Contribution ID: **32** Type: **Zamestnanci fyzika**

Accelerator Mass Spectrometry of Beryllium-10

Wednesday, November 26, 2025 3:30 PM (1 minute)

Beryllium-10 (^{10}Be) is a long-lived radioactive cosmogenic isotope of beryllium (half-life = 1.387 Ma), primarily produced in the Earth's atmosphere through spallation reactions induced by high-energy cosmic rays. Owing to its extended half-life and β^--decay mode, the quantification of ^{10}Be at ultratrace levels in natural samples is most effectively achieved using accelerator mass spectrometry (AMS). As a robust geochemical tracer, ^{10}Be is extensively utilised for geochronological applications and serves as a valuable tool in diverse fields of Earth and environmental sciences.
The CENTA (Centre for Nuclear and Accelerator Technologies) laboratory was founded in 2013 and is equipped with a 3 MV Pelletron accelerator from NEC (National Electrostatic Corporation, Middleton, USA). The first attempts to measure ^{10}Be in 2015 were done in cooperation with the VERA (Vienna Environmental Research Accelerator) laboratory of the University of Vienna; however, they were limited by insufficient background suppression in the high-energy part of the beamline. A major upgrade of the beam line was implemented in 2023 and allows almost total suppression of interfering ions. To suppress the main isobaric interference of ^{10}Be, the stable isotope ^{10}B, additional methods need to be implemented.
The full suppression of ^{10}B can be achieved by several techniques utilising different energy losses of boron and beryllium in matter. We have adopted the absorption technique, where a stack of silicon nitride foils with a defined areal density is used as an absorber in front of the gas ionisation detector used for the registration of ions. This technique was tested by using a 2+ charge state, for higher transmission and a gas ionisation chamber supplied by NEC was used as the end detector. Standard reference materials with an isotopic ratio of ^{10}Be/^{9}Be ranging from 2.502 × 10^{-11} to 1.01 × 10^{-13}, obtained from the University of California, were used for the determination of linearity in this range. When the production of BeH molecules was suppressed by increasing the pressure of the stripper gas in the accelerator, a background level of 5 x 10^{-14} was achieved.

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Session Classification: Poster session + káva: prezentácie vedeckých výsledkov FMFI UK Zamestnanci Fyzika

Track Classification: Poster session + káva: prezentácie vedeckých výsledkov FMFI UK Zamestnanci: Poster session + káva: prezentácie vedeckých výsledkov FMFI UK Zamestnanci Fyzika