CNGS target optimization: first simulation results

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- Target heating
- Particle yields
- Neutrino event rates at GS

- Beam size
- Target size and configuration
- Target material

All simulations done with the latest version of FLUKA

FIRST ITEM : WHICH BEAM SIZE ?

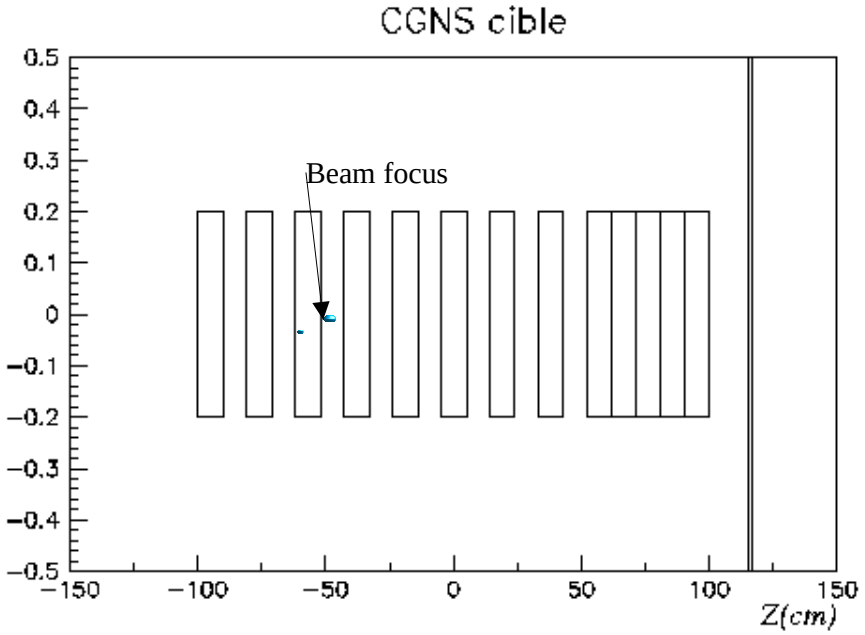
$\sigma = 0.26$ or $\sigma = 0.53$ mm ?

Consider :

- Target heating , mechanical stresses
- Neutrino production — Relative comparison ; π^+ and K^+ yield and spectra are good estimators

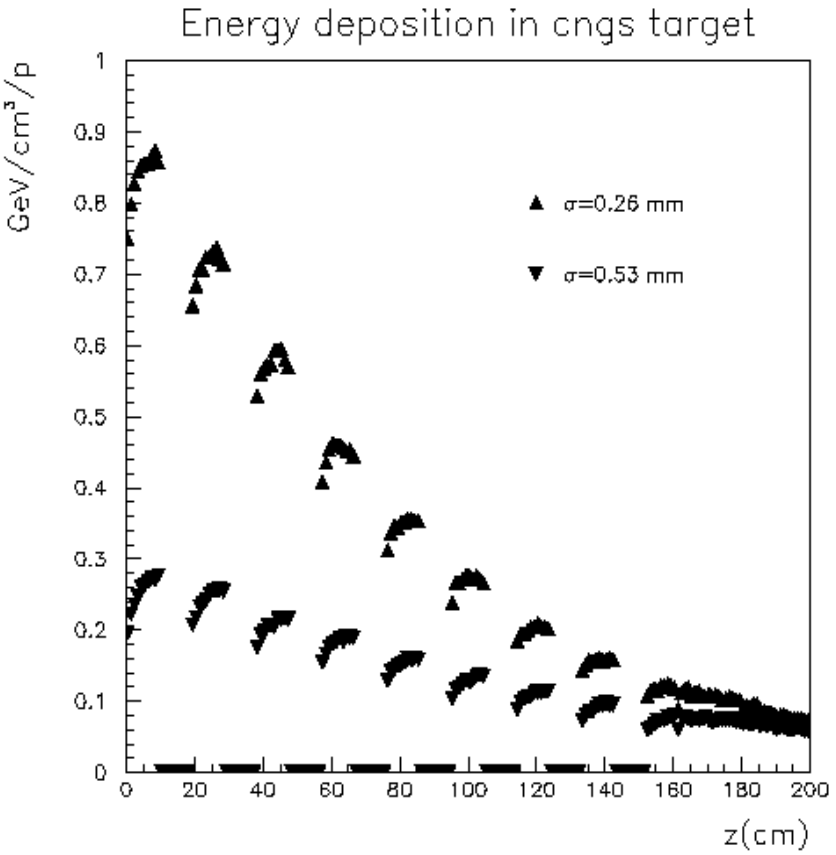
Standard CNGS target :

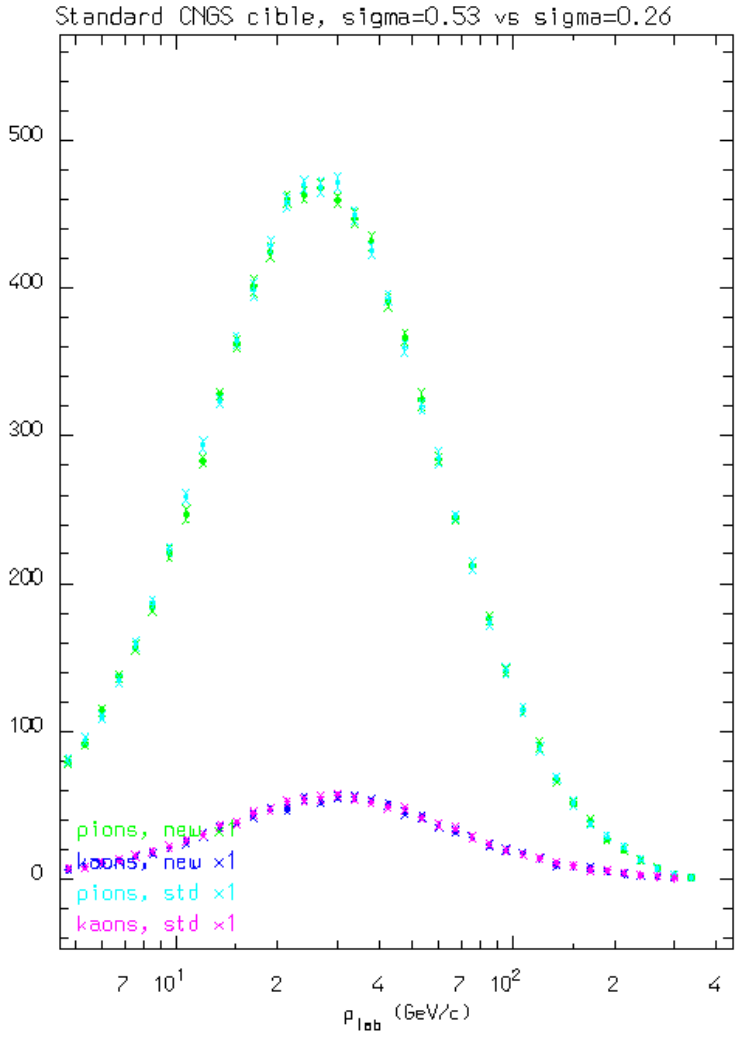
13 Graphite bars, ∅ 4 mm, total length 2000. mm , Carbon l. 1261 mm



Result : particle production and beam losses are identical

Peak energy deposition is lower by a factor 3

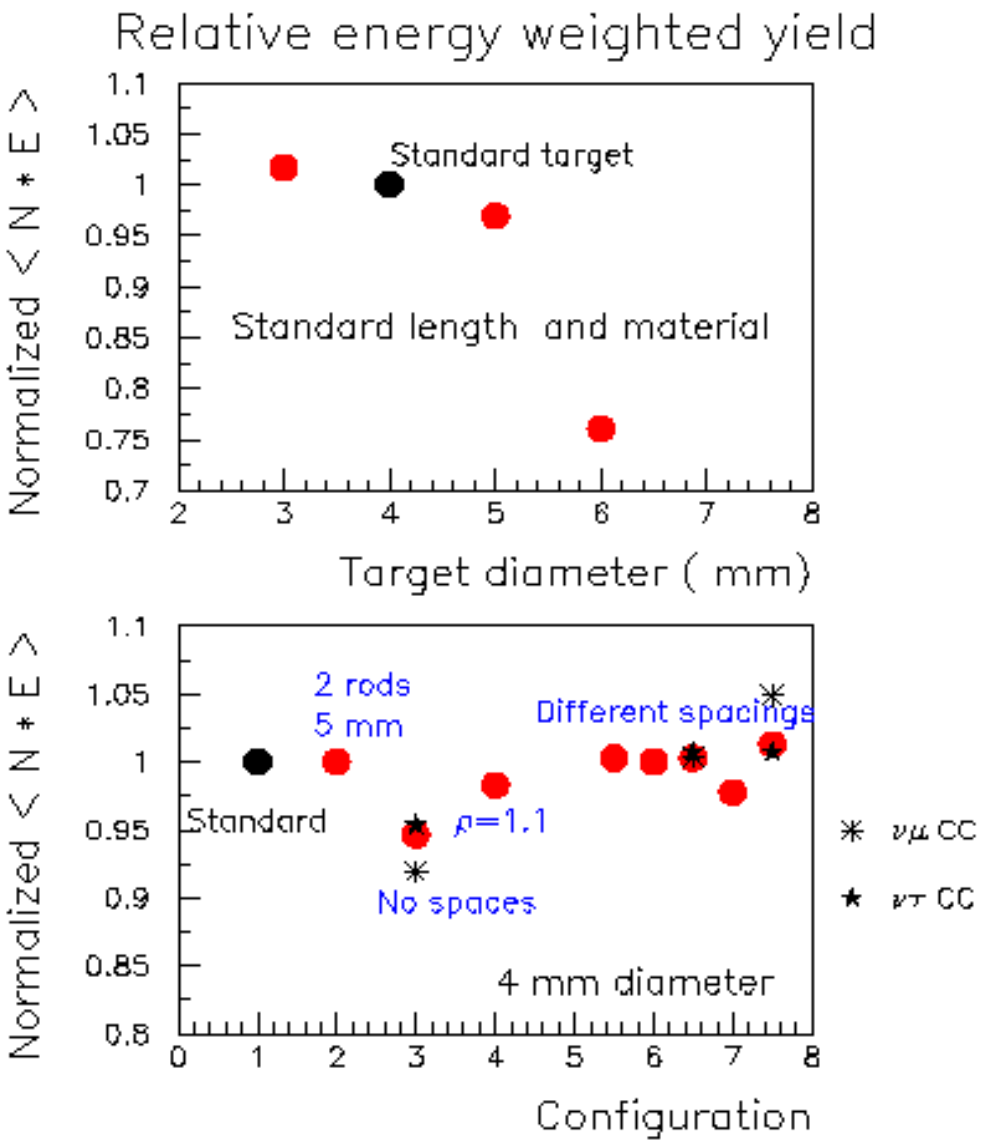


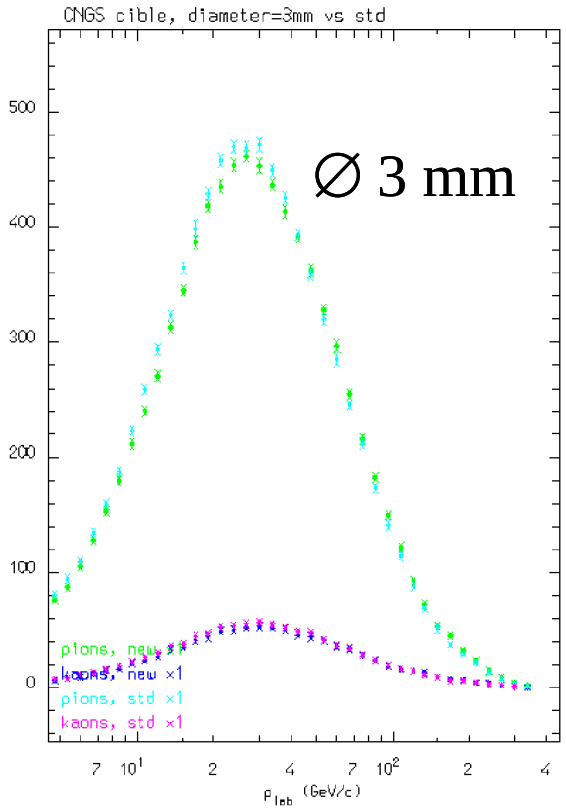


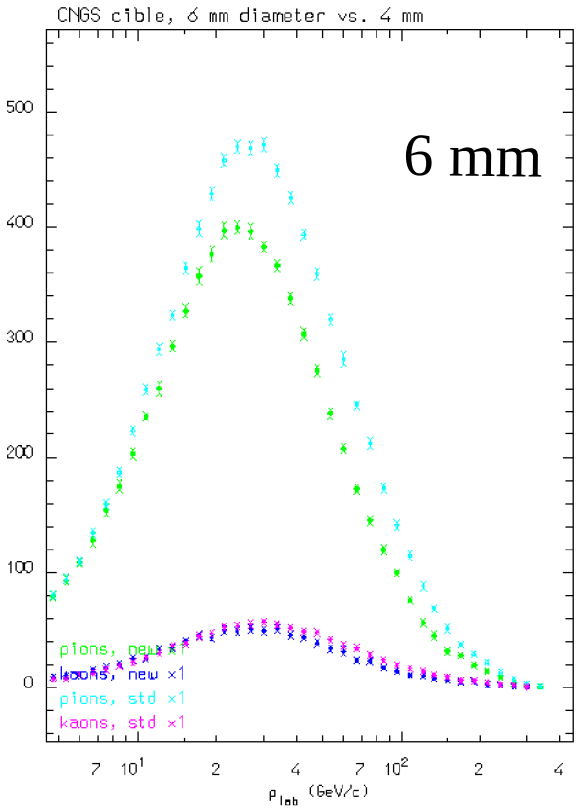
ν_μ CC rate : $\frac{R(0.53)}{R(0.26)}$ =1.005 ±1%

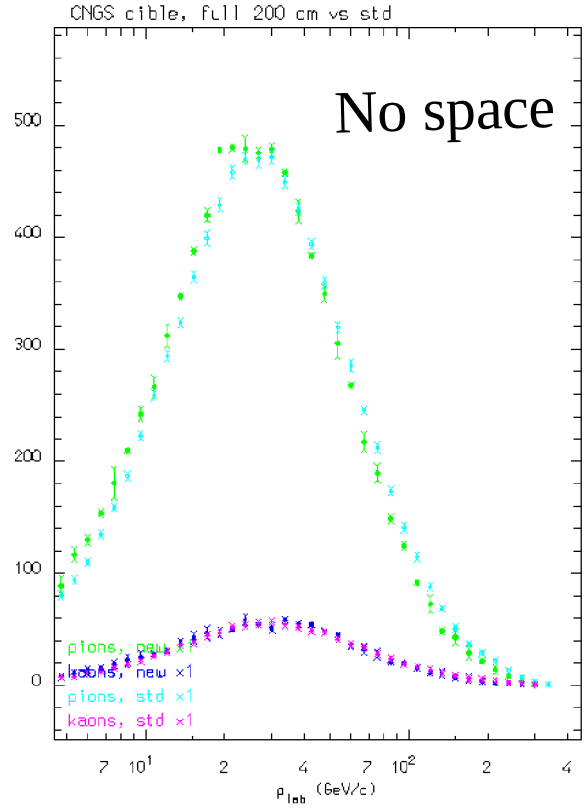
Varying target diameter , spacing, density : yield normalized to standard one

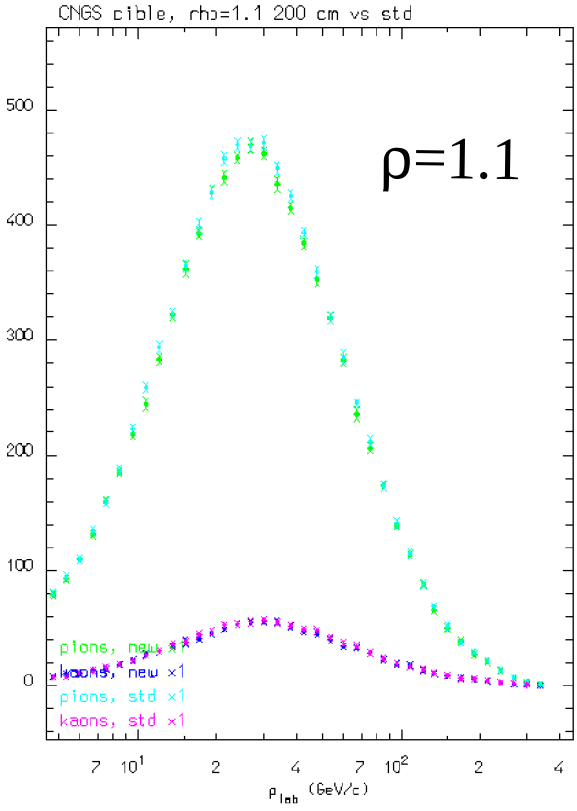
Beam size has no effect on particle yield (if fully contained)



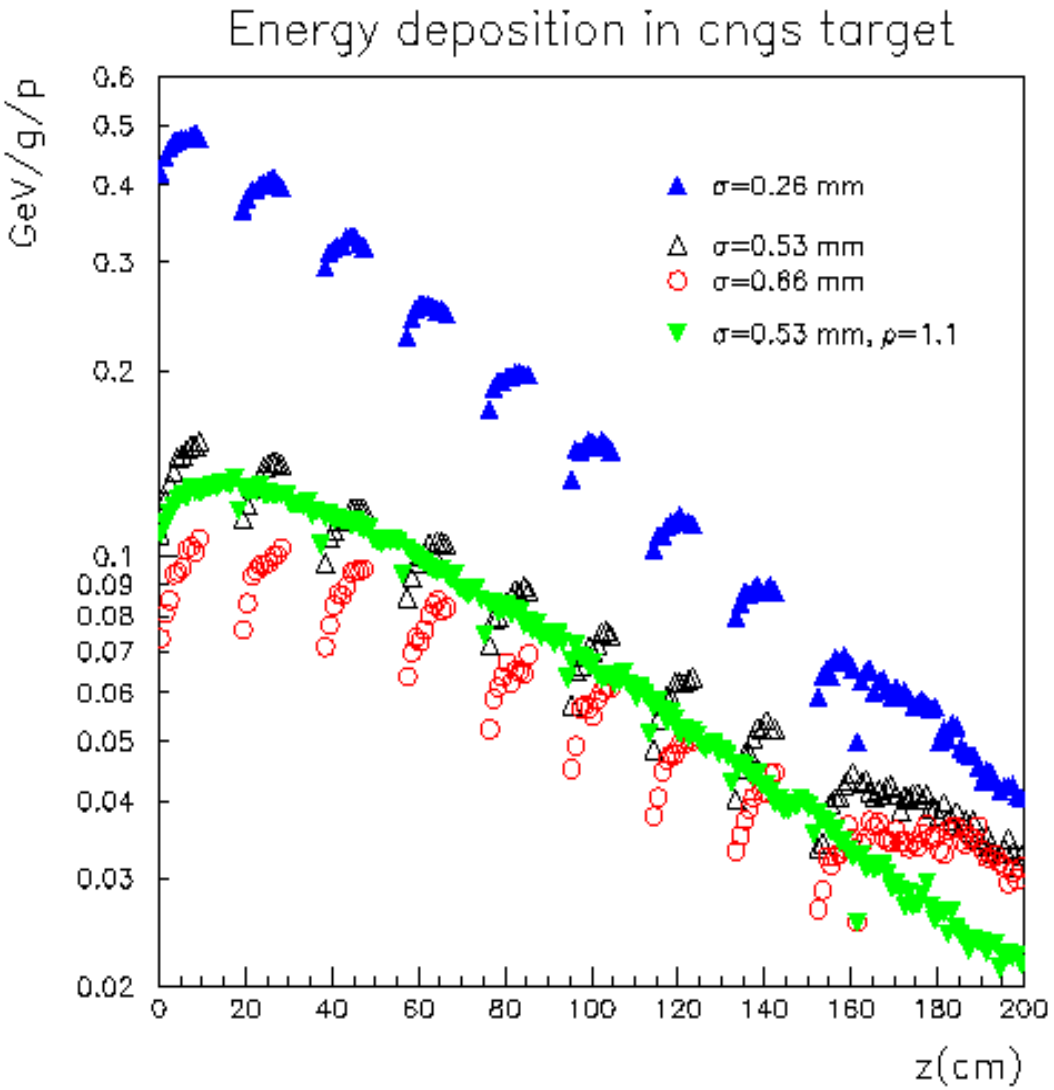

CNGS cible, diameter=3mm vs std
∅ 3 mm
pions, new
kaons, new ×1
pions, std ×1
kaons, std ×1
p_{lab} (GeV/c)


CNGS cible, 6 mm diameter vs. 4 mm
6 mm
pions, new
kaons, new ×1
pions, std ×1
kaons, std ×1
p_{lab} (GeV/c)


CNGS cible, full 200 cm vs std
No space
pions, new
kaons, new ×1
pions, std ×1
kaons, std ×1
p_{lab} (GeV/c)


CNGS cible, rho=1.1 200 cm vs std
ρ=1.1
pions, new
kaons, new ×1
pions, std ×1
kaons, std ×1
p_{lab} (GeV/c)

To gain in temperature: broader beam or lighter material



SUMMARY

Target diameter : ≤ 5 mm , unless needed to gain intensity

(first two rods can safely go to 5 mm)

Beam σ : As large as possible, effects of non−gaussian tails,
imperfect alignment, beam instability,
to be carefully estimated

Target structure : present segmentation OK for standard graphite
(broad maximum)

Target density : Lighter (1.1) graphite of 97 % equivalent length gives
Lower (85 %) energy deposition

1.7 % less yield

Supports to be investigated

Target material ..new ideas..

Possibility of multiple targets

Effect on ν_μ Rate

Effect on background events

→ Full simulation (reference CNGS optics)

Very long runs (background is at the % level with respect to signal)

Double target, 4 mm diameter, at 20 mm inter−axis distance

Event rate at GS (Evt/kTon/10^{19}pot ν_μ within 120 m, ν_e within 400m)

	STD	2 TG	Error	Δ(%)
ν μ	570	569	0.28%	−0.18
νe	4.26	4.45	2.40%	4.46
a νe	0.3	0.31	3.70%	3.33
a νμ	11.2	11.5	2.40%	2.68