Contribution ID: **187** Type: **poster**

All-Optical Atom Trap Trace Analysis –Potential Use of 85Kr in Safeguards Activities

Thursday, 23 October 2014 11:50 (40 minutes)

Sensitive measurement techniques for the detection of anthropogenic tracers demand measurement resolutions down to single atoms, as it has been demonstrated by the first atom trap trace analysis experiments. However, technical limitations had lowered the sample throughput to about 200 per year per machine. We have developed an all-optical apparatus which allows higher sample throughput and small sample sizes at the same time.

Krypton-85 as anthropogenic isotope is an ideal tracer for nuclear activities since the only relevant source term is fission. An increased 85Kr concentration in an air sample indicates, that a plume was passing by during sampling. In practice, however, its applicability may be limited by the global and regional background concentrations caused by the emissions of nuclear fuel reprocessing plants.

The potential of 85Kr monitoring for safeguards applications has been discussed extensively. Among these is the short range detection of elevated concentrations of 85Kr in the vicinity of reprocessing plants. Our ATTA technique needs sample sizes of about 1 L of air only and thus for the first time will allow simple environmental sampling of 85Kr with high spatial and temporal resolution. The design of such a study including local sampling and tracer transport modeling in proximity to a reprocessing plants is outlined. In addition, such a study could be used also for validating near-field atmospheric dispersion models if the 85Kr source term is known. The potential of environmental analyses of 85Kr during an IAEA short-notice access is discussed. It is shown that it crucially depends on the emission dynamics after shut-down of fuel dissolution which needs further study.

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Session Classification: Noble Gas Measurements in Support of Nuclear Safeguards Implementation: E-Posters