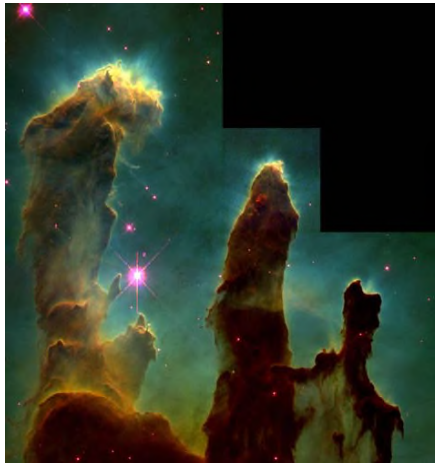
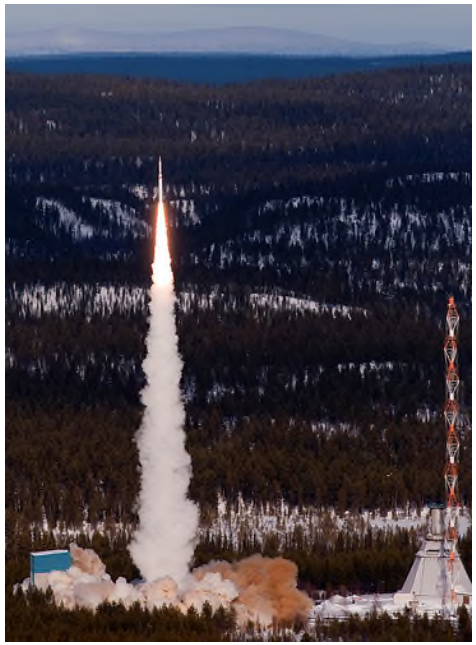
Sweden and Space – Investments in Research and Development for the Benefit of Society

Dr Olle Norberg
Director-General
Swedish National Space Board

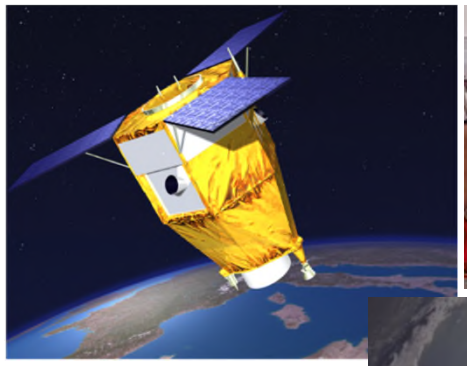




RYMDSTYRELSEN
Swedish National Space Board

SNSB at a glance

- Governmental space agency under the Ministry of Education and Research
- Responsible for national and international activities related to space and Earth observation
- Satisfy Sweden's need of space infrastructure
- Promote Swedish space industry and space research
- Annual budget ~100 M€
- Established in 1972




RYMDSTYRELSEN
Swedish National Space Board

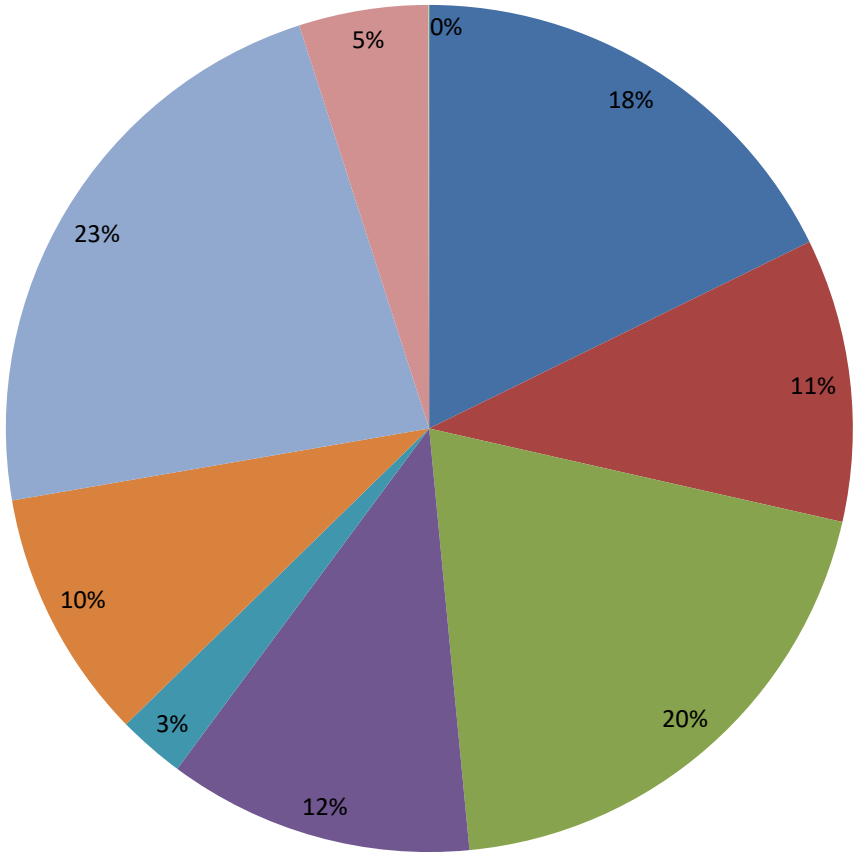
Context – what is going on worldwide?

- Space 4.0
  - Space 1.0 – for millennia we observed the skies above us
  - Space 2.0 – the space race to the Moon during the cold war
  - Space 3.0 – cooperation between states, ISS as most visible result
  - **Space 4.0 – Public as well as commercial, many services emerge**

- Space is now essential in our everyday life (TV, navigation, timing, weather, etc.)

- Large volumes of data becomes freely available
- Small satellites have become really useful
- Internet via satellite megaconstellations (OneWeb, others)
- Commercial launch vehicles, reusability (SpaceX), small launch vehicles
- Paving the way for massive downstream use of space assets

Swedish ESA participation (~70 M€/year)

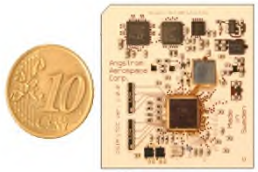


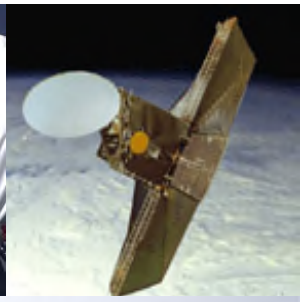
- Space Science
- Basic activities
- Earth observation
- Telecommunication
- Navigation
- ISS, microgravity, exploration
- Launchers
- Technology

2005-2014 (total)

SNSB support for industrial R&D

- Digital electronics
- Microwave technologies
- Miniaturization
- Attitude and orbit control systems
- Electrical propulsion
- Green propulsion
- Alloys and composites engineering





RYMDSTYRELSEN
Swedish National Space Board

New European Launch Vehicles

Launchers and technologies of the future: Ariane 6 and Vega C

European Ministers agreed at the Ministerial Council 2014 to develop **Ariane 6** and **Vega C.** These launchers will provide guaranteed access to space for Europe at a competitive price without requiring public sector support for commercial exploitation.

Ariane 6 - modular three-stage launcher with two configurations, using two (A62) or four boosters (A64);

Vega C - evolution of Vega with increased performance and same launch service cost;

Common solid rocket motor for Ariane 6 boosters and Vega C first stage;

New governance for Ariane 6 development and exploitation allocating increased roles and responsibilities to industry;

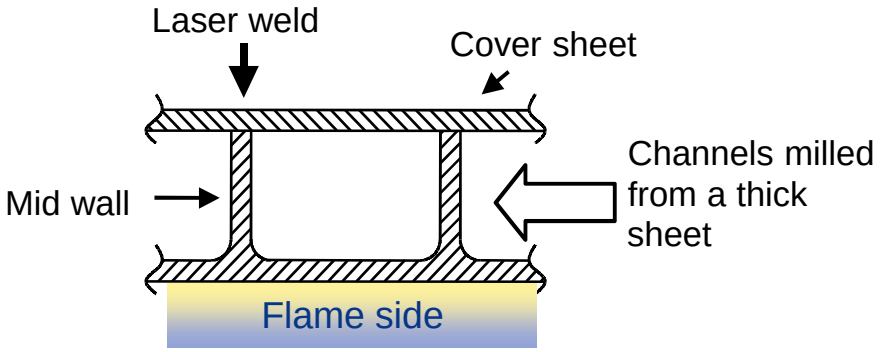
Vega C and Ariane 6 first flights - 2018 and 2020.

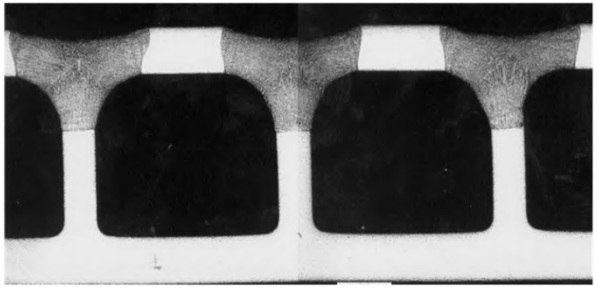
RYMDSTYRELSEN
Swedish National Space Board

Nozzles from GKN Aerospace

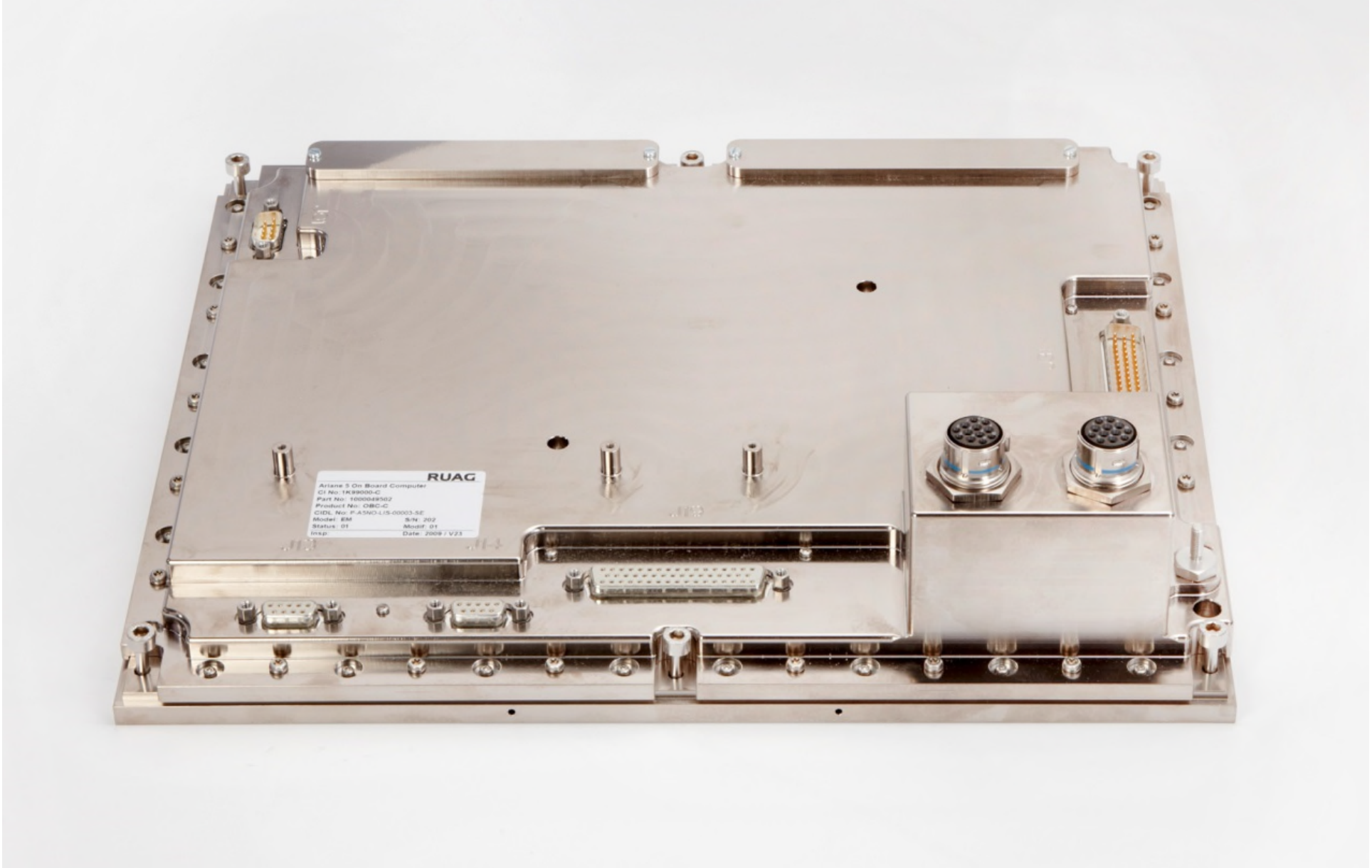
A new nozzle for the Vulcain engine

- A completely novel type of nozzle in sandwich technology
- Close industry cooperation: GKN, Snecma, Airbus





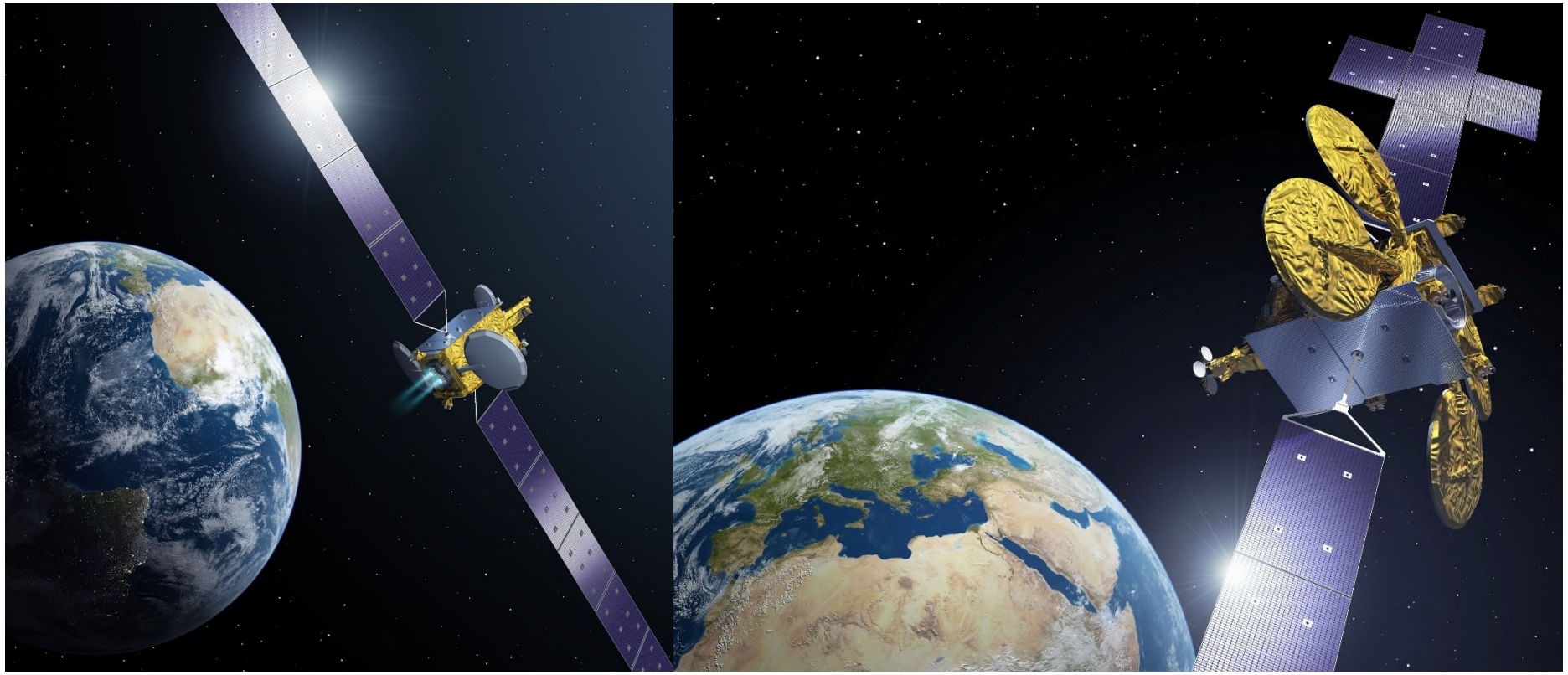
Computers for guidance and control from RUAG



Electric propulsion in space

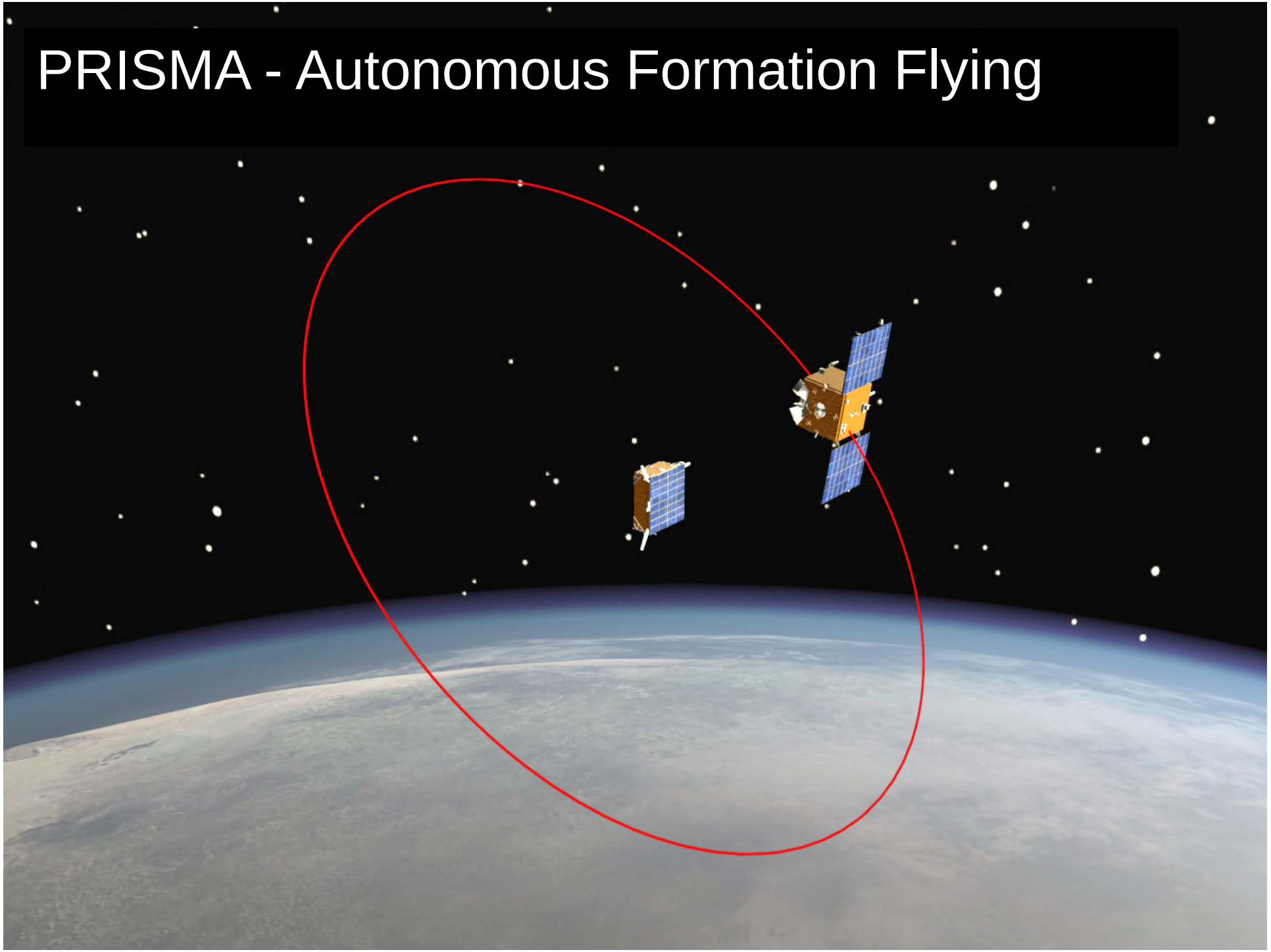
SMART-1 to the Moon in 2003-2004

Telecom – Electra and Neosat



RYMDSTYRELSEN
Swedish National Space Board

PRISMA - Autonomous Formation Flying

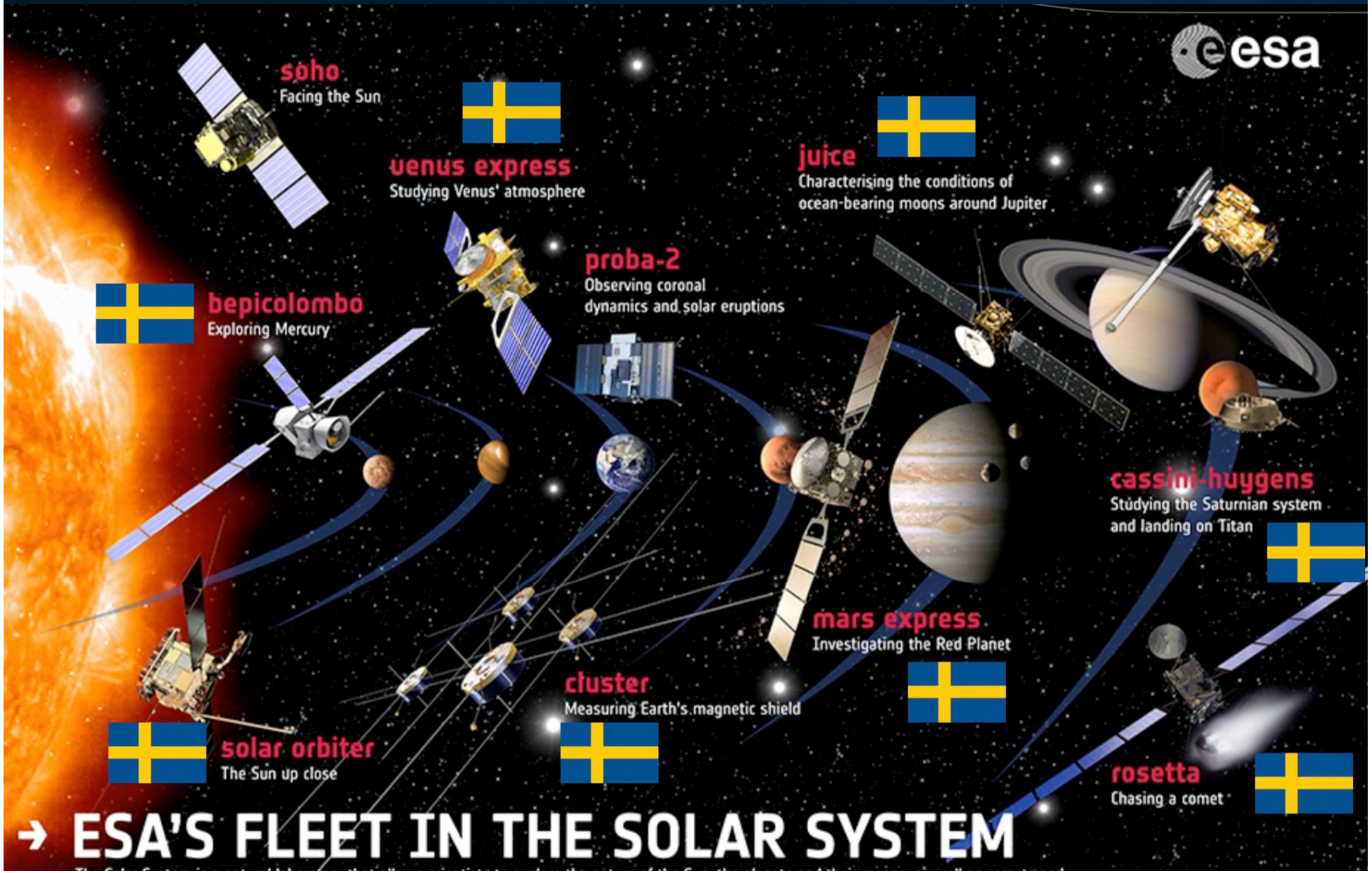


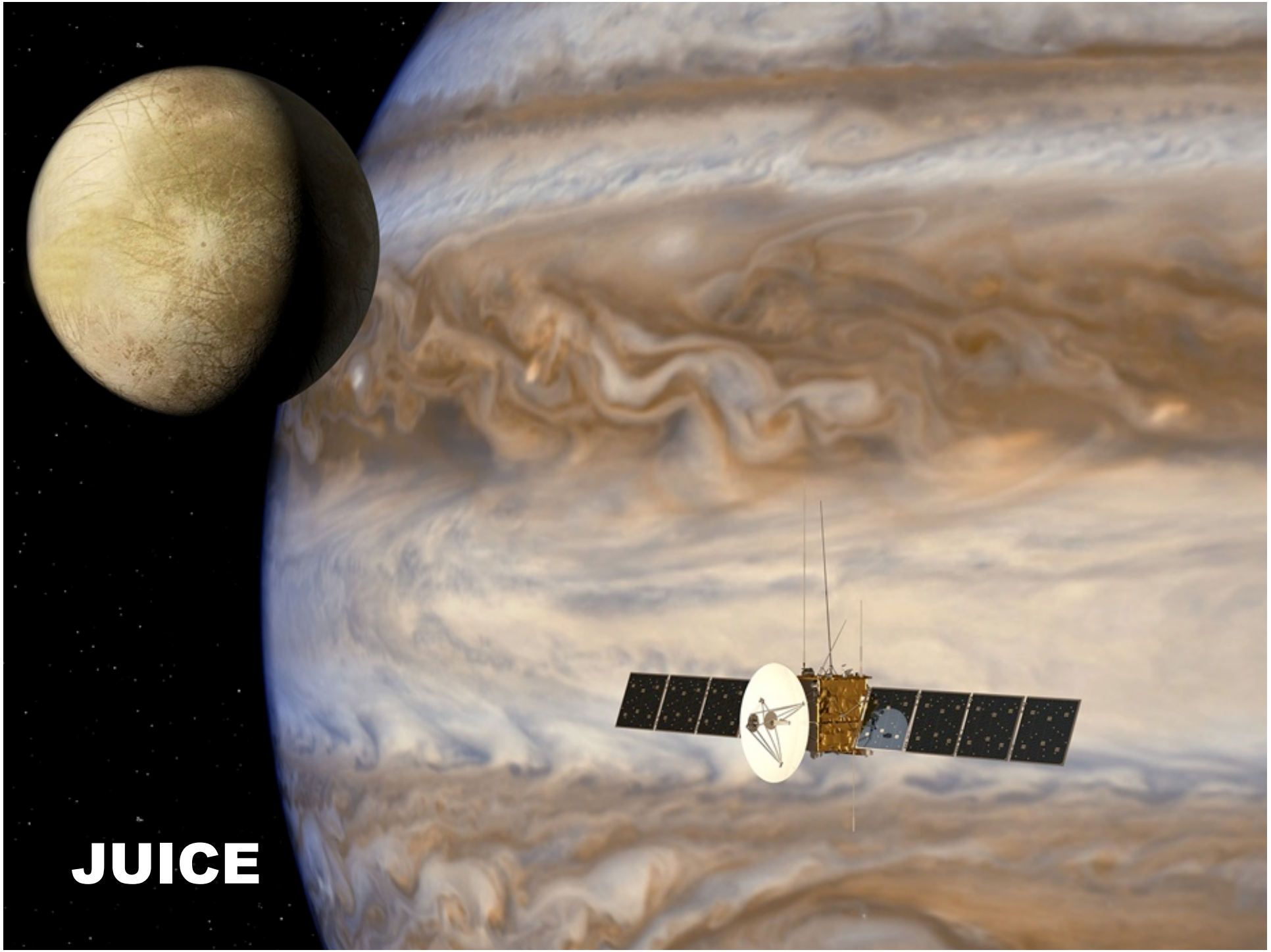
Green propulsion technologies

- The company ECAPS AB, supported by SNSB since the late 90's, has developed thrusters using a ”green” ADN-based replacement for hydrazine.
- 1N propulsion system was first tested on the Swedish satellite Prisma and is flying on the Google/Terra Bella fleet of imaging satellites.
- Since 2013 NASA and SNSB is cooperating on developing and testing 5 and 22N thruster systems based on this technology.

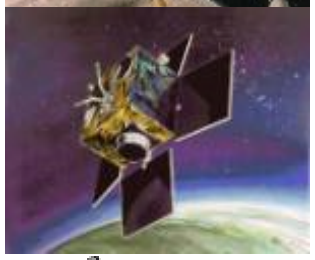
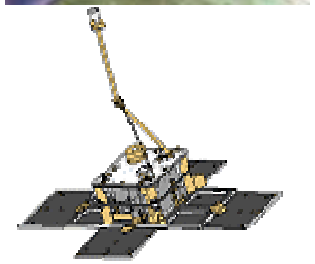

esa
SCIENCE

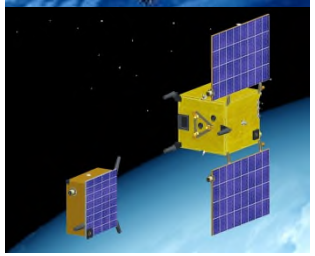
Contributions from Swedish scientists to ESA space science projects




JUICE



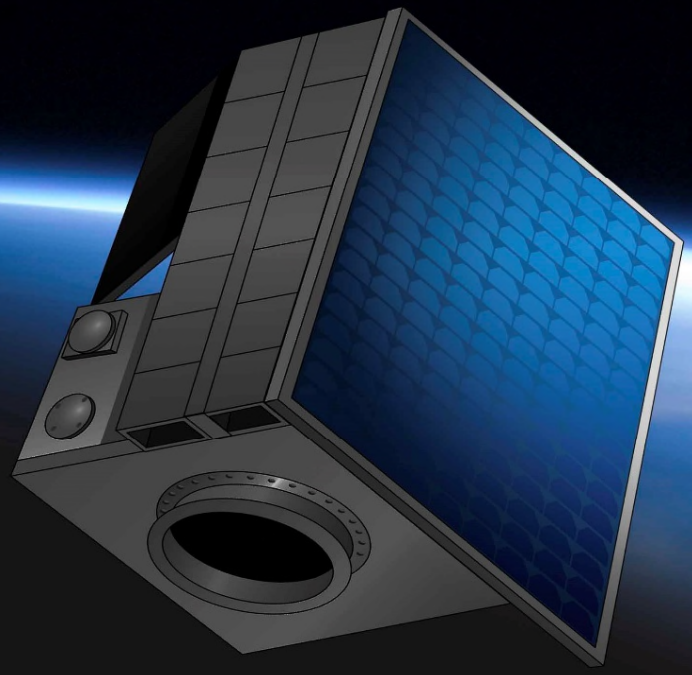


National/multilateral satellites to satisfy specific needs

Viking	Sweden	1986-1987
Freja	Sweden/Germany	1992-1996
Astrid-1	Sweden	1995-1995
Astrid-2	Sweden	1998-1999
Odin	Sweden /Canada/ Finland/France	2001-
Prisma	Sweden /France/ Germany/Denmark	2010-2015

Next is MATS

- Mesospheric Airglow/ Aerosol Tomography and Spectroscopy
- Studies of waves in the middle atmosphere and their influence on climate
- Mass: ~40 kg
- Launch: 2019



RYMDSTYRELSEN
Swedish National Space Board

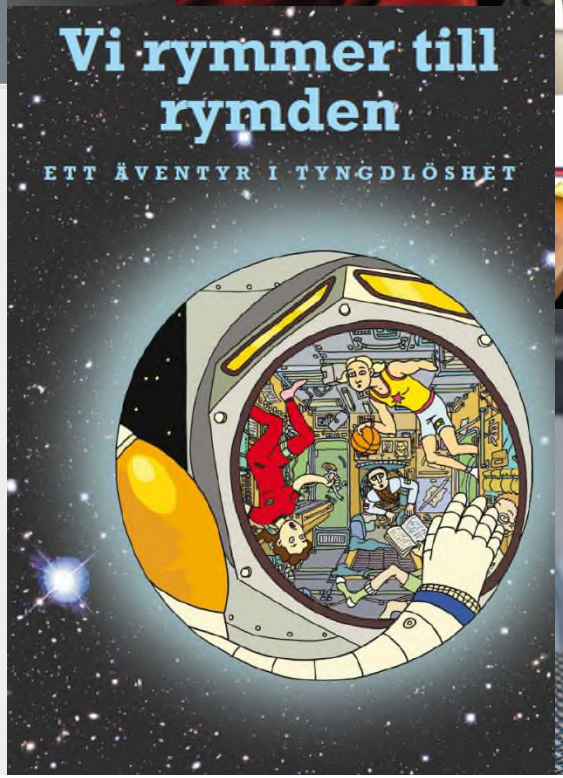
Esrange Space Center, managed by SSC

SWEA – Swedish user segment for Copernicus data

RYMDSTYRELSEN
Swedish National Space Board


→ ON TOUR IN SCANDINAVIA AND FINLAND
www.esa.int/rosetta
#rosettatour
rosetta
→ RENDEZVOUS WITH A COMET


http://www.rymdkanalen.se/
Rymdkanalen
RYMD
KANALEN
SÖK
Start
Bloggen
Våra filmer
På gång
Rymdfakta
Rymdsverige
Skolmaterial
Rymdkultur
Webdewey
Om oss
19 nov
3D-skrivare testas på rymdstationen
Europas första 3D-skrivare i rymden ska installeras ombord på ISS nästa år. Esa-astronauten Samantha Cristoforetti anländer till ISS den 23 november och en del av hennes arbete blir att genomföra tester av POP3D, Portable On-Board-Printer, som skrivaren heter. Skrivaren är ungefär stor som en skokartong, energisnål och tillverkad i biologiskt nedbrytbar plast, allt för att inte påverka besättningens miljö ombord på…
18 nov
Orion varvar jorden – två gånger
Rymdfarkosten Orion ska ta framtidens astronauter till outforskade platser i vårt solsystem. Uppsändningen planeras till 2017. Redan nu sker en obemannad testflygning från Cape Canaveral i USA. Med start den 4 december skickas Orion två…
"Mina dagar på raketbasen ser väldigt olika ut"
Anna Larsson
REDAKTIONEN TIPSAR
Med appen Gaia-Mission kan du följa uppdragets framsteg i din mobil
FILM
Trailer ESTEC


Vi rymmer till rymden
ETT ÄVENTYR I TYNGDLÖSHET


SVENSKA
RYMD
ÄVENTYR
– MÅNGA FLER ÄN DU ANAR


LÄTTMJÖLK
VAD ÄR EN KOMET?
HUR HINNER ROSETTA INNAN KOMETEN?

Return on investment?

- Pooling our resources within Europe to provide essential infrastructure in space
- Strong base of industrial actors, employing ~1300 persons, of which ~80% has an university exam, thereof 8% Ph.D.'s.
- Growing revenue, ~3 billion SEK/year
- ~60% of revenue from commercial customers
- Excellent scientists, highly experienced in international projects
- Inspiring and motivating coming generations to pursue science and technology

RYMDSTYRELSEN
Swedish National Space Board