# IC Electron-Lens Beam Profile Monitoring

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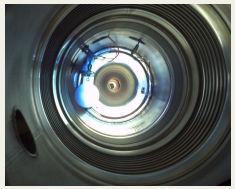
*Abstract*

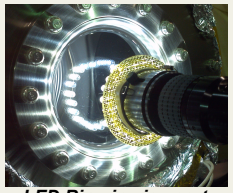
Beam profile measurements are ongoing of a 15keV electron beam, destined for an Electron Lens to be installed in RHIC this year. Two methods of profile measurements are compared. A pin-hole masked faraday cup collects charge from the beam pulses as the beam is raster scanned over it, developing a matrix of intensity measurements that are compared to a digital camera image of a YAG crystal.



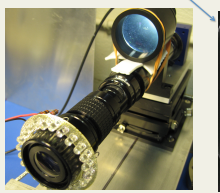
*View upstream into collector*

With Zoom

## Illumination Techniques

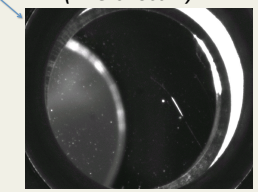


*LED Ring in viewport*

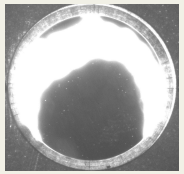


*LED Ring& Projector On the Lens*

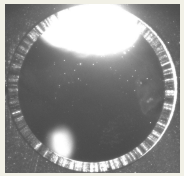
*(YAG offset 2°)*



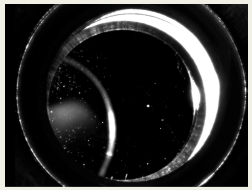
*LED Ring Illumination Increased detail on YAG*



*LED Ring Illumination*



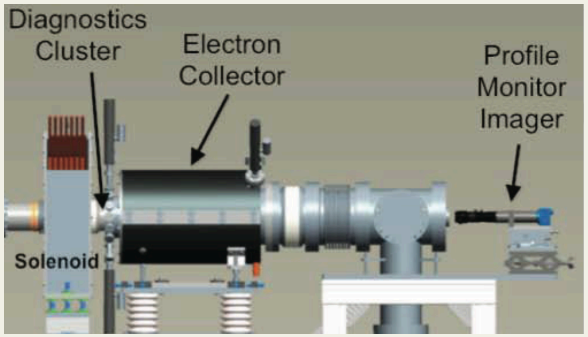
*Projected LED Illumination*



*Projected LED Illumination Increased detail on bezel*

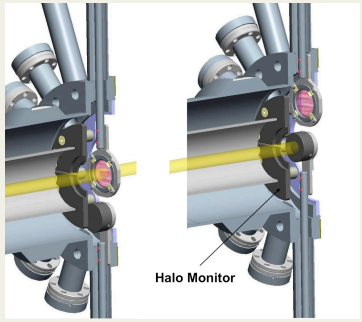
Mirror polished surface of YAG reflects illumination

Adding a 2° rotation to the crystal avoids blinding the camera *(below)*




## YAG Screen & Pinhole Faraday Cup

Two cutaway views of same diagnostics cluster upstream of collector showing segmented Halo Monitor (dark gray), YAG Screen (left, insert position), Pin Hole detector (right, inserted).

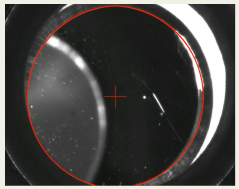



### YAG & Camera Details

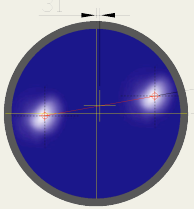
- Electron beam profile measurements will be made with a 30mm diameter, 0.1mm YAG:Ce screen from Crytur, Ltd. The expected beam diameter is ~10mm.
- Crystals are coated at BNL with 100nm of graphite. We will compare to an aluminium coated crystal for image performance, lifetime, and for backscattering electrons.
- The electron beam power deposited on the screen will be limited to avoid damage.
- Screen images will be acquired using a AVT Manta G-145B 2/3" CCD camera (GigE), and zoom lens from Navitar, mounted 1.2m downstream of the YAG.

## Calibration Procedure

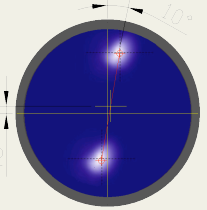
Overlaid beam YAG images at max & min deflection. SW calculates offsets $X_0$ & $Y_0$ and angles α & β from center-to-center lines.



Reference Circle drawn on image to establish $\mathbf{K_1}$ in Pixels/mm Calibration

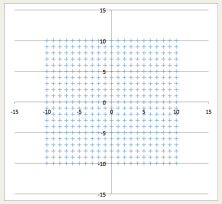


Horizontal center-to-center distance/Δsetpoint establishes $\mathbf{K_H}$ in pixels/Amps.



Vertical center-to-center distance/Δsetpoint establishes $\mathbf{K_V}$ in pixels/Amps.

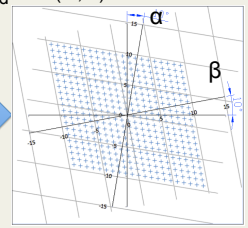
Pinhole data points have perfect (X,Y) coordinates.



(X,Y) coordinates transformed to (X',Y') include coupling angles α & β

$$X' = X\cos(\beta) - Y\sin(\alpha)$$
$$Y' = X\sin(\beta) + Y\cos(\alpha)$$

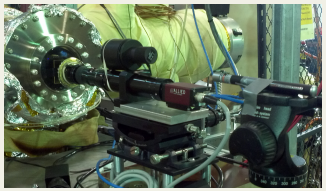
Coupled axes with new (X',Y') coordinates.



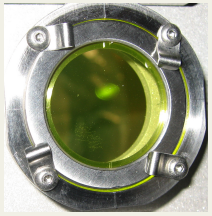

Final transformation employing coupling angles α & β calibration coefficients $\mathbf{K_H}$ & $\mathbf{K_V}$, and gain coefficient $\mathbf{K_1}$

$$X' = K_1\left[K_H\left(X\cos(\beta) - Y\sin(\alpha)\right) + X_0\right]$$
$$Y' = K_1\left[K_Y\left(X\sin(\beta) + Y\cos(\alpha)\right) + Y_0\right]$$

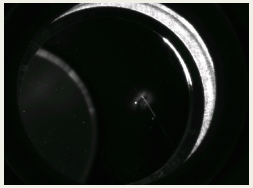
## Simulations with UV Laser



*UV Laser (405nm) on tripod illuminating the YAG crystal while white illumination of YAG target.*



*Laser on YAG during bench test*



*LED Ring Illumination + Laser On "scratch"*

*Laser only on "scratch" -> Not in YAG*