International Initiative on X-ray Fundamental Parameters

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ICRM 2025 Paris • France 19-23 May
24th International Conference on Radionuclide Metrology and its applications

Motivation

The **International Initiative on Fundamental Parameters (IIFP)** was launched knowing that:

Accurate data related to the interaction of X-rays with matter, called **Fundamental Parameters** (FP), are of paramount importance in many branches of physics and technology.

These are the **mass attenuation coefficients**, **X-ray emission intensities**, **fluorescence yields**, etc.

In radionuclide metrology, X-ray FPs can be **used to evaluate the decay scheme**, e.g., the X-ray emission intensities are often derived from electron capture probabilities or internal conversion coefficients and fluorescence yields of the daughter element.

The **lack of recent reliable values** of FPs with low associated uncertainties over a wide atomic number range, is regularly pointed out by end users of X-ray instrumentation (few measurements performed > 40 years ago);

The reliability of tabulated databases is questionable (uncertainties?);

The IIFP takes advantage of modern facilities

Monochromatic X-ray sources (synchrotron, high power X-ray tubes);

Energy selection with high energy resolution (a few eV);

High resolution energy-dispersive detectors (microcalorimeters);

Wave-length dispersive detectors;

Fast electronics (high count rates);

New theoretical codes (MultiConfiguration Dirac-Fock configuration, etc.);

Major **improvement in computing power.**

Methodology

Initiate and validate **new measurements** taking advantage of technical improvements;

Perform similar measurements in different institutes to establish reliability (mutual validation) and to **validate associated uncertainties** of the experimental values;

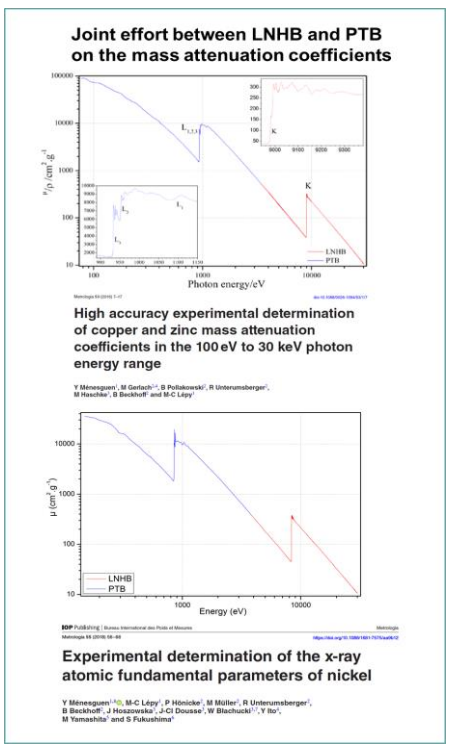
Perform theoretical calculations for selected cases;

Use calculations for interpolations and validation purposes;

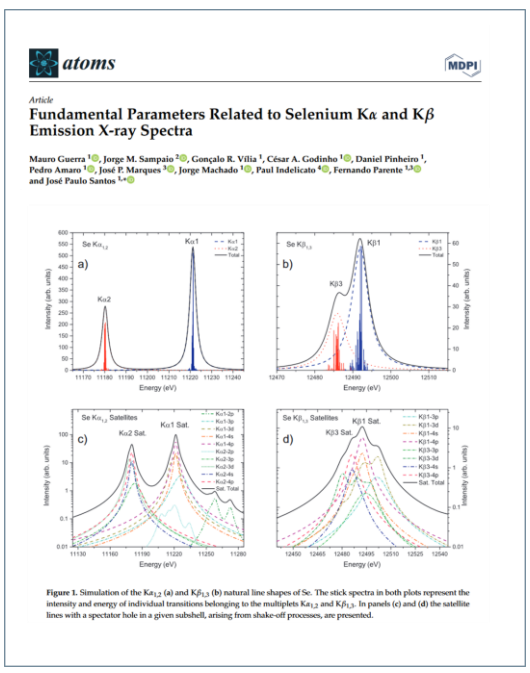
Compare calculations to experiments.

See P2-37

Examples of recent results

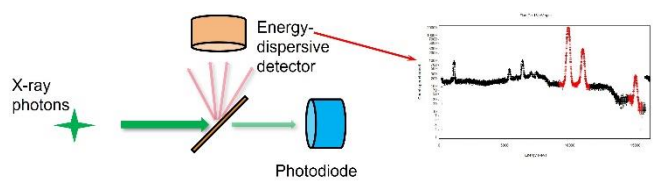


Measurements performed with monochromatic synchrotron radiation (BESSY2 and SOLEIL)



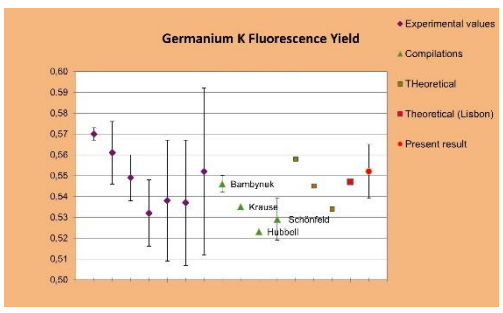
High-resolution measurement of the energy of K X-ray lines of selenium using wavelength-dispersive spectrometer with 4 crystals (Univ. Kyoto)

K fluorescence yields of germanium



LNHB experiments: ω_K(Ge) 0.552 (13)

Calculation with MultiConfiguration Dirac-Fock approach (Univ. Lisbon): ω_K(Ge) 0.545



Schönfeld (compilation 1995): ω_K(Ge) 0.529 (10)
Difference of about 3% with new resutls

Achievements of the IIFP

Discussion between experts during 13 international workshops (Europe / USA / Japan) since 2008;

> 100 participants (national metrology institutes, academic partners, industrial partners);

> 25 publications: on new measurements of FPs;

Mutual cooperation in various joint projects (e.g. academic, EURAMET and industry);

Series of **new accurate experimental data with reduced uncertainties**;

Validation between experimental data;

Comparison with theoretical calculations.

Next steps

"Easy" elements and energy range > 10 keV: done;

More difficulties with some elements (chemistry, toxicity, etc.) and low energies (L and M X-ray series);

Preparation and distribution of a documented **database** to end-users;

New collaborations are welcome.