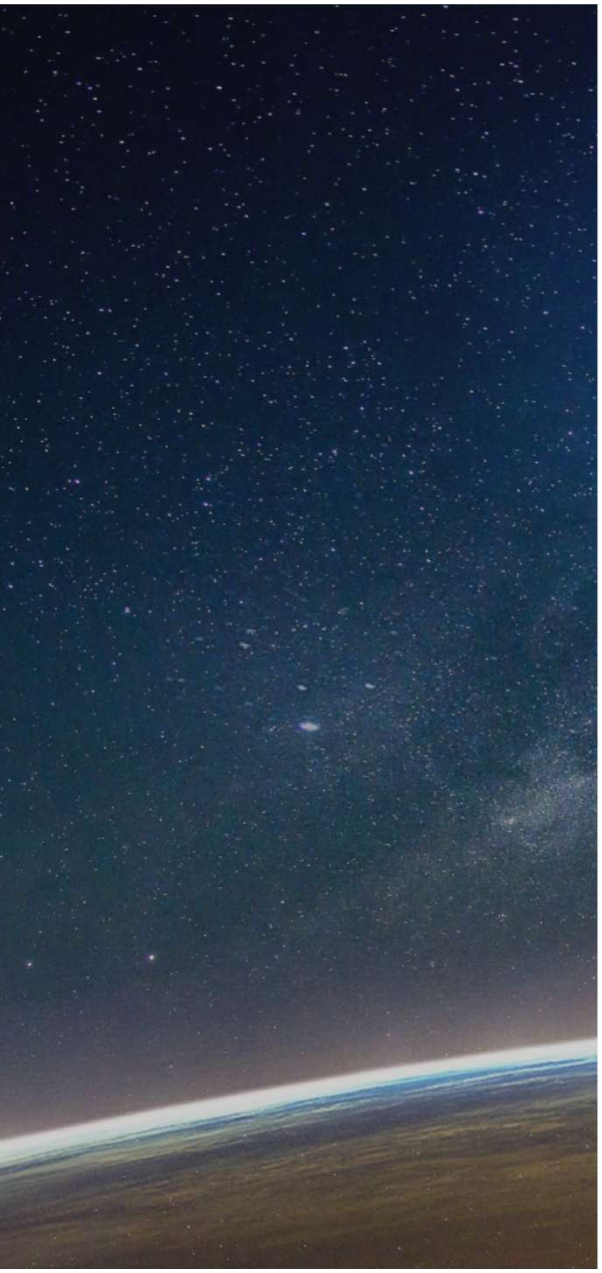

RIT 2021

Operated by

LULEÅ UNIVERSITY OF TECHNOLOGY

IRF

LTU BUSINESS AB

esa business incubation centre Sweden

ab! Arctic Business Incubator

Partners

SSC

OHB SWEDEN

GKN AEROSPACE

Sponsors

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REGION NORRBOTTEN

KIRUNA KOMMUN

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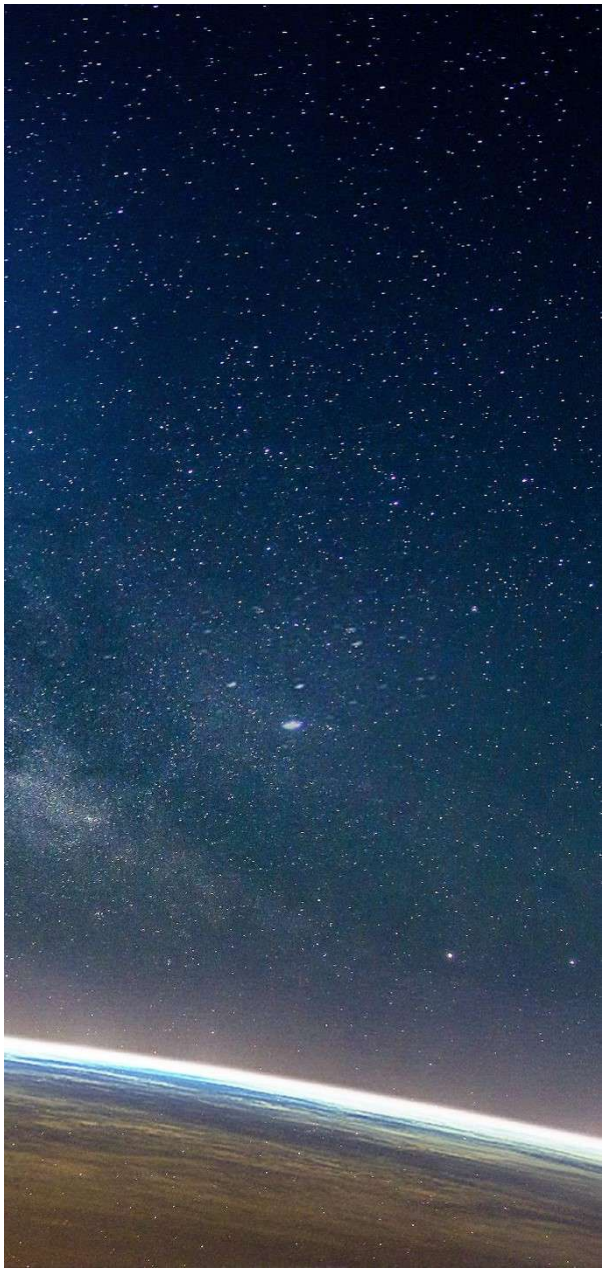

PROJECT BACKGROUND

THE GOAL OF **RIT(2015-2018)** WAS TO STRENGTHEN REGIONAL COLLABORATION BETWEEN INDUSTRY, ACADEMIA & ACTORS WITHIN THE INNOVATION SUPPORT SYSTEM

BACKGROUND RIT

FROM INITIATING IN RIT

- R&D collaboration
- PhDs with the Space Industry
- Centre of Excellence for Space
- Space Innovation Forum
- New Innovation Support System for Space

TO ESTABLISHING IN RIT 2021

All our achievements within the RIT project now need to get established and further developed

SPACE COMPANIES IN THE NORTH

AROUND 2015 BEFORE THE RIT PROJECT

Satmission

NordNav

TeleWide AB

Wasa Millimeter Waves

Aeroflex Geisler Forsway Scandinavia

Polymer Kompositer Omnisys Instruments

Carmenta Imego AB Gotmic

ÅAC Microtec NanoSpace/GomSpace BruhnSpace NanOSC

ECAPS C2SAT Spacemetrics Brockman Geomatics

Spectrogon Spectrogon Speed Power IRnova

Umbilical Design Comlase YoYo Technology

Instrument Control Sweden STARCS

APR Technologies DST Control

SPACE COMPANIES IN THE NORTH

AROUND 2018 AFTER THE RIT PROJECT

5 NEW COMPANIES ESTABLISHED DURING THE RIT PROJECT:

WIDEFIND
TLIGHT
SOLIONICS
VILDA SPÅRNING
N66 CONNECT
PASQ
ARCTIC SPACE TECHNOLOGIES

Satmission

NordNav

TeleWide AB

APPROX. 20 REGIONAL COMPANIES HAVE BEEN IDENTIFIED AS POSSIBLE SUPPLIERS TO THE AEROSPACE SECTOR

Wasa Millimeter Waves

Aeroflex Geisler Forsway Scandinavia

Polymer Kompositer Omnisys Instruments

Carmenta Imego AB Gotmic

ÅAC Microtec NanoSpace/GomSpace BruhnSpace NanOSC

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4 WORK PACKAGES

R&D PROJECTS

Current PhD:s

New PhD:s

Postdocs

TESTBED SPACE

SpaceLab

New Business Models

Commercialization

INNOVATION SUPPORT

New Methods

New Processes

New Business Cases

Students in action

CLUSTER BUILDING

Aerospace Business

Networking

Collaboration

Training Programmes

4 WORK PACKAGES

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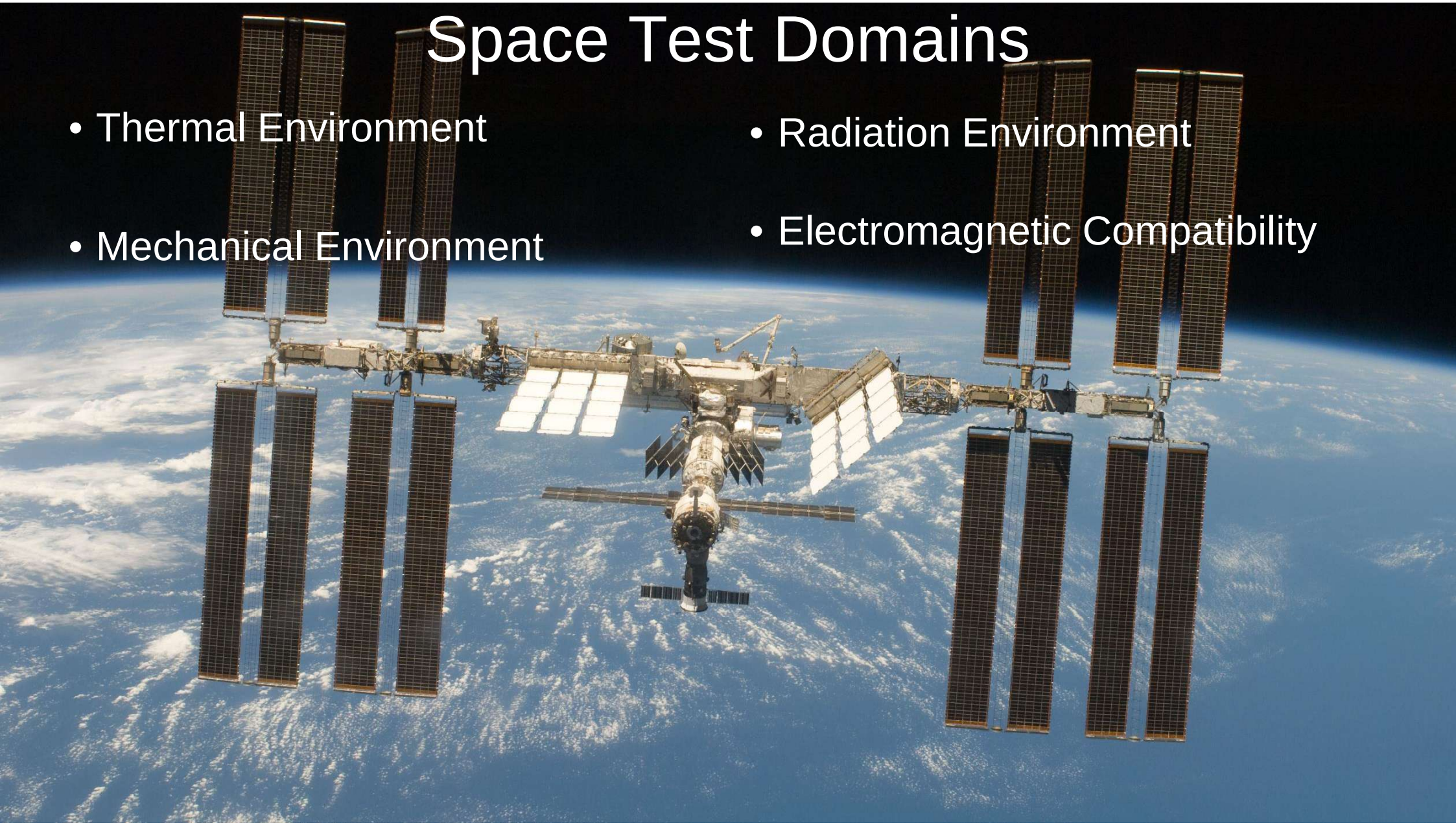
SPACE INNOVATION FORUM

Space Test Domains



- Thermal Environment
- Mechanical Environment
- Radiation Environment
- Electromagnetic Compatibility

Launch Vehicle Testing

Falcon Heavy Boosters

THE NEW SPACE ECONOMY

Many new actors, faster development cycles, iterative development – all this means the need for **testing of space systems** is increasing.

Our goal…

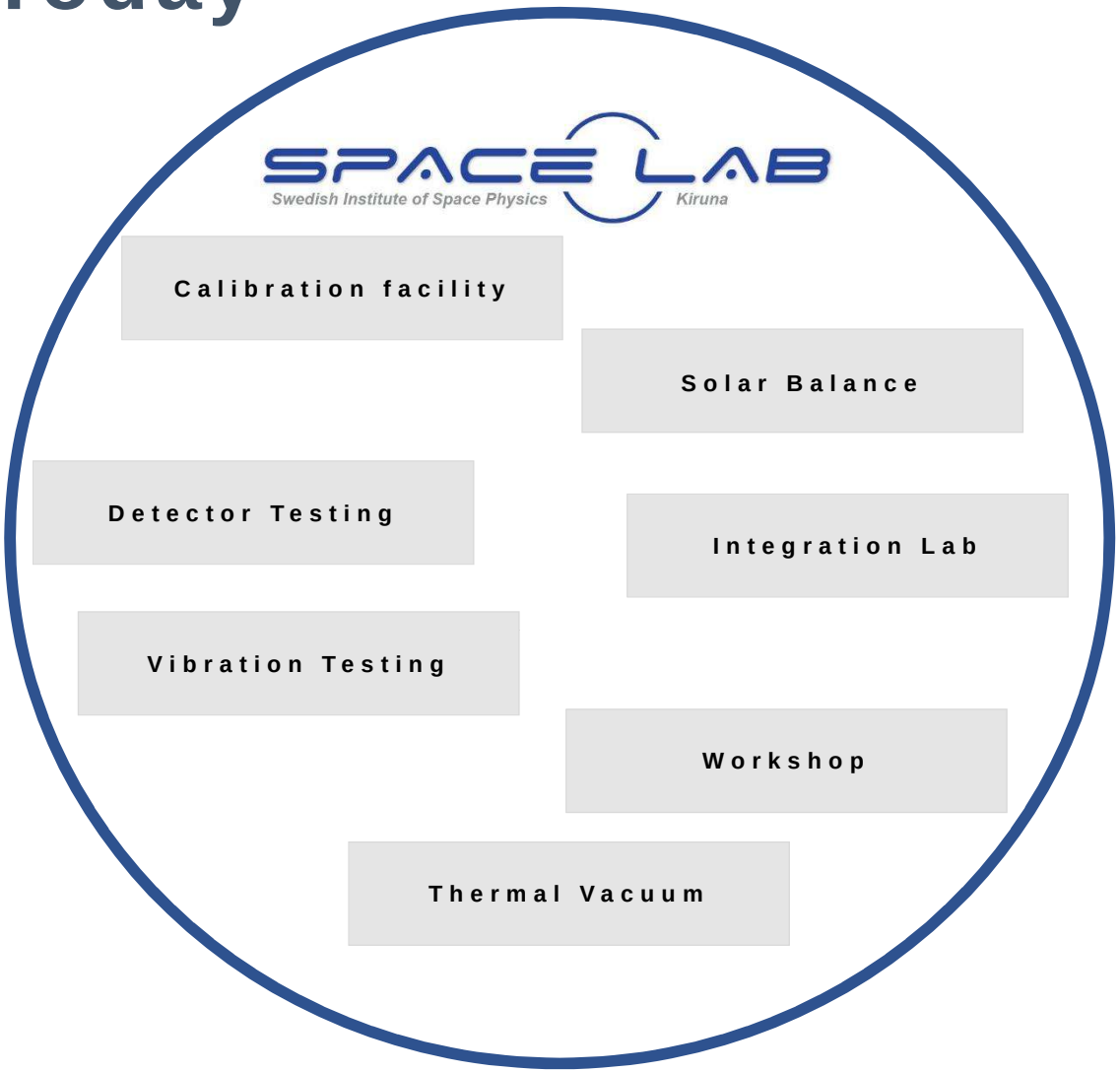
… is to strengthen the **Testbeds for Space** in Northern Sweden:

- Existing and future facilities and competencies at **Esrange, IRF, EISCAT, and LTU**
- Long term testing experience in Sweden at **IRF, OHB, RUAG, GKN, SSC, others**
- New Space experience of Swedish companies such as **GomSpace, ÅAC Microtec/Clyde**

Testbed at Kiruna Space Campus – SpaceLab

SpaceLab Today

accommodates 7 facilities



Solar Balance

- The space environment can constitute a challenge for space hardware:
  Large temperature range and fast temperature changes in vacuum
- Testing the **thermal design** of components and sensors (functionality and durability)

Dimensions	
Chamber (inside)	**1230 mm diameter, 1300 mm length**
Table for device under test	**Cu, 700 x 1200 mm**
Temperature	Oil temperature control system (-45°C … + 90°C) for table and shrouds N_2 cooling (down to -160°C) for shrouds T gradient ~1°C/minute
N_2 feed	
N_2 plant production	10l/h
Storage tank	3.5m^3
Pressure	In <1h down to 10^{-5} mbar (20°C), 10^{-6} mbar (90°C)
Illumination	400 x 400 mm area: 1-1350 W/m^2 500 x 500 mm area: 0-1310 W/m^2
Logging	PT100, 24 channels, of which 11 are available for the device under test

- 4 metal halide light sources (Philips MSR 575 HR) for the simulation of solar flux

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IRF
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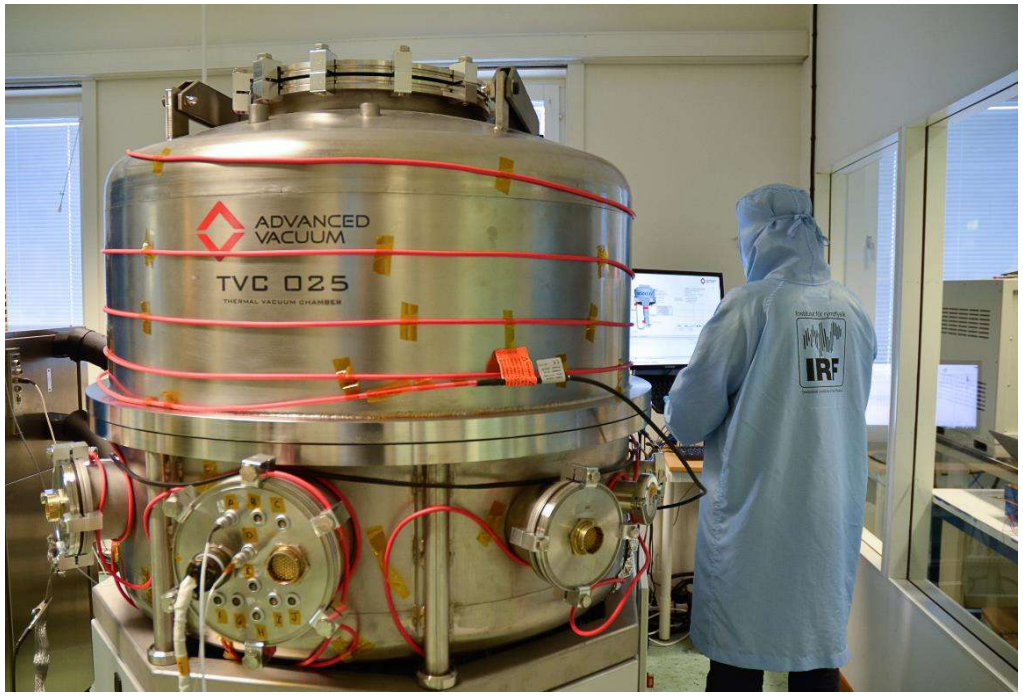
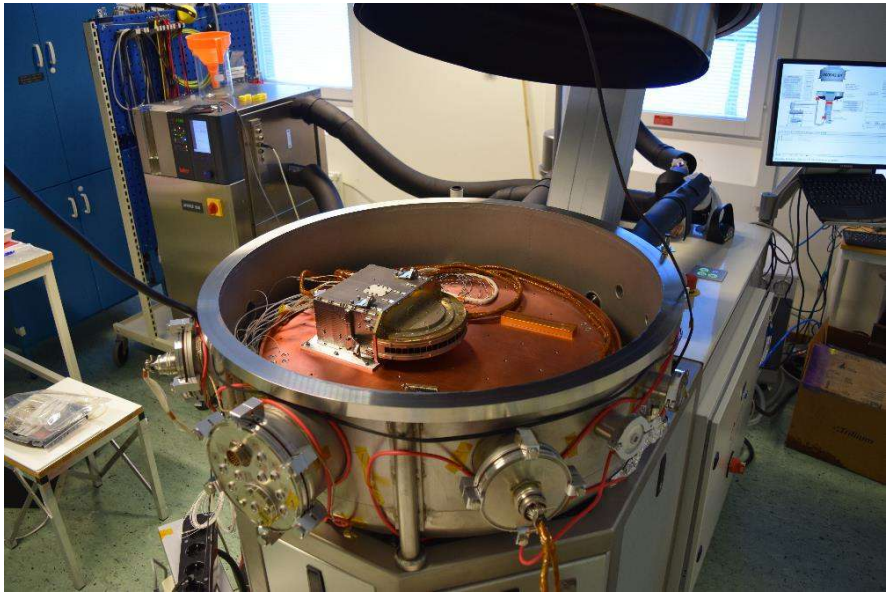
tillväxt verket

Thermal Vacuum

- Smaller TV chamber (model TVC 025, NanoVac)
- For test devices of a maximum size of 40 x 40 x 40 cm^3.
- Test device on a Cu-table for best thermal contact
- Chamber inside is covered with a black shroud
- Measurement control system allows for programmable temperature cycles.



Temperature range	**-55 …. + 125 °C**
Pressure	Down to low 10^{-7} mbar (cryopump)
Logging	8 x PT100



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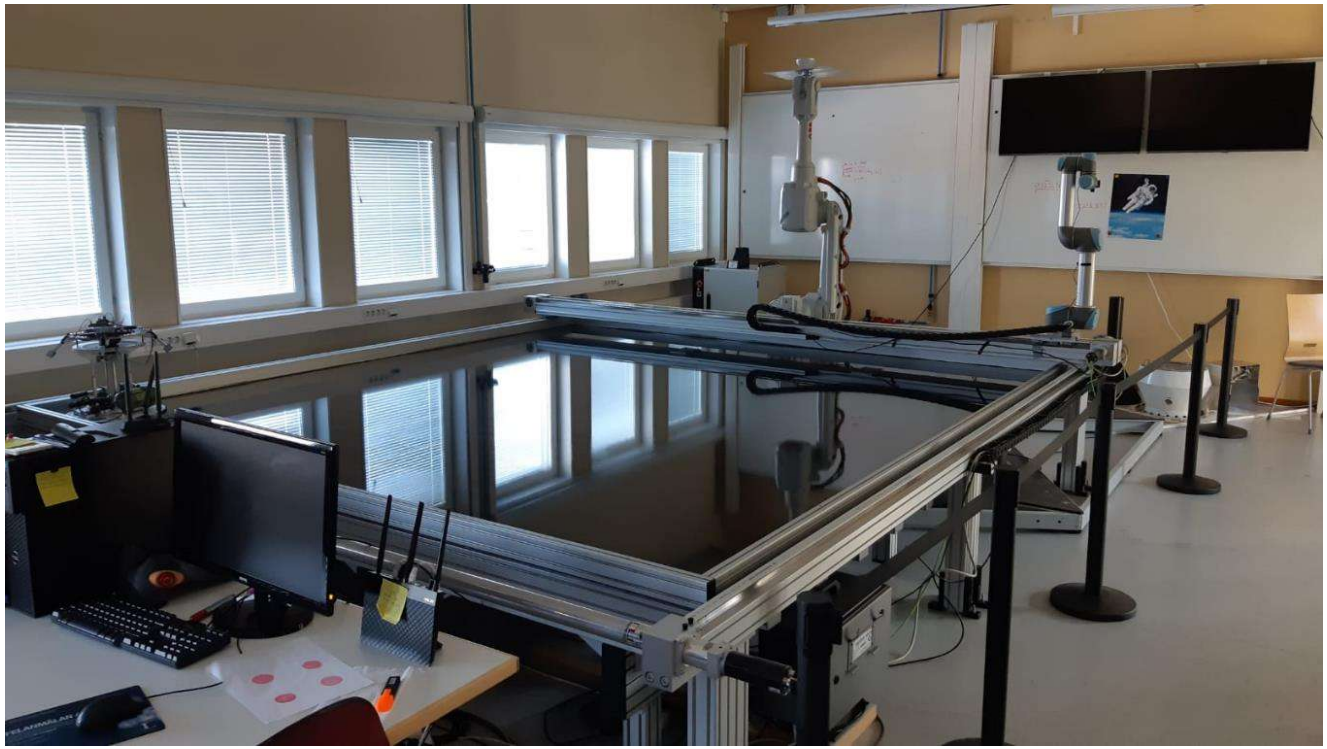
tillväxt verket

Frictionless table for free flying platform experiments



- **Testbed for floating platforms and nanosat development**

Provides conditions to evaluate concepts and designs to operate in orbit:

- ✓ Control of flexible structures
- ✓ Multibody dynamic analysis
- ✓ Rendezvous and docking
- ✓ Cold gas propulsion systems for nanosats
- ✓ Development, fabrication and tests of nanosats
- ✓ Hardware-in-the-loop
- ✓ …

Other Facilities

- ✓ Milling machine
- ✓ Clean room for electronics and sensitive devices
- ✓ 3D prototyping
- ✓ VHF/UHF Ground Station

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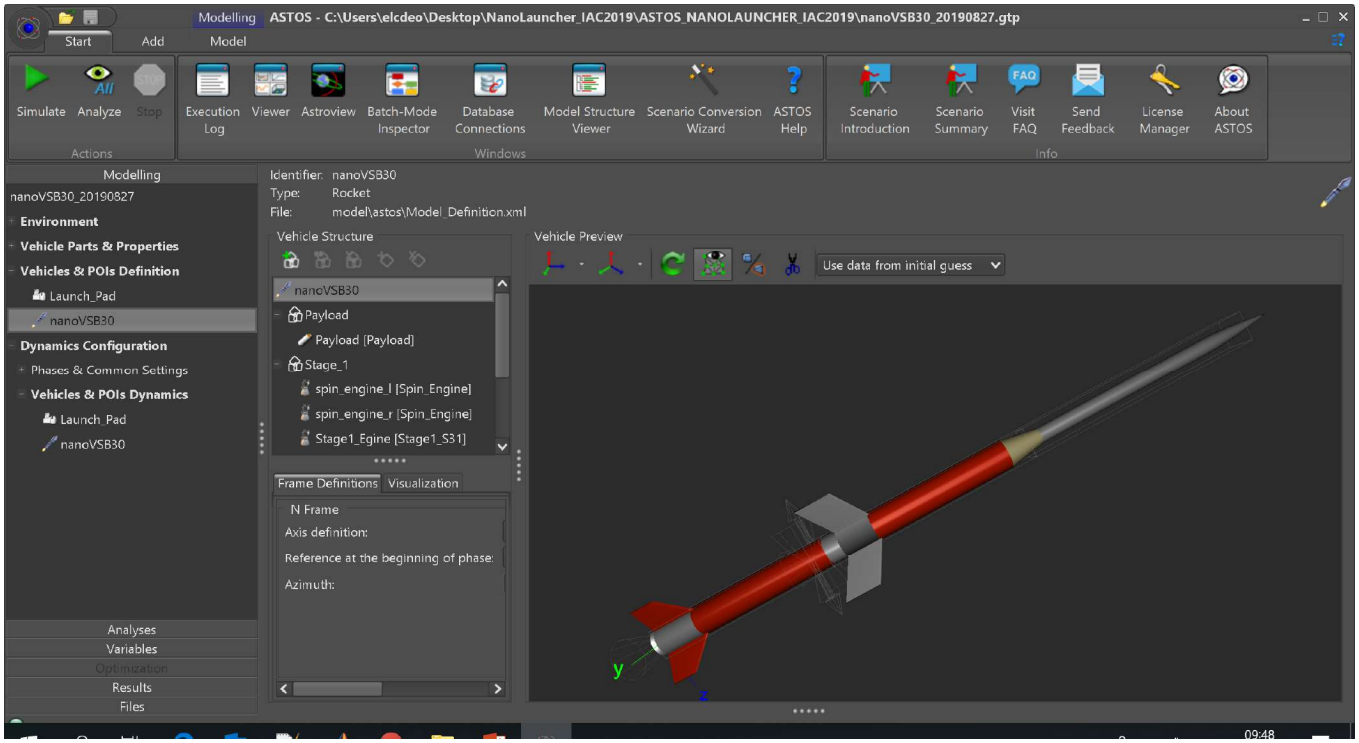
ASTOS trajectory simulation



- **ASTOS**

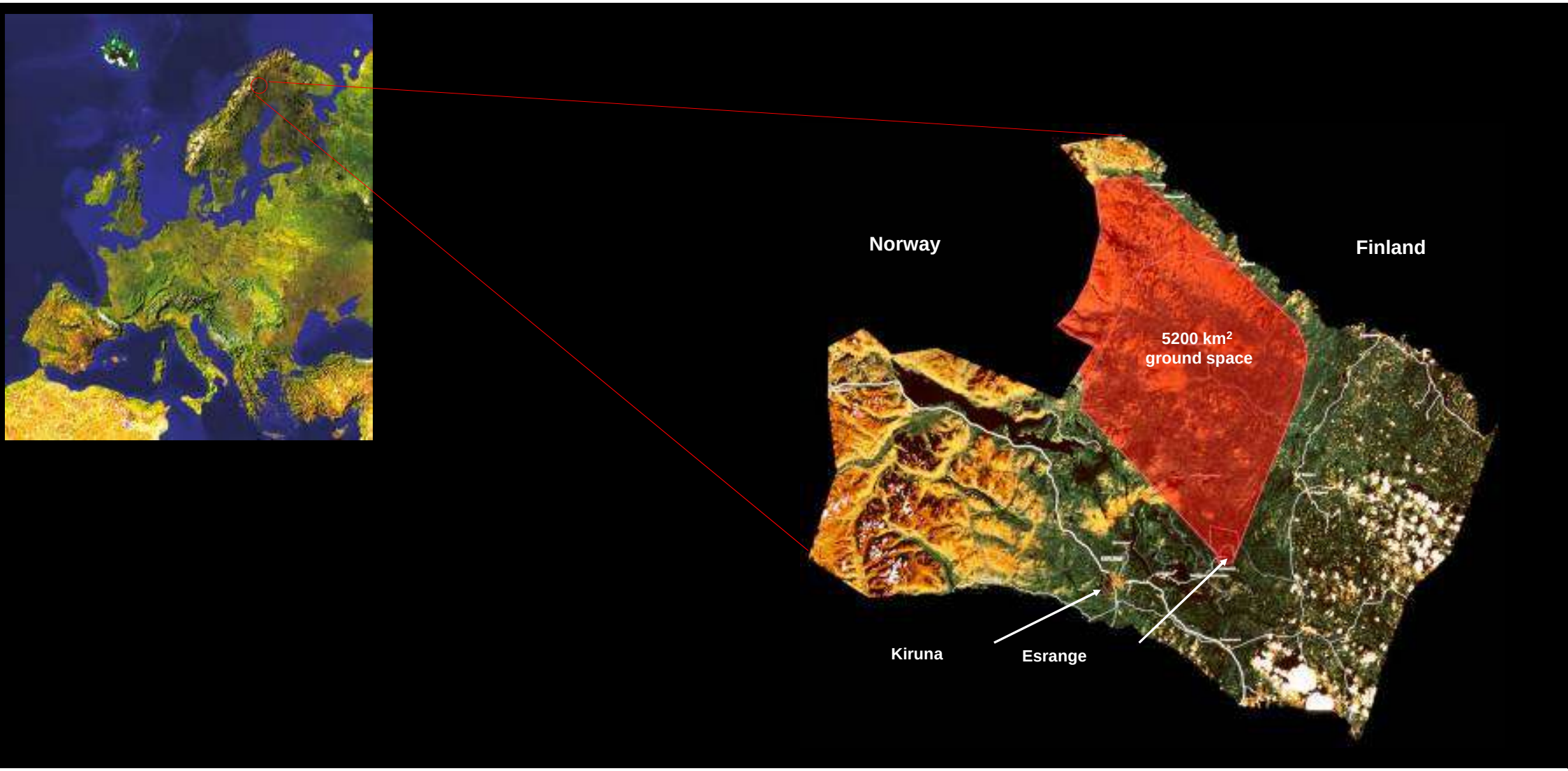
Provides conditions to evaluate concepts and designs for rockets and space missions:

- ✓ Trajectory optimization
- ✓ Launchers Guidance, Navigation & Control
- ✓ Mission analysis, tracking, telecommunication, orbits, …
- ✓ Launchers design

Plus a range of test facilities at the main LTU campus in Luleå

Testbed Esrange

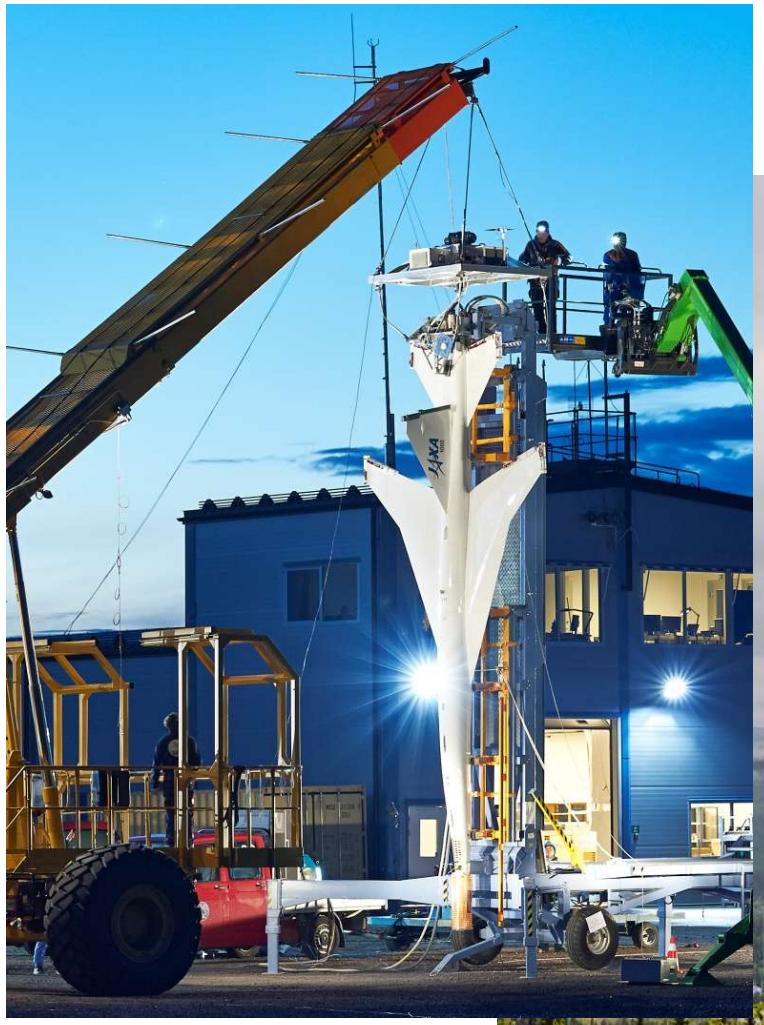
ESRANGE SPACE CENTER, 67.9°N - 21.1°E



Esrange Space Center

JAXA D-SEND 2B and 2C

Date	2013-08-16 and 2015-07-24
Customer	JAXA
P/L weight	1000 kg
Altitude	38 km
Mission	Measure the sonic boom produced from a supersonic aircraft



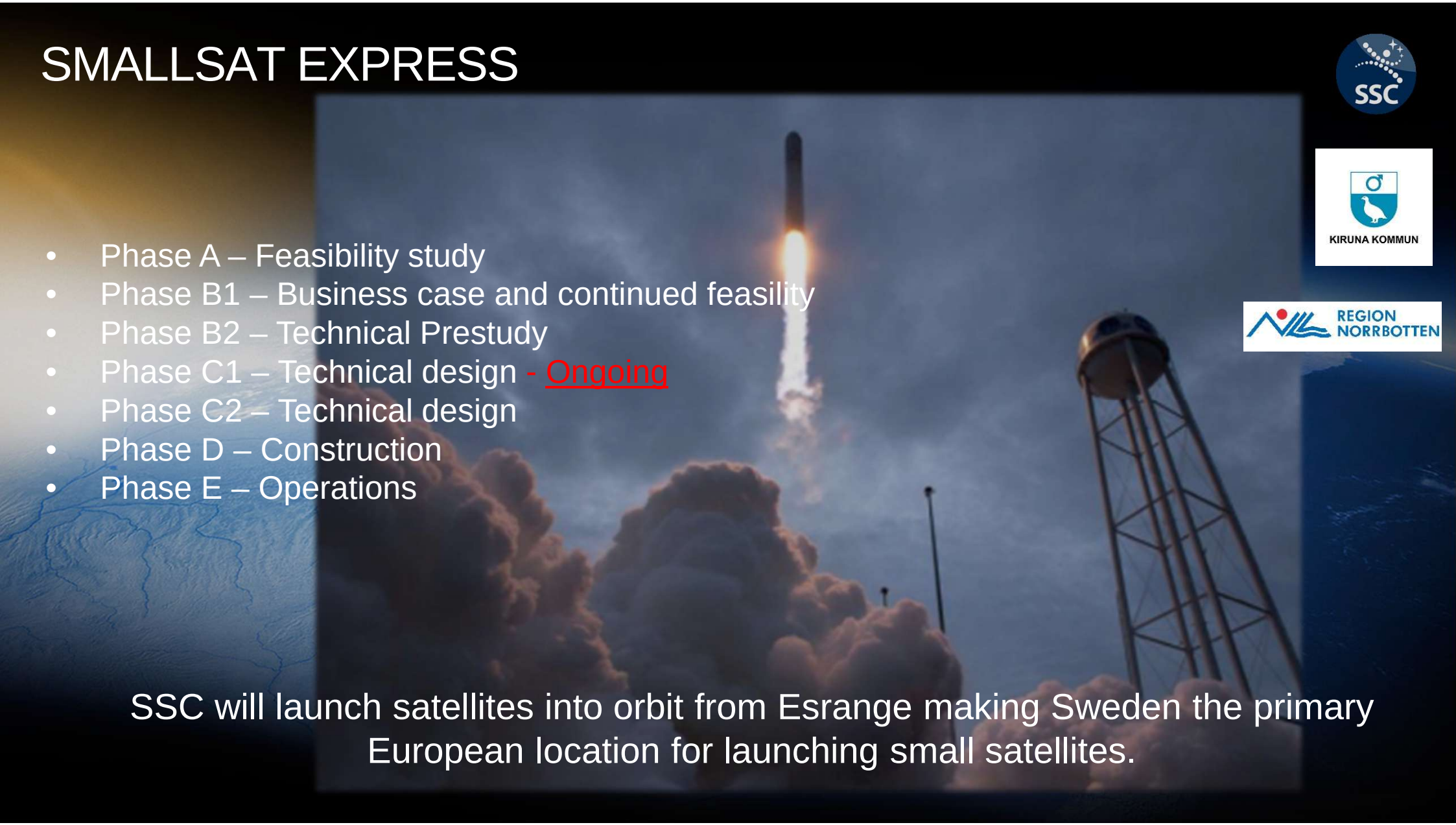
TESTBED ESRANGE

Capabilities:

- Horizontal teststand (Available now)
  - Booster tests
  - Component tests
- Vertical test stands (Available Q3 2020)
  - Engine tests
  - Stage tests
- Test launch pad (Available Q3 2020)
  - Validation of new rockets and systems
- Reusability launch/landing pads (Available Q3 2020)
  - Flyback booster test
  - GNC system test facility

Esrange is becoming a leading test site for rocket development.

SMALLSAT EXPRESS



- Phase A – Feasibility study
- Phase B1 – Business case and continued feasility
- Phase B2 – Technical Prestudy
- Phase C1 – Technical design - Ongoing
- Phase C2 – Technical design
- Phase D – Construction
- Phase E – Operations

SSC will launch satellites into orbit from Esrange making Sweden the primary European location for launching small satellites.

SMALLSAT EXPRESS

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Summary

Kiruna will be able to support a full range space testing:

- Satellites – Testing of complete small satellites
- Satellites – Instruments, Sensors, Subsystems, Components, etc
- Stratospheric Balloons – Payload tests as well as flights
- Rockets and small Launch Vehicles – from analysis to motor tests, stage tests and full flight tests, including reusability
- Launch of small satellites to Sun Synchronous Orbit


THANK YOU
SPACE INNOVATION GROWTH COOPERATION