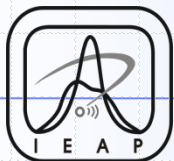


Van-de-Graaff accelerator at IEAP CTU Prague

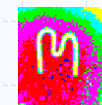


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Projects funded by the European Space Agency





Van-de-Graaff accelerator at IEAP CTU Prague



Outlook

- Staff and cooperators
- Accelerator history and parameters
- VDG working mode
- Associated labs
- Summary



Van-de-Graaff accelerator at IEAP CTU Prague



□ Staff and cooperators:

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* PhD student

former staff



Van-de-Graaff accelerator at IEAP CTU Prague



□ Accelerator history and parameters

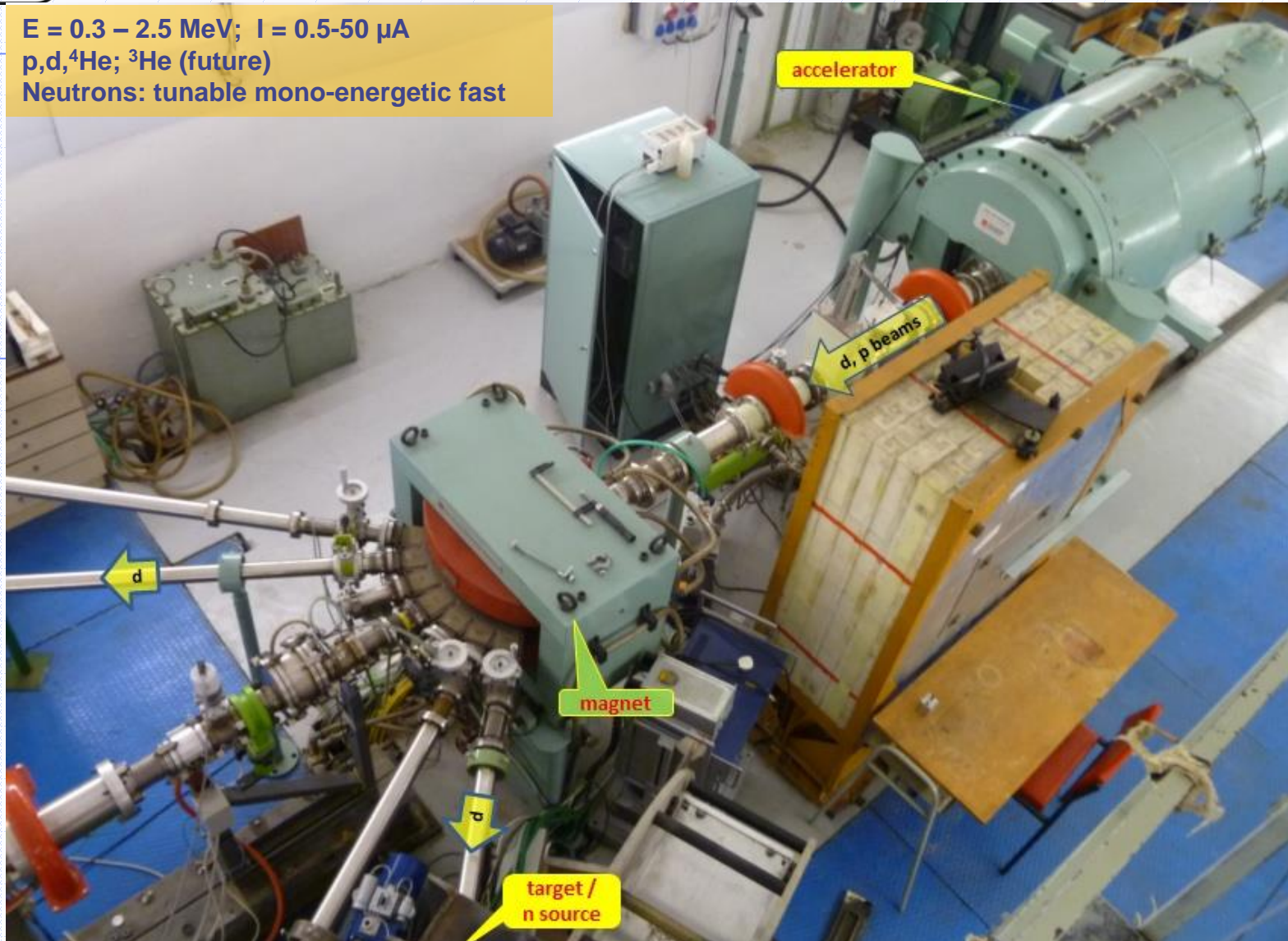
In the laboratory building of the Faculty of Mathematics and Physics, Charles University (FMP CU) in Prague Troja an **electrostatic ion accelerator, Van de Graaff HV2500** (product of the High Voltage Engineering Europa B.V.) with **maximum energy 2.5 MeV protons (hereinafter VdG)** is currently in operation. Accelerator was commissioned in 80th of 20th century, and now is upgraded and operated by IEAP CTU staff.



Van-de-Graaff accelerator at IEAP CTU Prague



$E = 0.3 - 2.5 \text{ MeV}$; $I = 0.5-50 \mu\text{A}$
p,d, ^4He ; ^3He (future)
Neutrons: tunable mono-energetic fast





Van-de-Graaff accelerator at IEAP CTU Prague



Accelerator history and parameters

Main VDG parameters

- light ions (200 keV – 2.3 MeV): ^1H , ^2H , ^4He , ^{12}C , ^{14}N (prospectively ^3He)
- Beam intensity: less than $0,1\mu\text{A}$ to cca $15\mu\text{A}$
- Particle flux from 10^2 to 10^{12} ps^{-1}
- Main application: testing of detectors, thin sensors and ICs



Accelerator history and parameters

Main VDG parameters

- tunable mono-energetic neutrons (30 keV – 19 MeV)
- Reactions, used for neutron generation:

Reaction	Q-value [MeV]	Threshold [MeV]	Ed (Ep) range [MeV]	En range [MeV]	Neutron flux at 30 cm from target [n/cm ² /s]
T(d,n)4He	+17.590	–	0.2 – 2.5	14.1 – 18.9	10 ³⁻⁵
D(d,n)3He	+3.269	–	0.2 – 2.5	2.5 – 5.7	10 ²⁻⁴
T(p,n)3He	–0.764	1.019	1.2 – 2.5	0.03 – 1.7	10 ³⁻⁵

- Main application: testing of detectors, irradiation, testing of scintillators**



Van-de-Graaff accelerator at IEAP CTU Prague



□ VDG working mode

VDG works generally in the „open access“ mode

At present the VdG has support from Research Infrastructure (RI) grant from Ministry for Education, Youth and Sport (MEYS). In the period 2012 - 2016 it covers about 70% at the RI operation, upgrades, development and activity expenses within the running RI grant. IEAP covers the remaining 30%. It is planned to maintain the RI in the mode "open access" for the next period to 2022.

Open access means, that scientific users can make their experiments at our labs free of charge (except for industry purposes), only by request for beam time.



Van-de-Graaff accelerator at IEAP CTU Prague



□ VDG working mode

Beam time request:

Request for beam time you can find at VDG web page

<http://www.utef.cvut.cz/vdg-details-and-schedules>

as a „User/ beam time form“



Van-de-Graaff accelerator at IEAP CTU Prague



□ Associated labs

Beside VDG itself, IEAP run also

- discrete wide-range gamma-ray stations
- CZ National Research Infrastructure
- ESA certified facility (neutron sources) in progress

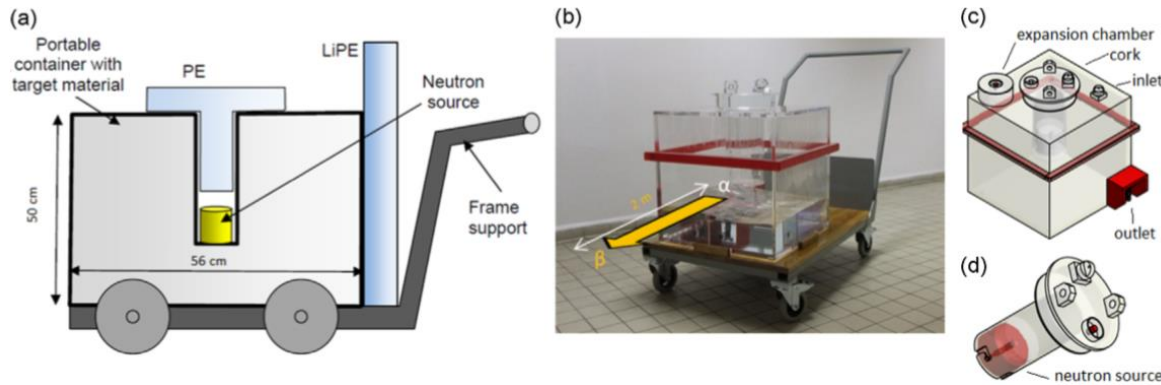
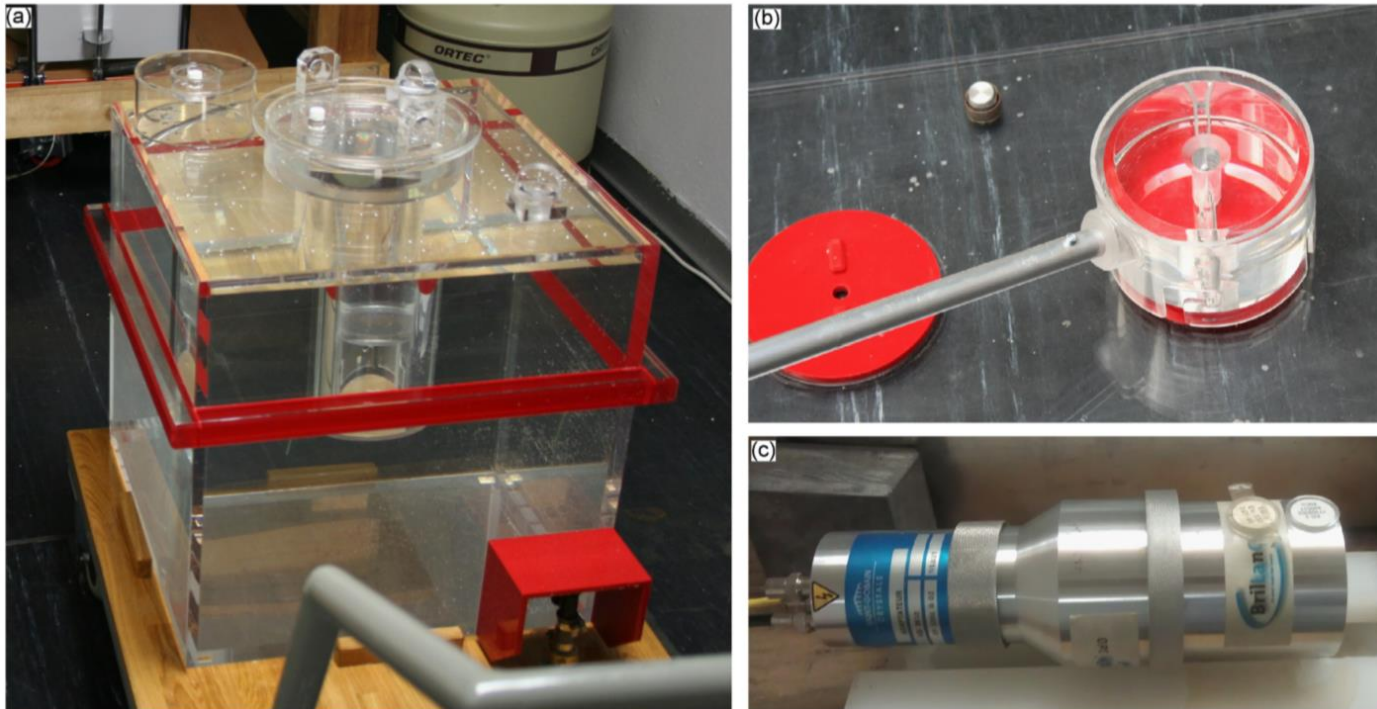
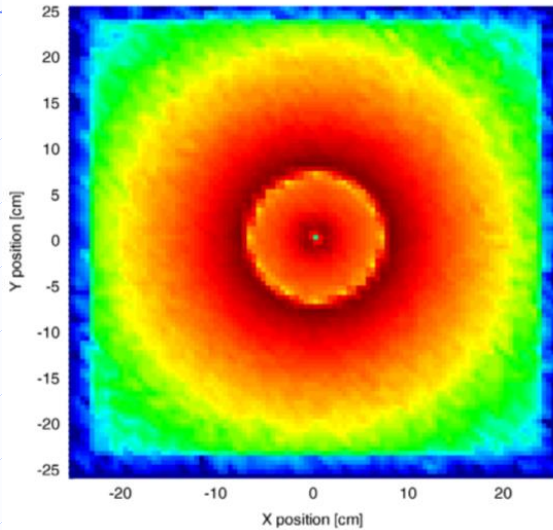
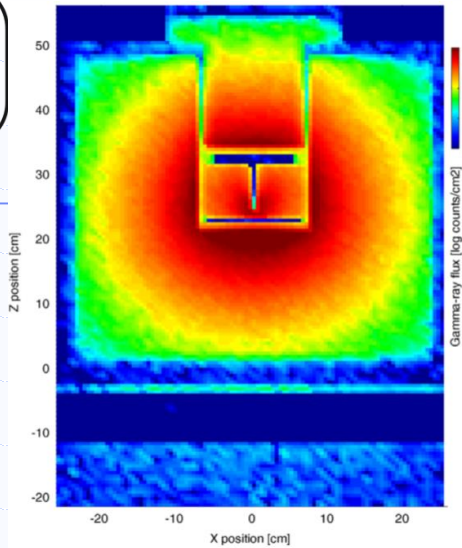


Illustration (a) of the transportable gamma-ray station (b). The container (c) is equipped with an expansion chamber and flow inlet and outlet as well as the central cork (d) containing the neutron source. The overall size and main parts are indicated. Labels for two measuring positions (α , β) are included (b).

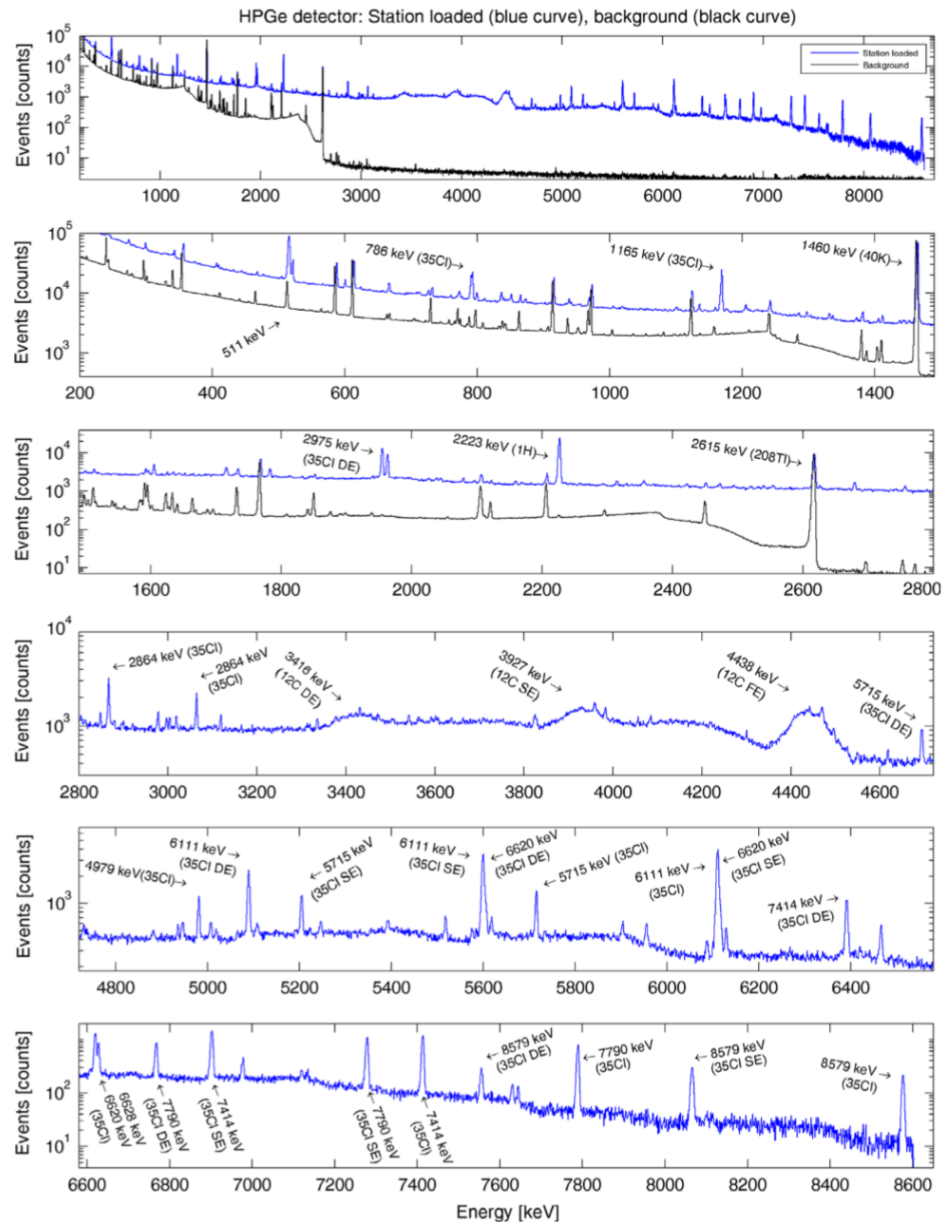
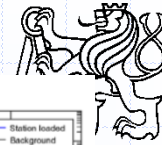


(a) Fully-loaded station (neutron source inside cork, container tank filled). (b) Cork element with loaded AmBe neutron source serving as highly-compact, hand-held gamma-ray source. (c) Tested scintillating LaBr₃:Ce detector (two radioactive sources used for efficiency for calibration are visible—on the top right side).



Monte Carlo simulation of the distribution of gamma-ray flux produced along the horizontal (a) and vertical (b) planes crossing the AmBe source at $x \approx 0$ cm, $y \approx 0$ cm and $z \approx 25$ cm. The gamma-ray flux (#/cm²) is given relative per one neutron emitted from the AmBe source

Gamma-ray spectrum, HPGe, portable station loaded





Van-de-Graaff accelerator at IEAP CTU Prague



□ Summary

- VdG accelerator: CZ national research infrastructure
- Long term fund grant MEYS
- Only particle accelerator in CZ Universities
- ESA certified facility (in progress) radiation source (tunable monoenergetic neutrons)
- New beam line (coop NPI Rez): nuclear reactions for astrophysics
- Registered facility for specialized training: IAEA Vienna
- Users (CZ, EU, world): academy, research centers, high-tech companies
- Modernization and small-scale upgrades (presently)
- Future: major upgrade (replacement of accelerator, control system)



Van-de-Graaff accelerator at IEAP CTU Prague



□ Summary

- **Gamma-ray sources (discrete, wide-dynamic range) for space-related research (mission related services – payload testing/calibration): stationary, portable**
- **Stationary gamma-ray station last use: spacecraft payload (U Dublin)**
- **Portable gamma-ray station presently in Moscow (Russian Space Institute IKI)**



Van-de-Graaff accelerator at IEAP CTU Prague



Acknowledgement

Prague Van-de-Graaff accelerator is funded by grant research infrastructure No. LM2011030 of the Ministry of Education, Youth and Sports of the Czech Republic".



Van-de-Graaff accelerator at IEAP CTU Prague



Thank you for attention