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Studies on the evolution of MTE for photocathdes subjected to controlled degradation by gas exposure

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The electron beam quality of a photocathode-based electron source is limited by the achievable mean transverse energy (MTE). The Liouville theorem states that the total emittance of a beam cannot improve as it propagates through an accelerator, only manipulated using lattice optics. Therefore minimising the intrinsic emittance of a photocathode is important. This alongside other factors such as the quantum efficiency (QE) of a photocathode determines the ultimate beam quality. The chemical properties of a photoemissive surface affect the energy spread of any emitted electrons, and consequently the intrinsic emittance of that source.
The robustness of the photocathode is also a crucial performance aspect, as this helps determine the lifetime of a cathode. I will talk through the performance data on two photocathodes, subjected to progressive degradation by controlled exposure to residual gases typically found in a UHV system: an Ag polycrystalline cathode at 266 nm and a Cs implanted Cu polycrystalline cathode at 405 nm. The data crucially shows the effect of this progressive degradation on photocathode performance due to gas exposure.

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