Hungarian Academy of Sciences
Centre for Energy Research

FIRST RESULTS OF THE TRITEL SPACE DOSIMETRY TELESCOPE FROM THE MISSION ON BOARD THE BEXUS-12 STRATOSPHERIC BALLOON

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Outline

- The REXUS/BEXUS programme
- Cosmic radiation environment in the atmosphere
- CoCoRAD experiment setup
- Results
- Outlook

REXUS/BEXUS

Rocket and Balloon Experiments for University Students

- ***The main goals***

» to increase the interest

in space sciences and technology

» to increase the awareness

of the benefits of rockets and balloons

for carrying out experiments

- ***The organizers***

» European Space Agency

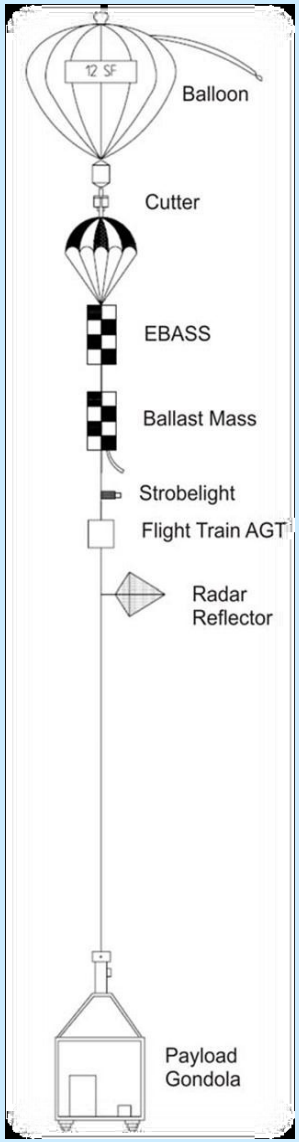
Educational Office (ESA)

» Swedish National Space Board (SNSB)

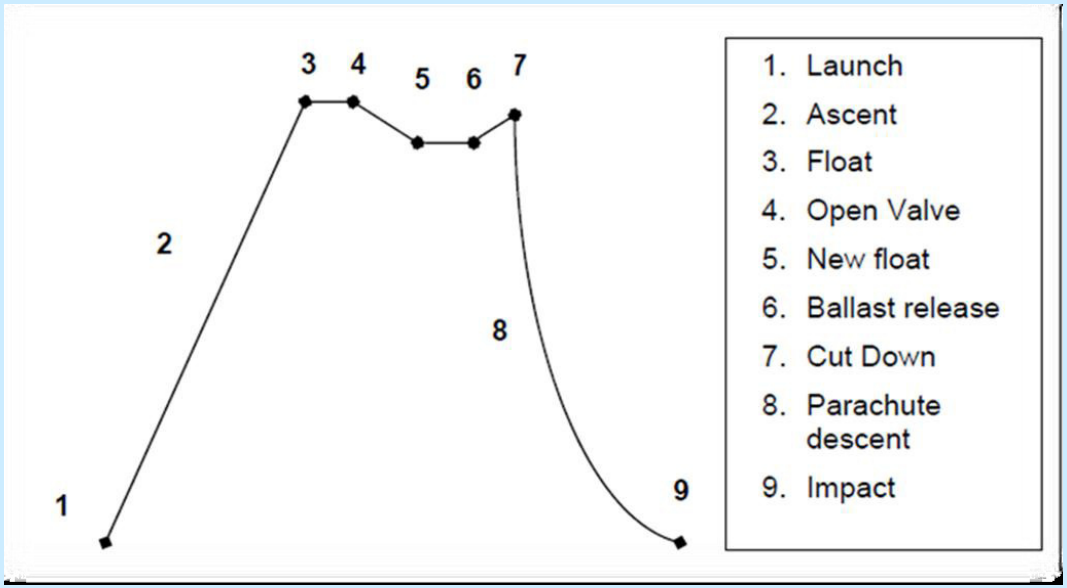
» Swedish Space Corporation (SSC)

» German Aerospace Center (DLR)

BEXUS



Ascent and descent velocity	**5 - 8 m/s**
Maximum expected acceleration	**+/- 25g**
Expected outside temperature	**-60…-90℃**
Mission time	**2-5 hours**
Height	**25-35 km**



Team CoCoRAD (Hu)

The first Hungarian student team participating the REXUS/BEXUS programme

CoCoRAD experiment

Combined TriTel/Pille Cosmic Radiation and Dosimetric Measurements

Team members:

Balázs Zábori – physics, hardware

Gergely Goldschmidt – software

Zsolt Váradi – electrical engineering

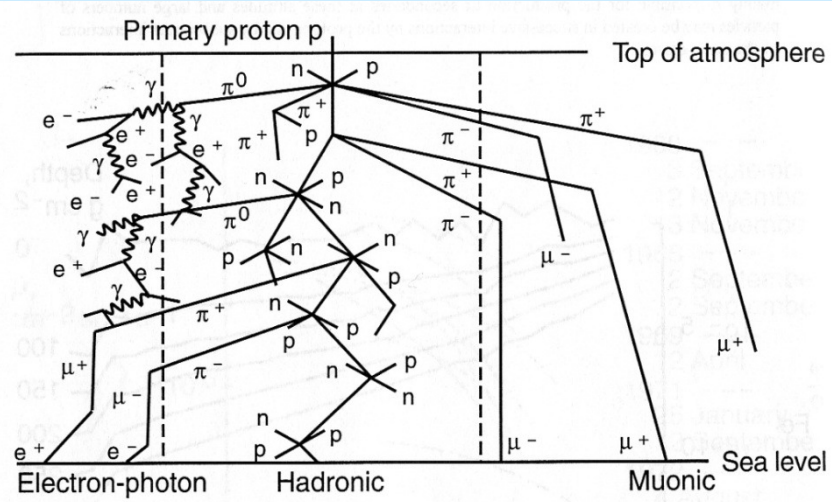
Dosimeters in the CoCoRAD experiment:

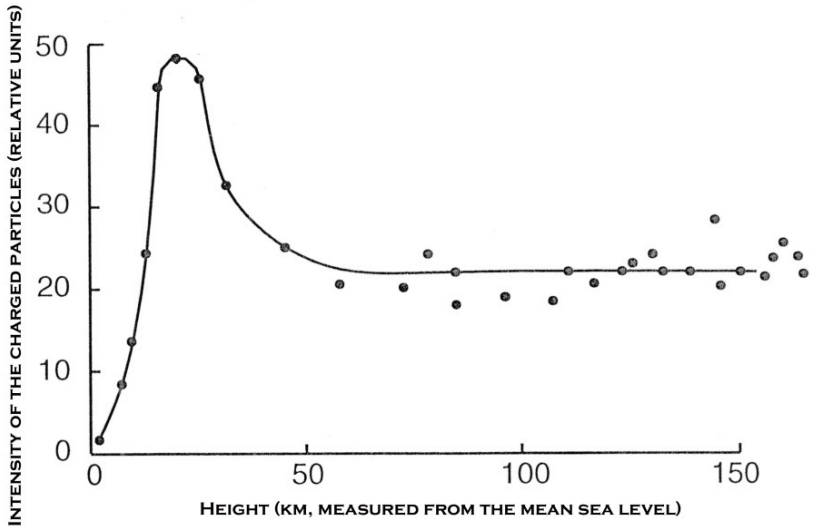
1 TriTel three-dimensional silicon detector telescope

10 Pille bulbs (+2 for reference)

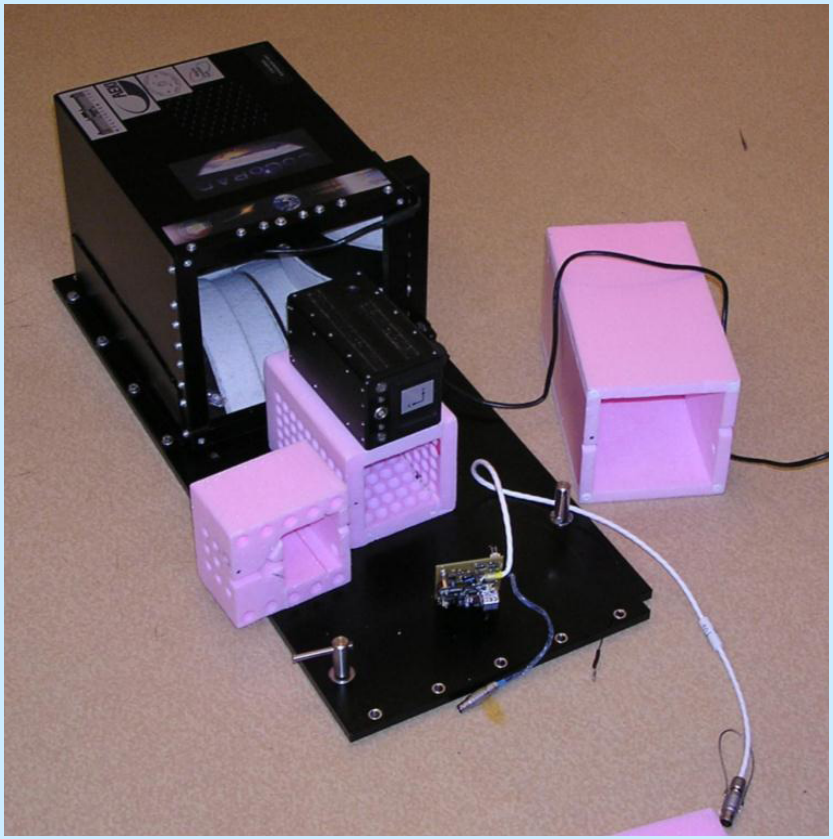
Cosmic radiation environment

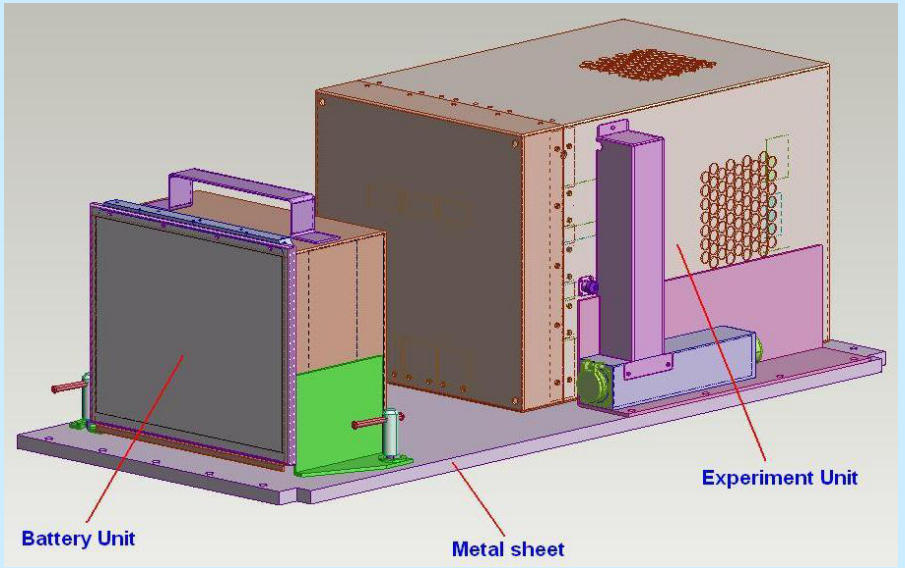
- **Primary component**
  - » High energy charged particles (GCR, solar wind)
  - » Trapped radiation
- **Secondary particle production**
- **Pfotzer maximum ~25 km**
  - » the region where the secondary particle intensity builds up
  - » above: atmosphere density is too low to generate many secondary particles
  - » below: atmosphere shielding

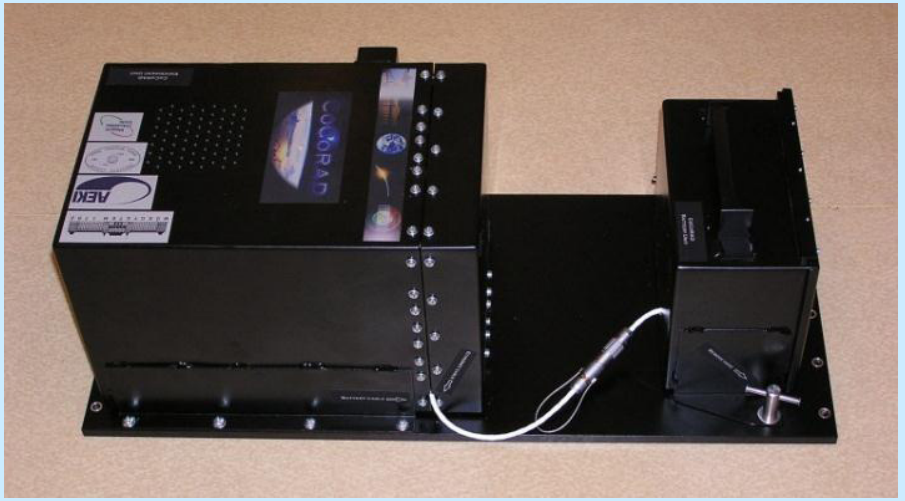




Experiment setup

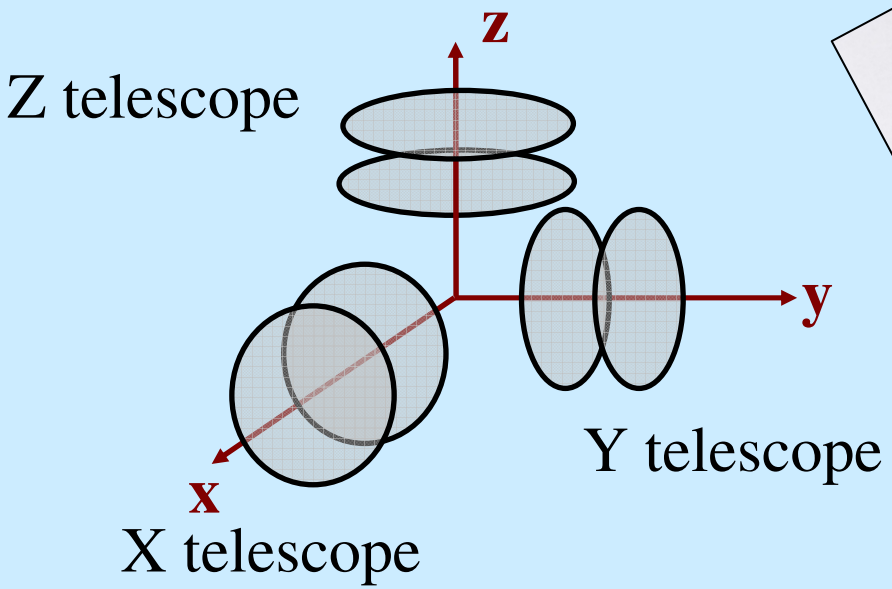


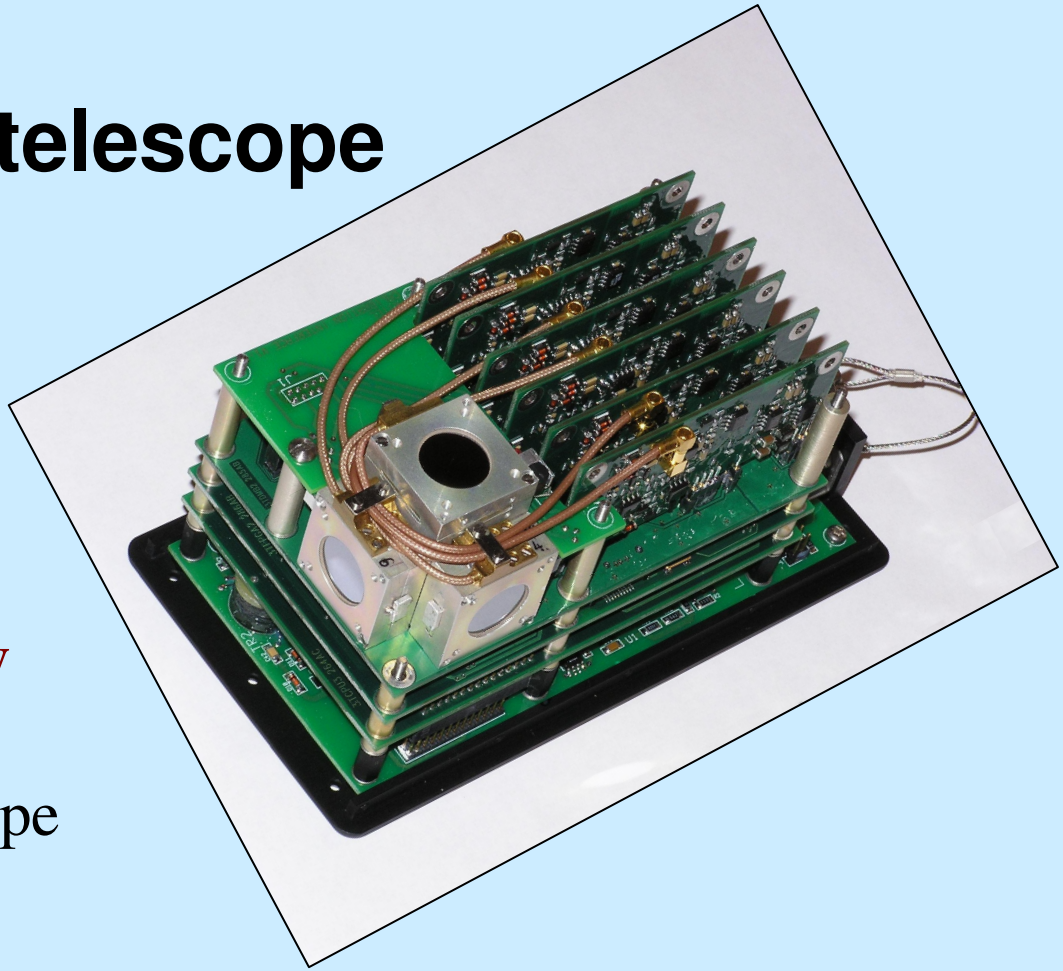




TriTel

3D silicon detector telescope





TriTel

parameter	value
effective surface of the detectors (A)	222 mm^2
separation between the detectors in one telescope axis (p)	8.9 mm
geometric factor, G (for one telescope axis in 4π)	5.1 cm^2sr
maximum angle of incidence (for one detector pair)	62.1°
minimum path length in the detector (depletion layer thickness, w)	300 µm
average path length in the detector (for an isotropic field)	361 µm
maximum path length in the detector (for maximum angle of incidence)	641 µm

LET range for BEXUS TriTel: 0.2 – 100 keV/µm in water

TriTel

Shielding:

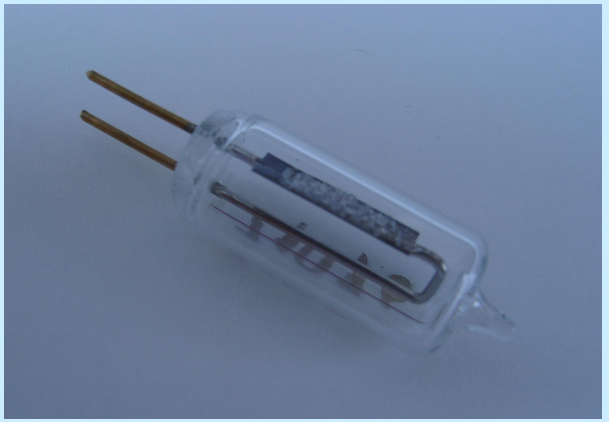
- Atmosphere @ ~27 km: ~ 7 g/cm^2
- Effective shielding of the hardware: ~0.5-0.6 g/cm^2

The axes of the TriTel telescope were aligned as follows:

- X-axis: perpendicular to the zenith direction (balloon was rotating)
- Y-axis: looking to the zenith direction
- Z-axis: perpendicular to the zenith direction (balloon was rotating)

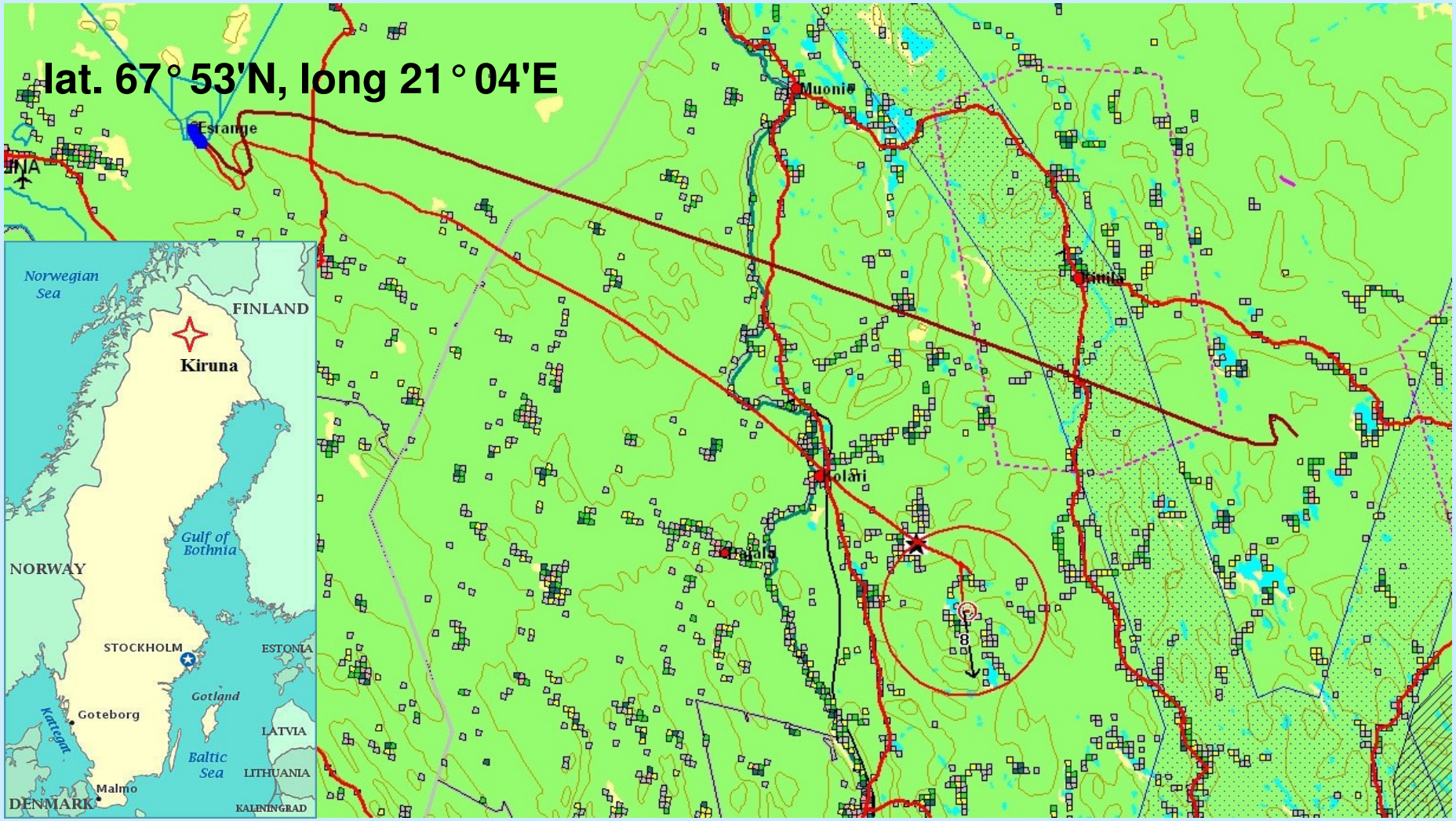
Pille

Dosimeters	
Type:	bulb
Material:	$CaSO_4$:Dy
Dimensions:	ϕ 20 mm * 60 mm

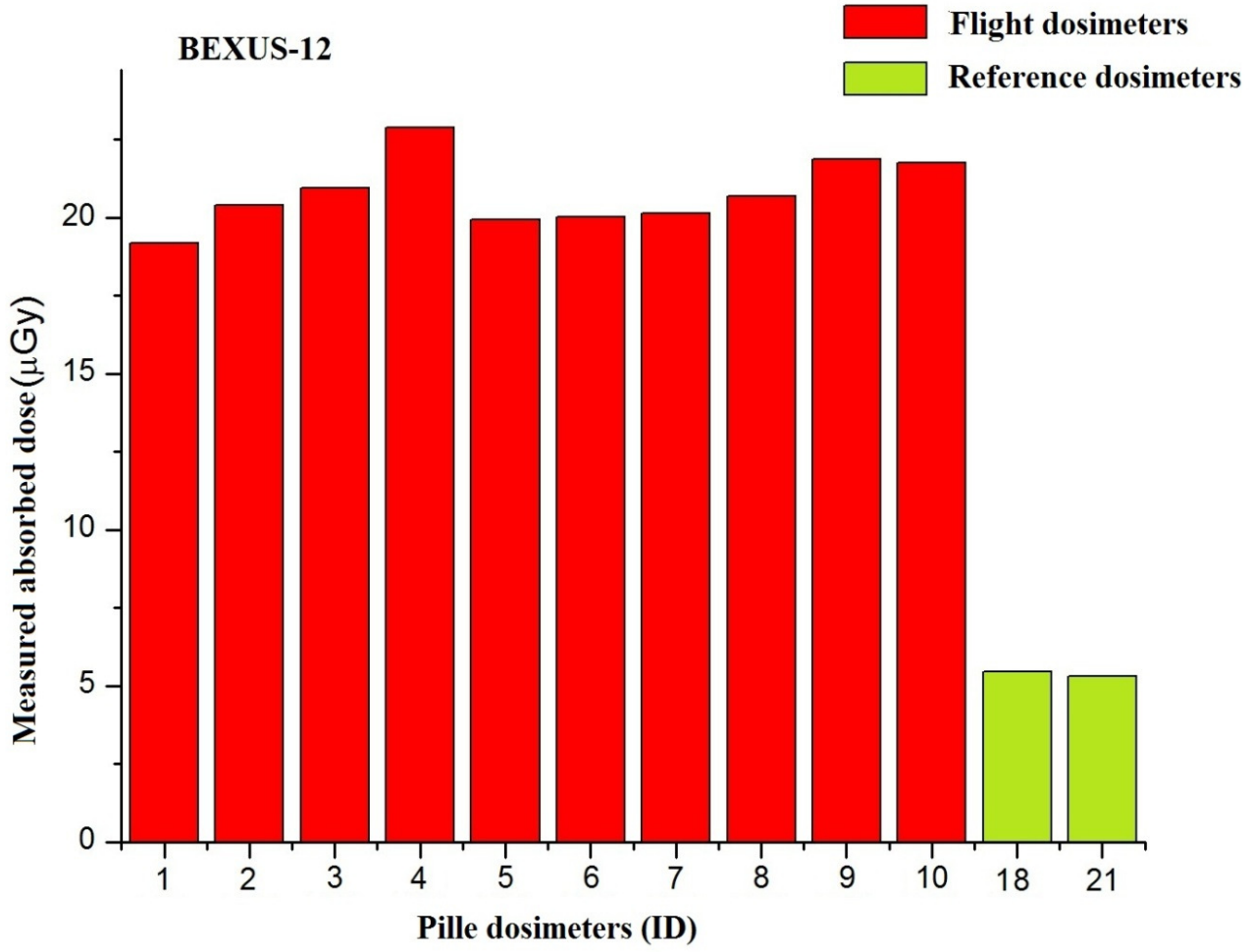


Reader	
Measuring range (s<10%):	3 μGy ÷ 10 Gy ($CaSO_4$:Dy)
TLD Efficiency (ε=1±10%):	$LET_\infty(H_2O)$ < 10 keV/μm
Accuracy (above 10 μGy):	δ < 5%

The BEXUS-12 mission



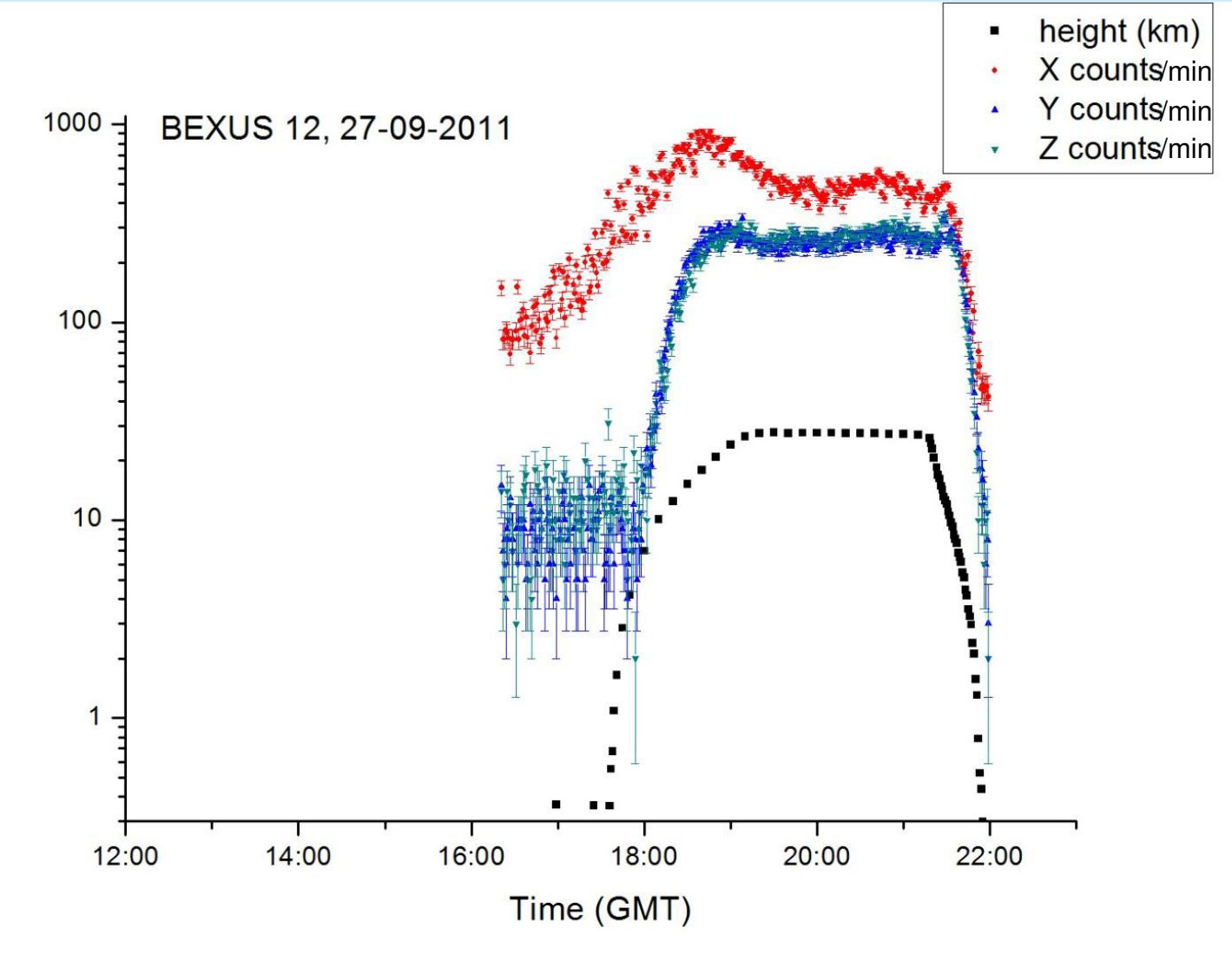
Pille results



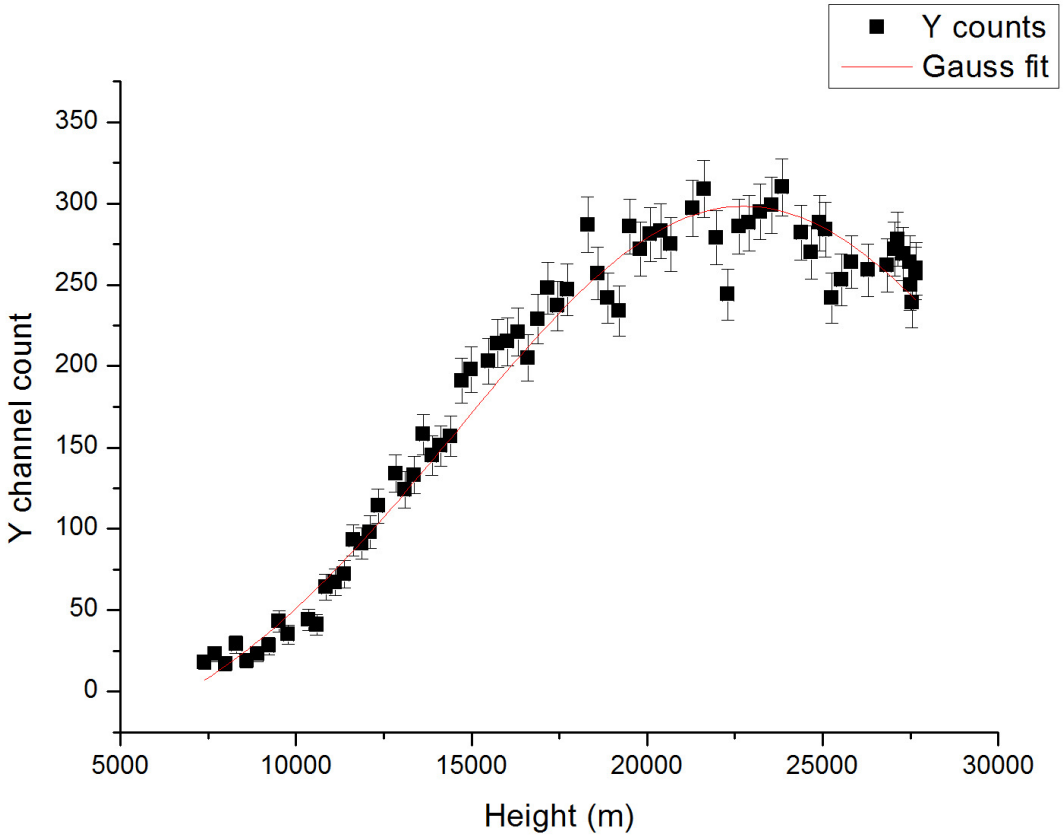
Pille results

Average noise level of the bulbs chosen	1.4 ± 0.5 µGy
Mission time	4.3 ± 0.1 h
Time between the read-outs	70 ± 0.5 h
The measured average absorbed dose (flight bulbs)	20.8 ± 1.1 µGy
The measured average absorbed dose (reference bulbs)	5.4 ± 0.1 µGy
The measured average dose rate on ground (ref.)	77.7 ± 1.5 nGy/h
The excess absorbed dose of the BEXUS-12 flight	15.6 ± 1.1 µGy
The average dose rate measured by TriTel	~100 nGy/h
Corrected excess absorbed dose of the BEXUS-12 flight	13. 1 ± 1.5 µGy
The estimated error of the measurements	~ 7-10 %

TriTel time spectra



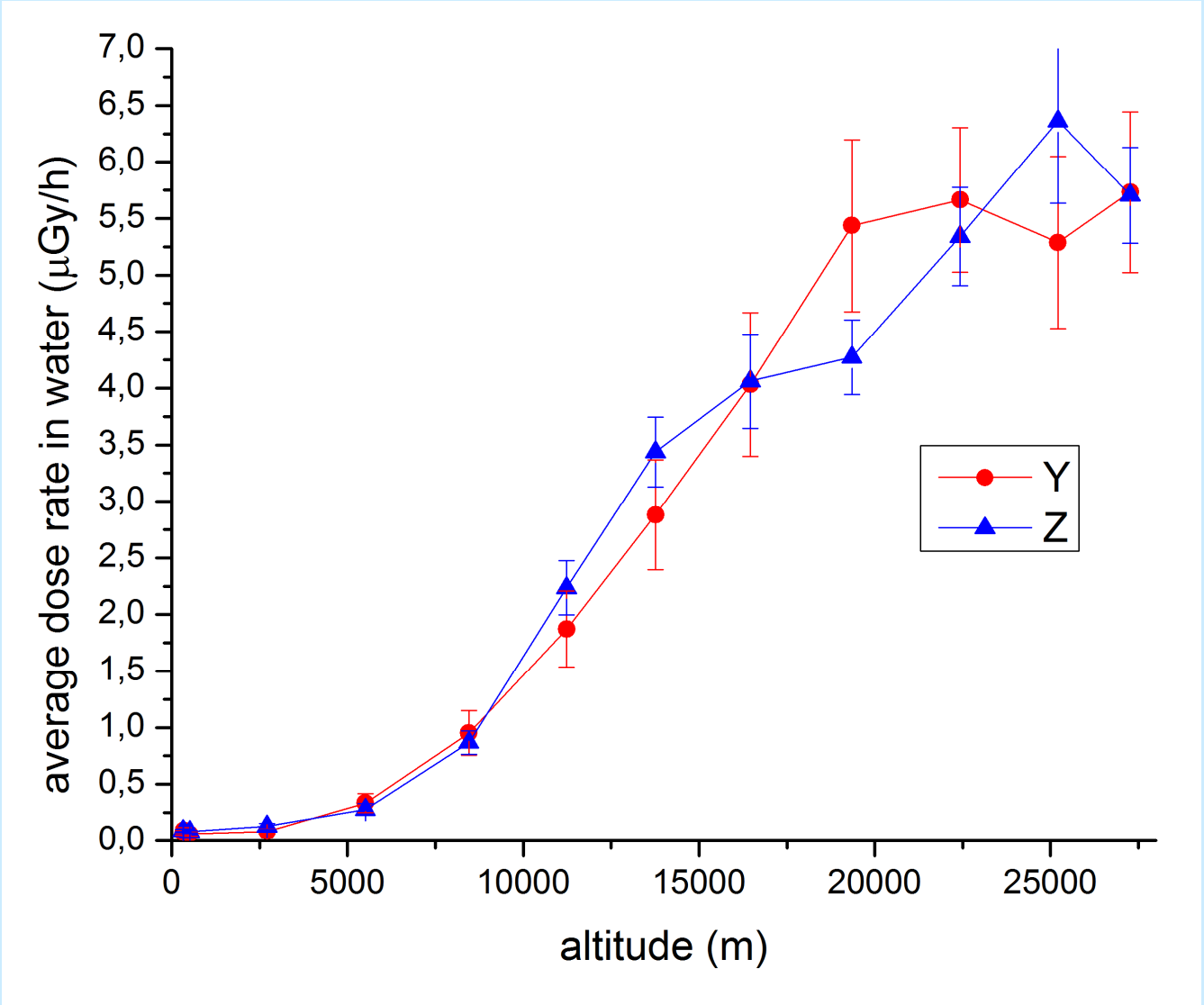
Pfotzer-maximum



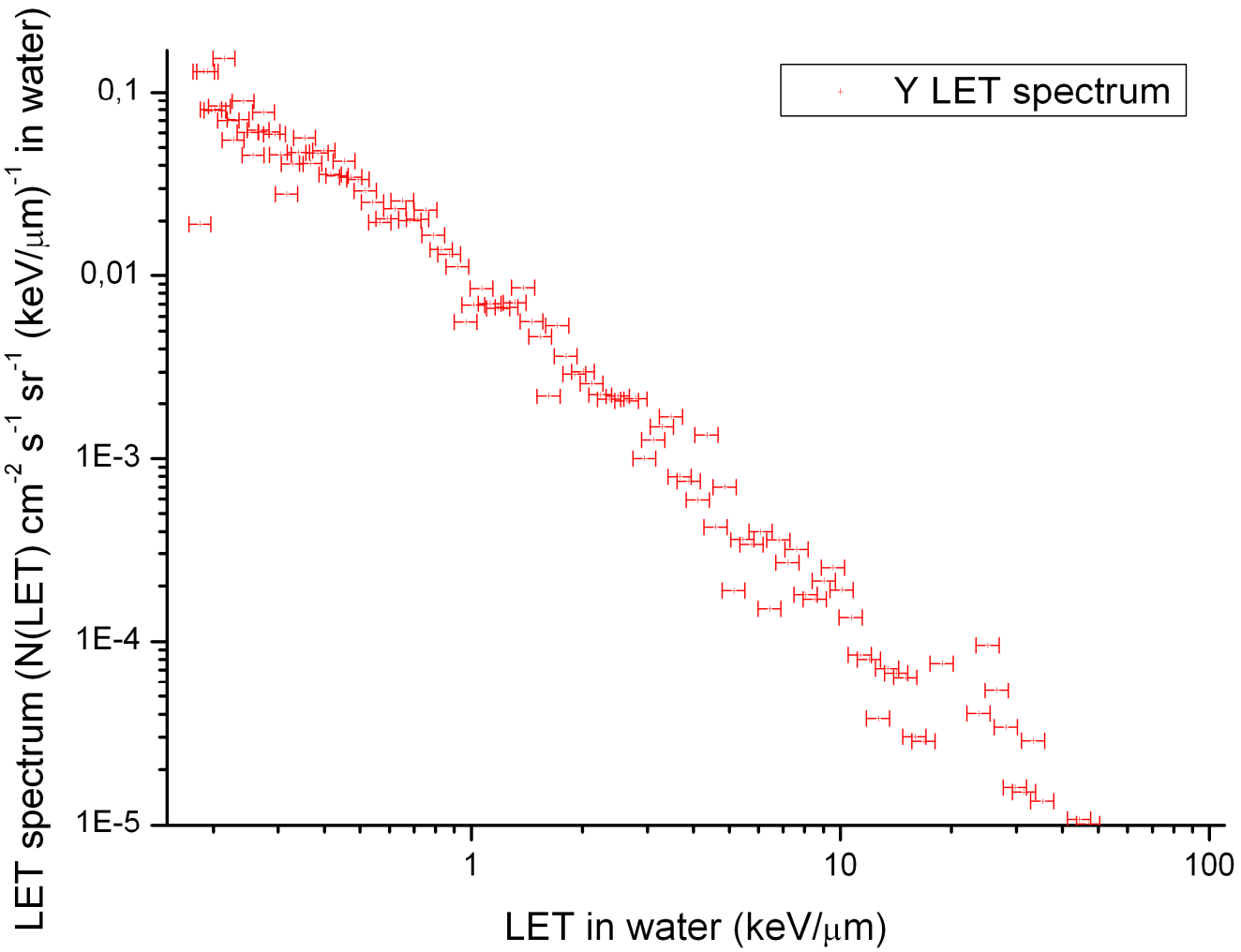
From the three time spectra:

23400 km ± 1200 km

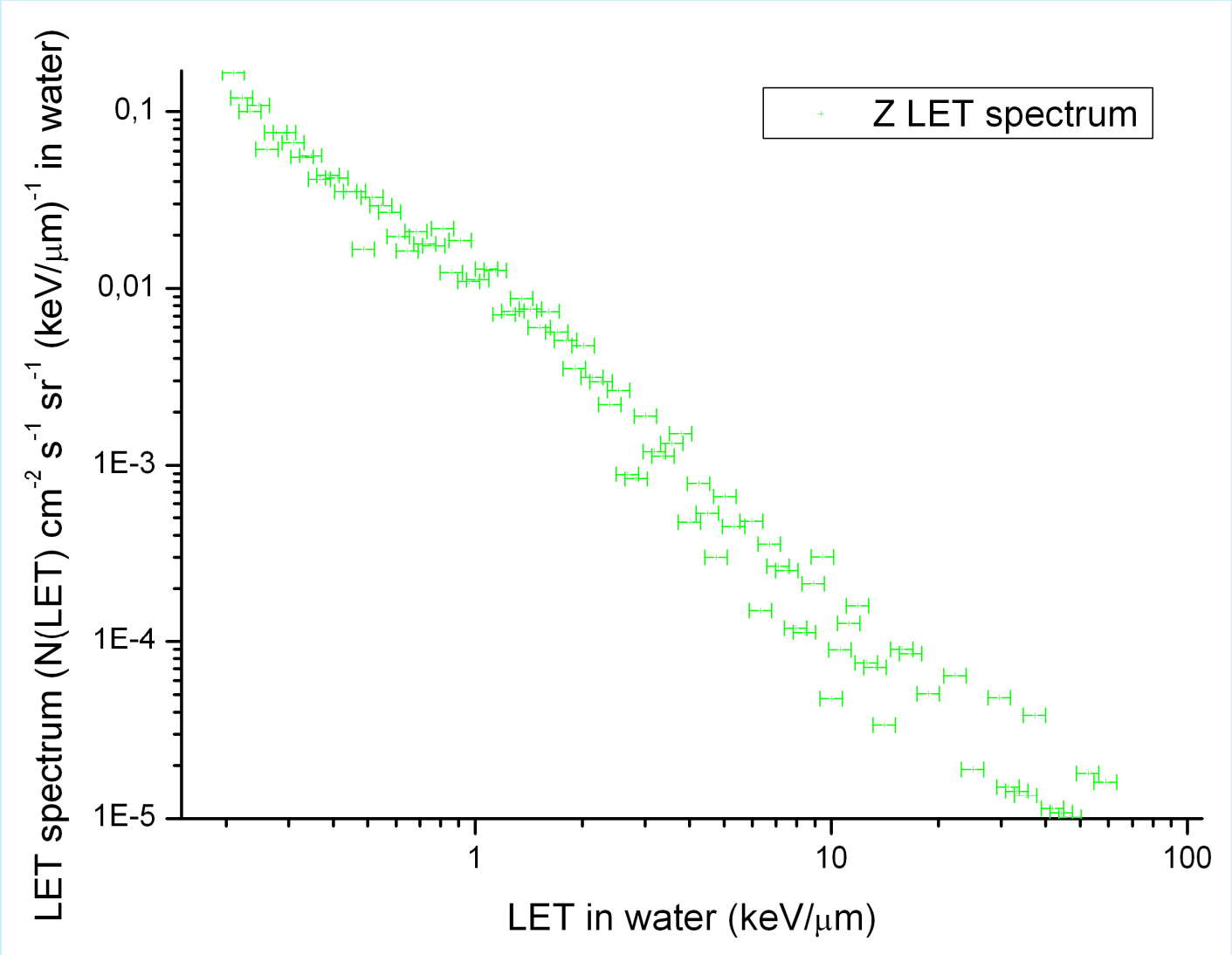
Dose rate vs. altitude



LET spectra at floating altitude



LET spectra at floating altitude



TriTel results

	The measured absorbed doses [μGy]			
	TriTel X	**TriTel Y**	**TriTel Z**	**Pille**
Ascent phase	14.8 ± 0.8	5.4 ± 0.3	5.5 ± 0.2	-
Float phase (27.6 km)	16.3 ± 2.0	11.5 ± 1.0	11.9 ± 0.3	-
Descent phase	7.4 ± 0.4	2.7 ± 0.1	2.8 ± 0.1	-
Together	**38.5 ± 1.8**	**19.6 ± 1.2**	**20.1 ± 0.8**	**13.1 ± 1.5**

Pille has low sensitivity to particles with LET higher than 10 keV/μm!

The correction factor for the Pille results:

1.5 ± 0.2

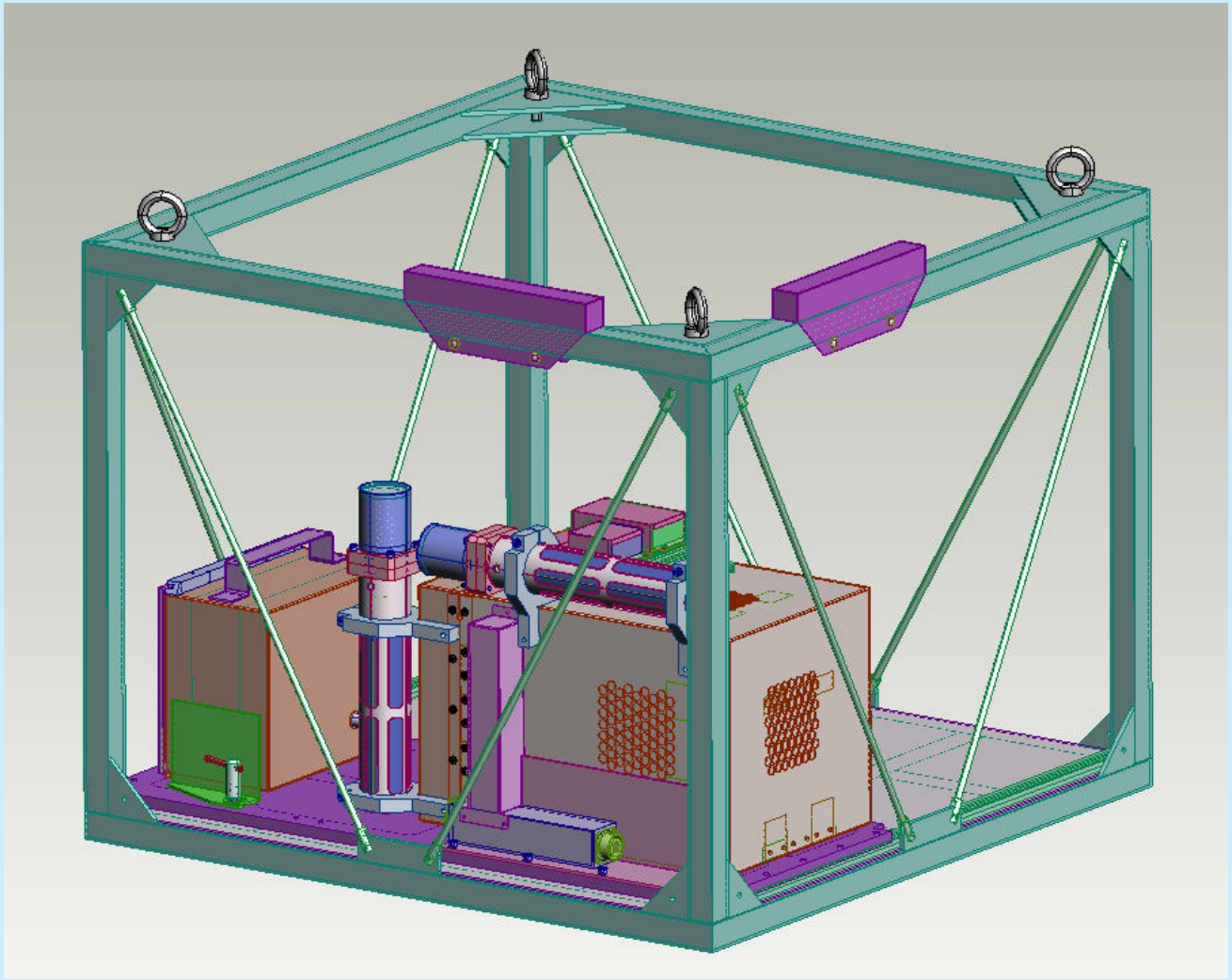
X-axis: $\langle Q \rangle_x = 4{,}0 \pm 1{,}2$

Y-axis: $\langle Q \rangle_y = 3.0 \pm 0.7$

Z-axis: $\langle Q \rangle_z = 4.0 \pm 1.1$

Outlook - 1

TECHDOSE on BEXUS 14 (Sept. 2012)



Outlook - 2

TRITEL-SURE

TRITEL-SURE experiment is co-funded by the EC project SURE, contract number RITA-CT-2006-026069 and the PECS contract No. 98057.

MTA EK SDL +

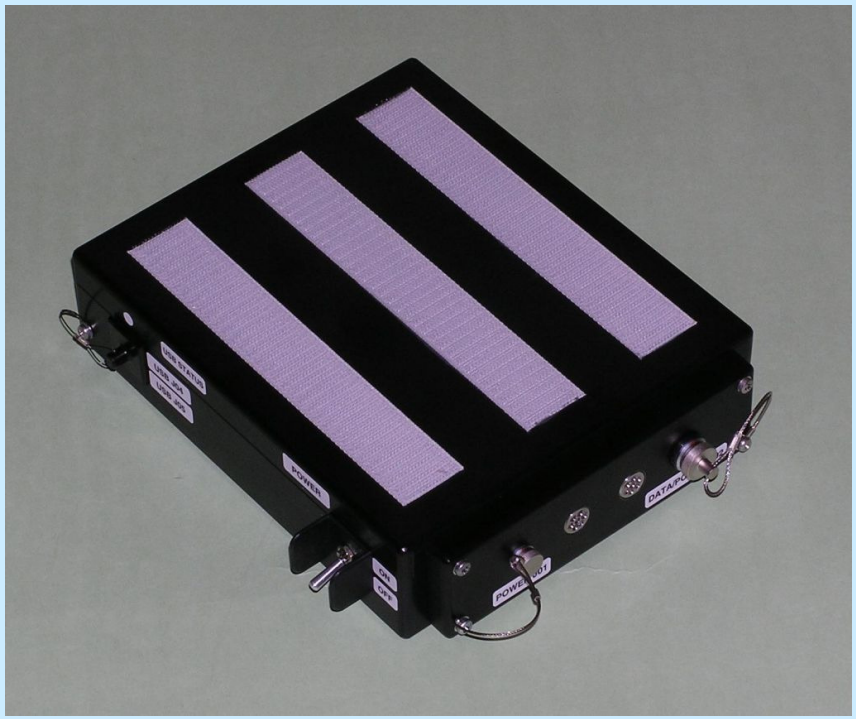
Co-investigators:

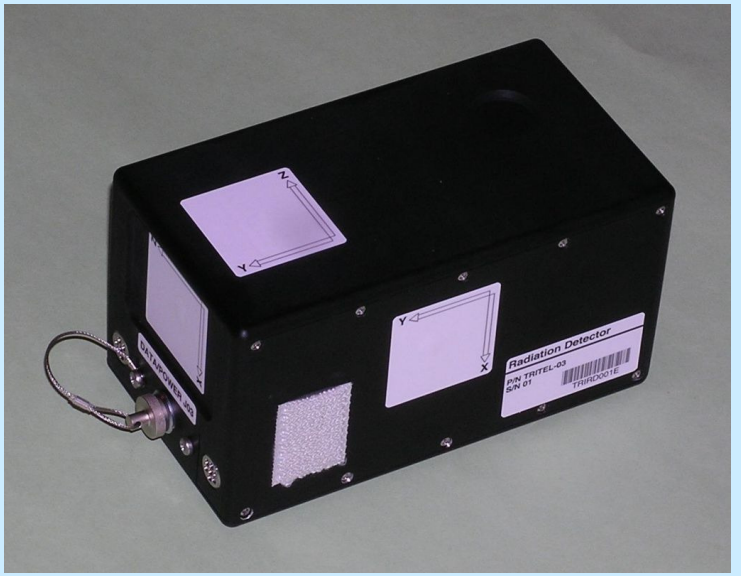
Günther Reitz (DLR)

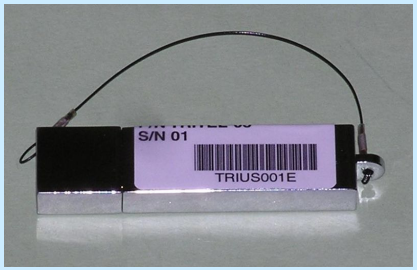
Sönke Burmeister (CAU)

Exp. Launch: Oct-Nov. 2012

Outlook - 2




Radiation Detector
P/N TRITEL-03
S/N 01
TRIH0001E


S/N 01
TRIUS001E

Outlook - 3

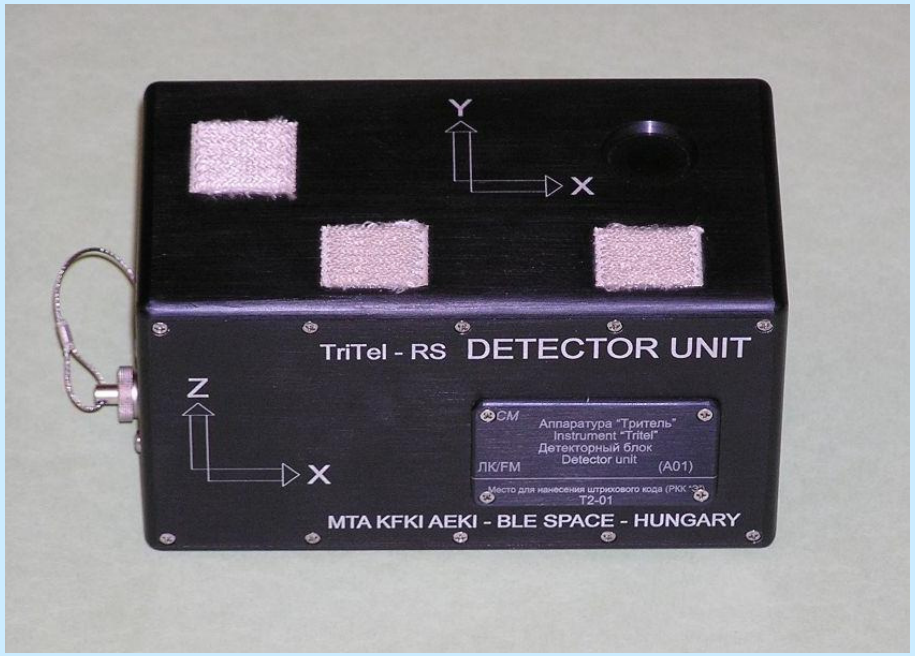
TRITEL-RS

TRITEL-RS will be uploaded to the ISS in cooperation with the Institute of Biomedical Problems, Moscow.

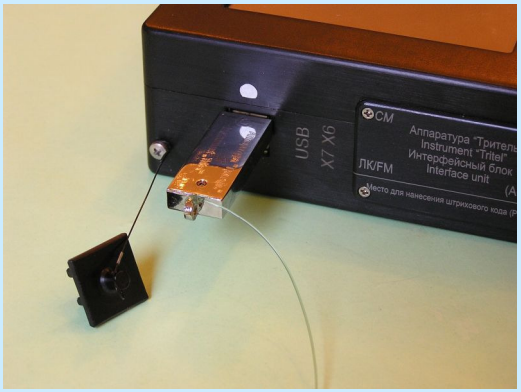
MTA EK SDL

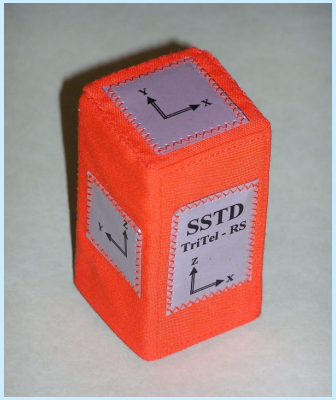
Exp. Launch: Febr. 2013

Outlook - 3


Y
X
Z
X
TriTel - RS DETECTOR UNIT
Аппаратура "Тритель"
Instrument "Tritel"
Детекторный блок
Detector unit
ЛК/FM
(A01)
T2-01
MTA KFKI AEKI - BLE SPACE - HUNGARY


TriTel-RS INTERFACE UNIT
POWER
ON
OFF
ESC
STATUS
MTA KFKI AEKI - BLE SPACE - HUNGARY
X4
X1
X2
X3
XT1


USB
X7 X6
Аппаратура "Тритель"
Instrument "Tritel"
Интерфейсный блок
Interface unit
ЛК/FM


SSTD
TriTel - RS

Acknowledgement

ESA BEXUS supporting experts:

Helen Page, Olle Persson, Mark Fittock,

Mark Uitendaal, Adam Lambert, Paul Stevens,

Koen Debeule, Martin Siegl, Dr. Alan Owens

Supporters:

Budapest University of Technology and Economics

MTA Centre for Energy Research

Hungarian Space Office

BME Space Research Group

ESA Educational Office

German Aerospace Center

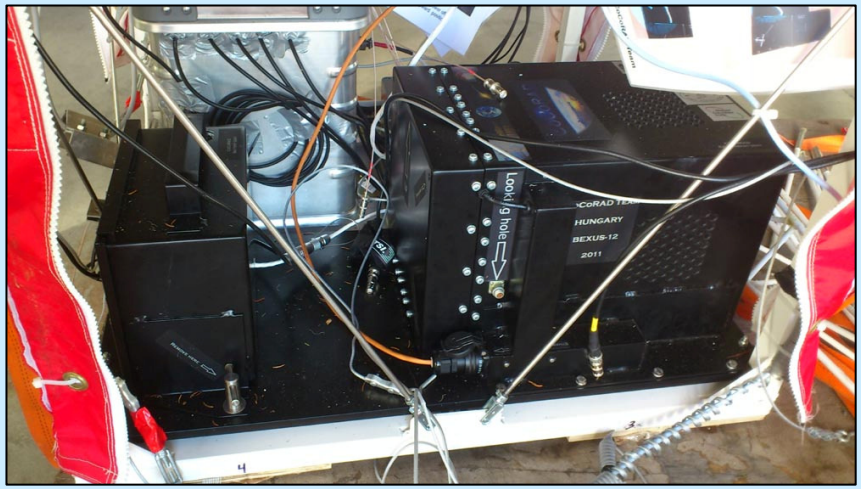
Swedish Space Corporation

Swedish National Space Board

Acknowledgement

The BEXUS CoCoRAD experiment was funded by the PECS contract No. 4000103810/11/NL/KML and by the Centre for Energy Research, Hungarian Academy of Sciences.

Thank you for your attention!



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