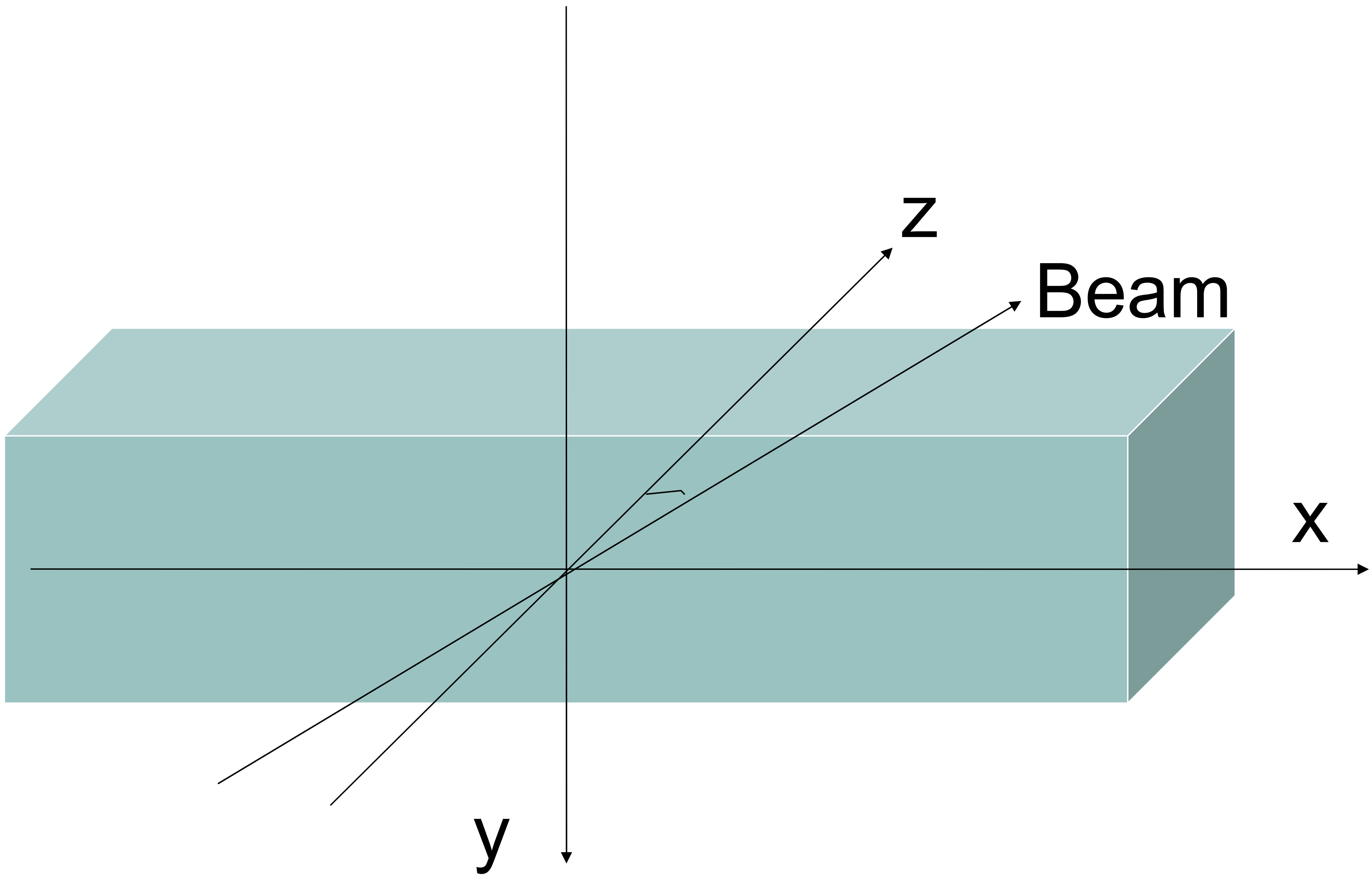
Algebra Exercises

psfile
ngeoacceptance

Reference Frame



Beam Direction

- At 0 degree:
  - $p(0) = (0, 0, 1)$
- After a rotation in xz plane (of an angle ω):
  - $p(\omega) = (\sin \omega, 0, \cos \omega)$

Cherenkov Light

- At 0 degree:

$$\mathbf{C}(0) = (\sin \mathbf{c} \cdot \cos\varphi,\ \sin \mathbf{c} \cdot \sin\varphi,\ \cos \mathbf{c})$$

$$= (\cos\alpha \cdot \cos\varphi,\ \cos\alpha \cdot \sin\varphi,\ \sin\alpha)$$

- c = Cherenkov angle
- α = critical angle with air = $\pi/2 - c$
- After beam rotation:

$$\begin{aligned}\mathbf{C}(\omega) = (&\cos\alpha \cdot \cos\varphi \cdot \cos\omega + \sin\alpha \cdot \sin\omega,\\ &\cos\alpha \cdot \sin\varphi,\\ &-\cos\alpha \cdot \cos\varphi \cdot \sin\omega + \sin\alpha \cdot \cos\omega)\end{aligned}$$

Geometrical Acceptance

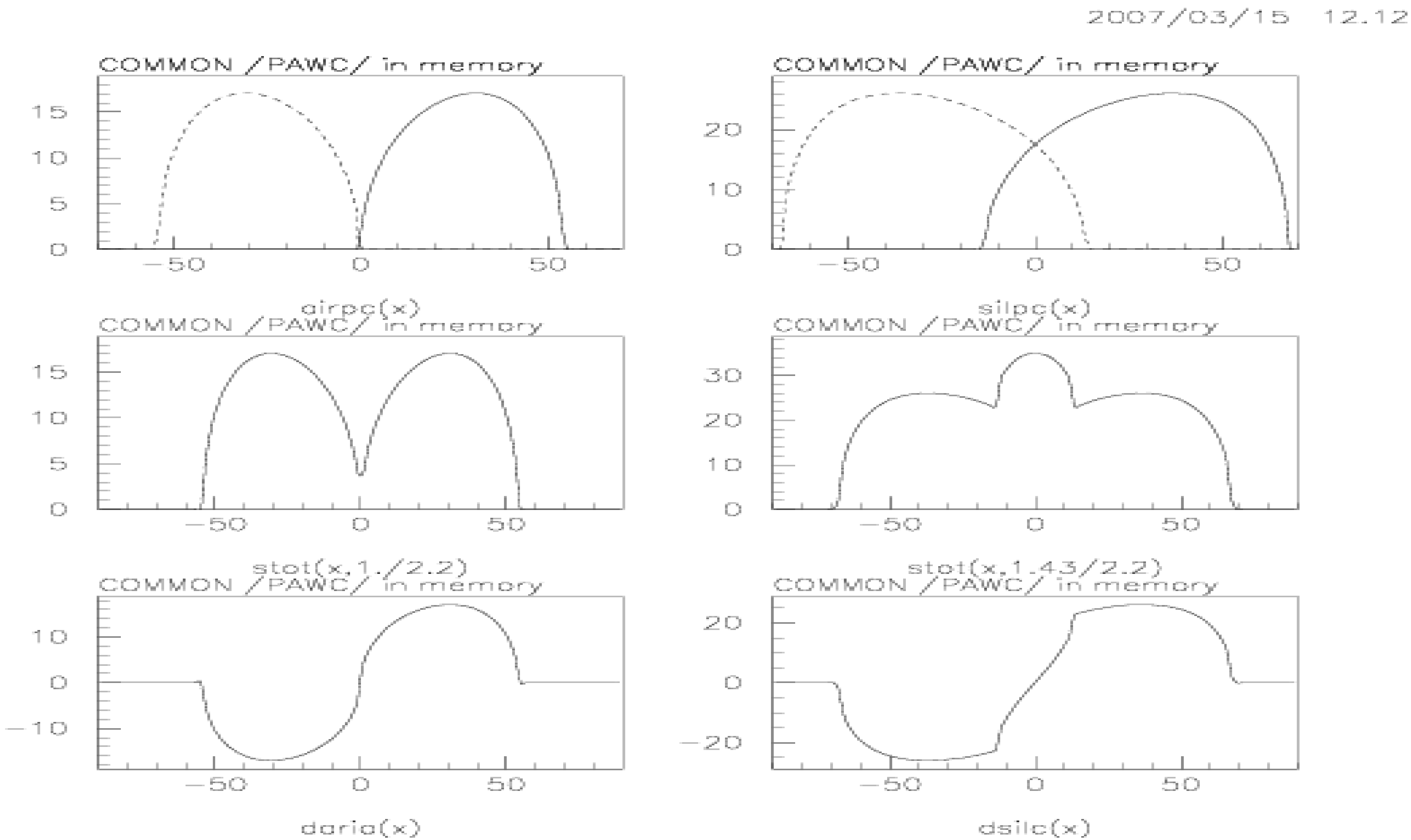
$$\mathbf{C} \;=\; (\cos\theta_{\mathbf{x}}, \cos\theta_{\mathbf{y}}, \cos\theta_{\mathbf{z}})$$

$$\cos\theta_x \;>\; \cos\eta \qquad (\eta \;:\; critical\;\, angle)$$

$$\cos\alpha\cdot\cos\varphi\cdot\cos\omega \;+\; \sin\alpha\cdot\sin\omega \;>\; \cos\eta$$

$$\cos\varphi \;>\; \frac{\cos\eta \;-\; \sin\alpha\cdot\sin\omega}{\cos\alpha\cdot\cos\omega} \;=\; \cos\lambda$$

$$\lambda \;=\; f(\omega,\alpha,\eta) \;...\; \alpha,\; \eta:\; "known" \;...$$



2007/03/15 12.12
COMMON /PAWC/ in memory
airpc(x)
COMMON /PAWC/ in memory
silpc(x)
COMMON /PAWC/ in memory
stot(x,1./2.2)
COMMON /PAWC/ in memory
stot(x,1.43/2.2)
COMMON /PAWC/ in memory
daria(x)
COMMON /PAWC/ in memory
dsilc(x)

Wrapping

- From the unitarity constraint:

$$\cos\theta_{\mathbf{y}}, \cos\theta_{\mathbf{z}} \leq \sin\theta_{\mathbf{x}} < \sin\eta < \cos\eta_{\mathbf{air}}$$

being :

$$\sin\eta_{\mathbf{air}} = \mathbf{1.0/2.2 = 0.45}$$
$$\sin\eta_{\mathbf{sil}} = \mathbf{1.43/2.2 = 0.65}$$
$$\cos\eta_{\mathbf{air}} = \mathbf{0.89}$$

so :

$$\theta_{\mathbf{x}}, \theta_{\mathbf{z}} > \eta_{\mathbf{air}}$$

anyway totally reflected on the non – instrumented faces

Reflective wrapping doesn't improve light collection.

Polarization

- Cherenkov light 100% linearly polarized in plane containing photon and incident particle momenta:

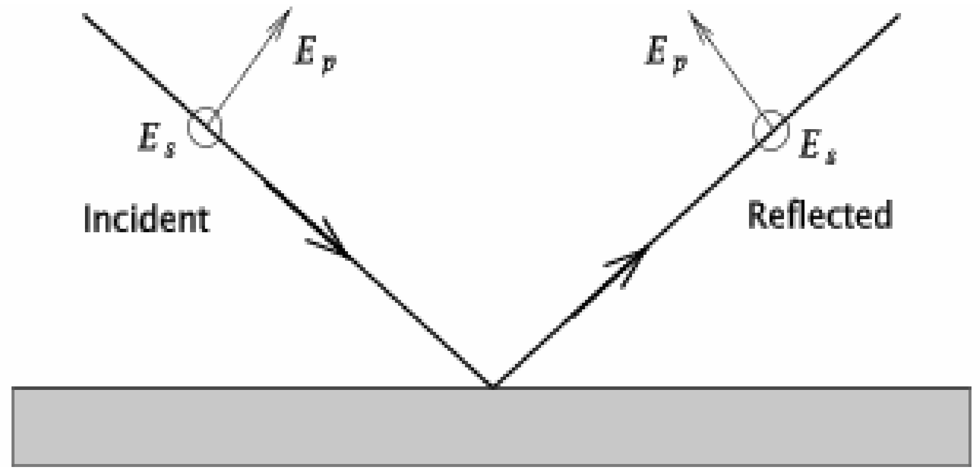
$$\overrightarrow{E(0)} = (\ \cos c \cdot \cos\varphi,\ \ \cos c \cdot \sin\varphi,\ \ -\sin c\ )$$
$$= (\ \sin\alpha \cdot \cos\varphi,\ \ \sin\alpha \cdot \sin\varphi,\ \ -\cos\alpha\ )$$

- After rotation:

$$\overrightarrow{E(\omega)} = (\ \sin\alpha \cdot \cos\varphi \cdot \cos\omega\ -\ \cos\alpha \cdot \sin\omega,$$
$$\sin\alpha \cdot \sin\varphi,$$
$$-\ \sin\alpha \cdot \cos\varphi \cdot \sin\omega\ -\ \cos\alpha \cdot \cos\omega\ )$$

Polarization

- Two components: Es and Ep



$$\overrightarrow{E}_p = (E_x, \ a \cdot E_y, \ b \cdot E_z)$$

$$\overrightarrow{E}_s = (0, \ (1-a) \cdot E_y, \ (1-b) \cdot E_z)$$

Transmission

$$|\mathbf{E_p}| = \frac{\mathbf{E_x}}{\sqrt{\mathbf{1 - C_x^2}}}$$

$$|\mathbf{E_s}| = \sqrt{\mathbf{1 - E_p^2}} = \frac{\sin\ \varphi \cdot \cos\ \omega}{\sqrt{\mathbf{1 - C_x^2}}}$$

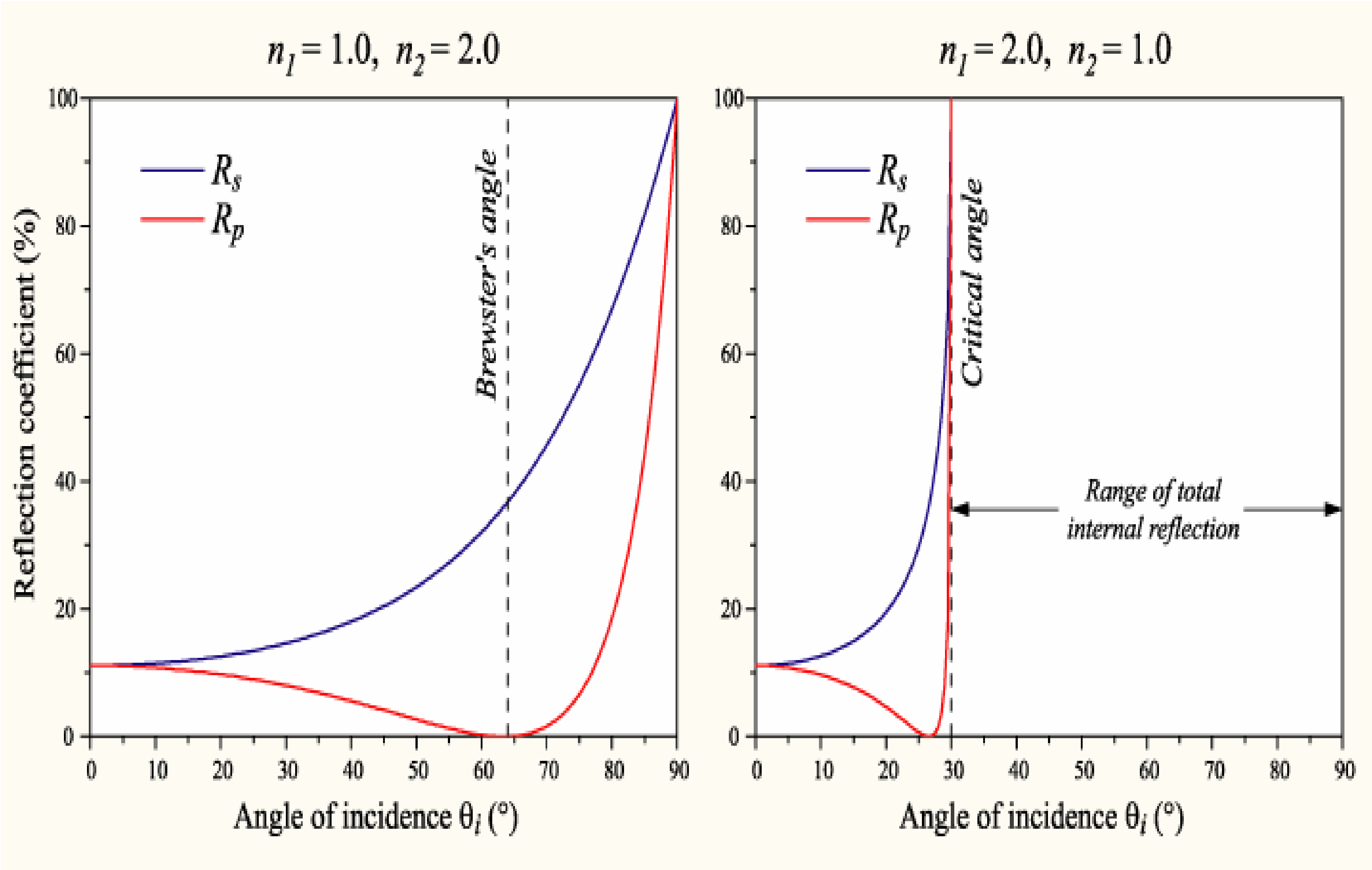
$$\mathbf{T_p} = \mathbf{1} - \left[\frac{\tan(\theta_{\mathbf{t}} - \theta_{\mathbf{x}})}{\tan(\theta_{\mathbf{t}} + \theta_{\mathbf{x}})}\right]^{\mathbf{2}}$$

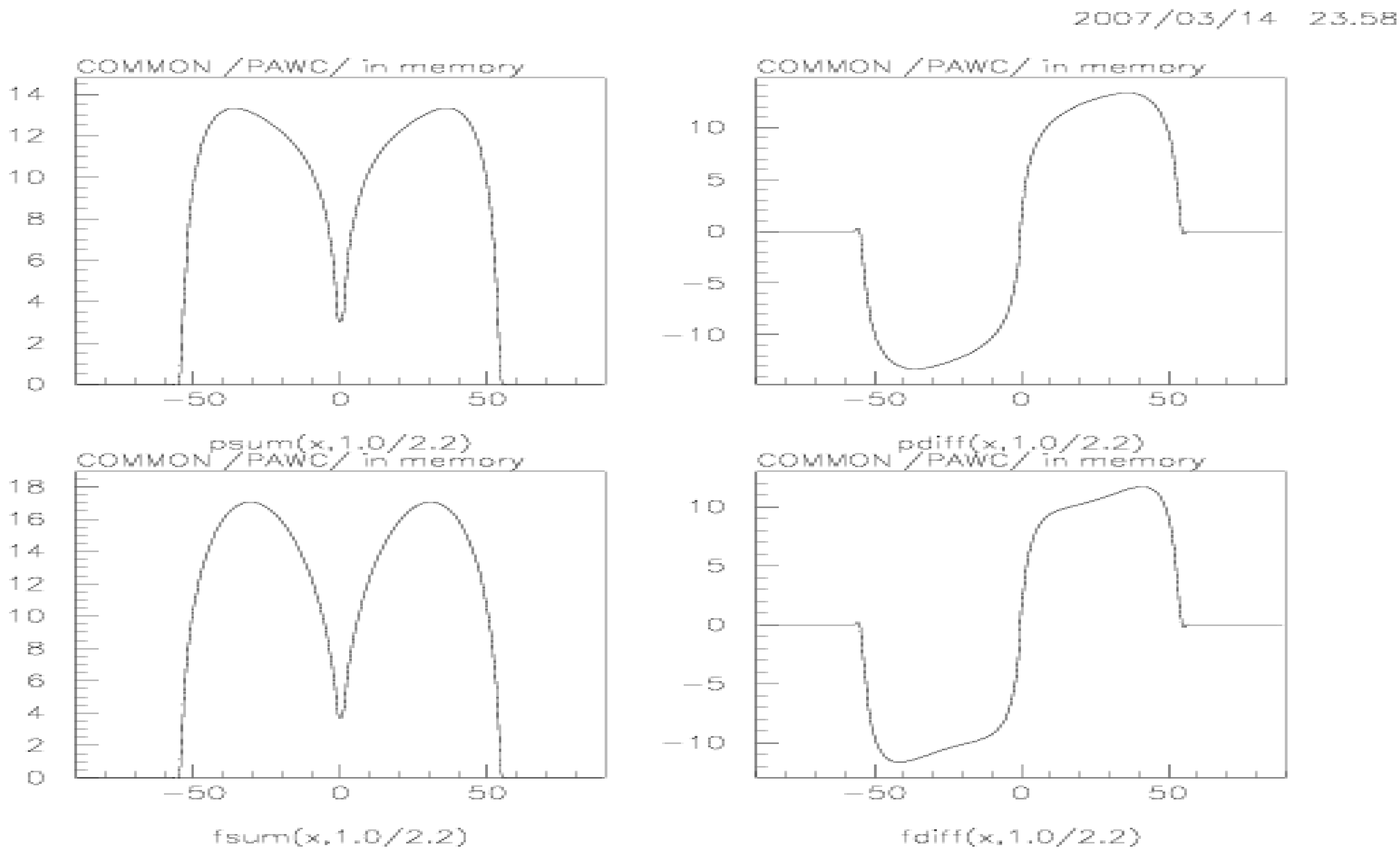
$$\sin\theta_{\mathbf{t}} = \frac{\sin\theta_{\mathbf{x}}}{\sin\eta}$$

$$\mathbf{T_s} = \mathbf{1} - \left[\frac{\sin(\theta_{\mathbf{t}} - \theta_{\mathbf{x}})}{\sin(\theta_{\mathbf{t}} + \theta_{\mathbf{x}})}\right]^{\mathbf{2}}$$

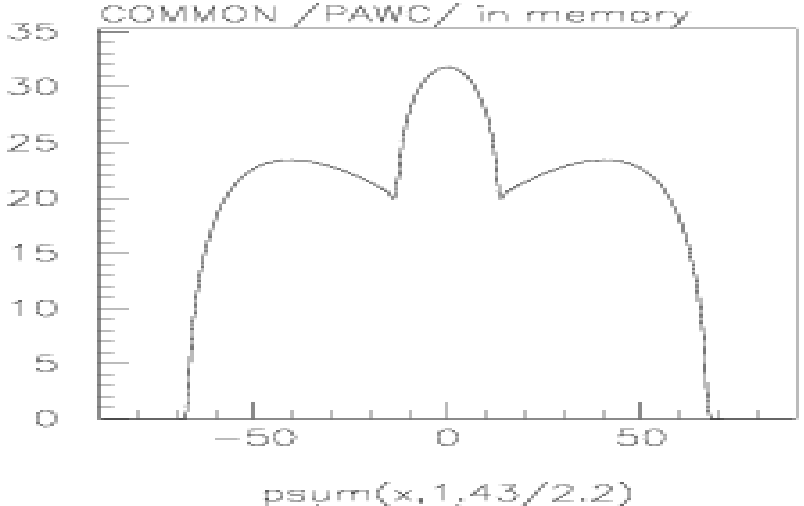
$$\mathbf{Prob(T)} = \mathbf{T_p} \cdot |\mathbf{E_p}|^{\mathbf{2}} + \mathbf{T_s} \cdot |\mathbf{E_s}|^{\mathbf{2}}$$

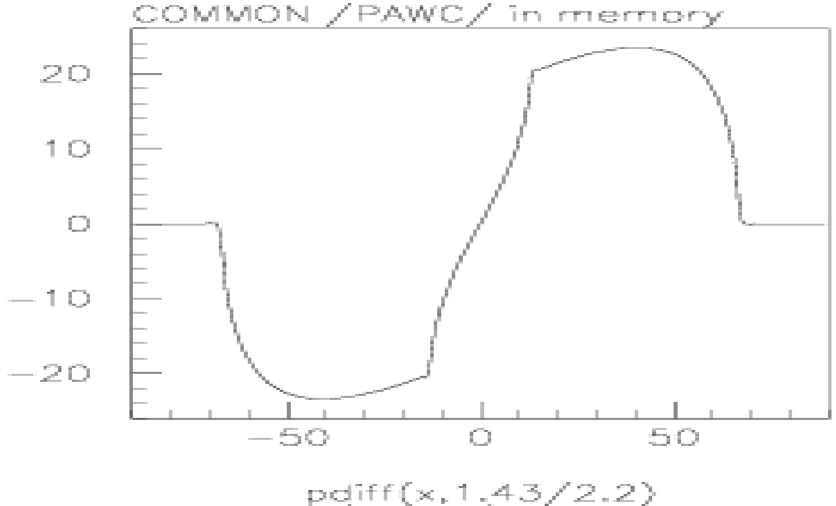
Reflection Coefficients

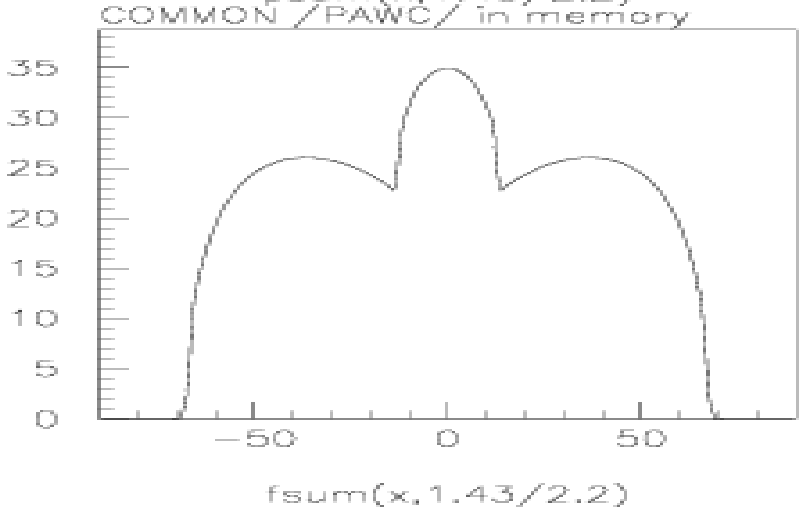


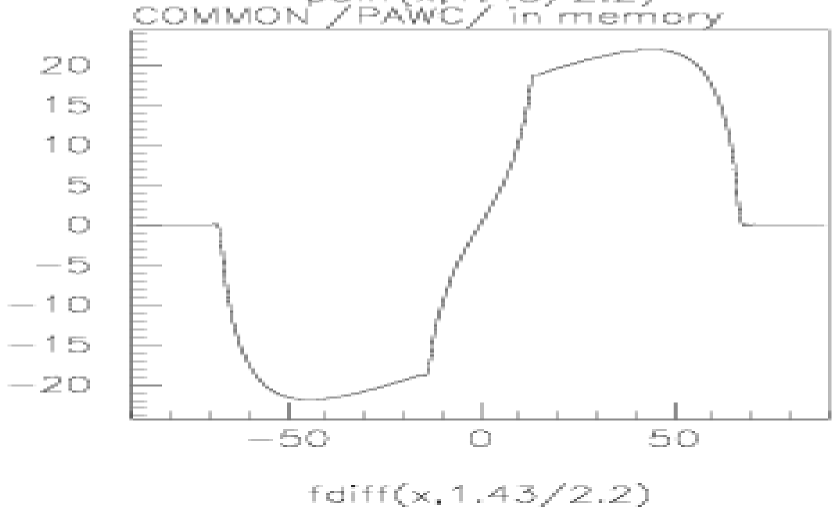

2007/03/14 23.58
COMMON /PAWC/ in memory
psum(x,1.0/2.2)
COMMON /PAWC/ in memory
pdiff(x,1.0/2.2)
COMMON /PAWC/ in memory
fsum(x,1.0/2.2)
COMMON /PAWC/ in memory
fdiff(x,1.0/2.2)

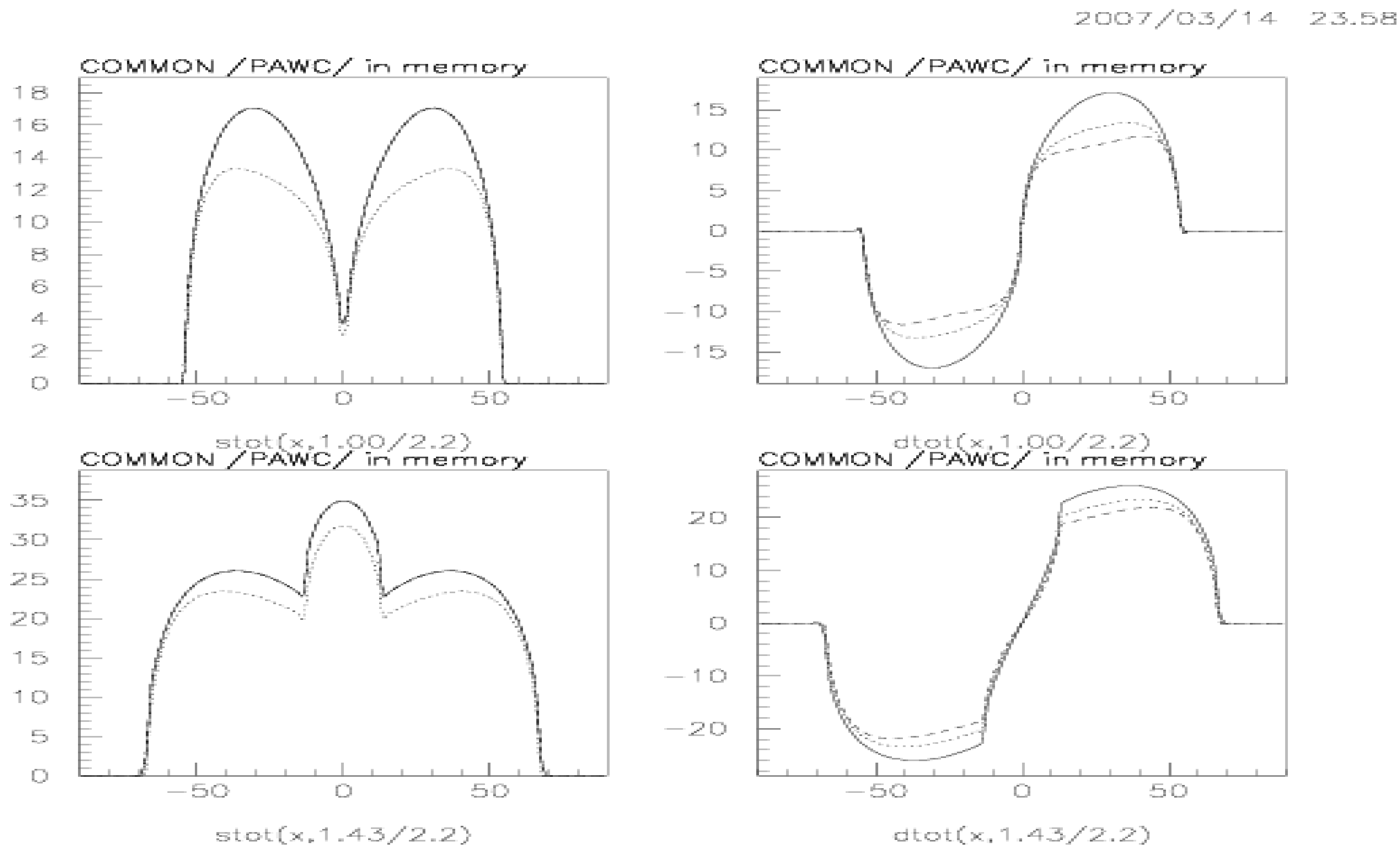
2007/03/14 23.58











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stot(x,1.00/2.2)
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COMMON /PAWC/ in memory
dtot(x,1.43/2.2)

Scintillating Light

- Calculations for scintillating light, for (TOTAL) geometrical acceptance, transmittance and prompt collection give:
- AIR : 11, 81, 9 %
- SILICON : 24, 90, 22 %

Conclusions

- I am convinced that geometry should likely be improved :