Introduction

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Department of Broadband Infocommunications and Electromagnetic Theory
Sputnik-1 (1957) 21 days, 1440 orbits
Vostok-1 (1961)
Telstar-1 (1962)
Apollo-11 (1969 20th July)
Pioneer 10/11, Voyager 1/2 (1970th)
GPS (1973-)
Meteorology (1977-)

[Image of Earth]

[Image of satellite in a clean room]

[Image of Europe on a map]

[Image of a person working on a satellite]
Columbia Space Shuttle (1981, 12th April)
Mars Pathfinder (1996)
- Science
  - Astronomy
  - Planetary missions
  - Material sciences
  - Medicine and biology
  - Physics, chemistry
  - Robotics
  - ...

- Commercial applications
  - Earth observation
  - Communication, broadcasting
  - Navigation
  - ...

- Technology transfer: space → Earth

- Military
Future missions 1: ESA James Webb Telescope (JWST) 2021
Future missions 2: Human Mars mission (after 2030 ??)
Future missions 3: Laser Interferometer Space Antenna (LISA) 2034
About the subject

- Lecturer: Dr. László Csurgai-Horváth, associate professor
- How can you find me: building V1/room205, csurgai@hvt.bme.hu

- Weekly schedule: 2 lectures / 1 practice
- Requirements: midterm test on 11th week + written exam

- Website: http://eik.bme.hu/~csurgai/SpaceTechnology/index.htm
About the department

Department of Broadband Infocommunications and Electromagnetic Theory

www.hvt.bme.hu

- 20 successful launches since 1976
- INTERCOSMOS, ESA, NASA, AMSAT cooperation
  - Power systems
  - Radiocommunication
  - Onboard computer
  - Measurement data collection
- Rosetta (cometary research): 2004-2014
- BEXUS (biodosimetry): 2012
- MASAT-1 CubeSat: 2012-15
- REXUS (ionosphere research): 2013
- ESEO (plasma diagnostics): 2008-2018
- Alphasat (propagation and communication): 2014-
- SMOG picosatellite family: 2019-
### About missions we participated so far

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<th>Mission</th>
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<td>INTERCOSMOS-17</td>
<td>1977. 09. 24.</td>
<td>Telemetry System, PSS</td>
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<td>INTERCOSMOS-18</td>
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<td>INTERCOSMOS-19</td>
<td>1979. 02. 27.</td>
<td>Onboard Data Collection System (ODCS) PSS</td>
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<td>INTERCOSMOS-20</td>
<td>1979. 11. 01.</td>
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<td>Phase III / A</td>
<td>1980. 05. 23.</td>
<td>PSS</td>
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<td>1981. 02. 04.</td>
<td>ODCS, PSS</td>
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<td>Phase III / B AO-10</td>
<td>1983. 03. 02.</td>
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<td>VEGA-1 &amp; 2</td>
<td>1984. 12. 15.</td>
<td>ODCS, TV-PS, PLAZMAG-PS, TÜNDE-PS</td>
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<td>Phase III / C AO-13</td>
<td>1988. 06. 15.</td>
<td>PSS</td>
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<td>INTERCOSMOS-24 ACTIVE</td>
<td>1989. 09. 28.</td>
<td>ODCS, SAS Experiment, SAS–TX</td>
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<td>INTERCOSMOS-25 APEX</td>
<td>1991. 12. 18.</td>
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<td>INTERBOL-1 TAIL</td>
<td>1995. 08. 02.</td>
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<td>MIR-PRIRODA</td>
<td>1996. 04. 23.</td>
<td>MOS-Obzor spectrometer PS</td>
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<td>STS-91</td>
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<td>Alpha Magnetic Spectrometer PS</td>
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<td>Phase III / D “AO-40”</td>
<td>2000. 11. 16.</td>
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<td>ROSETTA</td>
<td>2004. 03. 02.  (2004-16)</td>
<td>Roland-PSS</td>
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<td>MASAT-1</td>
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<td>2012. 25.09.</td>
<td>Experiment + Data collection system</td>
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<td>“Daemon” Balloon exp.</td>
<td>2013. 10. 08.</td>
<td>Experiment + Data collection system</td>
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<td>“Gekko” Rocket experiment</td>
<td>2013. 06. 06.</td>
<td>Experiment + Data collection system</td>
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<td>Alphasat TDPS experiment</td>
<td>2013. 07. 25. (2014-)</td>
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<td>ESEO</td>
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<td>Alphasat COMEX</td>
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<td>Esa technology transfer</td>
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<td>5G propagation tester</td>
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<td>SMOG-1/SMOG-P/ATL</td>
<td>2019</td>
<td>RF spectrum monitoring</td>
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The history 1: BME

- 1959-1969: short wave radio station, meteorological rocket development, satellite receiver station
- 1967: Hungary joined to Interkosmos (a Soviet space program)
- 1970: establishment of the Space Research Group

BE7 for IK19/20

A/D for IK15, 1976
The history 2: electronics

- **The 60th:**
  - Vacuum tubes
  - Discrete components
  - no PCBs

- **The 70th:**
  - Silicon semiconductors
  - TTL digital circuits
  - 2-sided PCBs

- **The 80th:**
  - MSI/LSI integrated circuits
  - Microprocessors (NSC-800)
  - CMOS technology

ODCS – Onboard Data Collection System
The history 3: one of ESA’s cornerstone missions

- Rosetta Lander project (1996-2015)
  - The Lander’s Power Subsystem
  - 10 boards
    - power control
    - power management
    - wakeup
    - battery/solar power management
    - A/D, housekeeping data

- HC technology, FPGA, radhard components
1998: Hungary joined to ESA PRODEXX (PROgramme de Développement d'EXpériences scientifiques) programme

2003: Hungary joined to ESA PECS (Plan for European Cooperating States)

2015: Hungary became full ESA member
Power distribution system development for ESA ESEO satellite
   - European Student Earth Orbiter, a micro-satellite to Low Earth Orbit (2008-18)

Participation in ESA student programmes
   - REXUS Rocket Experiments for University Students
   - BEXUS Balloon Experiments for University Students
     - bio-dosimetry, ionosphere-monitoring
   - The Bremen drop tower: Drop your thesis!

The ESA Alphasat propagation and communication experiment (2014-)

MASAT-1: The first Hungarian cubesat (2012-15)

SMOG family: PocketQube Class Satellite (2019-)
Spacecraft subsystems and payloads

**Subsystems**
- Structure and Mechanism
- Electrical Power System
- Thermal Control
- Propulsion
- Attitude Control
- Data Management (onboard computer)
- Communication
- (Software)

**Payloads**
- Technology demonstrations
- Scientific experiments
- Commercial devices
The curriculum of subject Space Technology

Weekly 2 lectures / 1 practice

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Midterm test

Visiting the Alphasat receiver stations
Sources:

- Gary D. Gordon, Walter L. Morgan: Principles of Communications Satellites
- Wilfried Ley, Klaus Wittmann and Willi Hallmann (ed): Handbook of Space Technology