Absolute detection efficiencies for multi coincidence studies

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Synopsis: We measured the detection efficiency of "standard" micro channel plates (MCP) as well as efficiency enhanced (so called funneled) MCPs, once absolute via the break-up of H2 and relative for a 5-atomic molecule, breaking-up completely.

The investigation of complex targets requires the detection of multi-particles in coincidence detection. Hereby it is of great importance that the single particle detection efficiency ε becomes as close to 100 % as possible, as the overall efficiency scales with the number of detected particles as ε^n. Besides the transmission of the spectrometer, also the detection efficiency of the detector itself is important. In this contribution, we present a comparative study of "standard MCPs", which are supposed to have a detection efficiency of 60%, with efficiency enhanced "funnel MCPs" (90%). The required measuring time for a 5-particle coincidence of former 1 day would be reduced by to approximately 3 hours. This greatly increased detector efficiency opens the door to further and far more complex measurements.

To commission and prove this efficiency gain, we performed two experiments. At first we measured the absolute detection efficiency of protons, via the reaction $He^{2+} + H_2 \rightarrow He^0 + H^+ + H^+$. We used a COLTRIMS spectrometer [2, 3], which was free of meshes and compared the absolute detection efficiency of normal and funnel MCP.

In a second experiment, the two types of MCPs were tested under identical conditions in a 5-particle coincidence experiment. During a continuous measurement, the two different MCPs, mounted on opposite sides of a symmetrical spectrometer were alternately used to detect the break-up of CHFClBr into 5 ions [1].

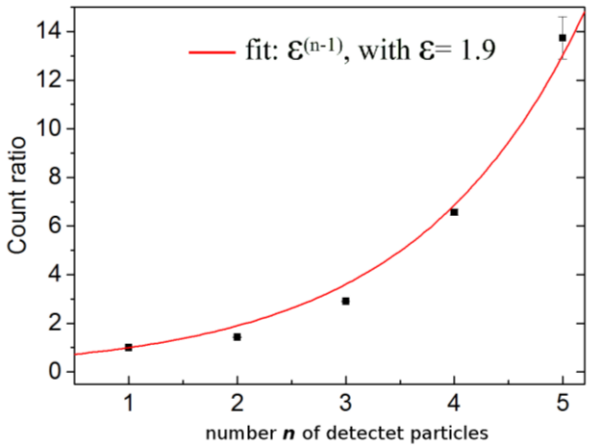

Figure 1 Gain in multi particle detection efficiency by use of new "Funnel MCPs" compared to the "Standard MCP". The data are normalized to the same single ion count rate. The fit shows that the Funnel MCP increases the efficiency.

Normalized to the same single ion count rate, the enormous improvement of a gain increase by a factor of 14 for 5 particles in coincidence is presented in Fig 1. The count rates for the different numbers **n** of detected particles are derived by gating on a complete detection of one of the fragmentation channels for the break up in to **n** particles.

References

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[2] R. Dörner *et al*. 2000 *Phys. Rep*. 330 95-192
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