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Report:

In this commissioning experiment we made a first test of new components developed for the observation of nuclear resonant scattering of y-rays with energies > 30keV at the undulator beam line ID18. The development of such components is necessary as the concepts which work well in the lower energy range are no longer effective. Also the 2/3 filling mode of ESRF, which is of no use in normal nuclear resonant diffraction work, could be chosen for these experiments.
All components were tested before at a bending magnet at DORIS and worked reliable under those conditions.
The various steps done in this experiment at ESRF were:

- testing the tunability of the undulator in the energy region of 60 - 70 keV for the first time;
- testing artificially broadened Si-crystals with increased angular acceptance as elements of the first monochromator;
- testing the use of Ta- and Hf-absorbers for energy calibration;
- testing the new fast switchable detector.

It was a pleasure to see how well the tuning of the undulator worked. The 9^{th} harmonic proved to yield the largest flux. Unfortunately there was a serious interaction problem beween the "undulator tuning program" and the service programs of the beam line. So it was not possible to perform energy scans keeping the undulator at maximum throughput. Nevertheless the strong effect of Hf- and Ta-K-edges on transmission of y-radiation was safely seen and tested that energy calibration by this method worked well.

The Si-crystals with artificially broadened reflection profile proved to be able to accept the intrinsic angular divergence of the undulator source. They are clearly superior to the flat crystals with narrow bandwidth reflections. Nevertheless we would prefer in future runs to use units with bent single crystals because of their smaller bandpass. Such a unit is under development and will be finished this year.

Our main effort was devoted to the test, of the switched scintillation detector. The result was very encouraging.

We used the ESRF bunch clock signal as trigger to switch the voltage of some dynodes of the multiplier on and off, realizing slopes of $\approx 400\,\mathrm{V}$ in 10ns. This worked stable without any problems during the whole experiment. So we could study the behaviour of the detector in detail. It turned out however that even without incident beam from ESRF a delayed counting rate of $0.2\,\mathrm{s}^{-1}$ was present. This proved to be due to cosmic radiation events, which are not negligible with a scintillator of $1\frac{1}{2}$" x 1" size. With a modified electronic setup we could reject those events.

With beam incident from the undulator typically a delayed counting rate of $\approx 1.0\,\mathrm{s}^{-1}$ was observed which varied depending on the filling of ESRF. A two days delayed coincidence measurement revealed that in 2/3 mode - at least at that time - a background of spurious bunches was filled quasi continuously. In case of a weak resonant signal the reduction of spurious bunches may become an important condition for future work. The same experiment showed the excellent time resolution of the detector which resolved the single bunches filled in ESRF. Also there were no events in the time spectrum in between the bunches. This proved the excellent rejection of signals due to afterglow of the scintillator crystal under the conditions of a measurement at ESRF.

Most important was the unexpected observation that at high intensity of the primary beam an intrinsic dead time of the detector occured. This is due to the fact that the fast phototube XP2020, which we used, does not allow to switch off the photocurrent. Another tube will be applied in future work.

As a summary all tested units worked in principle as expected. The ideas which led to their construction are applicable under the conditions of a measurement at ESRF. This test beamtime under "nonresonant nuclear scattering conditions" was necessary to find the modifications of the new setup which are necessary and possible.

We are more optimistic than before to be able to observe nuclear resonance scattering with quantum energies above 30 keV soon.