High energy synchrotron bremsstrahlung beams from Advanced Photon Source in Argonne National Laboratory were used to excite L-X and K-X fluorescence radiation of heavy and super heavy elements. Samples were preliminary selected at HIL using a Si(Li) detector for X-ray detection and a 200 mCi Am-241 source for the excitation.

Three different experimental methods were tested at ANL:

- Beam of 50 keV ($10^{10}$ ph/s) was used for the L-X ray excitation of elements with $Z$ ranging from 110 to 130 and energies of 20.2-29.2 keV, respectively. An Si(Li) detector was used to measure the characteristic radiation. Difficulties were encountered due to the fact that if a sample contained Th, U or Rh, Pd, Ag, In elements, quite intense lines were present in the measured spectra in the same energy region as the one where the SHE lines were expected. Thus, in some cases the information from the Si(Li) detector is not sufficient. It is necessary to measure observed lines with higher energy resolution. The estimated sensitivity for the element 120 was about $1E15$ atoms.

- A crystal spectrometer built at APS, including a curved Si crystal, a goniometer, a 2m long copper tube as a collimator and a Ge detector to measure photon energies, was used for a higher energy resolution measurement. A 50 keV beam (1E12 ph/s) was used for the excitation and the characteristic radiation was measured using the crystal spectrometer and the Si(Li) detector. Several measurements were performed, in case of one sample the U L-X lines ($\gamma_1$, $\gamma_2$, $\gamma_3$, $\gamma_4$, $\gamma_5$, $\gamma_6$, $\gamma_7$) were observed. This method required very long measurement times. The estimated sensitivity was about $1E13$ atoms.

- To excite K-X ray in SHE the following beam energies were chosen: 300 keV ($3\times10^8$ ph/s), 276 keV ($3\times10^9$ ph/s) and 205 keV ($3\times10^{10}$ ph/s). The K edges calculated for SHE are equal 182.03 keV for element 110 and 297.48 keV for element 130. In this case a 10-element intrinsic Ge detector was used for the characteristic radiation measurement. A few $10^4$ second long measurements were performed. The background from the scattered X-rays was quite high and no lines were observed. The estimated sensitivity was more than $1E17$ atoms.

The optimal approach seems to be the one employing the crystal spectrometer and Si(Li) detectors.

4. Scintillation Ionization Detector (SID) for heavy and superheavy elements detection

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In order to minimize the background effect we proposed to equip the detection system dedicated for superheavy element search at GANIL with an additional scintillation-ionization detector located just before the implantation detector [1]. The detector consists of two main parts: photo-tube with focusing mirror (scintillation part) and two planes of proportional counters (PPC). Both parts of SID detector are working in the same gas. Scintillation pulses are characterised by a very short rise time and could be used in ToF (time of flight) measurements as well as in pileup rejection.
systems. PPC detectors have high efficiency for light charged particles (LPC) detection thus can strongly reduce the LPC background.

![Figure 1: Ionization part (left side) and the scintillation part (right side) of the SID detector.](image)

The SID chamber was recently used in the complete fusion SHE experiment (E533) at GANIL. At the Warsaw cyclotron facility (HIL) we plan to make further tests of the SID detector by using low-energy Ar beam.

References:


5. Coulomb excitation of light Hg nuclei

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In light, even mass Hg isotopes, a weakly deformed oblate ground state band is found to coexist with a more deformed prolate band. To investigate the origin and evolution of shape coexistence in the N = 102-108 mid shell region Coulomb excitation measurements of ¹⁸²,¹⁸⁴,¹⁸⁶,¹⁸⁸Hg were performed at REX-ISOLDE using the MINIBALL detector array. Beams of ¹⁸²,¹⁸⁴,¹⁸⁶,¹⁸⁸Hg isotopes were provided by ISOLDE and post accelerated by REX, for the first time, to an energy of 2.85 MeV/u and delivered to the target position of MINIBALL.

Using the Coulomb excitation analysis code GOSIA matrix elements can be obtained for the observed low-lying states in the measured nuclei which will enable the magnitude and sign