Two Novel Approaches for Electron Beam Polarization from Unstrained GaAs

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Abstract. Two novel approaches to producing highly-polarized electron beams from unstrained GaAs were tested using a micro-Mott polarimeter. Based on a suggestion by Nakanishi [1], two-photon photoemission with 1560 nm light was used with photocathodes of varying thickness: 625μm, 0.32μm, and 0.18μm. For each of these photocathodes, the degree of spin polarization of the photoemitted beam was less than 50%. Polarization via two-photon absorption was highest from the thinnest photocathode sample and close to that obtained from one-photon absorption (using 778 nm light), with values 40.3±1.0% and 42.6±1.0%, respectively. The second attempt to produce highly-polarized electrons used one-photon emission with 778 nm light in Laguerre-Gaussian modes with different amounts of orbital angular momentum. The degree of electron spin polarization was consistent with zero, with an upper limit of ~3% for light with up to ±5ℏ of orbital angular momentum. In contrast, the degree of spin polarization was 32.3±1.4% using circularly-polarized laser light at the same wavelength, which is typical for thick, unstrained GaAs photocathodes.