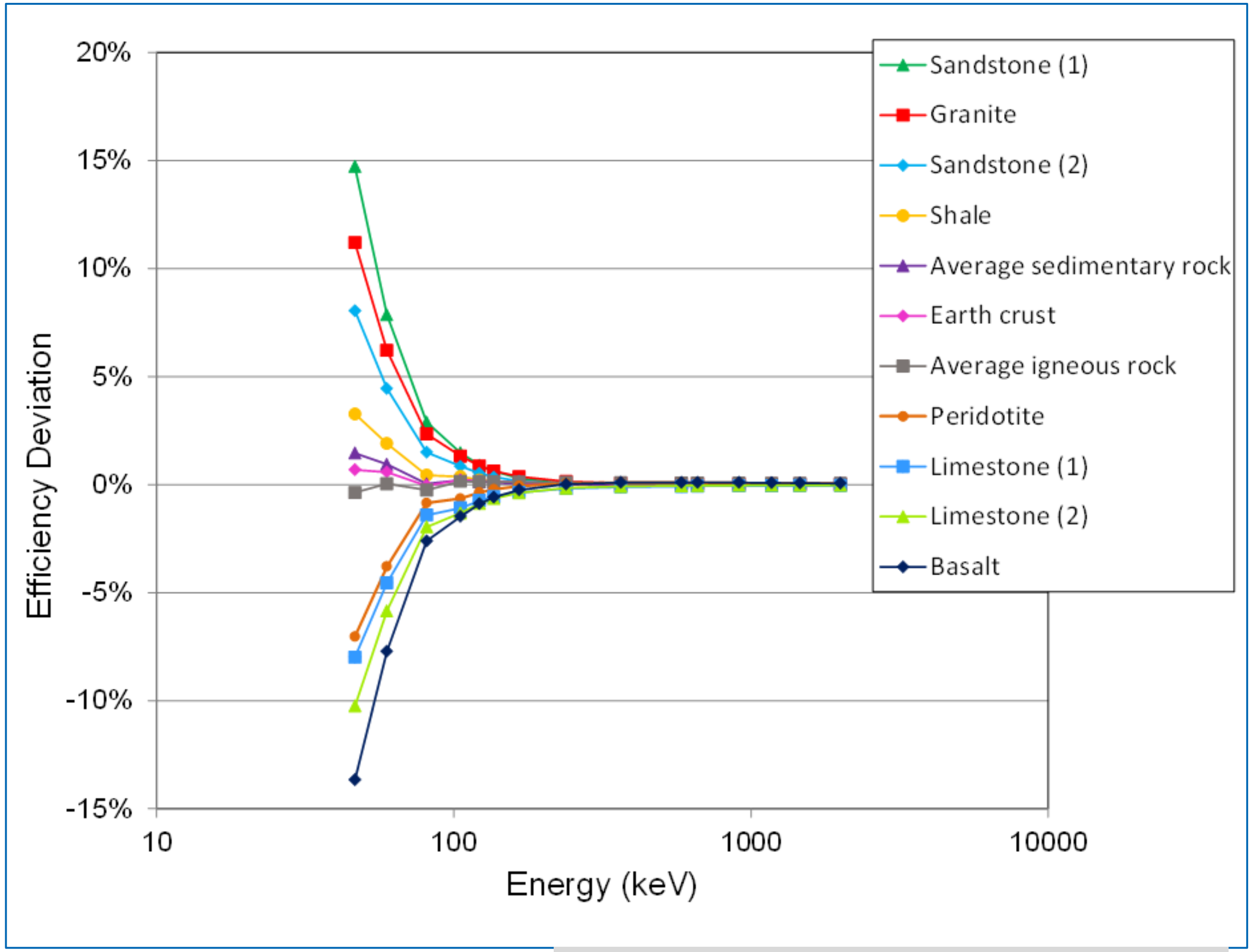
Recent activities/development in STUK’s gamma ray laboratory

Roy Pöllänen, Jani Turunen

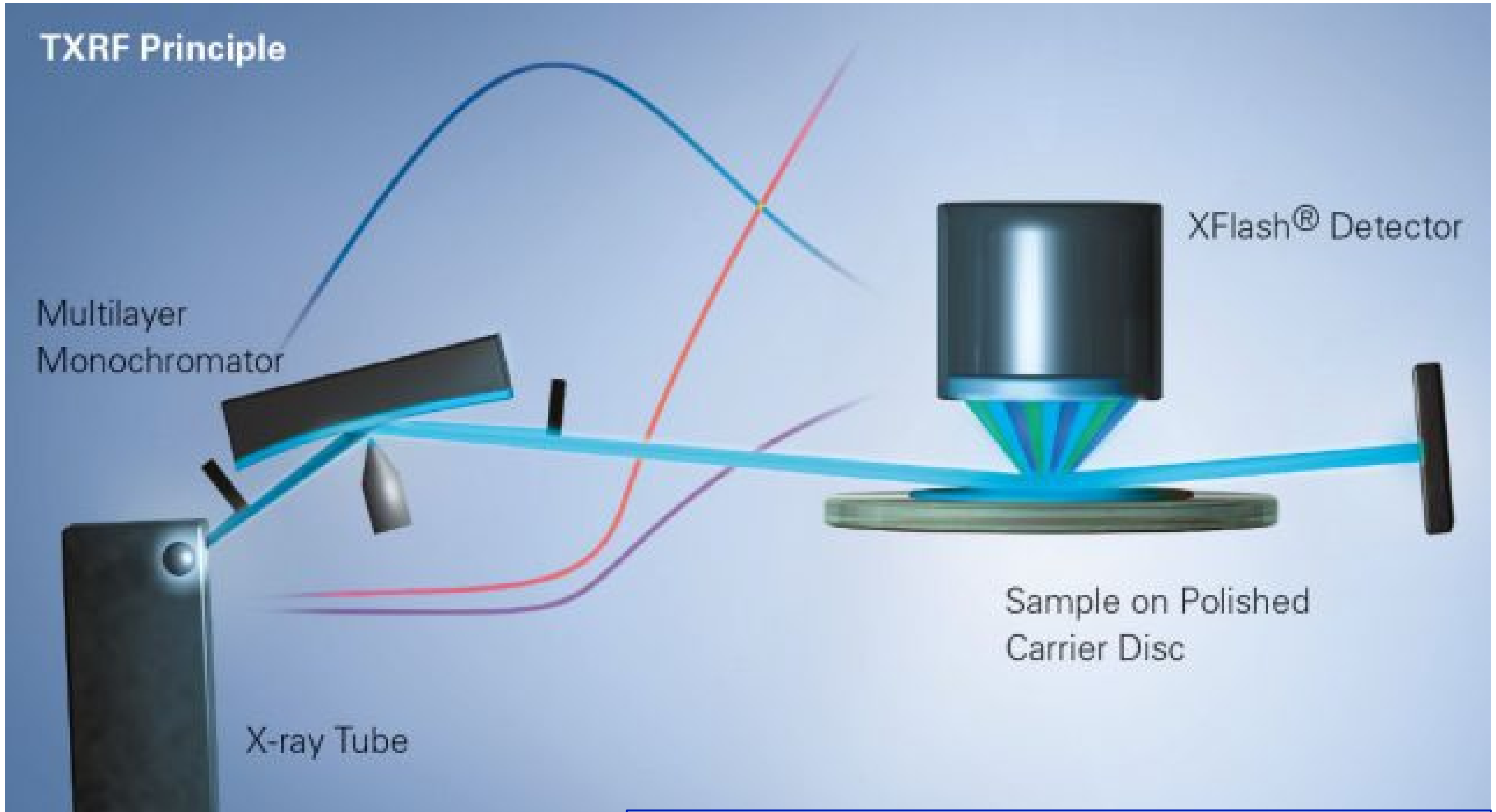
1. The influence of the sample elemental composition

- STUK measures samples of varying geometry and composition.
- The measurement geometry is in good control, but the elemental composition is not.
- The composition is relevant especially for low-energy gammas.
- STUK will buy TXRF equipment to determine the elemental composition of the samples.



Christoph Wilhelm - Analysis of NORM samples by gamma-ray spectrometry

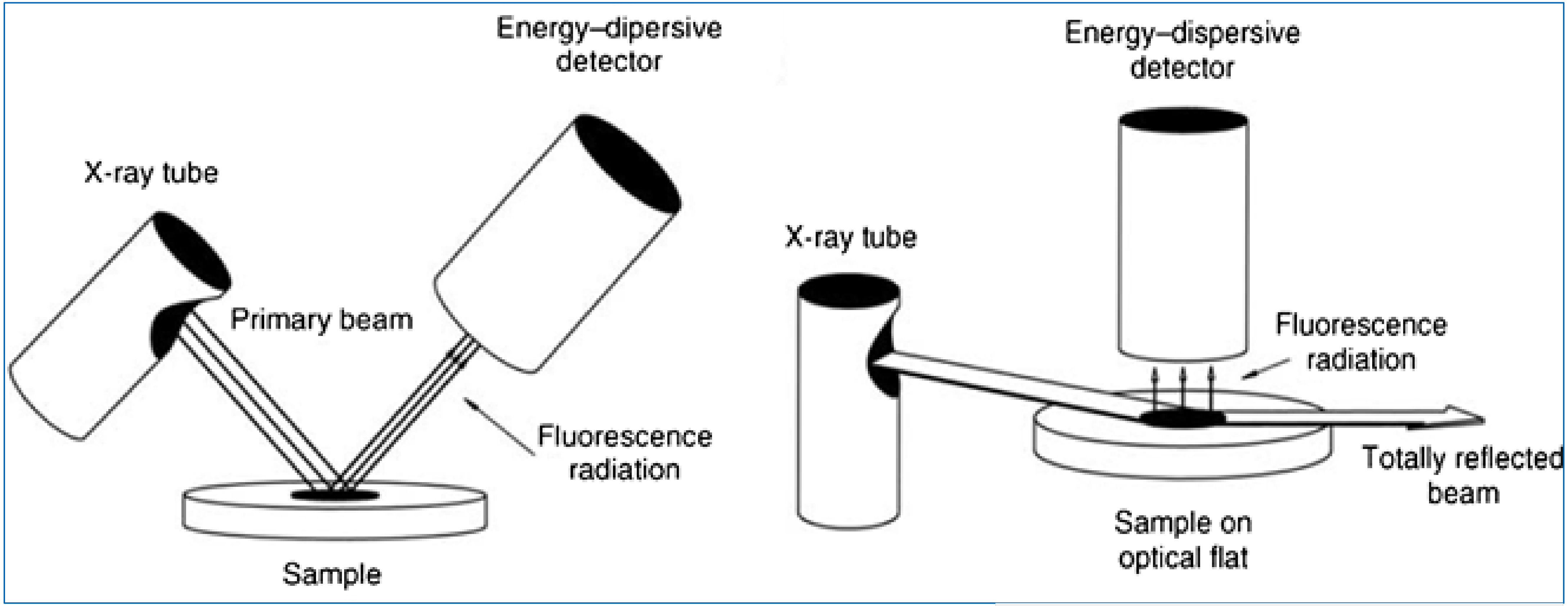
Total Reflection X-Ray Fluorescence



https://www.bruker.com/en/landingpages/bna/how-does-TXRF-work.html

TXRF spectroscopy utilizes a multilayer monochromator to generate a fine beam which impinges on a sample at a very small angle for enhanced fluorescence yield and reduced noise enabling trace elemental analysis.

Traditional XRF vs. TXRF



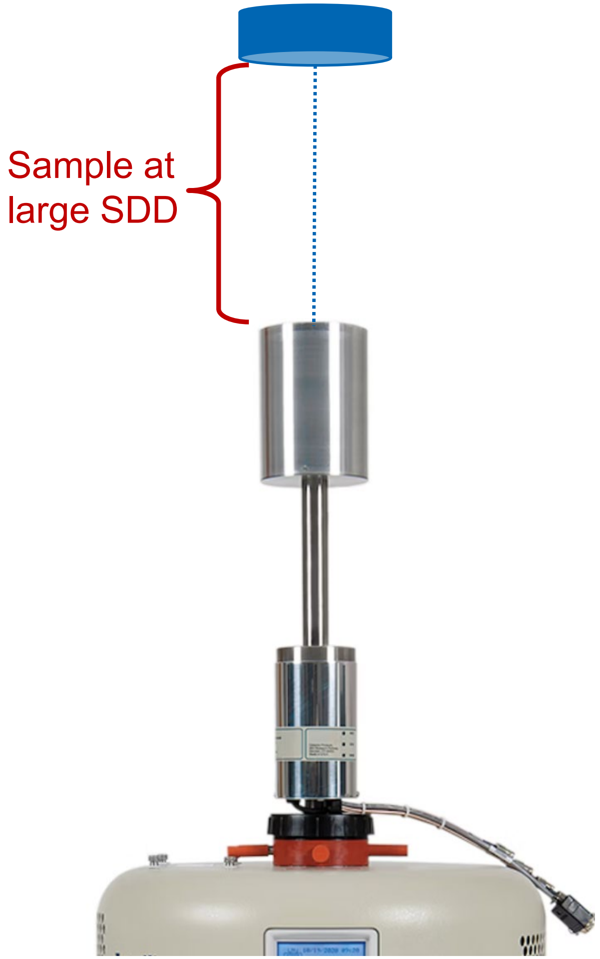
Total Reflection X-Ray Fluorescence Spectroscopy
Tibo Yang, Xinyang Fan, Jinge Zhou
Chengdu University of Technology, Chengdu, China.

2. Gamma-ray measurements in STUK's lab at larger source-to-detector distances, SDD

- Because of the low-activity of (typical environmental) samples, the measurements in the STUK's laboratory are usually performed in contact with the detector window.
- However, e.g. in case of a nuclear incident/accident the samples might have high activity concentrations.

→ Too large dead time

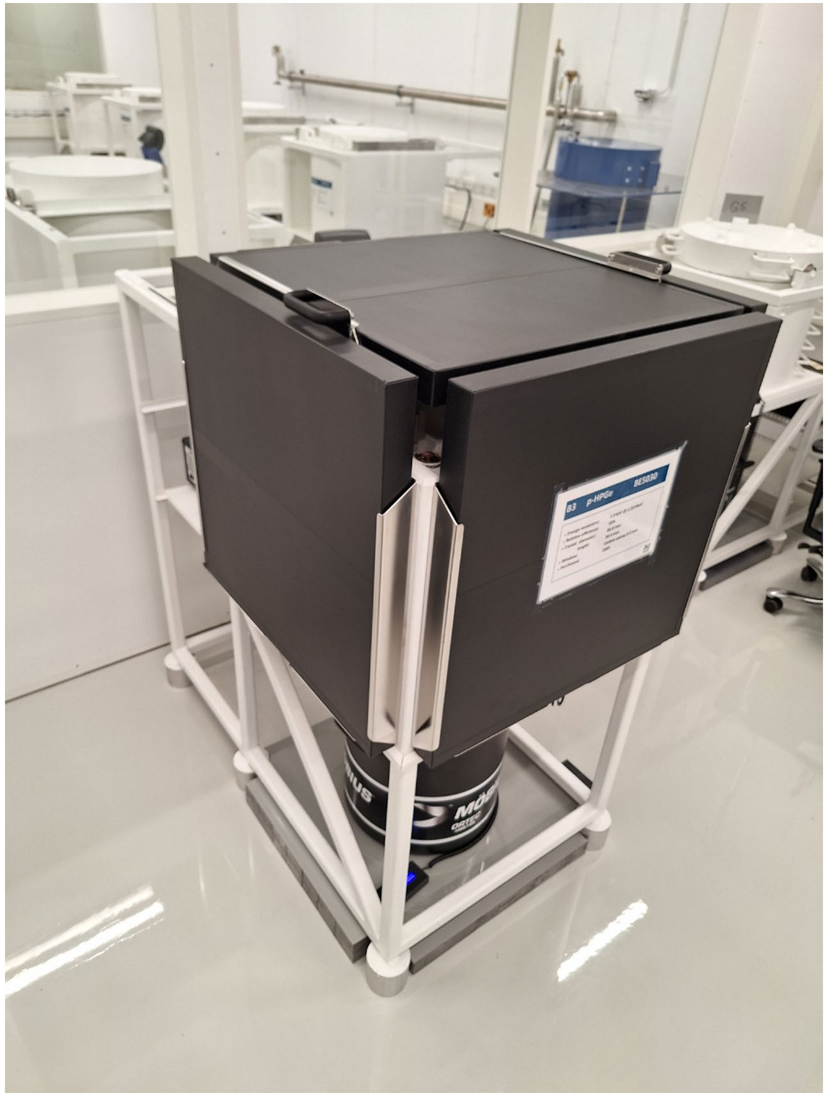
- Two main options:
  - to divide the samples into smaller pieces or by using radiochemical techniques
    ➡ Tedious & time-consuming
  - to measure the samples at larger source-to-detector distances
    ➡ Advantage: small coincidence correction



- A MSc. thesis is under preparation to investigate the validity of efficiency transfer software (EFFTRAN) when larger source-to-detector distances are used in the measurements.

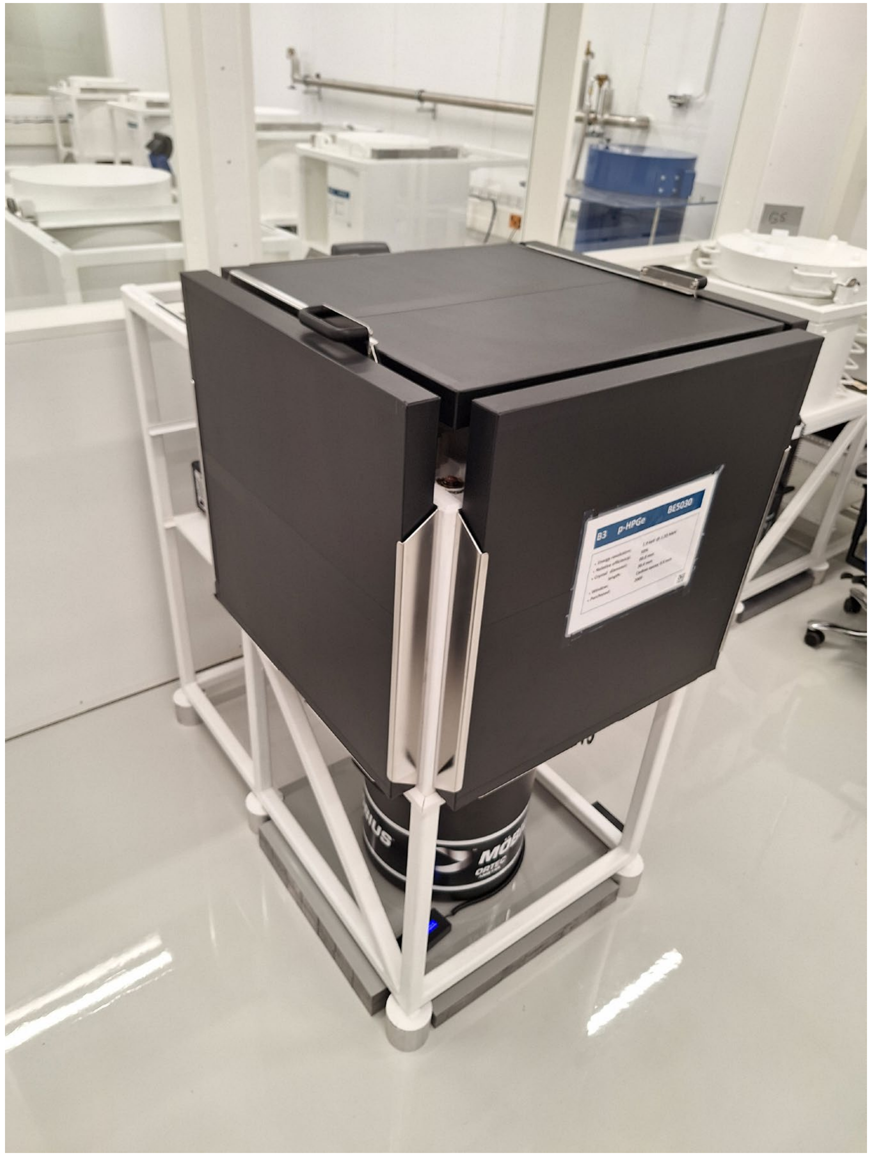
3. Reduction of cosmic gamma-ray background

- Upgrading one existing BEGe detector system in the gamma laboratory.
- Five plastic scintillator detector plates installed outside the lead shield.
- Data acquisition will be done using an upgraded model DSPEC 502A.
- Setup was built but not fully tested or taken into routine use.
- Master’s Thesis project for a student from the Aalto University (Espoo) started in August 2025.



Main tasks to do:

- Testing the detectors and equipment.
  - Parametrization of the coincidence system.
  - Signal timing of BEGe and scintillators.
- Integration of the setup to STUK's laboratory information management system NAMIT.
  - Raw gamma, coincidence, anticoincidence spectra saved separately.
  - In addition, the total spectrum from the scintillation detectors saved for QC purposes.
- Measurements and analysis with empty chamber, various environmental samples and reference sources.
- Writing a manual for the device for STUK's gamma spectrometry handbook.



4. Developing measurement quality

- STUK’s γ-laboratory is actively developing quality of the measurements.
- STUK is a national metrology laboratory.
- Accreditation as a testing laboratory since 1999; ISO/IEC 17025: 2017
- STUK is a member of EURAMET and ICRM (International Committee for Radionuclide Metrology, https://icrm-org.github.io/icrm/).


FINAS
Finnish Accreditation Service

AKKREDITOINTITODISTUS
ACCREDITATION CERTIFICATE

SÄTEILYTURVAKESKUS (STUK)
YMPÄRISTÖN SÄTEILYVALVONTA

T167

FINAS-akkreditointipalvelun akkreditoima testauslaboratorio T167
Akkreditointipäätöksen viimeinen voimassaolopäivä: 17.12.2023
Pätevyysalue, toimipaikat ja akkreditoinnin voimassaolo: www.finas.fi

Testing laboratory No. T167 accredited by FINAS Finnish Accreditation Service
Date of expiry of the accreditation decision: 17.12.2023
Scope of accreditation, sites and current status of the accreditation: www.finas.fi

Toimielin täyttää seuraavan standardin vaatimukset:
The above body conforms of the requirements of the following standard:

SFS-EN ISO/IEC 17025:2017

Helsinki 08.04.2021

Risto Suominen

FINAS kuuluu European co-operation for Accreditation (EA) monenkeskiseen tunnustamissopimukseen (EA MLA).
FINAS is a signatory of the European co-operation of Accreditation (EA) Multilateral Agreement for accreditation.

STUK’s γ-laboratory has started a process to submit a CMC (Calibration and Measurement Capability) entry in the KCDB (Key Comparison Data Base). Key benefits are:

International Recognition and Trust

- **Official Approval:** CMC entries are published in KCDB only after evaluation and approval through the CIPM MRA process, ensuring international recognition of the measurement capabilities.
- **Reliability:** KCDB serves as a global reference, demonstrating that the laboratory can produce traceable and accurate measurement results.

The **CIPM Mutual Recognition Arrangement (MRA)** is a global framework established by the **International Committee for Weights and Measures (CIPM)** in 1999. It enables metrology institutes to mutually recognize each other's measurement standards and calibration and measurement capabilities. This arrangement ensures international equivalence of measurements, which is essential for global trade, regulatory compliance, and scientific collaboration.

Traceability and Comparability

- **Compliance with SI Units:** CMC submission ensures that measurements are traceable to international standards.
- **Comparability:** Enables comparison of measurement results across countries, which is crucial for radiation safety and regulatory oversight.

Collaboration and Networking

- **Participation in Comparisons:** CMC submission requires involvement in international comparisons, strengthening the laboratory's expertise and standing in the metrology community.
- **Networks:** Facilitates participation in expert networks such as CCRI, EURAMET and IAEA.

CCRI (Consultative Committee for Ionizing Radiation) is one of the consultative committees of the BIPM (Bureau International des Poids et Mesures), focusing on metrology in the field of ionizing radiation.

EURAMET (European Association of National Metrology Institutes) is the metrology organization for Europe, coordinating metrology activities among its member states.

Visibility and Service Development

- **Service Promotion:** KCDB publication also serves as a showcase of the laboratory's expertise and services to other stakeholders.
- **Quality Management:** The CMC process supports the development and maintenance of the laboratory's quality system.

Enhancing Radiation Safety

- **Regulatory Oversight:** Reliable measurement capabilities support regulatory control and management of radiological emergencies.
- **National Preparedness:** Improves national readiness for radiation incidents and supports the protection of critical functions.