On the possibilities of observation of proton volume deflection from different crystal planes in one crystal

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Outline

The idea of multiple volume reflection possibility by crystal axes in a single crystal

PNPI conditions

- VR experiment simulations
- MVR predictions

IHEP conditions

- VR experiment simulations
- MVR predictions

SPS H8 conditions

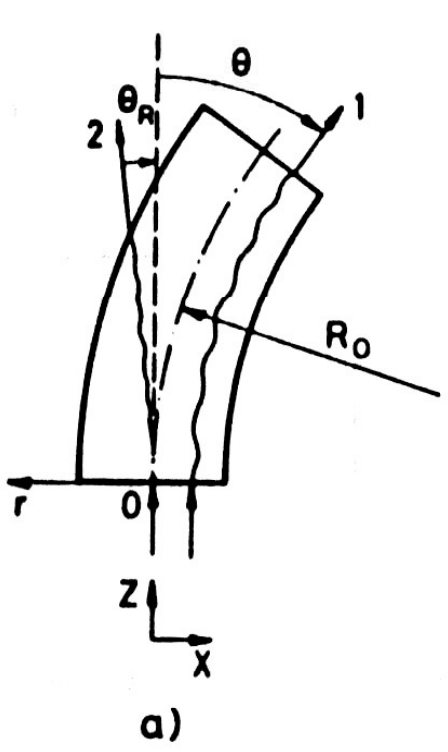
- VR experiment simulations
- MVR predictions
- **Optimal condition of MVR observation**

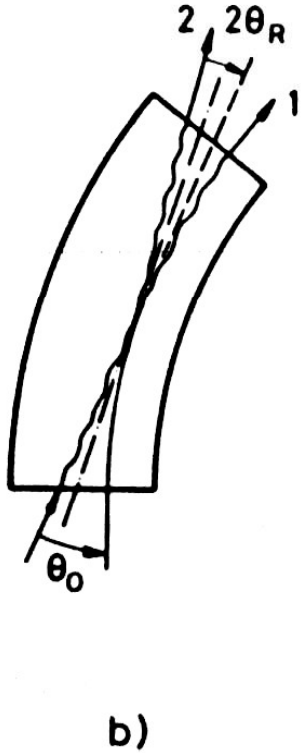
Volume Reflection prediction

A.M.Taratin and S.A.Vorobiev, Phys. Lett. A119 (1987) 425

and

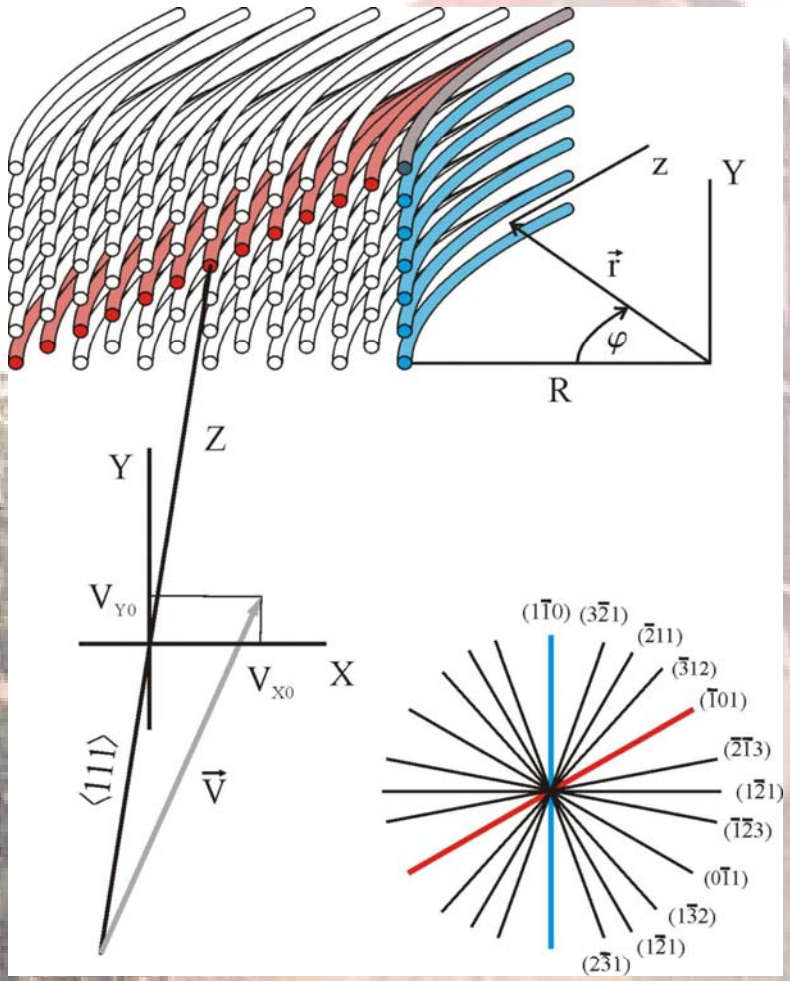
A.M.Taratin and S.A.Vorobiev, NIM B26 (1987) 512

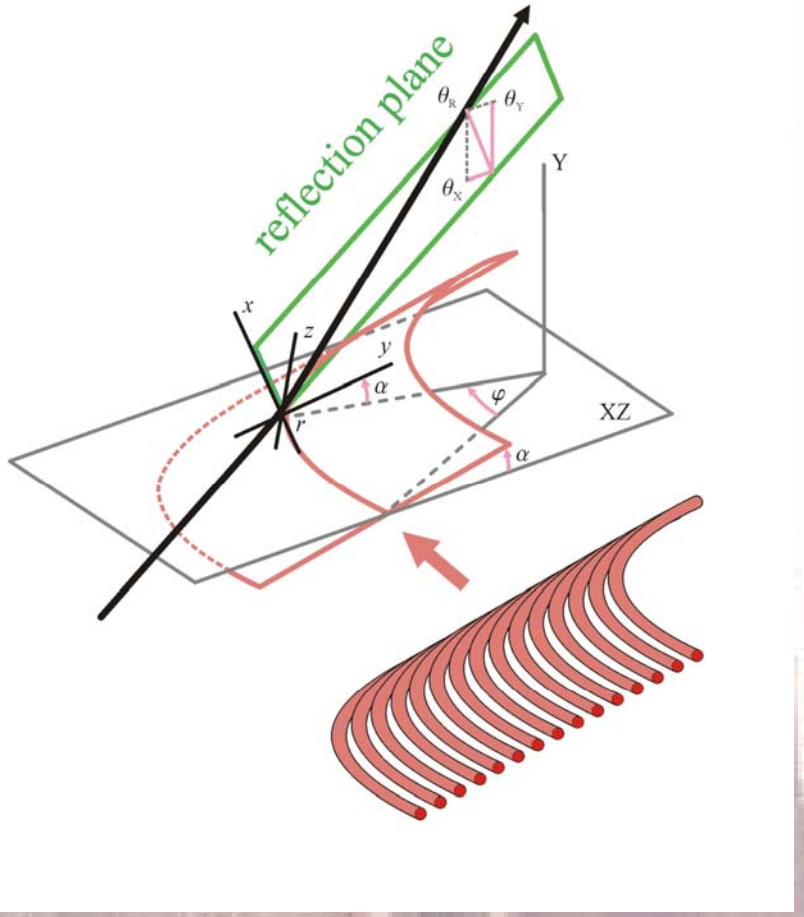




Volume reflection by crystal ***axes***

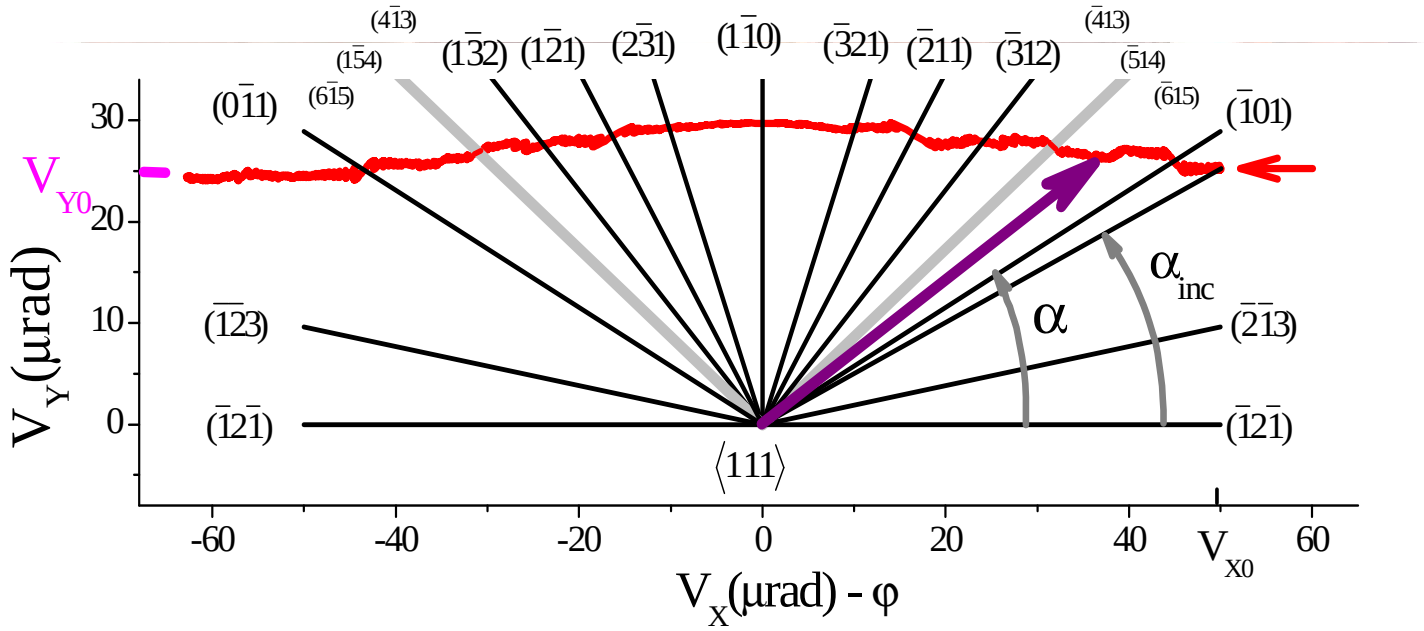
V.V. Tikhomirov, PLB 655(2007)217



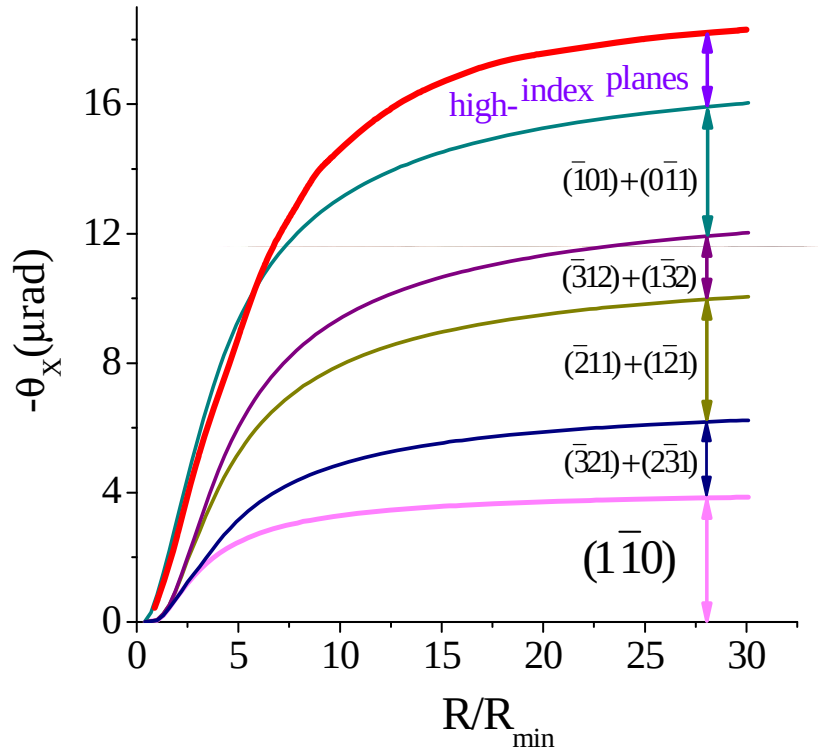


Axes form ***many*** inclined reflecting planes

Protons are reflected from ***many*** crystal plane sets of ***one*** crystal



Reflection from many crystal planes increase VR angle ***4 times*** (LHC case)



$$\upsilon_x(x) = \sqrt{\frac{2}{\varepsilon}\left(\varepsilon_{\perp x} - V(x) + \frac{p\upsilon}{R} x \cdot \sin\alpha\right)} \cdot c$$

$$\varepsilon_{\perp x} - V(x_{turn}) + \frac{p\upsilon}{R} x_{turn} \cdot \sin\alpha = 0$$

$$\tilde{\upsilon}_x = \sqrt{\frac{2}{\varepsilon}\left(\varepsilon_{\perp x} - V(x_{turn}) + \frac{p\upsilon}{R} x_{turn} \cdot \sin\alpha\right)} \cdot c$$

$$\upsilon_y(x) = \sqrt{\frac{2}{\varepsilon}\left(\varepsilon_{\perp x} - \frac{p\upsilon}{R} y \cdot \cos\alpha\right)} \cdot c$$

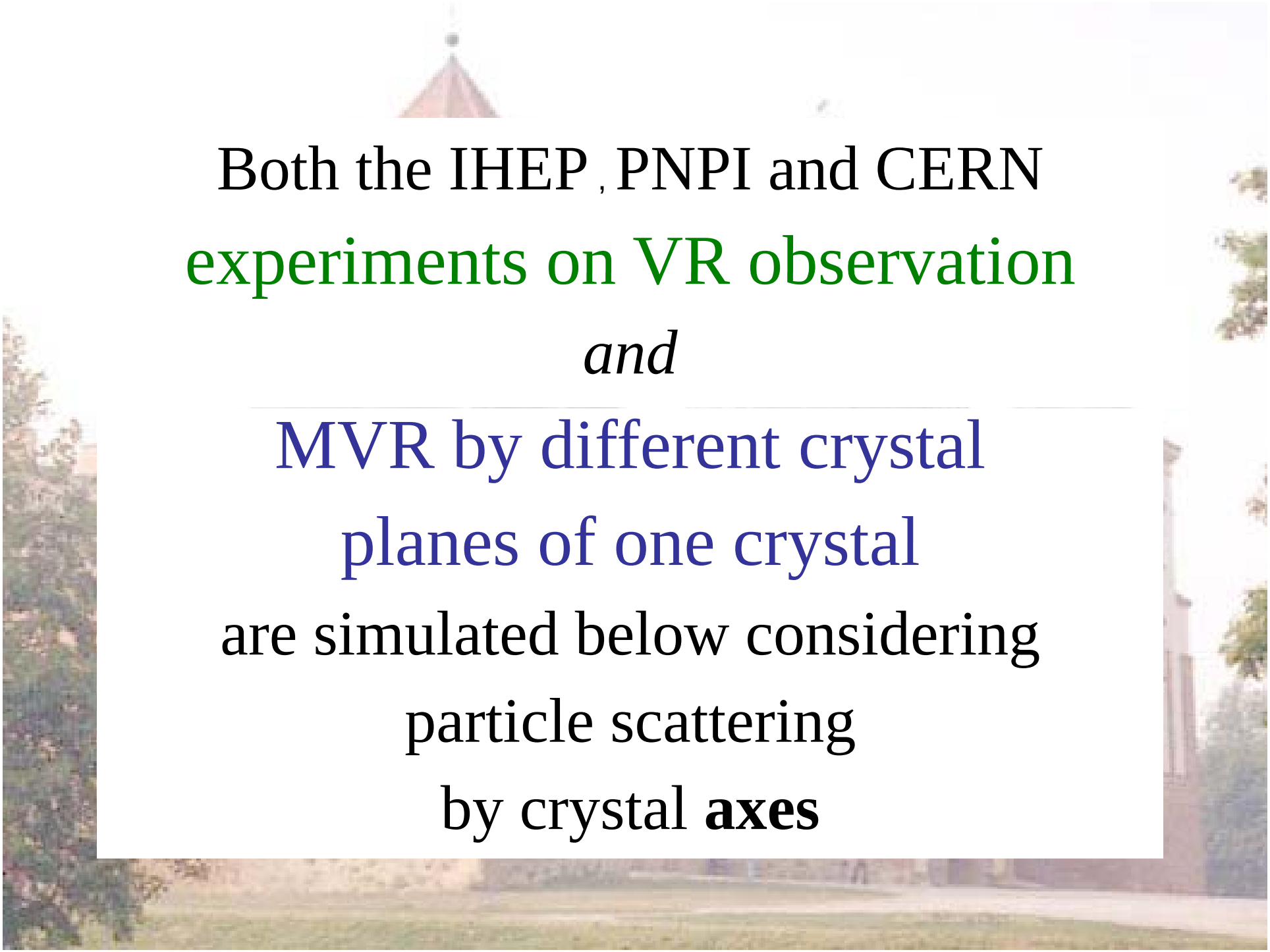
$$\theta_X = \theta_R(R/\sin\alpha) \cdot \sin\alpha$$

$$\theta_Y = \theta_R(R/\sin\alpha) \cdot \cos\alpha$$

$$\theta_R(R/\sin\alpha) = \frac{2\upsilon}{R/\sin\alpha} \int_{x_{turn}}^{\infty} \left(\frac{1}{\tilde{\upsilon}_x} - \frac{1}{\upsilon_x(x)}\right) dx$$

V.V. Tikhomirov, PLB 655(2007)217

The approach of V.A. Maisheev, Phys. Rev. ST Accel. Beams 10:084701,2007 was used.



Both the IHEP , PNPI and CERN

experiments on VR observation

and

MVR by different crystal

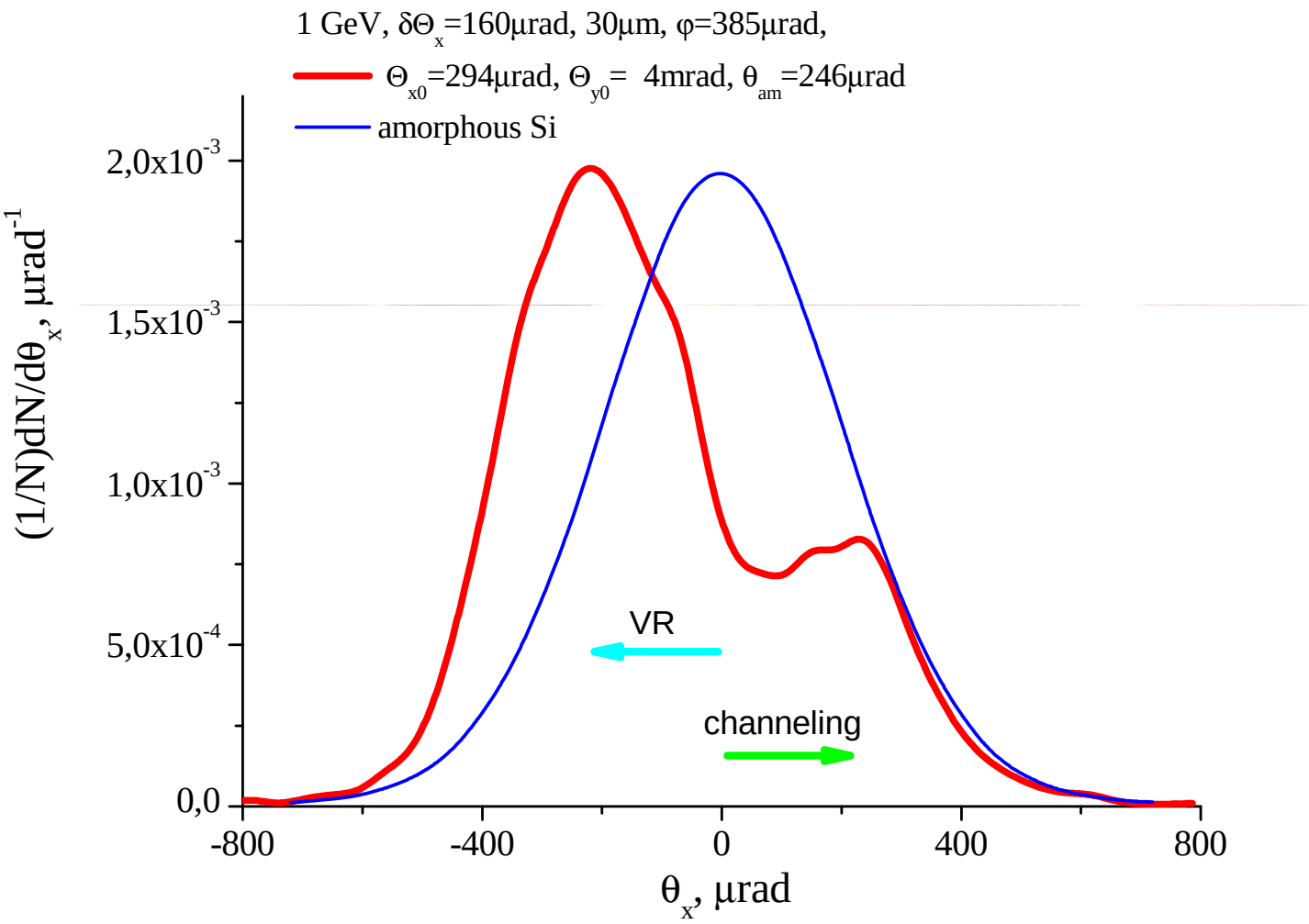
planes of one crystal

are simulated below considering

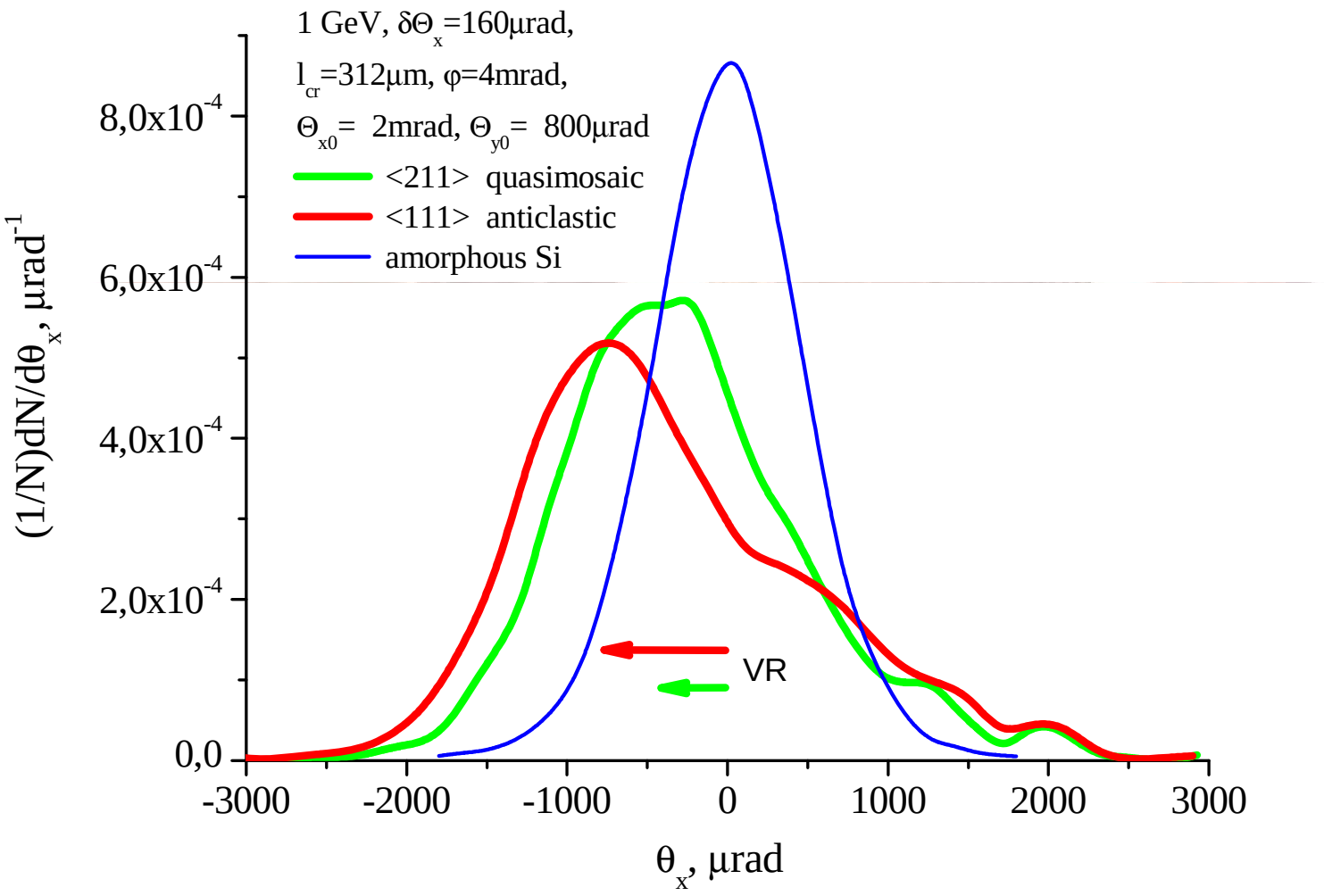
particle scattering

by crystal **axes**

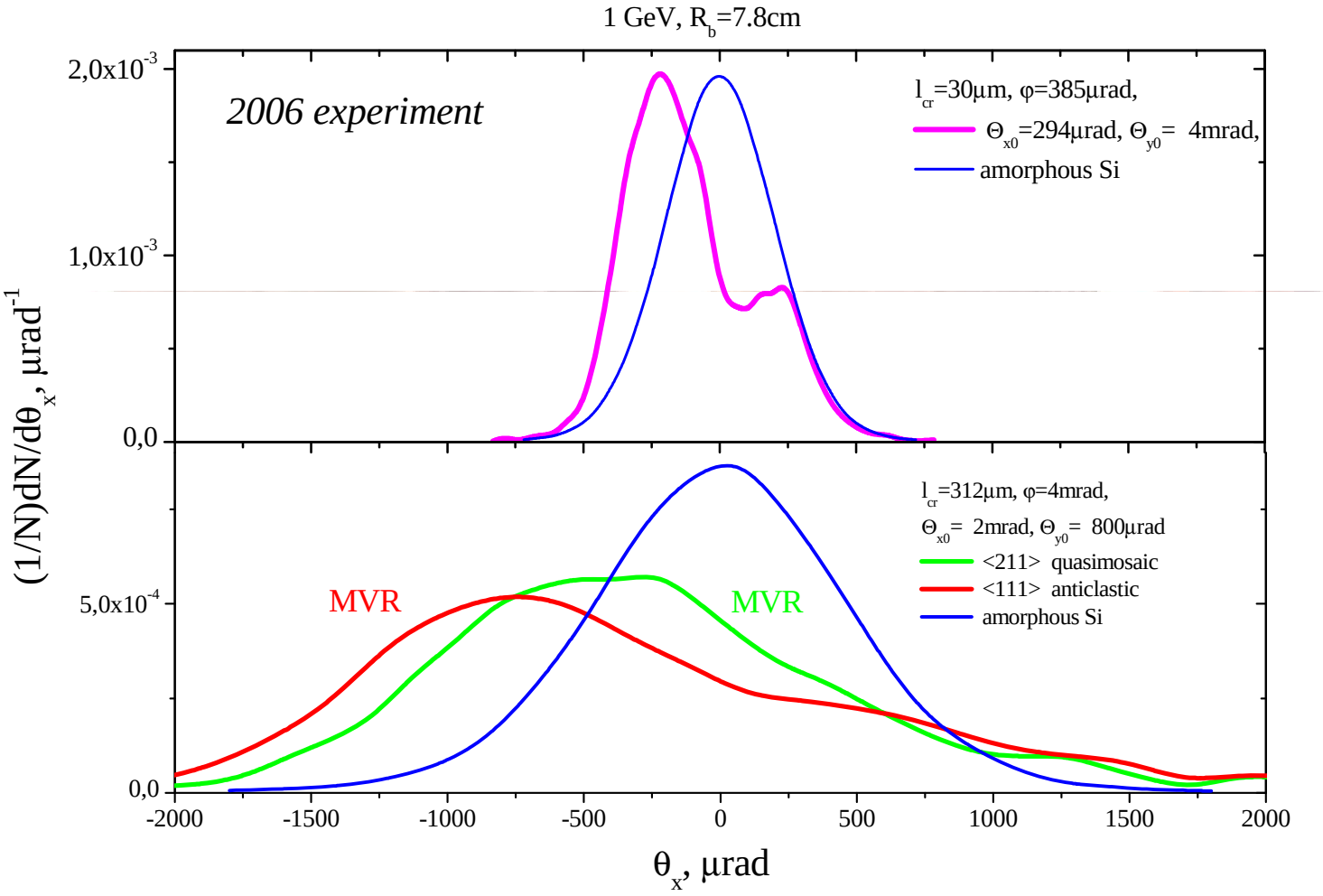
PNPI experiment, 1 GeV; VR



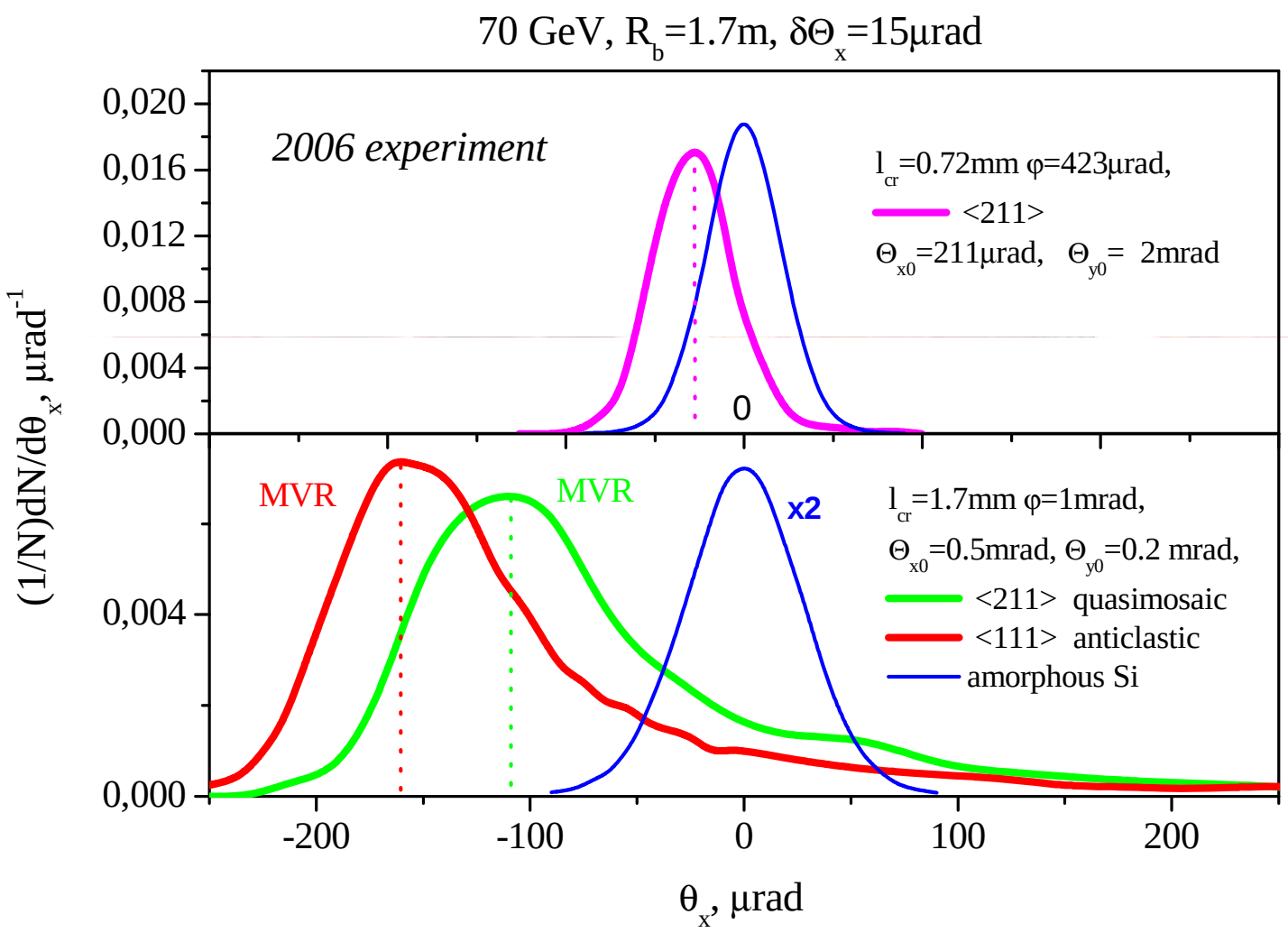
MVR of 1 GeV protons



Comparison of MVR and VR of 1 GeV protons

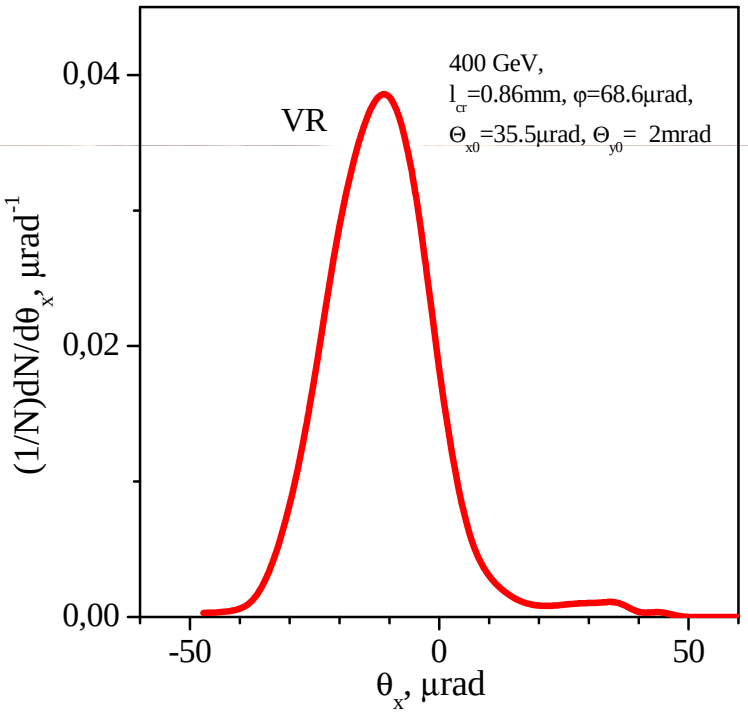


IHEP, 70 GeV; VR experiment and MVR

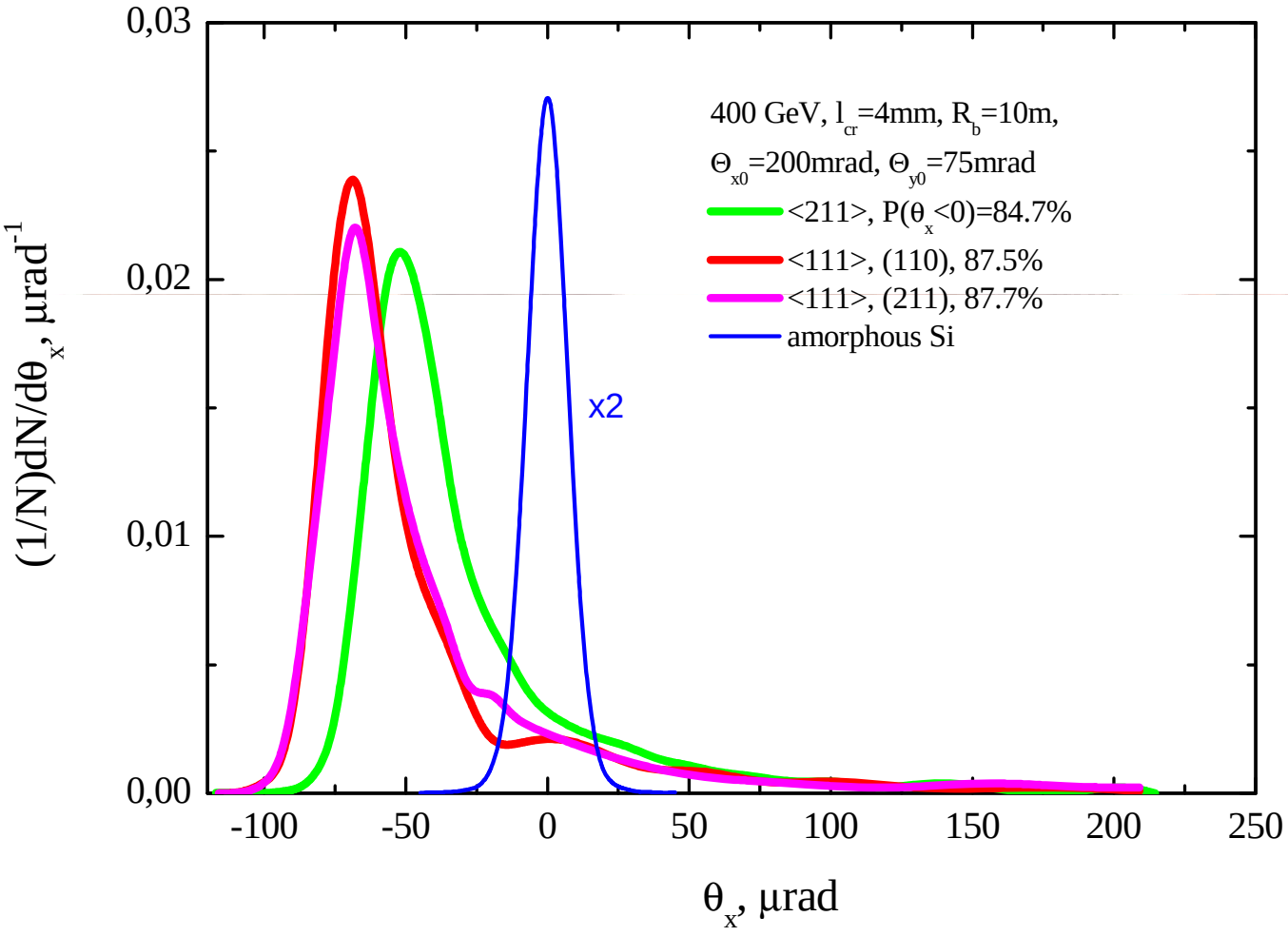


SPS experiment, 400 GeV

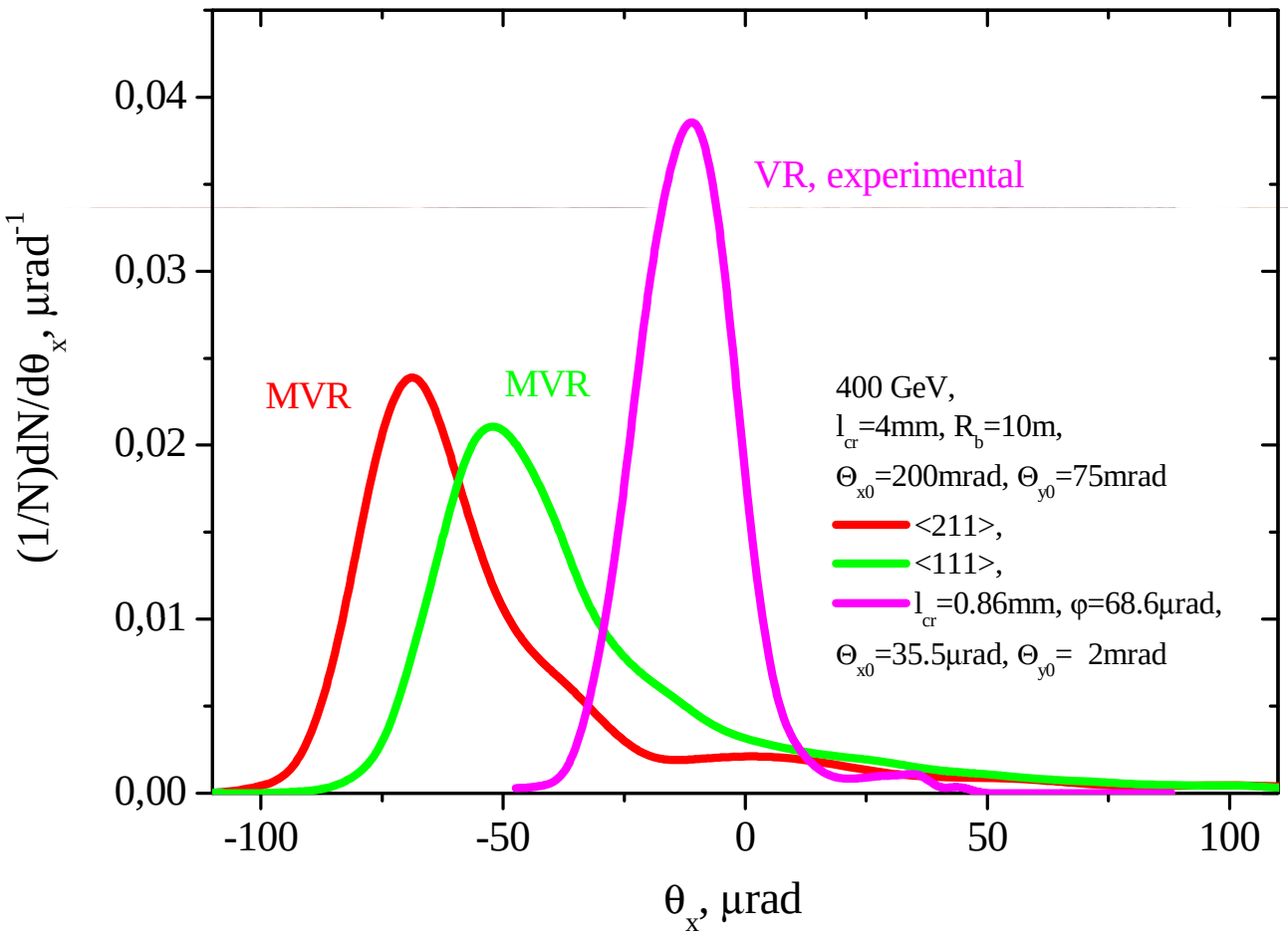
VR:



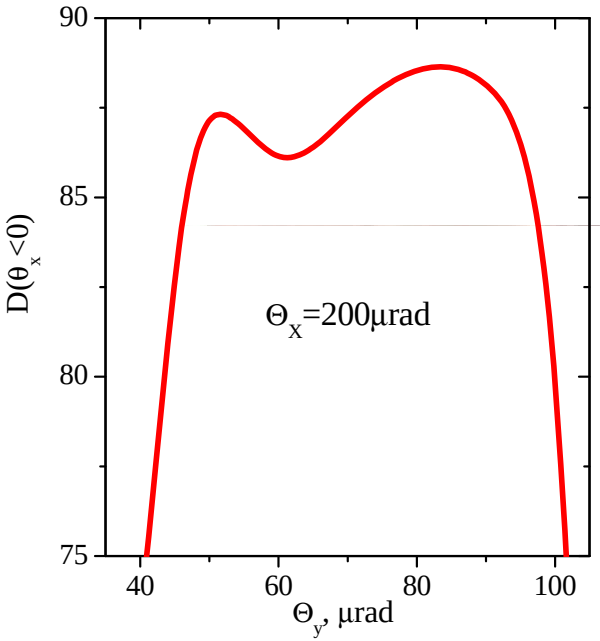
400 GeV; MVR simulations

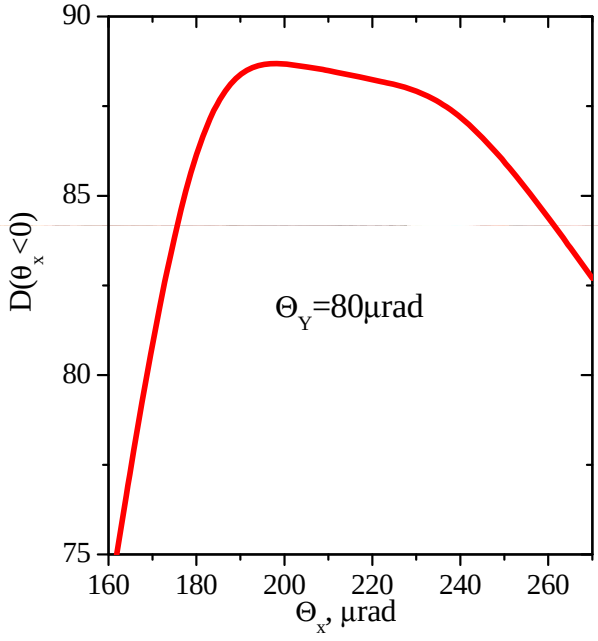


400 GeV, comparison of SPS VR experiment and MVR simulations



MVR efficiency dependence on proton incidence direction
E=400GeV, l_{cr}=4mm, R_b=10m

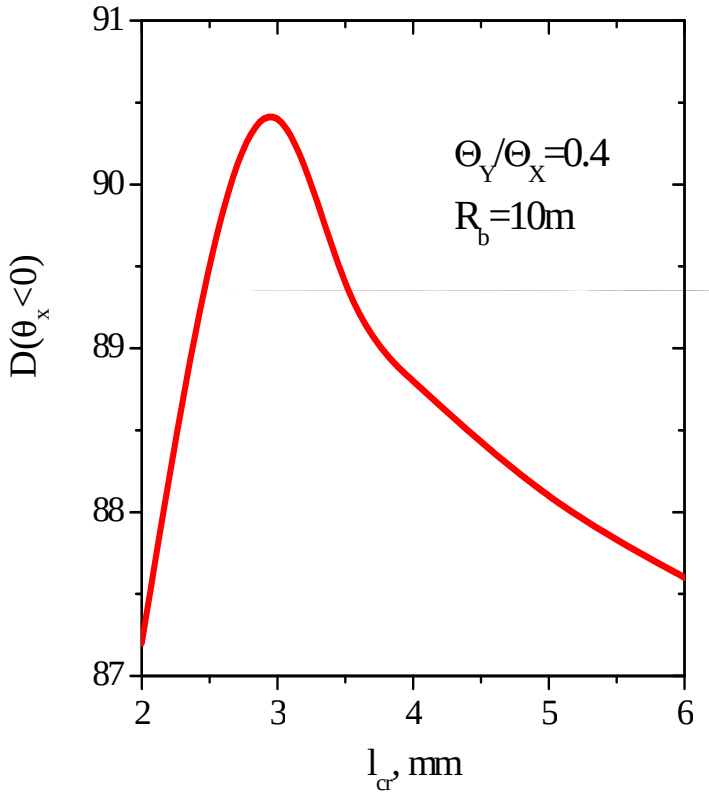


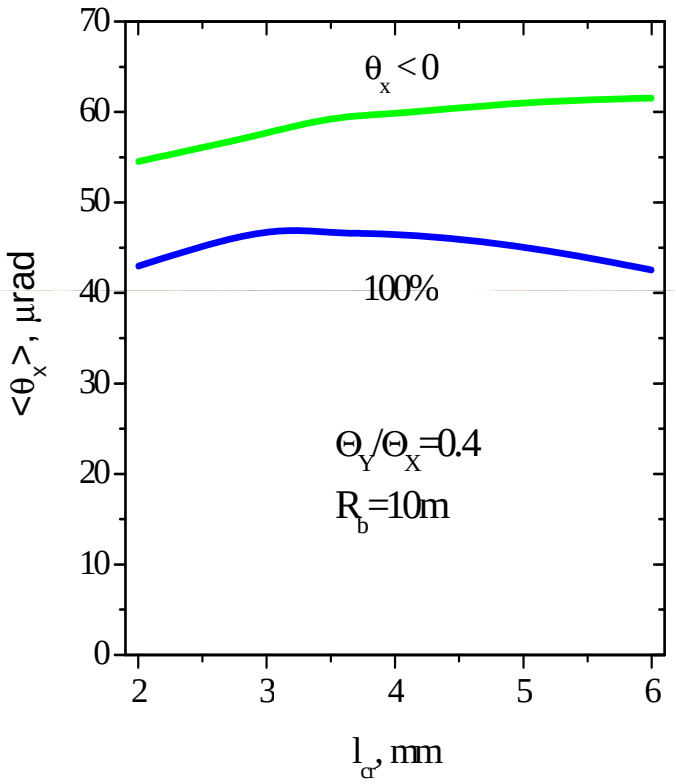


The angular deflection efficiency dependence is week

The ratio $\Theta_y / \Theta_x = 0.40$ looks close to optimal one

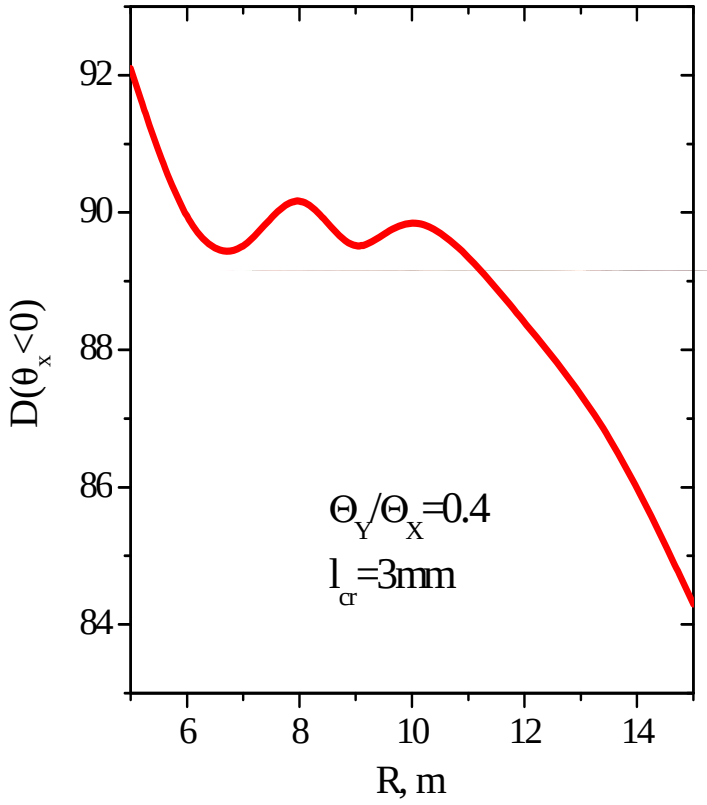
Optimal l_{cr} values

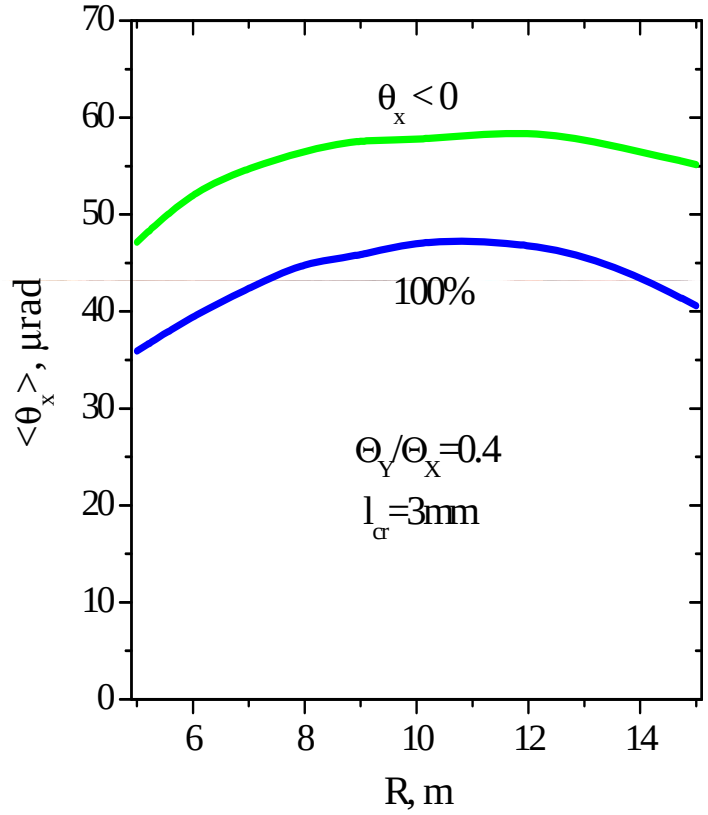




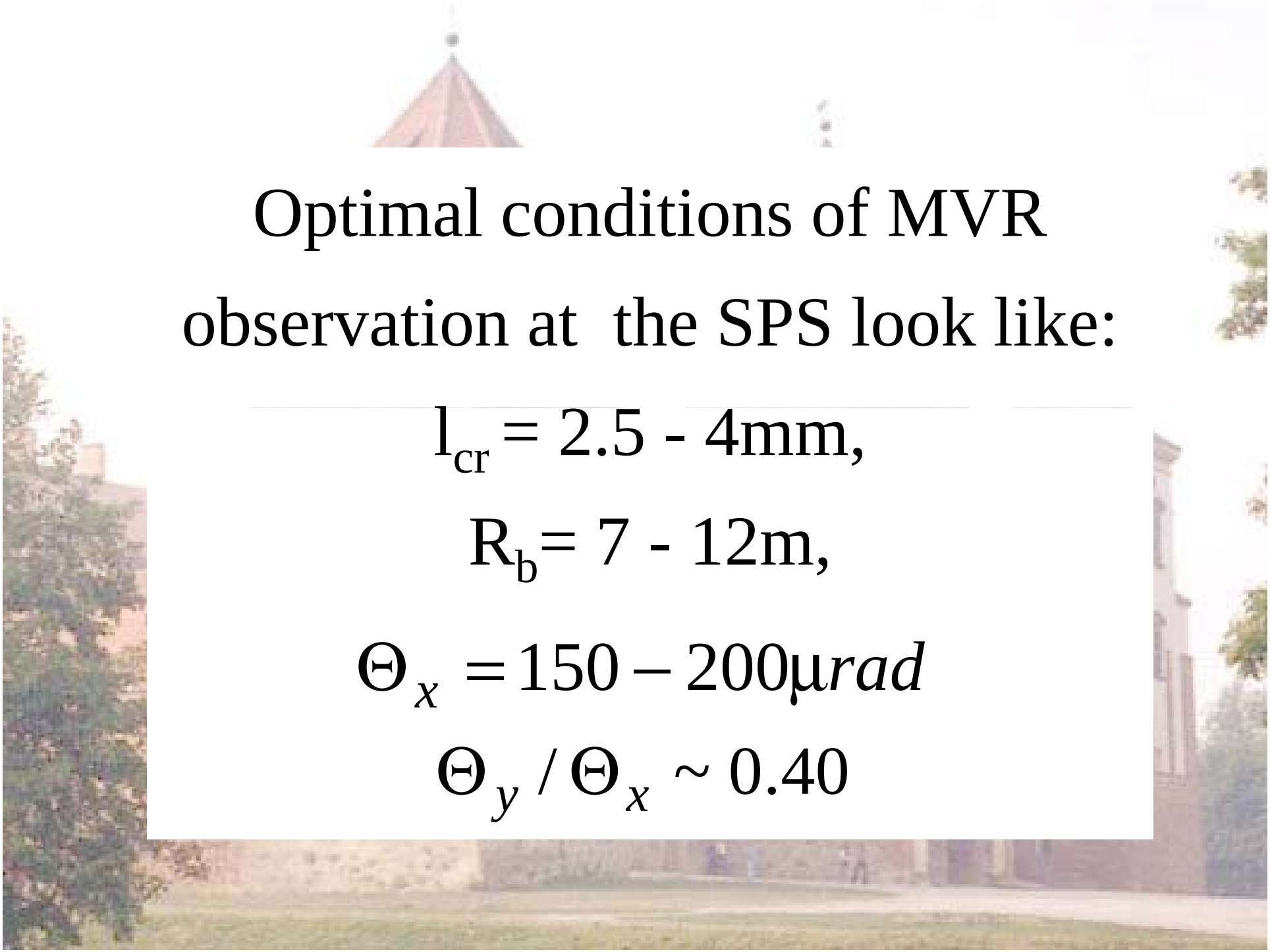
The optimal l values are l_{cr}=2.5 - 4mm

Optimal R_b values





The optimal R_b values are R_b=7-12m



Optimal conditions of MVR observation at the SPS look like:

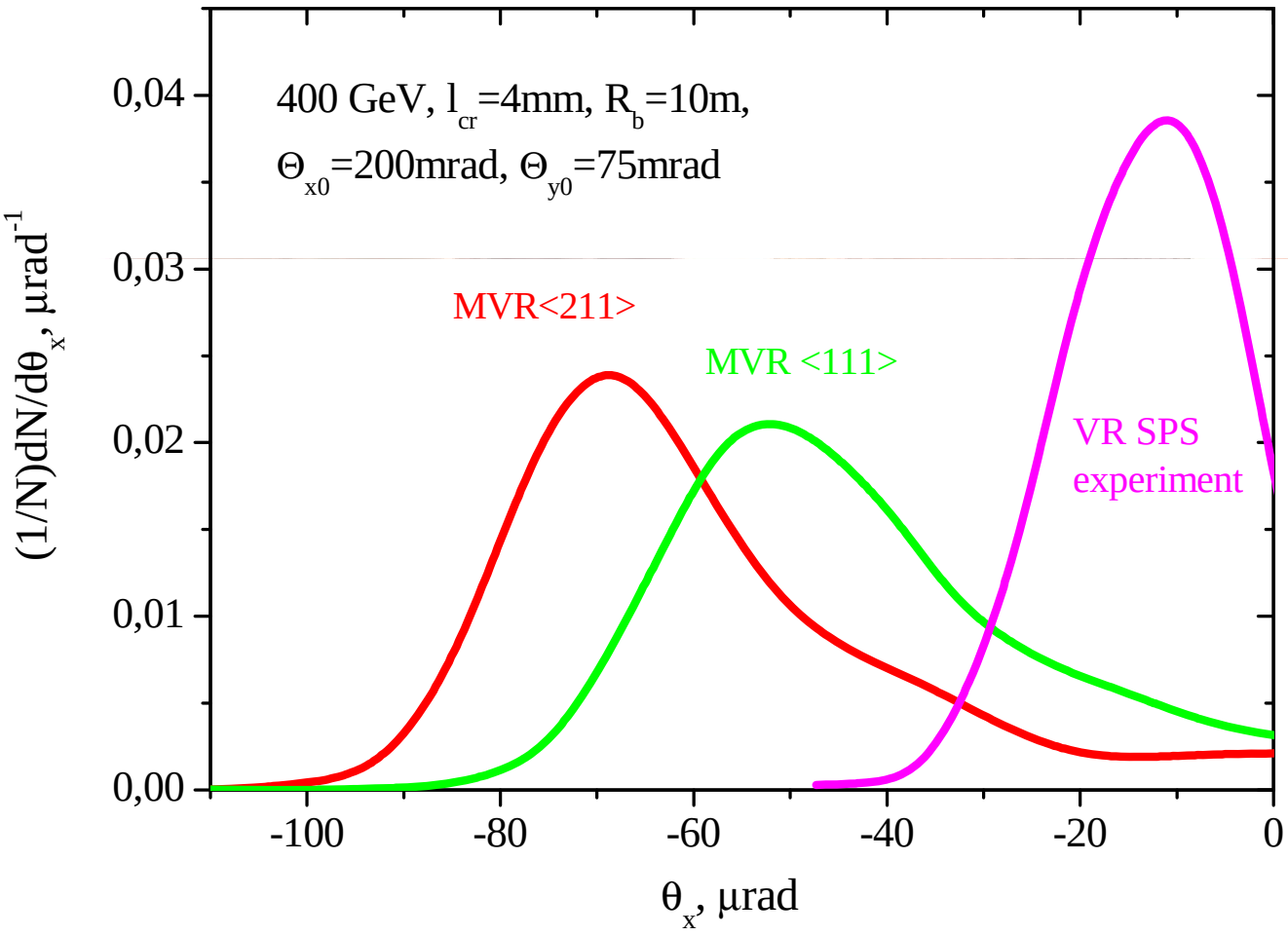
$$l_{cr} = 2.5 - 4\text{mm},$$

$$R_b = 7 - 12\text{m},$$

$$\Theta_x = 150 - 200\mu rad$$

$$\Theta_y / \Theta_x \sim 0.40$$

VR experiment and MVR simulations, $\theta_x < 0$




Thank you for attention!

The Mir castle