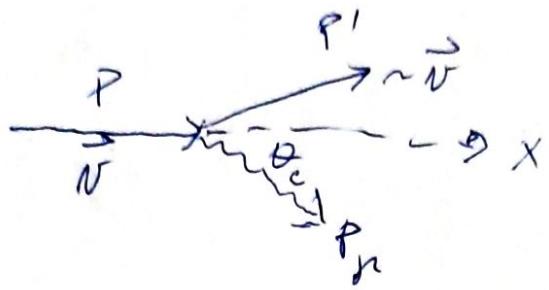


Števci sevačja Čerenkova

①

na začetku semestra:

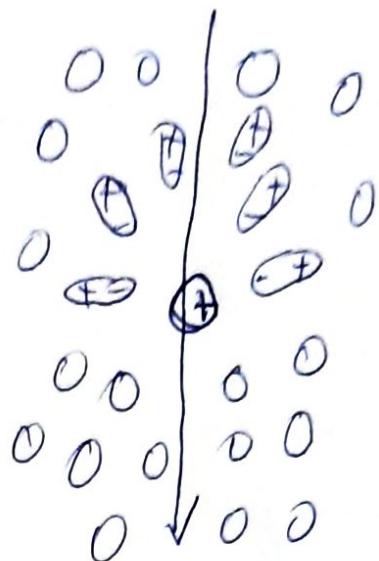
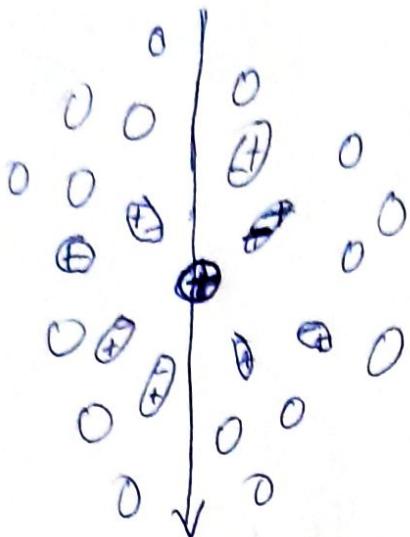


$$k_y = \frac{\omega}{v} \sqrt{\frac{v^2}{n^2} - 1} \quad u = \frac{c}{\sqrt{\epsilon}}$$

če $v > u \Rightarrow k_y$ realen

$$\operatorname{tg} \theta_c = \frac{k_y}{k_x}$$

$$\cos \theta_c = \frac{1}{\sqrt{1 + \operatorname{tg}^2 \theta_c}} = \frac{u}{v} = \frac{c}{nv} = \frac{1}{n \beta}$$

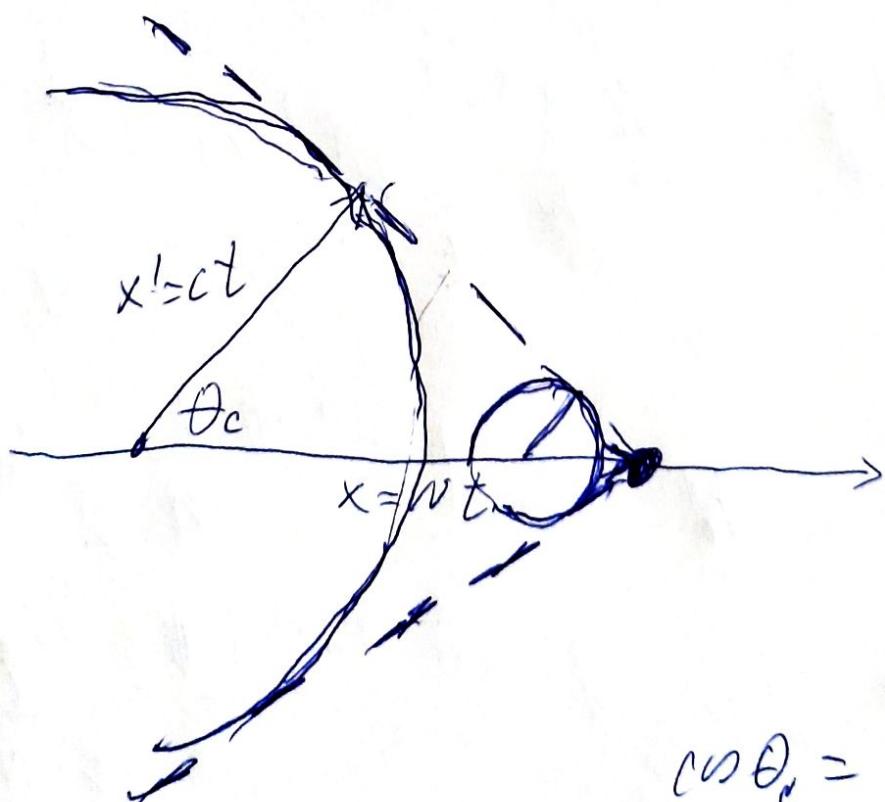


$$\frac{r}{c} < 1$$

$$\frac{r}{c} > 1$$

simetrično,
ni dipola,
ni sevanja

asimetrično,
dipol, sevanje



$$\cos \theta_c = \frac{x'}{x} =$$

$$= \frac{ct}{vt} = \frac{c}{v} = \frac{c_0}{\sqrt{\mu \nu}} = \frac{1}{B \nu}$$

(2)

veľkáfia miera $\beta_n > 1 \Rightarrow$

$$\Rightarrow N > \frac{C_0}{m}$$

spekter izsevaných fotonov:

$$\frac{dN}{d\lambda} = \frac{2\pi d}{\lambda^2} L \sin^2 \theta_c$$

↑
debelina
sevalca

$$\frac{dN}{d\lambda} \propto \frac{1}{\lambda^2} \quad \left(\frac{dN}{d\nu} \sim \text{konst.} \right)$$

$$\sin^2 \theta_c = 1 - \frac{1}{\beta_n^2} \Rightarrow \text{čím večji } n \rightarrow \\ \text{več fotonov}$$

Sevalci:

pliui $n-1$
 $\sim 0(10^{-3})$

silica aerogeli $\sim 0(10^{-2})$

tekvicí in $\sim 0(10^{-1})$
 tvrdci

(3)

silica aerogeli $(\text{SiO}_2)_m(\text{H}_2\text{O})_{2m}$

zanimive lastnosti (optične,
termične, ...)

st. izsvrnih fotonov v sevanju
čevulkova $\propto \frac{\sin^2 \theta_c}{\lambda^2}$

Detektorji fotonov občutljivi
v določenem frekvenčnem
območju \Rightarrow

$$\frac{N}{L} = 2\pi \alpha \int_{\lambda_1}^{\lambda_2} \frac{\sin^2 \theta_c}{\lambda^2} d\lambda \approx \frac{500}{\text{cm}} \sin^2 \theta_c$$

$[\lambda_1, \lambda_2]$: občutljivo ut.
detektorja

[400 nm, 700 nm]

primer: $\mu = 1,05$ $K^\pm \rightarrow e^\pm + \nu_e$

$$\Rightarrow f_s = 0,971 \Rightarrow \frac{N}{L} = 20/\text{cm}$$

izkoristek detektorja $\approx 70\%$ ④

$$\rightarrow \frac{N}{L} \sim \sigma(\text{n/cm})$$

- pravovni čevci Čerenkova

$n_1 < n_2$; pri dani p
en detec(n_1) že
seva, drugi se ne;

$$\frac{N}{L} \propto \sin^2 \theta_c = 1 - \frac{1}{\beta_2^2 n^2}$$

n čim večji, a onejek

$$t \quad \frac{1}{\beta_2 n} < 1 \Rightarrow \cancel{\text{ne}}$$

$$\Rightarrow \frac{1}{n} \leq \beta_2$$

$$\Rightarrow \frac{N}{L} \propto 1 - \frac{\beta_2^2}{\beta_1^2}$$

$$\beta = \frac{cp}{E} \approx 1 - \frac{m^2 c^4}{2c^2 p^2}$$

$$m^2 \ll cp$$

(5)

$$\frac{N}{L} \propto 1 - \left(1 - \frac{m_2^2 c_0^4}{2c_0^2 p^2}\right) \left(1 + \frac{m_1^2 c_0^4}{2c_0^2 p^2}\right) \approx$$

$$\approx \frac{m_2^2 - m_1^2}{2p^2} c_0^2$$

$$N \propto L \frac{m_2^2 - m_1^2}{p^2}$$

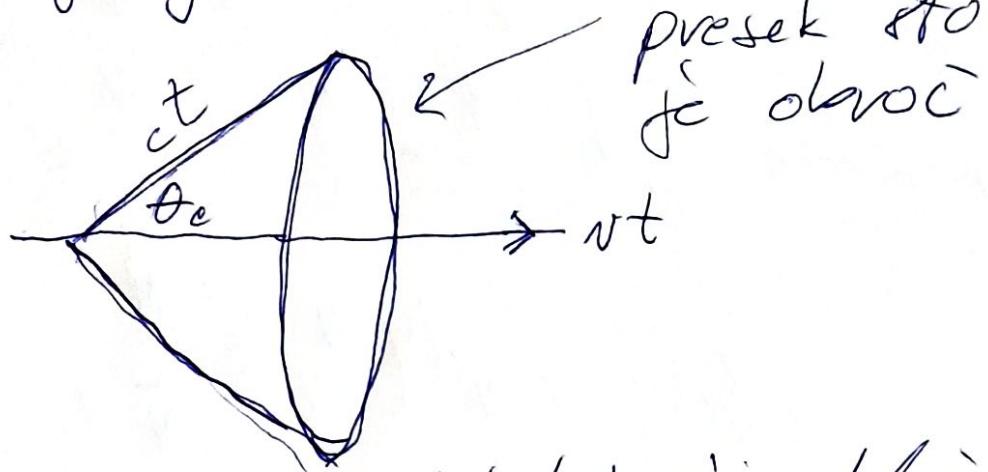
za dano št. fotouov pri
2x višji p potrebuje 4xL

\Rightarrow ~~taki~~ št. delovanje

takih števcer omogoča pri
visokih p (zgodobno kot za
štence časa preleta)

(6)

- měříci obročov čerenkova
(Ring Imaging Cherenkov Detectors - RICH)

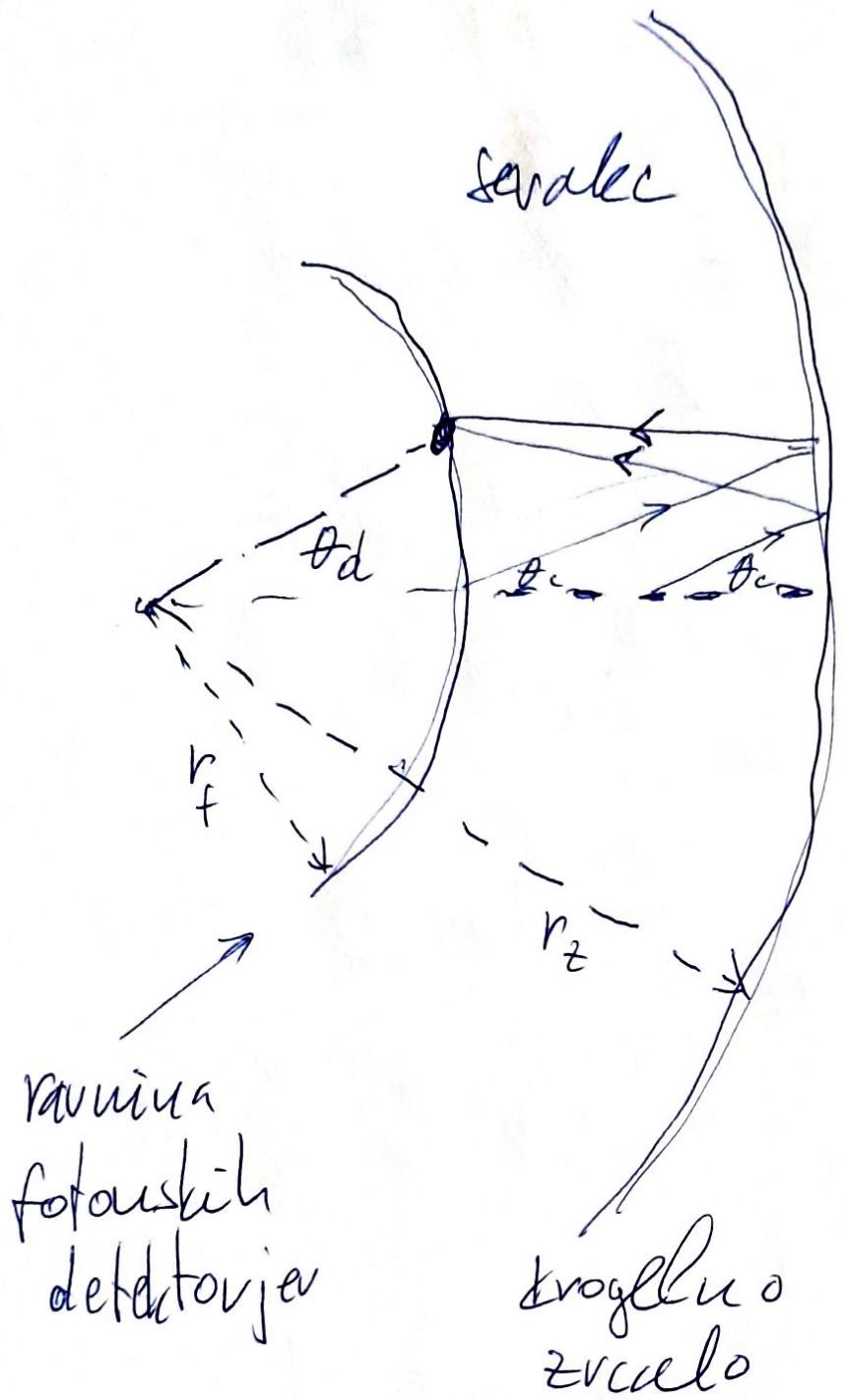


• takimi detektoryjí dosídamo
neposrednou θ_c , → tím pa
šířnost ($\cos \theta_c = 1/\beta u$).

technické závadky mohou
obstrukcijí nebo zvuku
položit fotonův $\leftrightarrow \theta_c$

Mpr.:

(7)



$$\text{če } r_f = \frac{1}{2} r_z \\ \Rightarrow \theta_i = \theta_c$$

Ravnina
fotoustih
detektorjev

kroglovo
zrcalo

Natancost detekcija mase
preko θ_c :

$$\cos \theta_c = \frac{1}{\beta n}$$

⑧

$$d(\cos \theta_c) = -\frac{d\beta}{\beta^2 m}$$

$$\beta \approx 1 - \frac{mc^4}{2c^2 p^2}, \quad d\beta = -\frac{c^4 m d m}{c^2 p^2}$$

$$d(\cos \theta_c) = \frac{c^4 m d m}{c^2 p^2}$$

$$\Gamma_{\cos \theta_c} = \frac{mc^4}{c^2 p^2} \Gamma_m$$

$$\Gamma_m = \frac{c^2 p^2}{mc^4} \Gamma_{\cos \theta_c}$$

\Rightarrow pri vysokih p so detekt.

RICH onejeli z reakciu s vysokimi
odločajmi θ_c .

(9)

Detektorji prehodnega svetja

Nabiti delci ob prehodu
meje med snovni in poljicini
in sevajo.

Prehod med snovnico

$$\text{z } \xi_{1,2} = \frac{\omega_{p1,2}^2}{\omega^2}$$

$$\omega_{p_{1,2}} \propto \sqrt{S_{1,2} \frac{t_{1,2}}{A_{1,2}}}$$

za delce z $\gamma \gg 1$

(ultrarelativistični) in za

$\xi_i \ll 1, \theta \ll 1$:

$$\frac{dW}{d\Omega d\theta} = \frac{d\theta^2}{\pi^2} \left[\frac{1}{\eta^{-2} + \theta^2 + \xi_1^2} - \frac{1}{\eta^{-2} + \theta^2 + \xi_2^2} \right]^2$$

(10)



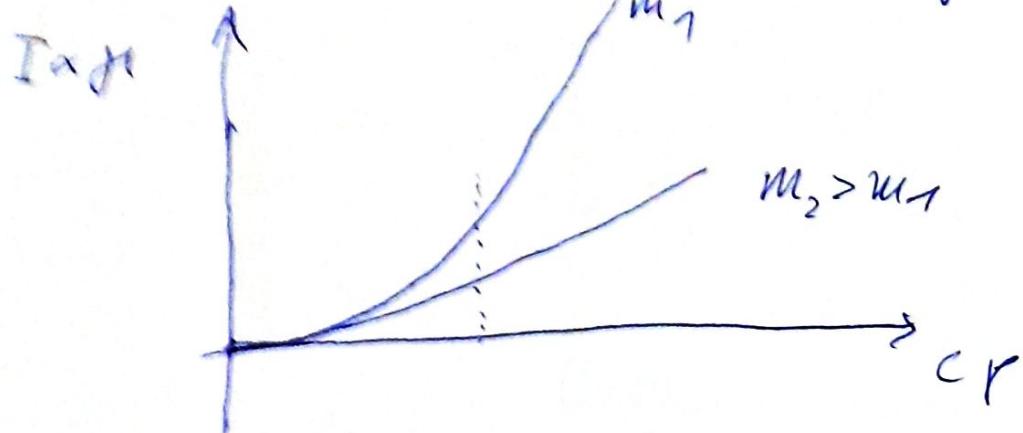
$$\uparrow \alpha \frac{1}{Jr}$$

$$\theta_{\max} \propto \frac{1}{Jr}$$

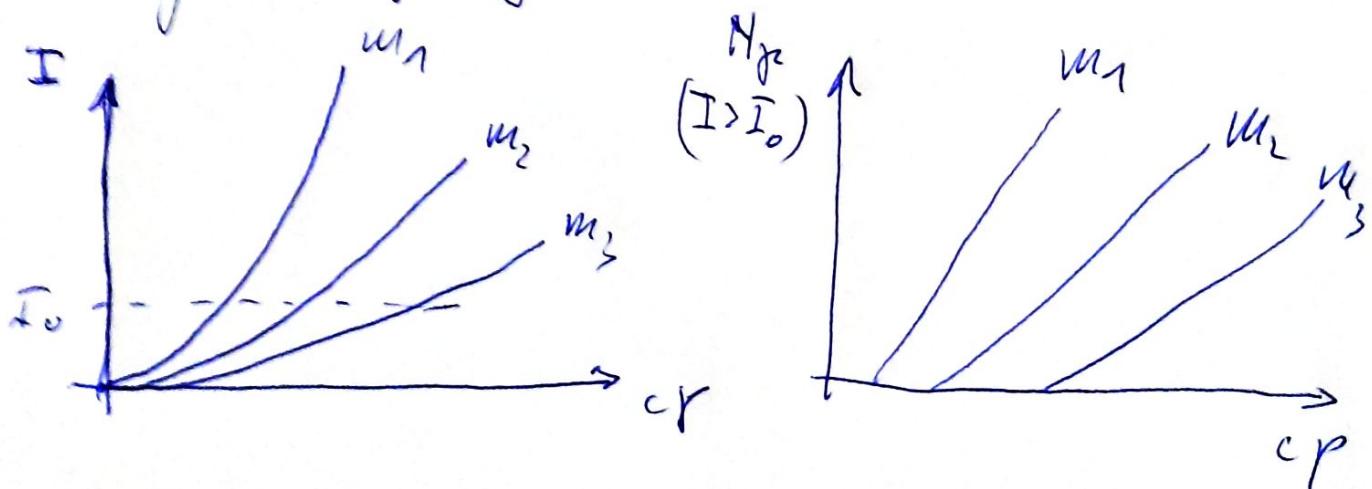
~~W~~ \propto α Jr

Tako prekodno sevanya $\hat{\theta}$
skoncentrirano na stozcu s
kotom $\frac{1}{Jr}$; intenziteta sevanya α Jr.

$$\mu = \frac{E}{mc^2} = \frac{\sqrt{(mc^2)^2 + (cp)^2}}{mc^2} \approx \frac{cp}{mc^2} \quad p \gg 1$$

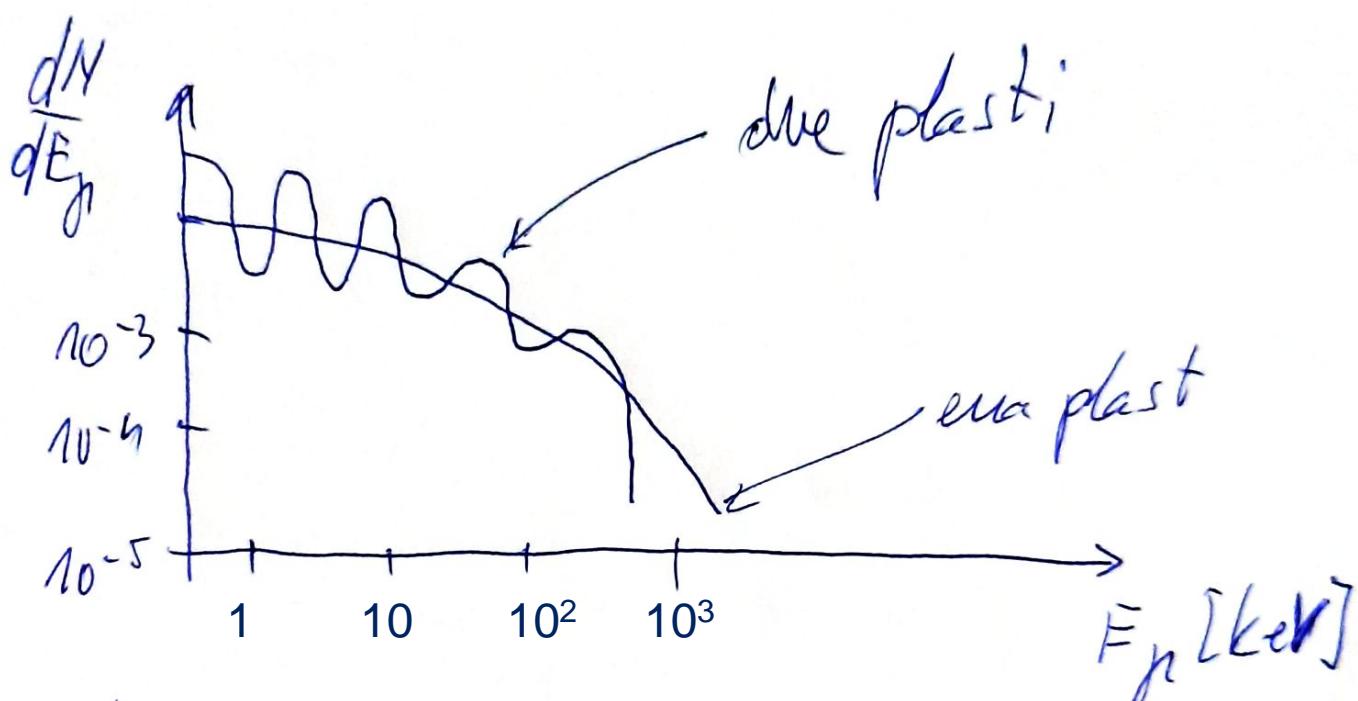


pri dati p delci \propto vijicu
 μ (nizja masa) vfectivnije
 tekojo \rightarrow pravovui stevec



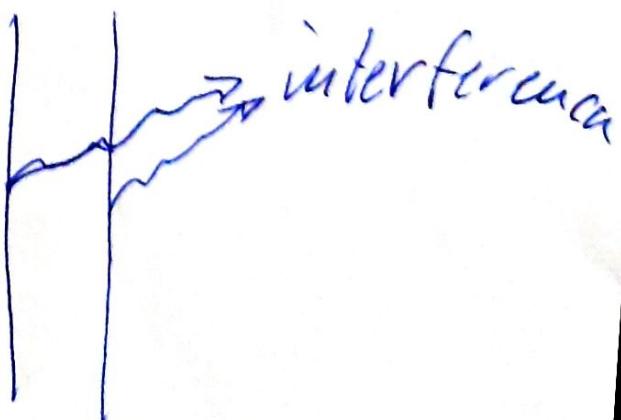
(11)

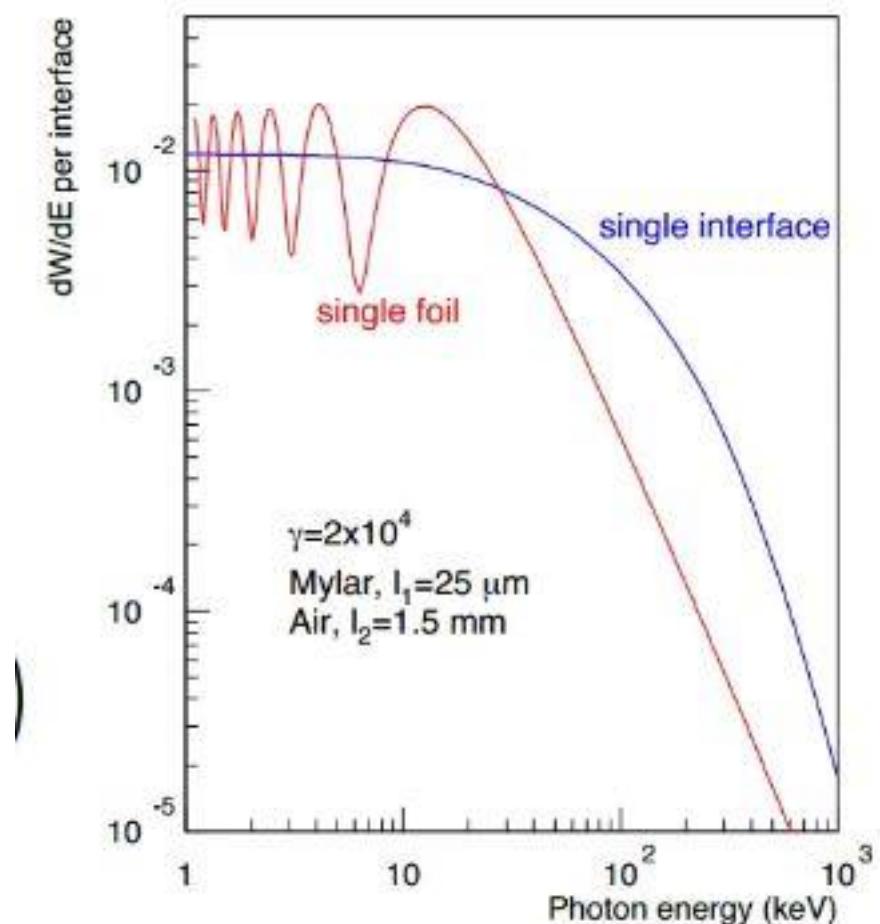
interferenčni efekt za
majhne debeline snovi
(folije,



fotoni izsevani na prvi
nejti interferirajo s listini iz
druge nejte

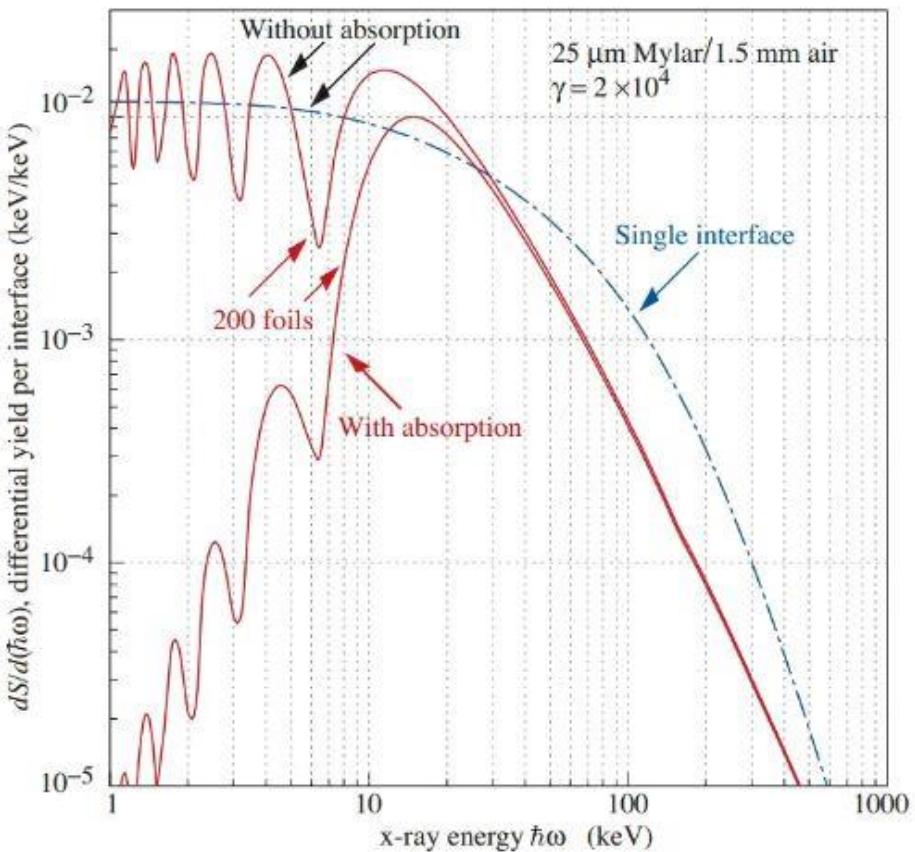
Izsevani fotoni se tudi absorbirajo
na nadaljnji poti skozi snov, skozi plasti
debeline $50 \mu\text{m}$ pride v povprečju
le 10^{-2} fotona.





$$\left(\frac{d^2W}{d\omega d\theta} \right)_2 = \left(\frac{d^2W}{d\omega d\theta} \right)_1 \times 4 \sin^2 \left(\frac{l}{2Z} \right)$$

$$Z = \frac{2\beta c}{\gamma^{-2} + \theta^2 + \xi^2}$$



$$\left(\frac{d^2W}{d\omega d\theta} \right)_s = \left(\frac{d^2W}{d\omega d\theta} \right)_2 \times \exp \left(\frac{1 - N_f}{2} \sigma \right) \frac{\sin^2(N_f \phi_{12}/2) + \sinh^2(N_f \sigma/4)}{\sin^2(\phi_{12}/2) + \sin^2(\sigma/4)}$$

$$\phi_{12} = \phi_1 + \phi_2 = l_1/Z_1 + l_2/Z_2$$