SoLID SIDIS-Cherenkov Update
Jan. 18, 2012
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Goal: check the SoLID Cherenkov simulation against the PHENIX (BNL) results

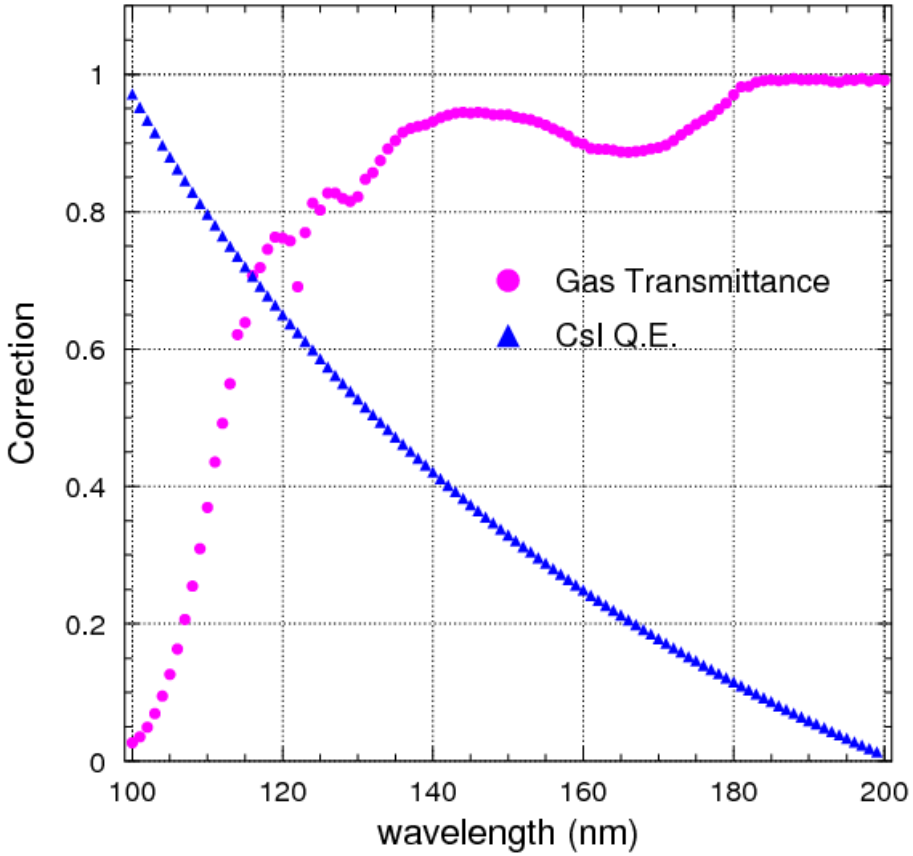
: update simulation

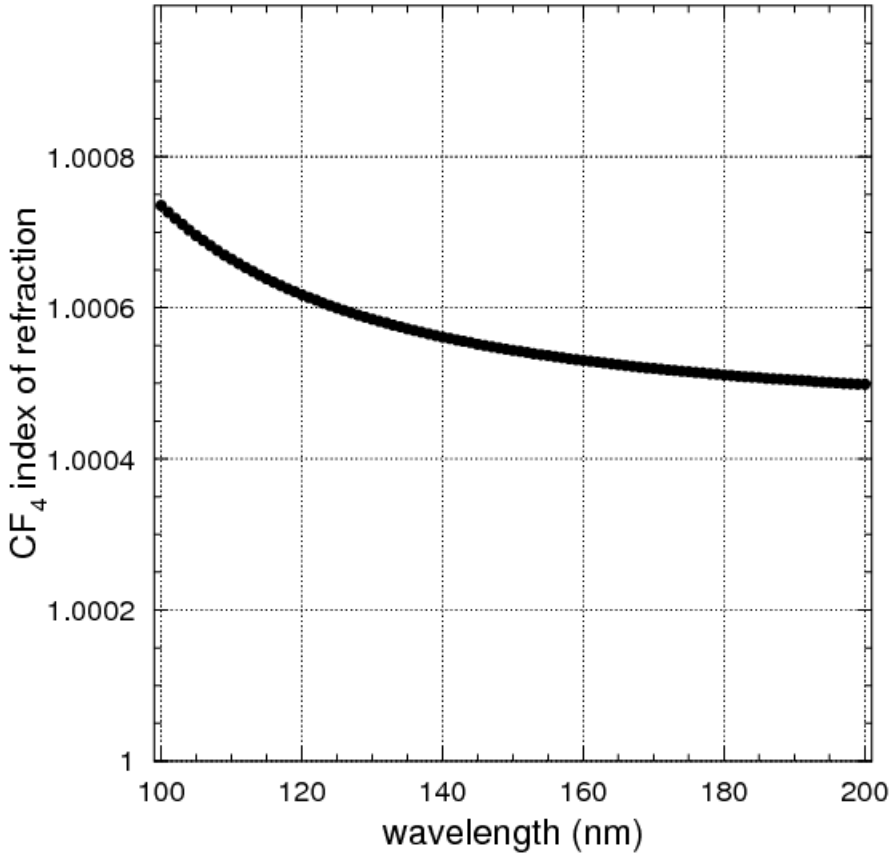
PHENIX

$$N_{pe} = 370 \cdot L \cdot T_M \cdot T_{PC} \cdot \epsilon_{RB} \cdot \epsilon_{Tr} \cdot \epsilon_{th} \int_{6.2}^{12.4} QE \cdot T_G \cdot \cdot dE/\gamma_{th}^2$$

0.515 m

0.516



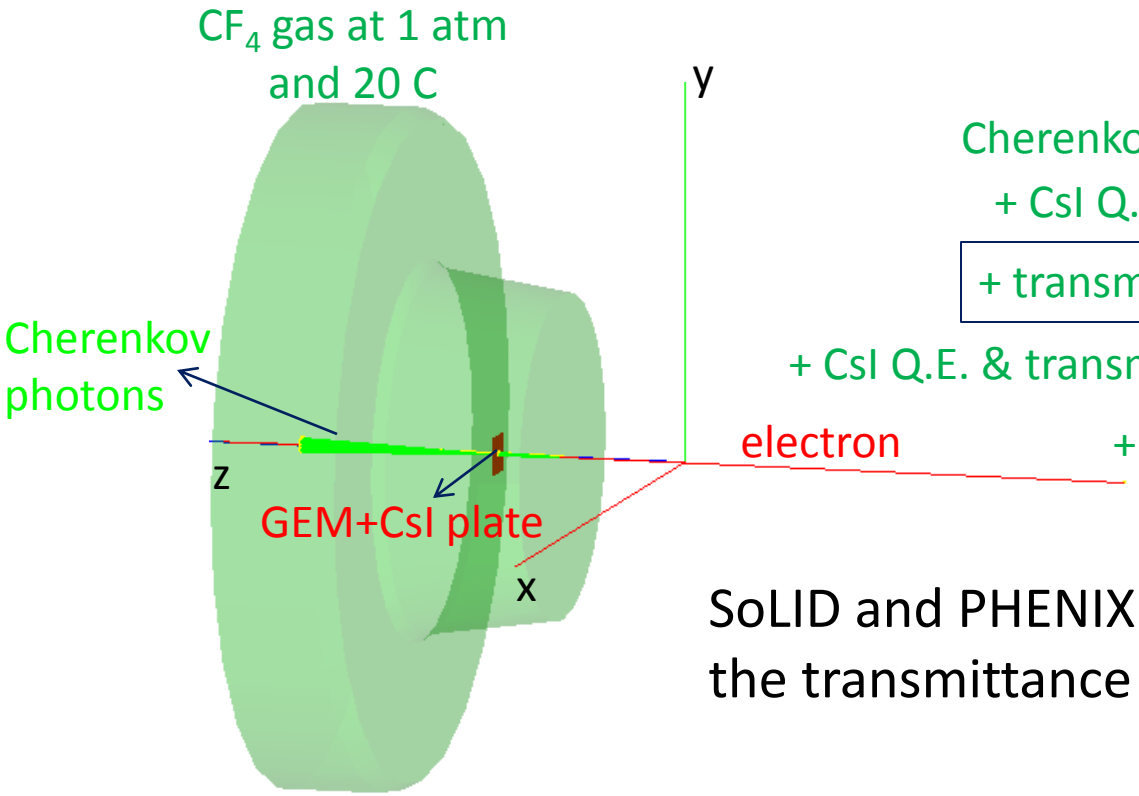


Thanks to Bob Azmoun (BNL) for providing me with very detailed information on the PHENIX N_{pe} calculation

SoLID vs PHENIX

Gas length: 0.515 cm

Index of refraction n, CsI Q.E., CF_4 transmittance corrections: same as PHENIX



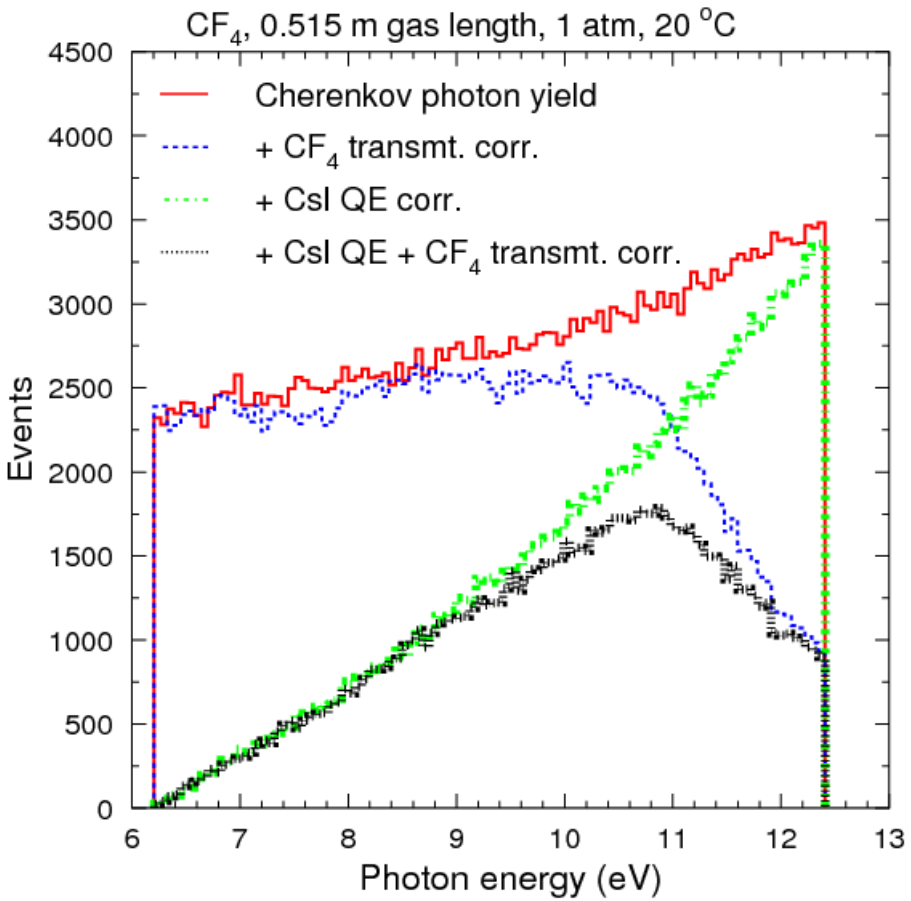
	SoLID	PHENIX	
Cherenkov yield	139.33	141.14	1.81
+ CsI Q.E. corr.	72.46	74.17	1.71
+ transmt. corr.	112.35	96.25	16.1
+ CsI Q.E. & transmt. corr.	51.17	39.27	11.9
+ all corr.	26.4	20.3	6.1

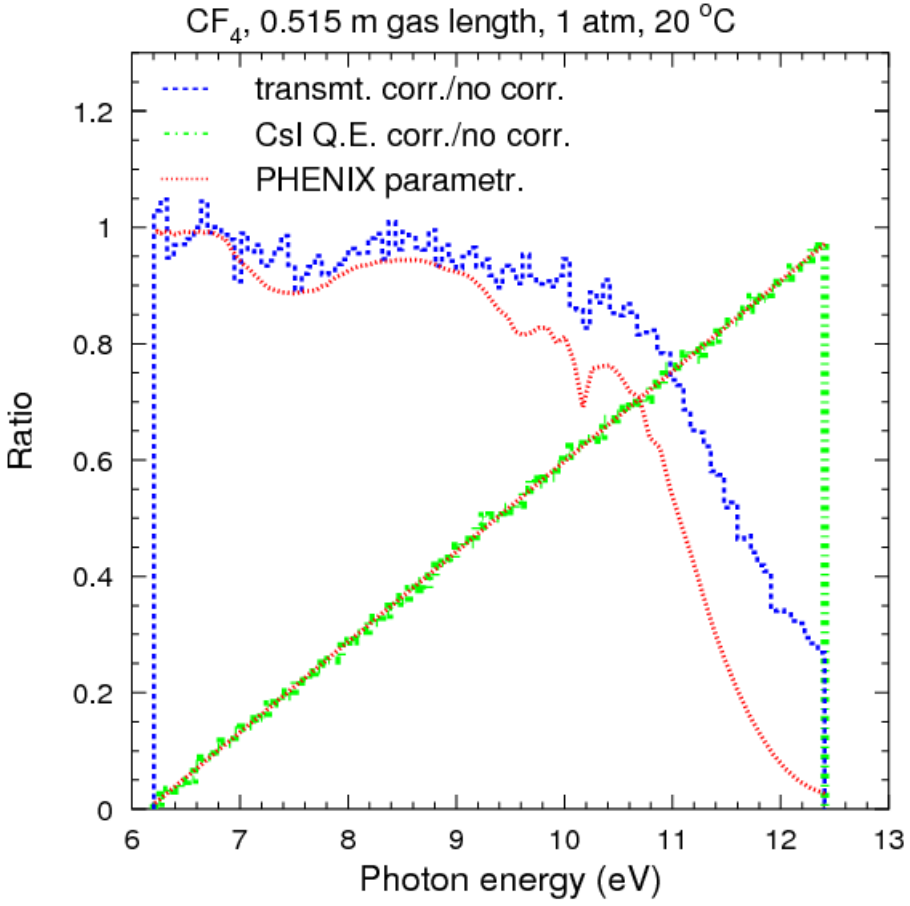
SoLID and PHENIX in very good agreement until the transmittance correction is applied

Note: In the excel table sent by Bob the integration is actually done between 99.5 nm and 200.5 nm; if I use these limits in GEANT4 (instead of 100 nm to 200 nm as above) I would get an yield of 141.29 in very …. very good agreement with the PHENIX number

SoLID: GEANT4-based simulation

The Cherenkov photon yield (dependent on index of refraction and gas density) is calculated in energy bins defined by user





The photocathode Q.E. is taken into account as an energy-dependent correction

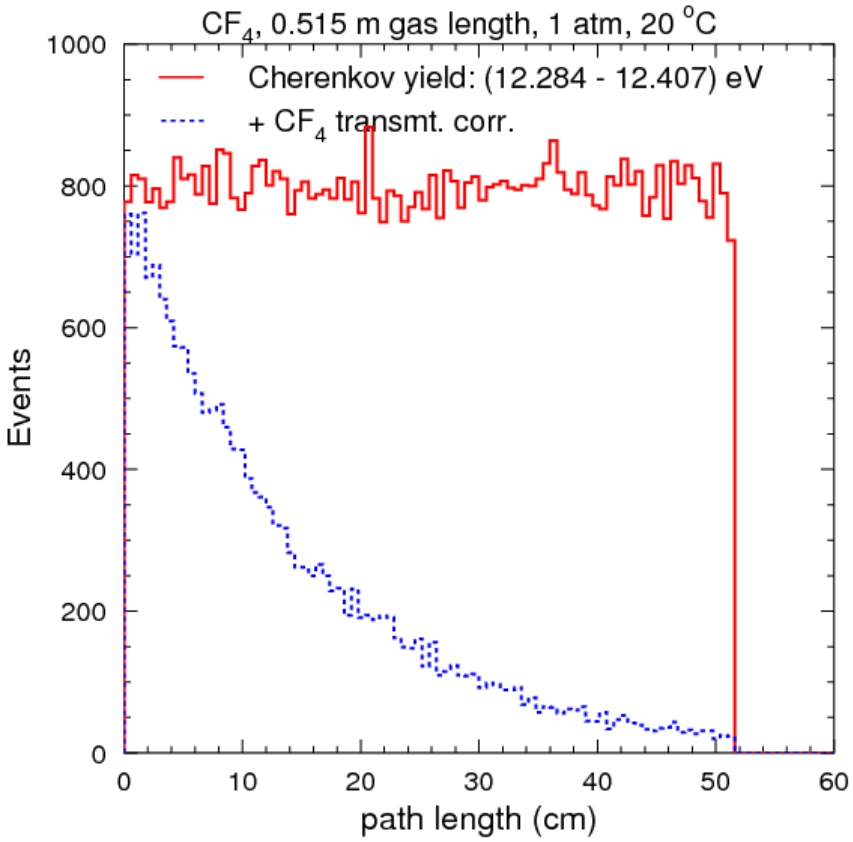
The gas transparency is taken into account as an energy-dependent correction via the absorption length

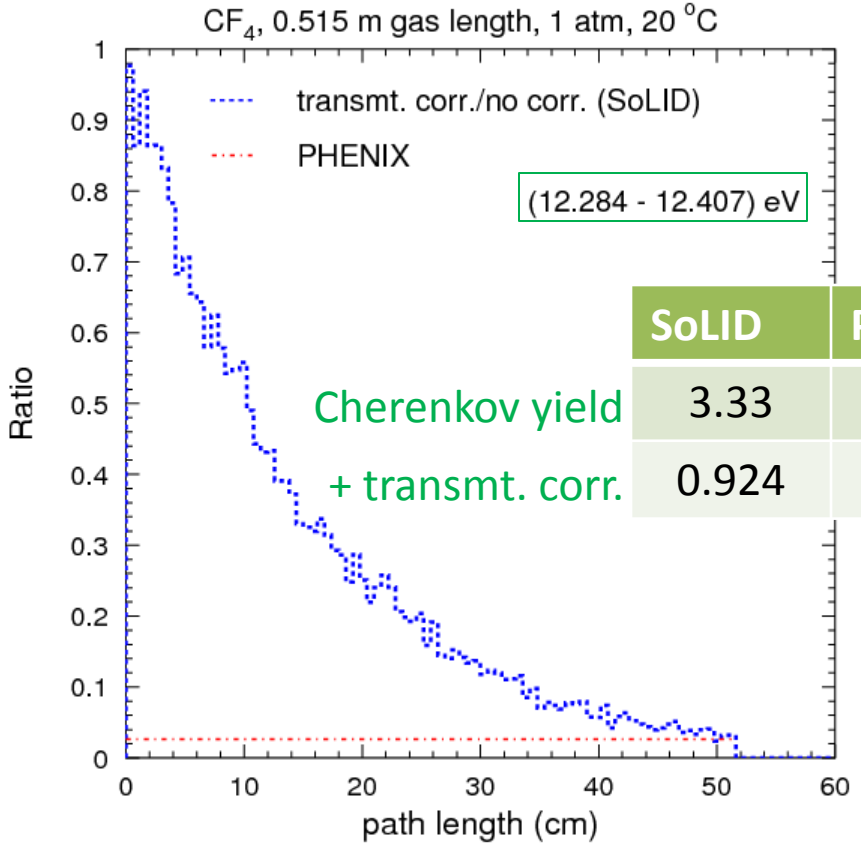
SoLID: GEANT4-based simulation

Example: Cherenkov yield in one energy bin

SoLID Geant4: uses the convolution of the gas transparency with the photon path length (not all Cherenkov photons are created at the entrance in the gas)

Highest energy bin: transmittance correction very large





	SoLID	PHENIX
Cherenkov yield	3.33	3.46
+ transmt. corr.	0.924	0.093

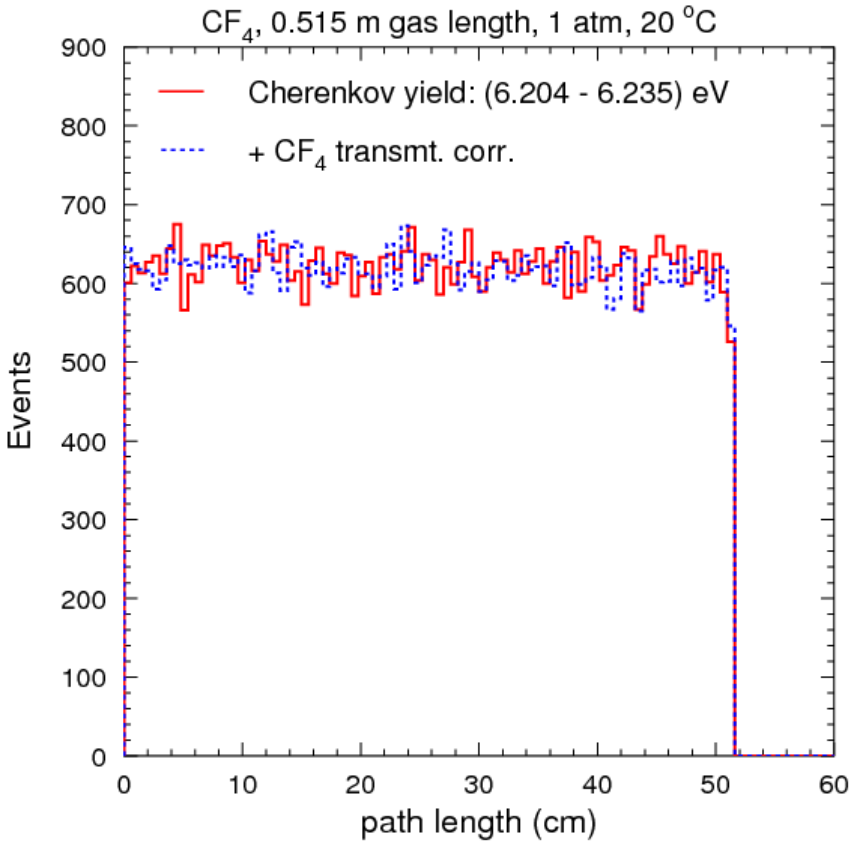
PHENIX: applies an **overall correction** to all photons created in **a given energy bin regardless of their path length**

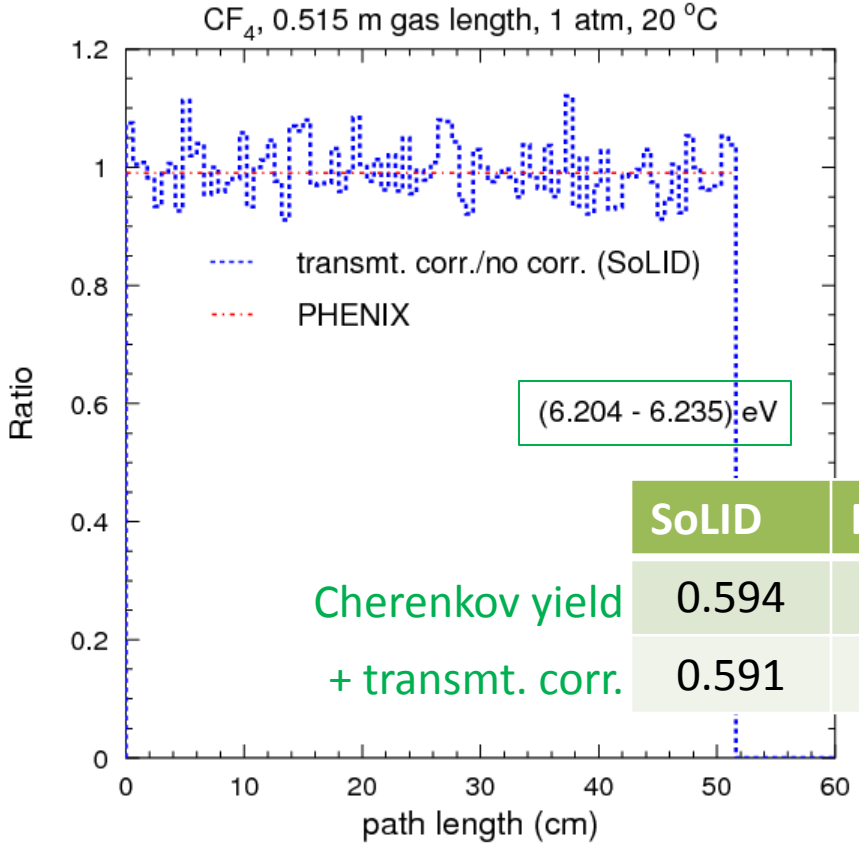
SoLID: GEANT4-based simulation

Example: Cherenkov yield in one energy bin

SoLID Geant4: uses the convolution of the gas transparency with the photon path length (not all Cherenkov photons are created at the entrance in the gas)

Lowest energy bin: transmittance correction very small





	SoLID	PHENIX
Cherenkov yield	0.594	0.588
+ transmt. corr.	0.591	0.582

PHENIX: applies an **overall correction** to all photons created in **a given energy bin regardless of their path length**

Conclusion

SoLID and PHENIX in very good agreement until the transmittance correction is applied

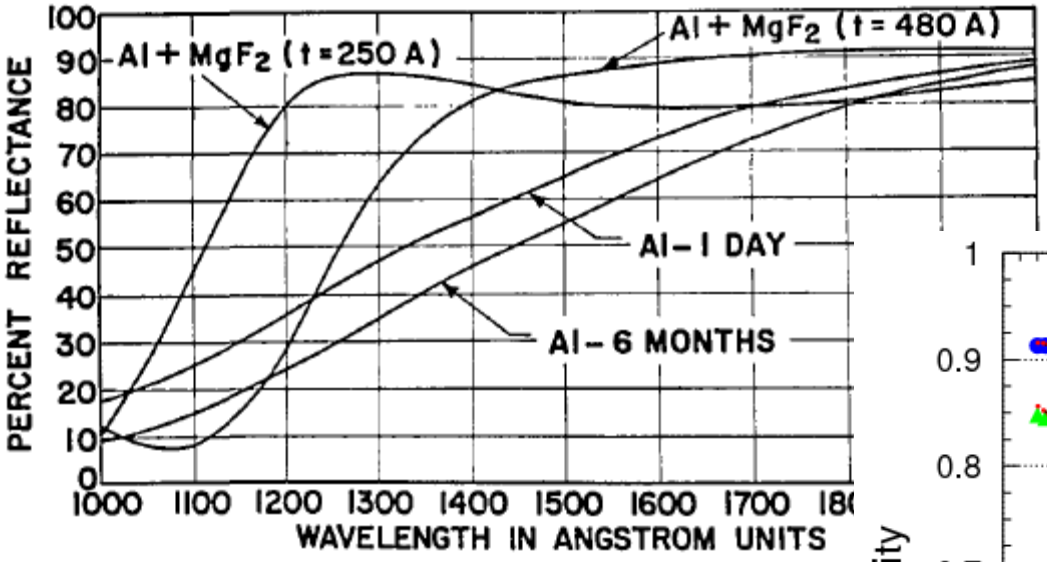
The discrepancy arises because the simulations have different modalities of taking the gas transmittance into account

Geant4 (SoLID): perhaps a more realistic approach as it takes into account not only how transparent the gas is but also the path length of the Cherenkov photons in the gas

<u>To do for the GEM+CsI option</u>:

→The SoLID simulation will be updated with the PHENIX parameters for CsI Q.E. and gas transmittance
→ the SoLID wavelength cutoff will be kept at 120 nm (still)
→ newly found parametrizations for mirror reflectivity in FUV will be implemented (systematic study)

Mirror Reflectivity in FUV



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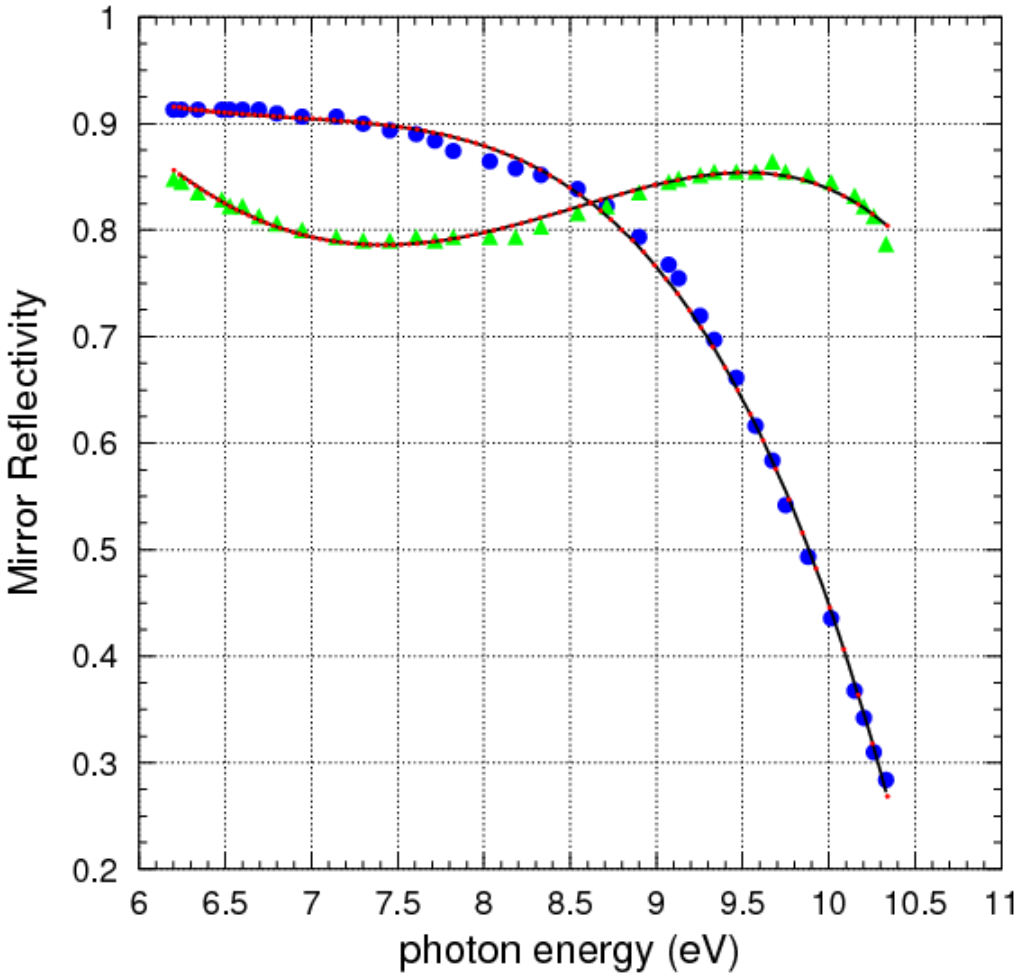
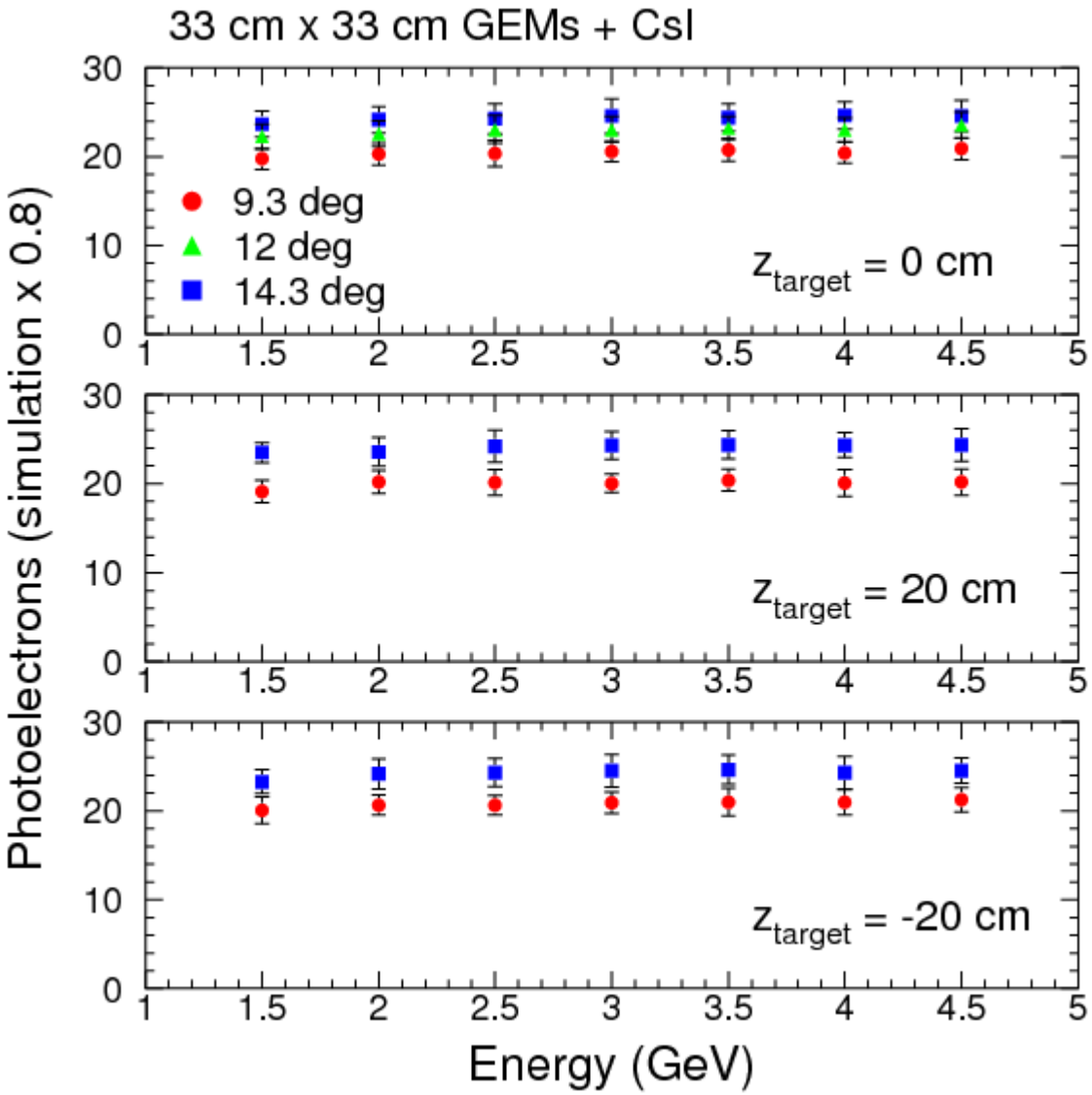


Electron Cherenkov Signal: GEMs + CsI

The PHENIX parameters are used for the index of refraction, CsI Q.E., gas transmittance



Two parametrizations for mirror reflectivity used (gives the uncertainty)

PHENIX factor: 0.516 (mesh and photocathode transparency, transport efficiency)

Safety factor: 0.8