

Emittance Control of the Photoelectron Beam using Transverse Laser Shape Modulation and Tomography Technique, M. BABZIEN, I. BEN-ZVI, R. MALONE, V. YAKIMENKO - A low emittance beam is very important for many applications, such as short-wavelength Free-Electron Lasers. A diagnostic that provides detailed information on the density distribution of the electron bunch in multi-dimensional phase-space is an essential tool for obtaining small emittance at a reasonable charge. Measurement of a slice emittance has been achieved and provided a clear demonstration of the linear longitudinal emittance compensation scheme [1]. Changing the laser pulse profile of a photocathode RF gun has been suggested as one way to achieve non-linear emittance compensation [2]. The tomographic reconstruction of the phase space was suggested [3] and implemented [4] using a single quadrupole scan. In the present work we give special attention to the accuracy of the phase space reconstruction and present an analysis using a transport line with nine focusing magnets and techniques to control the optical functions and phases. This high precision phase space tomography together with the ability to modify the radial charge distribution of the electron beam presents an opportunity to improve the emittance and apply non-linear radial emittance corrections. Combining the slice emittance and tomography diagnostics lead to an unprecedented visualization of phase space distributions in 5 dimensional phase-space and an opportunity to perform high-order emittance corrections.

- [1] X. Qiu, K. Batchelor, I. Ben-Zvi and X.J. Wang, Phys. Rev. Let. 76 No. 20, 3723, (1996)
- [2] J.C. Gallardo, BNL Report 522246, (1990).
- [3] J.S. Fraser, IEEE Trans. Nucl. Sci. NS-26, No. 1, 1641 (1979)
- [4] C.B. McKee, P.G. O'Shea and J.M.J. Madey, Nucl. Inst. And Meth. In Phys. Res. A358, 264 (1995), I. Ben-Zvi, J.X. Qiu and X.J. Wang, Proc. PAC'97, Vancouver BC Canada, May 12-16, 1997