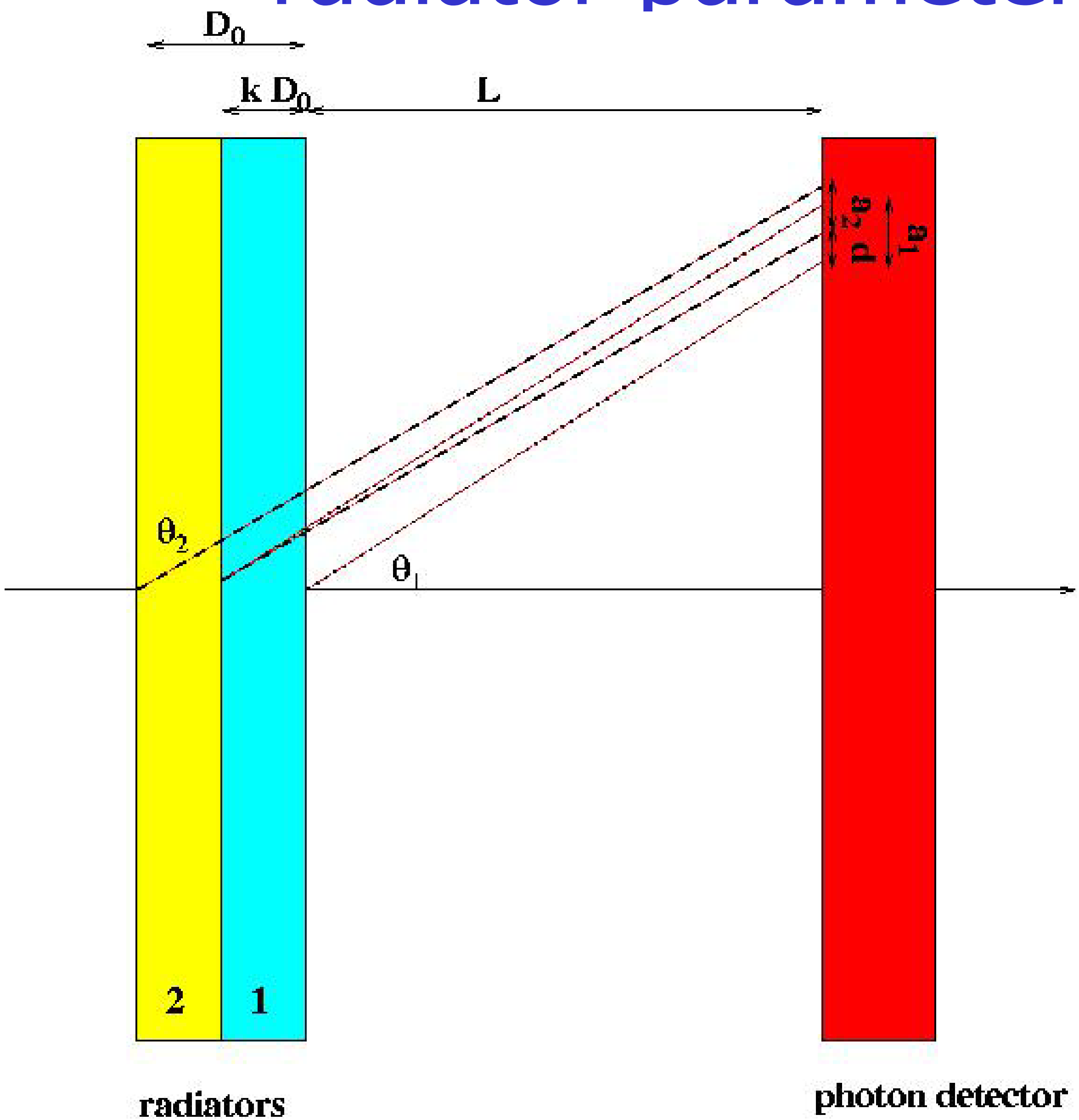
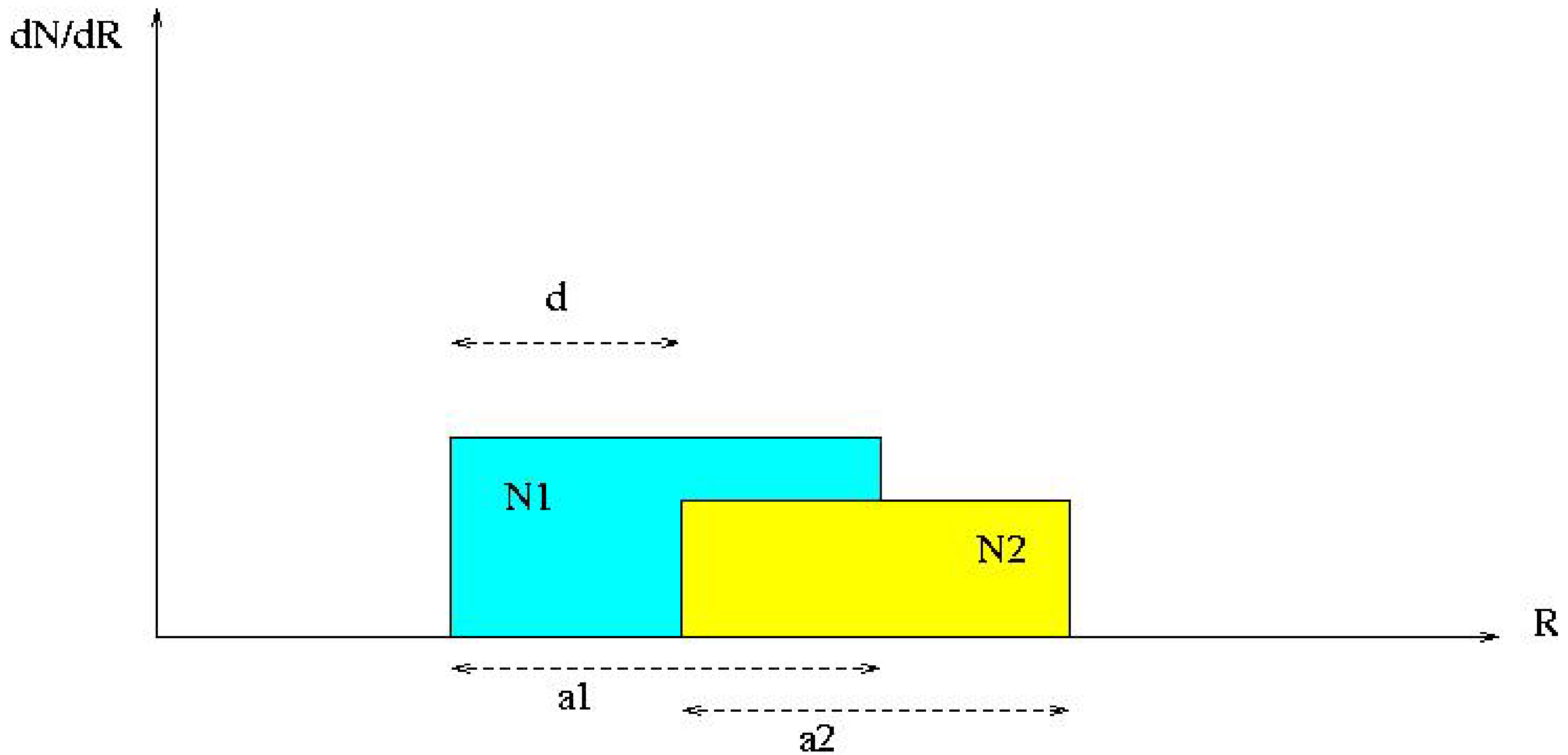
Multiple radiator: Optimisation of radiator parameters – cont'd



Dual radiator: three parameters (if fixed space available)

- Difference in θ
- Ratio of radiator thicknesses
- Total radiator thickness

Radial photon impact point distribution



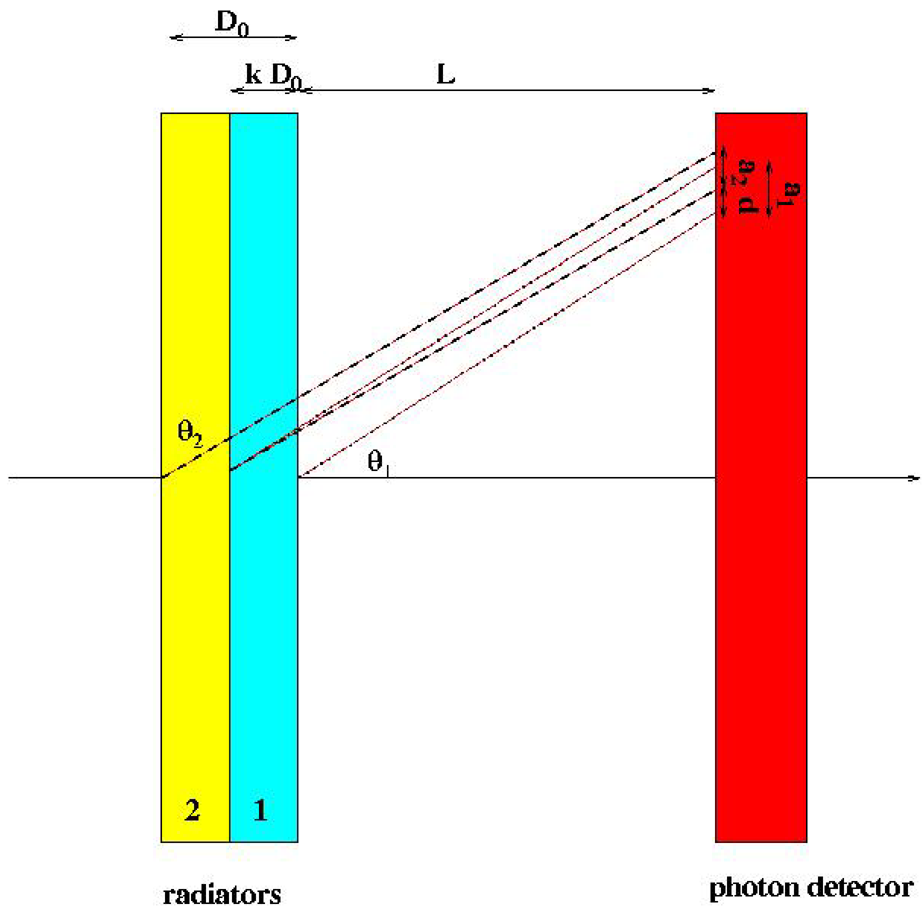
Parameters of the counter

$$a1 = D1 * Tan[\Theta 1]; \; a2 = D2 * Tan[\Theta 1 - \delta];$$

$$d = L * Tan[\Theta 1] - (L + D1) * Tan[\Theta 1 - \delta]; \; D1 = k * D0;$$

$$D2 = D0 - D1; \; N1 = 50 * D1 * (Sin[\Theta 1])^2 * Exp[-D1/2/Lam1];$$

$$N2 = 50 * D2 * (Sin[\Theta 1 - \delta])^2 * Exp[-D2/2/Lam2 - D1/Lam1];$$



What comes today?

- Repeat the optimisation study with σ_{rest}
- Extend the full calculation to the multilayer case
- Study the robustness of the optimum

Minimized: error per track

$$\sigma_{track} = \frac{1}{\sqrt{N_{\det}}}\sqrt{\sigma_{emp}{}^2 + \sigma_{\det}{}^2 + \sigma_{rest}{}^2}$$

$$\frac{1}{(L + D0/2)}$$

Distance to photon detector

$$\sqrt{\left(\frac{1}{(N1 + N2)}\right.}$$

Number of photons

$$\left(\frac{1}{12\,(N1 + N2)^2}\right.$$

$$\left(-3\,(a1\,N1 + (a2 + 2\,d)\,N2)^2 + \right.$$

$$\left.\left. 4\,(N1 + N2)\,\left(a1^2\,N1 + \left(a2^2 + 3\,a2\,d + 3\,d^2\right)\,N2\right)\right) + \right.$$

$$\left.\left. pad\hat{}2 / 12\right)\right)$$

Emission point error

Pad size contribution

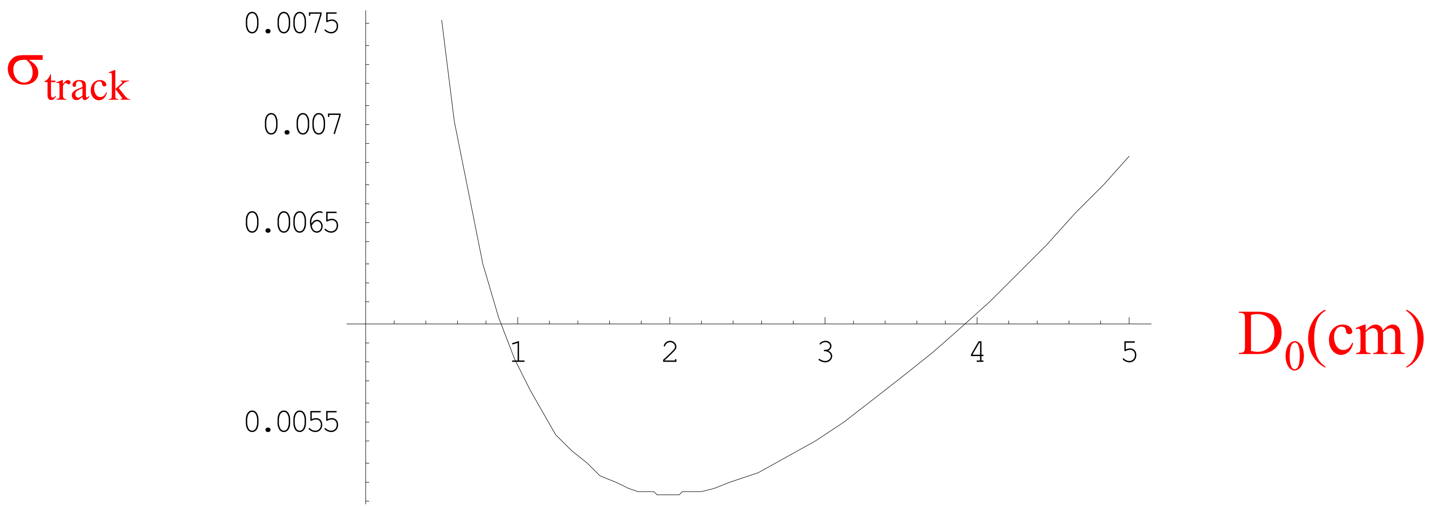
Now assume σ_{rest}=0.006

Check the single radiator result – NIM paper

Vary total radiator thickness D_0

Input data:

- total length $L+D_0$ is fixed (20cm)
- dn=0.0
- Cherenkov angle = 0.3, pad size 6mm, trans. len.= 4.5cm



Minimum at 2cm: OK

Minimize track error vs.

Relative radiator thickness k and refractive index difference dn and total thickness D_0

Transm. length 3cm	Transm. length 4.5cm
dn=0.0046	**dn=0.0053**
k=0.43	**k=0.44**
D_0 = 2.7 cm	**D_0 = 3.0 cm**
σ at minimum 0.0047	σ at minimum 0.0044

Available space in front of photon detector: 20cm

σ_{rest}=6mrad

Minimize track error vs.

Relative radiator thickness k and refractive index difference dn and total thickness D_0

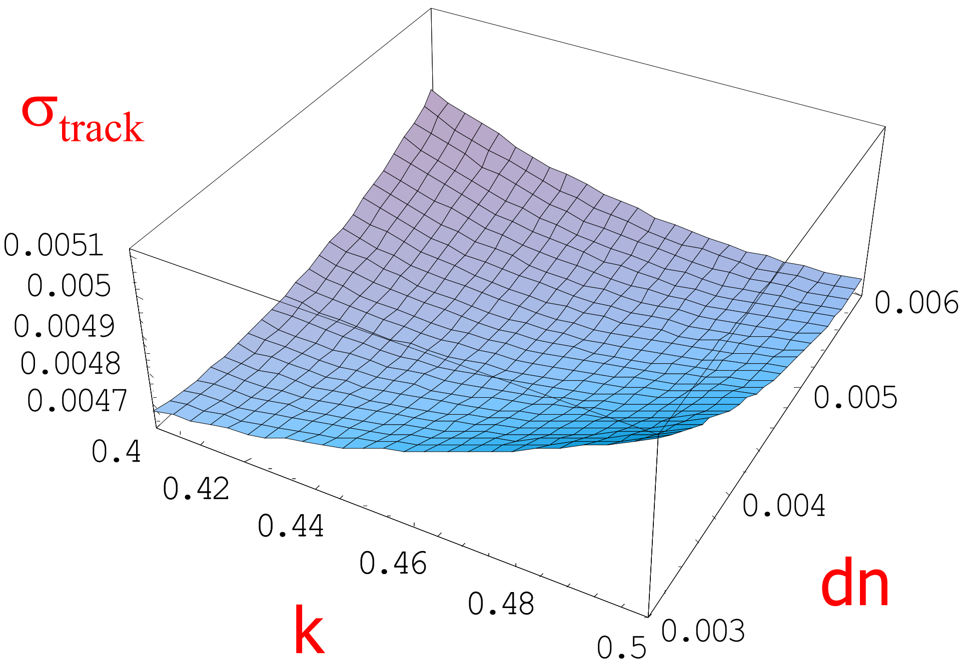
σ_{rest}=6mrad	σ_{rest}=8mrad
dn=0.0053	**dn=0.0056**
k=0.44	**k=0.44**
D_0 = 3.0 cm	**D_0 = 3.2 cm**
σ at minimum 0.0043	σ at minimum 0.0047

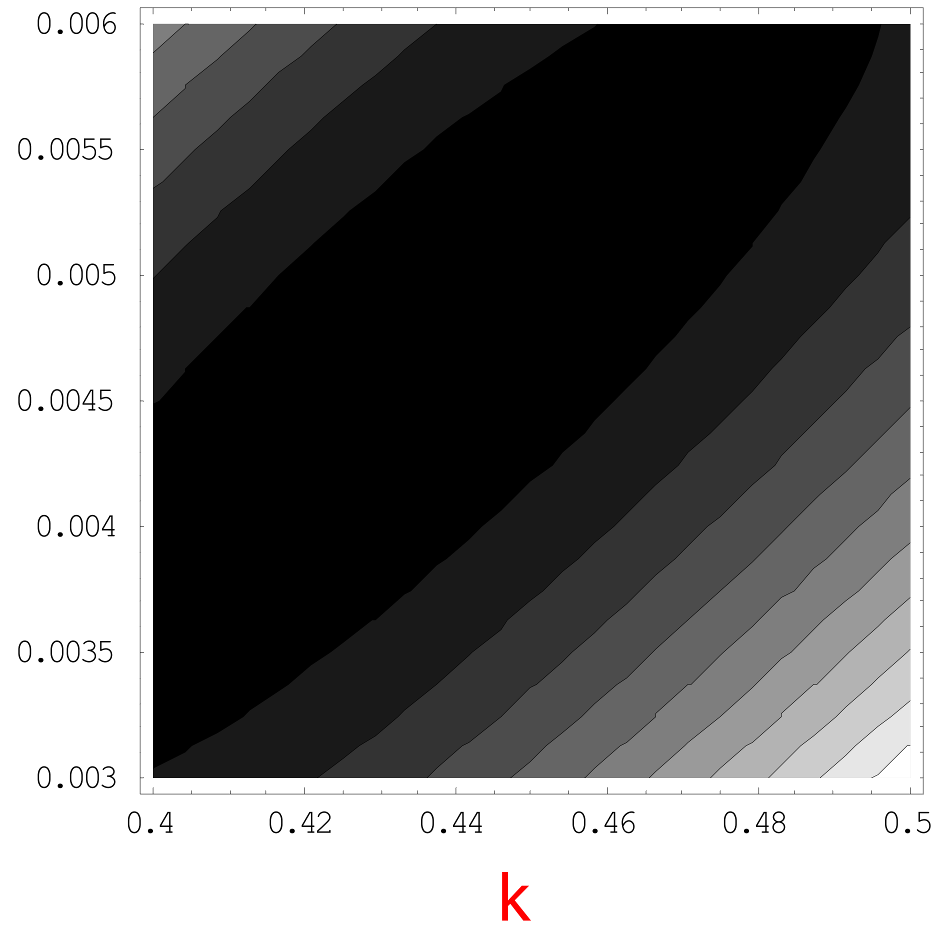
Available space in front of photon detector: 20cm
Transm. length 4.5cm

Robustness of the optimum

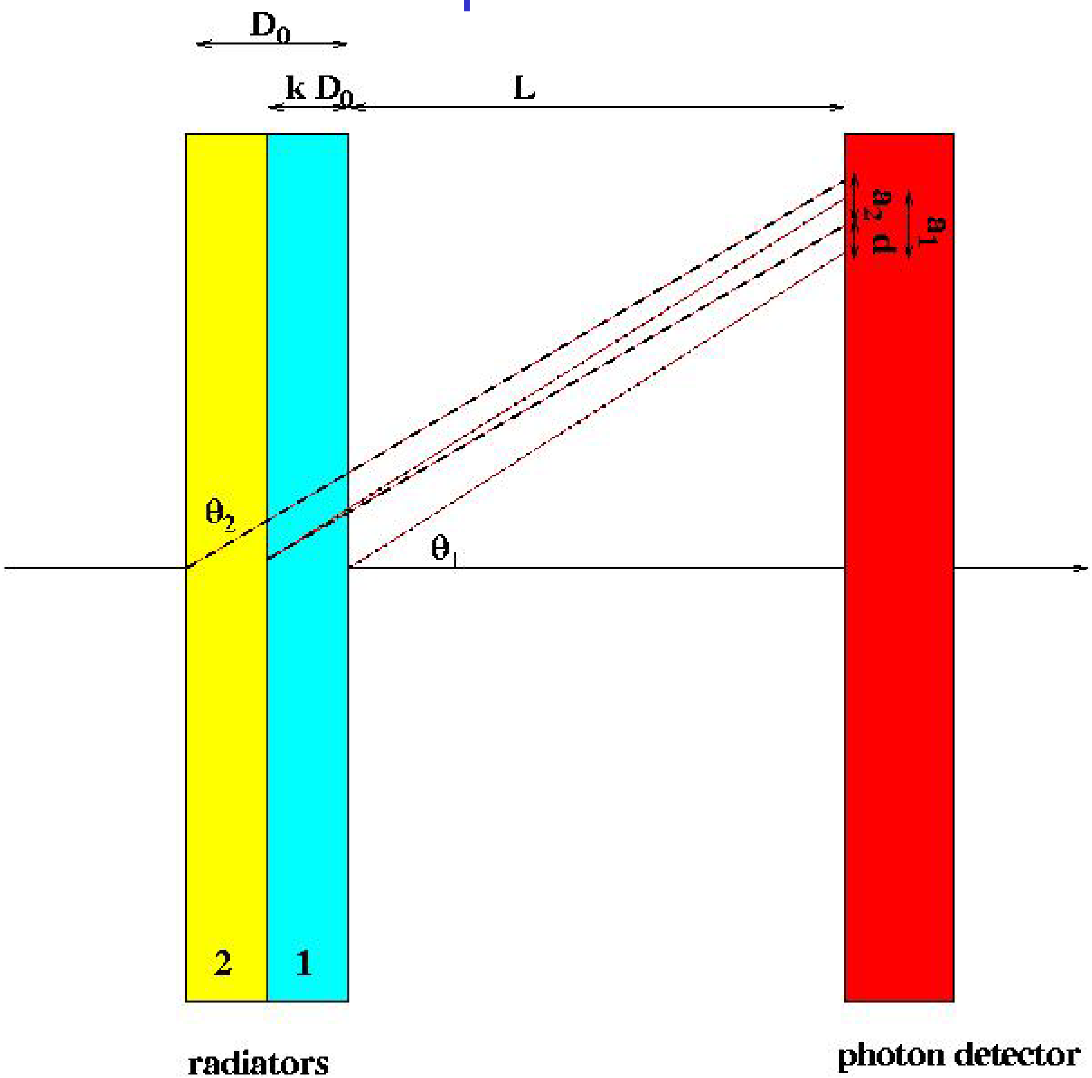
Take the case with transm. length 3cm, σ_{rest}=6mrad, with dn=0.0046, k=0.43, D_0 = 2.7 cm, σ at minimum 0.0047.

Fix D_0, vary k and dn.

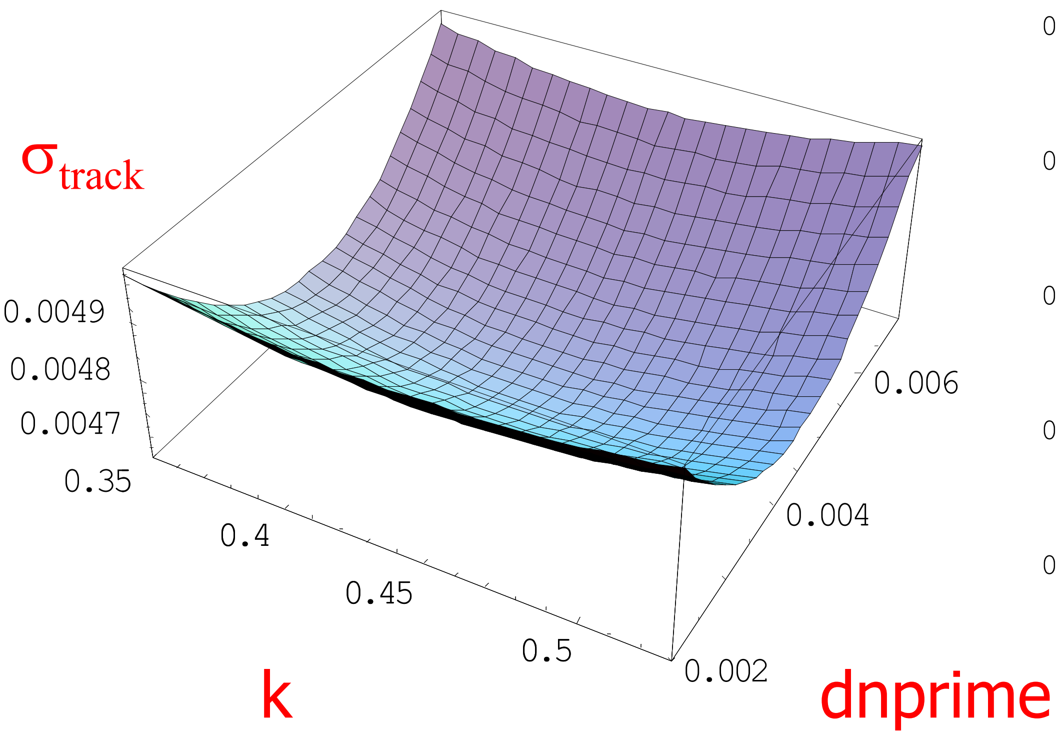


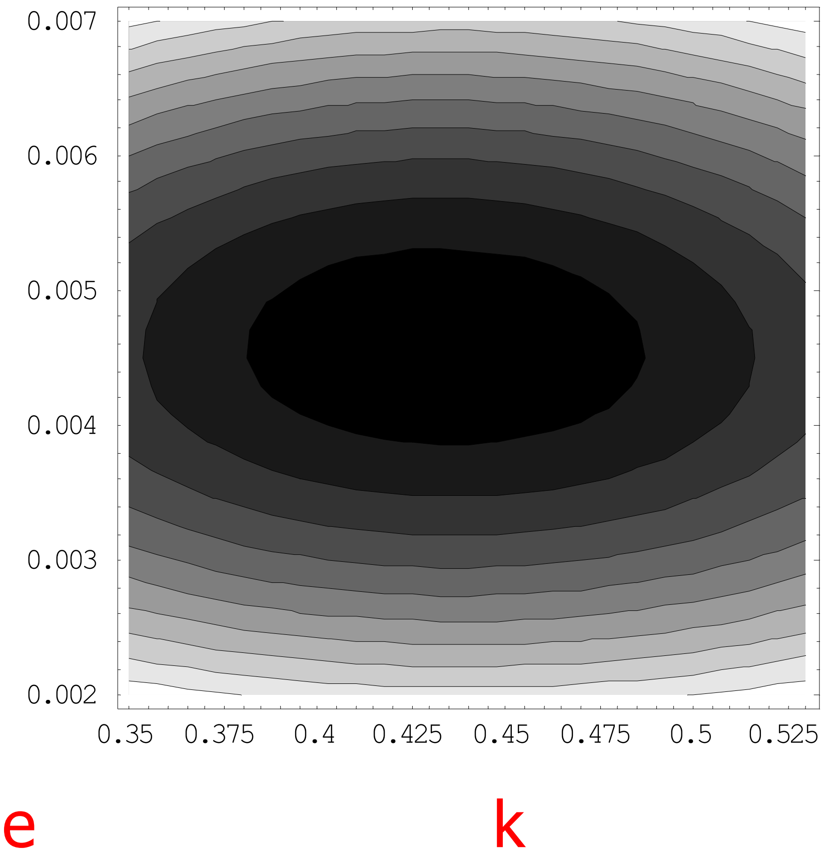


Correlation between dn and k: larger k means thicker radiator 1 (downstream) -> need a larger dn to compensate.



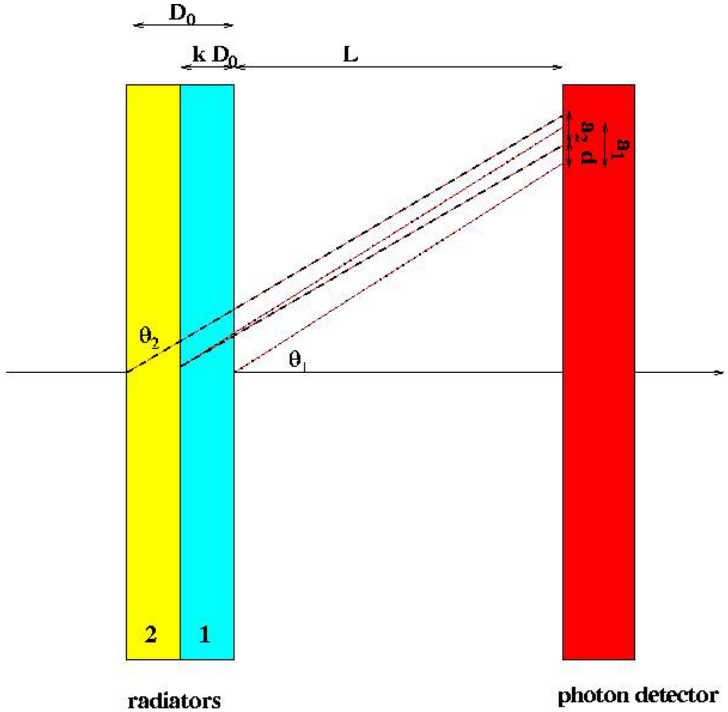
New variable -> easier to see

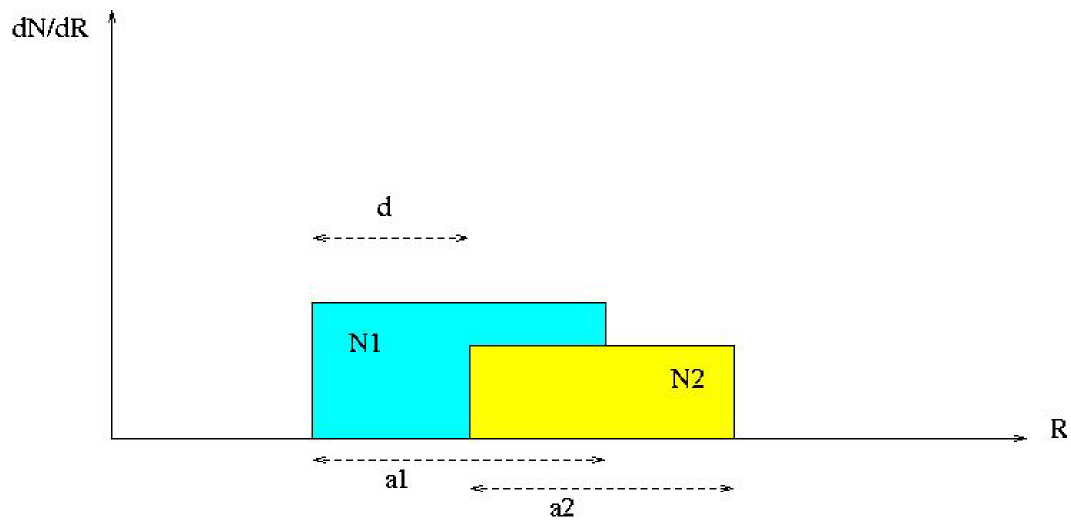




$$dn = dnprime + 0.025 * (k - 0.433)$$

Extend the full calculation to the multilayer case





Use the same method to calculate the spread on the photon detector as for the two radiator case

- Triple radiator case
- Quadruple radiator case

Triple radiator

Transm. length 3cm, σ_{rest}=6mrad

dn1=0.0033

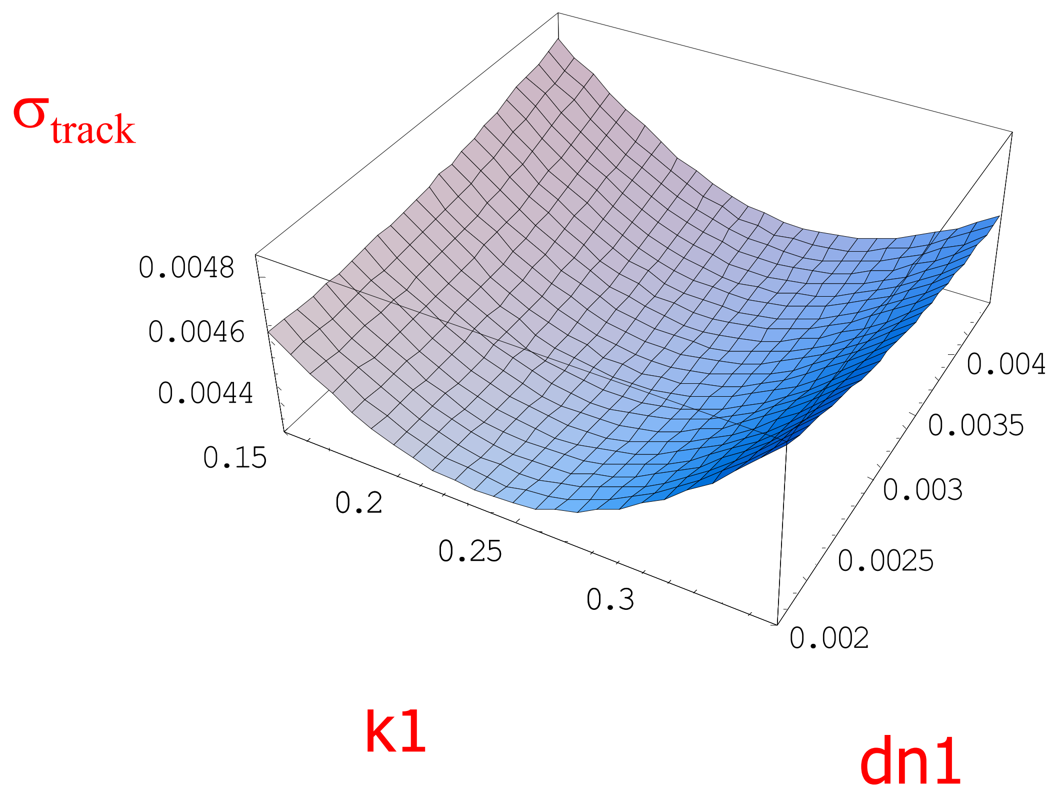
dn2=0.0081

k1=0.25

k2=0.34

D_0 = 3.4 cm

σ at minimum 0.0043



Quadruple radiator

Transm. length 3cm, σ_{rest}=6mrad

dn1=0.0020

dn2=0.0062

dn3=0.0105

k1=0.16

k2=0.24

k3=0.28

D_0 = 3.9 cm

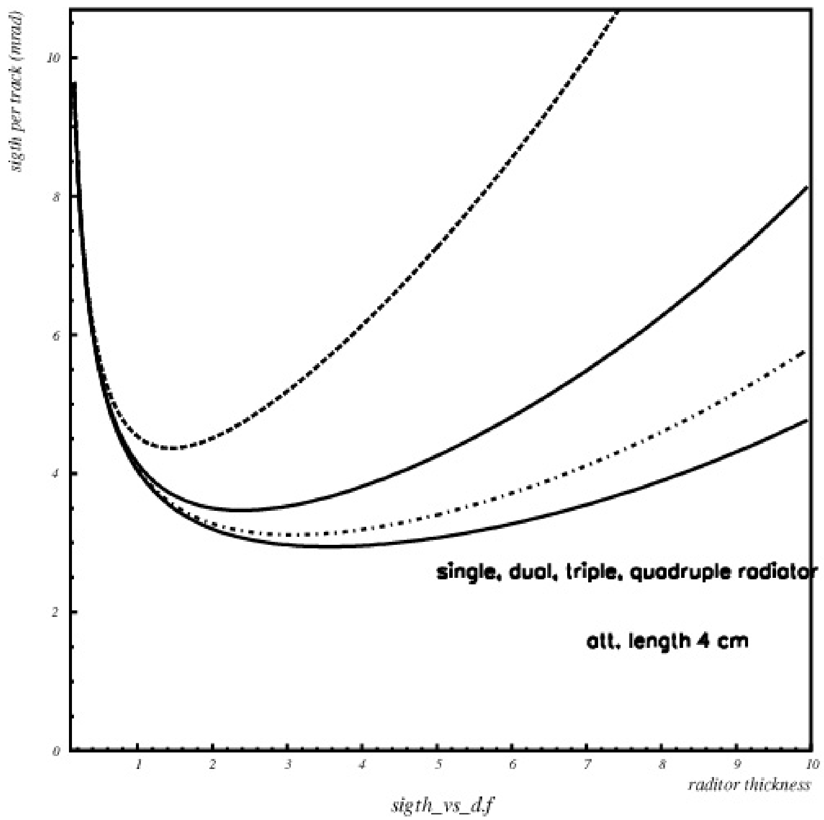
σ at minimum 0.0041

Lower ref. index -> smaller emission point error at same thickness-> optimal if upstream radiators thicker

Last meeting: a simple model of what happens when we go from the single layer to focusing multilayer arrangement:

If the indices are well adjusted, the error in emission point goes down by a factor of two in the dual radiator case etc

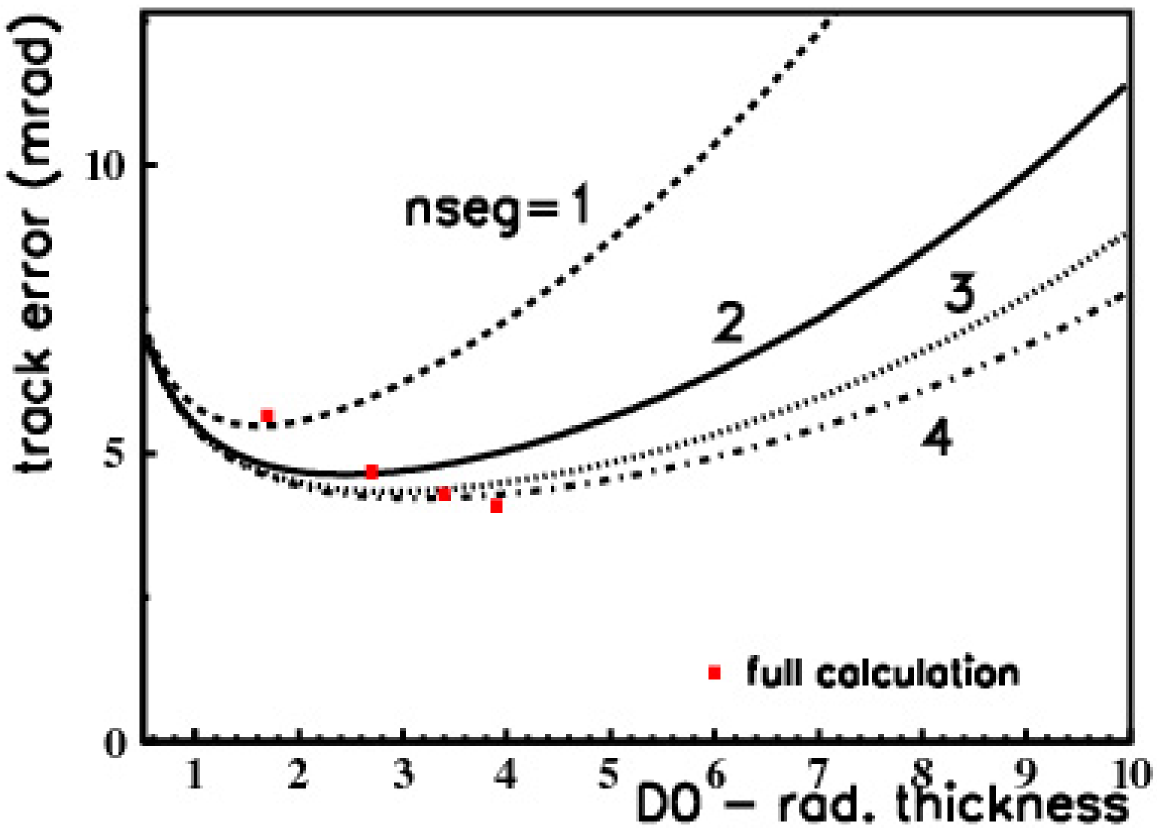
σ_{track}



D_0(cm)

Simple model

How good is this simple model? Contrast it with the full calculation



Curves: simple model
Points: full calculation

What comes next?

- Evaluate the multilayer results
- Continue the study of robustness of the optimum

(need input for what is realistic error in n, thickness)