SHMS Heavy Gas Čerenkov February 2009 Update

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Progress since Oct/08 Update

- **Work continues on optical raytrace simulations to better understand the interplay between:**
  - **Detector outer length (100-160cm)**
  - **Mirror radius (100-180cm)**
  - **PMT placements**

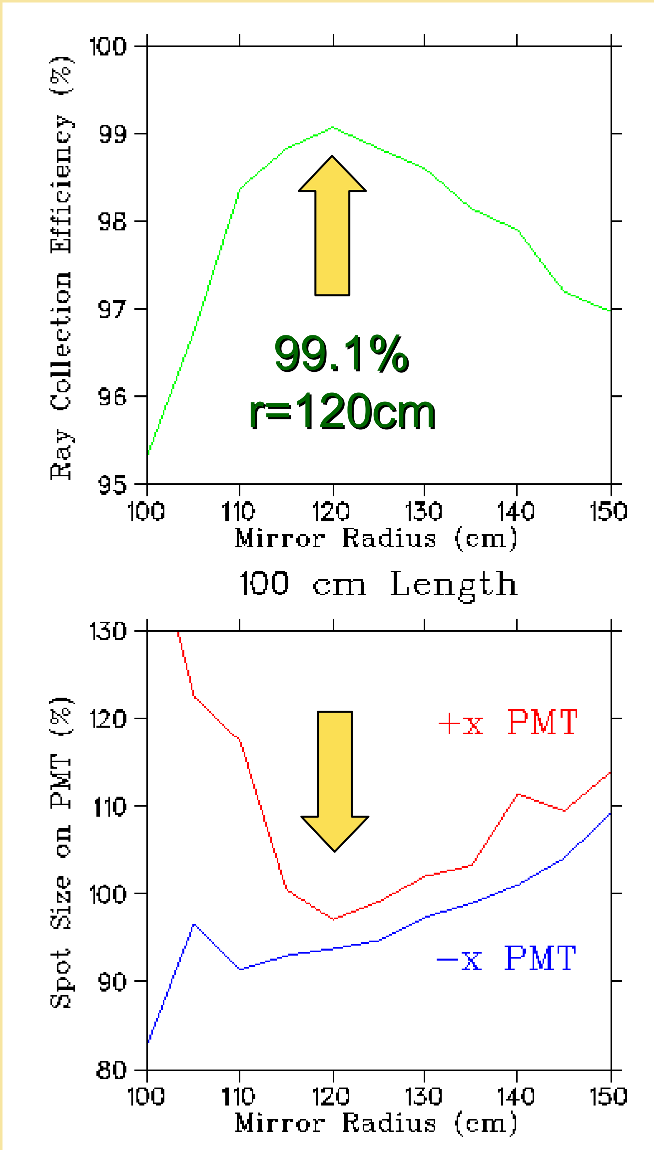
  in determining the optimal configuration of the Heavy Gas Čerenkov.
- Ray tracing program used to iterate over many mirror radii, mirror and PMT placements.
  - Studies require much CPU to iterate over many configurations.
  - Thanks to WestGrid high performance computing center in Vancouver for the necessary computing resources.

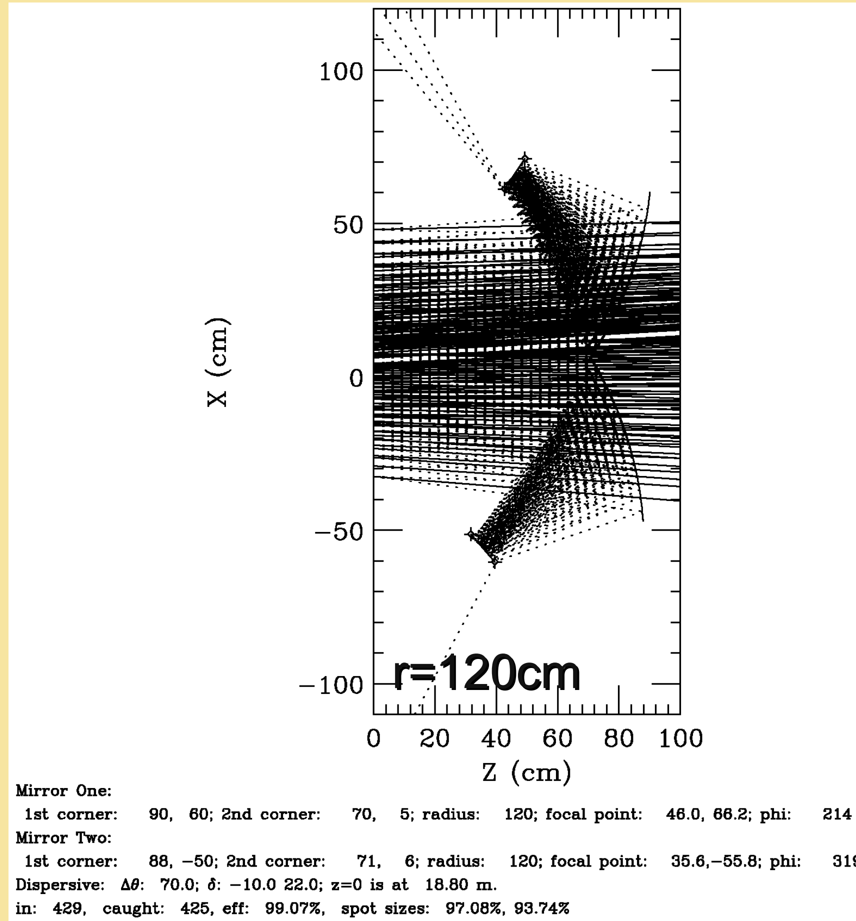
Optical Ray Trace studies

- **raytr** program was originally developed at U.Va. for design of HMS Čerenkov.
  - Grid of tracks generated using SHMS matrix element and light rays traced using the Čerenkov cone angle (θ=2.84^o for 7.0 GeV/c pions).
  - Ray tracing is confined to the dispersive plane only (i.e. 2D).

- **CONSTRAINT ADDED:**
  - **Mid-way through study, it became apparent that the optimal PMT placement for small Mirror radii was inside the beam envelope (obvious in retrospect).**
    - **Skewed the result of the study.**
  - **Needed to explicitly exclude PMT placements inside beam envelope and start study over.**

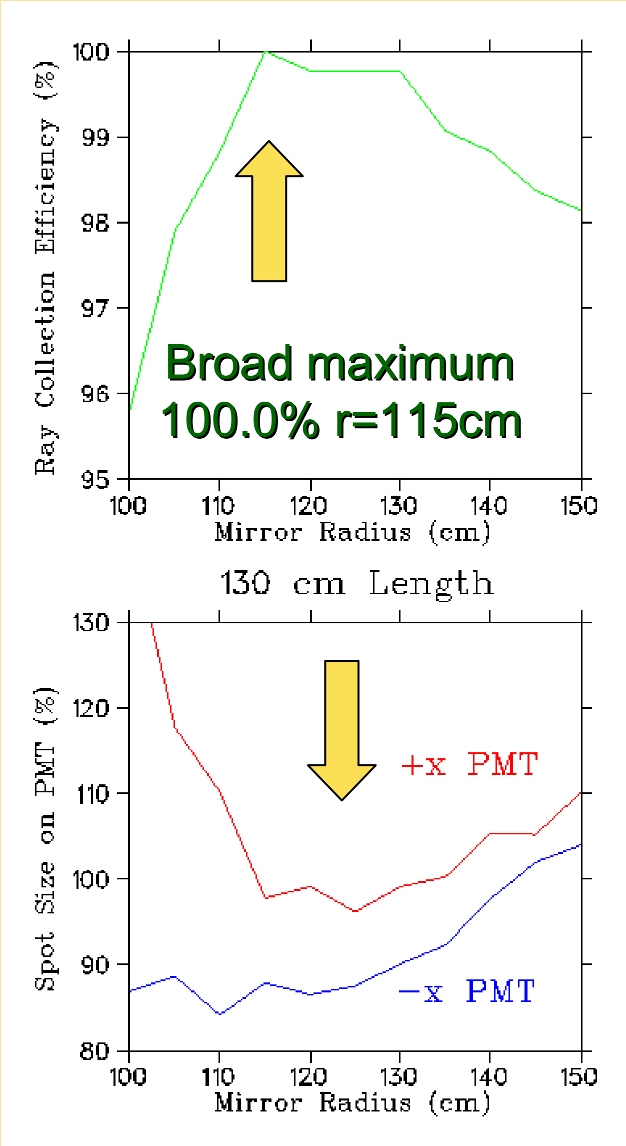
Length=100 cm Studies

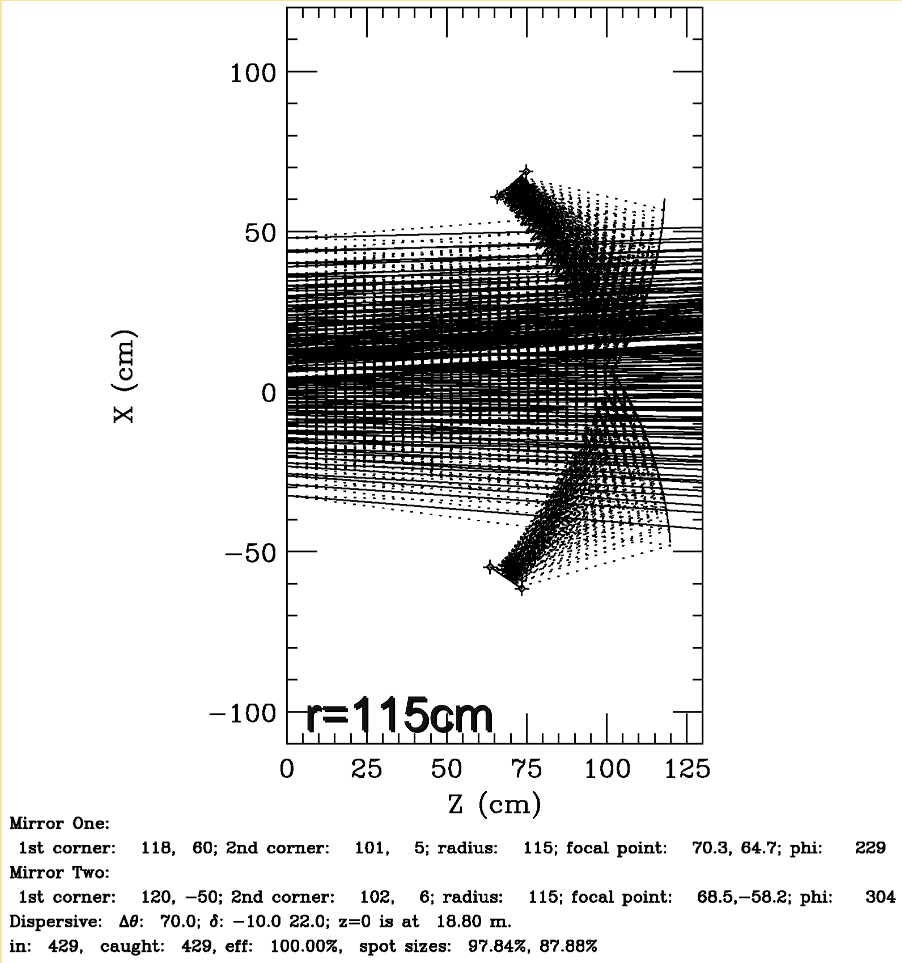




Radiator path varies ~55-80 cm over focal plane
→ ~8.0-11.7 p.e. @3.2 GeV/c
→ ~0.3% local inefficiency.

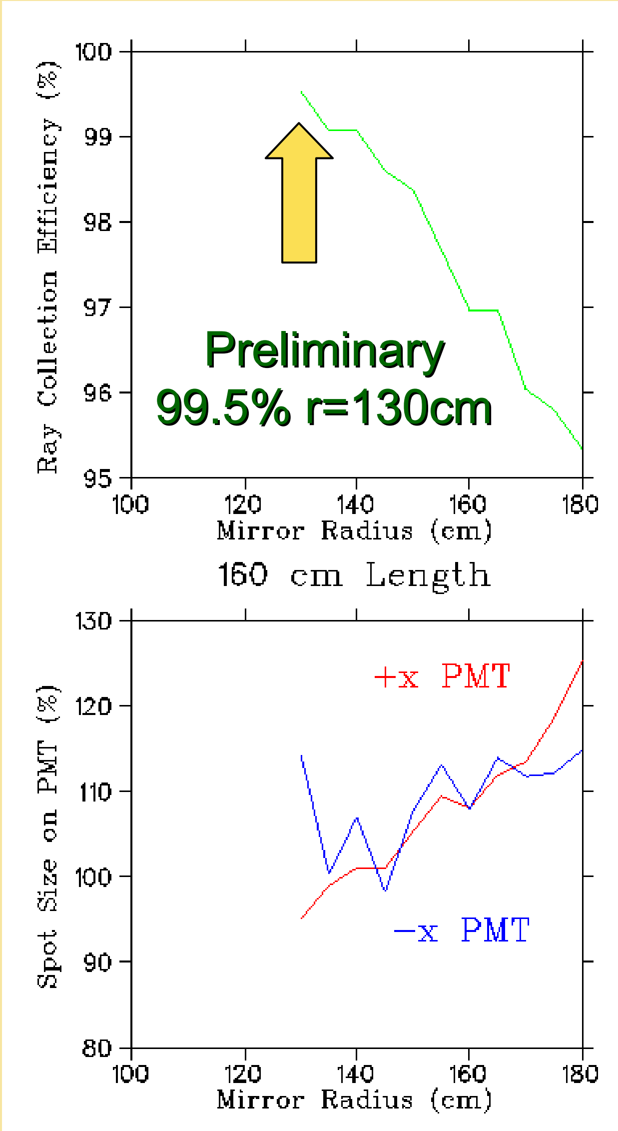
Length=130 cm Studies

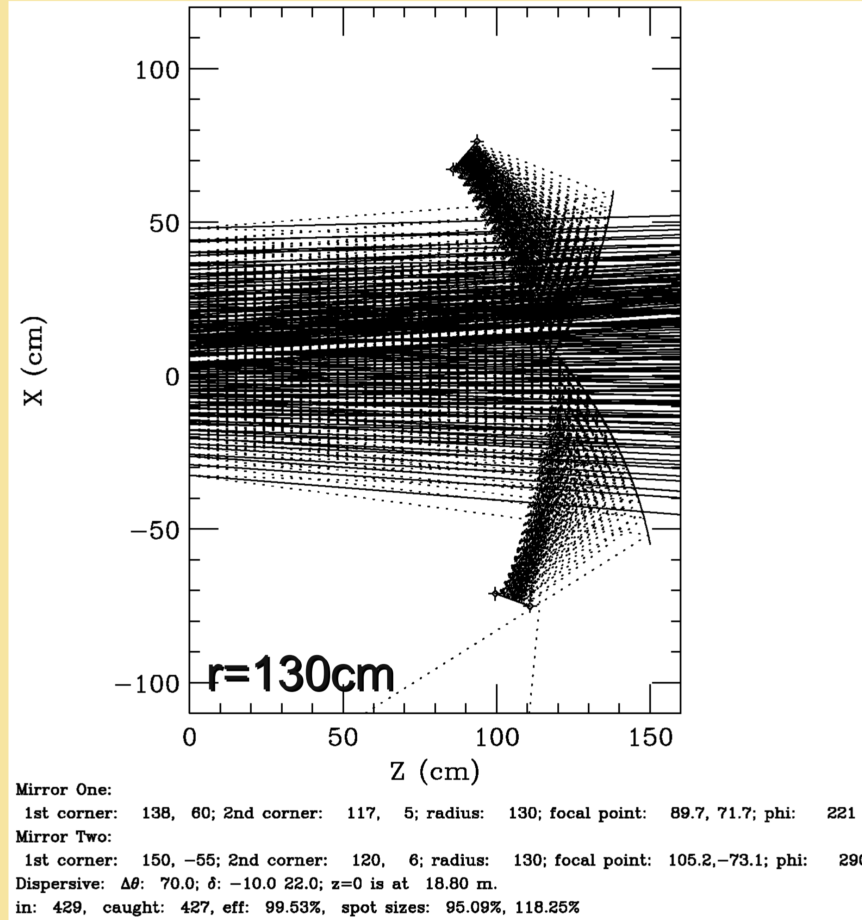




Radiator path varies ~85-110 cm over focal plane
→ ~12.4-16 p.e. @3.2 GeV/c
→ <0.05% local inefficiency.

Length=160 cm Studies

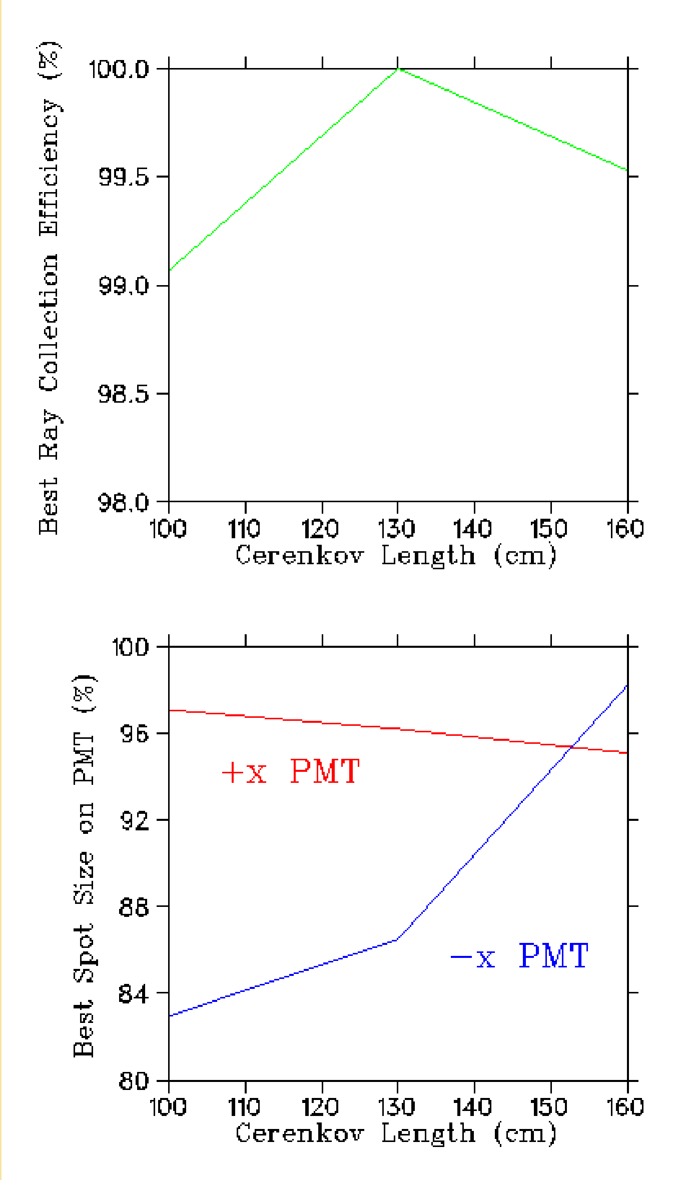




- Unlike earlier study, optimal mirror radius now appears similar to L=100,130cm.

Preliminary Optical Ray Trace Conclusions

- 130cm length reduces local inefficiency at x=0 to <0.1% and has generally better optical characteristics.
- Typically more difficult to focus light onto +x PMT than –x PMT.
  - Much more sensitive to mirror radius chosen.
  - Typically larger “spot size”.
  - Most likely due to highly asymmetric SHMS δ acceptance.



Larger # is better

Smaller # is better

Plans for further study

Mar-Apr: Continue **raytr** studies.

- Although 2D, studies are very useful to identify the most promising detector configurations for more detailed 3D study.
- Study also 115,145cm length to better understand the dependence of optical performance with length.

May-Aug: Senior undergrad has applied for a NSERC Undergraduate Summer Research Award (USRA).

- Vahe Mamyan has set up NGČ and HGČ in **geant4** framework.
- Select one or two “best cases” from **raytr** study and investigate transverse orientation of PMTS and mirrors.

Should mirrors focus light on PMTS directly above and below, or is better performance obtained if light is directed slightly left and right as well?

5” PMTs and Bases

- **Advantageous to select 5” PMTs with common pin arrangement for all SHMS detectors.**
  - Allows set-up charges for base circuitry to be spread over more bases, as well as allowing for common spares.
  - UofR electronics technician could probably make 5” bases for all SHMS detectors.
- **Suggest Photonis XP4508B for Heavy Gas Čerenkov.**
  - Fast flat-face PMT with excellent UV sensitivity.
  - Common pin arrangements with XP4500B,4512B,4572B.
  - Similar to XP4572 installed in Hall A aerogel Čerenkov except with sensitivity to 200nm vs 300nm.
    - XP4572B effective quantum efficiency shown to be 2x higher than Burle 8854 Quantacon 5” PMTs [B. Wojtsekhowski].
- **Let’s co-ordinate!**

Funding Considerations

- **NSERC Research Tools and Instrumentation (RTI-1) application planned for October, 2009, pending upcoming announcement re. Canadian contributions to GlueX.**
  - Total net equipment cost must be below C$250,000, provided funding is secured from other sources to bring the amount requested from NSERC to below C$150,000. Funding must be in place and confirmed at the time that the application is submitted.
- **RTI-1 application requires a detailed cost estimate and vendor quotes for any items above C$20,000.**
  - Generally consistent with Howard's plans for October review.
  - Support requested from NSERC-funded Detector Engineer at the University of Alberta to help with structural design and firm up cost estimates.
- **NSERC decisions are released April 1 each year.**
  - If successful, it will count as a foreign contribution to the Hall C upgrade and help relieve pressure on the 12 GeV cost book.