# An Implantation Detector with High Granularity for Decay Studies of Exotic Fragments

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A new implantation detector has been built in order to study the decays of exotic isotopes near $^{100}$Sn, which are produced by fragmentation of a $^{112}$Sn or $^{124}$Xe beam. It was used in our experiment S192, which took place in november/december 1998 at GSI [1].

The isotopes of interest were separated in the GSI fragment separator (FRS) and identified with a set of detectors [2]. After implantation, decays with half-lives between 10 ms and 20 s were studied.

The implantation zone of the detector consists of four two-sided Si-strip detectors ($64 \times 25 \times 0.5\,\mathrm{mm}^3$, Eurisys), mounted in a compact stack (fig. 1). The detectors are highly segmented (128 strips on the p-side, 50 strips on the n-side) with a strip pitch of 0.5 mm on both sides. Their main purpose is the suppression of background by correlating the implantation position of an identified ion with its decay position. The background rate is caused by long living decay products, which accumulate in the detector during the run. It can be reduced by maximizing the granularity of the implantation zone. Another source of background originates in the misinterpretation of the correlated decay position of the daughter and the mother nuclei. This happens when the energy deposition of the decay of the mother nucleus in the detector layer is below the trigger threshold and therefore lost. Low energy depositions are possible for decays, if the nuclei are implanted very near to the surface of one detector layer or for an EC-decay without conversion electrons.

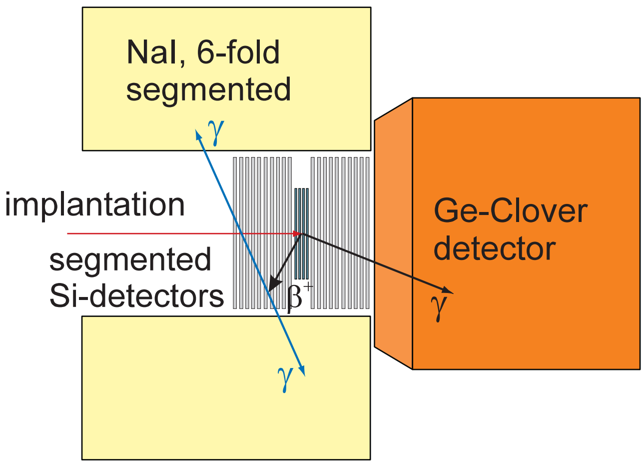


Fig. 1: Schematic view of the implantation detectors and the surrounding gamma detctors (not to scale).

Therefore our design goals were:

- a low trigger threshold for decays (50 keV),
- low noise of detector and readout electronics (20 keV FWHM per strip),
- high granularity (2048 pixels for each of the 4 detectors).

The 128 strips on the p-side of each detector were read out by highly integrated GASSIPLEX chips. A single GASSIPLEX chip consists of 16 preamplifiers, shapers, a track and hold stage and an analog multiplexer. As the GASSIPEX chips need a hold signal, the n-side was read out by specially designed discrete electronics with the same functional units, but with additional low noise timing filter and discriminator stages.

Two 10 mm thick stacks of Si-detectors in front and behind the implanation zone served for the $\beta$-energy measurement (fig. 1). The 10 detectors ($60 \times 40 \times 1\,\mathrm{mm}^3$, Micron) on eather side were 7 fold segmented to ensure a good suppression of compton electrons.

For gamma spectroscopy about 25% of the solid angle was covered by the segmented clover germanium detector [3] (fig. 1). Another 50% was covered by NaI-detectors with high efficiency but low resolution (fig. 1). Fig. 2 shows a raw spectrum of the clover detector with the FRS set for $^{104}$Sn. The lines can all be attributed to the decays of $^{104}$Sn and its daughters. The background is still high because a correlation between implantation and decay position is not yet required.

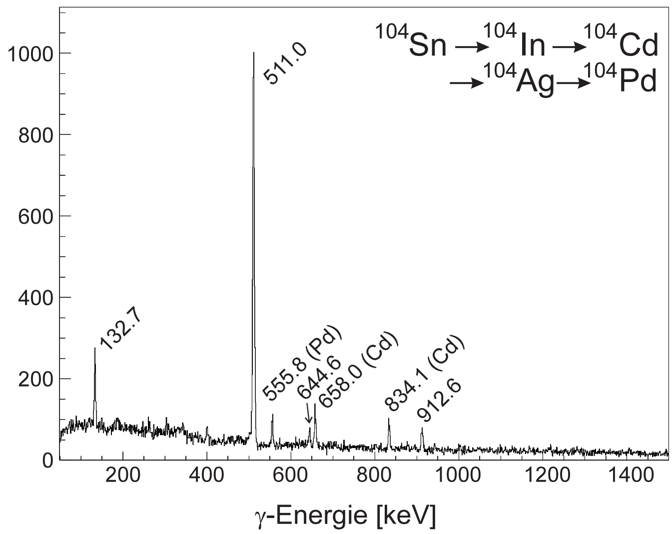


Fig. 2: Raw gamma spectrum from the decay of $^{104}$Sn and its daughters measured with the Ge-clover detector. Beside the 511 keV positron annihilation line and lines of excited $^{104}$In states, transitions of excited $^{104}$Cd and $^{104}$Pd states are clearly observable.

## References

[1] T. Faestermann *et al.*, this report p.13
[2] T. Faestermann *et al.*, this report p.90
[3] M. Kaspar, J. Gerl, GSI report 98-1, p. 195