

Study of crystal extraction of circulating beam from the U-70 at injection energy.

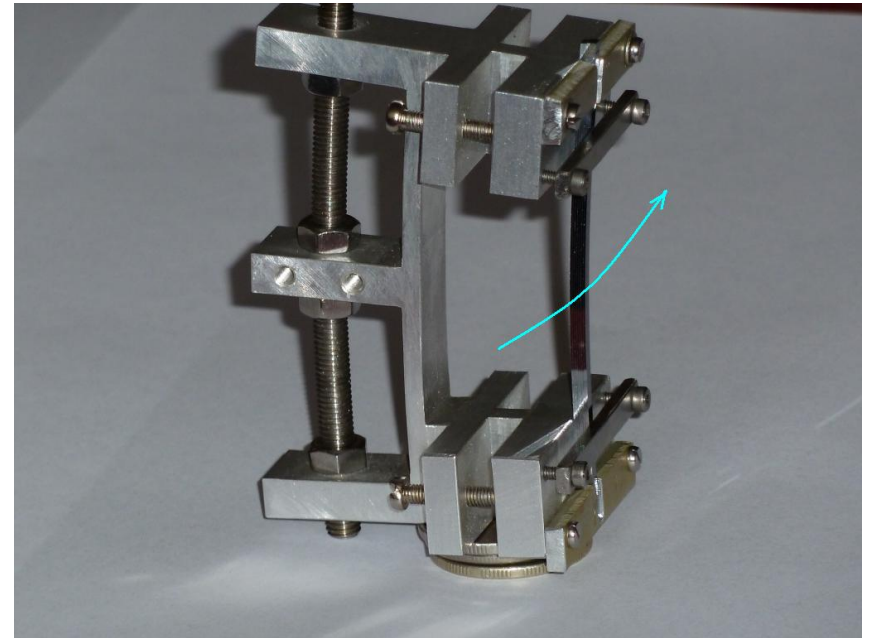
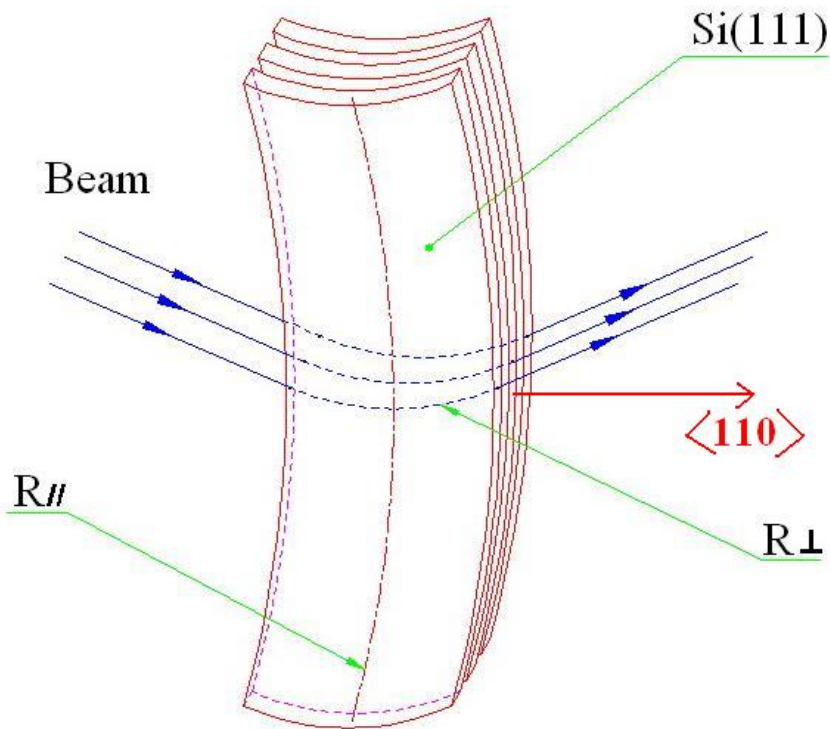
**Yu.A. Chesnokov, A.G. Afonin, V.T. Baranov, G.I. Britvich,
P.N. Chirkov, V.A. Maishev, D.A.Savin, V.I. Terekhov**

**Institute for High Energy Physics in National Research Centre Kurchatov
Institute,
142281, Protvino, Moscow region, Russia**

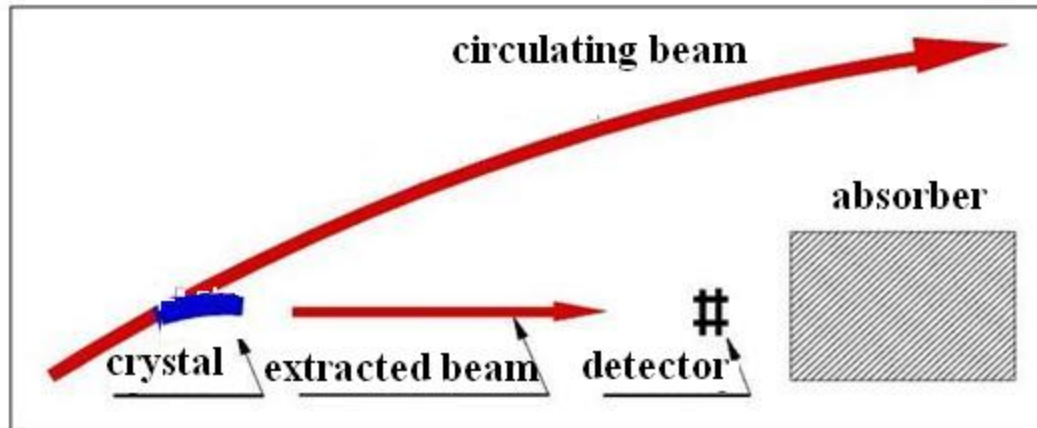
Abstract.

Phenomenon of deflection of charged particle beam due to channeling in a bent crystal is good investigated and successfully applied for extraction of beam in high-energy accelerators, at the energies of about 10 GeV and higher. However, a big practical interest presents the task of bending and extraction of charged particles with energies below 1 GeV, for example, production of ultrastable beams of low emittance for medical and biological applications. That's why two novel crystal technique, namely: thin sequential straight crystal targets, and array of short bent crystal strips were investigated in this report as elements for extraction of beam from U-70 accelerator. Experimental results were obtained for extraction of 1.3 GeV protons and six-charged carbon ions with energy of 450 MeV/nucleon.

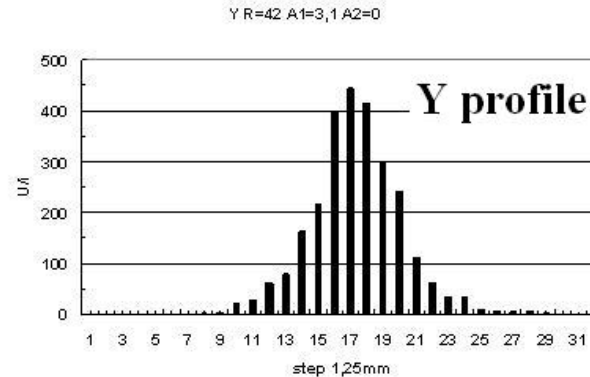
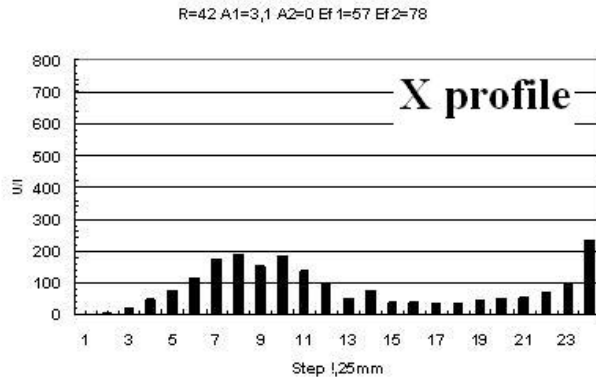
Crystal array



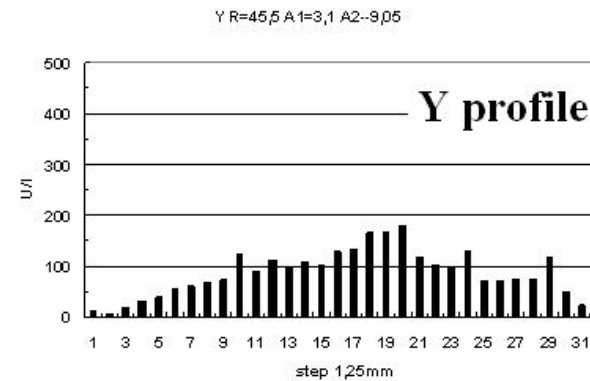
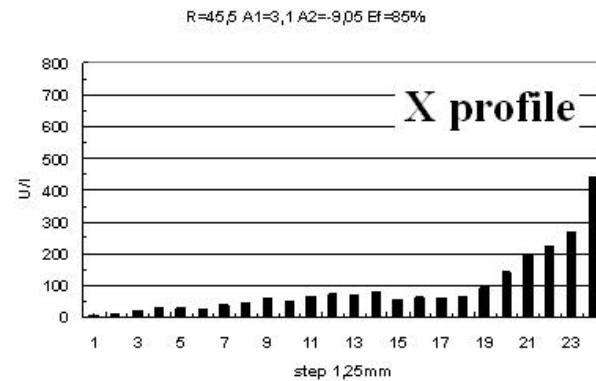
Scheme of experiment



Testing at 50 GeV at first

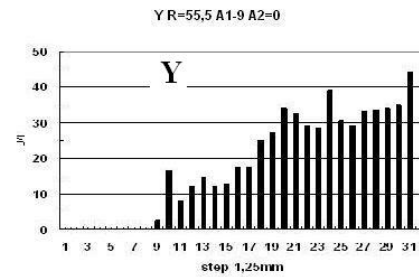
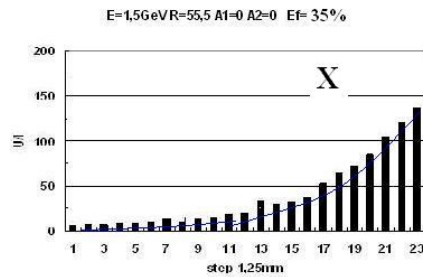


**Planar (111)
effect 80%**

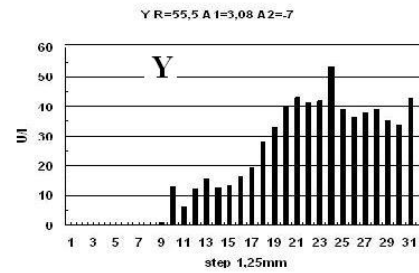
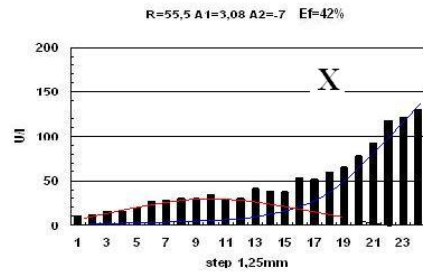


**Axial <110>
effect 90%**

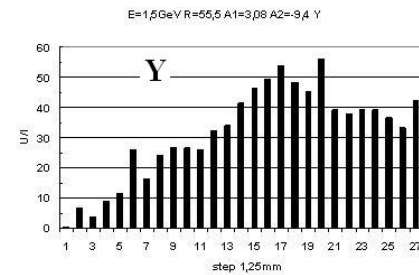
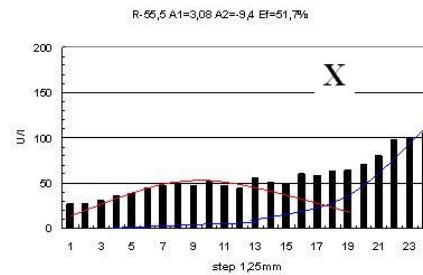
Testing at 1.3 GeV



amorphous
35%

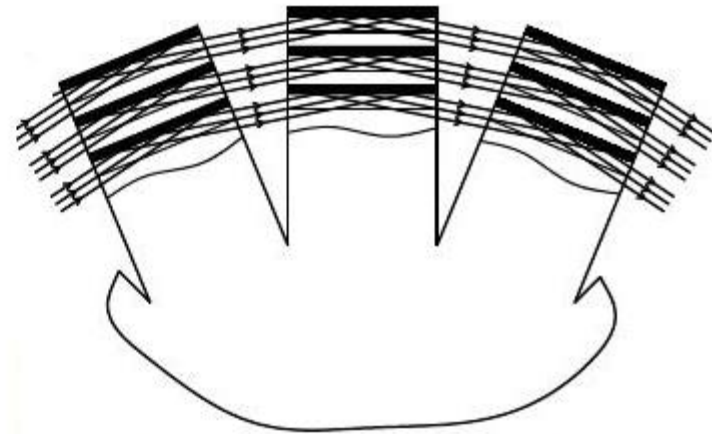


Planar (111)
effect 15%



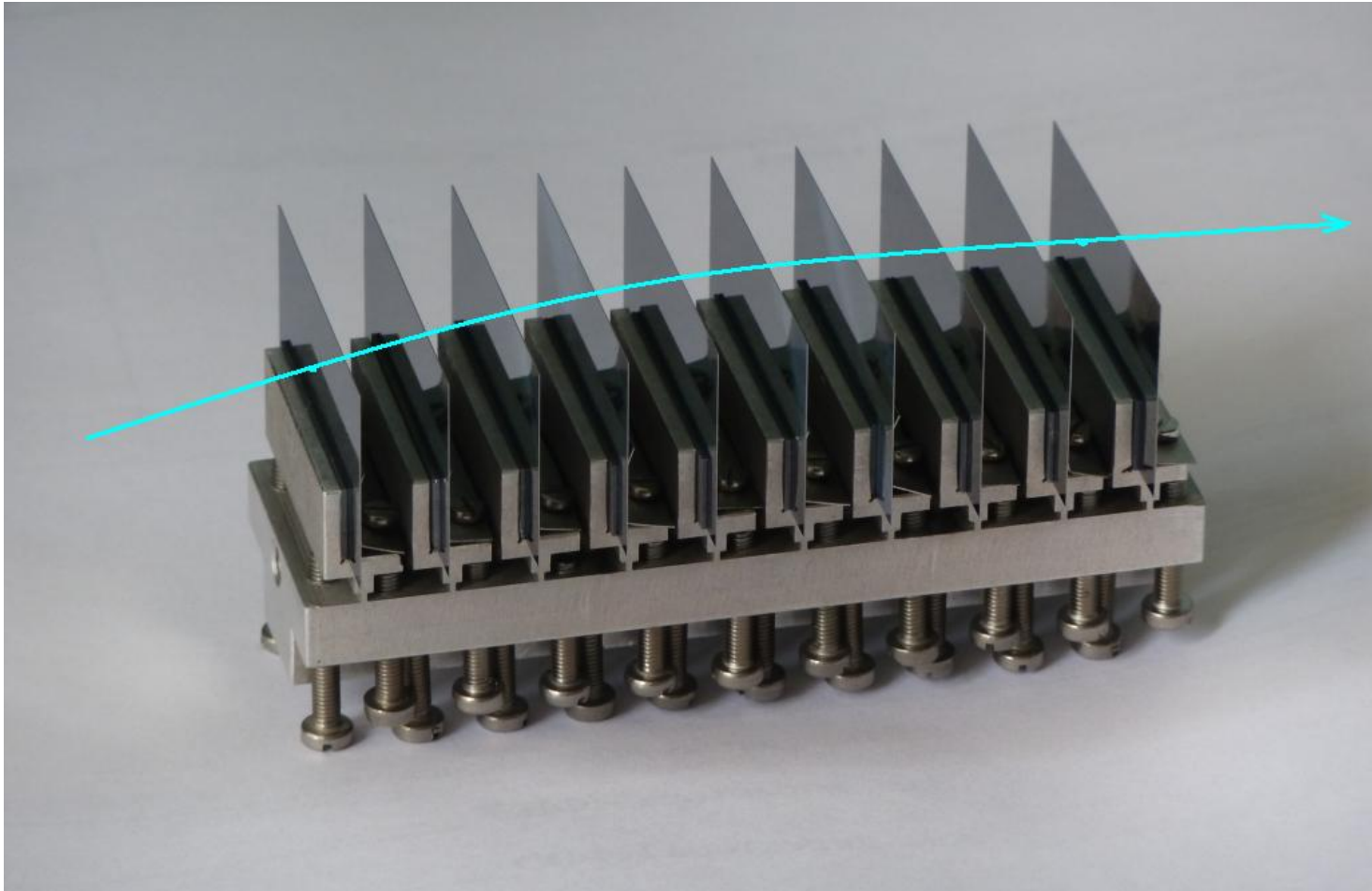
Axial <110>
effect 25%

Fan-like reflector

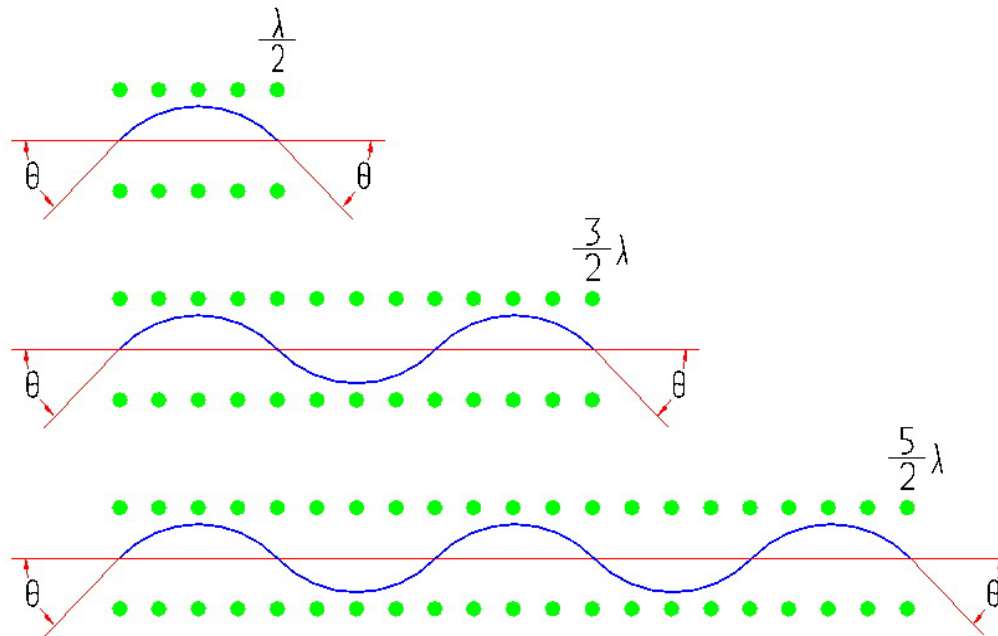


Fan – type reflector

Photo of the device

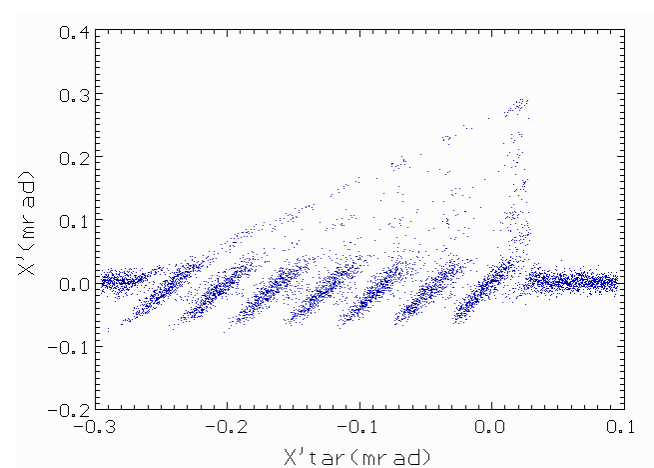
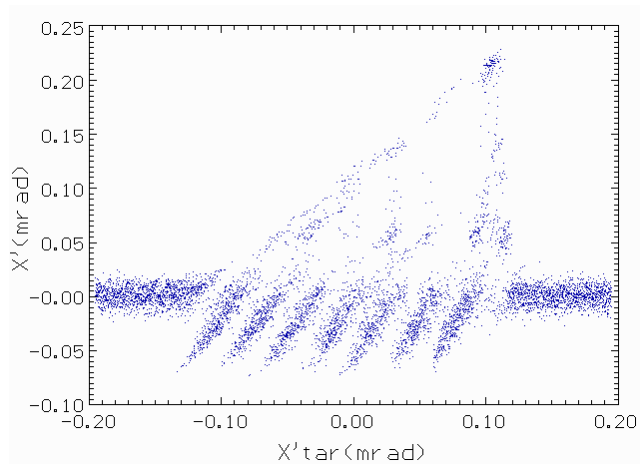
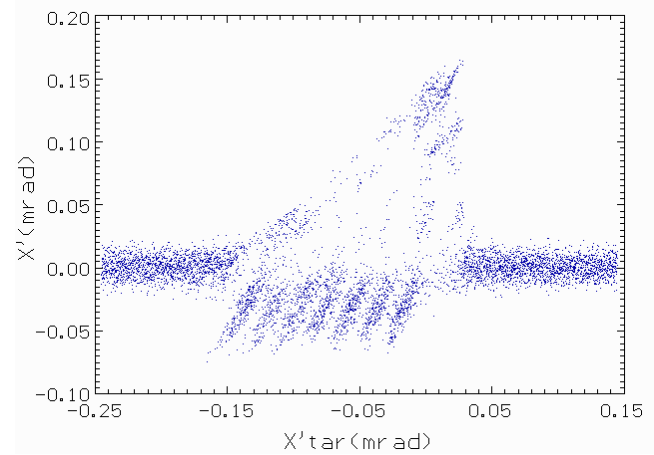
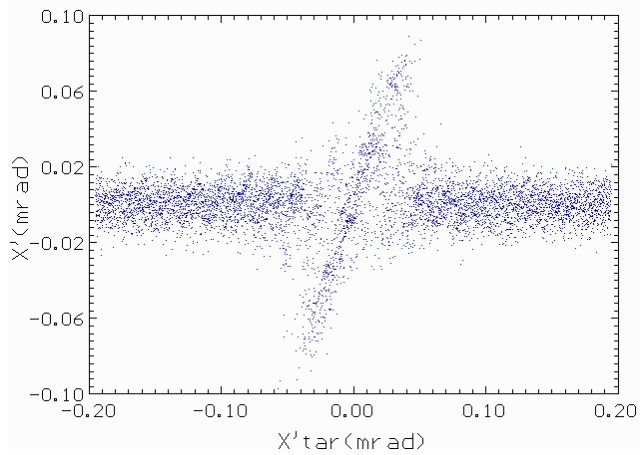


Principle of particle beam steering by thin straight crystals

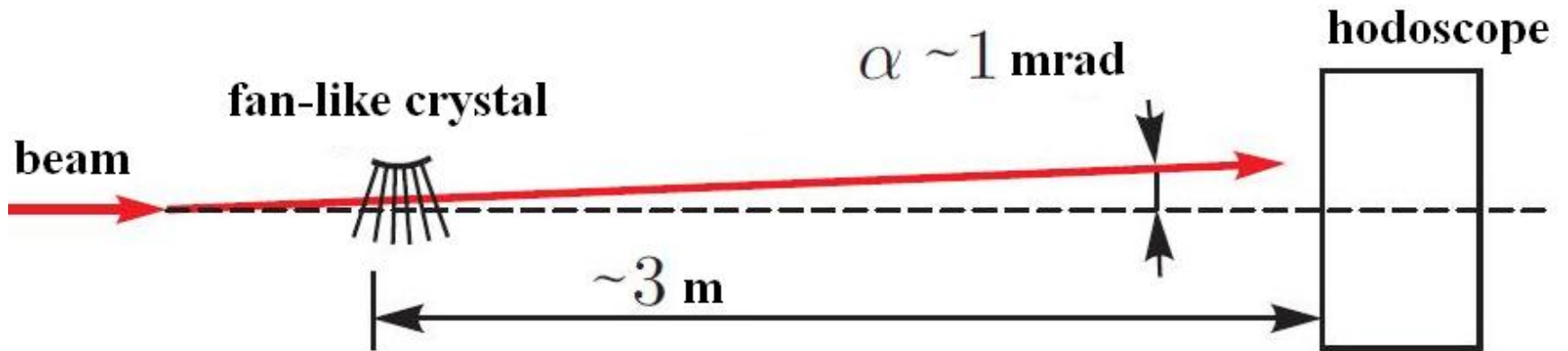


Effect of particle trajectory bending in thin crystal.

Distribution of protons after passage of a crystal fan from seven plates depending on its angular orientation with respect to the beam.

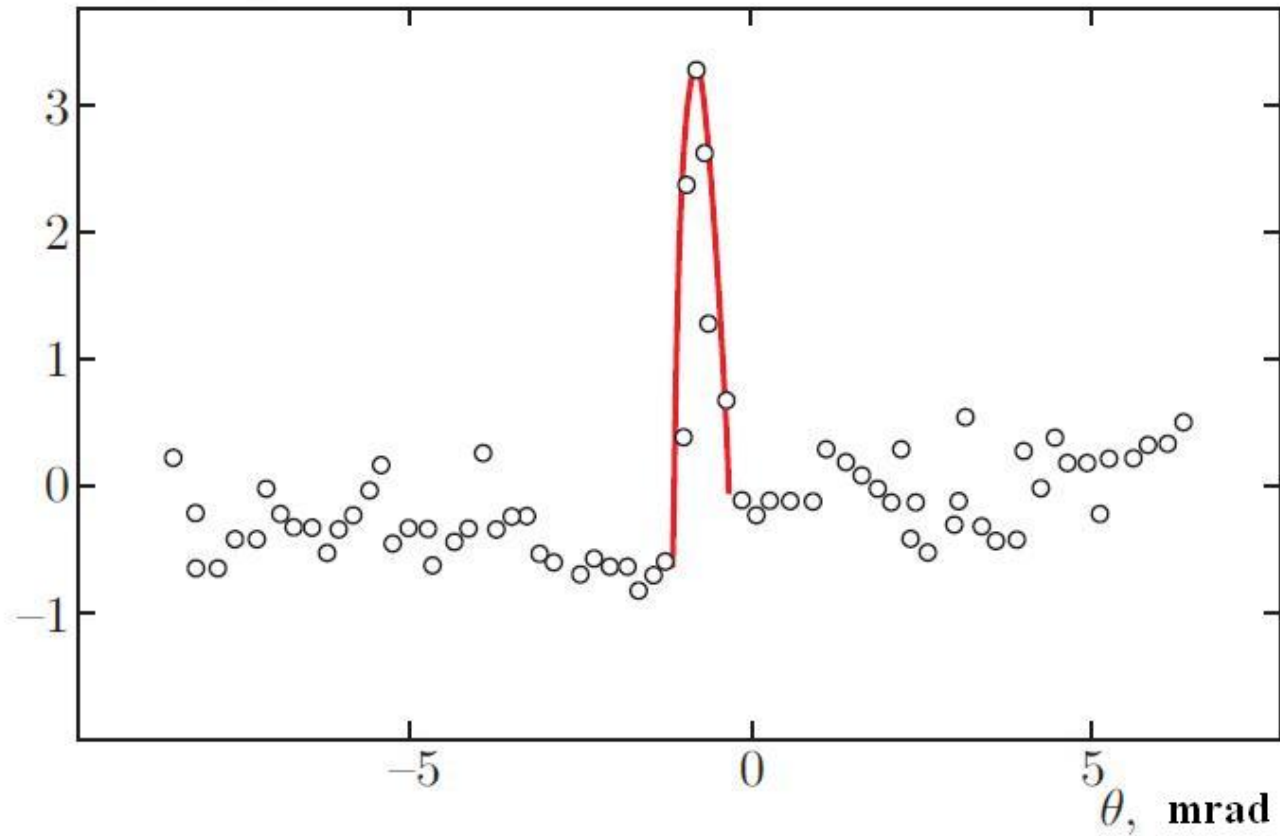


Experiment in beam line (1.3 GeV)



Results

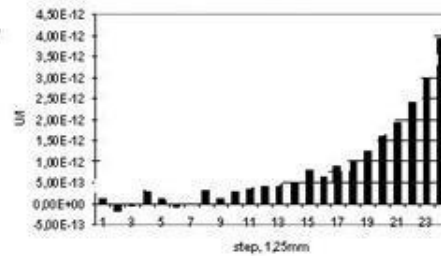
beam displacement, mm



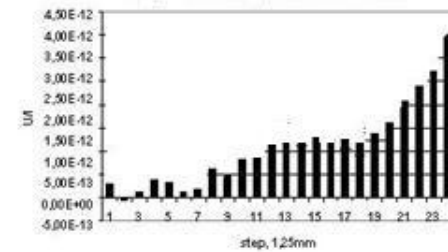
Fan device in circulating beam



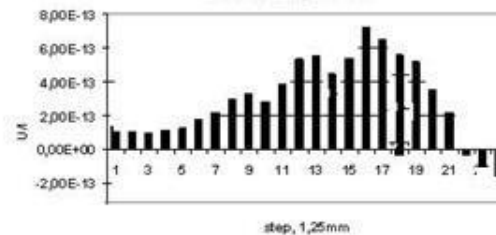
disaligned crystal



aligned crystal



difference



**cogent effect
plane (110) 18%**

Conclusion

At the moment efficiency of crystal extraction achieved the value 25%. This result can be improved after optimization of beam direction towards the crystal devices. Using RF noise is planned instead of slowly increasing bump magnets.