

Measurement of the Cathode Recess

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The 113 MHz SRF gun for the coherent electron cooling is designed with adjustable position of the cathode vs. the nose piece of the quarter wave gun as it is shown in Fig. 1. By changing the cathode position we modify the profile of the accelerating field. By retracting the cathode, we reduce the surface field but increase the focusing component as it shown in Fig. 2. The optimal position is defined by the beam dynamics and is found based on simulations.

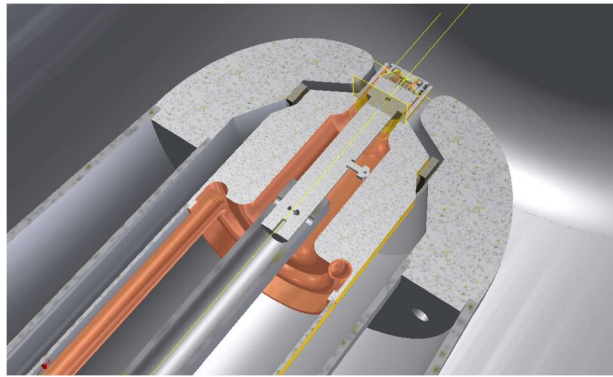


Figure 1: Cross section of the cathode region of the 113 MHz SRF quarter wave electron gun. The nose piece is held at cryogenic temperature. The cathode is inserted inside of the water-cooled stalk. To change the cathode recess measured from the outer edge of the nose piece the stalk position should be also adjusted.

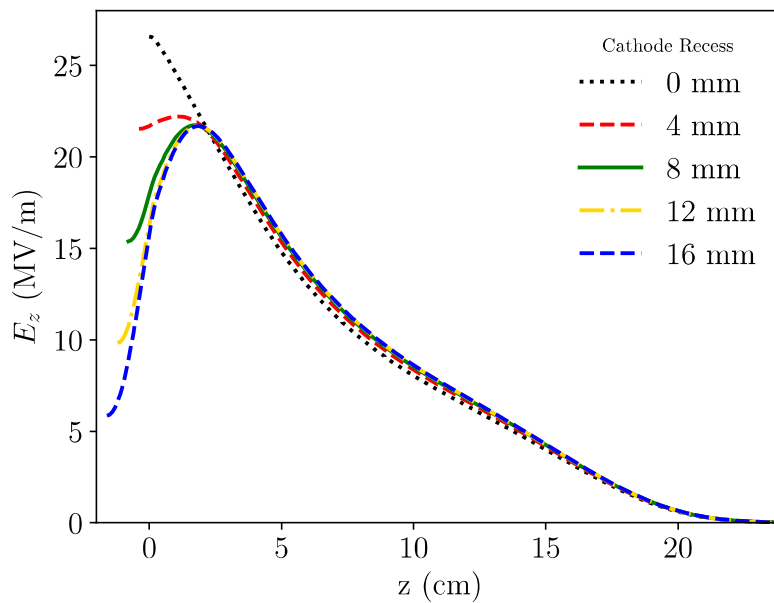


Figure 2: Longitudinal field profiles for different cathode recesses.

We need to verify the cathode recess each time after installation. For this purpose, we measure the motion of the electron beam on the profile monitor while scanning the laser spot on the cathode. Figure of merit is ratio of the displacements called magnification. The negative magnification factor means that spots are moving in the opposite direction. The dependence of the magnification vs cathode recess is shown in Fig. 3. Three different simulation codes (PARMELA, ASTRA, GPT) were used to find the correspondent values.

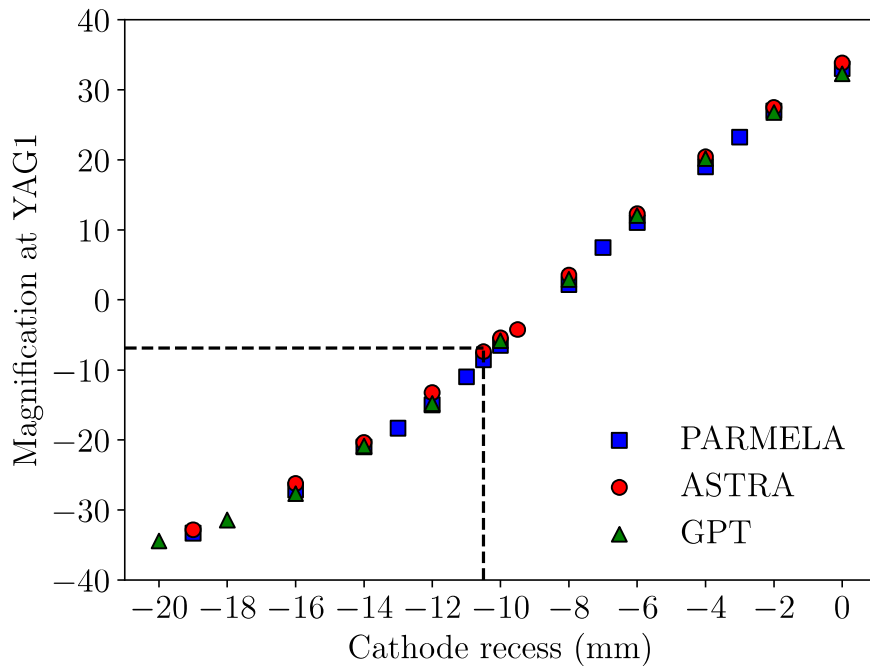


Figure 3: Dependence of the magnification factor vs. the cathode recess.

Experimental procedure requires turning off the focusing elements since they will affect the magnification factor. To maintain the reasonable electron beam size on the profile monitor we close the laser iris to minimum. Next, we reduce the laser power to have small bunch charge to suppress space charge forces. To have sufficient brightness of the electron beam image on the profile monitor we increase the number of the electron pulses. The gun and LEBT solenoids are turned off with compensating orbit with adjacent trims. The image of the electron beam after the described procedure is shown in Fig. 4.

Initial measurements were performed with manual scan of the laser spot. Later a dedicated MATLAB script was developed. The application screenshot is shown in Fig. 5. The laser system has two stages for moving beam in the vertical and horizontal directions. Both are utilized. For each plane the magnification factor is measured, and recess is calculated using polynomial fit.

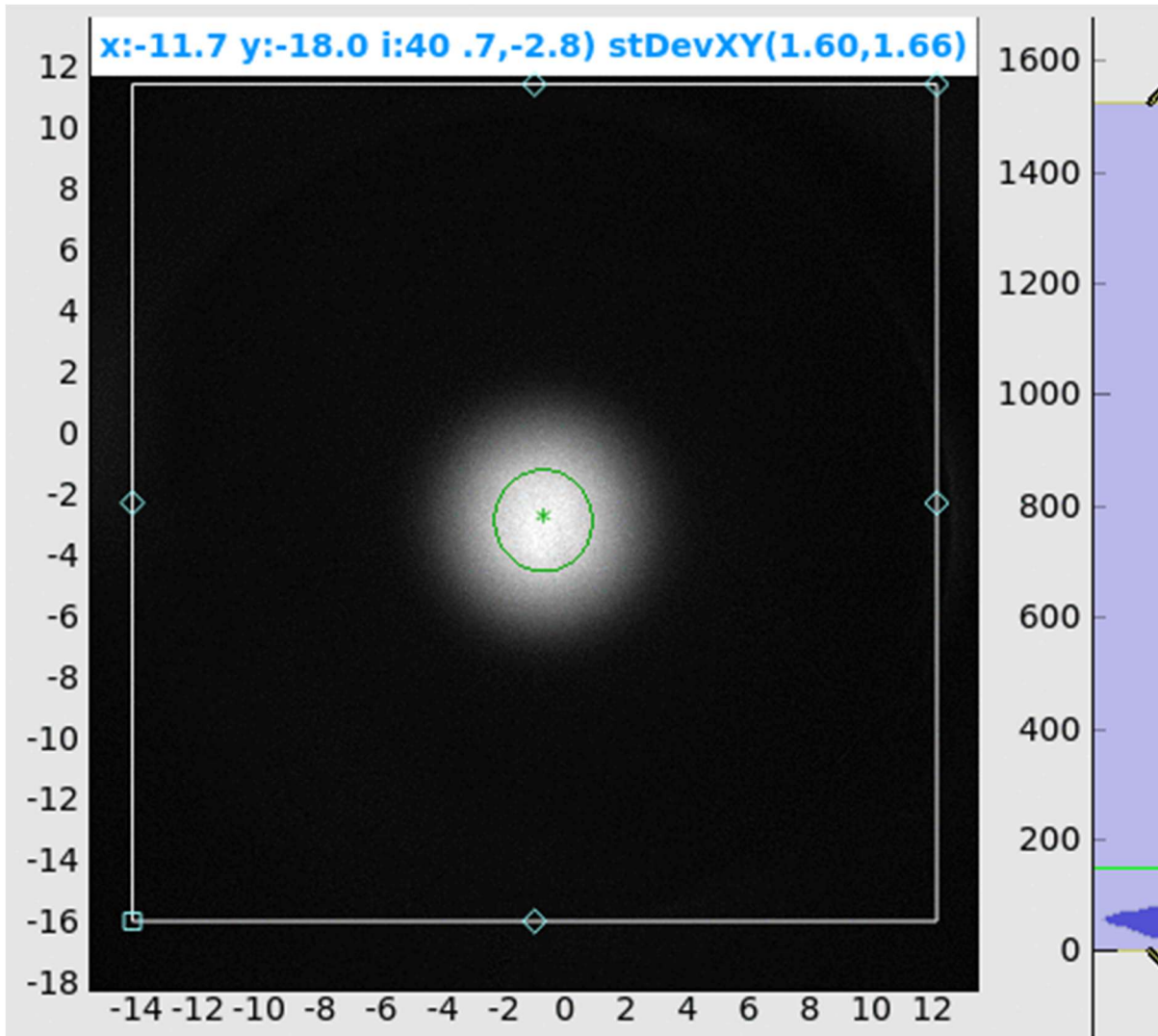


Figure 4: Image of the electron beam on the profile monitor with fully closed laser iris and reduced laser power. The focusing solenoids are switched off. The square corresponds to the limits of the YAG crystal.

Cathode Recess Measurement

Measure

Ho, mm	Vo, mm	H range	V range	N
0.2000	0.4000	0.7000	0.7000	11

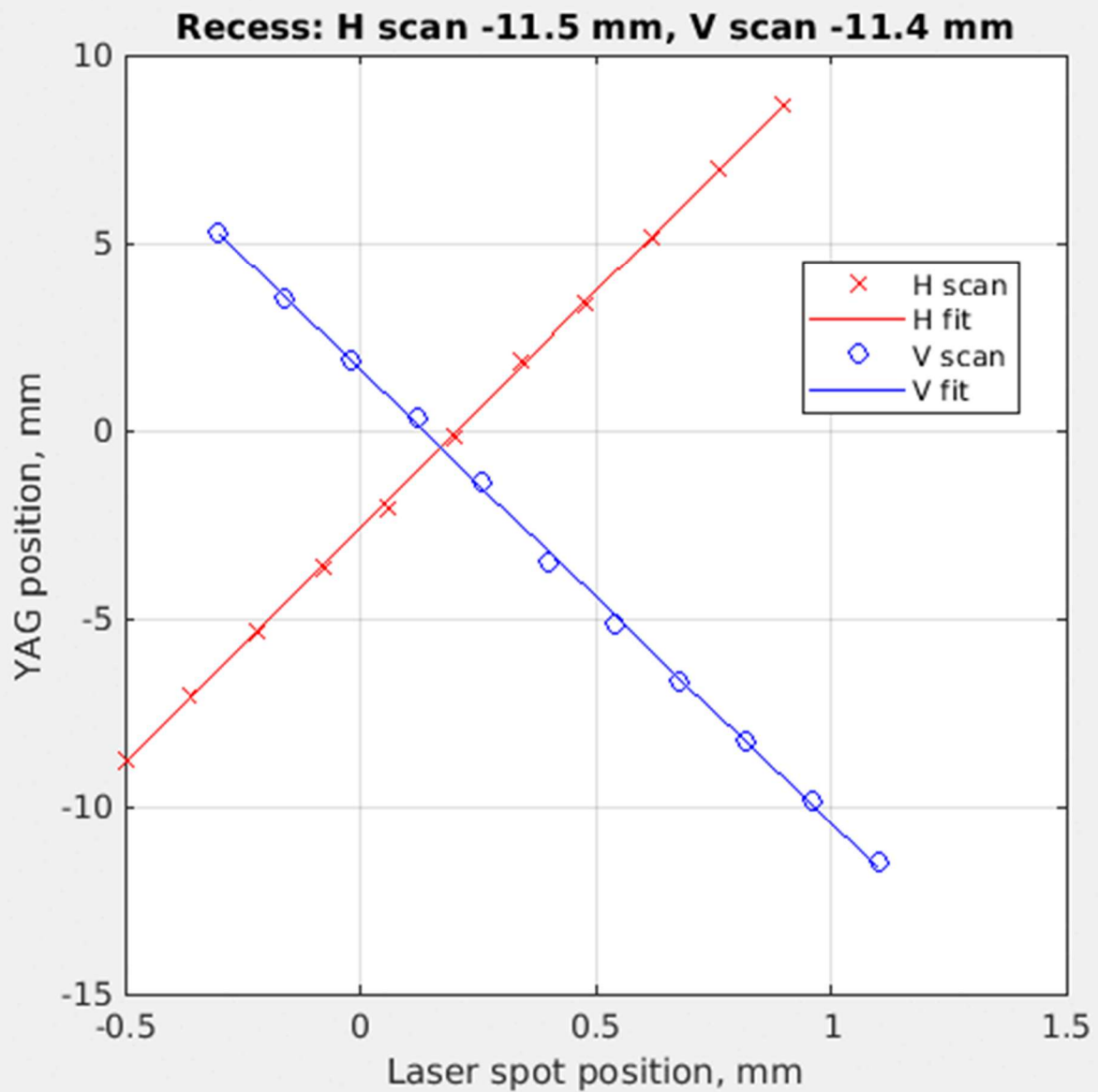


Figure 5: Screenshot of the MATLAB application for the cathode recess measurement.