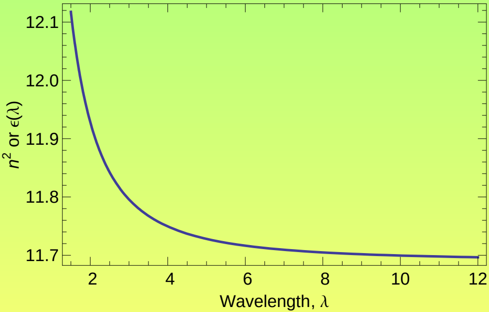
Silicon refractive index

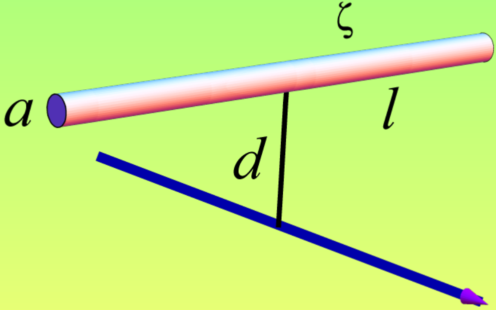
The dispersion producing the best fit to measurements at ambient room temperature (293 K) [D.F. Edwards, Silicon (Si). In: E.D. Palik, Editor, Handbook of Optical Constants of Solids, Academic Press Inc. (1985) pp. 547-569, ISBN 0-12-544420-6] with the following modified Sellmeier expression ($\epsilon = 11.7$, $\lambda_1 = 1.1\ \mu$m):

$$n^2(\lambda) = \epsilon + \frac{A}{\lambda^2} + \frac{B\lambda_1^2}{\lambda^2 - \lambda_1^2}$$



Approximations

Large value of $\epsilon \approx 12$ makes reasonably good a model of perfectly conducting metal. We assume a metal bar of radius a and length l located at a distance d from the beam orbit. If the bunch length $\sigma_z \gg d$, then the field on the bar is a slow function of time, and one can use electrostatic approximation to solve the fields.



Calculations

ζ is coordinate measured along the bar.
The potential generated at point ζ of the bar at time t is

$$\phi_B(t, \zeta) = 2\lambda_B(t) \ln \sqrt{d^2 + \zeta^2}$$

where λ_B is the charge per unit length of the bunch

$$\lambda_B(t) = \frac{Q}{\sqrt{2\pi}\sigma_z} e^{-t^2c^2/2\sigma_z^2}$$

This potential should be compensated by the image charge on the bar. $\Lambda(t, \zeta)$ is the charge per unit length of the bar. In the limit $a \ll l, d$, the potential generated by the image charge on the surface of the bar is

$$\phi_{im}(t, \zeta) \approx 2\Lambda(\zeta) \ln \frac{2l}{a} - \int_0^\infty d\zeta(\Lambda'(\zeta + \xi) - \Lambda'(\zeta - \xi)) \ln(\xi/l)$$

The sum of two potentials does not depend on ζ

$$\phi_{im}(t, \zeta) + \phi_B(t, \zeta) = \phi_0(t)$$

Solution

To solve the equation, neglect the integral. This introduces a relative error of order of $1/\ln(2l/a)$.

$$\Lambda(\zeta) = \frac{\phi_0 - 2\lambda_B(t)\ln\sqrt{d^2+\zeta^2}}{2\ln(2d/a)}$$

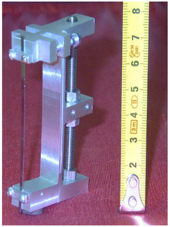
The constant ϕ_0 is found from the condition that the total charge on the bar is zero: $\int \Lambda(\zeta)d\zeta = 0$.
The electric field of the bar kicks the beam.
Further calculations will be numerical and require more specificity. I need better knowledge about d, a, l.

Geometry of the experiment

One of realizations of Strip-type bent crystals

This is IHEP device N1
for efficient (85%)
extraction

Small angle - few mrad
minimal material



Device N2 - big angle, long crystal.
Bent crystal parameters are: 150 mrad bend,
100 mm length and 12 mm width

Device N3 – strong curvature.
Big angle over short length.