X TH POLISH-AMERICAN CONFERENCE ON SCIENCE AND TECHNOLOGY

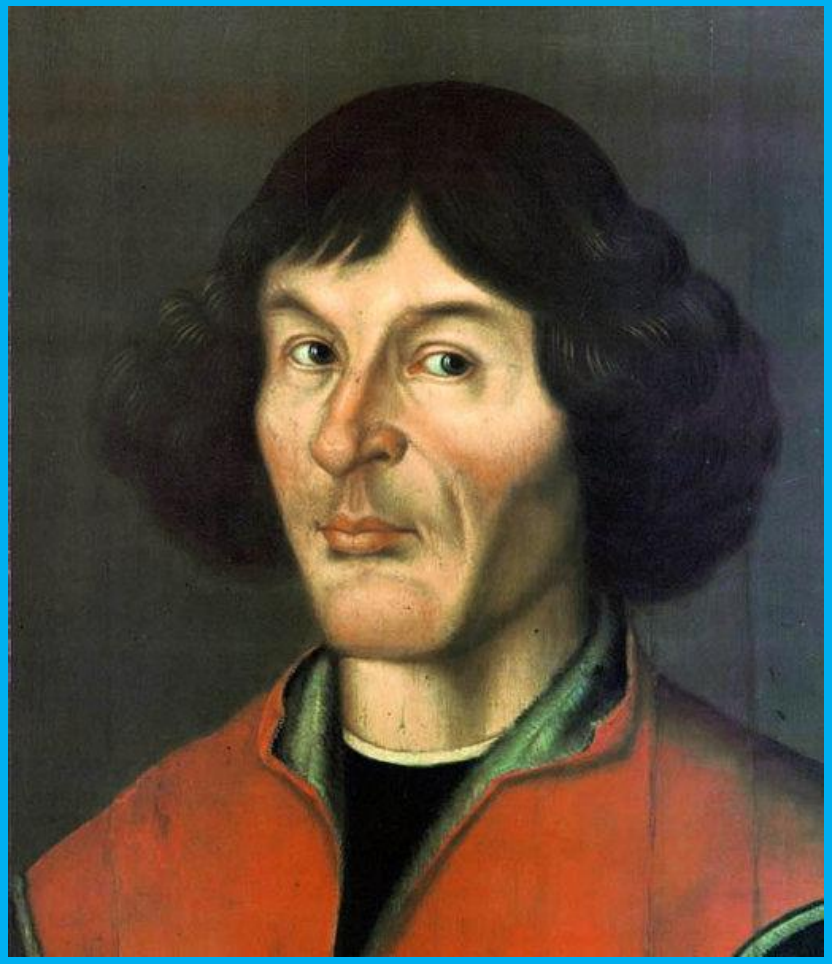
„TRANSFER OF TECHNOLOGY AND KNOWLEDGE"

Piotr Wolański

Polish Aerospace Activities

WASHINGTON D.C., 3-4 DECEMBER 2009

Mikołaj Kopernik (1473-1543),
Polish Astronomer, Matematiciam and Economist



„De revolutionibus orbium coelestium”

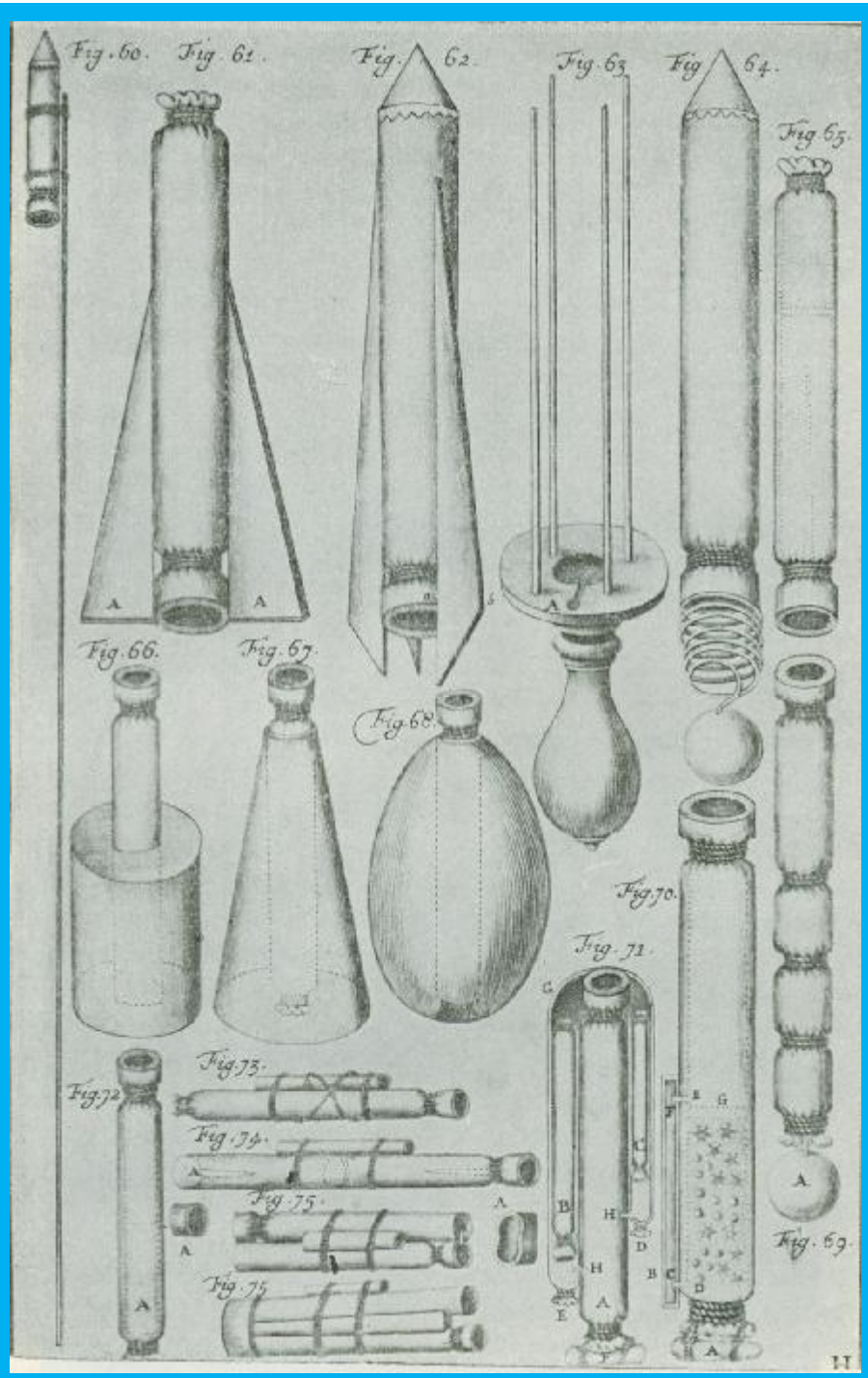
Jan Heweliusz
1611 - 1687

- Build largest telescope (50 m)
- Author of first map of the Moon
- From 1664 member of the Royal Society of London

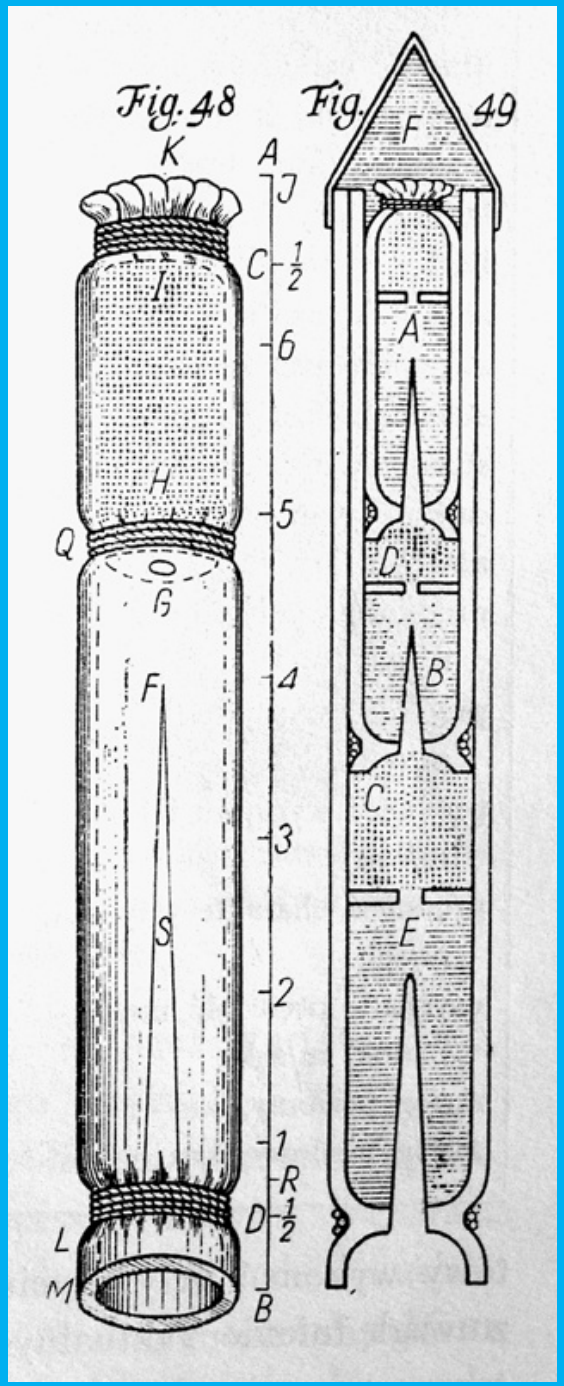
First map of the Moon by J. Heweliusz

Kazimierz Siemienowicz

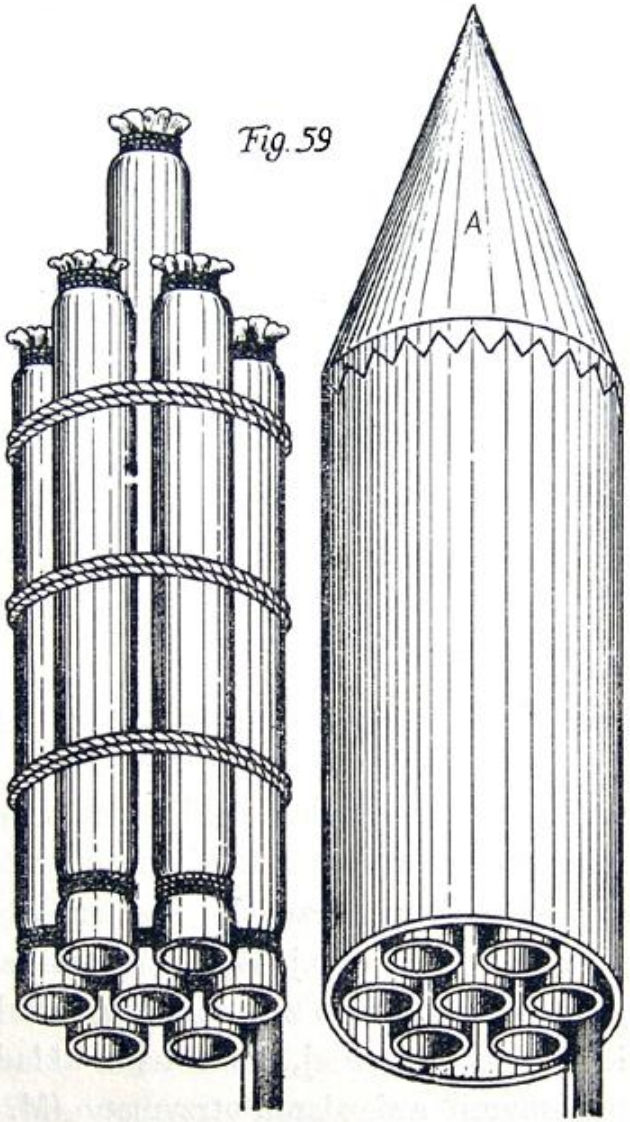
(1600 – 1651)

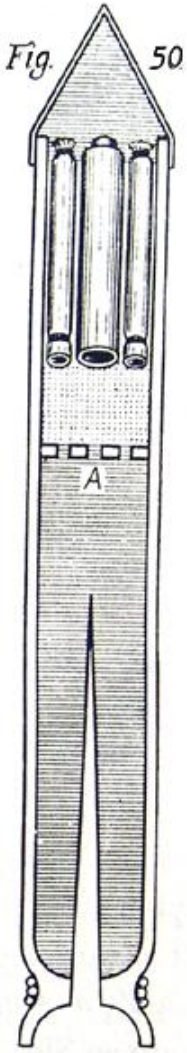


Page from his book: "*Artis Magnae Artilleriae pars prima*" ("Great Art of Artillery, the First Part"), first printed in Amsterdam in 1650, was translated to French in 1651, German in 1676 and Dutch in 1729 and finally Polish in 1963.



First multistage rockets proposed by Kazimierz Siemienowicz in 1650

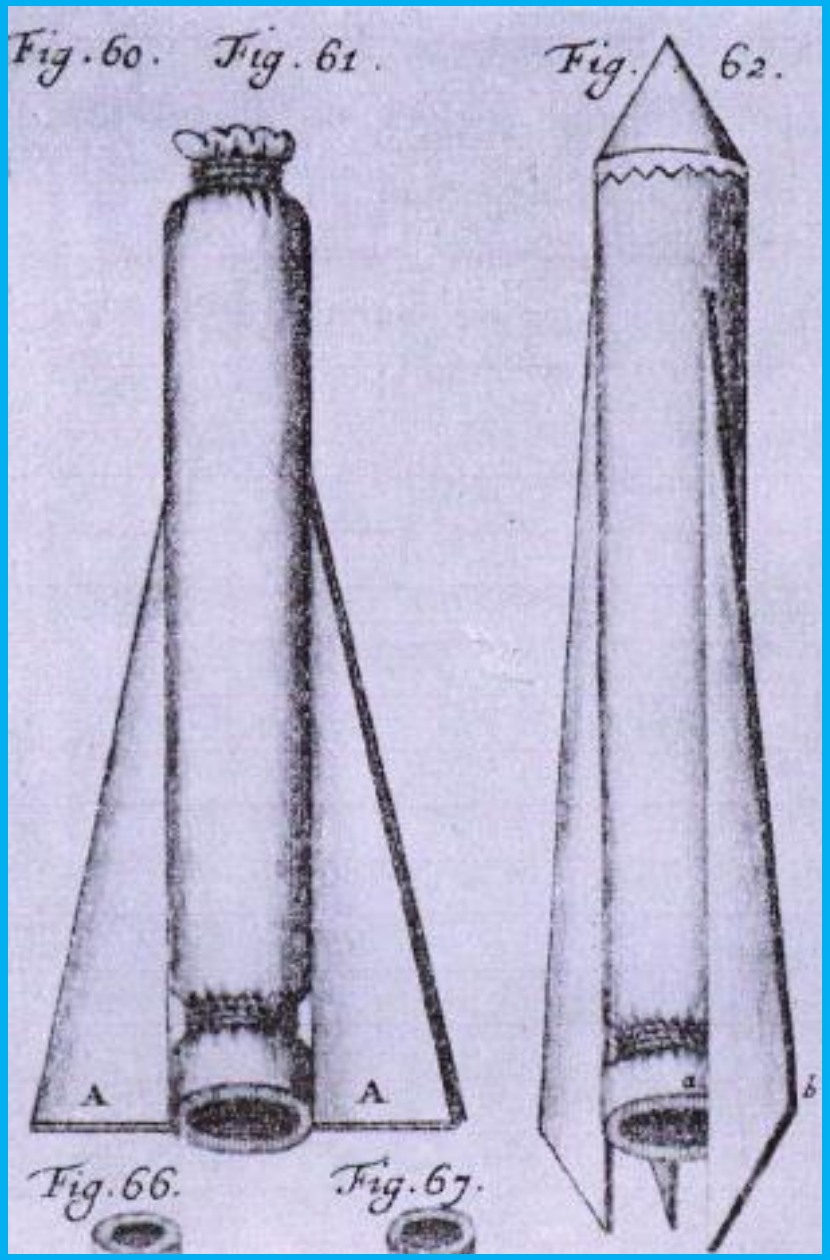




a) b)

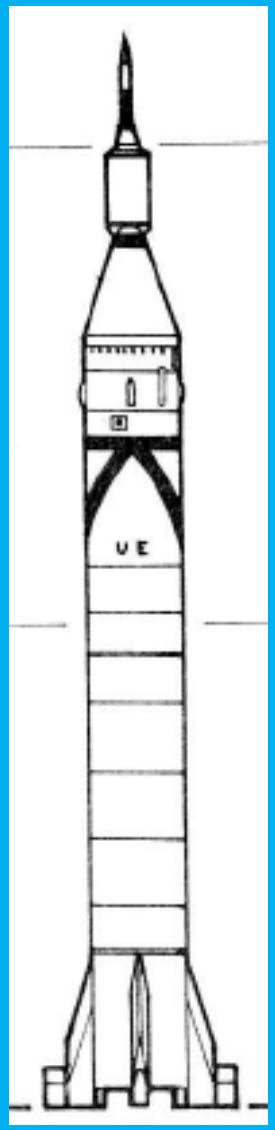
Rys. V—6. a) Oznaczony jako fig. 59 szkic stanowi pierwszą w historii wersję baterii rakietowej, podaną przez K. Siemienowicza w 1650 r. b) Oznaczony jako fig. 50 szkic stanowi pierwszą w historii wersję kombinowanej rakiety złożonej; drugi stopień jest baterią rakietową, złożoną z dwu rakiet. Autorem tego wariantu jest K. Siemienowicz 1650 r.

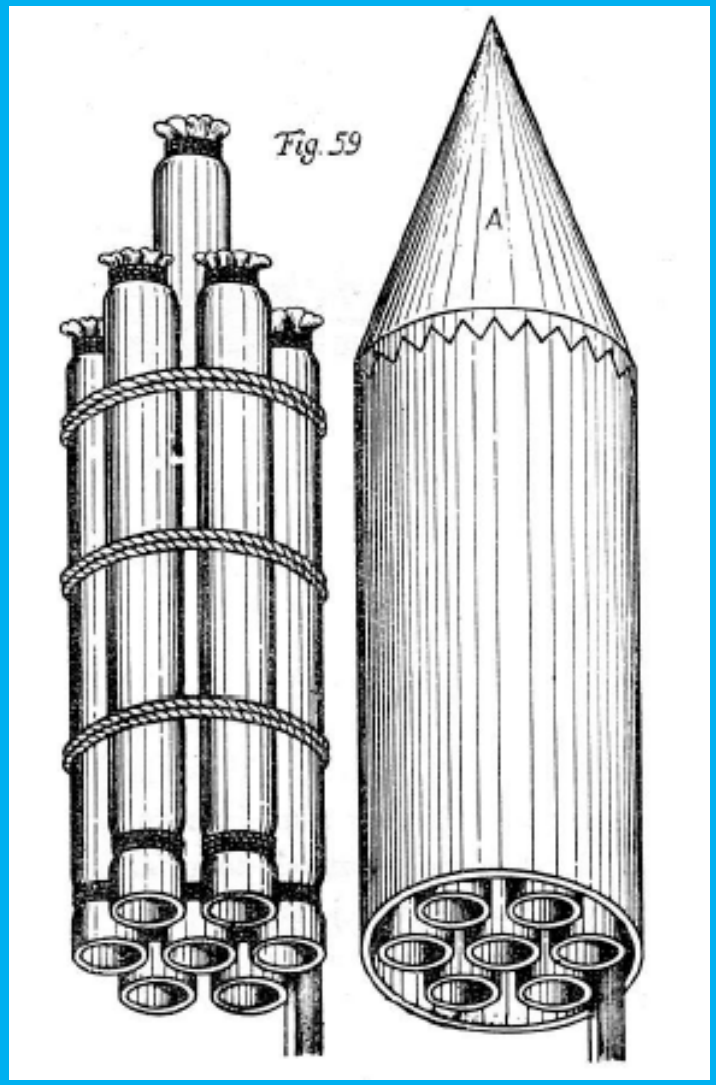
First rockets clusters proposed by Kazimierz Siemienowicz in 1650

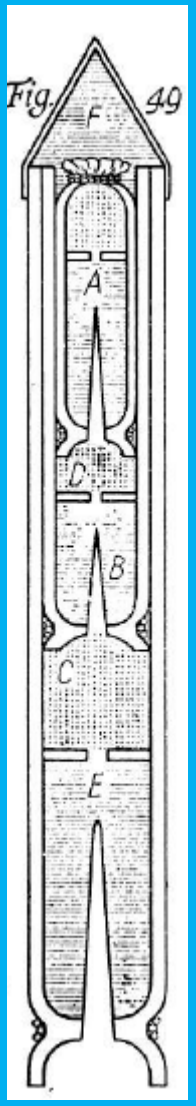


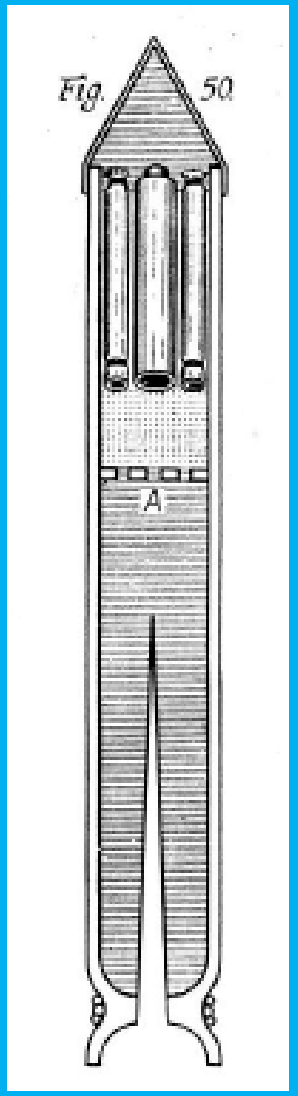
First rockets stabilized by aerodynamic fins proposed by K. Siemienowicz in 1650

K. Siemienowicz ideas introduced into practical applications





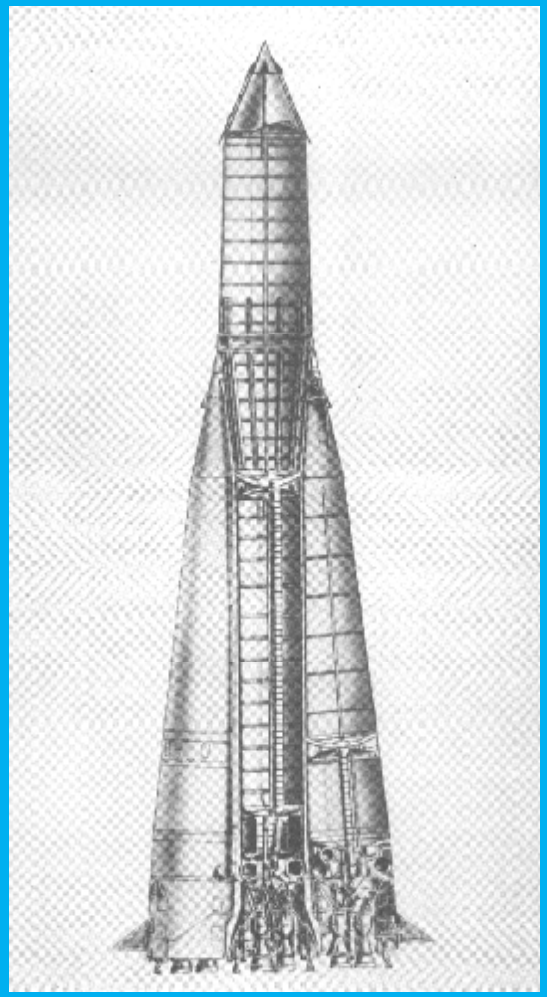


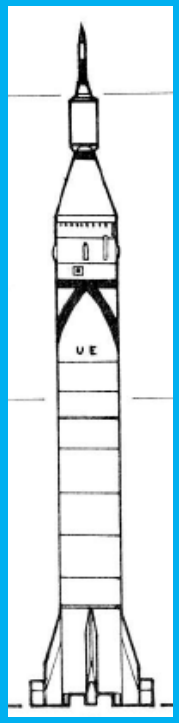


Rocket Propellants

1853 - Ignacy Łukasiewicz first obtained kerosene from crude oil – today's commonly used as the rocket fuel

1883 - Karol Stanisław Olszewski and Zygmunt Wróblewski were first which obtained liquid oxygen – most commonly used liquid rocket engines oxidizer



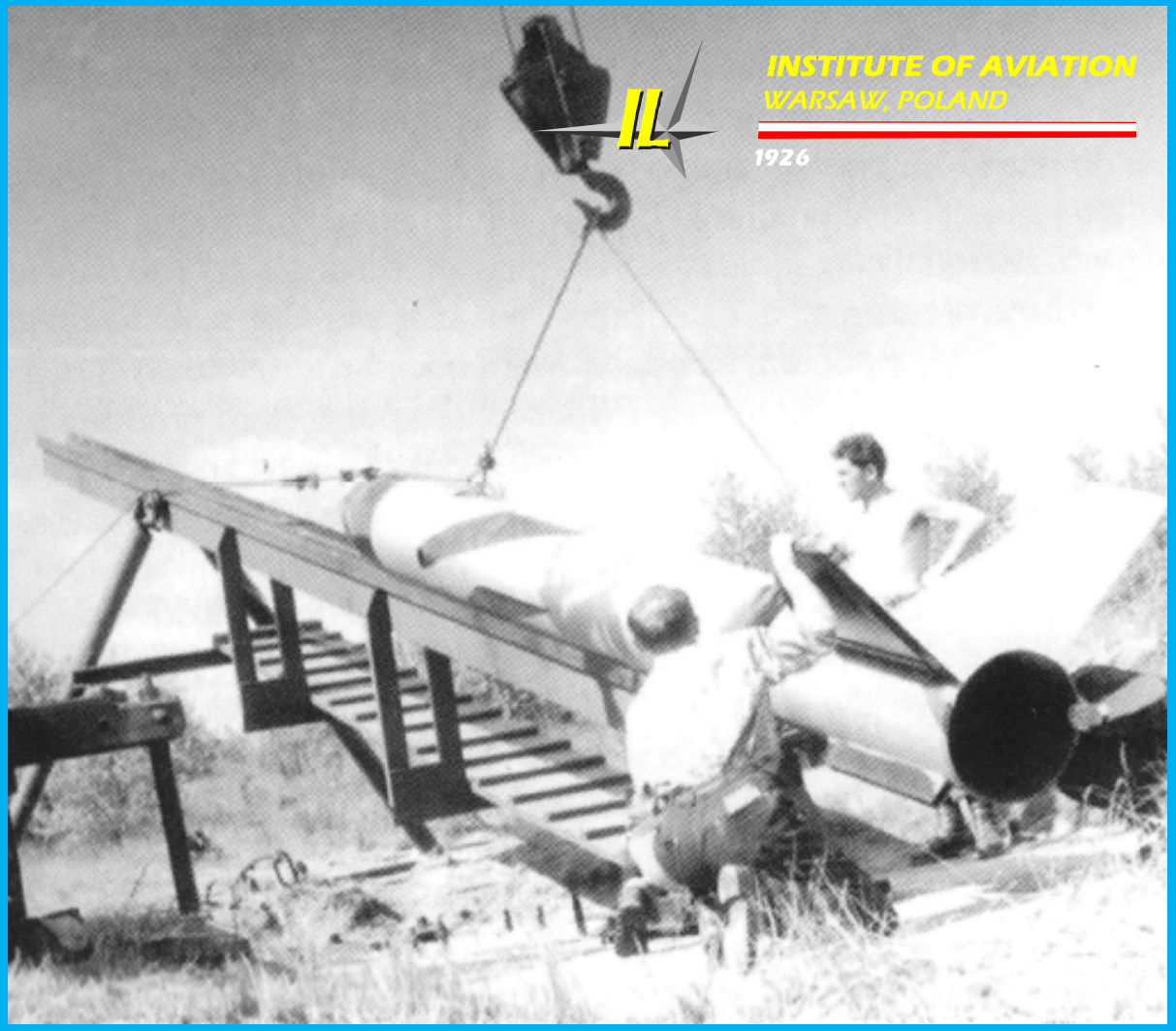


Sputnik-1 and Explorer-1 Rockets

(used ideas of K. Siemienowicz, all engines of Sputnik-1 rocket were propel by liquid oxygen and kerosine)

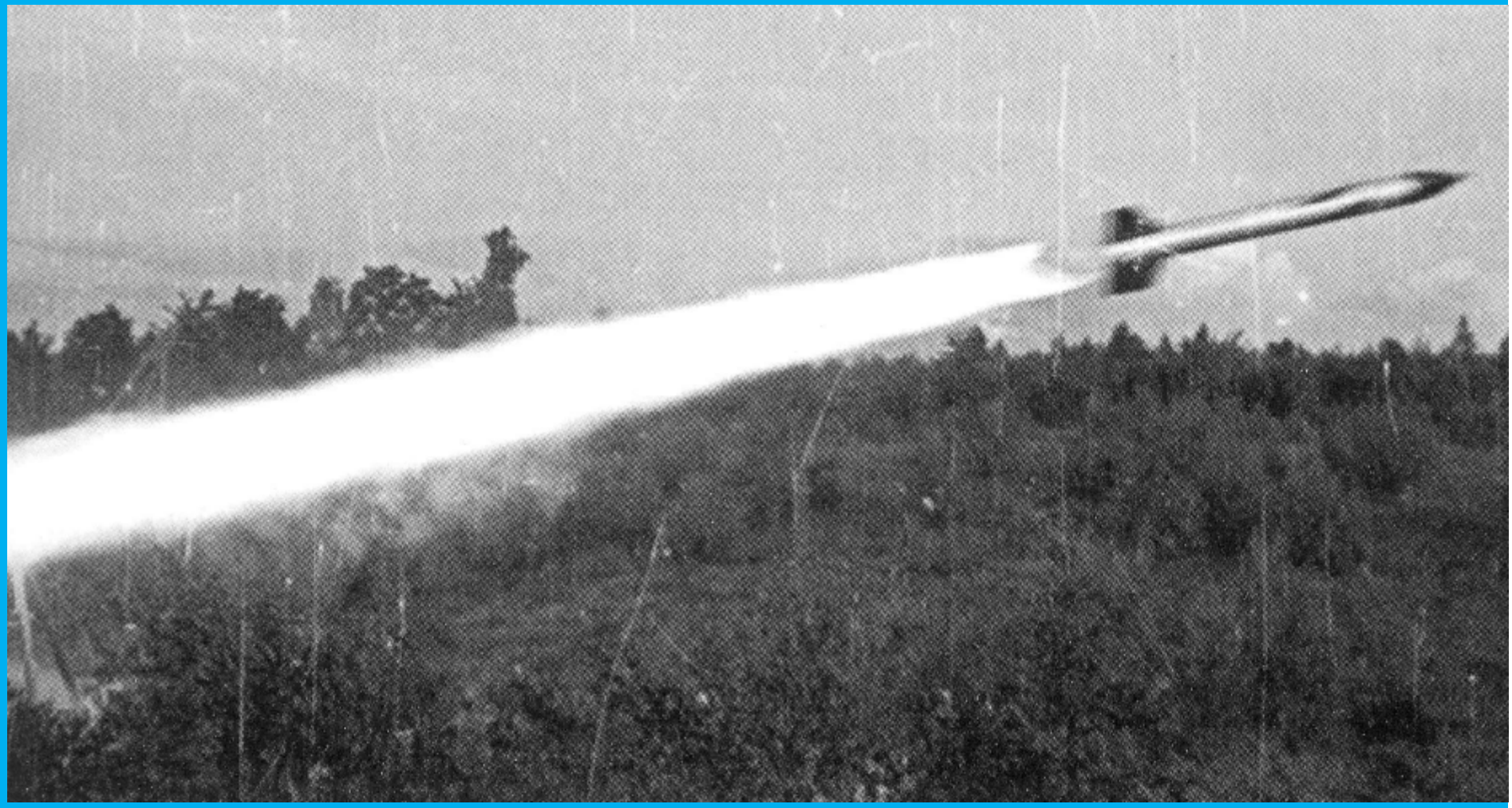
Institute of Aviation

Rocket development at the Institute of Aviation



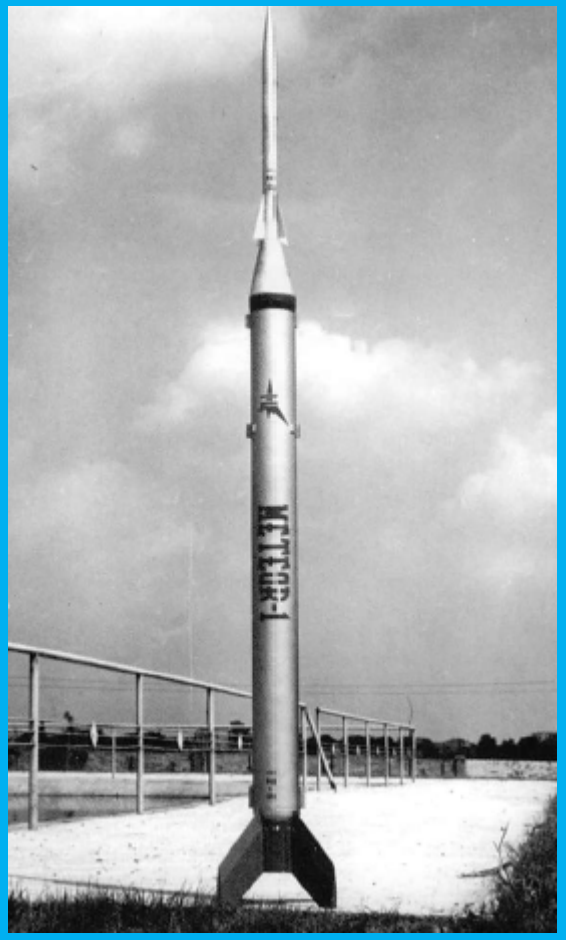
Possible booster of satellite launcher

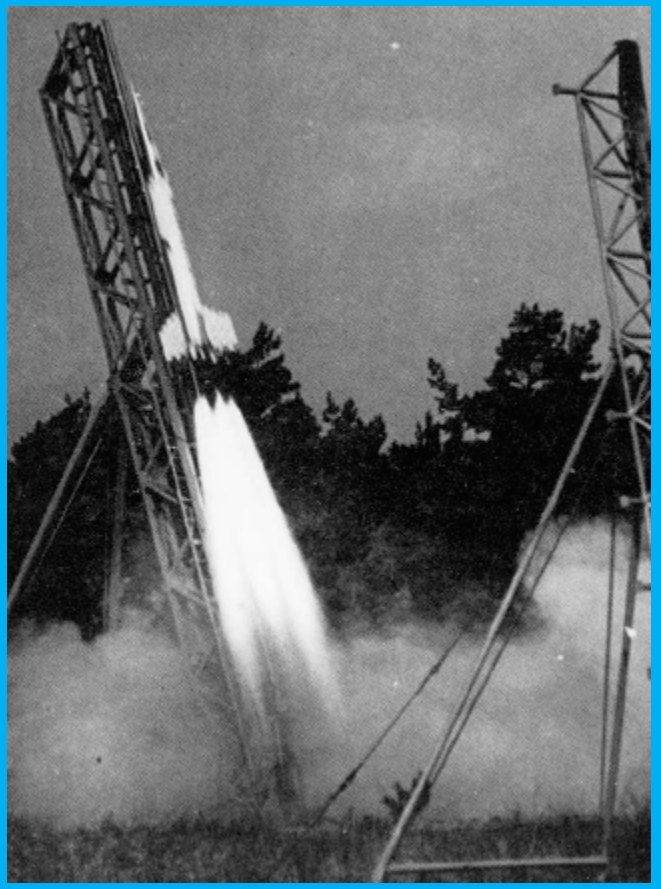
Launch of the ballistic missiels developed at the IofA

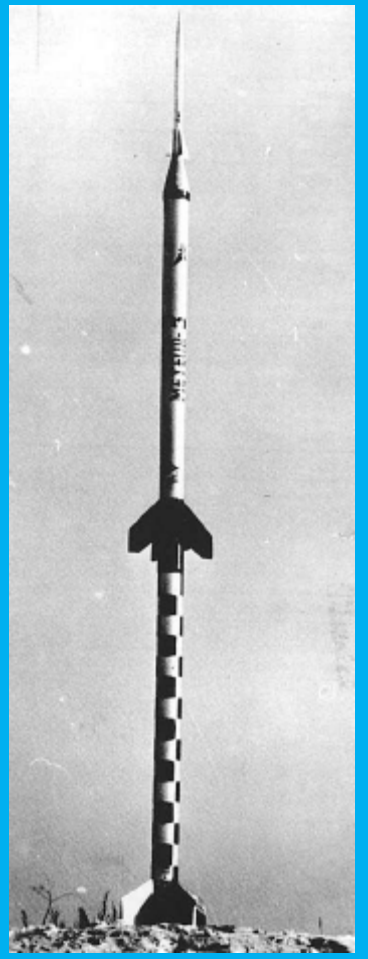


INSTITUTE OF AVIATION
WARSAW, POLAND
1926

Polish meteorological rockets

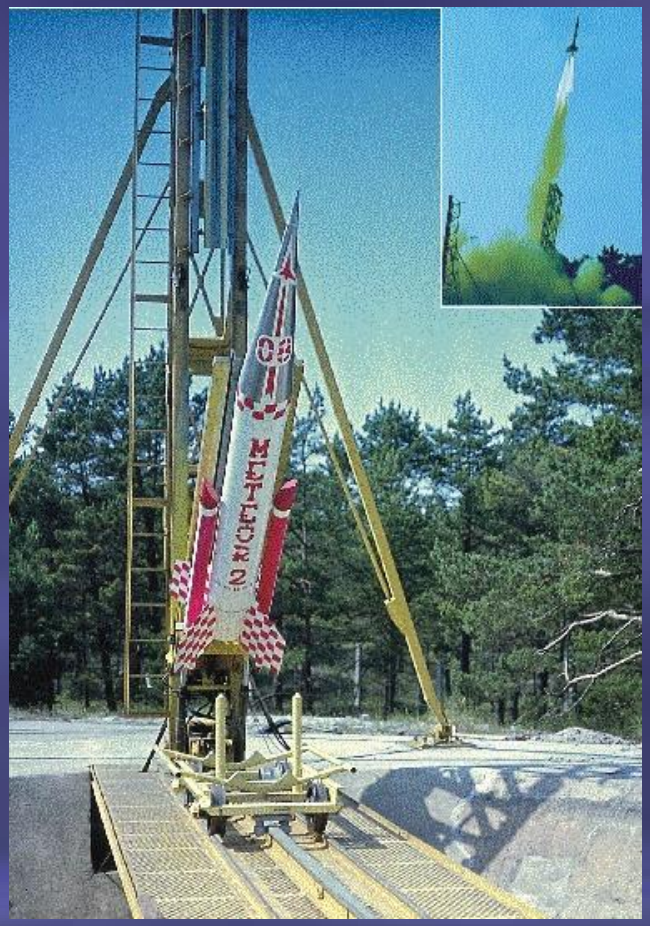






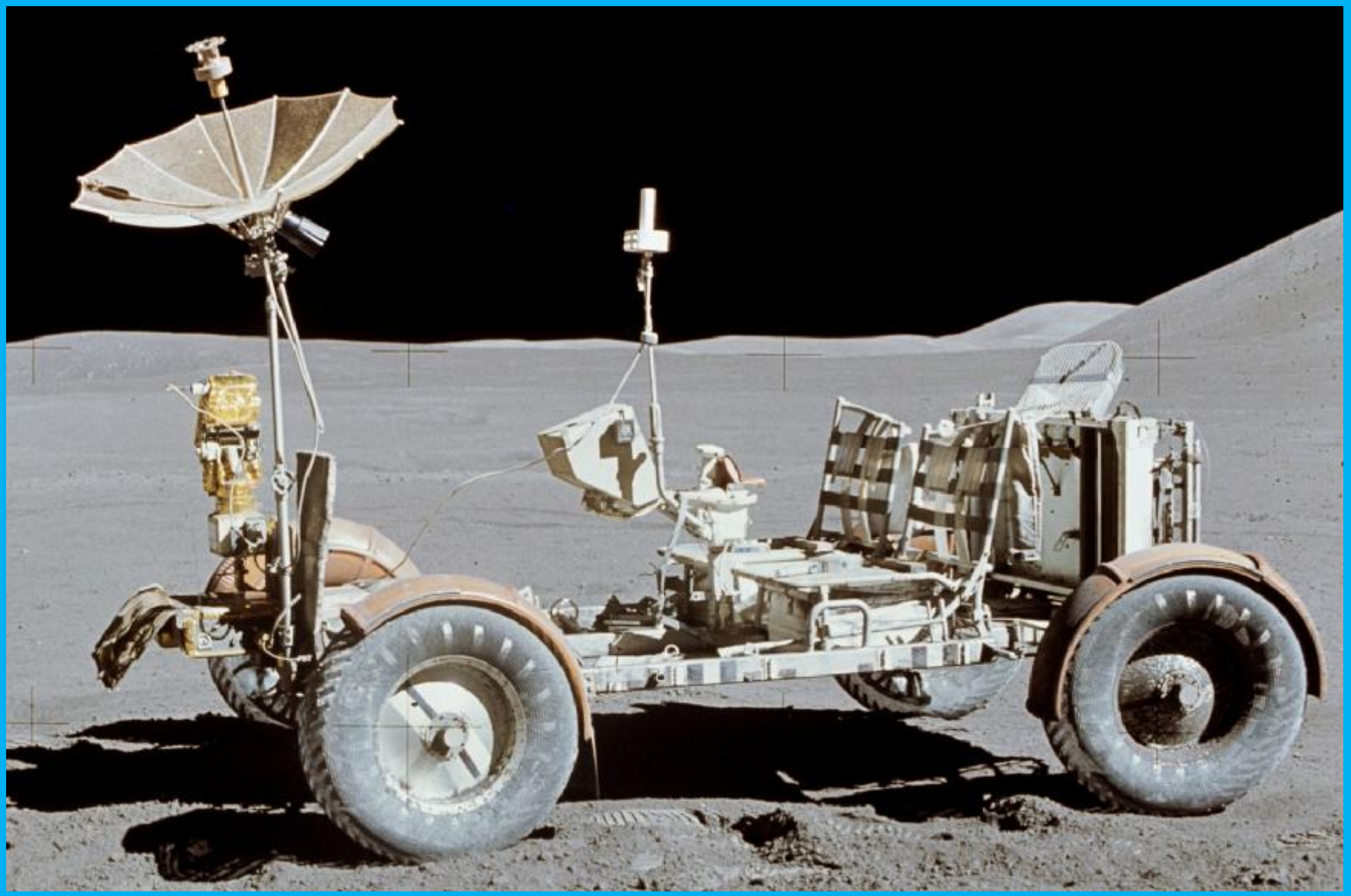
INSTITUTE OF AVIATION
WARSAW, POLAND
1926

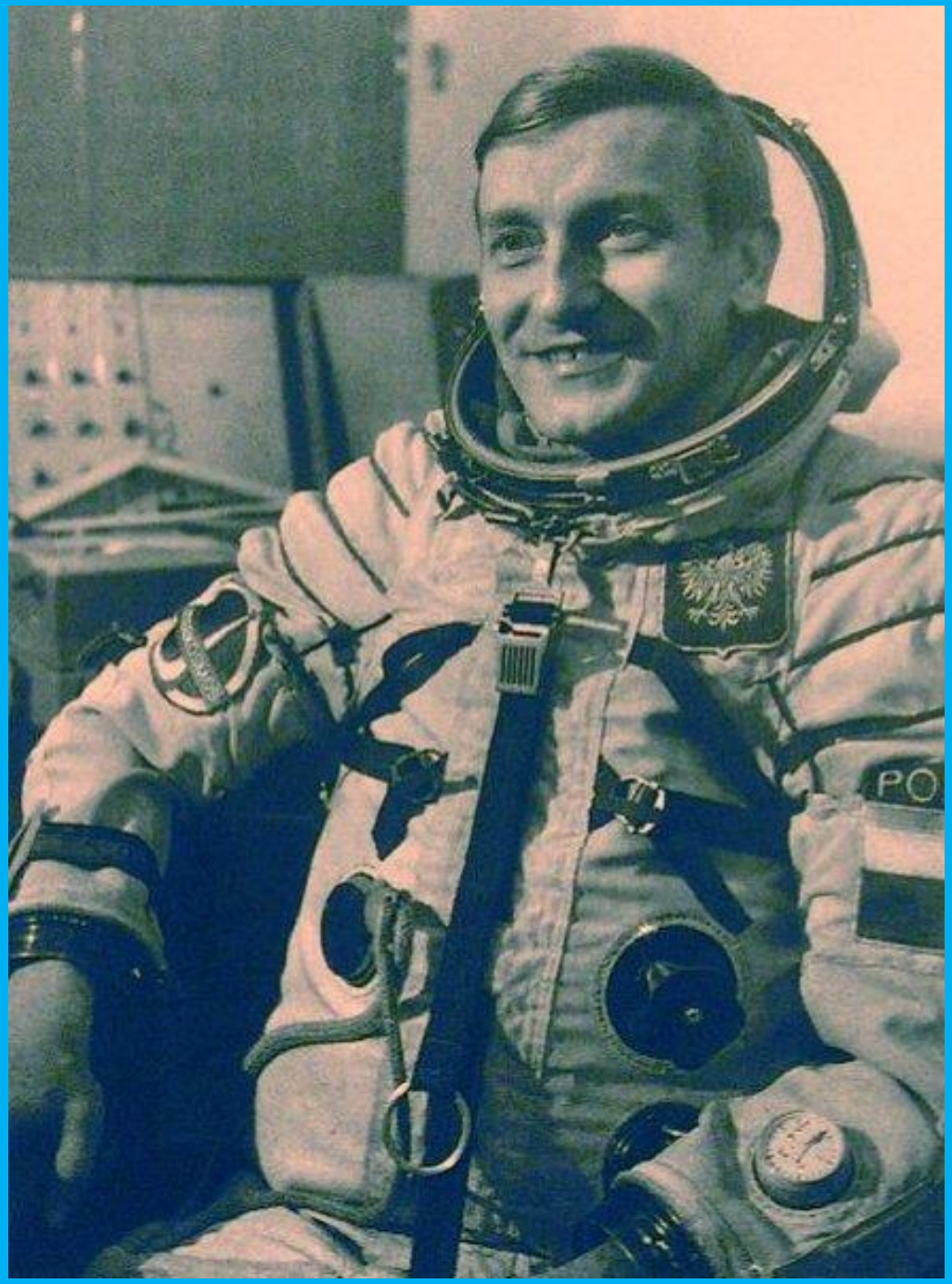
Initial way into space



”METEOR -2” reach altitude of 105 km

Mieczysław Grzegorz (Gregory) Bekker





Mirosław Hermaszewski

only Polish Cosmonaut

Soyuz – 30

Salyut -7

27,06 – 5,07 1978

Space applications

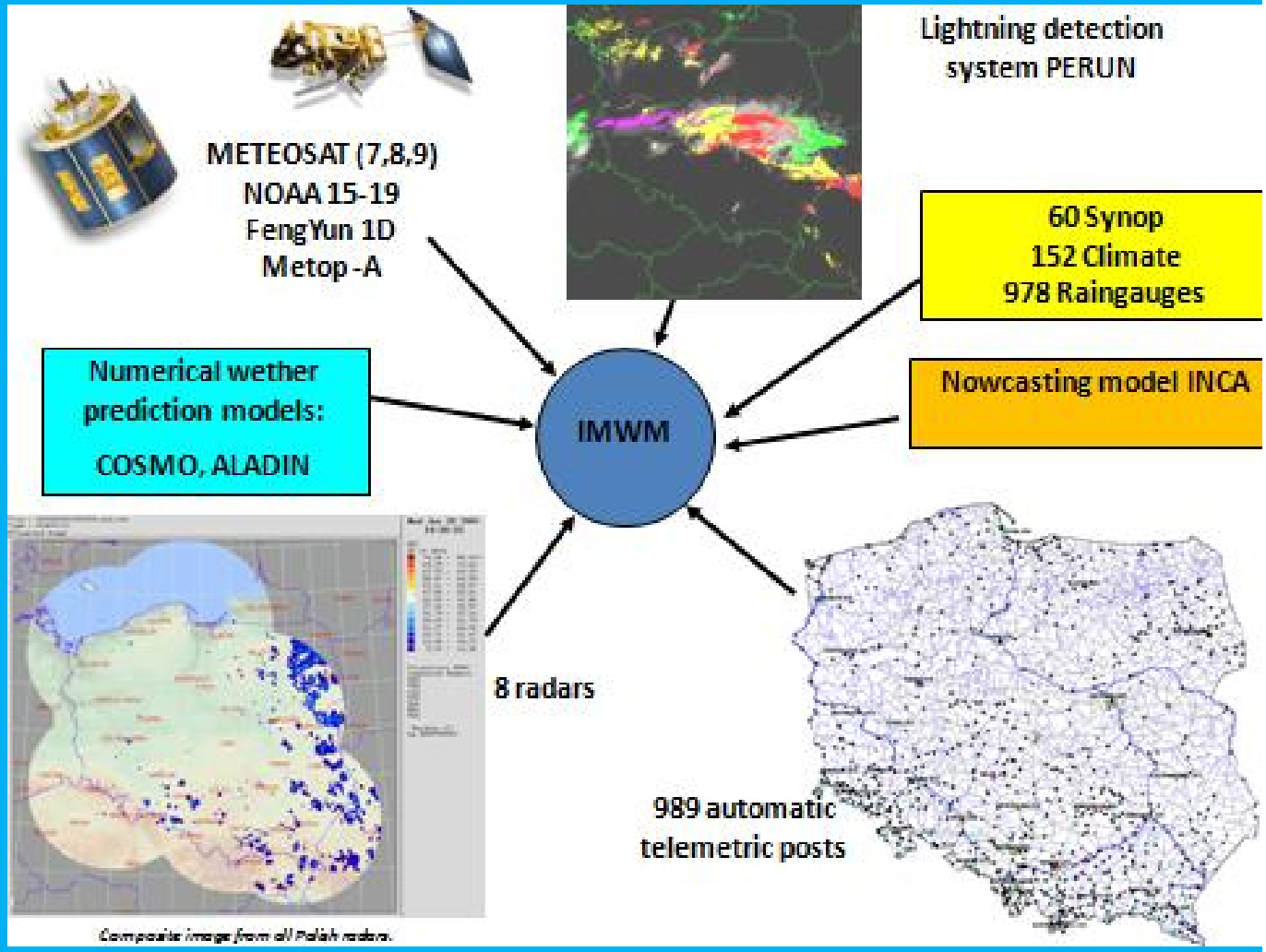
- Meteorology
- Telecommunication
- Remote Sensing
- Geodesy and Navigation

METEOROLOGY

Institute of Meteorology and Water Management
use satellites data for more then 40 years

Applications:

- weather forecast
- snow and ice cover
- atmospheric data and ozone monitoring
- water level and land temperature
- vegetations
- radiation balance



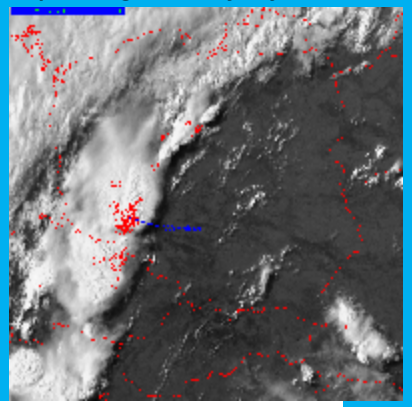
Satellite Systems available to IMGW

- Geostationary satellites
  - METEOSAT 9 (MSG-2)
  - METEOSAT 8 (backup)
  - METEOSAT 7 (Indian Ocean)
  - METEOSAT 6 (backup)
  - Pośrednio: GOES-E, GOES-W, MTSAT-1R

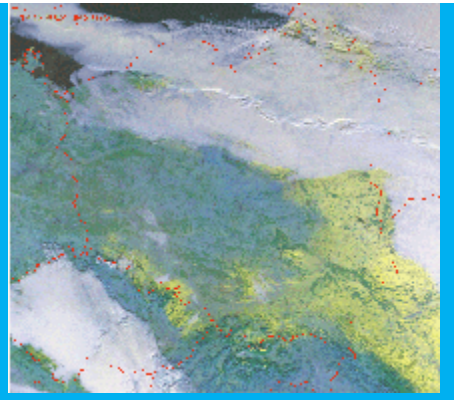
- Polar orbits
  - NOAA- 15, 16, 17, 18, 19
  - FengYun 1D
  - METOP-A

Application of methorological satellite data's in IMGW

Wspomaganie wykrywania zagrożeń

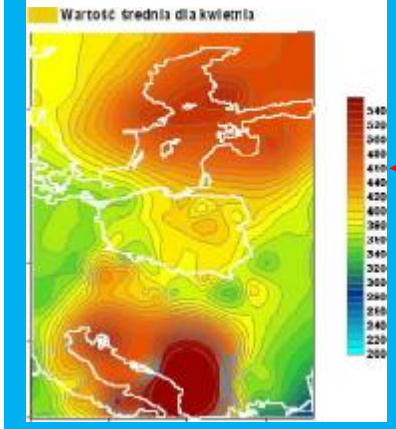


Aktualna sytuacja meteorologiczna

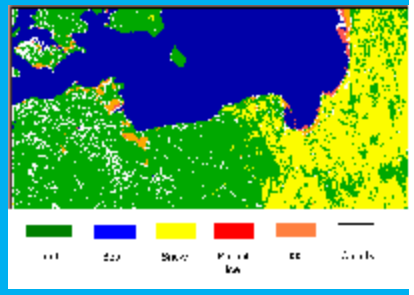


Zasięg pokrywy śnieżnej

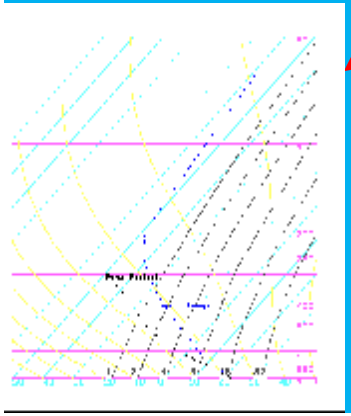
Monitoring ozonu stratosferycznego



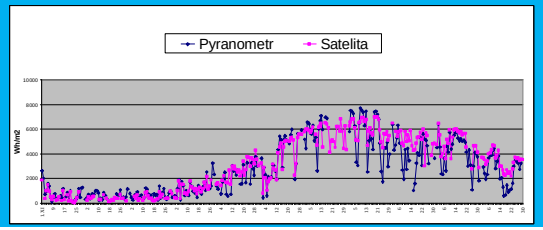
Zlodzenie Bałtyku



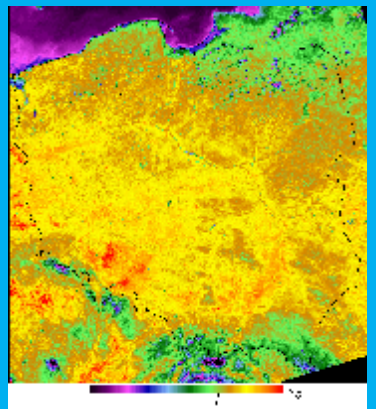
Sondaż atmosfery



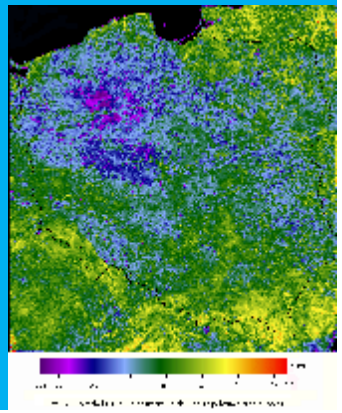
Bilans promieniowania

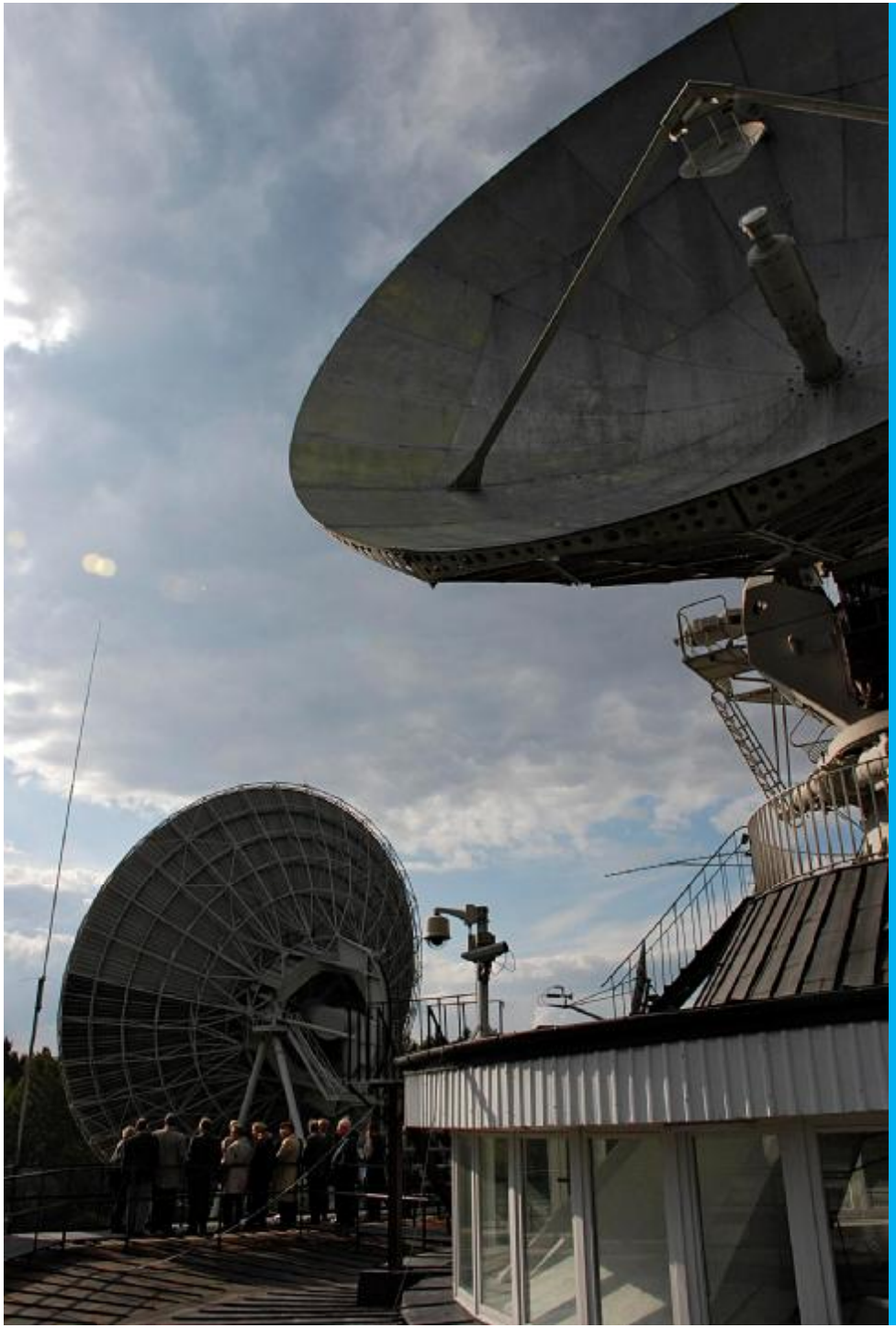


Temperatura powierzchni



Stan pokrycia roślinnego





PSARY

Satellite Services Centre of Telekomunikacja Polska

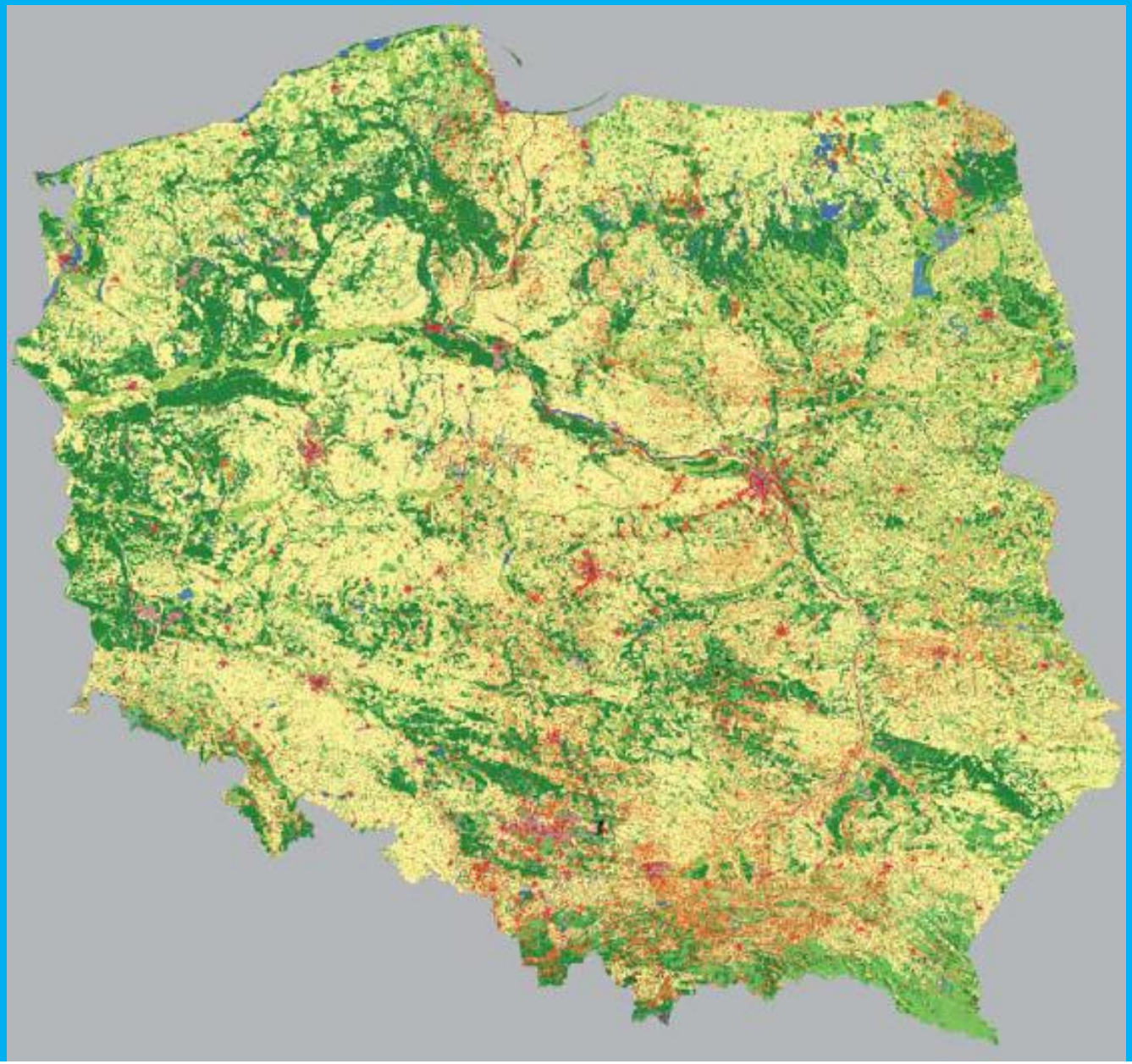
The centre offered services in:

1. **VSAT data transmission,**
2. **Voice, telefax, and data transmission in Inmarsat system,**
3. **Capacity lease of space segment,**
4. **Operator services for satellite ground stations.**

Psary

Remote Sensing

Land use in Poland based on Landsat data IG&C – 1976-81



Laser Ranging Station - Borowiec

Geodesy and Navigation

Polish segment of EUPOS

Recent activities of the Space Technology Division Institute of Aviation

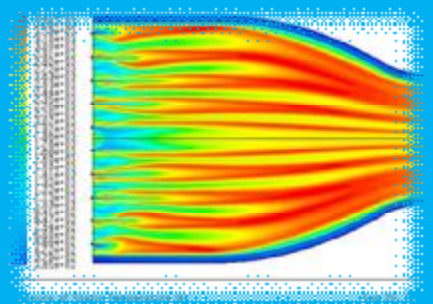
INSTITUTE OF AVIATION

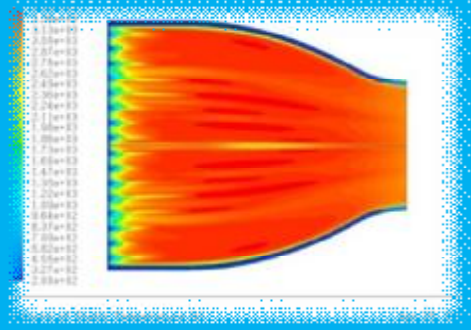
Warsaw, POLAND
http://www.ilot.edu.pl

SPACE TECHNOLOGY DEPARTMENT

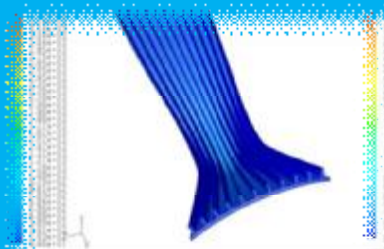
CFD ANALYSES: COMBUSTION, COOLING, PERFORMANCES OF ROCKET ENGINE

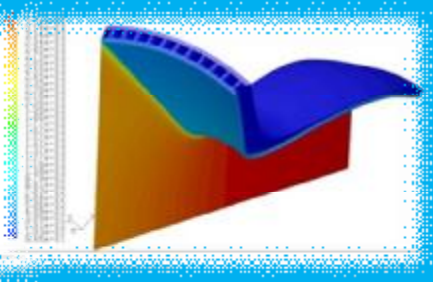
COMBUSTION



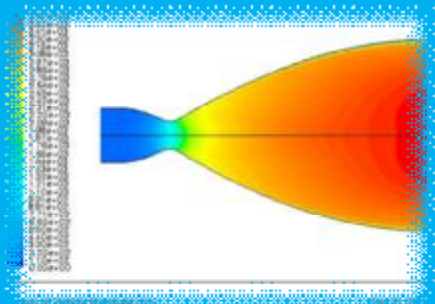


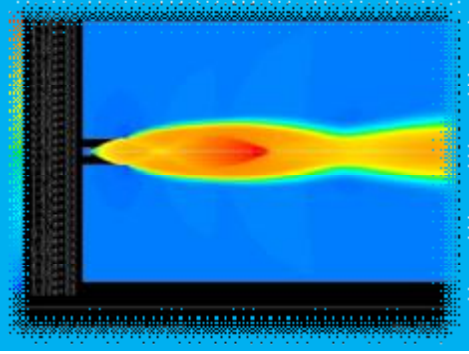
COOLING





PERFORMANCES





INSTITUTE OF AVIATION

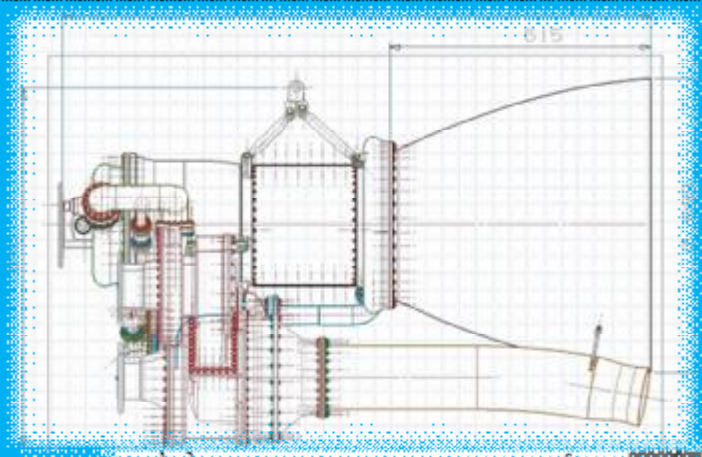
Warsaw, POLAND
http://www.ilot.edu.pl

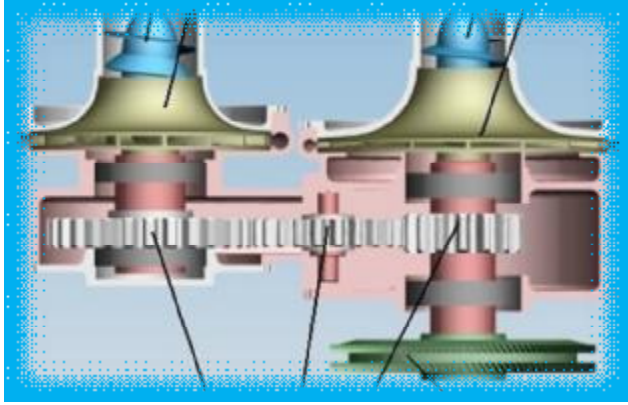
SPACE TECHNOLOGY DEPARTMENT

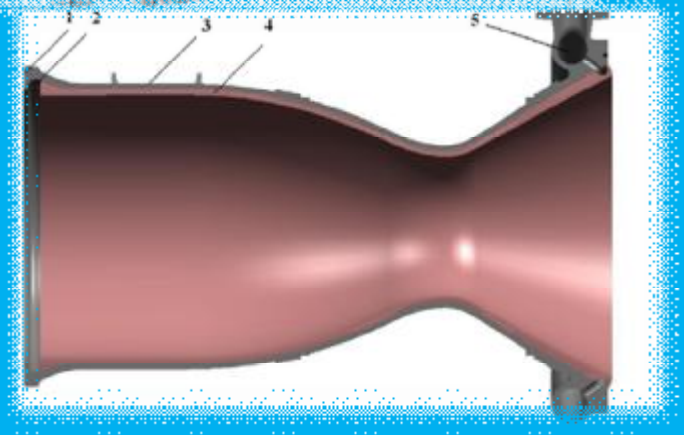
DESIGN OF LIQUID ROCKET ENGINES

Rocket engine with turbo-pump feed system

Possible application:
Propulsion unit for first stage of small rocket launcher, as a march engine .



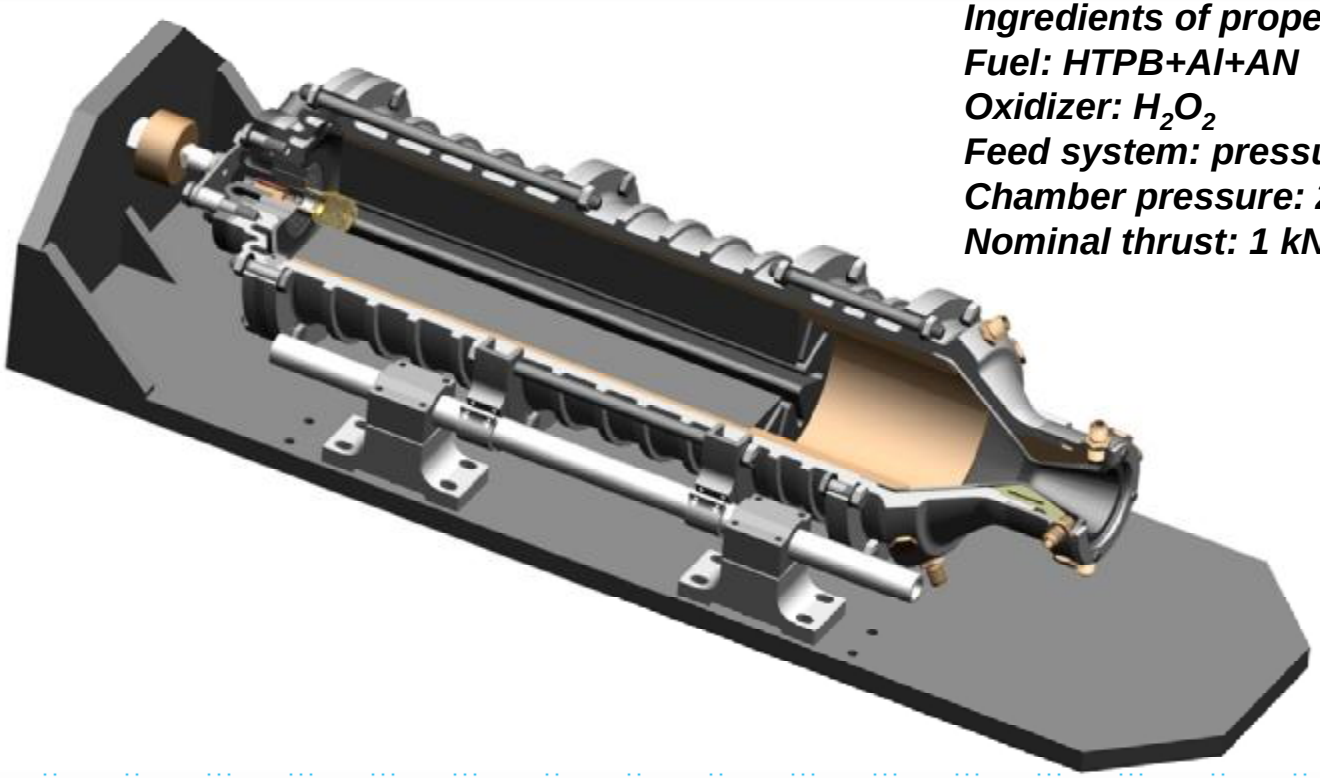




INSTITUTE OF AVIATION
Warsaw, POLAND
http://www.ilot.edu.pl

SPACE TECHNOLOGY DEPARTMENT

DESIGN OF HYBRID EXPERIMENTAL ROCKET MOTOR

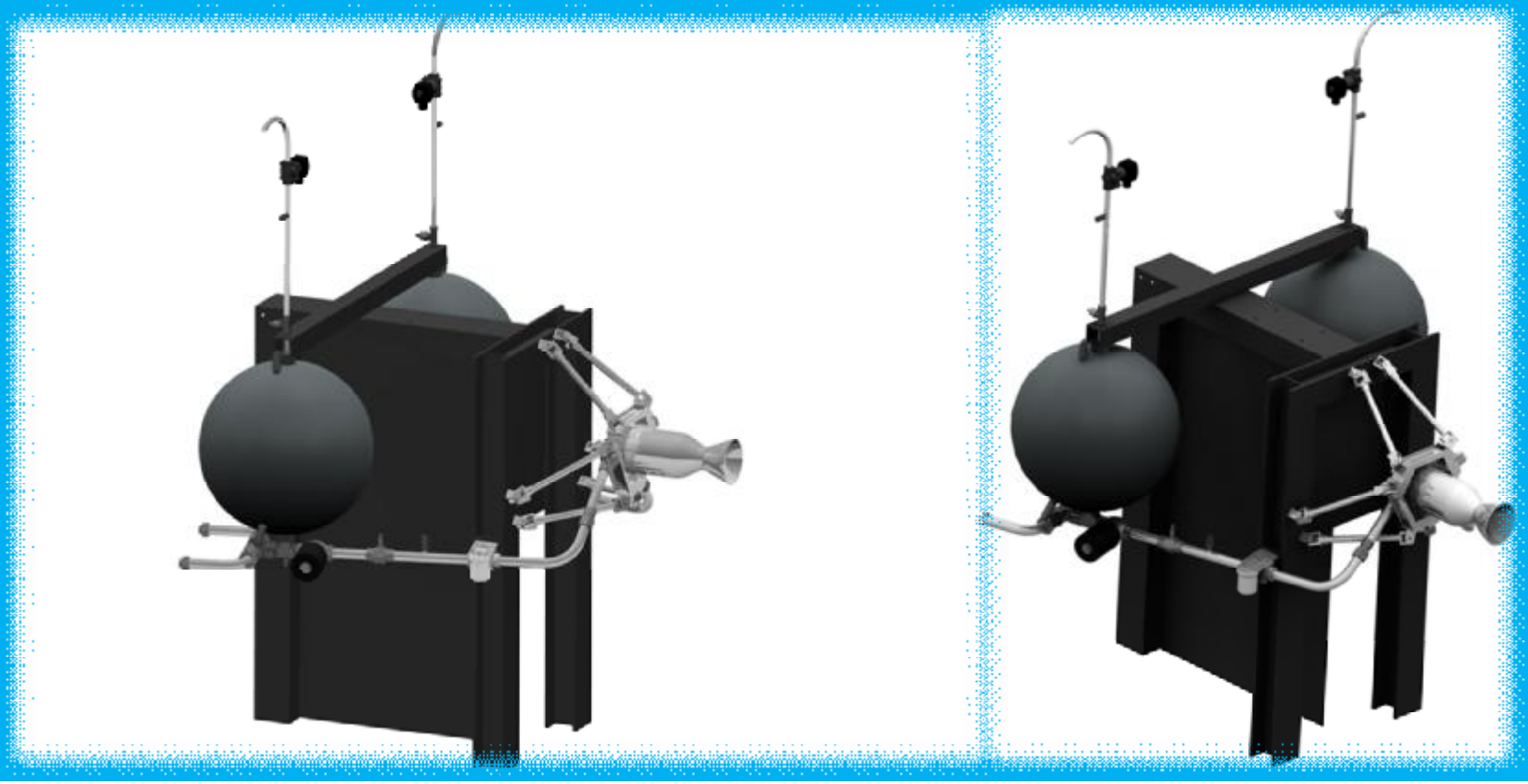


Ingredients of propellant
Fuel: HTPB+Al+AN
Oxidizer: H_2O_2
Feed system: pressured
Chamber pressure: 20 bar
Nominal thrust: 1 kN

INSTITUTE OF AVIATION
Warsaw, POLAND
http://www.ilot.edu.pl

SPACE TECHNOLOGY DEPARTMENT

PROJECT OF MOVEABLE TEST STAND FOR ROCKET ENGINES



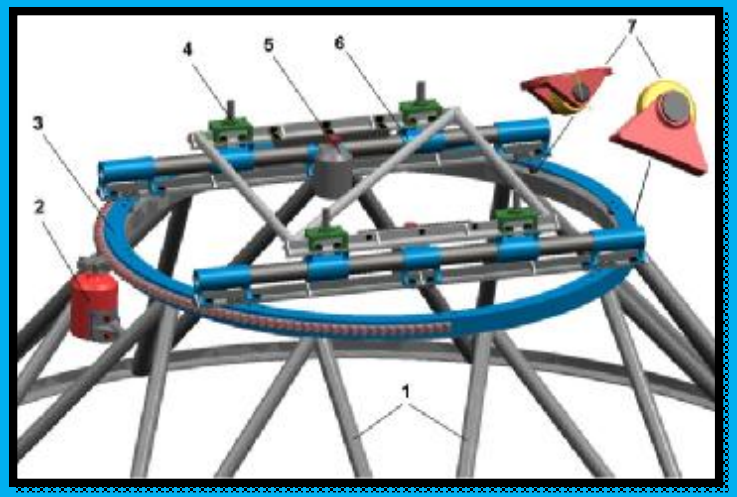
INSTITUTE OF AVIATION
Warsaw, POLAND
http://www.ilot.edu.pl

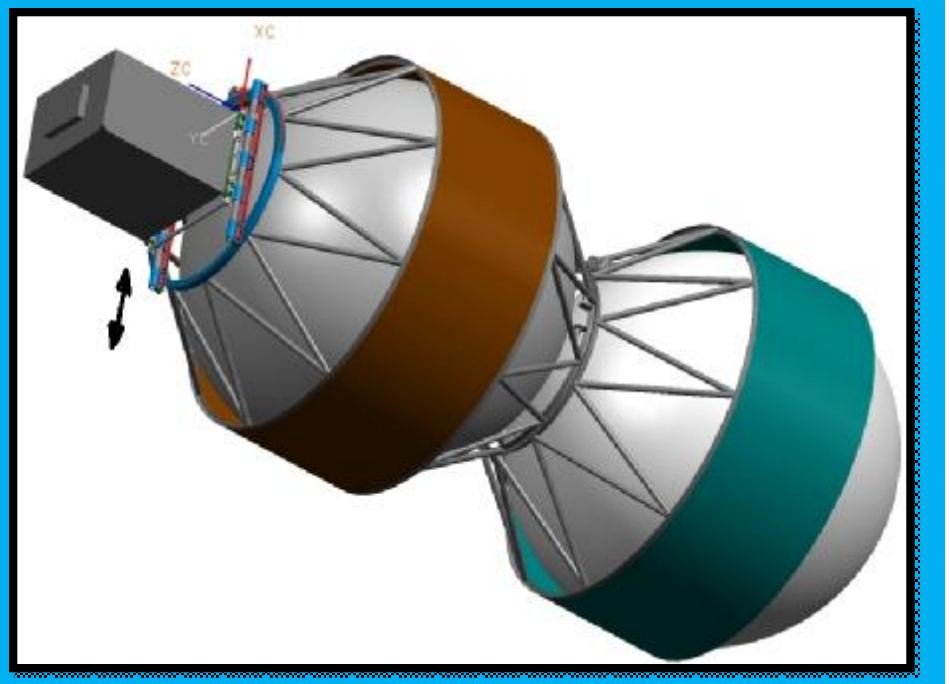
SPACE TECHNOLOGY DEPARTMENT

NEW METHOD FOR STEERING UPPER STAGE OF ROCKET LAUNCHER

Possible solutions:

- Additional element with big mass and able to relative motion in reference to upper stage
- Liquid propellants
- Relative motion of rocket stages

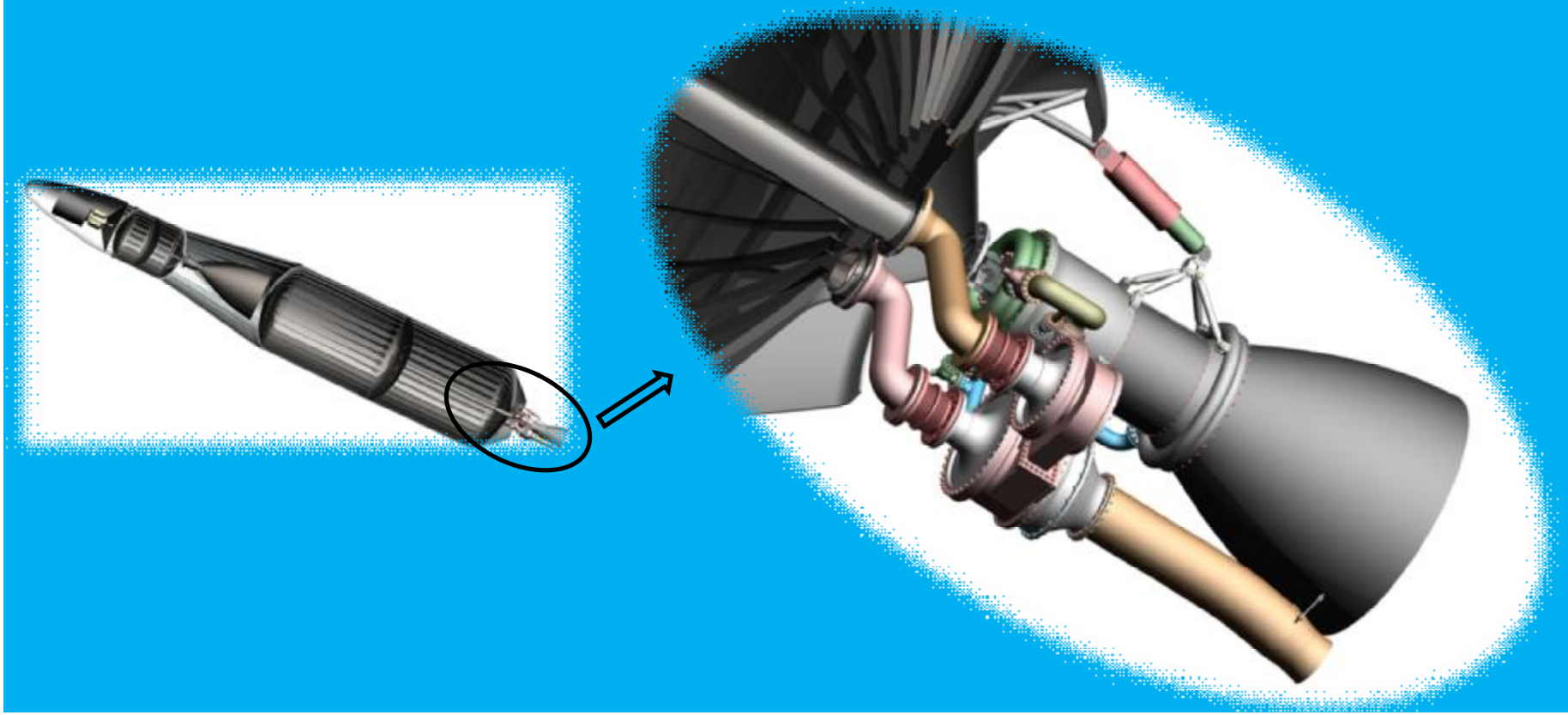




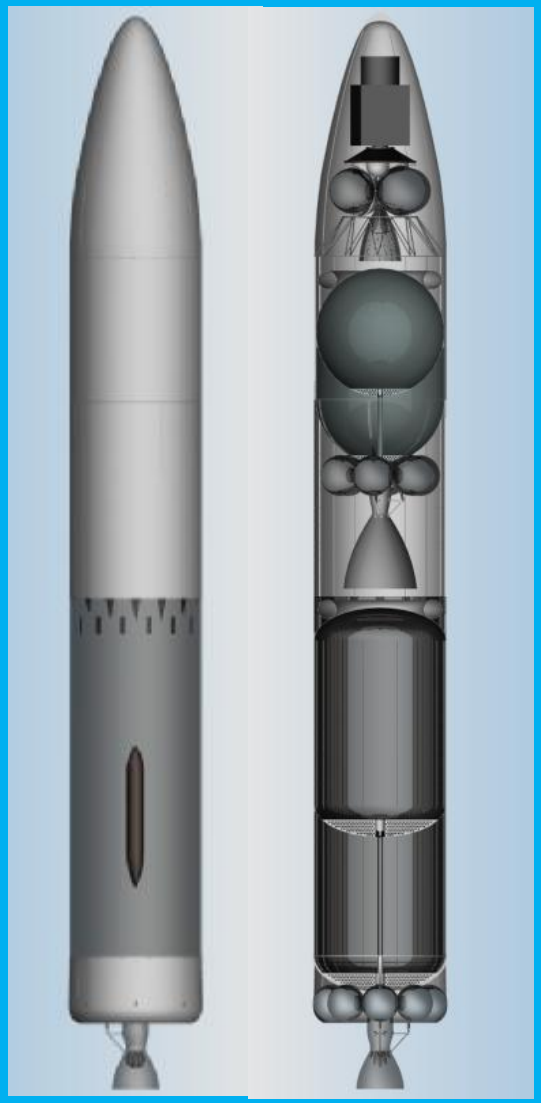
INSTITUTE OF AVIATION
Warsaw, POLAND
http://www.ilot.edu.pl

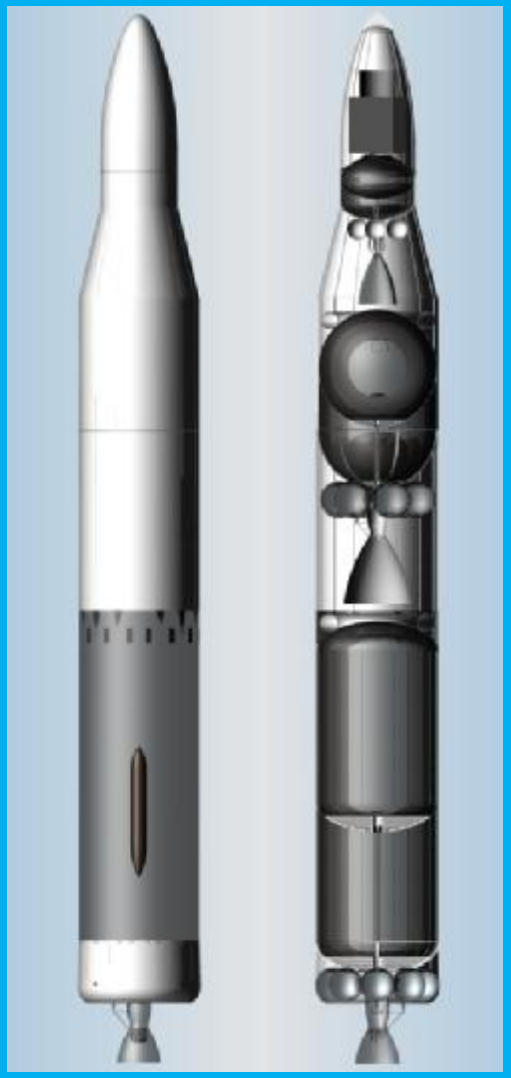
SPACE TECHNOLOGY DEPARTMENT

DESIGN OF LIQUID ROCKET ENGINES



Studies of different rocket configurations





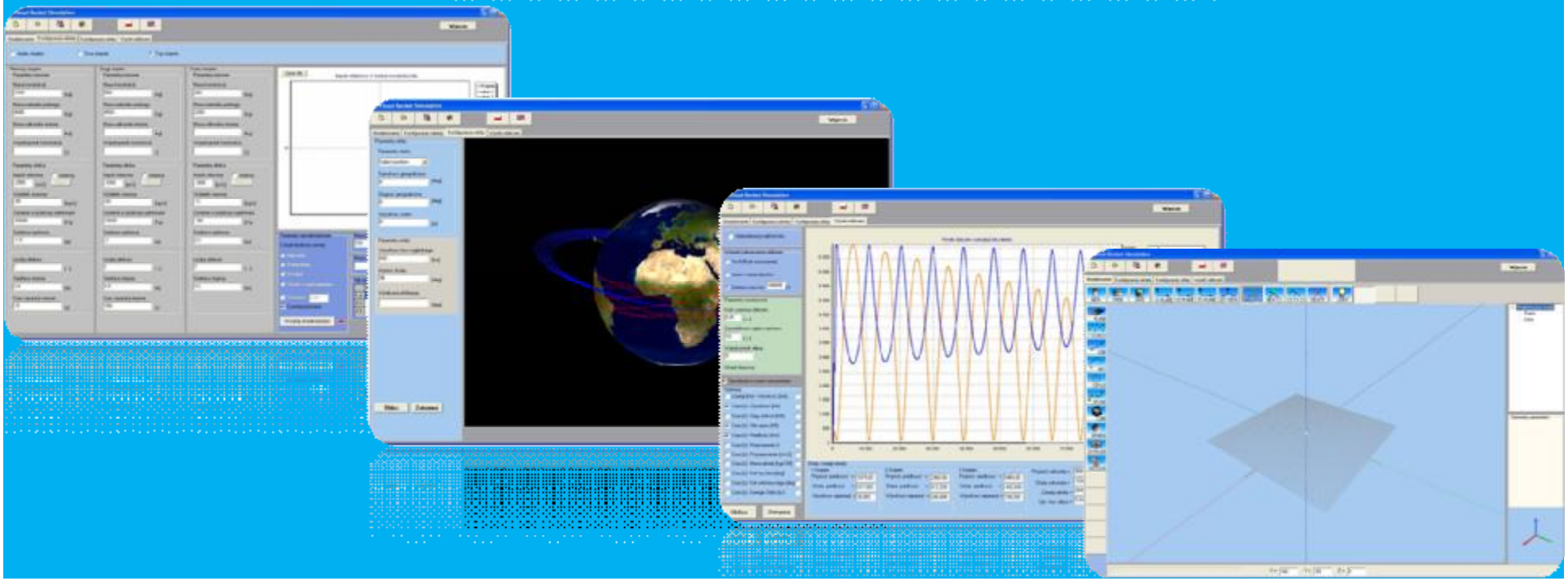
INSTITUTE OF AVIATION

Warsaw, POLAND
http://www.ilot.edu.pl

SPACE TECHNOLOGY DEPARTMENT

SOFTWARE DEVELOPMENT TO AID DESIGN PROCESSES

VRS- VISUAL ROCKET SIMULATION



INSTITUTE OF AVIATION

Warsaw, POLAND
http://www.ilot.edu.pl

SPACE TECHNOLOGY DEPARTMENT

RESEARCHES ABOUT NEW PROPELLANTS TO SPACE APPLICATIONS OBTAINED FROM PLANTS (FUELS OF SECOND GENERATION)

Bio-fuels of second generation to space and aeronautic industry applications (rocket engines and aircraft engines)

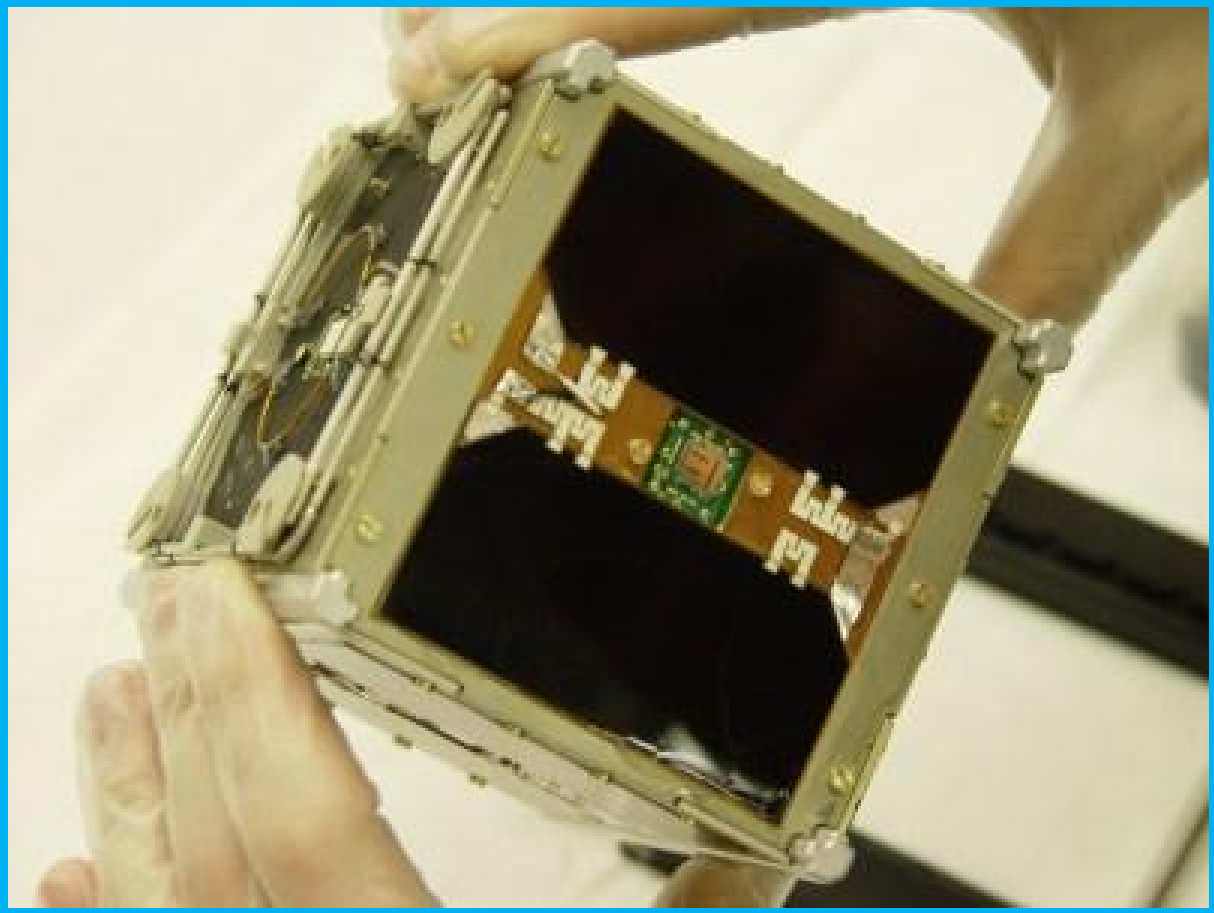
Main purpose of recently researches provided in Institute of Aviation with bio-fuels:

- point of new advantages and replace old bio-fuels by new second generation bio-fuels
- development bio-fuel that will be possible to use for rockets and aircrafts
- increase market and improvement technology for new bio-fuels

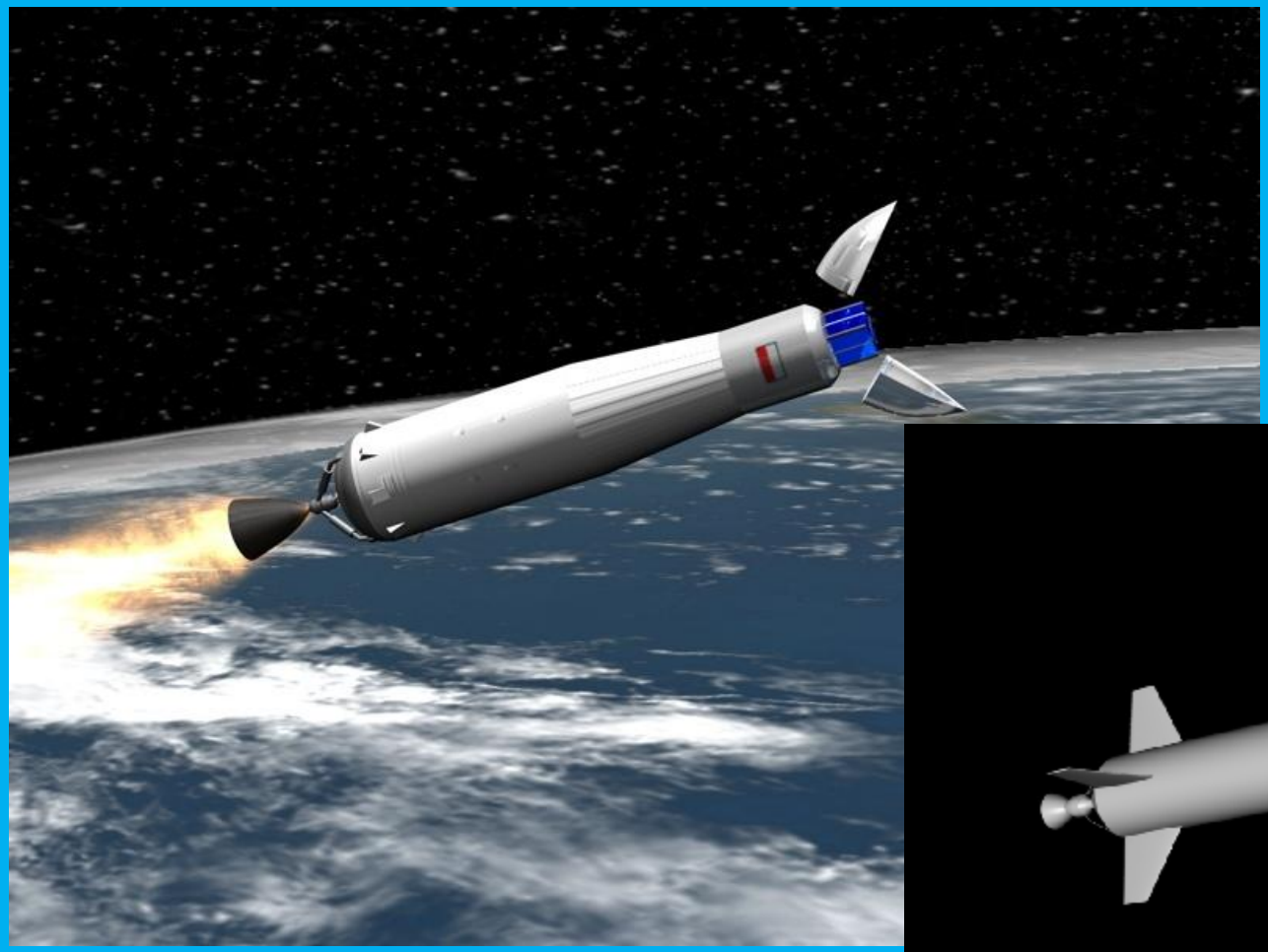
Students Activities

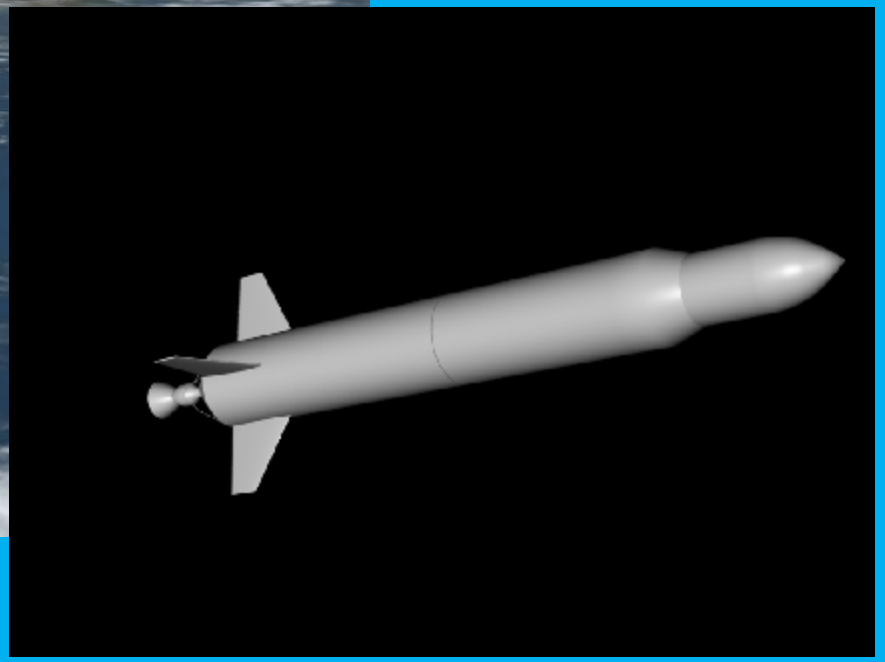
Students microgravity fligths

Warsaw University of Technology
PW-SAT

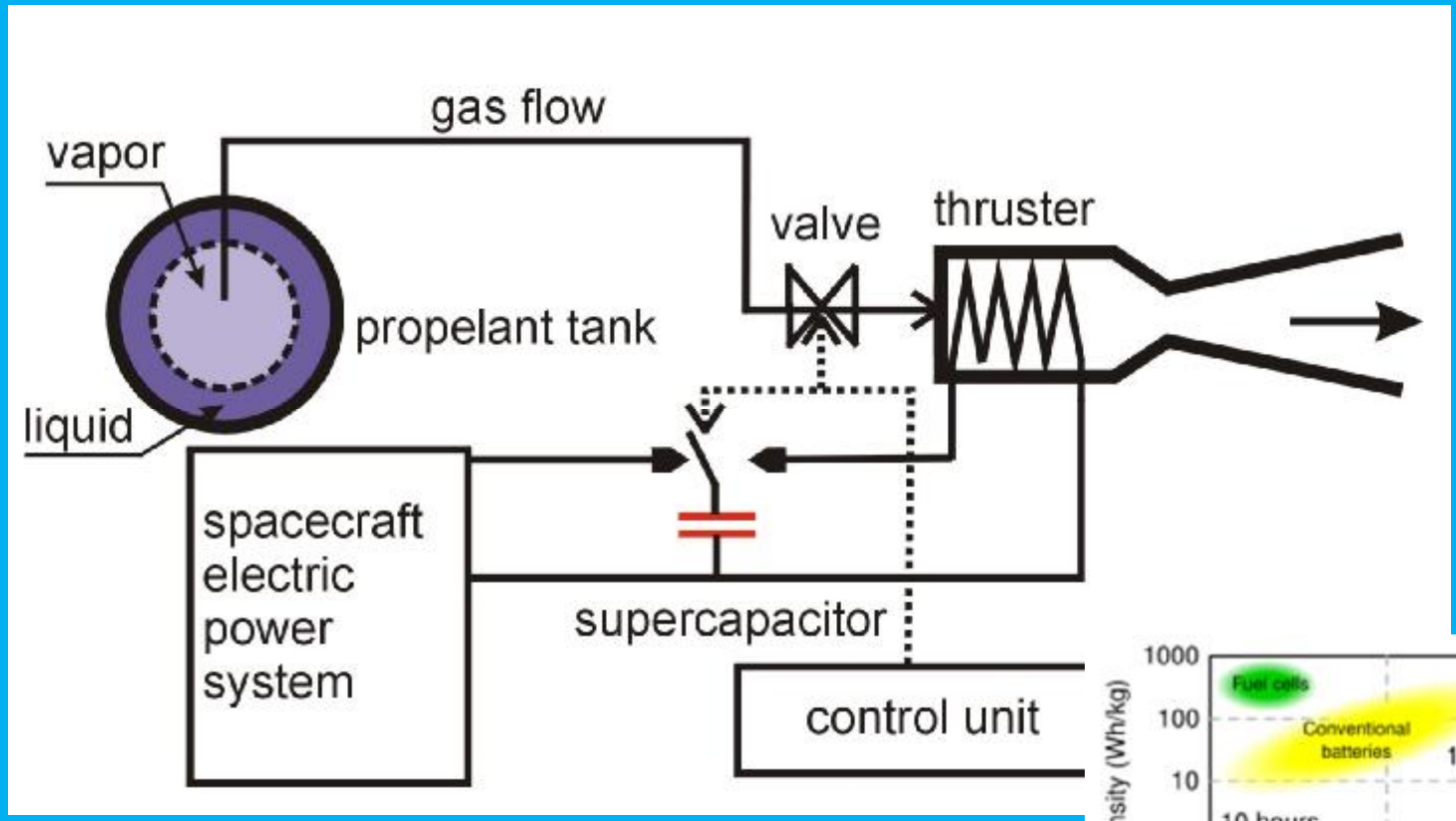


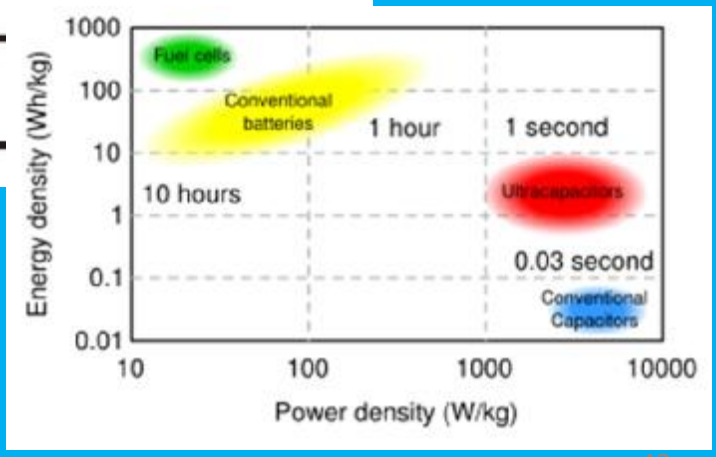
Artist's impression of the student's rocket launcher



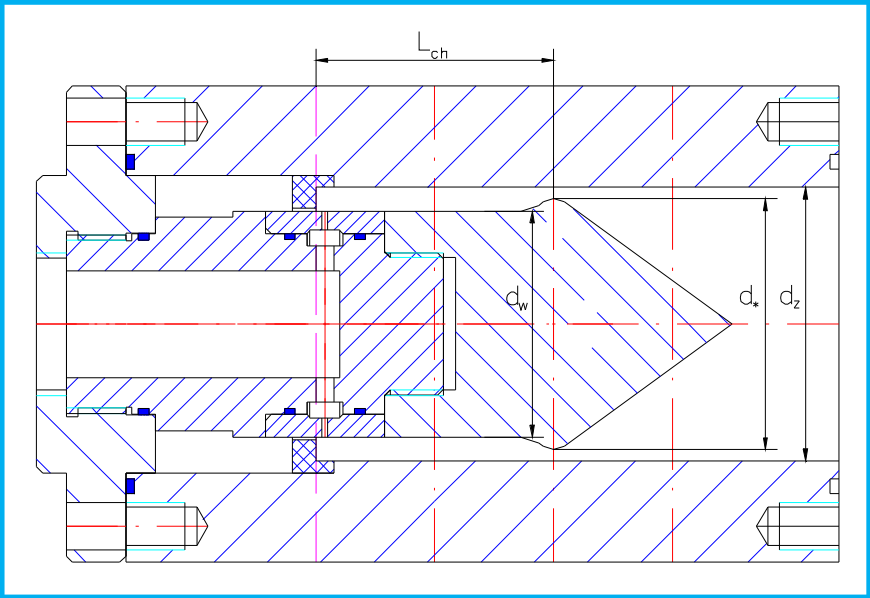


Gas Resistojet Thruster





ROTATING DETONATION – ROCKET ENGINE



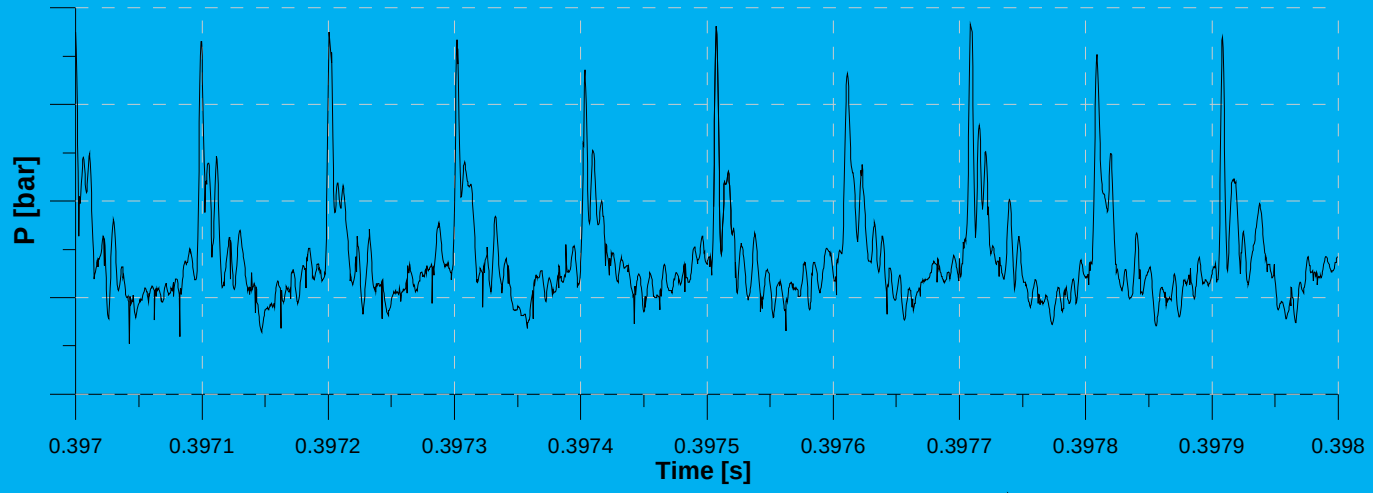
d_w – inner diameter of the channel,

d_z – outer diameter of the channel

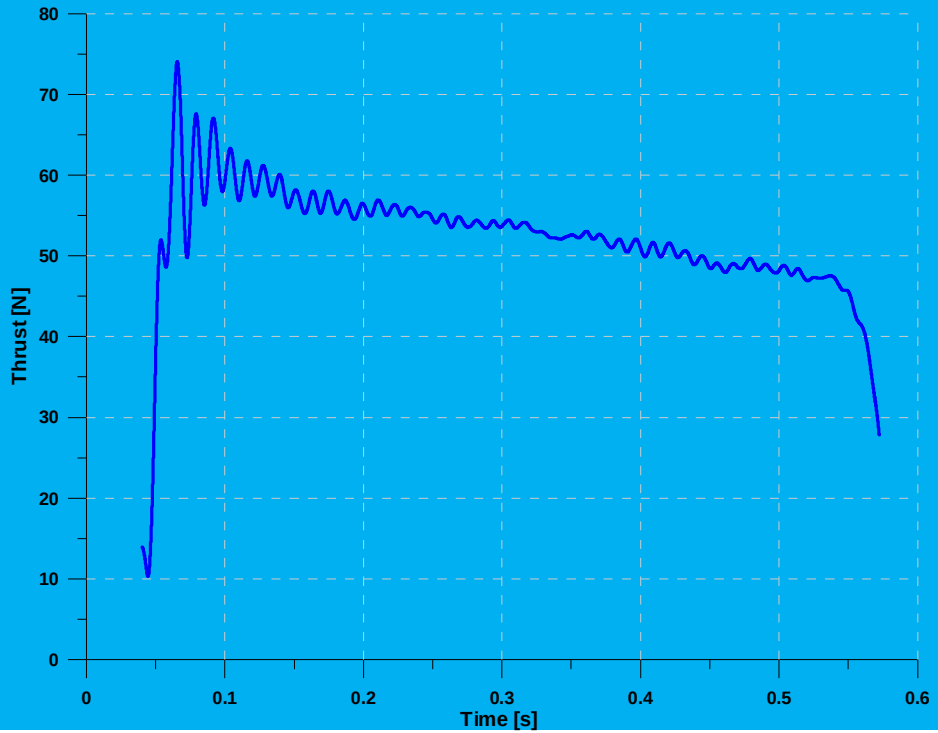
d_* - throat diameter

L_{ch} – channel length

THRUST and PRESSURE vs TIME



Pressure vs time

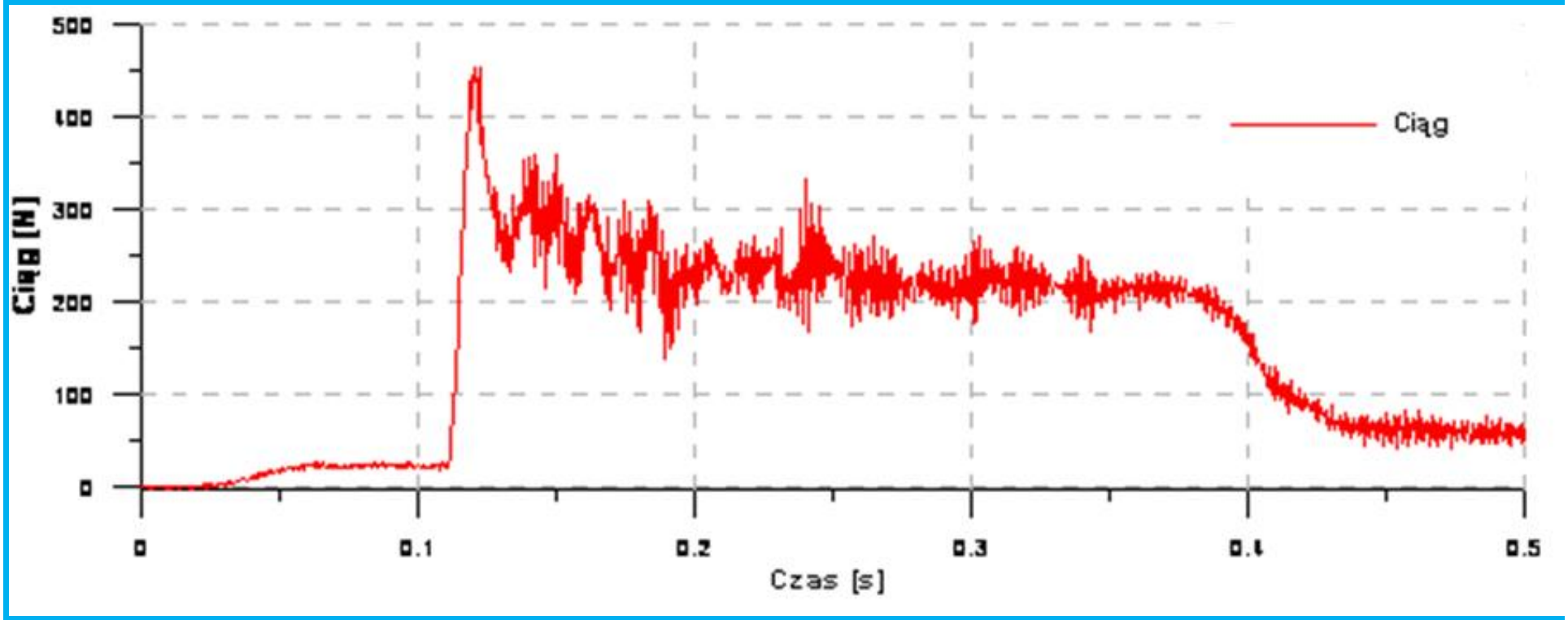


Methane-Oxygene mixture, initial conditions p=0,05bar; nozzle 77deg

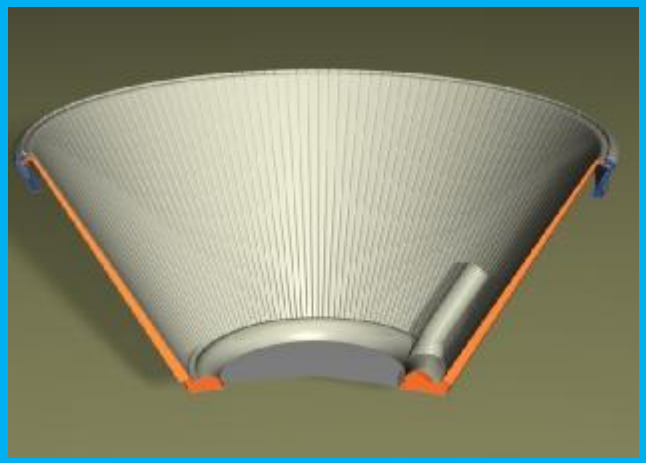
Thrust vs time

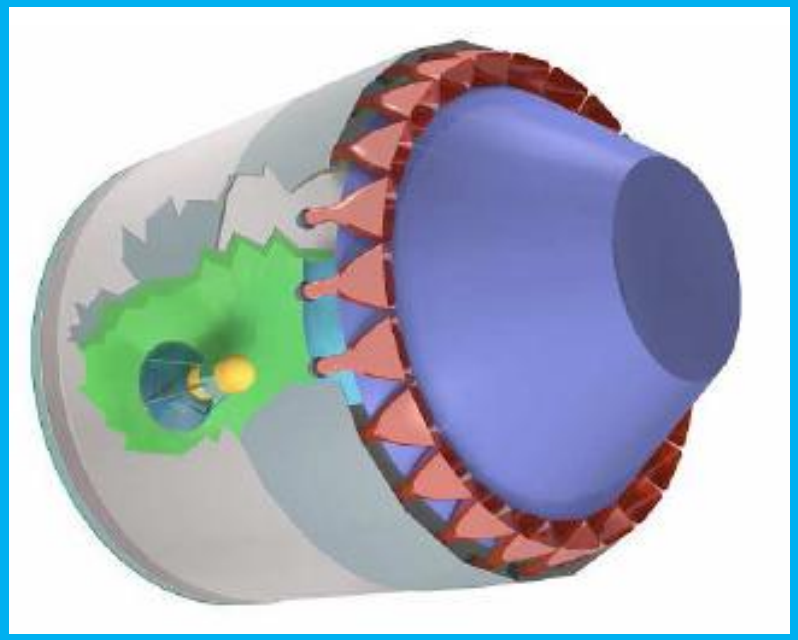
Experimental Test Stand

Thrust measurements

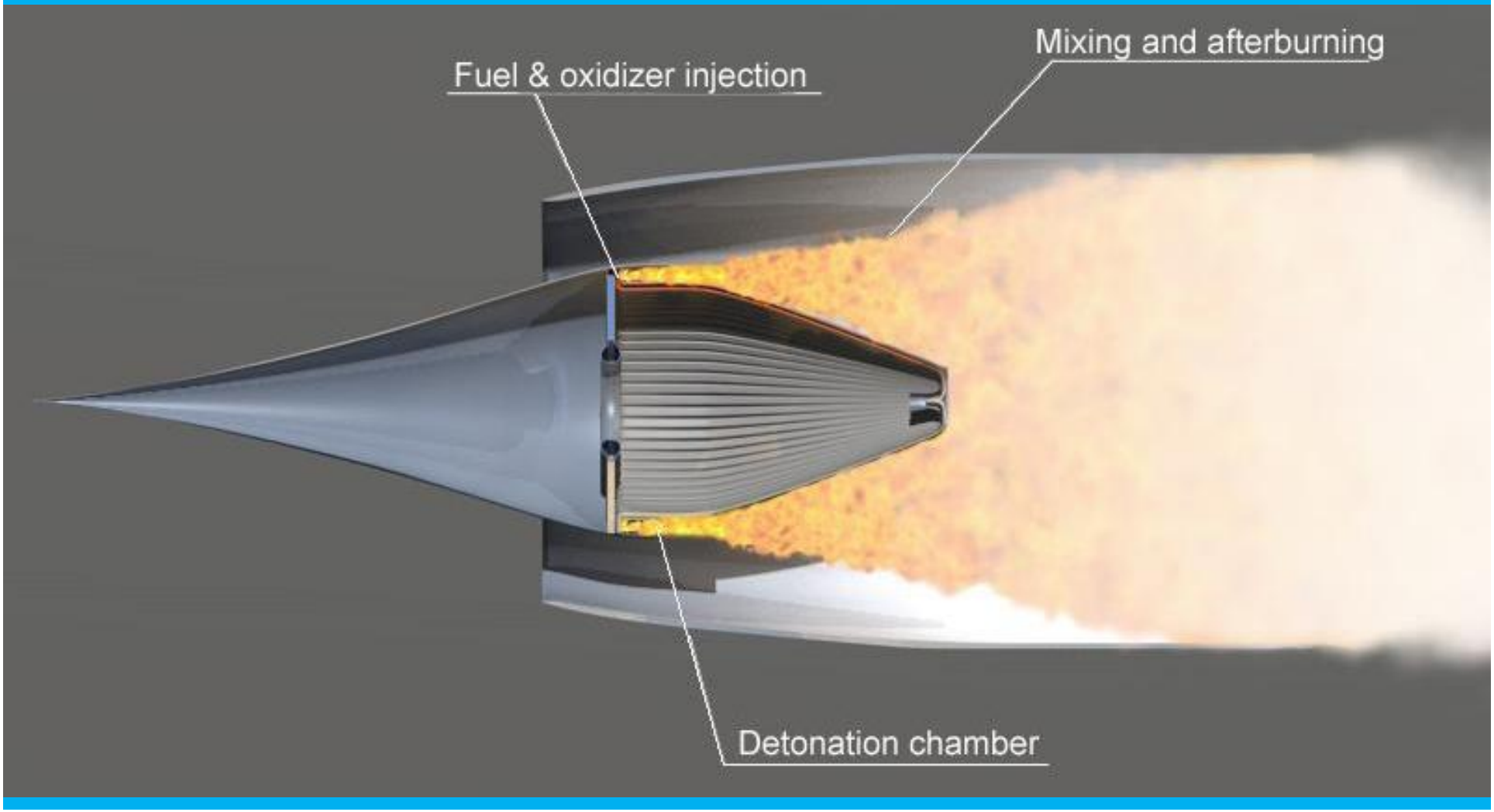


Comparison of Continuous Detonation Rocket Engine (CDRE) with classical Rocket Engine

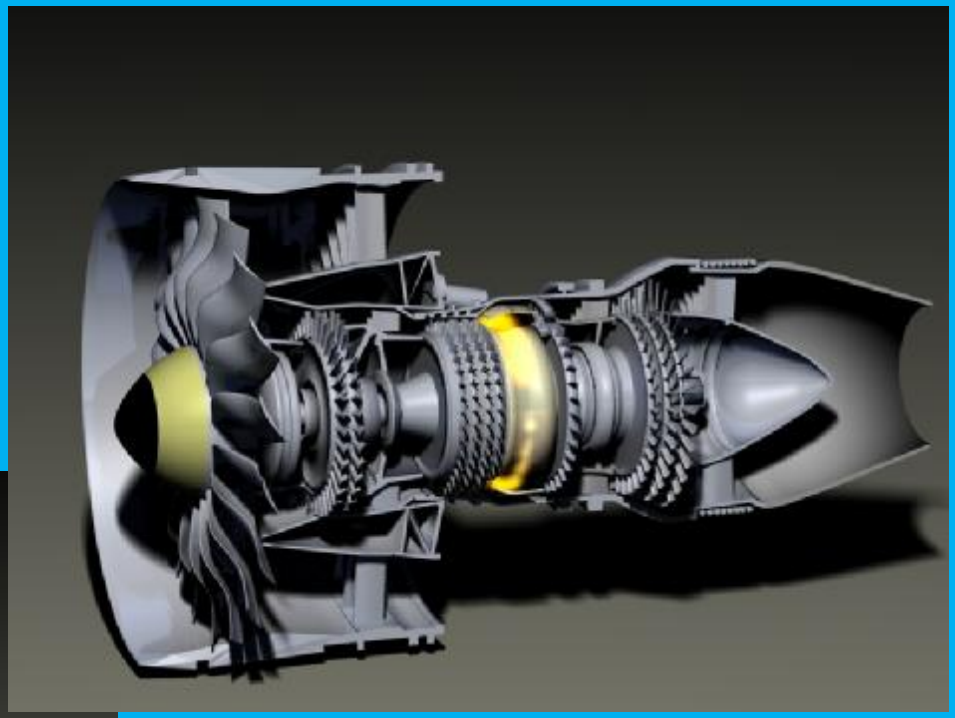


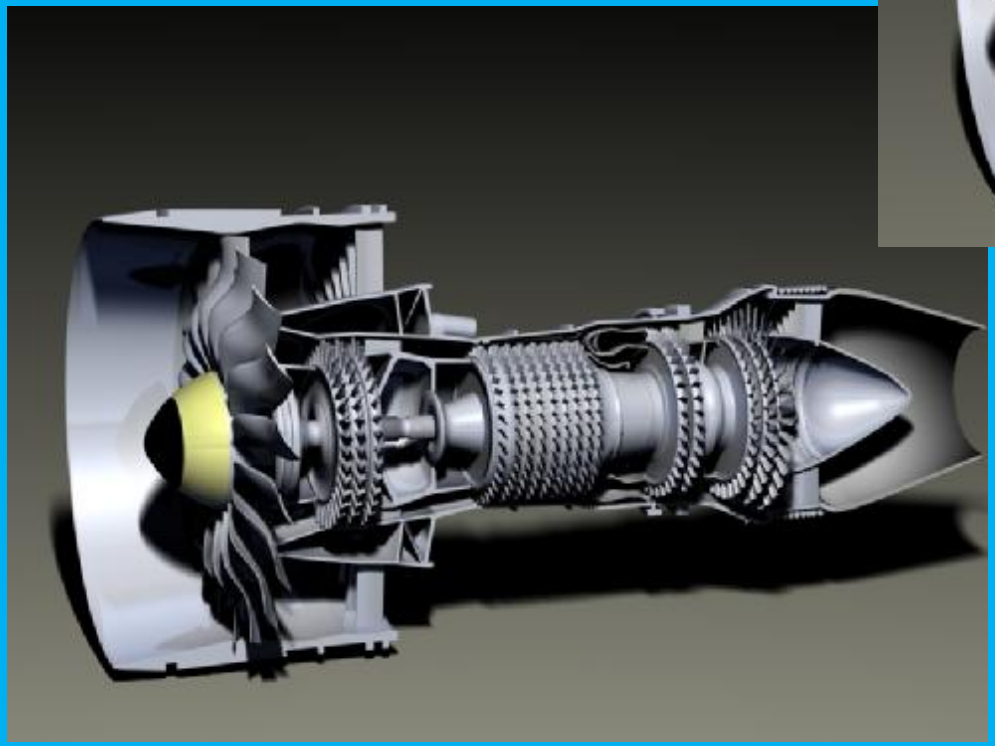


Integrated – Rocket-Ramjet Engine

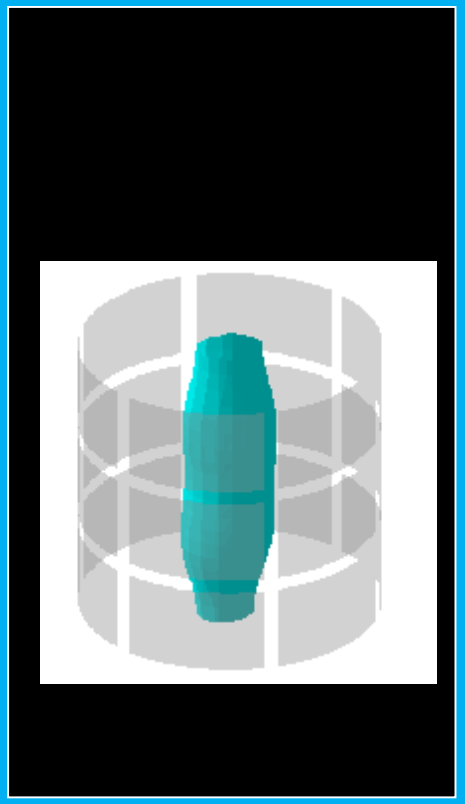


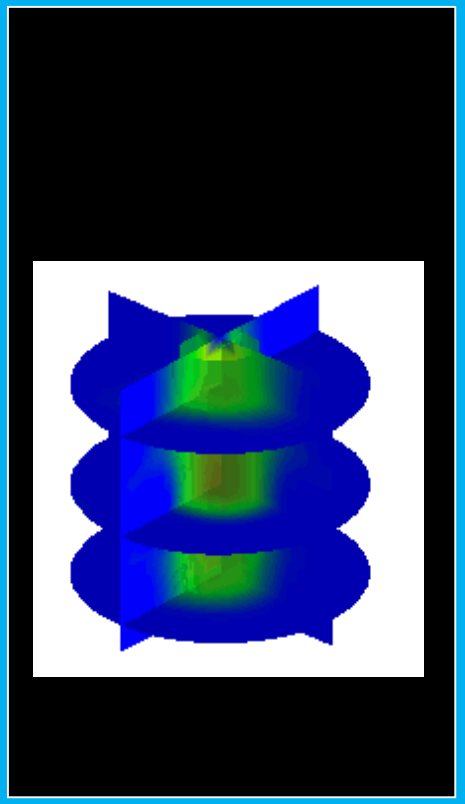
Conventional and RD Turbofan Engines





3D tomography of gaseous flame – research for P&W





New Technologies Center

Institute of Aviation, Aleja Krakowska 110/114, 02-256, Warsaw, Poland.

Acronym: IoA

Country: Poland, PL

Web Side: **www.ilot.edu.pl**

The main research centre for aeronautics in Poland, founded in 1926. The mission of the IoA is to provide the R&D support for aircraft, helicopter and power plant industrial enterprises. The activity of IoA with the staff of 680 comprises the fundamental scientific research, as well as the experimental and numerical applications in the development phase of new aeronautical projects.

Aircraft Department
Institute of Aviation

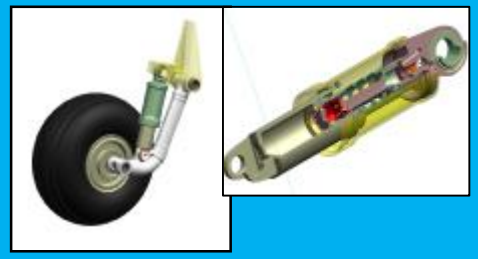
(DESIGN OFFICE)

ŚWIADECTWO TYPU SPRZĘTU LOTNICZEGO
TYPE CERTIFICATE

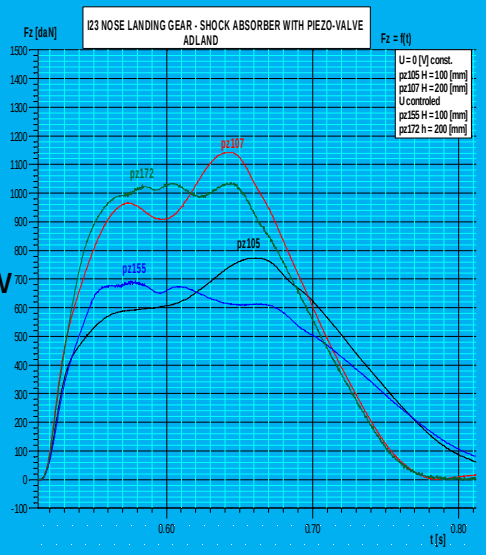
ADLAND

Airplane Skytruck (PZL-Mielec Poland)

Adaptive Shock Absorber
& New Landing Gear
during drop tests in
Institute of Aviation in Warsaw
Right – results
(with and without control).



3D CAD models of new
Landing Gear & Adaptive
Shock Absorber



Aerodynamic Department
Institute of Aviation

5 Meter Low Speed Wind Tunnel

The test of the M-18 DROMADER agricultural aircraft model

The special stand for helicopter models testing has been constructed which can be used for studying:

- fuselage models,
- rotor models,
- rotor and fuselage models together.

The maximum rotor model diameter is 2.5 m.

The range of tunnel flow velocity is from 0 up to 40 m/s.

The test of the flutter model of the I-22 IRYDA jet trainer aircraft

The test of the new jet - trainer aircraft Bielik model at high angles of attack up to 90 degrees

The two-dimensional airfoil ILL-417 model with end plates

CESAR Project: tests of low speed advanced airfoil with high lift device

PCA
Polskie Centrum Akredytacji
BADANIA
AB 132

RESEARCH EQUIPMENT:

Sinusoidal vibrator
frequency range:
5 – 2000Hz
maximal acceleration:
200m/s2
maximal mass of tested object:
50 kg

Shock vibrator
maximal acceleration:
3200m/s2
shock impulse duration range:
6 – 30ms
surge frequency:
up to 3Hz
maximal mass of tested object:
450 kg

EDC – GE – Aviation, Energy & Oil and Gas

Conclusions

- Poland have big traditions in Aerospace Research
- Application of Space Technologies such as: Meteorology, Telecommunication, Remote Sensing and Geodesy and Navigation are commonly applied
- Research in Space Technology were reactivated and we are slowly integrating with ESA and EU space project
- Institute of Aviation is actively involved in cooperation with USA as well as with EU research centers

Thank you for your attention!