Initial results of magnetic surface mapping in HSX

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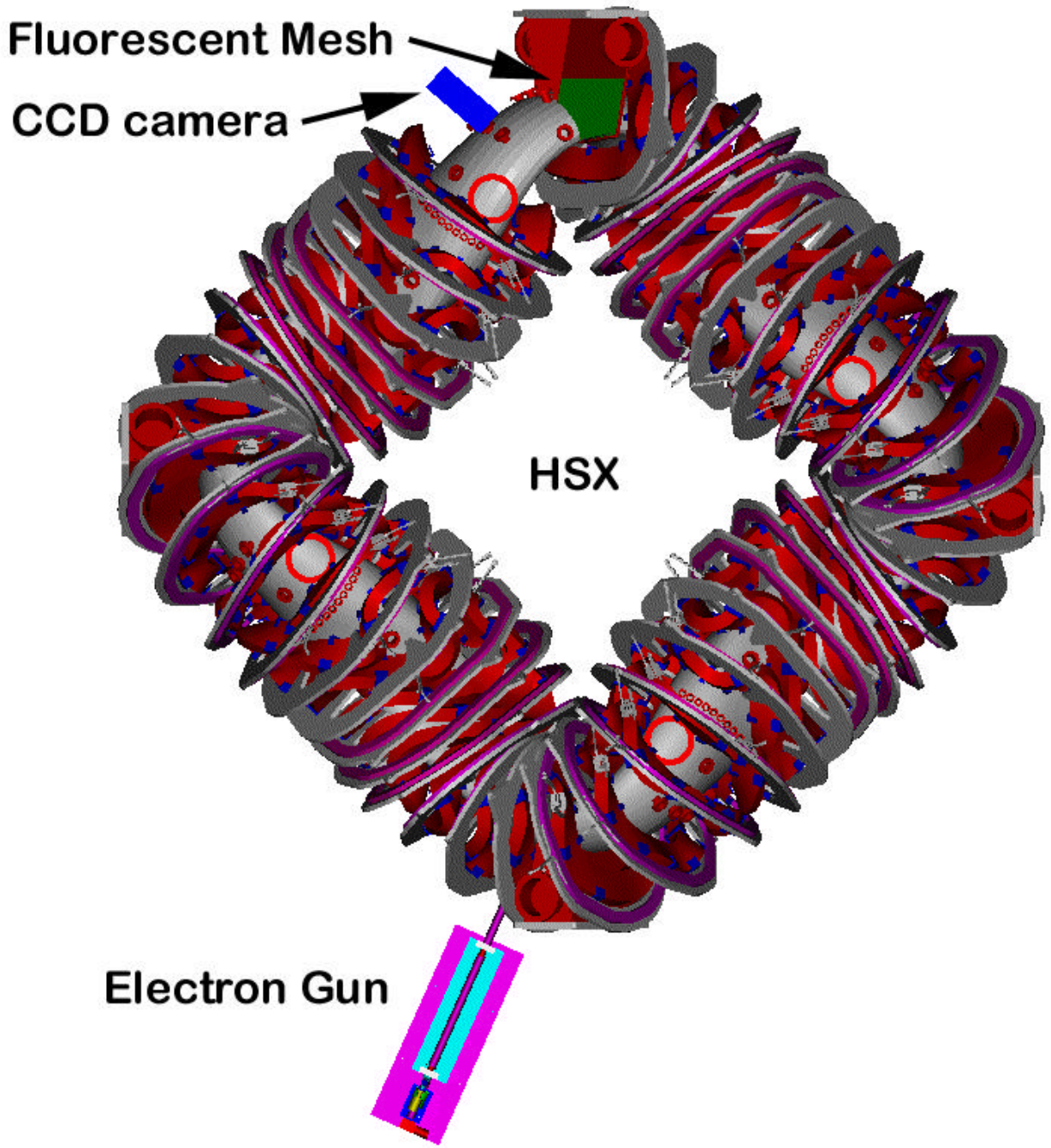
Objective

- **Experimental verification of closed, nested magnetic surface formation in HSX.**
- **Evaluate magnetic surface shape, quality and rotational transform profile for different magnetic configurations (QHS, Mirror, Well, Hill) of HSX.**

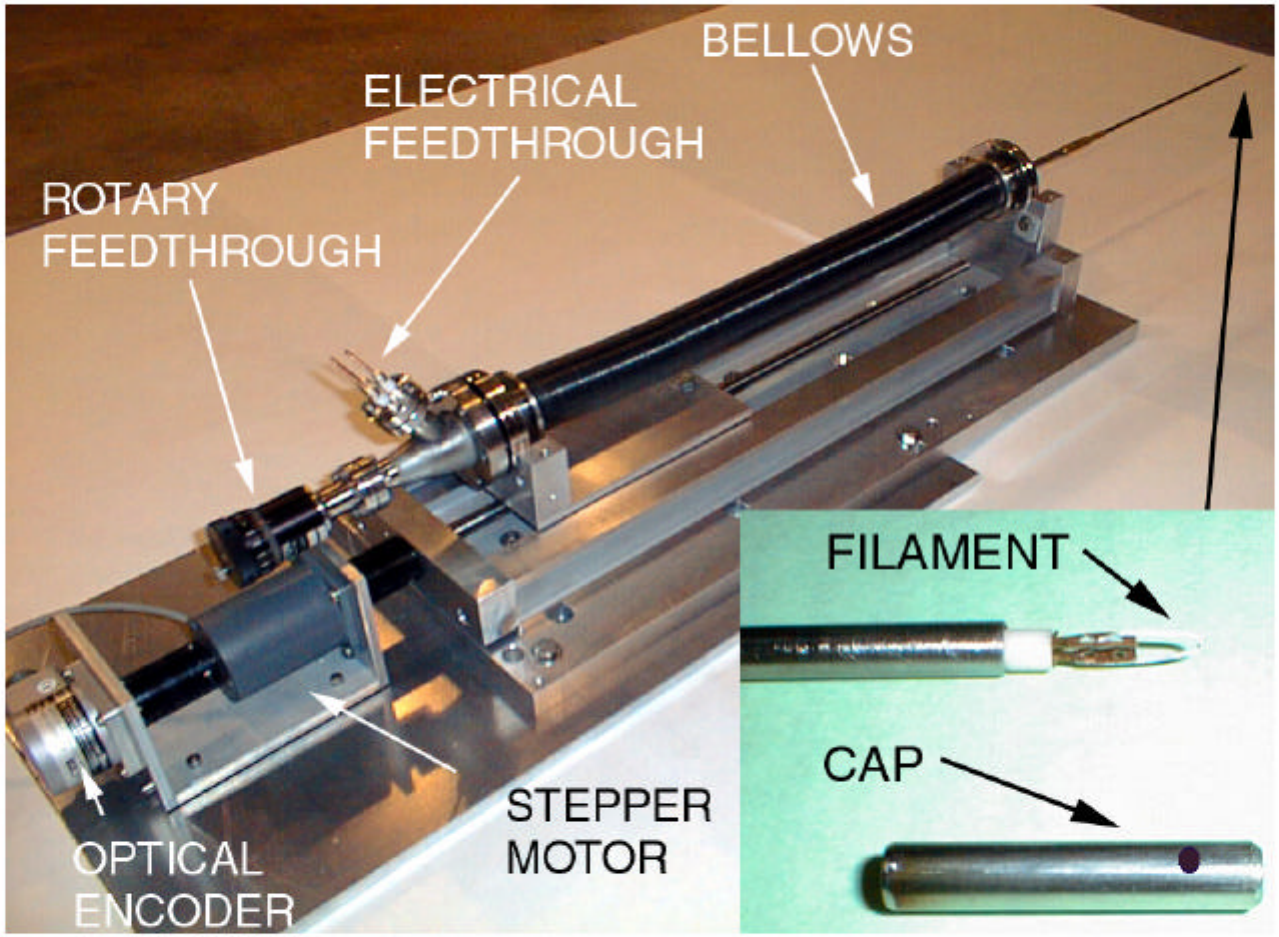
Cutaway view of experimental setup



Electron Gun

- Thoria-coated iridium ribbon-type filament Z1mm width.
- Electron beam energy R100eV.
- Beam diameter at gun exit Z2mm .
- 304-SS housing Z6mm in diameter.

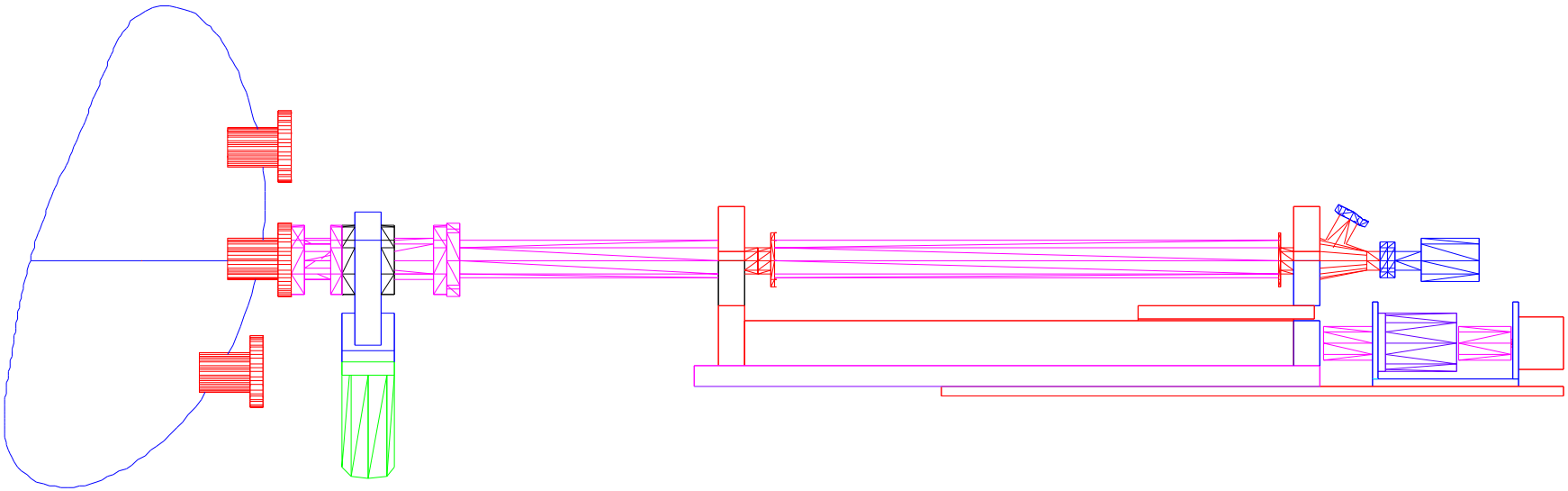
Electron gun assembly



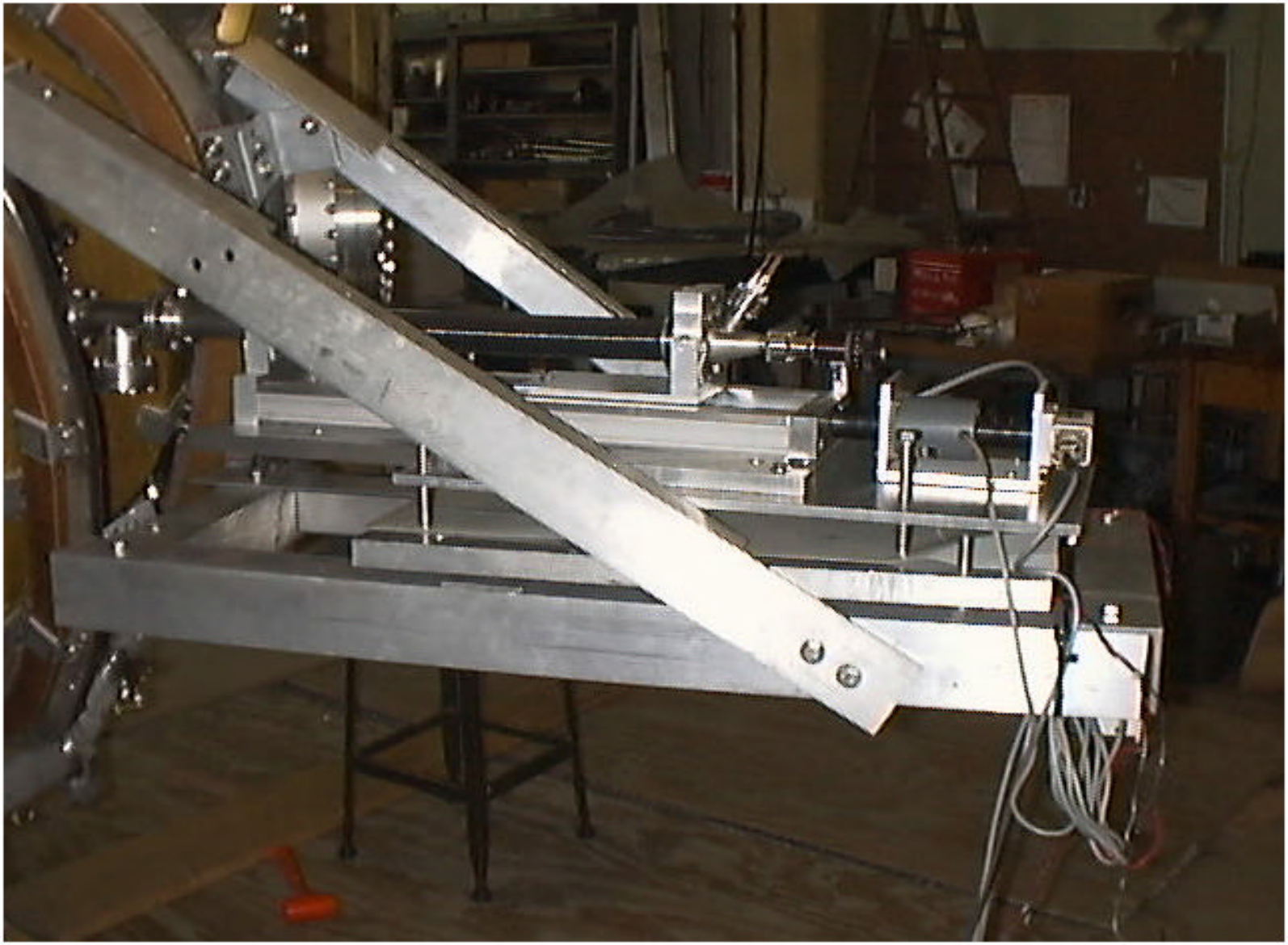
Gun positioner

- Linear drive with 38cm of effective travel to span "radial" direction at insertion point.
- Allows rotation of gun for alignment.
- Linear movement and feedback provided by stepper motor and optical encoder.

Gun positioner



Electron Gun supporting structure

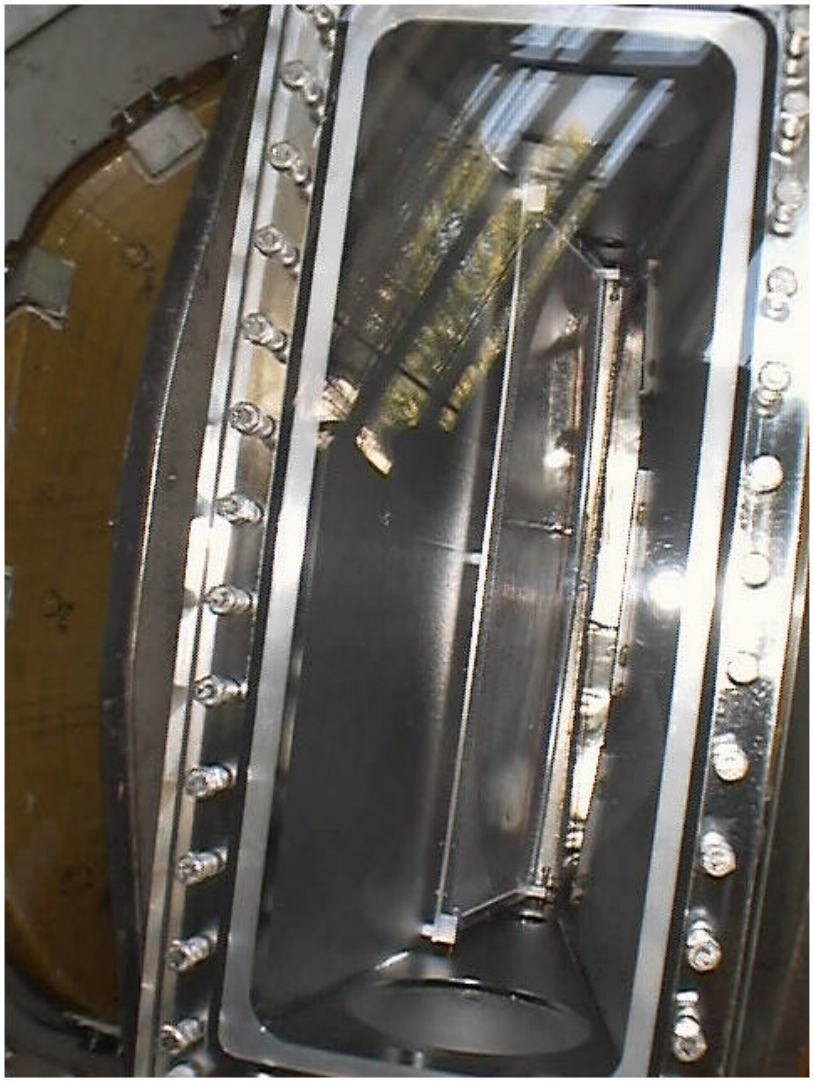


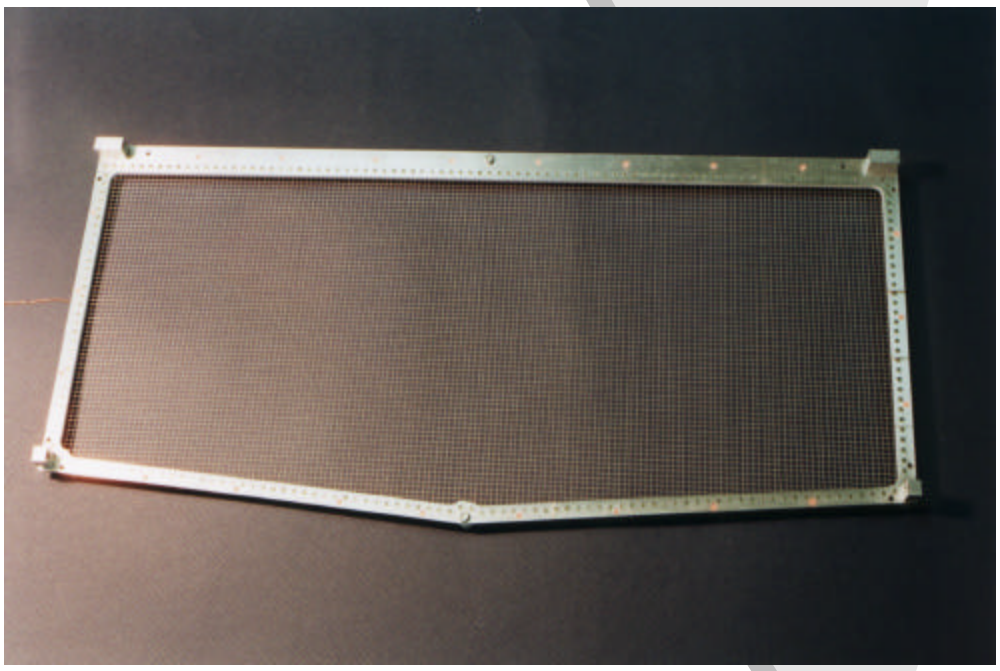
Fluorescent screen

- Aluminum frame ≥3mm thickness. Electrically isolated from HSX vacuum vessel.
- Grid made of copper wire 0.076mm. in diam. Wire spacing ≥3mm for 95% transparency.
- Frame referencing is made by using 22 LED's located along its periphery.
- P-24 fluorescent coating.

Fluorescent screen

Fluorescent screen in boxport





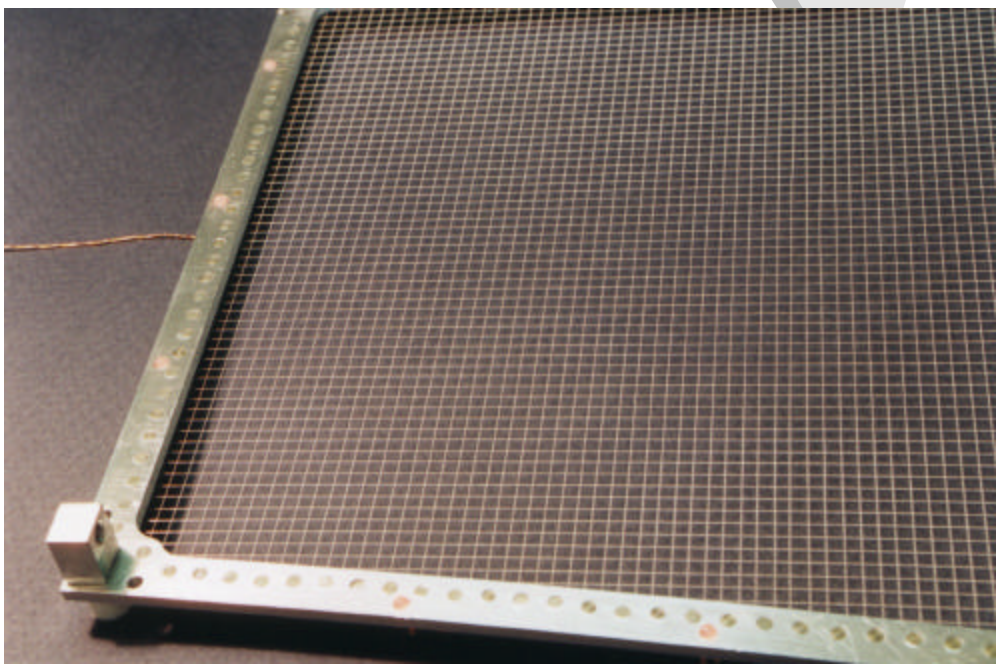
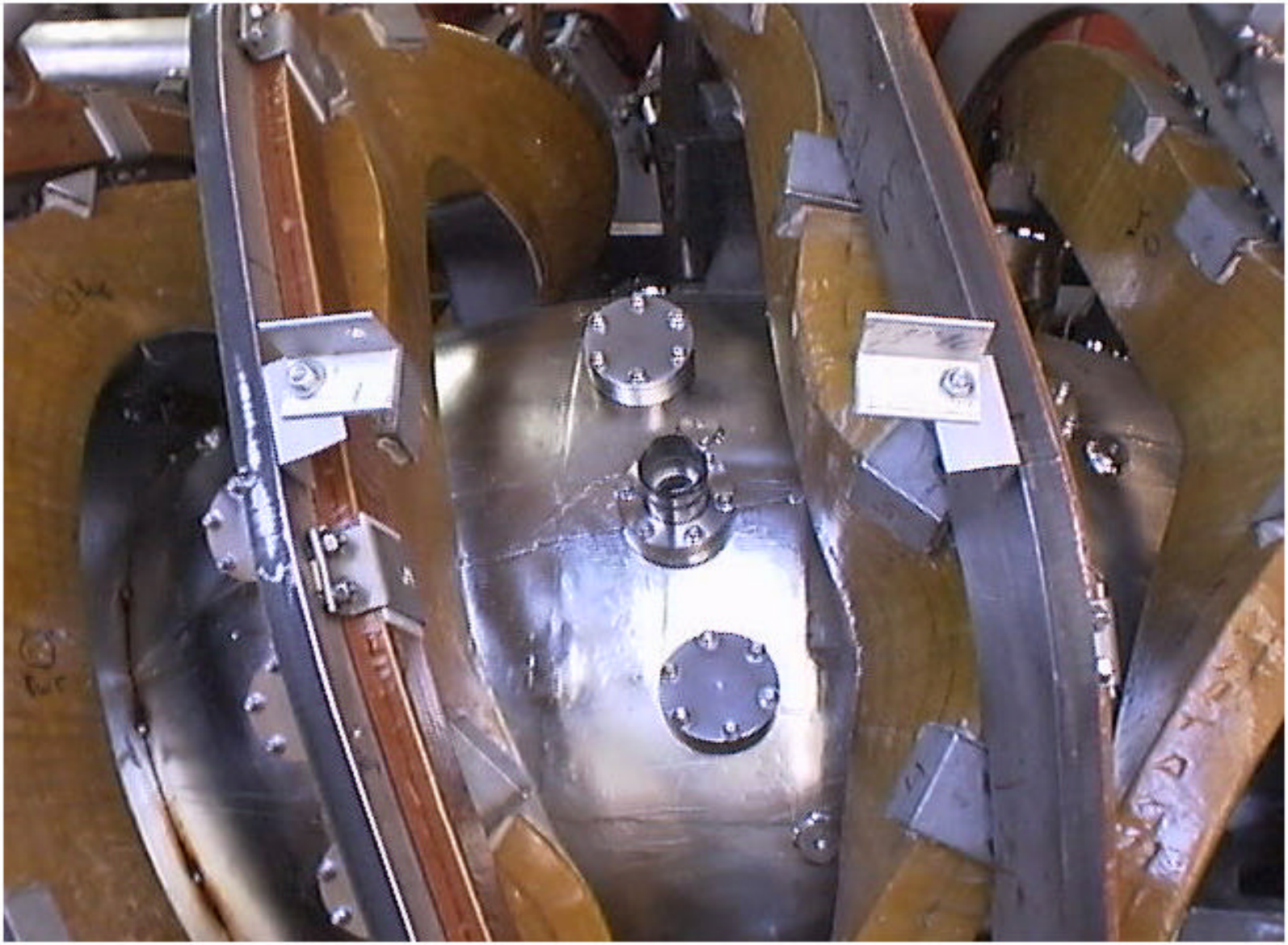


Image Acquisition

- **Periscope located in center port between coils B2-B3.**
- **High-sensitivity (Z10^-5 lux) RS-170 BW CCD camera.**
- **Image is digitized using a computer-interfaced frame-capture board.**

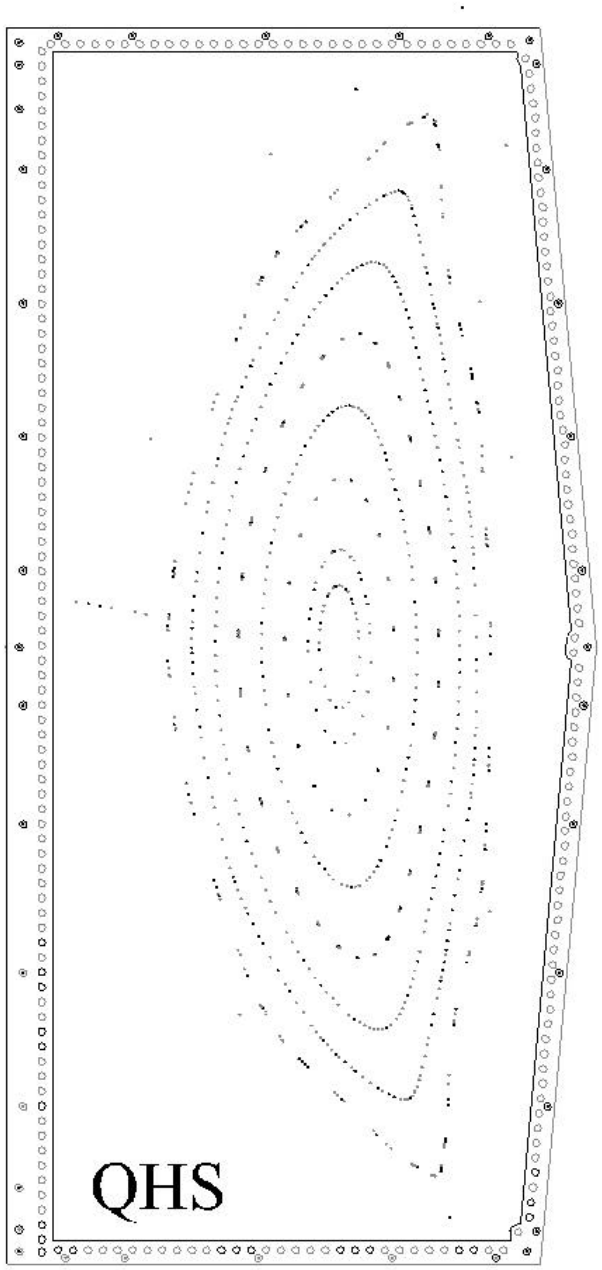
Viewing port location

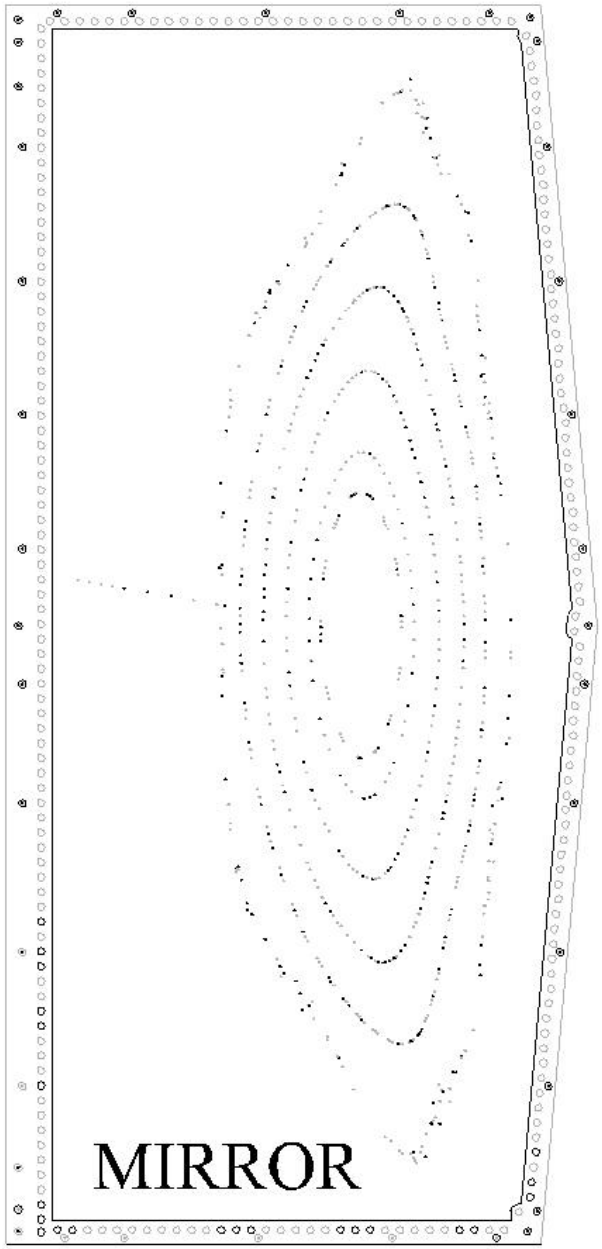


Numerical Calculation

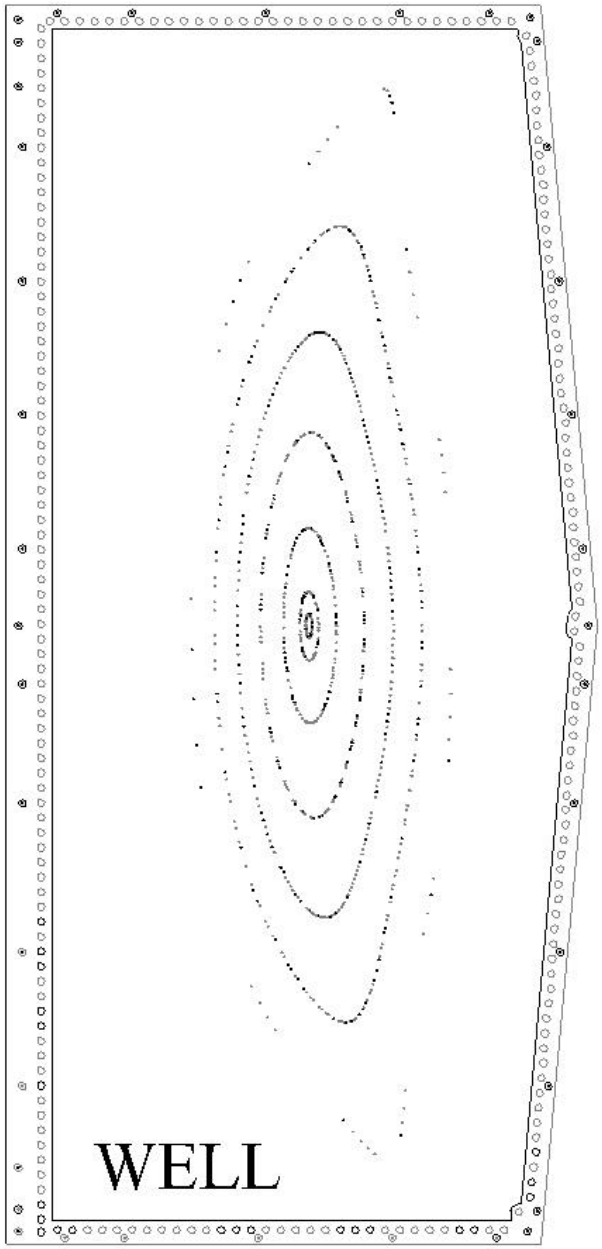
- Original code modified to calculate Poincare plots at plane of screen, starting from gun position.
- "Canonical" cases (QHS, Mirror, Well and Hill) have been calculated for typical launching points.

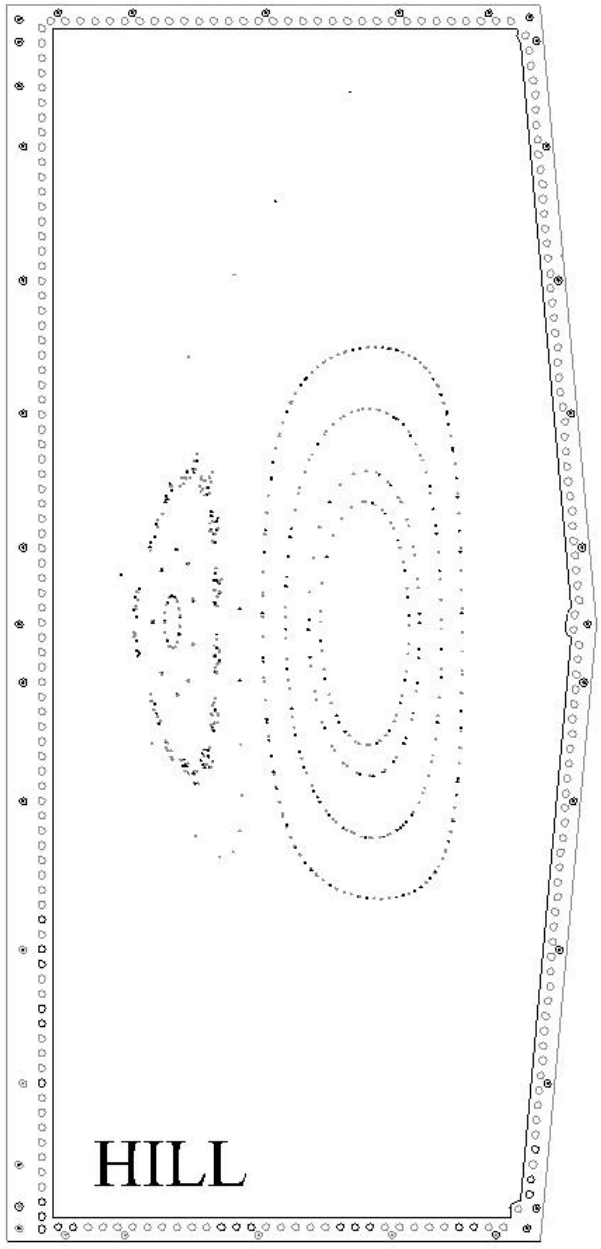
Numerical Calculation



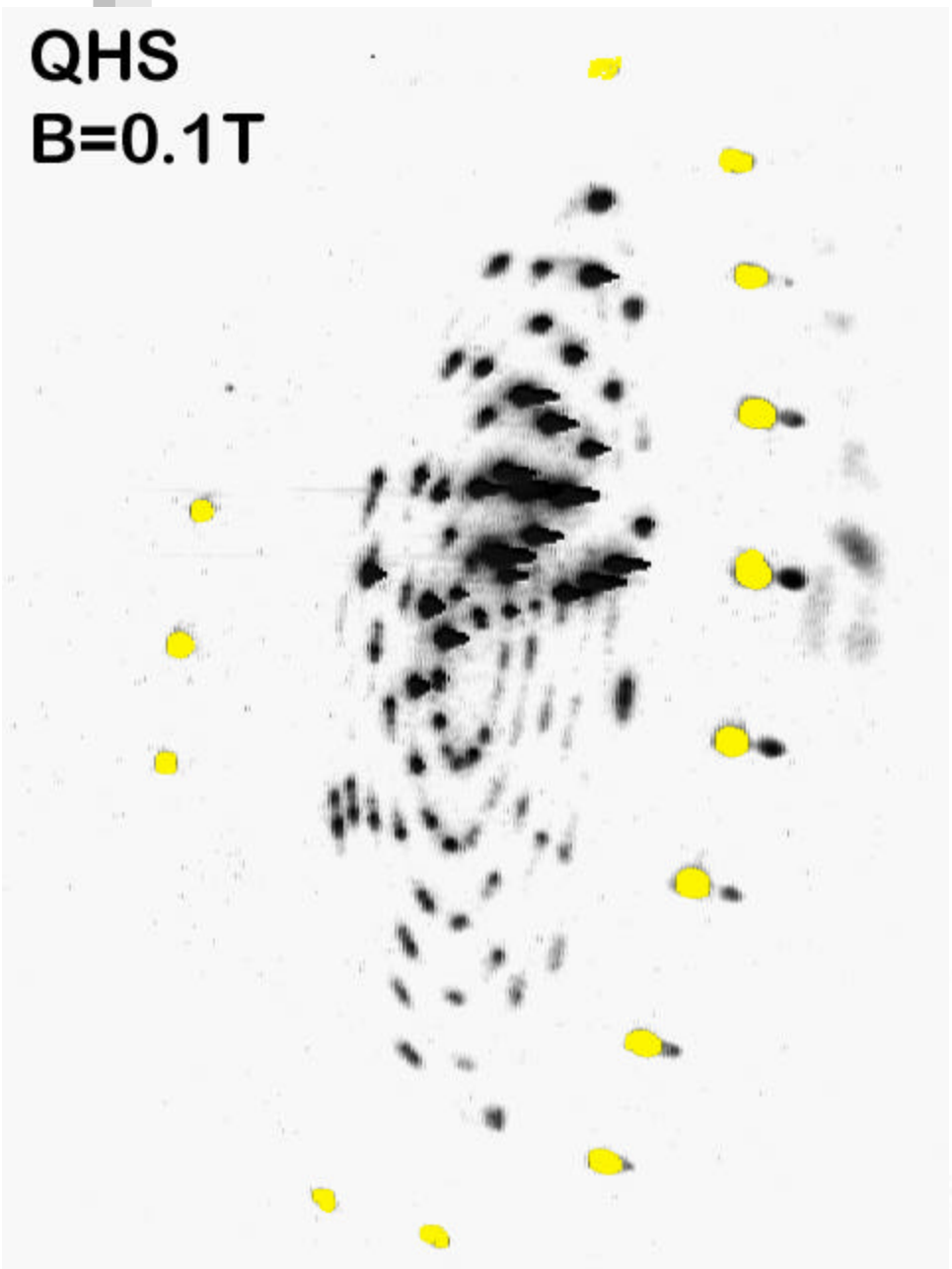


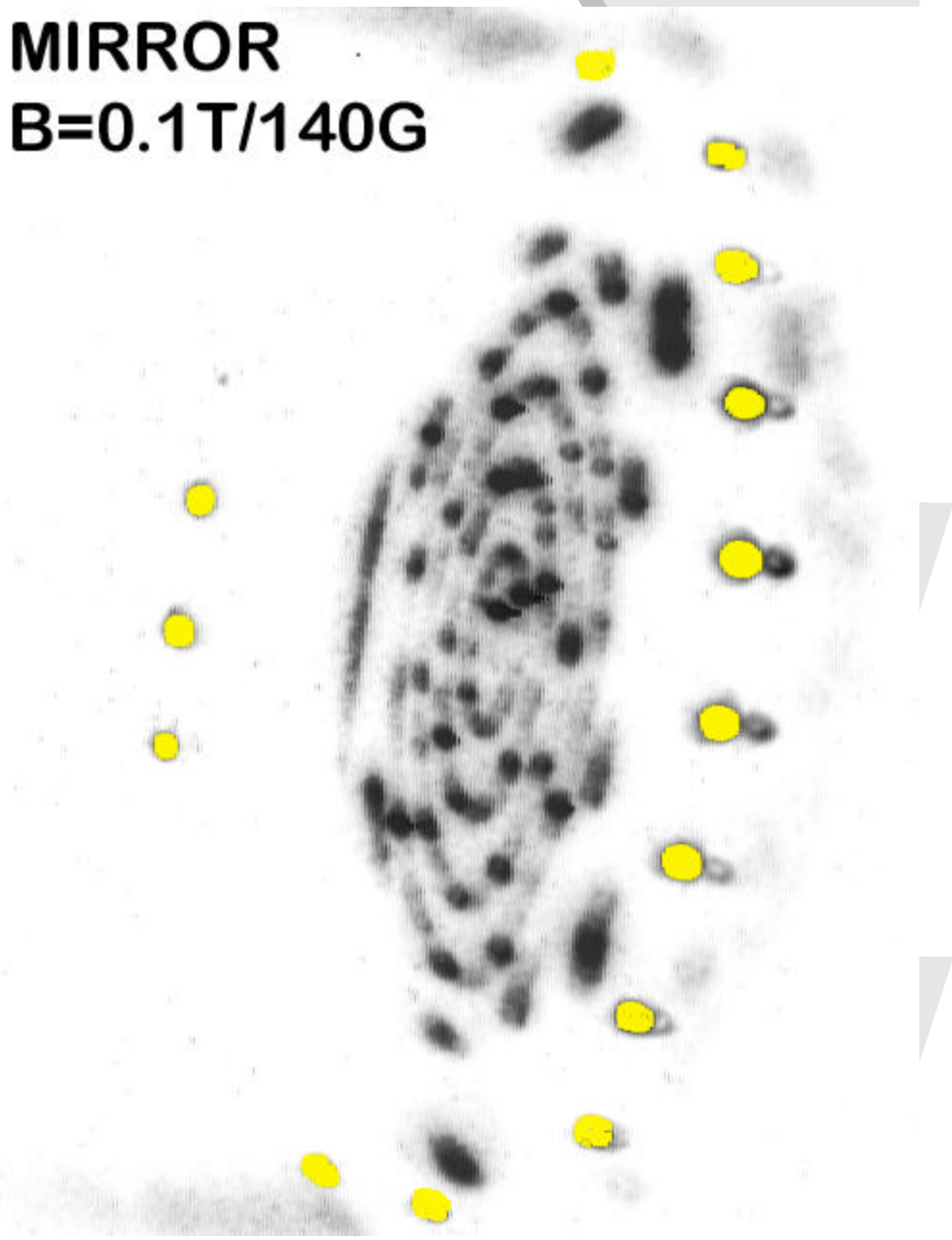
Numerical Calculation



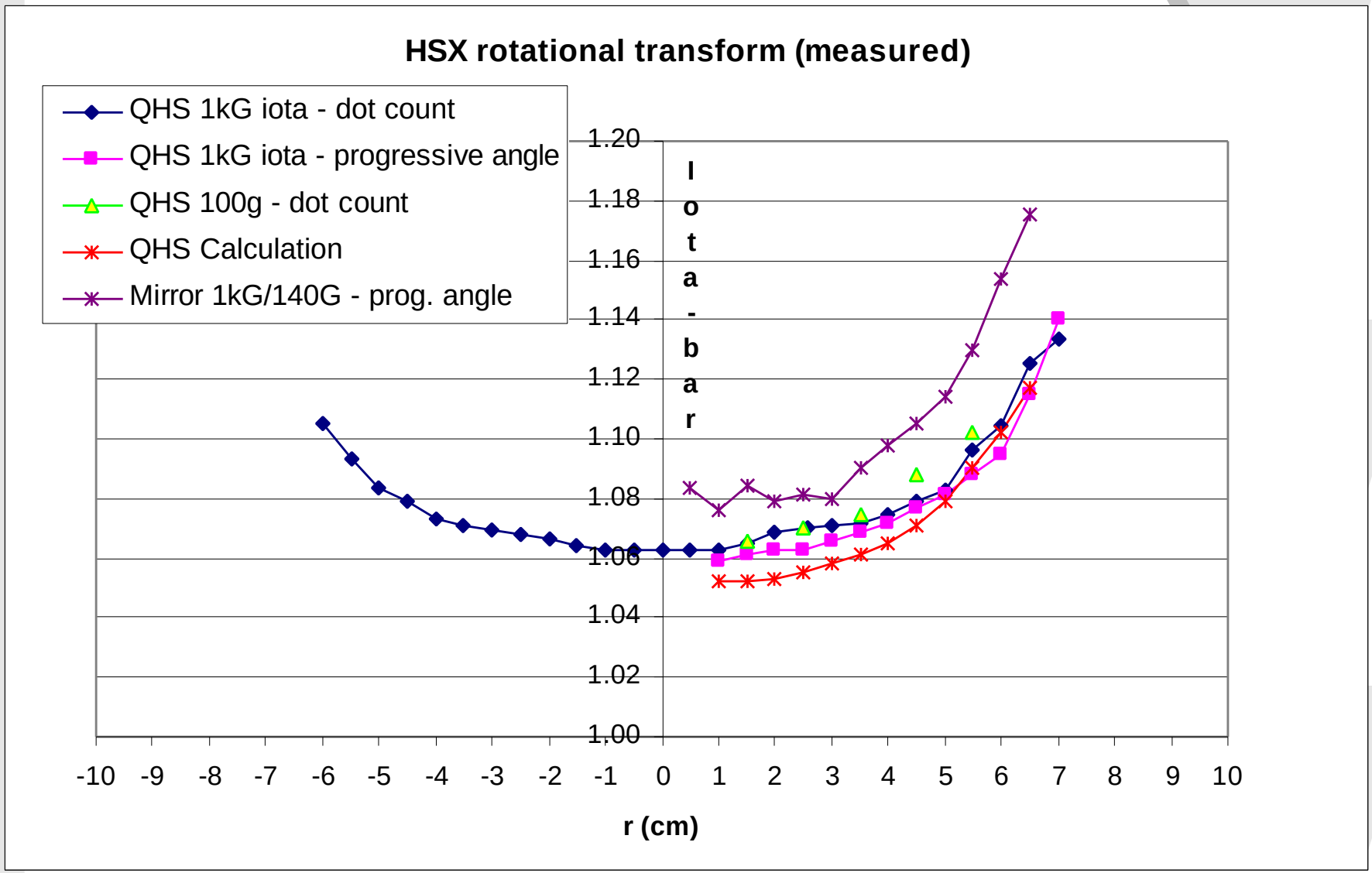


Experimental Results





Experimental Results



Rotational Transform (design)

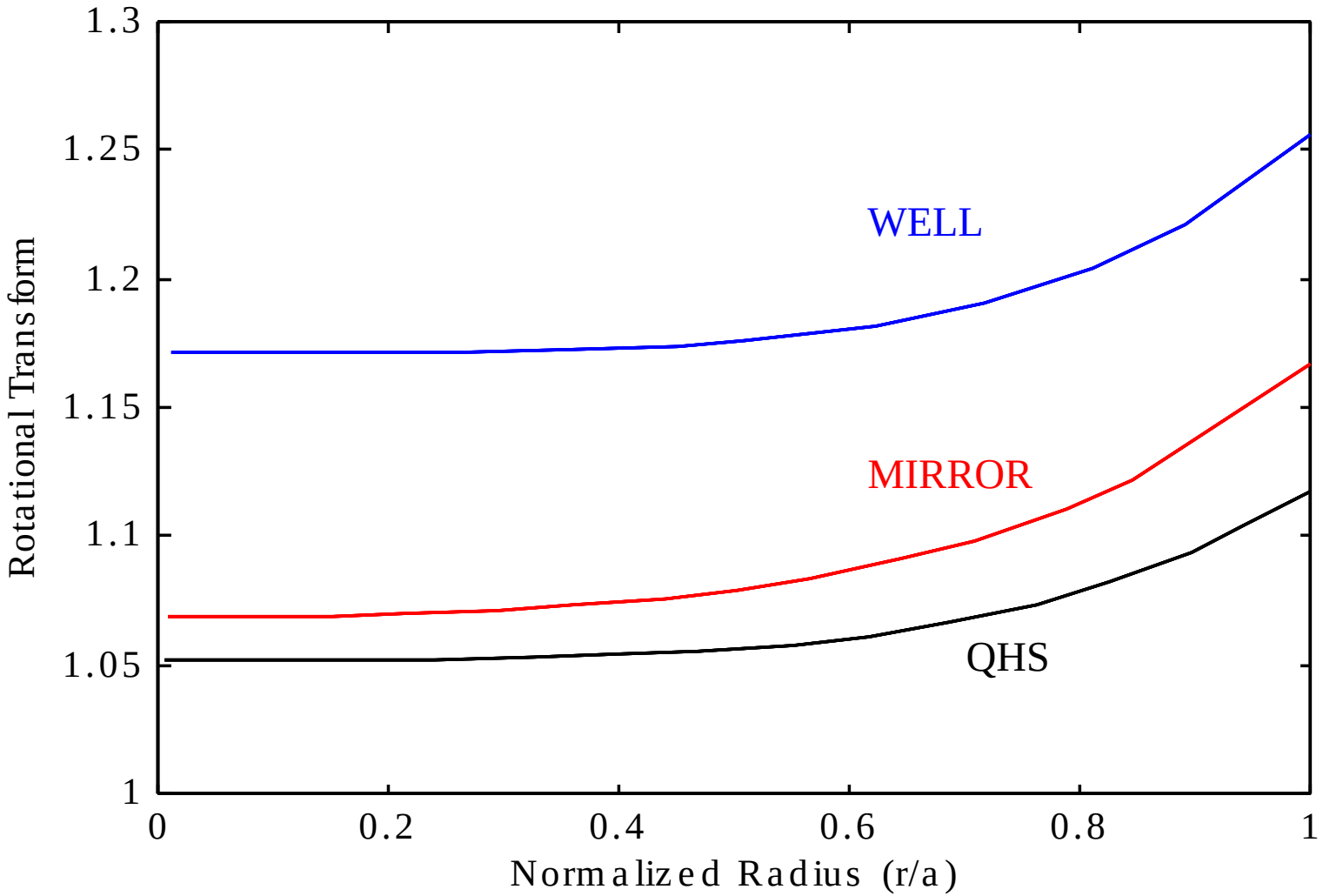


Image Restoration

- Distortions to image introduced by camera lens and periscope.
- LED's on frame are used as reference points.
- Distortion removal code under development.

Conclusions

- Experimental results show the formation of closed, nested magnetic surfaces.
- No islands due to error fields were detected.
- Preliminary rotational transform profile in good agreement with calculation.