Current status of the ATTA experiment at Hamburg University—Initial experience in the optical production of metastable krypton atoms

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Kr-85 is anthropogenically produced noble gas isotope and mainly emitted into the atmosphere by nuclear fuel reprocessing. It has a high potential for uncovering undeclared reprocessing activities[1] and could detect non-compliance to the Non-Proliferation-Treaty (NPT) if employed by the International Atomic Energy Agency (IAEA). At present, the implementation of the method is limited by the large required sample size and the significant number of samples.
In 1999 a new experiment—Atom Trap Trace Analysis (ATTA)—was built at the Argonne National Laboratory (ANL)[2] with potential to overcome the limitation of sample size and measurement time. At the Carl Friedrich von Weizsäcker Centre for Science and Peace Research a new ATTA experiment based on the ANL design is designed to work with a small sample size and a high throughput of samples.
Previous work of the ANL indicates that only the use of optically produced metastable Krypton has the capability to work with small samples[3]. The implementation of optically produced metastable Krypton within our ATTA-experiment will be accomplished by a newly designed durable vacuum-ultra-violet(VUV)-lamp.
This VUV-lamp has a lifetime of over 500 hours (25–30% compared to the initial intensity) and was developed for ultra high vacuum applications. To achieve a long lifetime, considerable efforts went in construction, cleaning and the identification of optimized parameters for operation[4].
The designated combination of an ATTA experiment, based on a combination of a 3D-MOT for detection and a $2D^{+}$-MOT as the isotope selective element, with this new VUV-lamp shows a high potential to detect the Kr-85 concentration of air samples by measuring the Kr-85/Kr-81 ratio.

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