Application of quadrupole lenses systems for shaping the high intensity neutrino beams

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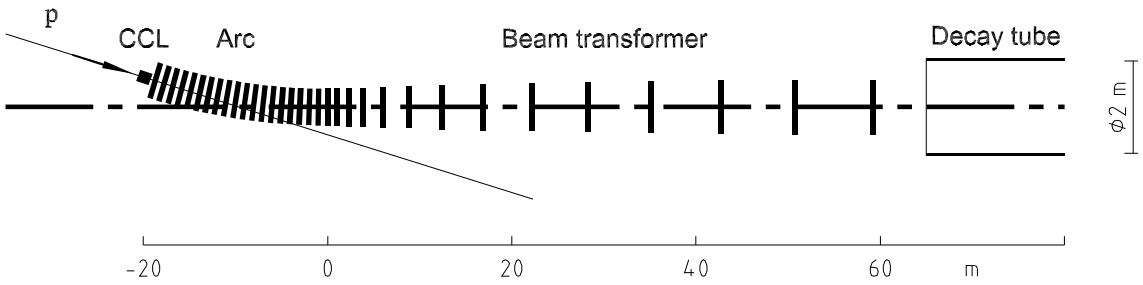
The channel structure

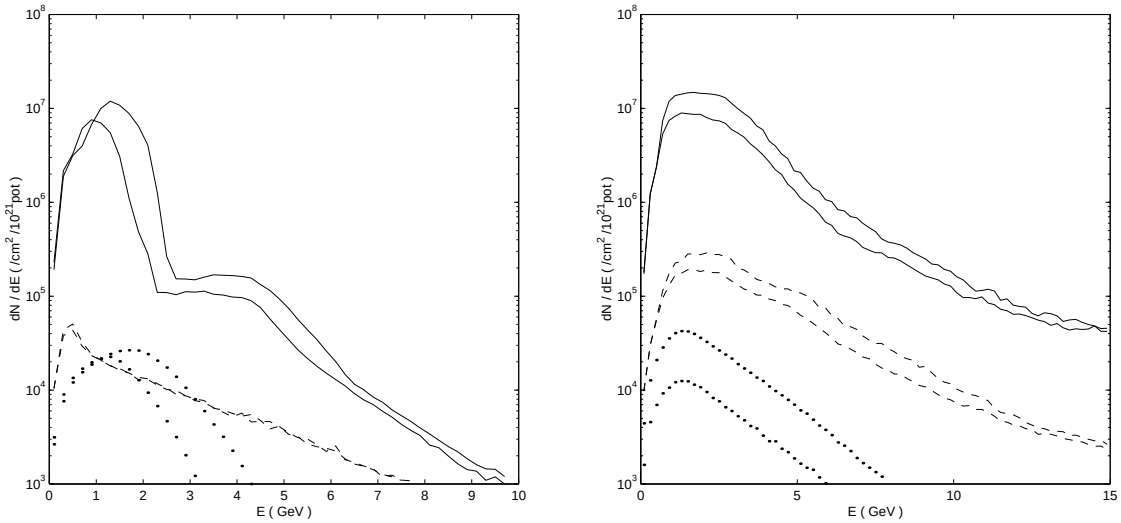


CCL: the current coaxial lens with target (may be considered as a high intensity secondary particles source of single charge sign with relatively small angular and linear sizes);

Arc: the densely packed FD -structure with the displaced quadrupols (bends of the seconary paticales beam);

Beam transformer: the slowly changed FD -structure (reduces of the secondary paticales beam angular sizes).

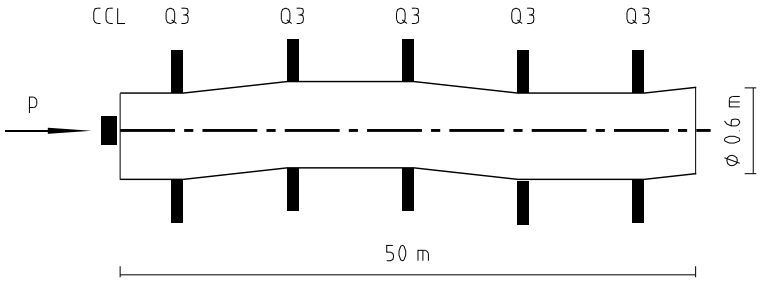
The channel at protons energy of 50 GeV



ν -spectra: ν_μ -solid lines, $\tilde{\nu}_\mu$ -dashed lines, ν_e -points:
on the left) the channel with arc ($< p_\pi >$ = 2 GeV/c and 3 GeV/c),
on the right) the direct channel (decay space L=120 m and L=60 m).

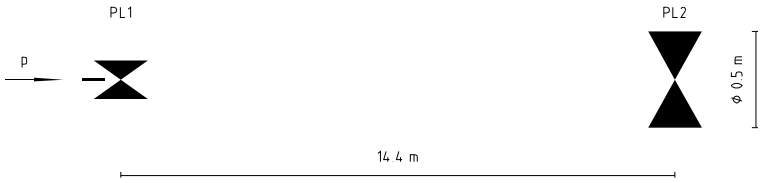
	$\tilde{\nu}_\mu/\nu_\mu$	ν_e/ν_μ
channel with arc:$< p_\pi >$=2 GeV/c	0.0059	0.0039
channel with arc:$< p_\pi >$=3 GeV/c	0.0038	0.0030
direct channel(without arc):L=120 m	0.0240	0.0025
direct channel(without arc):L=60 m	0.0273	0.0012

The direct channel with FD -structure decay space

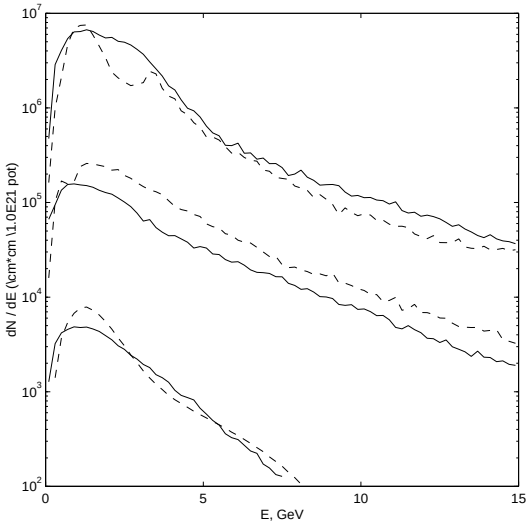


The quadrupole lenses channel

In this channel $\nu_e/\ \nu_\mu$ -flux ratio can be reduced with the help of sinusoidal bending of the decay FD -structure with amplitude A.

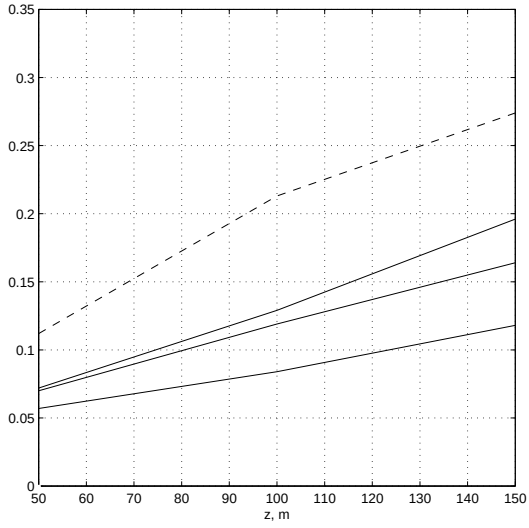


The parabolic lenses channel (Protvino)



ν_μ, $\tilde{\nu}_\mu$, ν_e -spectra

(z=50 m, A=40 mm)

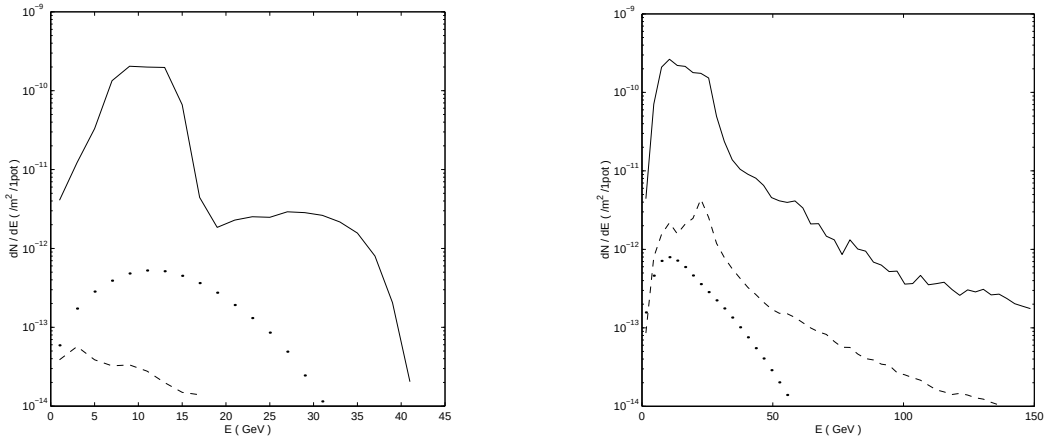


$\nu_e/\ \nu_\mu$ -flux ratios

(A=0, 40, 80 mm)

solid line -the quadrupole lenses channel (l = 1 m, G = 0.1 kGs/cm), dashed -the parabolic lenses channel (I1 = 320 kA, I2 = 230 kA).

The channel at protons energy 450 GeV



ν -spectra: ν_μ -solid lines, $\tilde{\nu}_\mu$ -dashed lines, ν_e -points:
on the left) the channel with arc ($< p_\pi > = 26$ GeV/c),
on the right) the direct channel (without arc).

	$\tilde{\nu}_\mu/\nu_\mu$	ν_e/ν_μ
channel with arc:$< p_\pi >$=26 Gev/c	0.0003	0.0037
direct channel(without arc)	0.0139	0.0033

The maked analysis shows, that the proposed optical schemes of the neutrino channels with quadrupoles

have the wide possibilities for its optimization,

can be used in the wide energy range,

are quite competitive with respect to the standard channels with horns.

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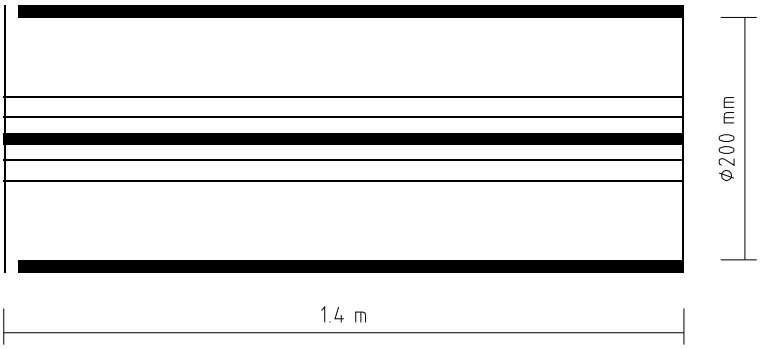
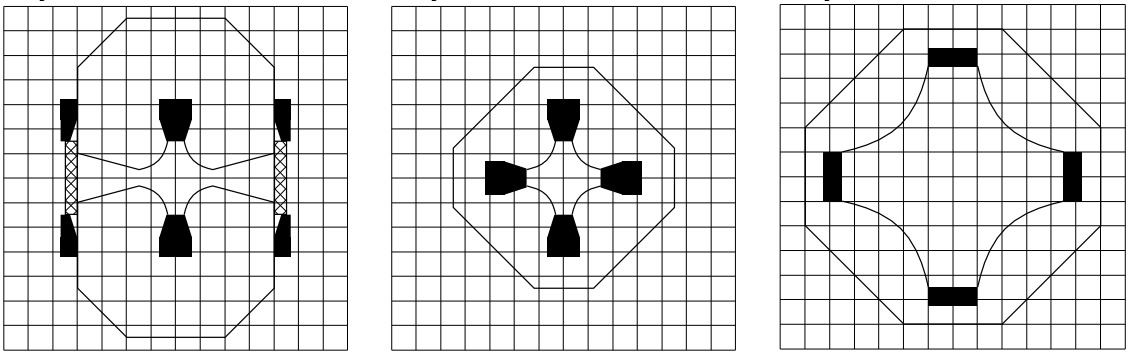
The current coaxial lens with target



	l m	r mm	δr mm	I kA
target	1.4	5		10
tube1	1.4	17	1.0	100
tube2	1.4	34	1.0	200
casing	1.4	100		

The special quadrupole lenses

Q1 **Q2** **Q3**



	Q1	Q2	Q3
Radius of the aperture, mm	100	100	300
Overall dimensions, mm×mm	900×1300	900×900	1200 ×1200
Weight, t/m	6.4	3.9	4.9
Gradient, kGs/cm	0.8	0.8	0.08
Current, kA	33	32	29