



The 8th International Conference
Charged & Neutral Particles Channeling Phenomena

CHANNELING 2018

September 23 - 28, 2018 Ischia (NA), Italy

High-energy e⁻/e⁺ spectrometer via
coherent interaction in a bent crystal

E. Bagli¹, A. Howard²

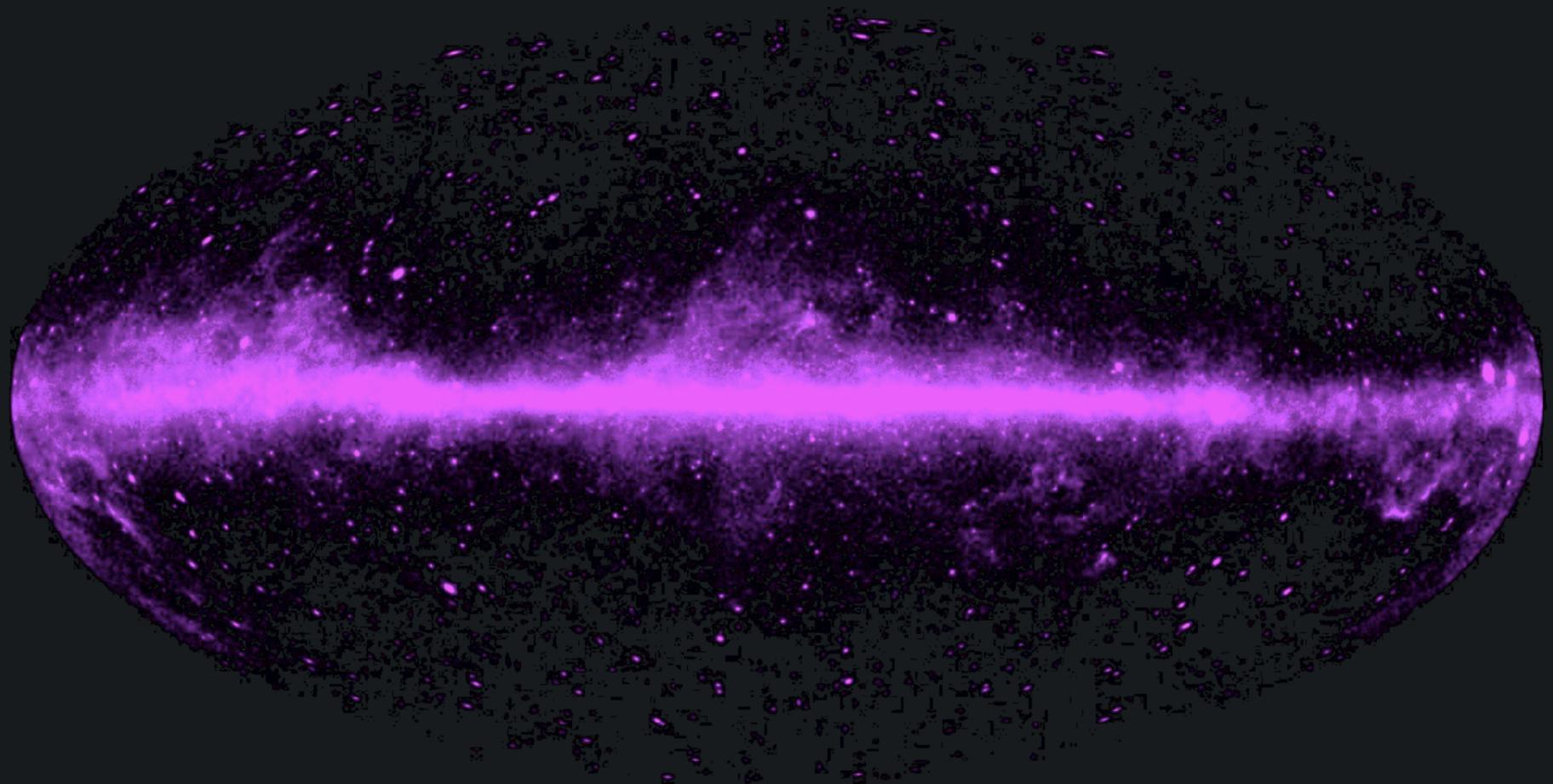
¹ INFN Sezione di Ferrara, Via Saragat 1, Ferrara, 44121, Italy

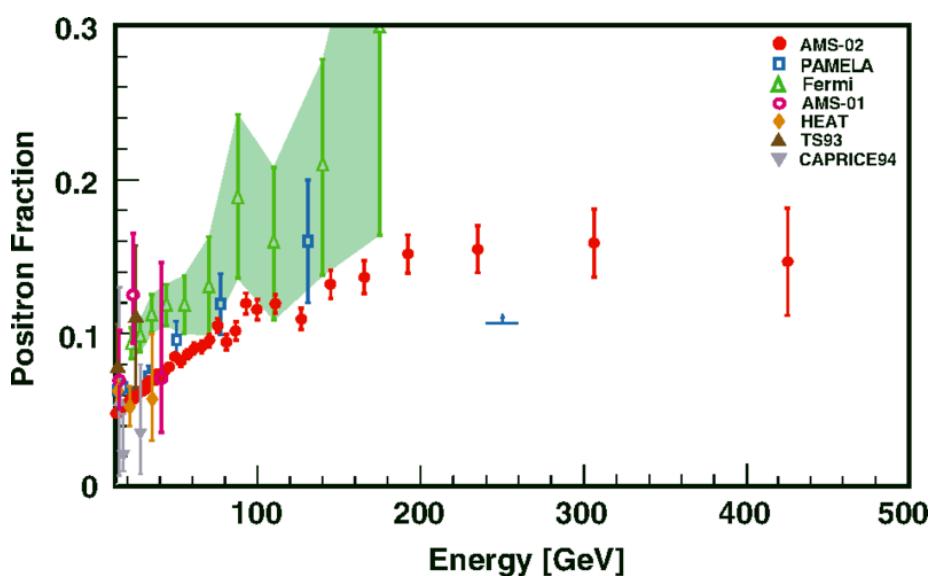
² Imperial College London, London SW7 2AZ, U.K.



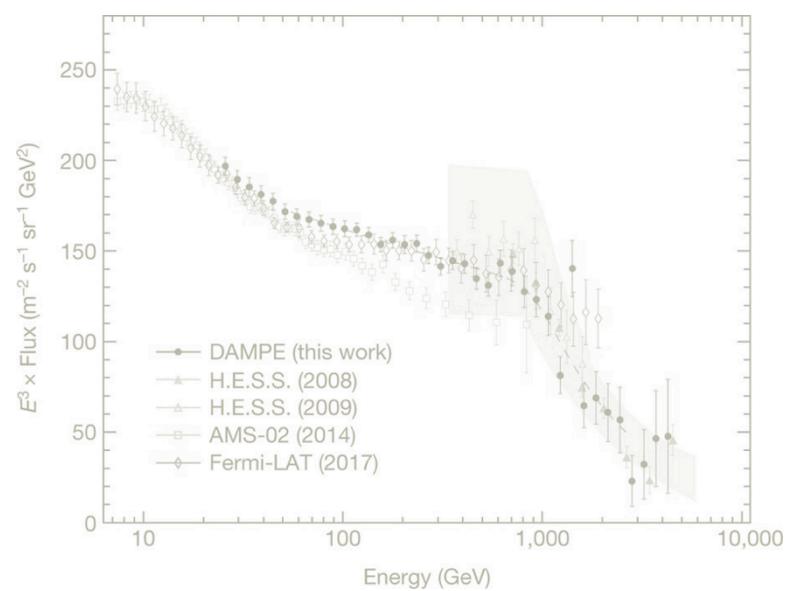
27 September 2018

Charged & Neutral Particles Channeling Phenomena Channeling 2018

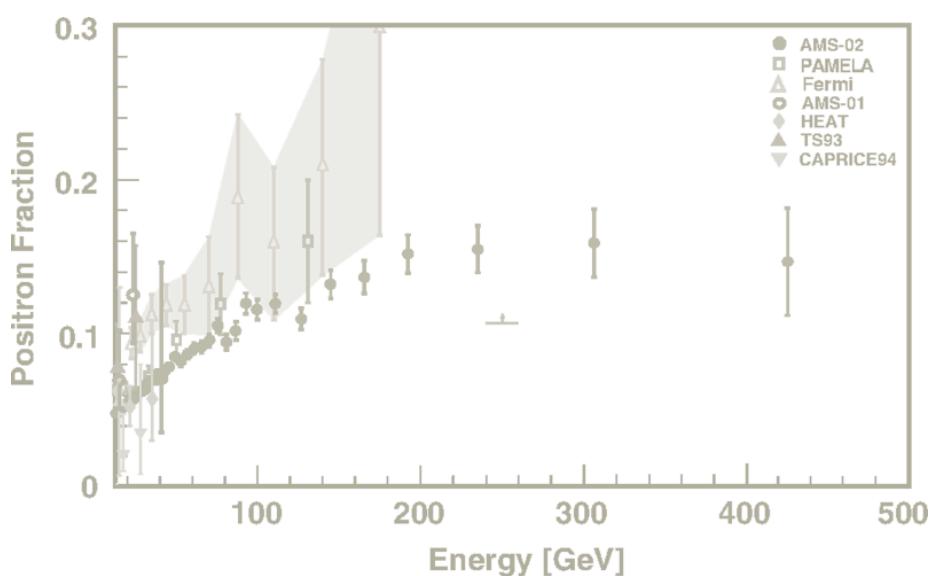


AMS Collaboration, Phys. Rev. Lett. **113**, 121101

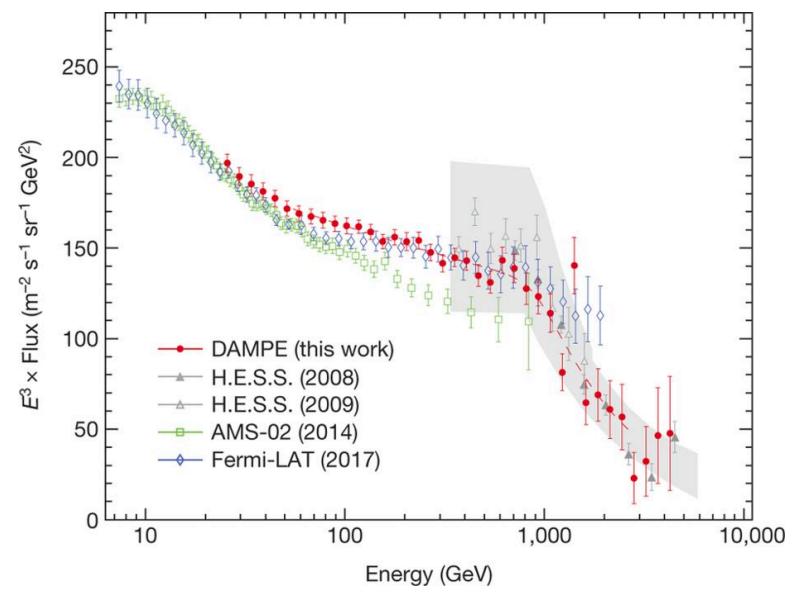
Positron Flux Excess

DAMPE collaboration, Nature **552** (2017) 63

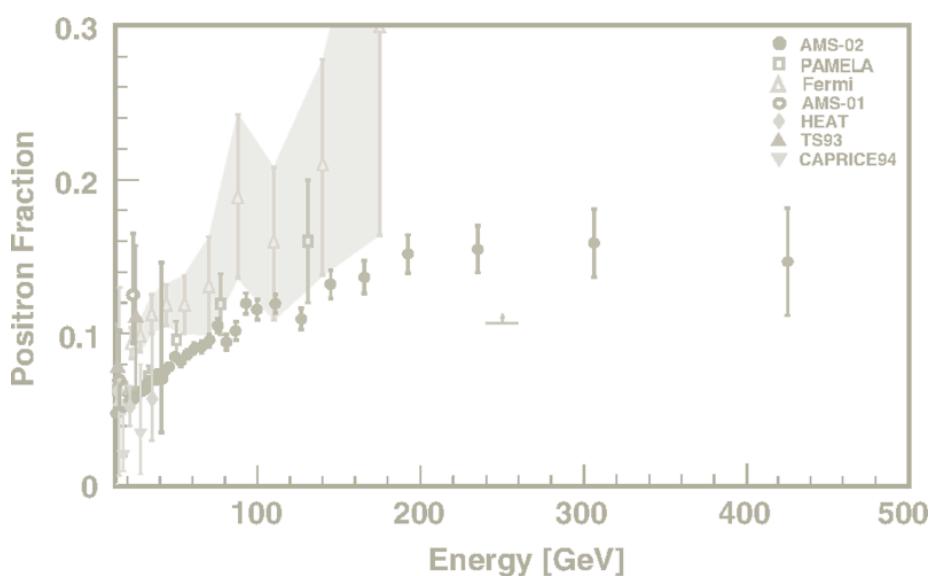
Positron+Electrons Excess

AMS Collaboration, Phys. Rev. Lett. **113**, 121101


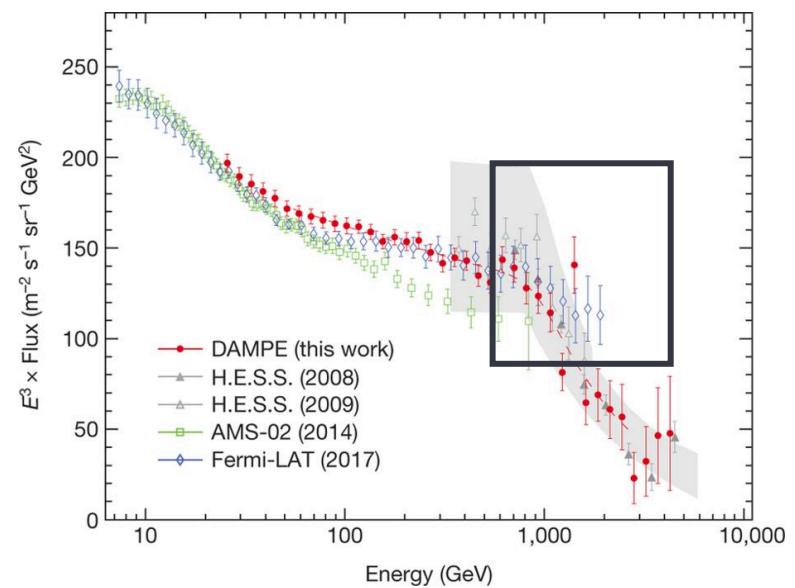
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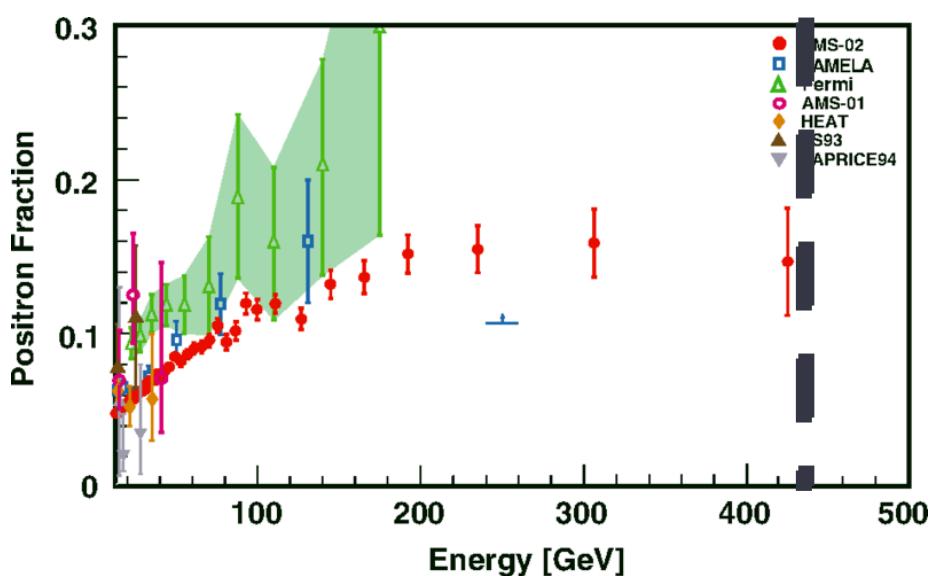
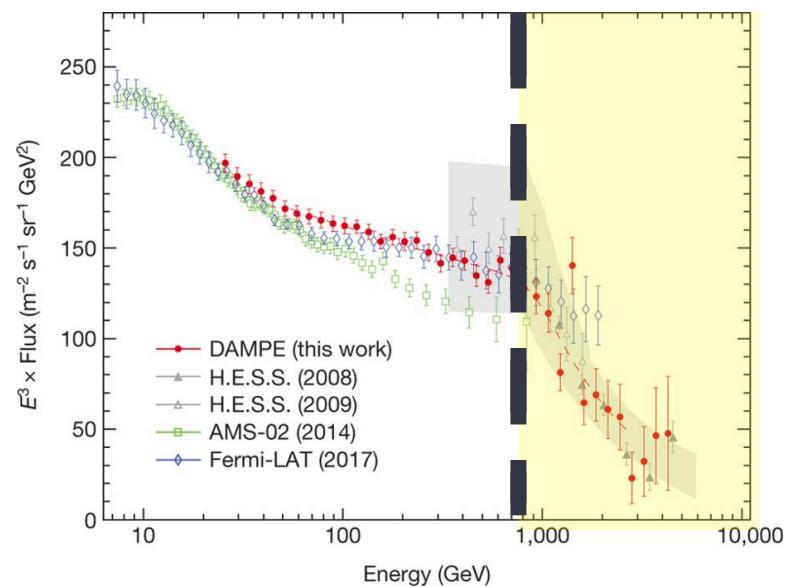
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Positron Flux Excess

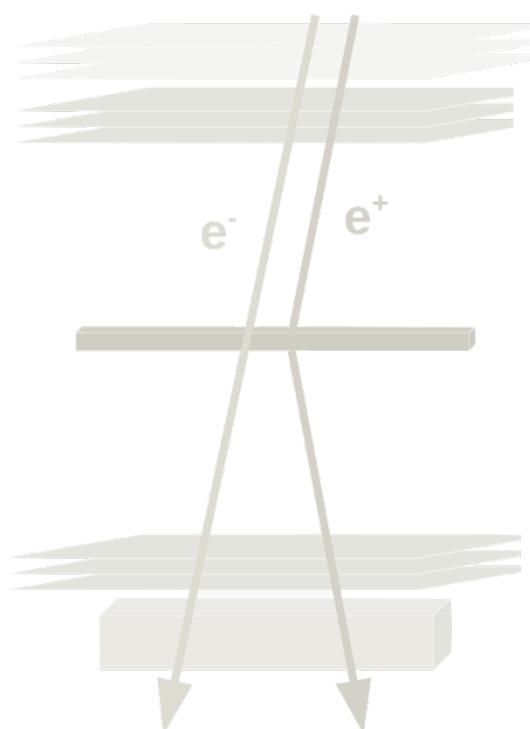
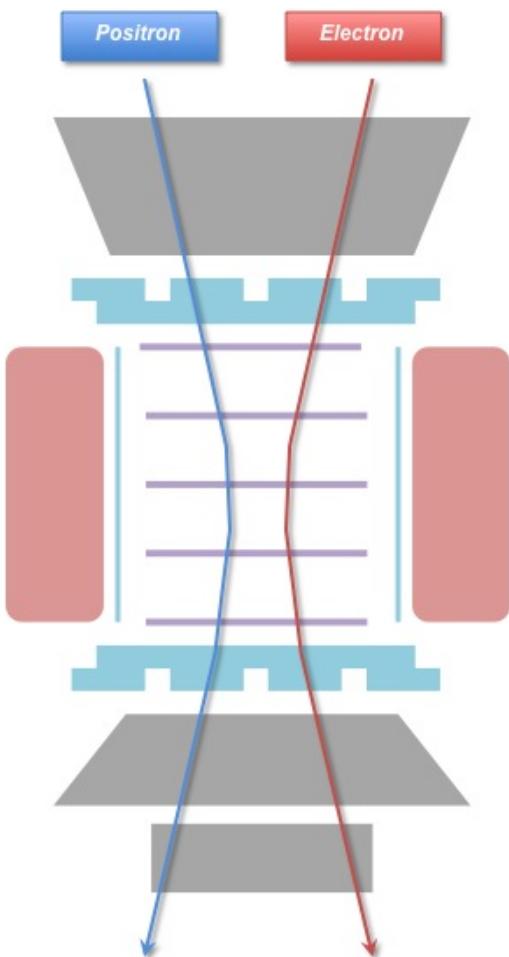
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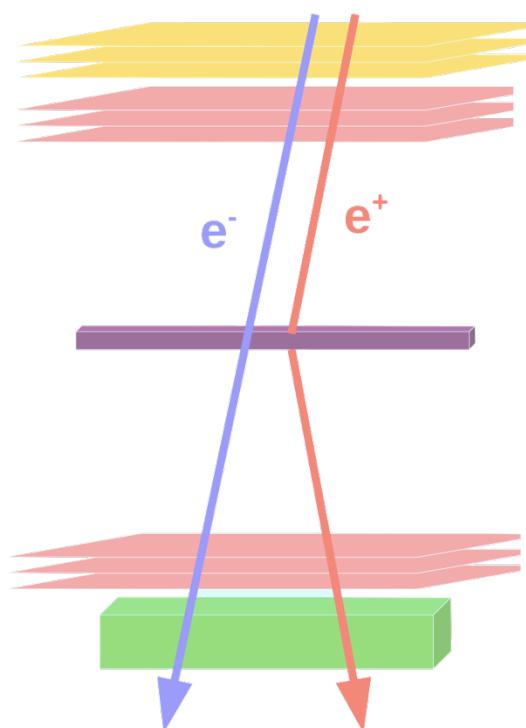
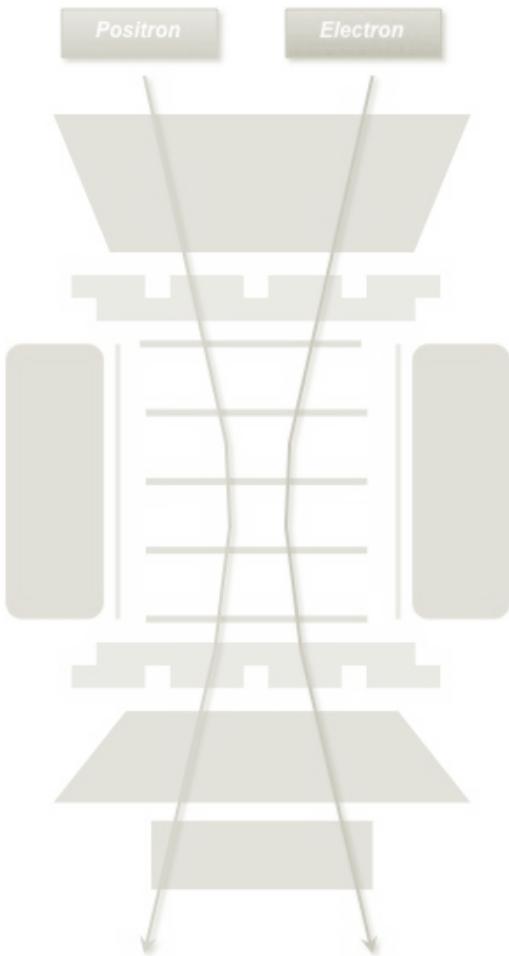
unexplored region for
positron excess!

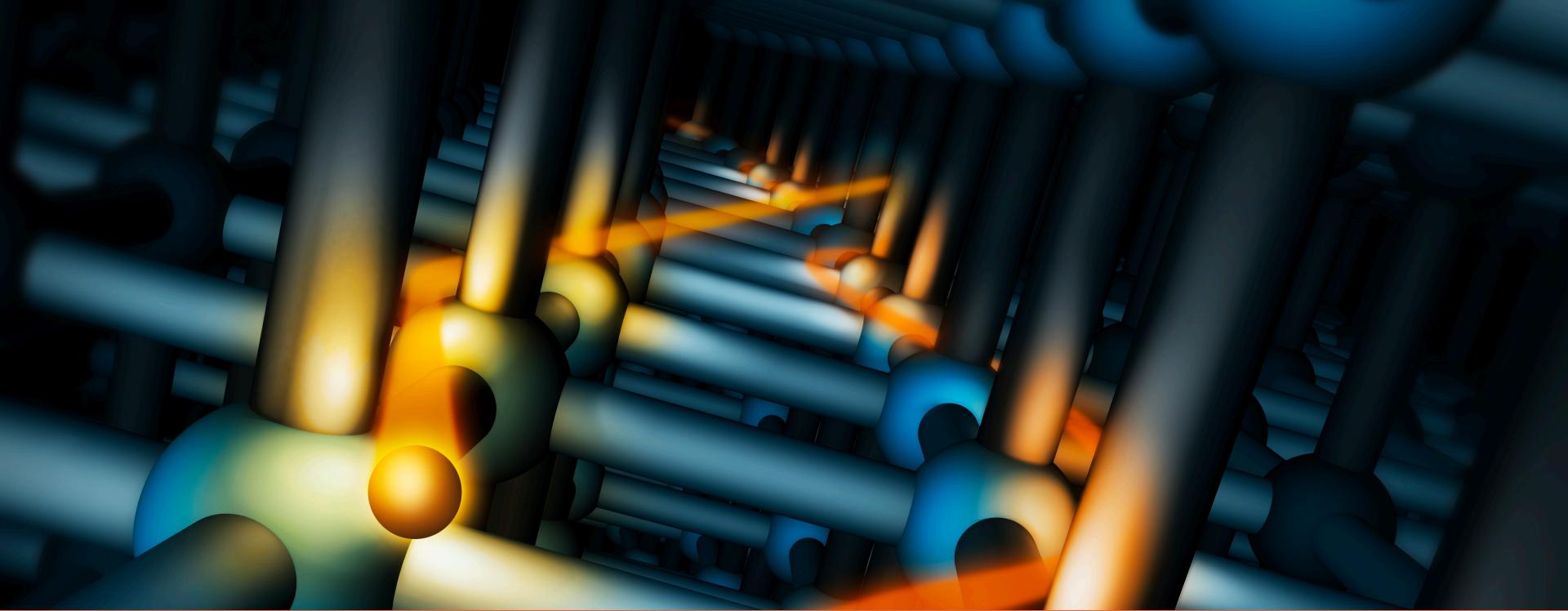
can a Tesla/m magnet being replaced by 1 cm bent crystal?





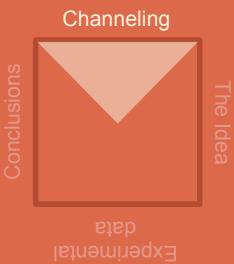
can a Tesla/m magnet being replaced by a cm-long crystal?





CHANNELING

Entrapment of charged particles by the ordered pattern of crystalline atoms





Key Ingredients

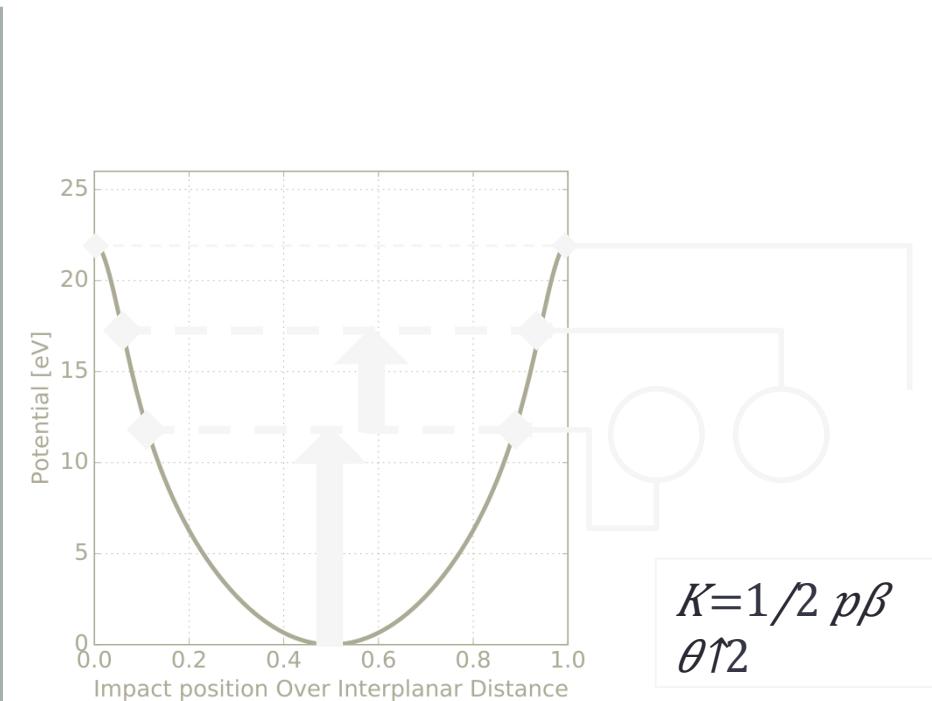
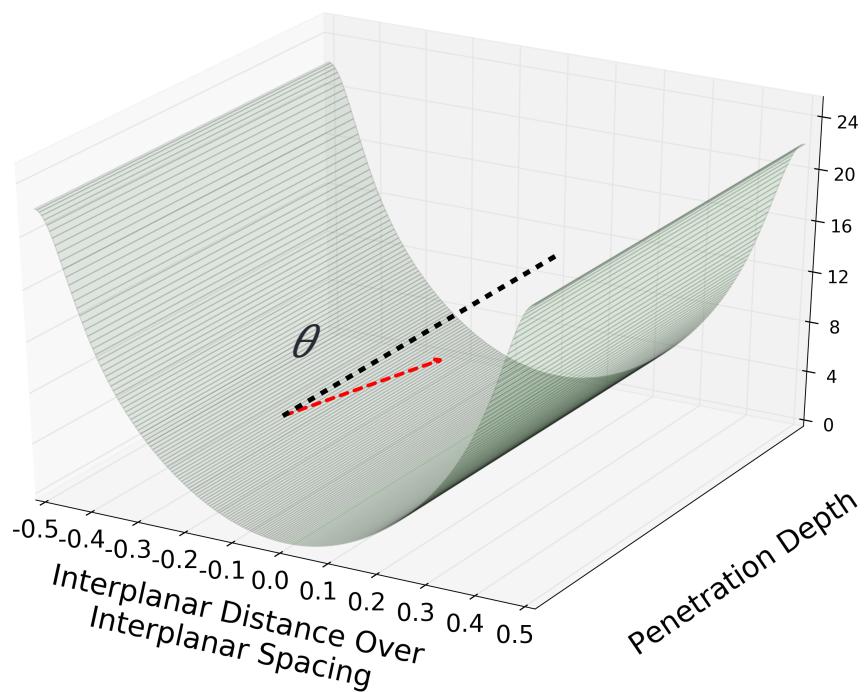
1. Maximum Angular Acceptance
2. Maximum Deflection Angle
3. Maximum Deflection Efficiency



Key Ingredients

1. Maximum Angular Acceptance
2. Maximum Deflection Angle
3. Maximum Deflection Efficiency

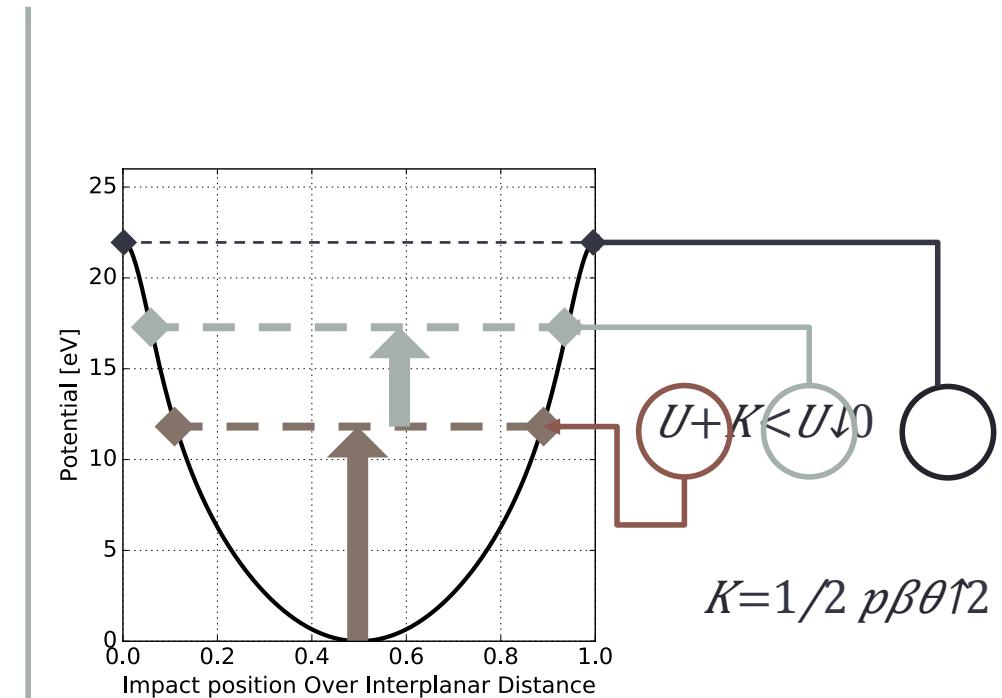
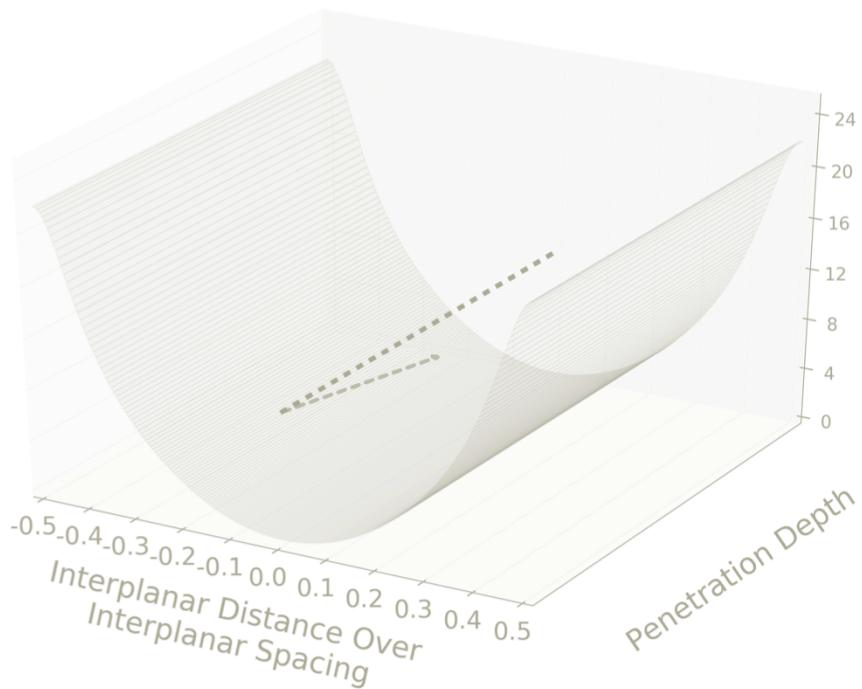
1. Maximum Angular Acceptance



$$K = \frac{1}{2} p\beta$$
$$\theta_{12}$$

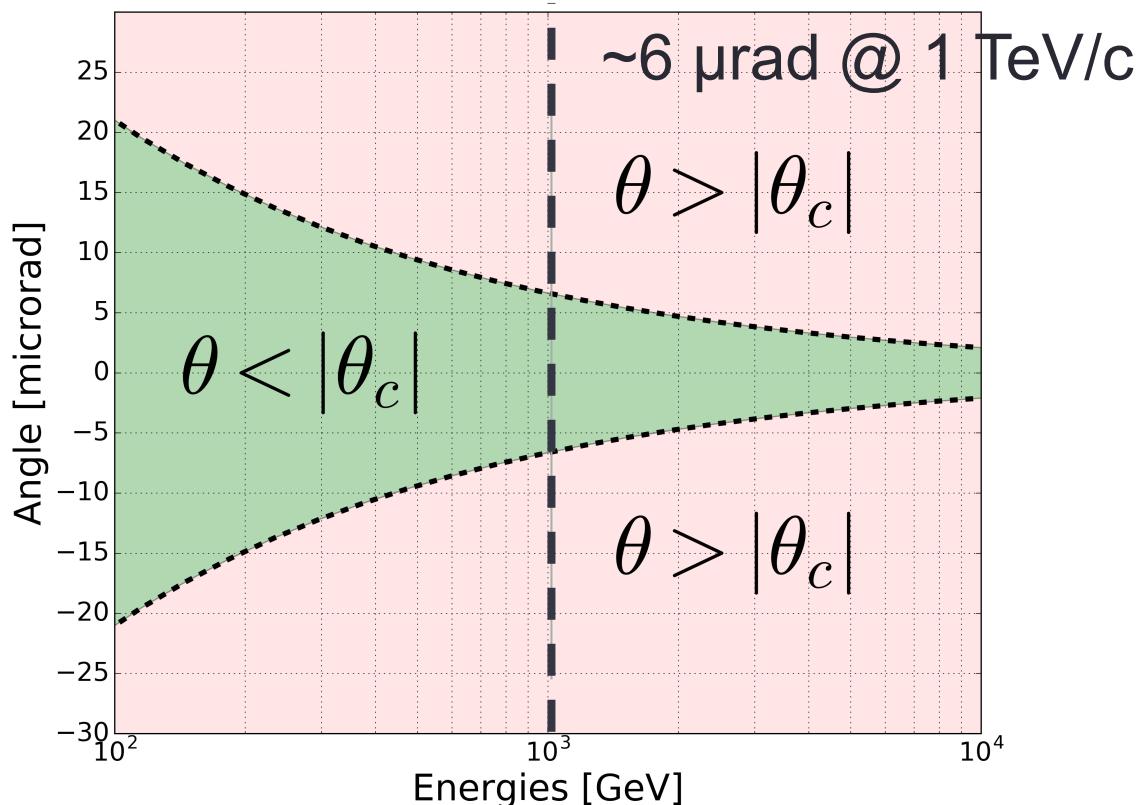


1. Maximum Angular Acceptance





1. Maximum Angular Acceptance



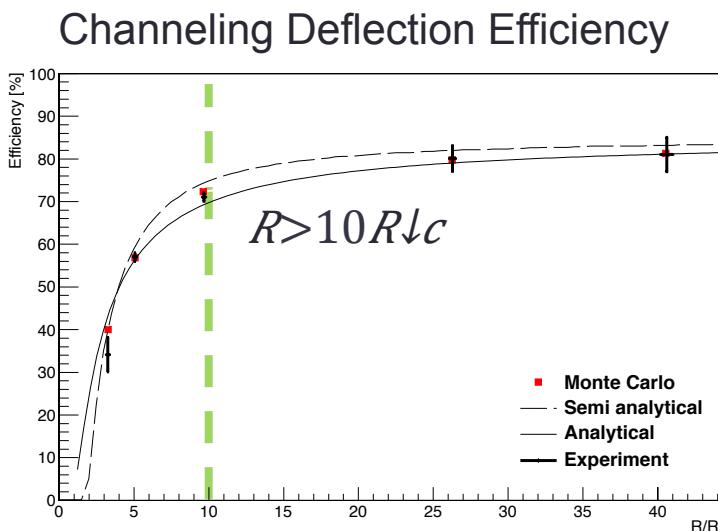
$$|\theta| < \theta_{lc} = \sqrt{2} U_{l0} / p\beta$$



Key Ingredients

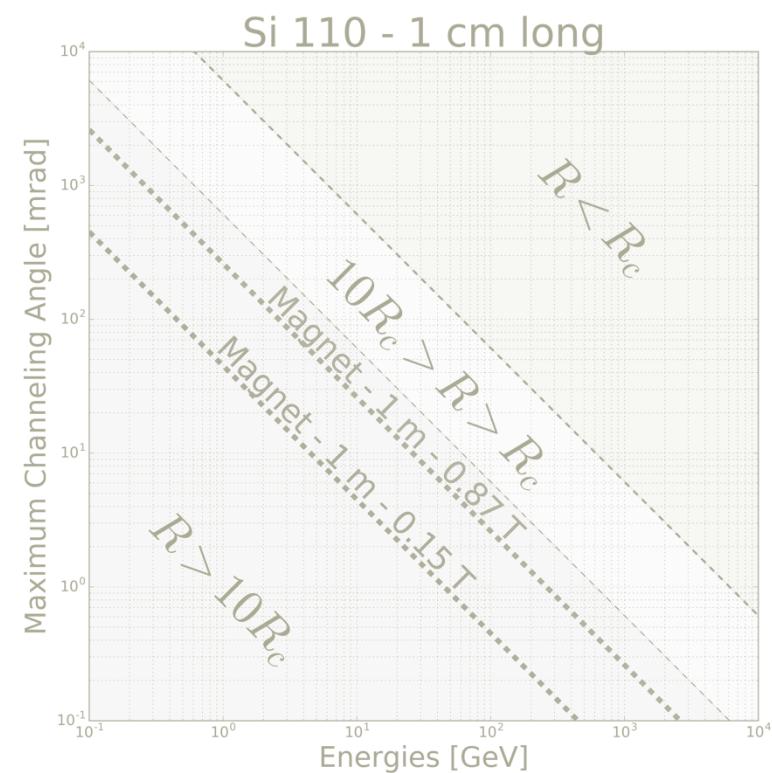
1. Maximum Angular Acceptance
2. Maximum Deflection Angle
3. Maximum Deflection Efficiency

2. Maximum Deflection Angle



E. Bagli et al., Eur. Phys J. C, 74 (2014), 2740

$$R \downarrow c = p\beta / U' \downarrow \max$$

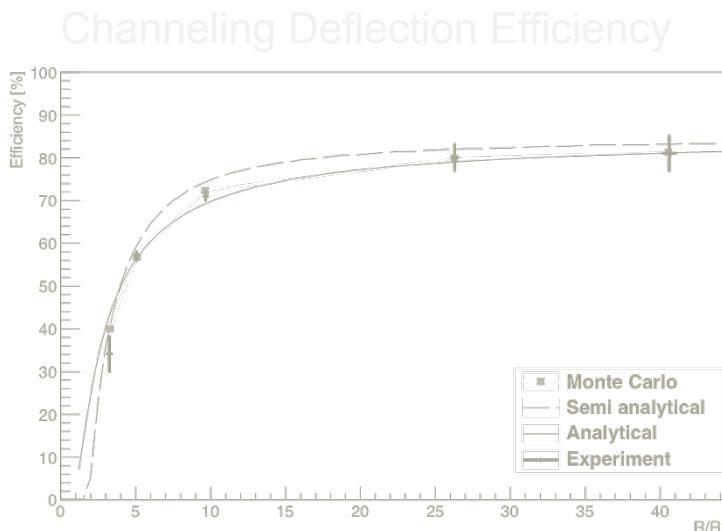


$$\theta \downarrow D = L/R \sim 1 \text{ mrad}$$

E. Tsyganov, Tech. rep., Fermilab (1976) Preprint TM-682

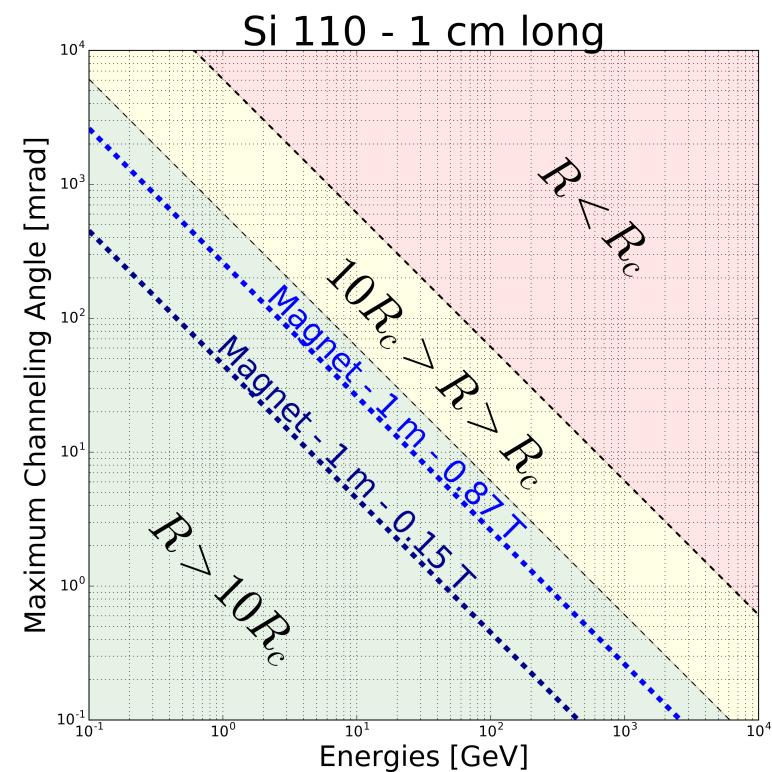


2. Maximum Deflection Angle



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$$R \downarrow c = p\beta / U' \downarrow \max$$

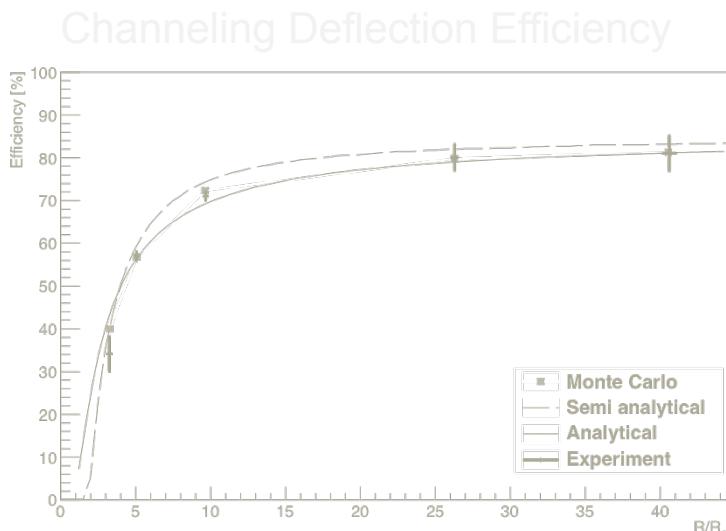


$$\theta \downarrow D = L/R \sim 1 \text{ mrad}$$

E. Tsyganov, Tech. rep., Fermilab (1976) Preprint TM-682

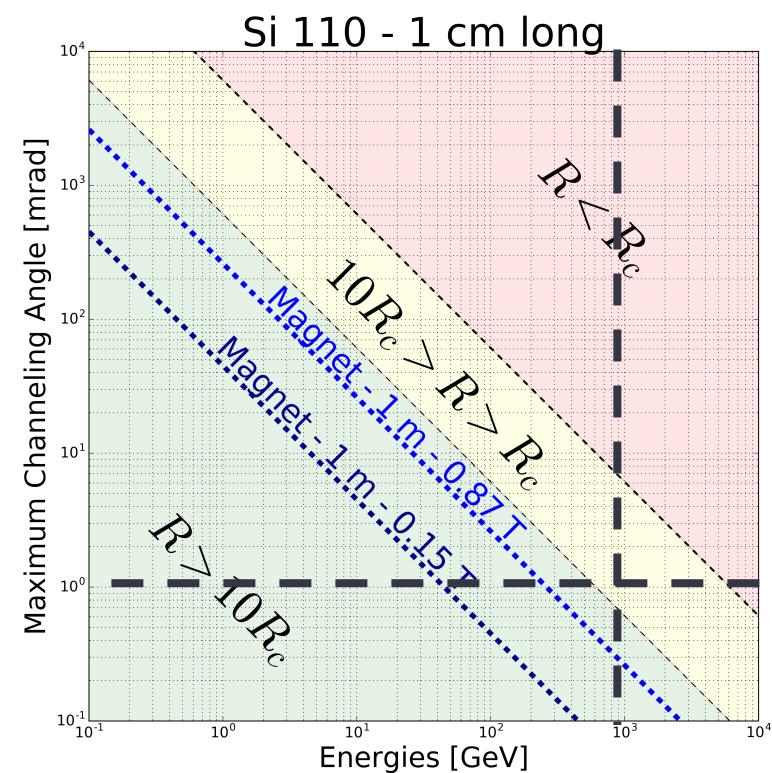
2. Maximum Deflection Angle

$\sim 1 \text{ mrad} @ 1 \text{ TeV}/c$



E. Bagli et al., Eur. Phys. J. C, 74 (2014), 2740

$$R \downarrow c = p\beta / U' \downarrow \max$$



$$\theta \downarrow D = L/R \sim 1 \text{ mrad}$$

E. Tsyganov, Tech. rep., Fermilab (1976) Preprint TM-682

$$R/R \downarrow c \sim 6$$

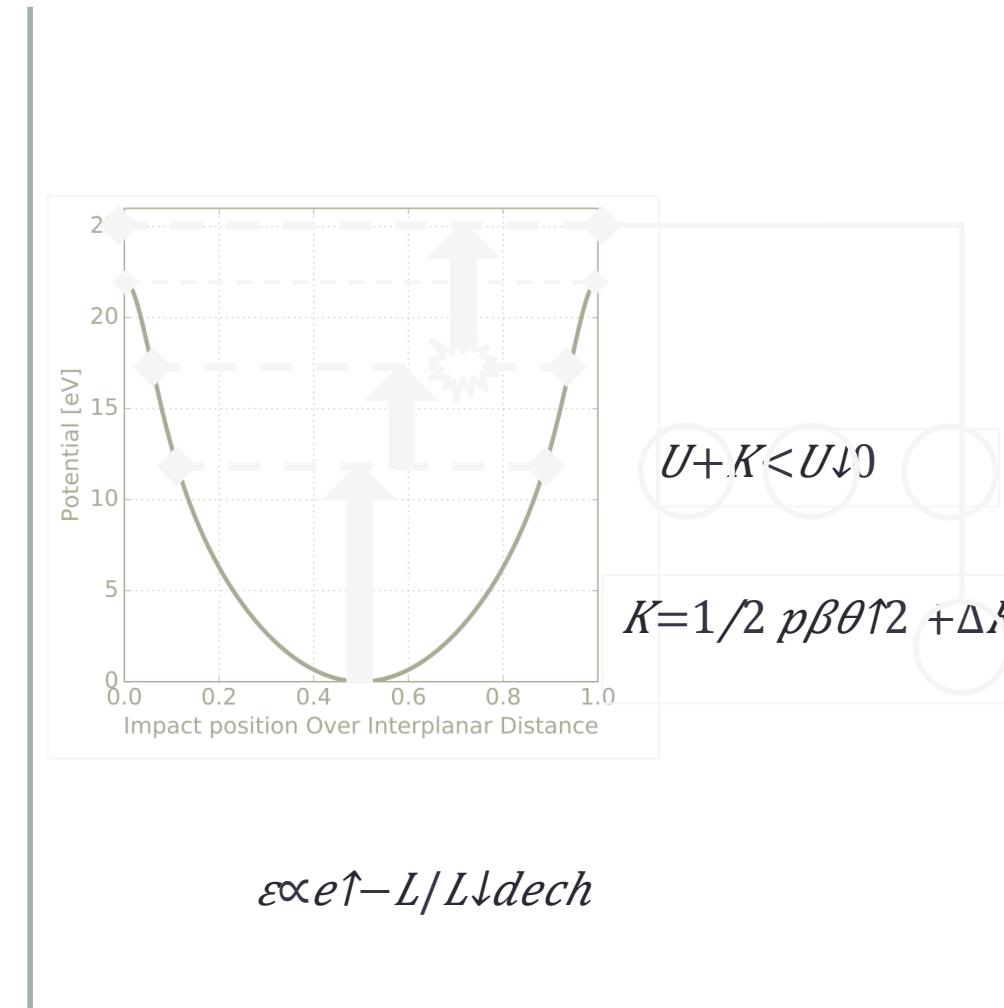
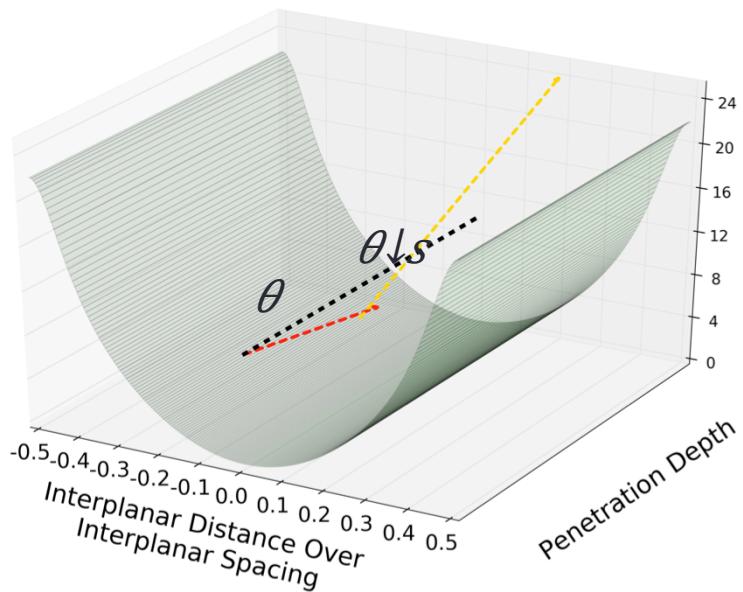


Key Ingredients

1. Maximum Angular Acceptance
2. Maximum Deflection Angle
3. Maximum Deflection Efficiency

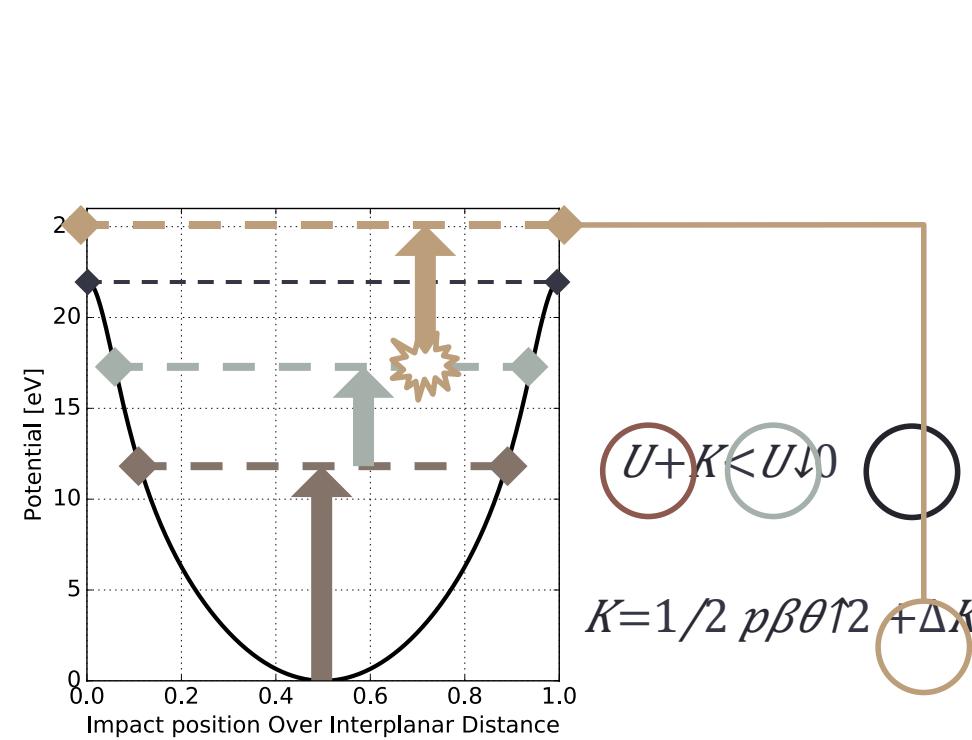
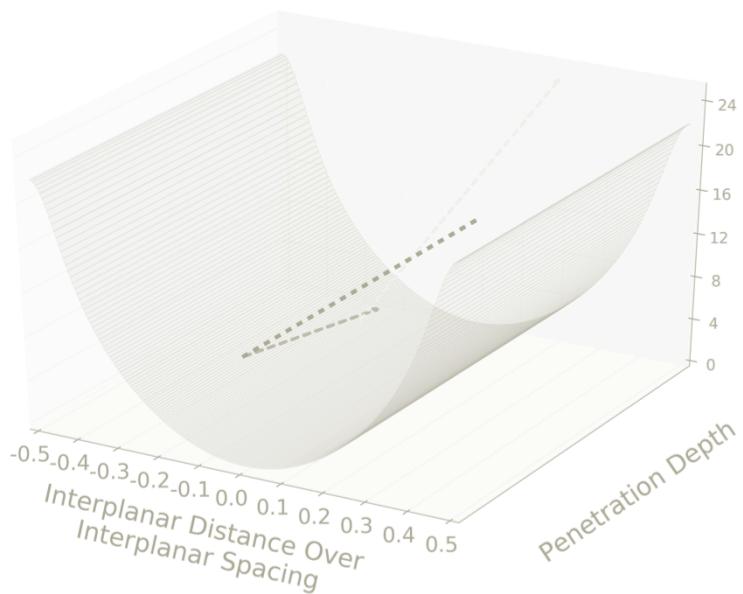


3. Maximum Deflection Efficiency





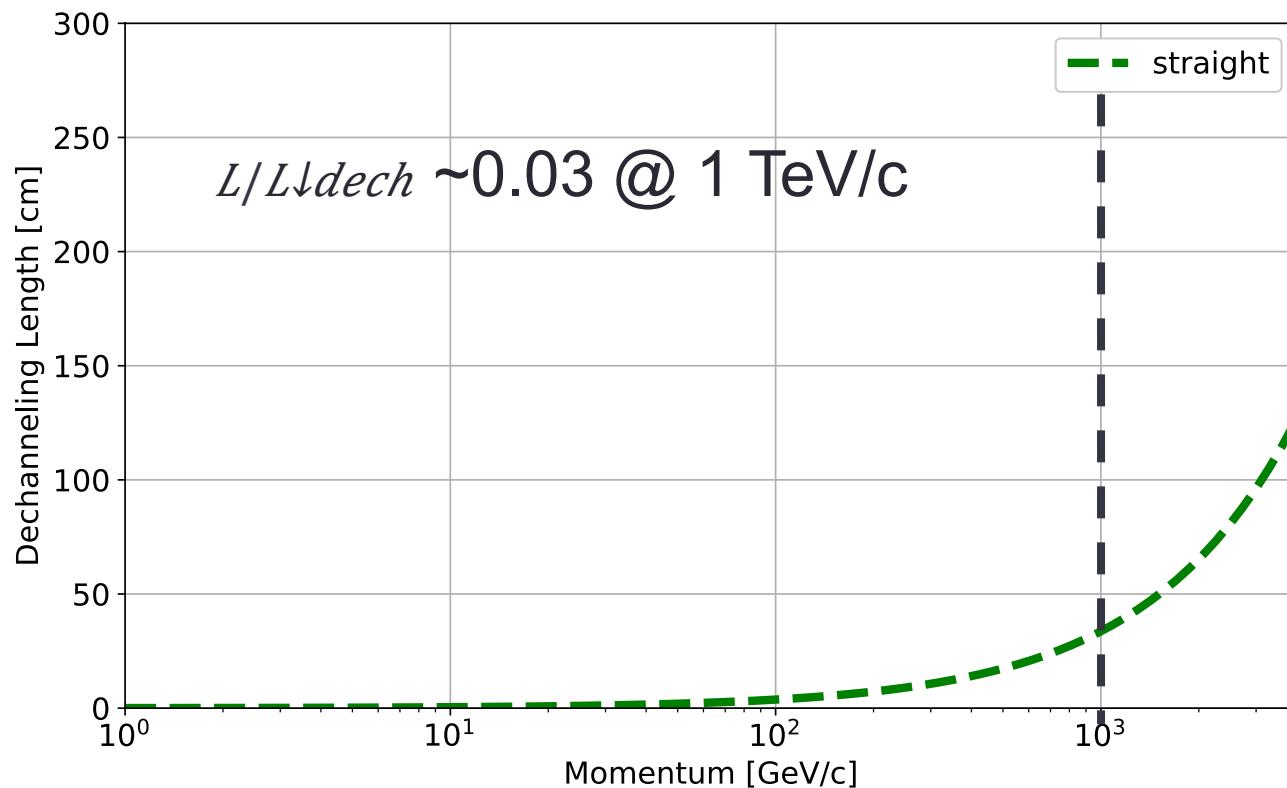
3. Maximum Deflection Efficiency



$$\propto e\uparrow - L/L\downarrow dech$$



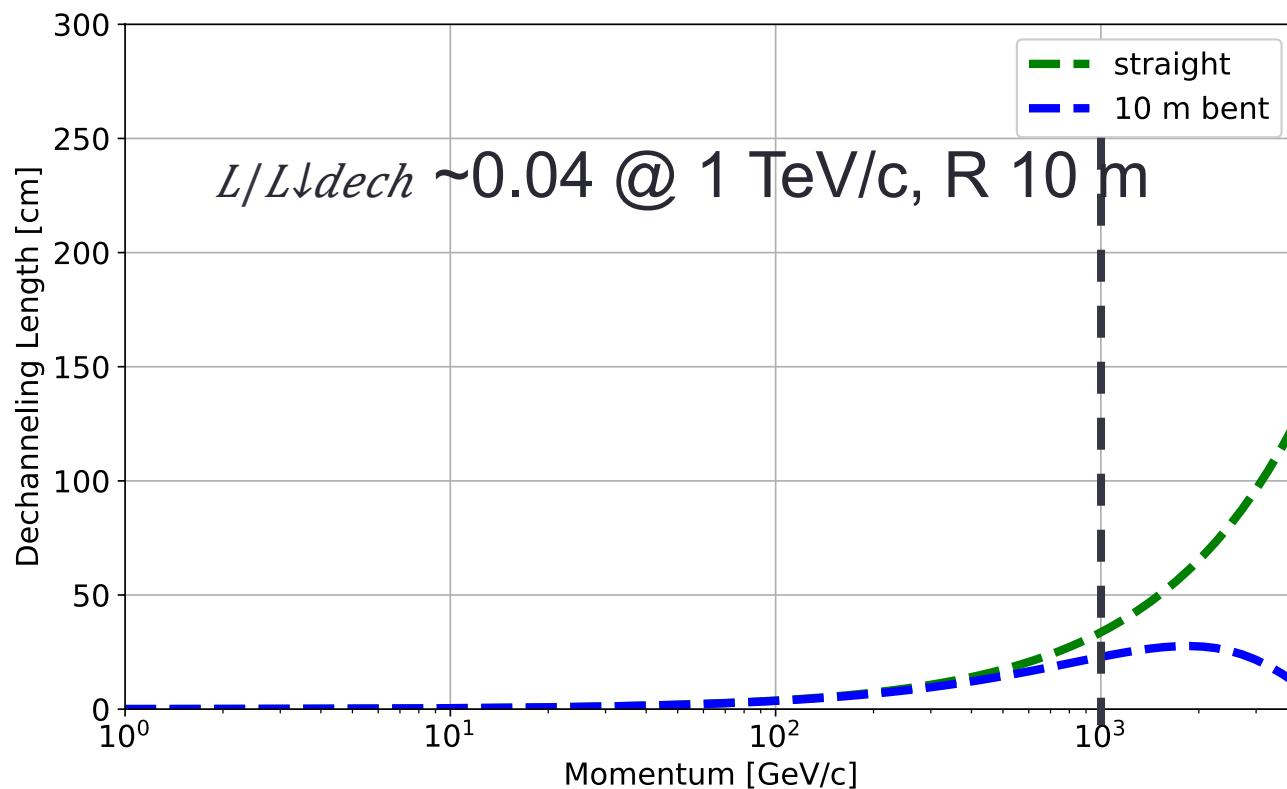
3. Maximum Deflection Efficiency



$$L \downarrow dech \propto p\beta$$



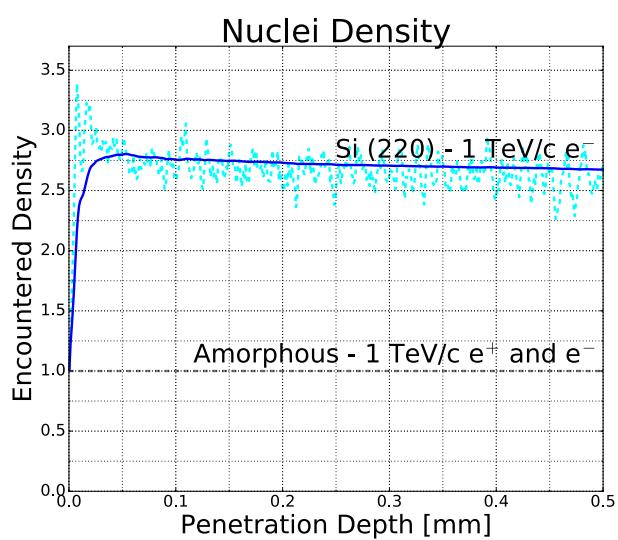
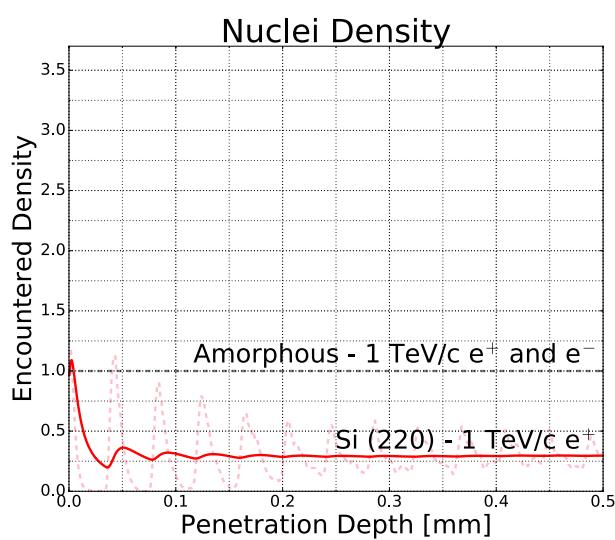
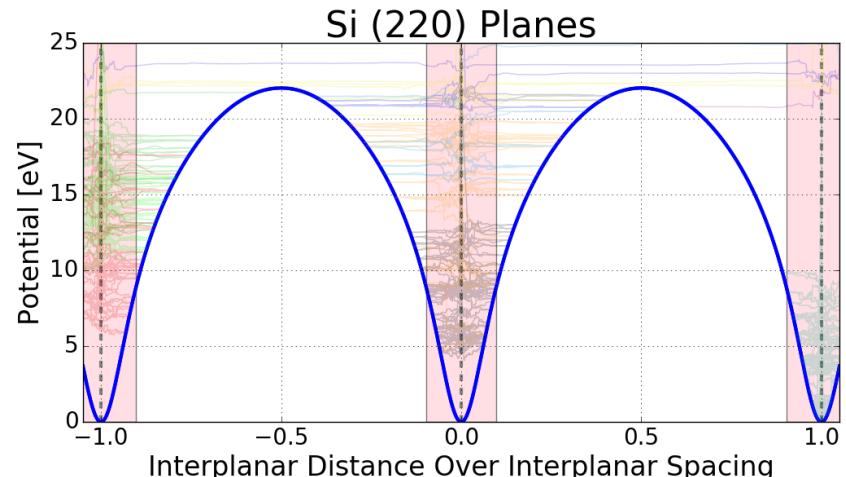
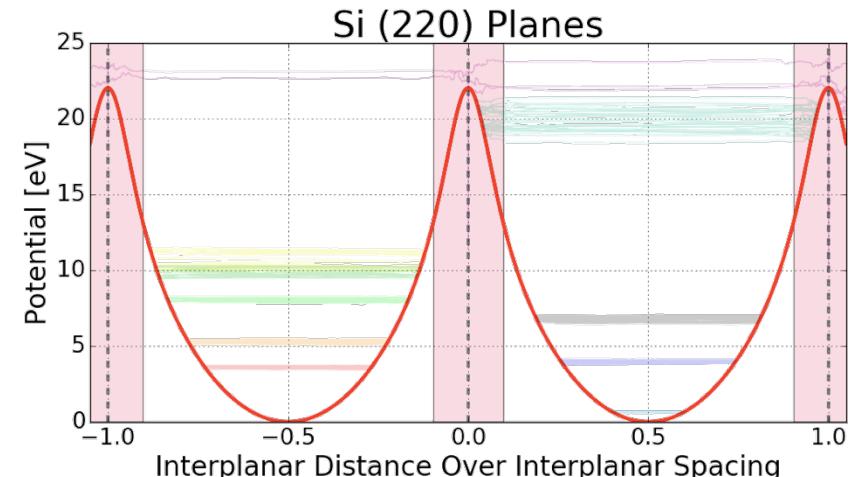
3. Maximum Deflection Efficiency



$$L_{\downarrow dech} \propto p\beta \cdot (1 - R_{\downarrow c}/R)^{1/2}$$

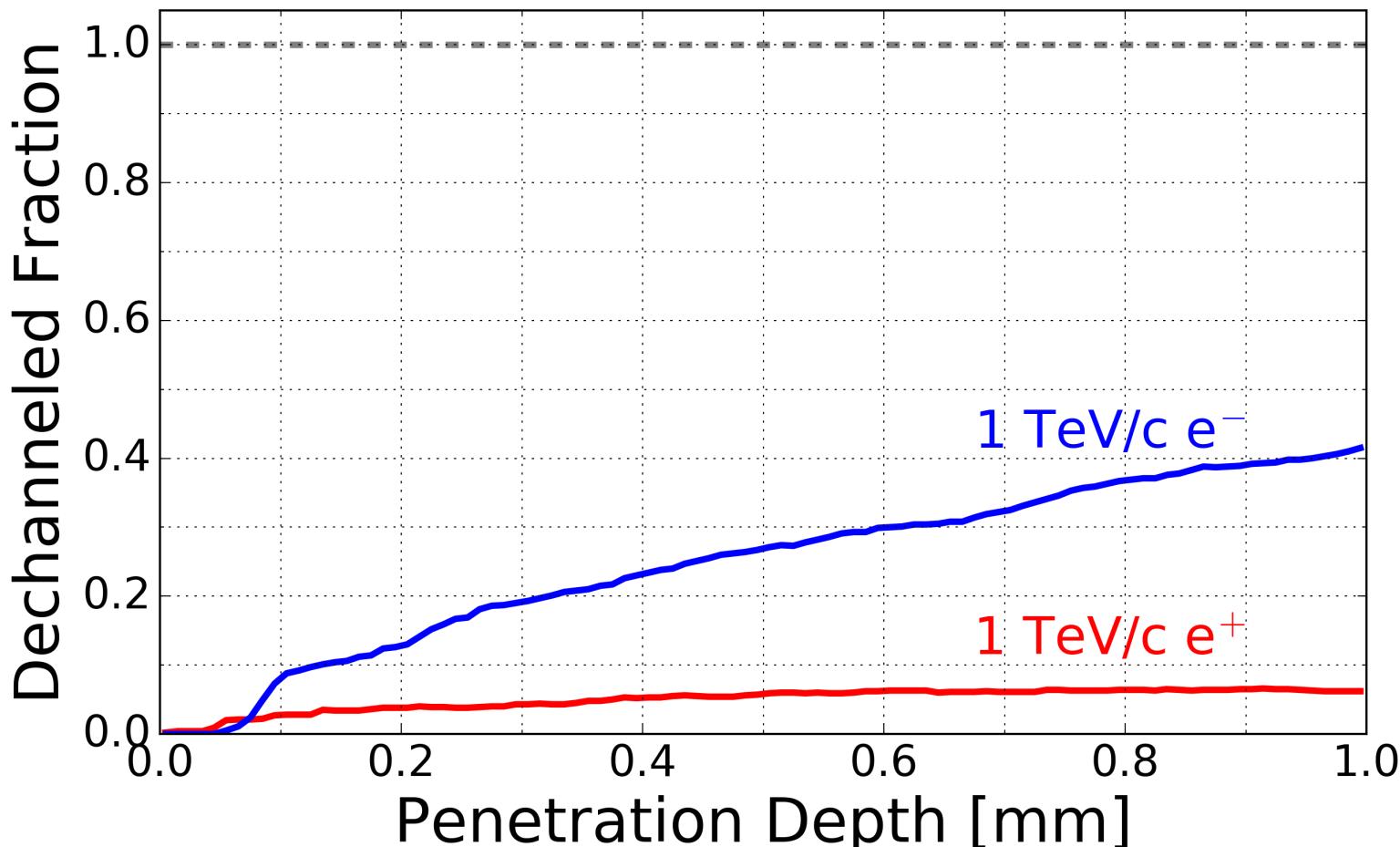
Positrons

Electrons





Dechanneling Ratio



THE IDEA

Channeling

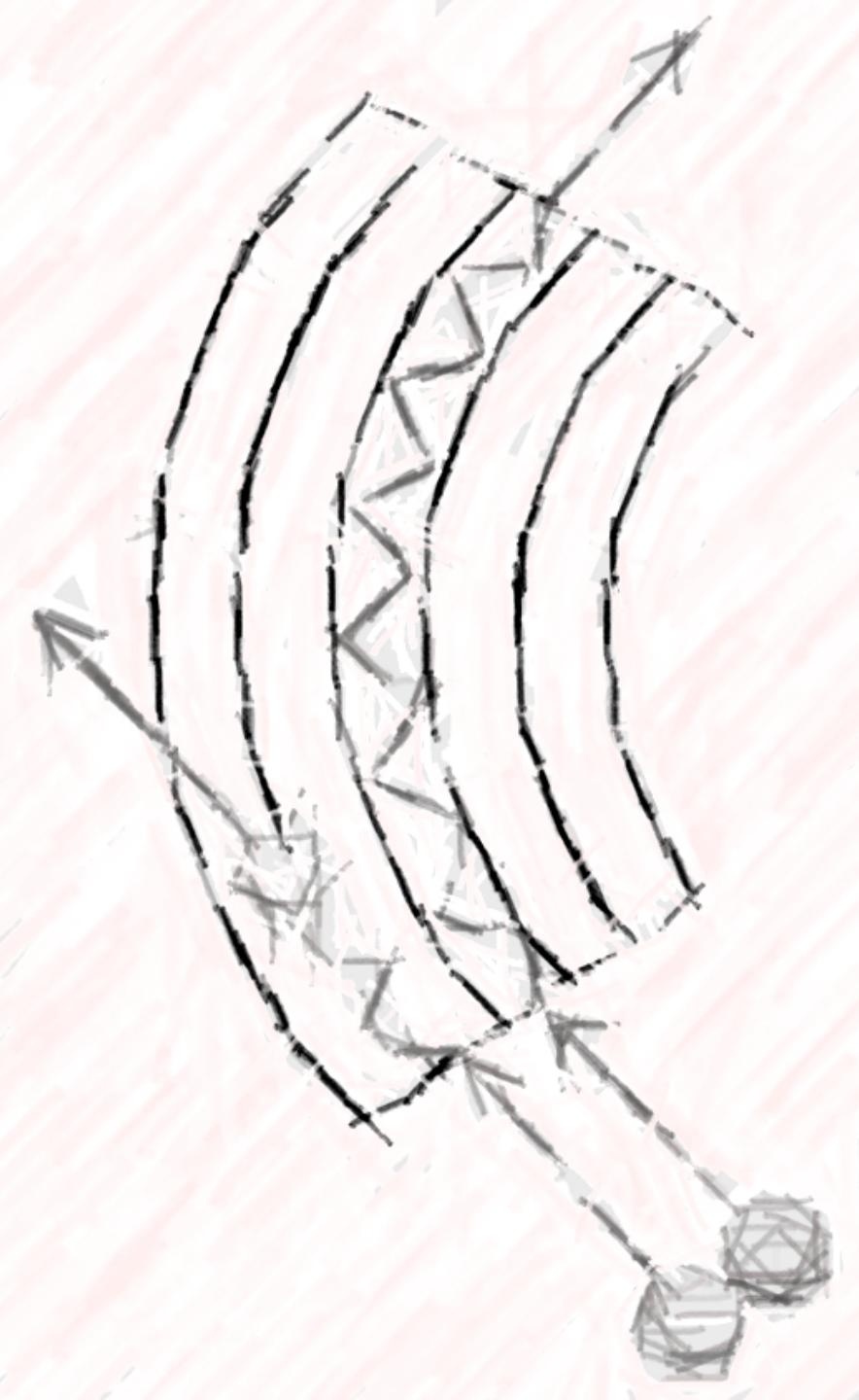


The Idea

data

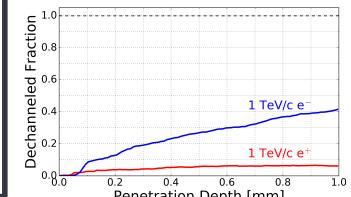
Experimental

Conclusions





Different dechanneling rate

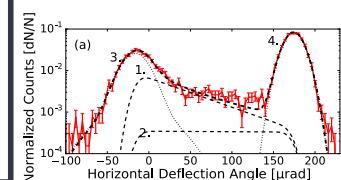
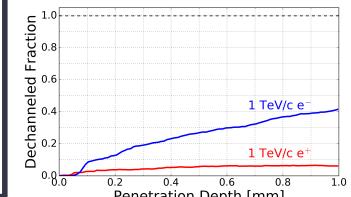


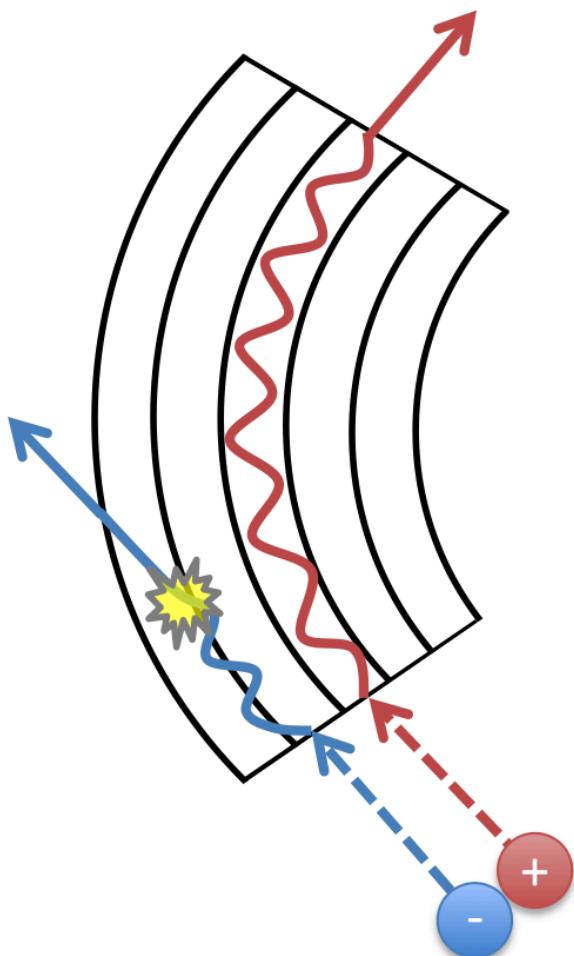


Different dechanneling rate



Deflection in bent crystals

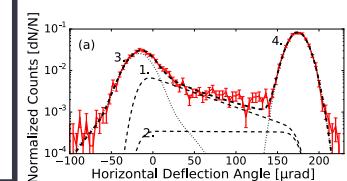
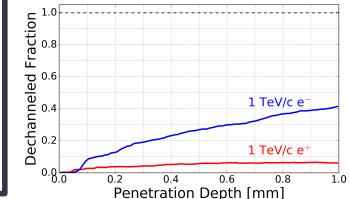


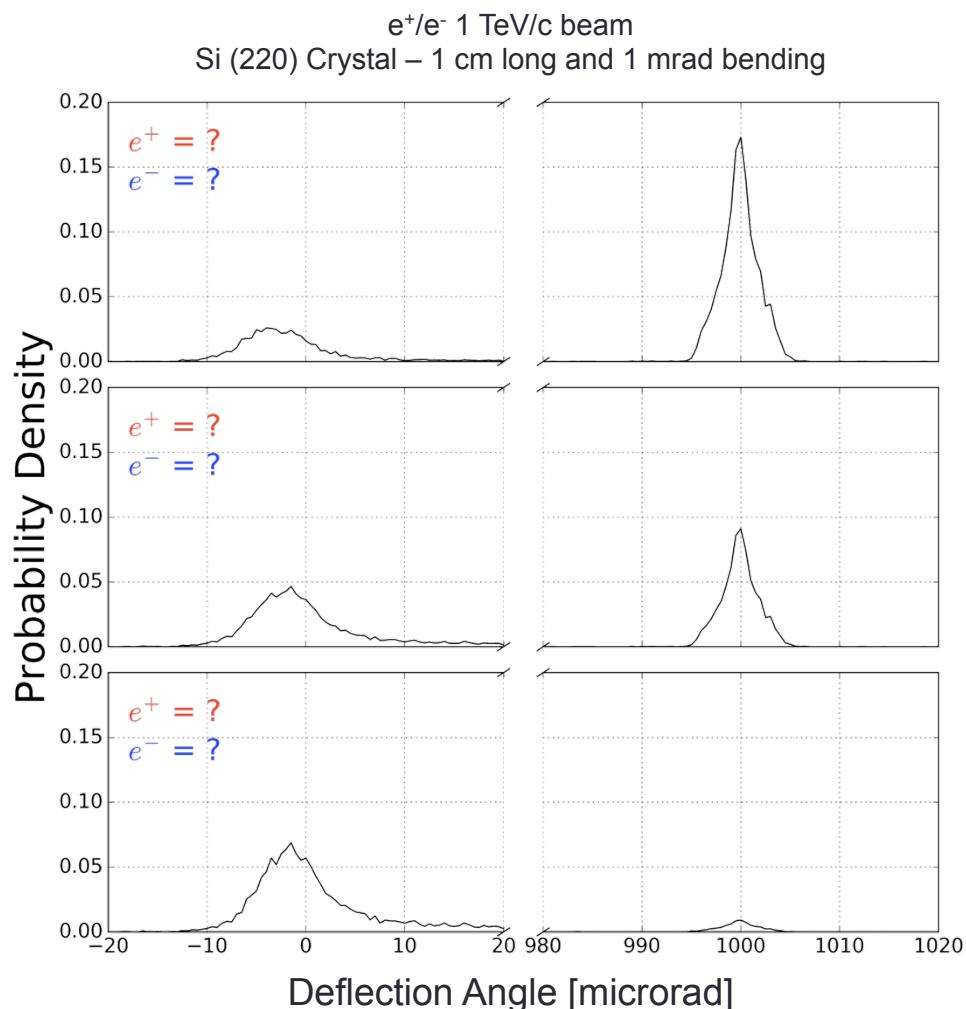


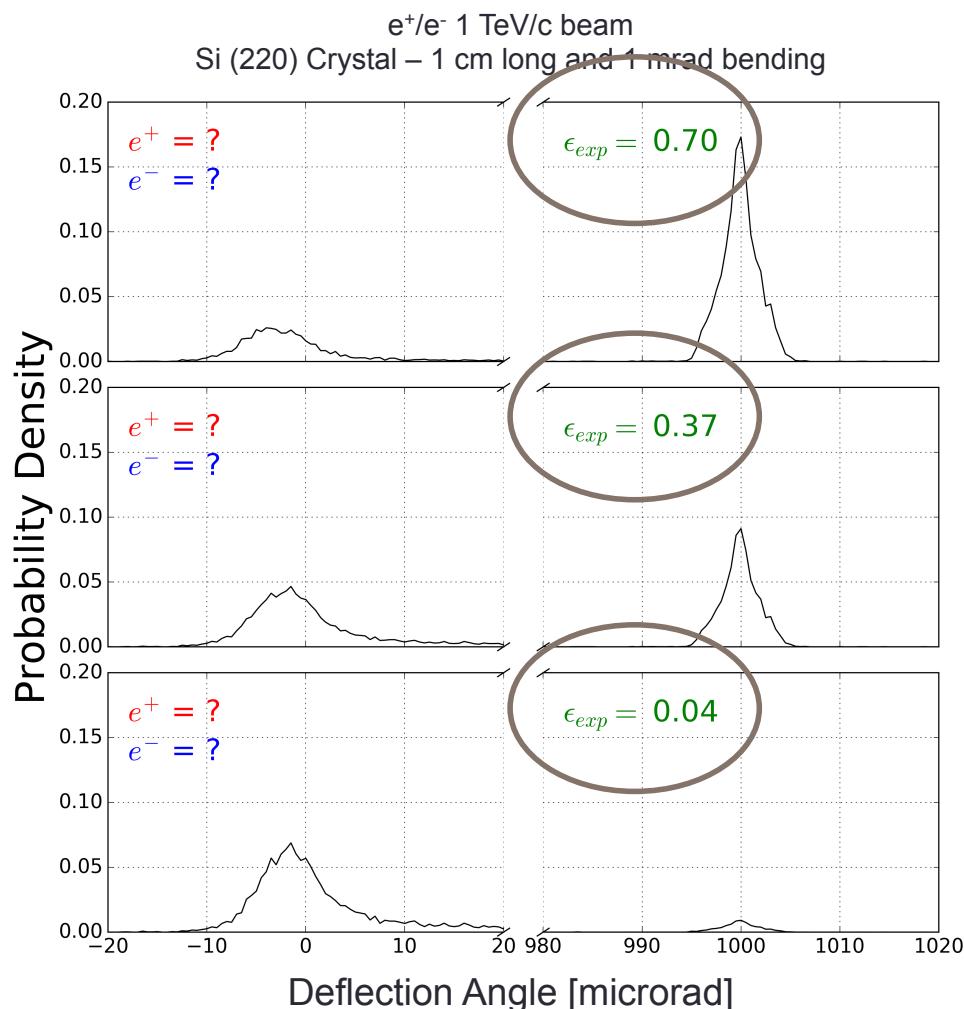
Different
dechanneling rate

Deflection in bent
crystals

Channeling
Spectrometer









27 September 2018

Charged & Neutral Particles Channeling Phenomena Channeling 2018

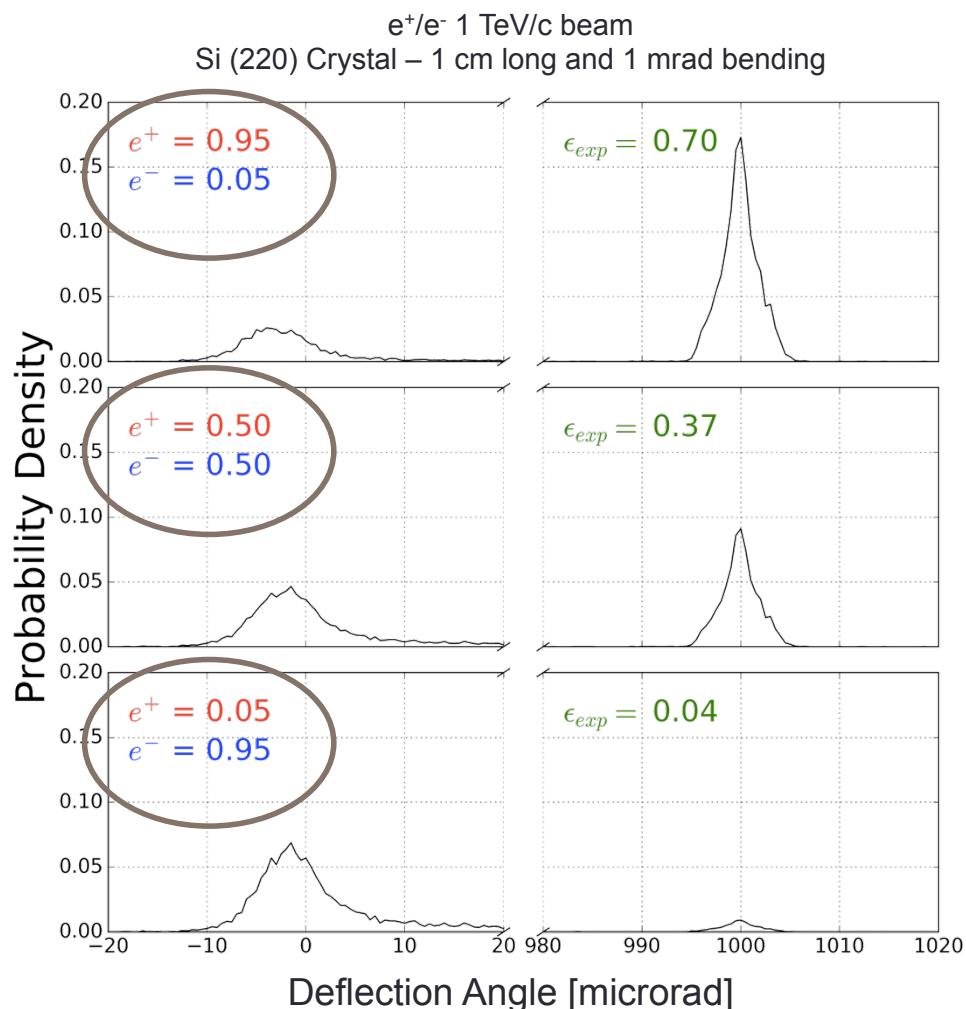


e^+/e^- 1 TeV/c beam
Si (220) Crystal – 1 cm long and 1 mrad bending



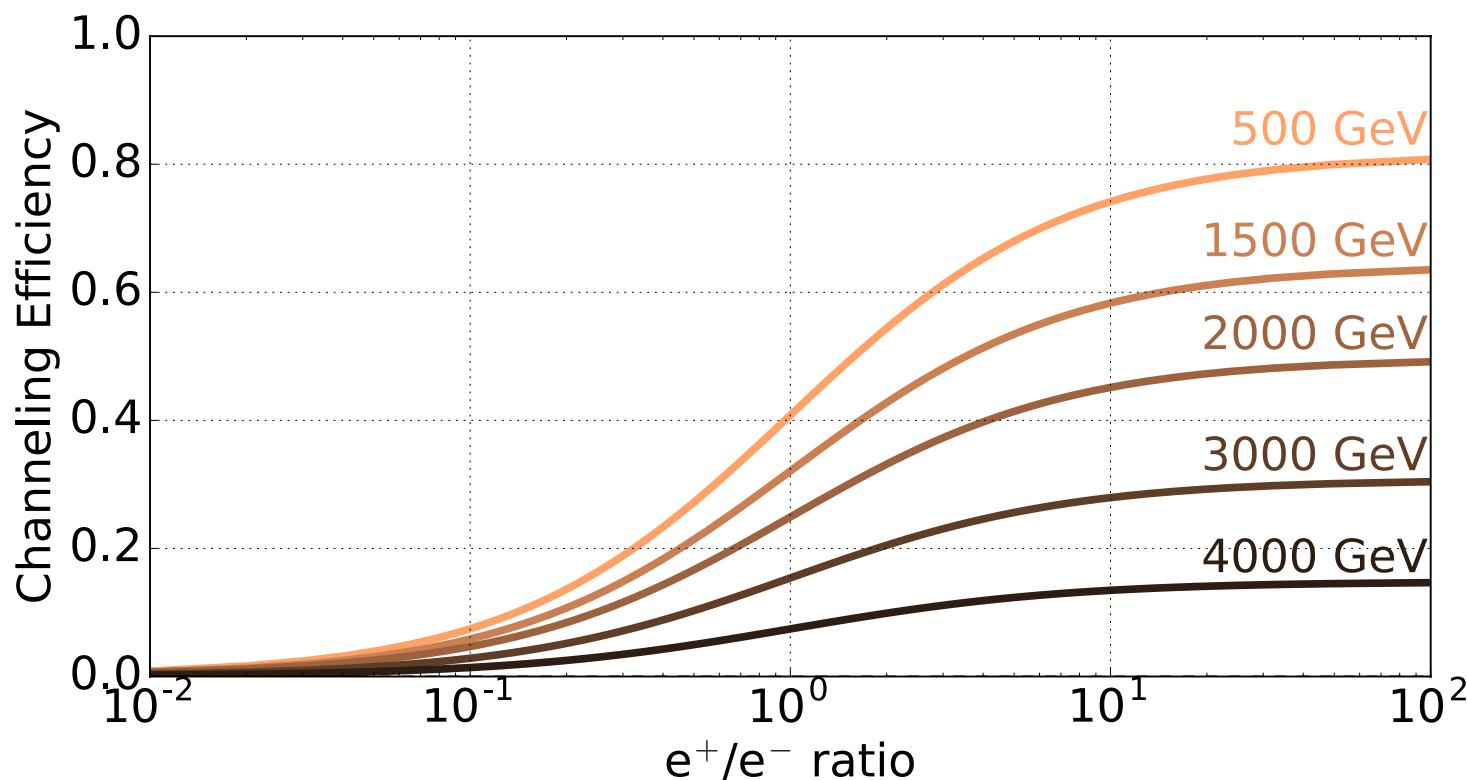
The image cannot be displayed. Your computer may not have enough memory to open the image, or the image may have been corrupted. Restart your computer, and then open the file again. If the red x still appears, you may have to delete the image and then insert it again.

Deflection Angle [microrad]





e^+/e^- ratio vs deflection efficiency

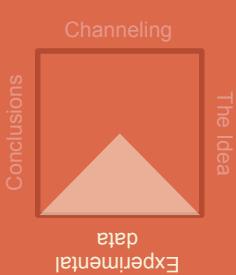


Si (220) Crystal – 1 cm long and 1 mrad bending

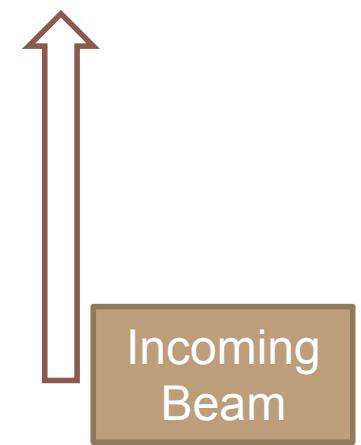
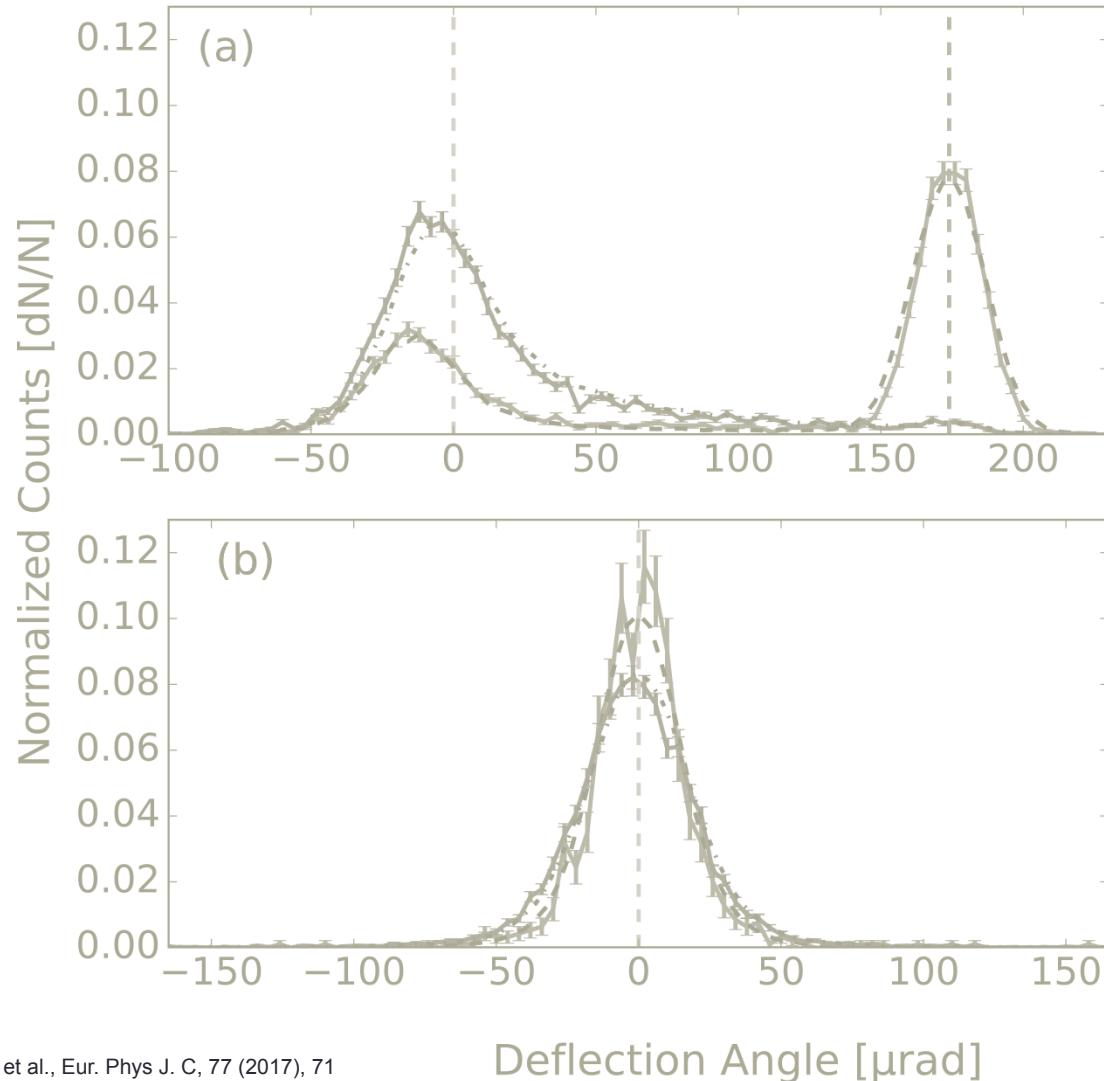


EXPERIMENTAL DATA

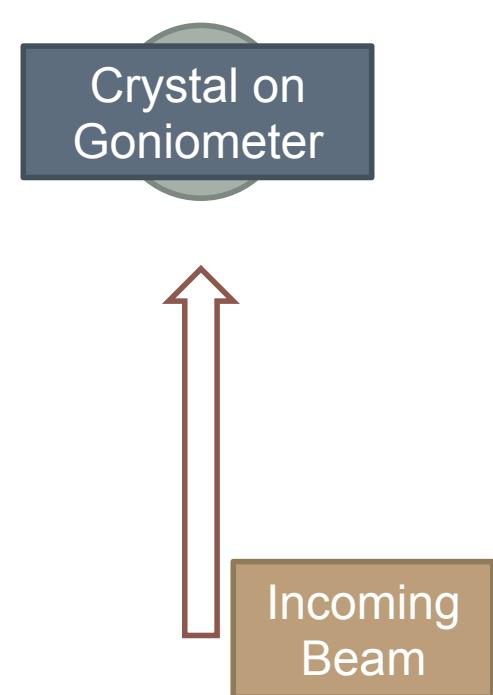
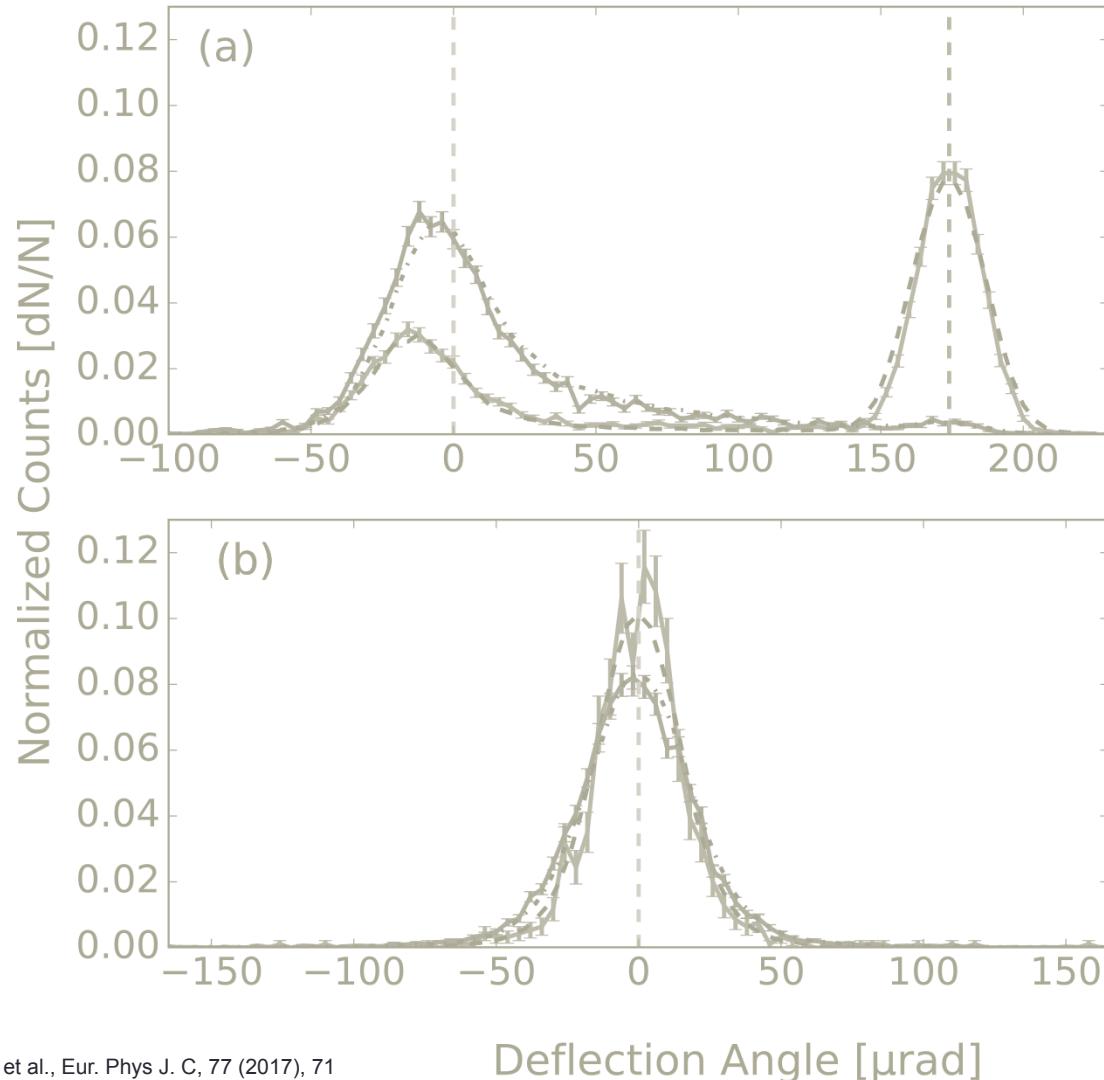
Test beam at the CERN SPS-H4 line



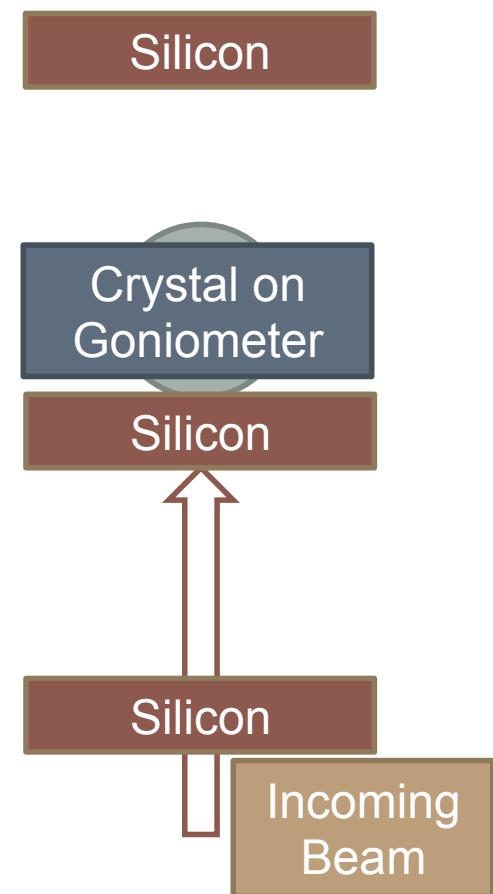
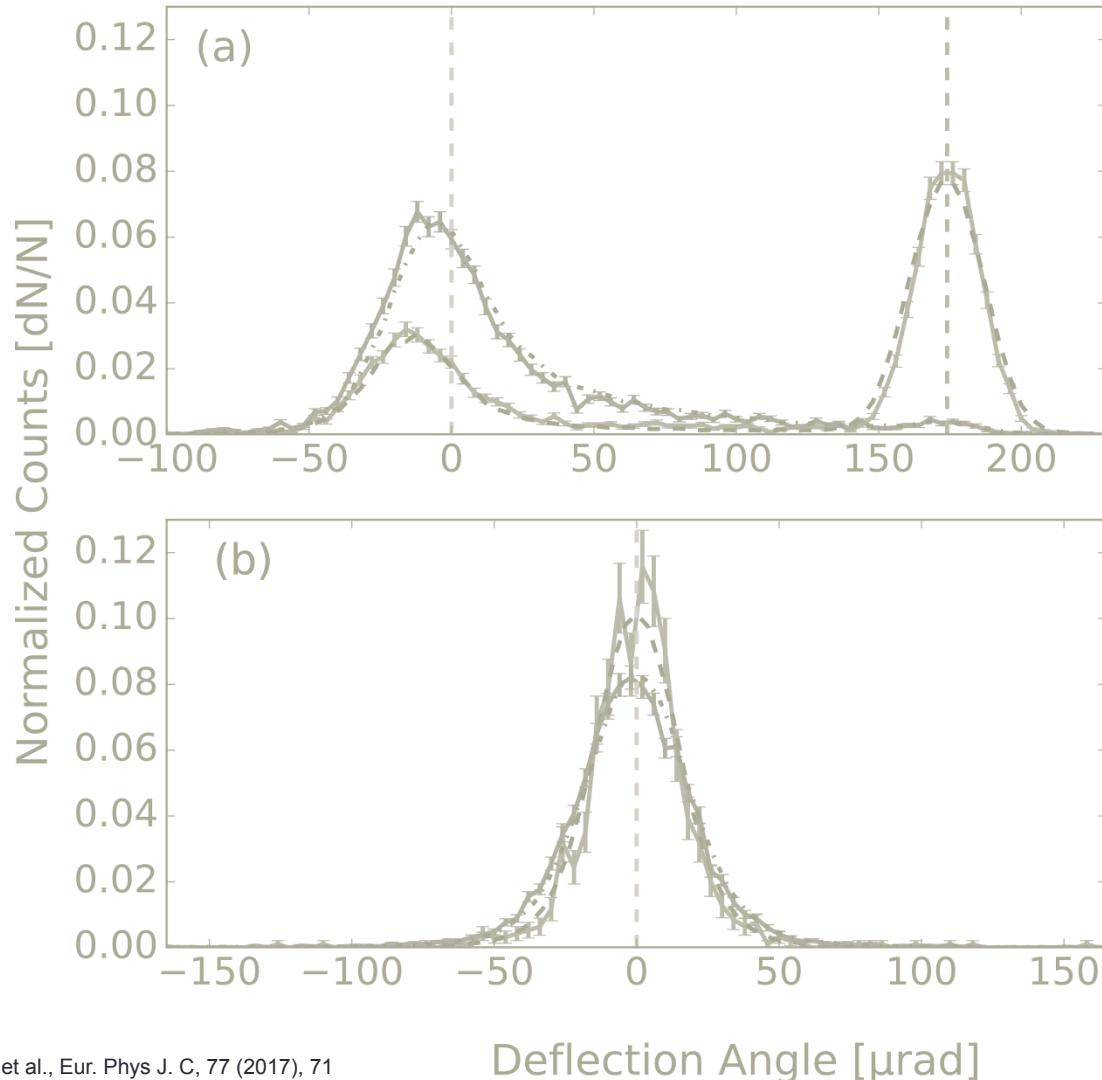
CERN SPS-H4 line



CERN SPS-H4 line

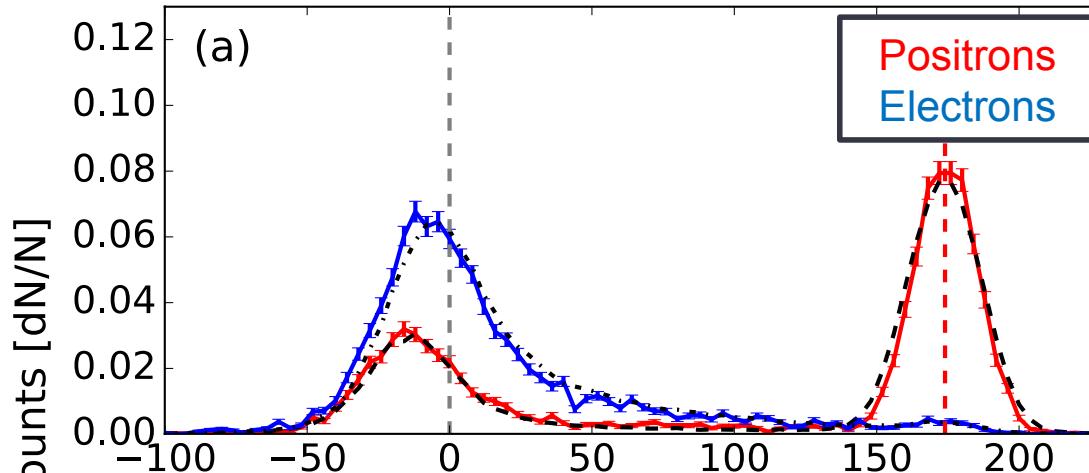


CERN SPS-H4 line

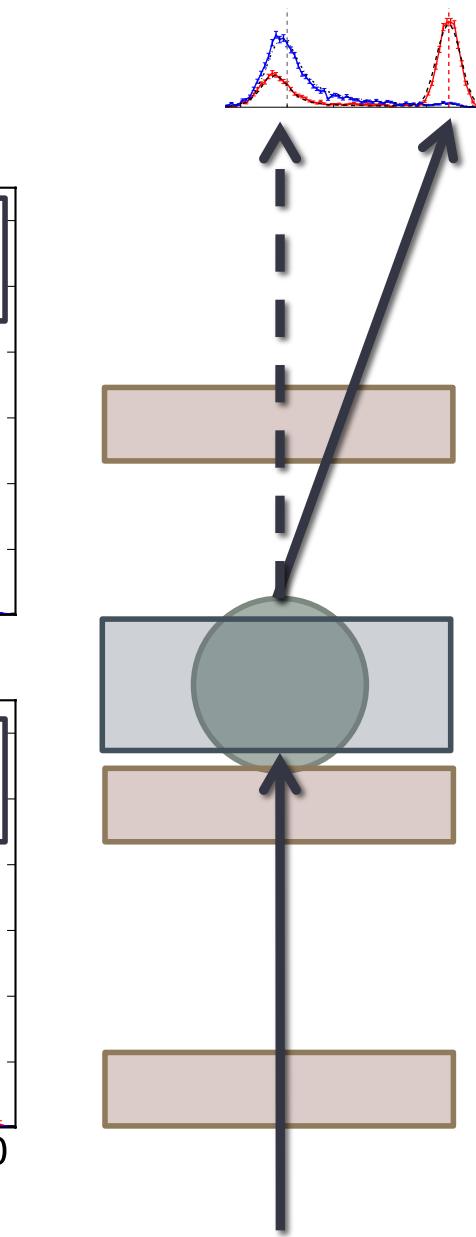
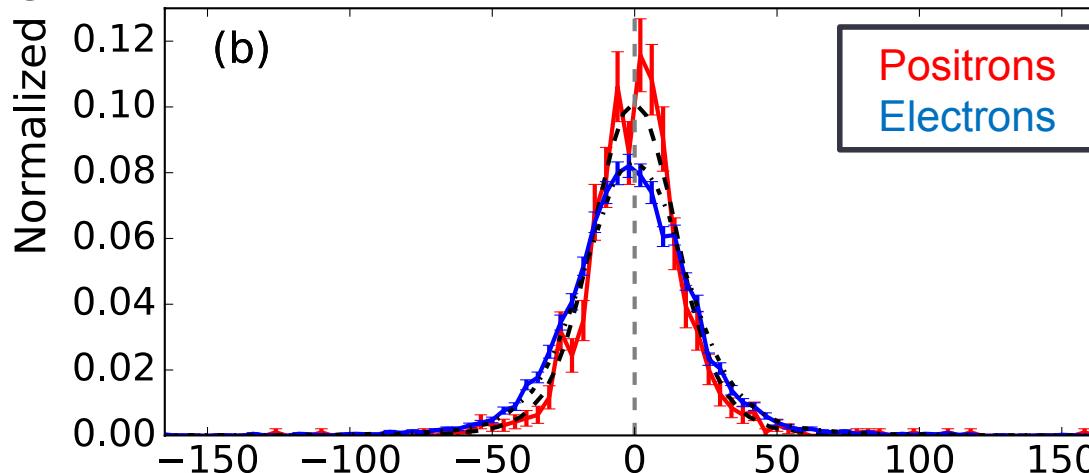


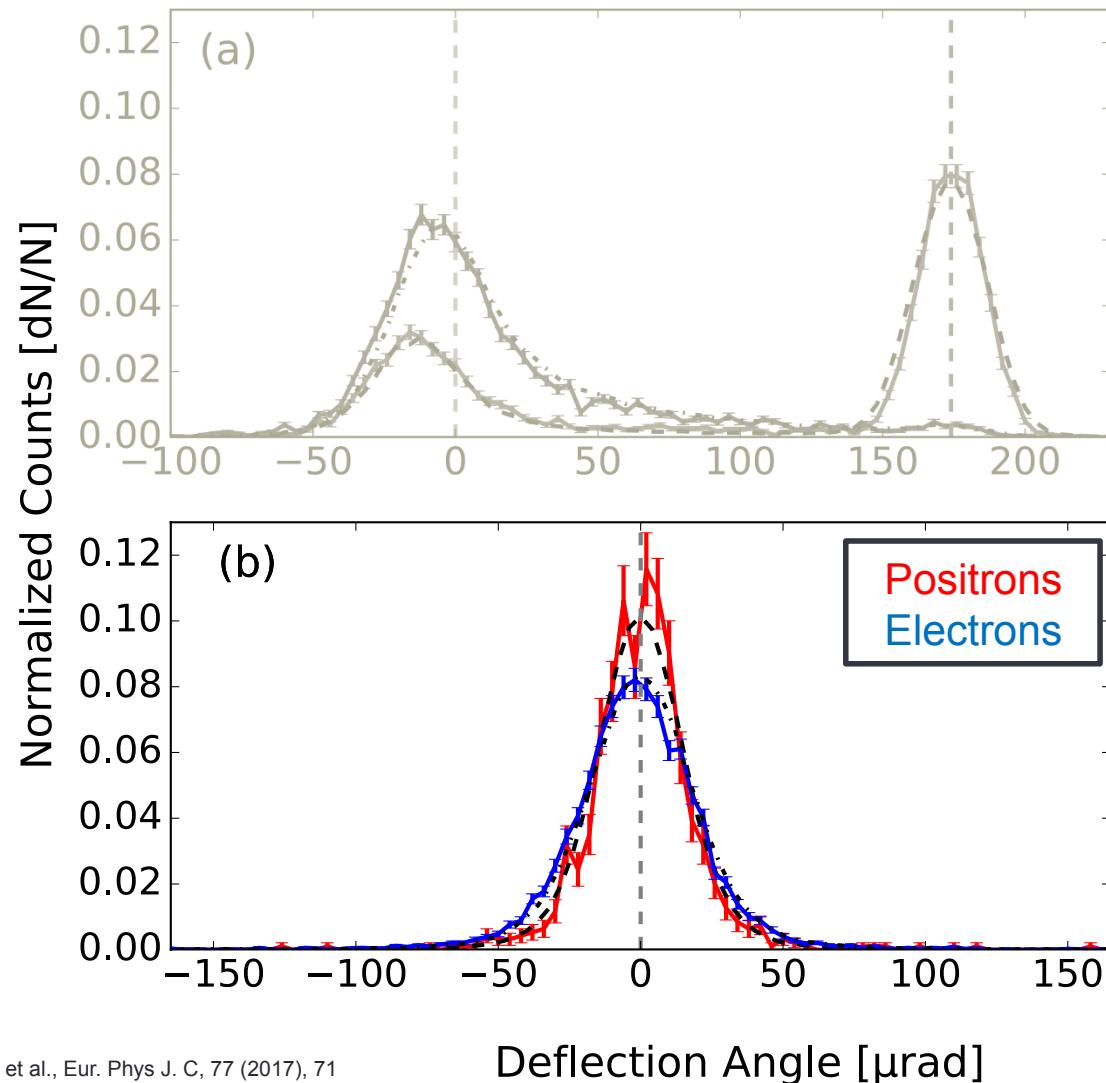
CERN SPS-H4 line

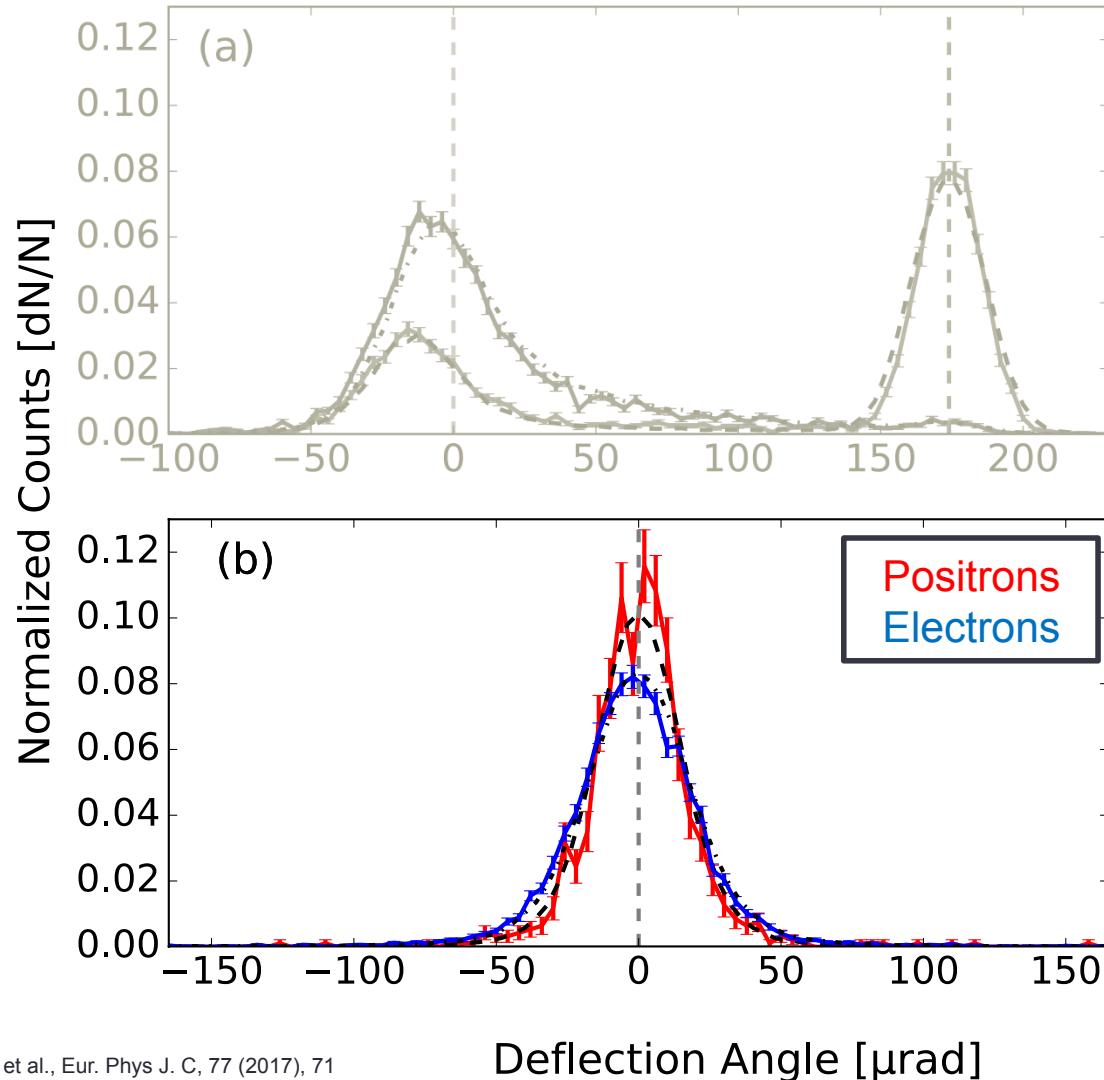
Horizontal



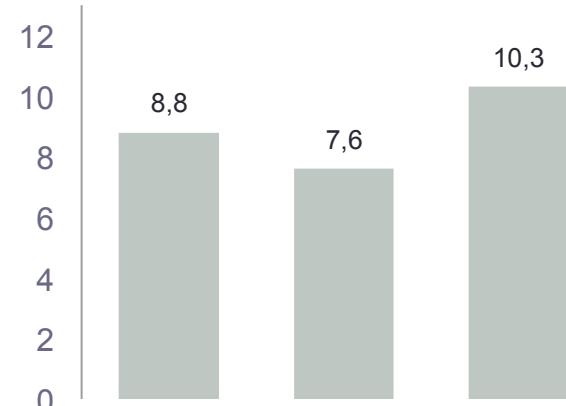
Vertical

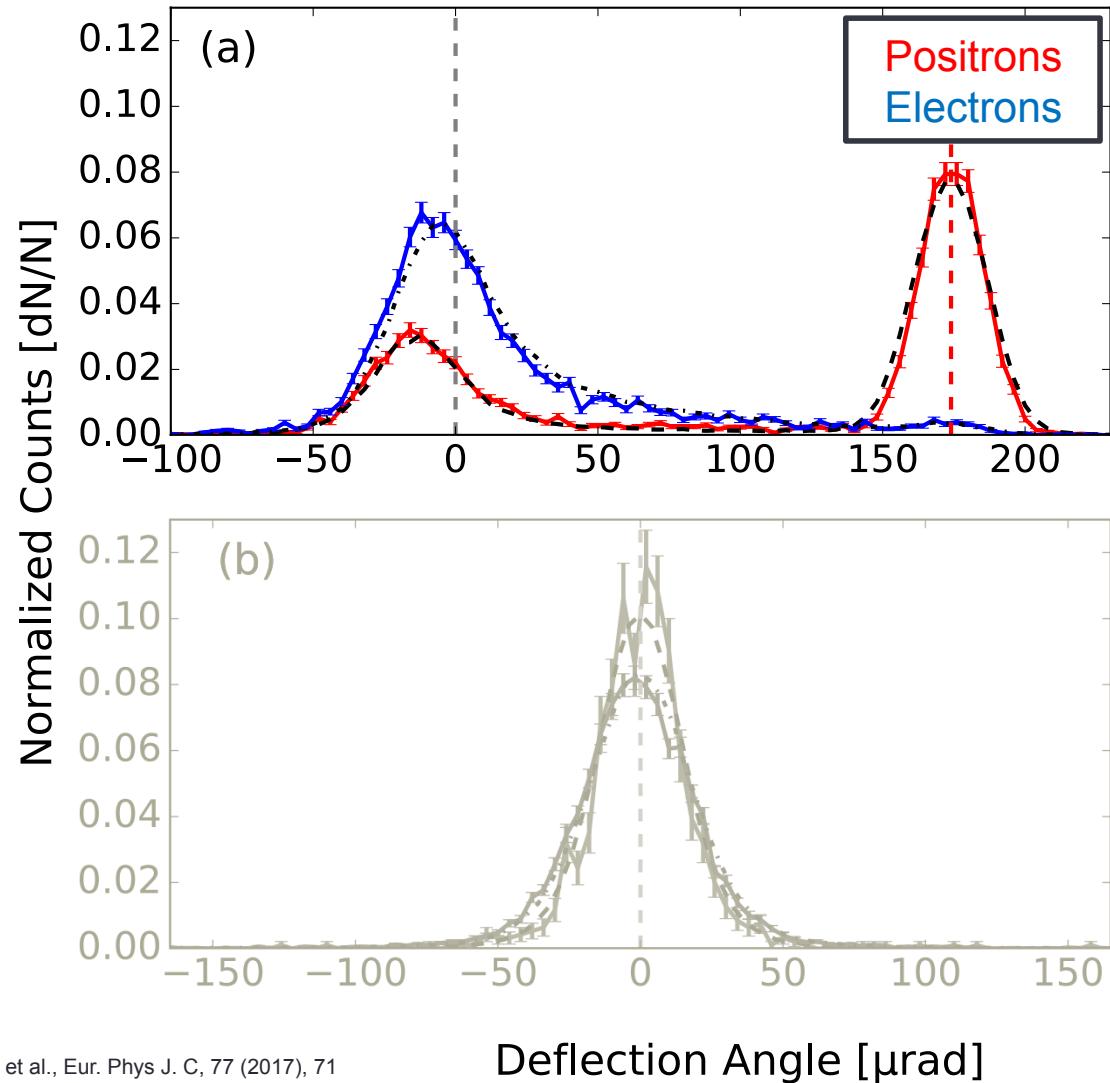


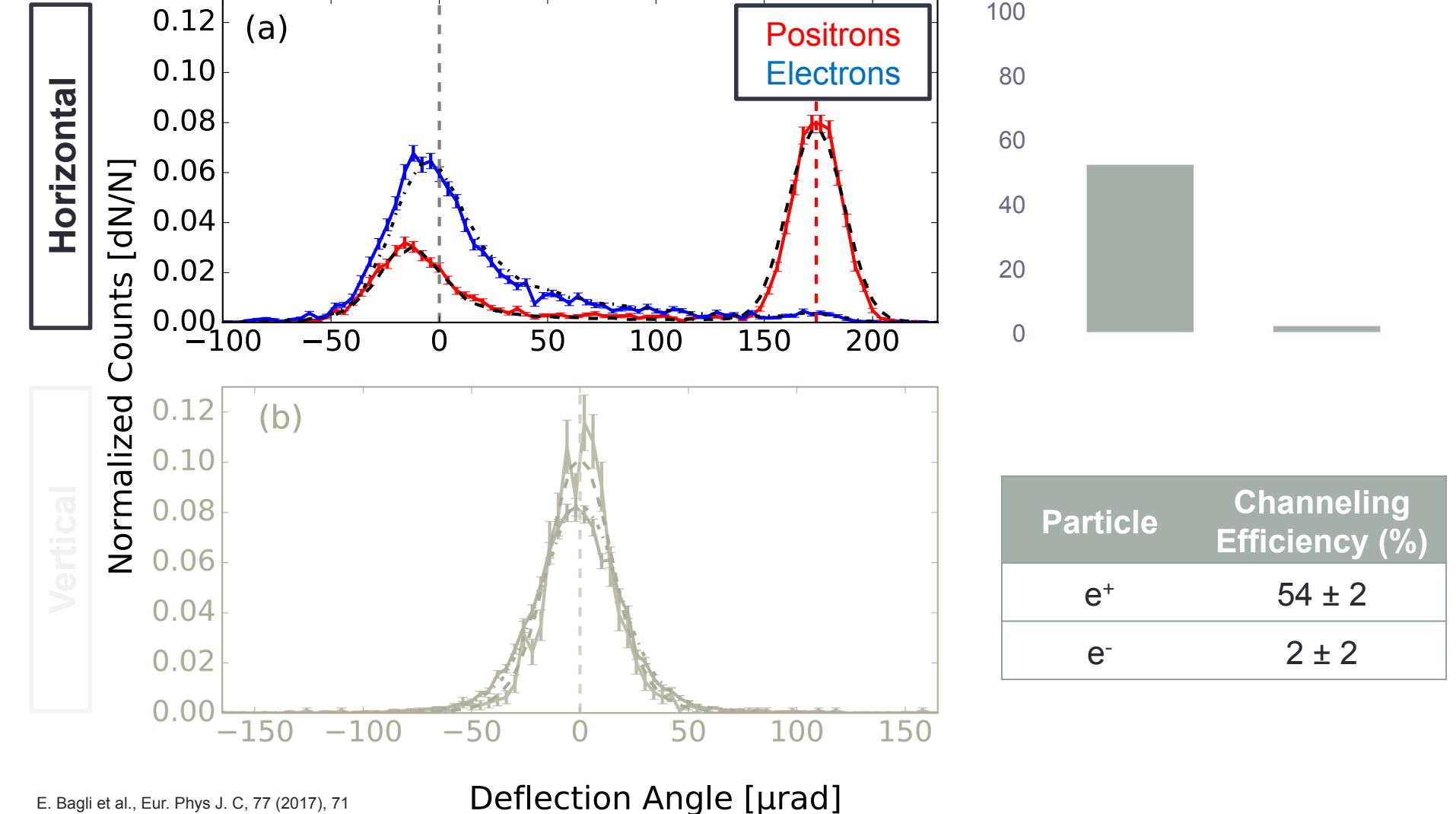


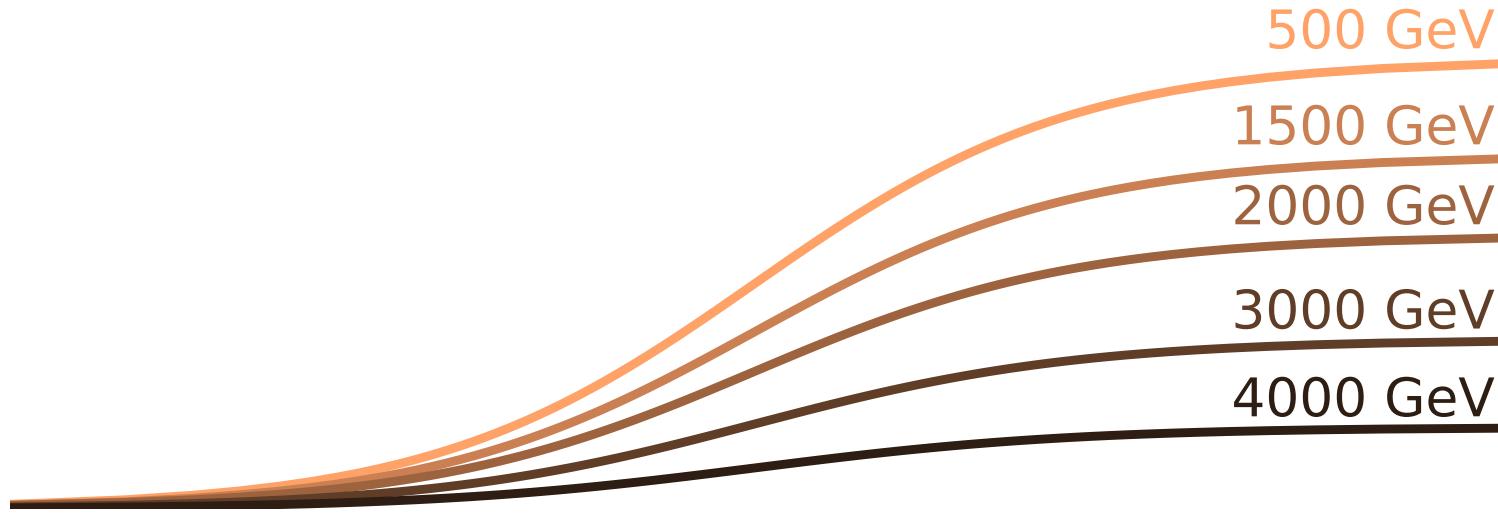


Particle	Condition	r.m.s. (μrad)
e^+/e^-	Not Aligned	8.8 ± 0.1
e^+	Channeling	7.6 ± 0.4
e^-	Channeling	10.3 ± 0.2

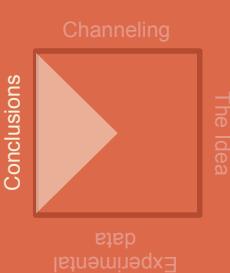




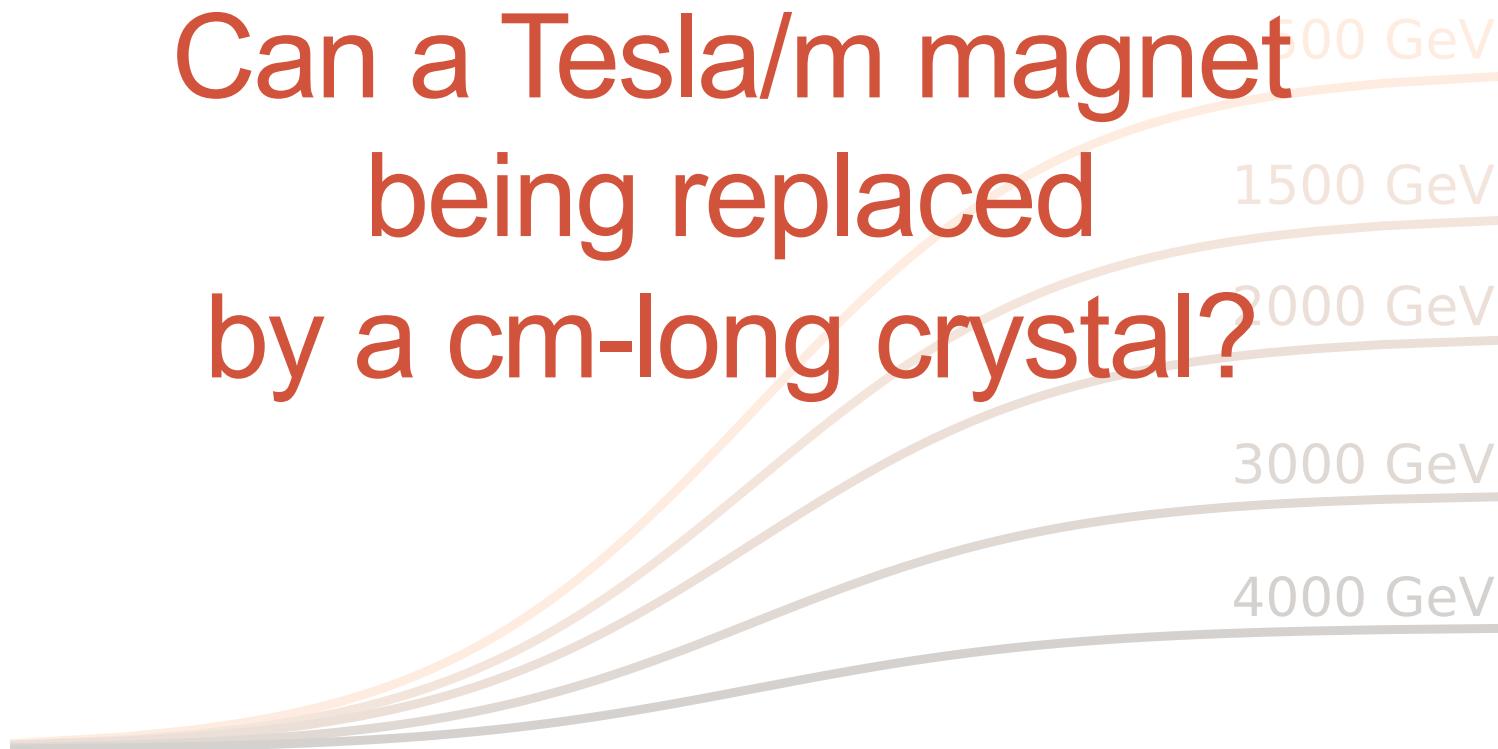




CONCLUSION



Can a Tesla/m magnet
being replaced
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Charged & Neutral Particles Channeling Phenomena

CHANNELING 2018

September 23 - 28, 2018 Ischia (NA), Italy

THANK YOU FOR THE ATTENTION

bagli@fe.infn.it

alexander.howard@cern.ch