

# *Estonian Student Satellite Program ESTCube-1*

Urmas Kvell and the EstCube team  
[www.estcube.eu](http://www.estcube.eu)

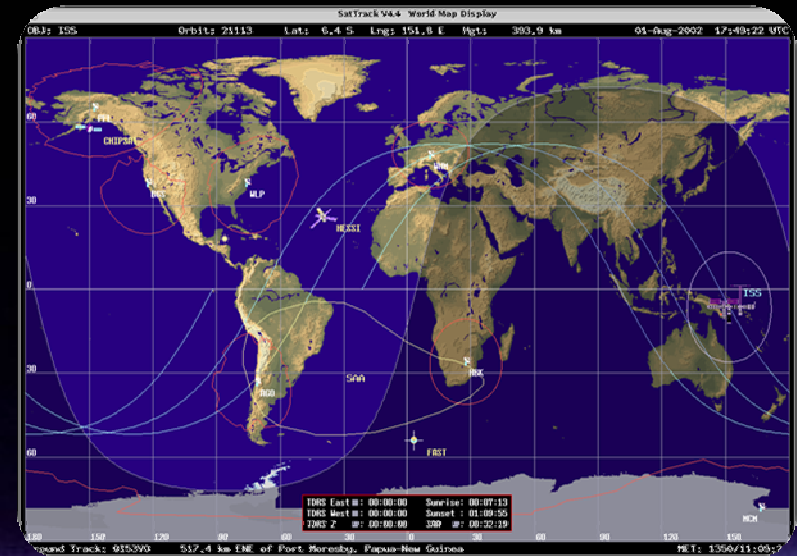


- Estonian space activities
- How can we sail on Solar Wind?
- Challenging goals of ESTCube-1

# Estonia in numbers

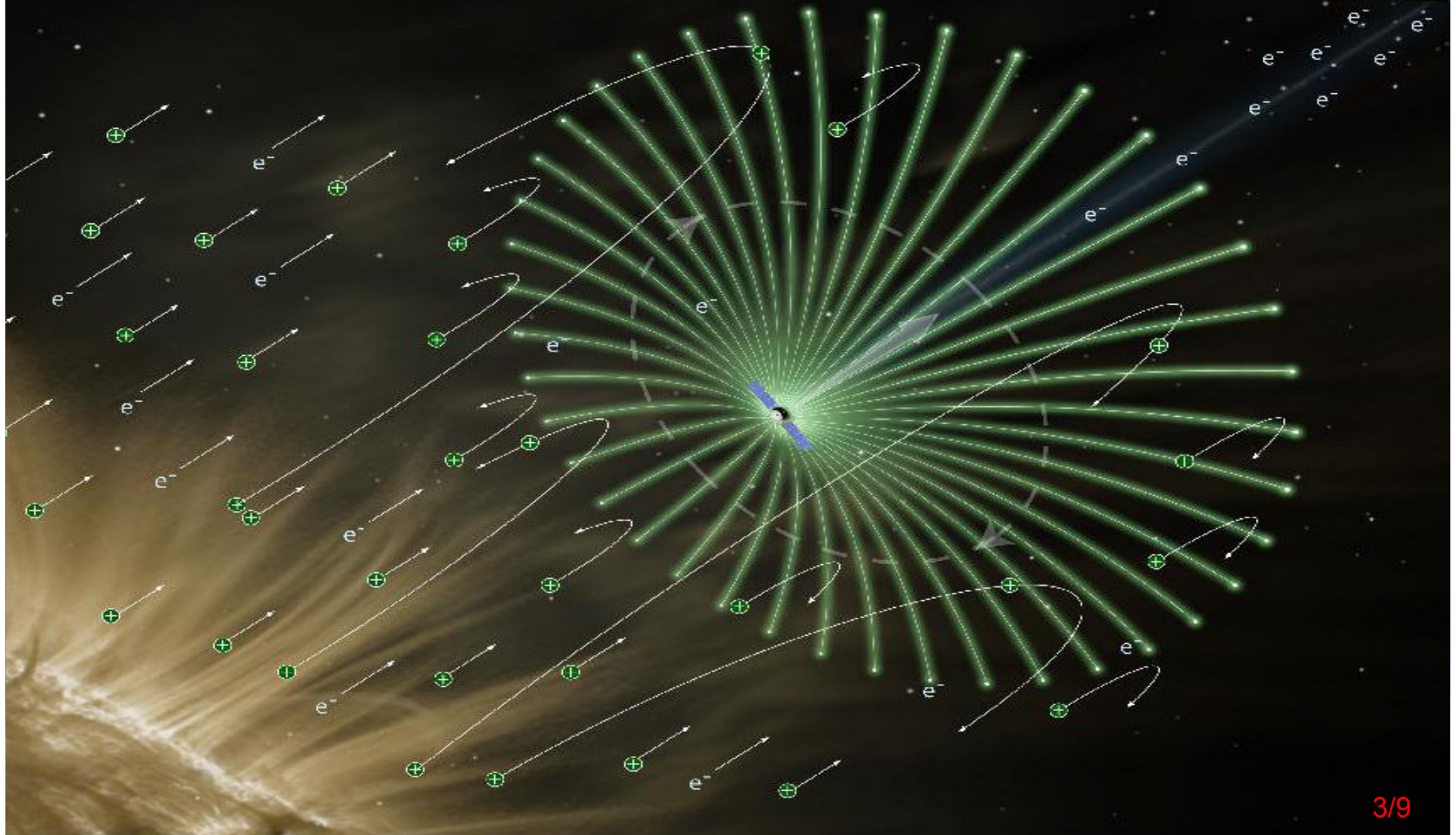


- Population 1,3 million
- Joining ESA in 2009 as European Cooperating State (ECS)
- Instruments on 7 space missions before 1991



# Electric Solar Wind Sail

Pekka Janhunen, FMI Finland, 2006



# Electric sail advantages



- Main advantages:
  - No fuel needed after deployment
  - Small mass and volume
  - Significant final speed
  - Scalable architecture

Spacecraft	Final speed (Au/year)
Pioneer 10	2,6
Pioneer 11	2,4
Voyager 1	3,6
Voyager 2	3,3
New Horizons	2,5
NASA Interstellar Space Probe	14
<b>Electric Sail</b>	<b>10,5</b>

# Electric sail applications



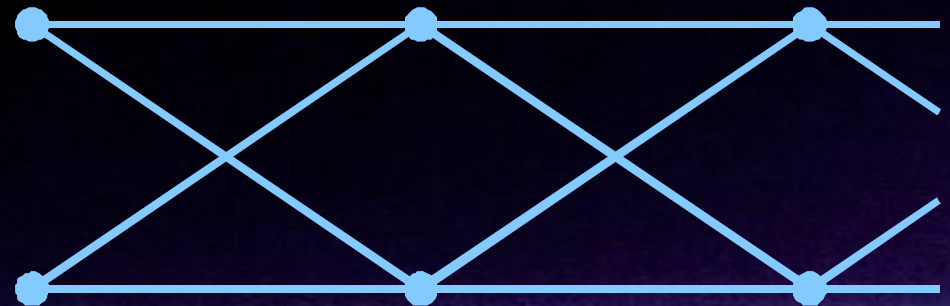
- Missions out of Solar System
- Missions towards the Sun
- Permanent position between Earth and Sun at non-Lagrange points
  - Space weather monitoring
- Mining of asteroids



# Example spacecraft



- 200 kg spacecraft:
  - 100 tethers
  - Effective sail area 100 km<sup>2</sup>
  - Force 200 mN
  - Acceleration 1 mm/s<sup>2</sup>
- The tether structure:
  - Diameter 20  $\mu$ m
  - Length 20 km
  - Potential +20 kV
  - Hoytether design
- Electron gun
  - Solar powered

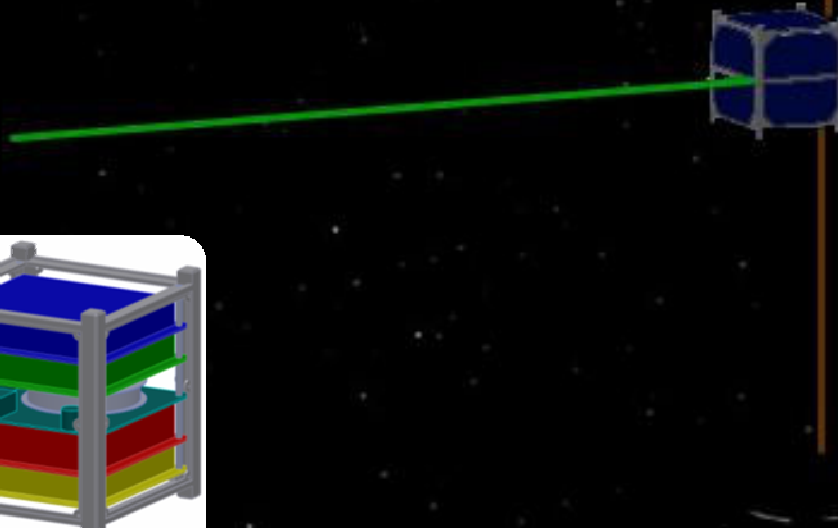
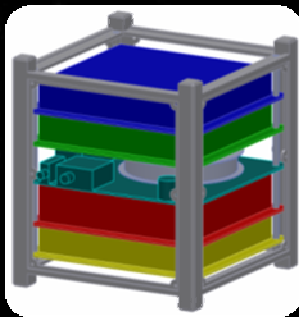




# ESTCube-1 Mission



- Controlled deployment of a single 10 m Hoytether at Low Earth Orbit





# Thank you!



[www.electric-sailing.com](http://www.electric-sailing.com)

[FYYSIKA.EE](http://FYYSIKA.EE)

Vangelis Space Ltd

[www.estcube.eu](http://www.estcube.eu)