The standard detector systems of the PHOIBOS analyzer series are based around the extended range CEM. This device is a specially formed and treated glass tube which has the effect of multiplying a single electron at the input to a pulse of around $10^8$ electrons at the output. Because of the low resistance the extended range CEMs are suitable for extremely high count rates.

A voltage between 2.5 - 3.5 kV across the cone and the tail-end initiates the electron multiplication. Electron multiplication is produced by the emissive layer along the inner surface of the channel. The gain is governed by the detector voltage and the condition of the emissive layer.

The condition of this layer changes with usage and to compensate for a drop in emissive quality of the surface an increased detector voltage can be applied, thus keeping the overall gain constant.

If the detector voltage has reached the limit of 3.5 kV at this point the CEM is at the end of its life and needs replacing.

**Experiment**

The PHOIBOS SCD and a modified EQ 22 electron gun were installed on a UHV system without bakeout (base pressure $2 \times 10^{-7}$ mbar). A constant count rate was measured in the flat region of a Cu AES spectrum a couple of days. Several times the beam current was increased.
The ageing of the CEM due to the bakeout of the analyzer should be investigated.

While the CEMs were not counting, residual gases in the system were adsorbed onto the channel walls which are kept clean by electron bombardment during operation. When counting was resumed, the gains were initially higher due to the increased work function by the adsorbed species.

When initially running a new CEM it needs approximately $20 \times 10^9$ counts for conditioning. Once properly conditioned, or "burned in", the surface on the semiconducting glass channel is quite stable.

The test results suggested that accumulations to $5 \times 10^{12}$ counts and higher can be expected without serious degradation.

The extended range CEMs are suitable for extremely high count rates without serious degradation.

Further studies
- The ageing of the CEM due to the bakeout of the analyzer should be investigated.

References