

Guiding of the Beam of 10 keV Electrons by Micro Size Tapered Glass Capillary

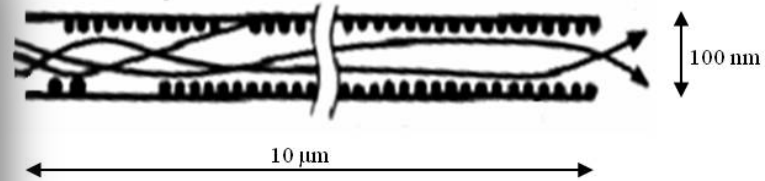
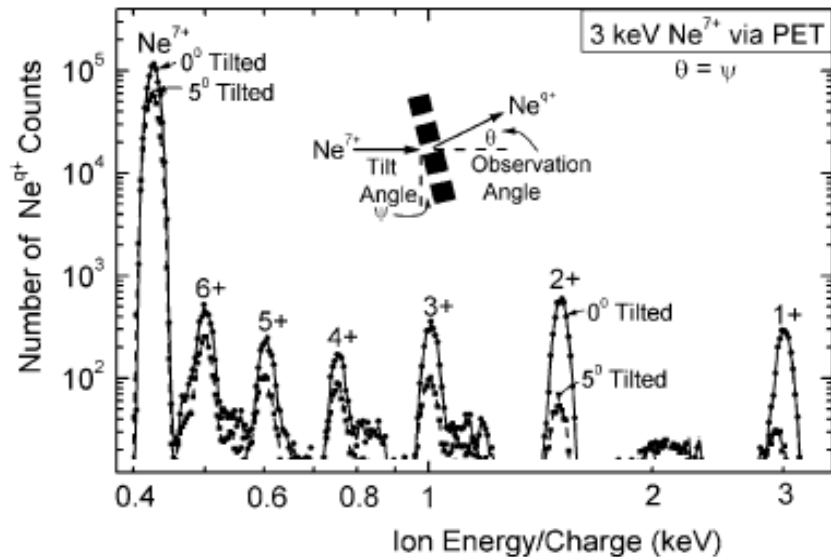
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Russia

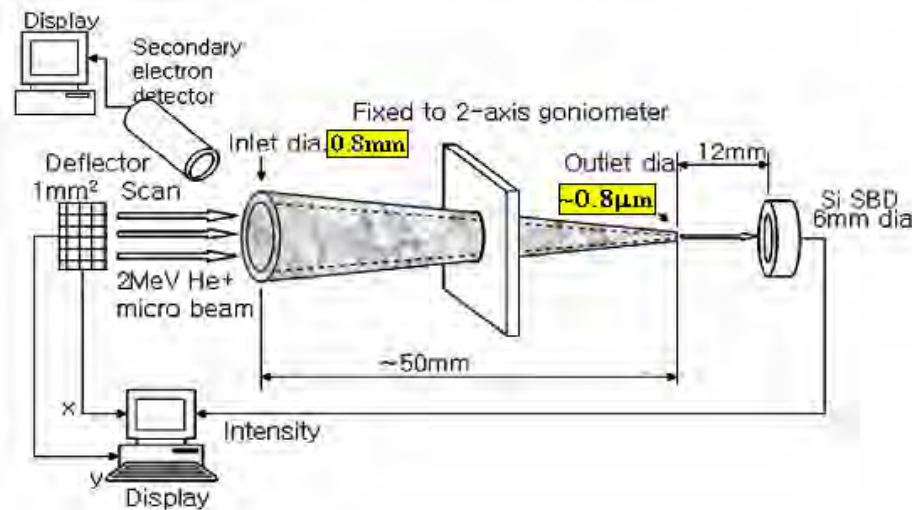


Guiding of ions...



Guiding of 3 keV ions of Ne^{7+} transmitting through PET

N. Stolterfoht, J.-H. Bremer, V. Hoffmann et al. //Phys.Rev.Lett. 2002. V.88. p.133201



Focusing of ion beam by means of tapered glass capillary was demonstrated in 2003 in the work of *T. Nebiki, T. Yamamoto, T. Narusawa //J.Vac. Sci. Technol. 2003.A 21(5), p.1671*. **The current density of the beam was increased by four orders.**

Guiding of electrons...

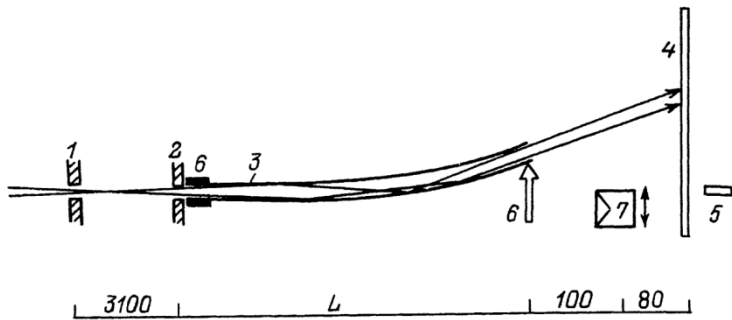


Рис. 1. Схема эксперимента. 1, 2 – алюминиевые коллиматоры; 3 – капиллярная трубка; 4 – фотокассета; 5 – лазер; 6, 6' – изгибающее устройство; 7 – подвижный цилиндр Фарадея.

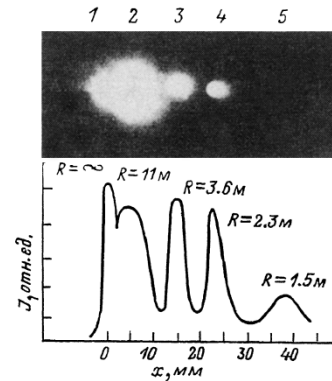
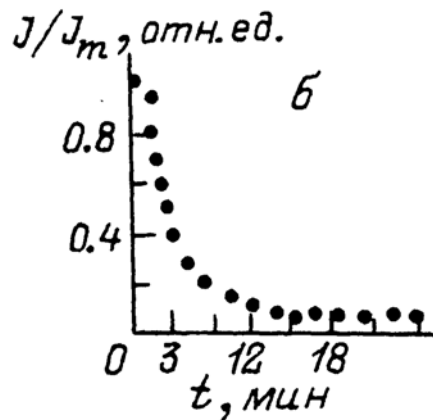


Рис. 2. Фотография отклоненного пучка и кривая фотометрирования для стеклянной трубки диаметром 1.2 мм и длиной 180 мм.

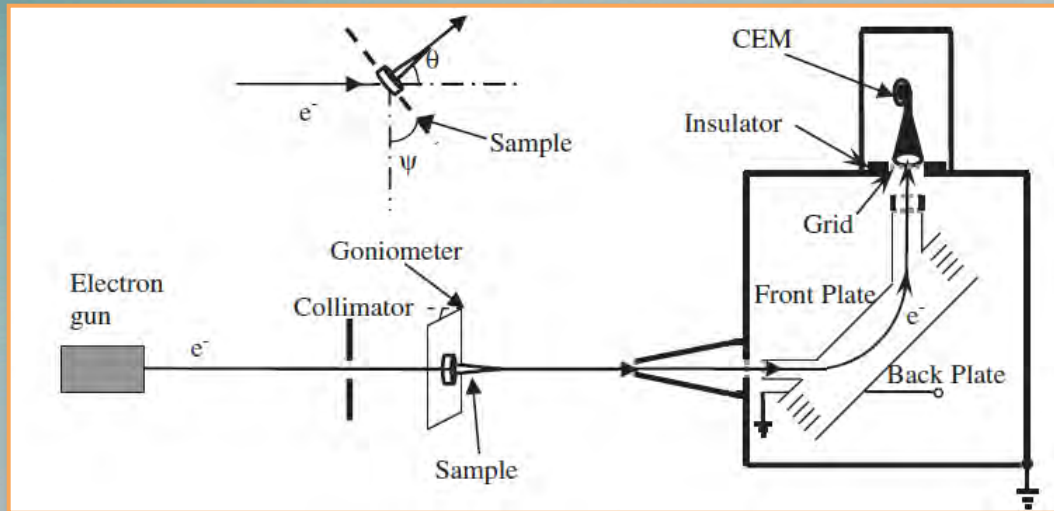
A.Yu. Basai, C.A. Vorobiev, V.V. Kaplin et al.// *Technical Physics Letters*, V. 14(9), pp.849-854, 1988

Deflection of the high current pulse beam of electrons with energy of 1.5 MeV by the bended glass tubes. For the bending radius of 5 m the intensity was less then 2% of initial beam.

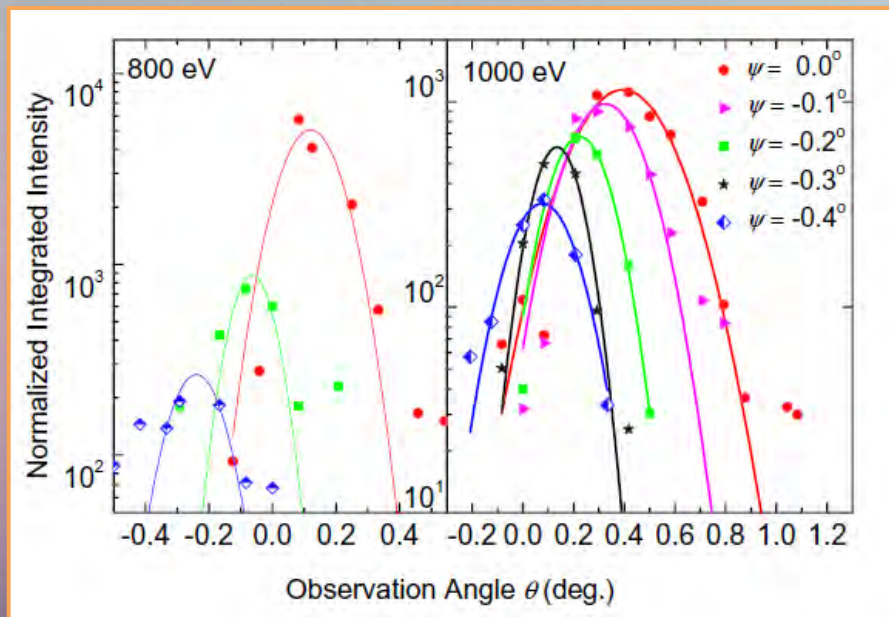


Time dependence of the electron transmission through the straight glass tube of 180 mm length and 1.2 mm diameter. For the bended tubes the reduce of the current was not observed.

Tapered channels...800 eV and 1000 eV electron beams



“No significant energy loss was found for the sample tilt angles investigated.”



“The guiding ability of electrons was found to decrease with increasing energy...”

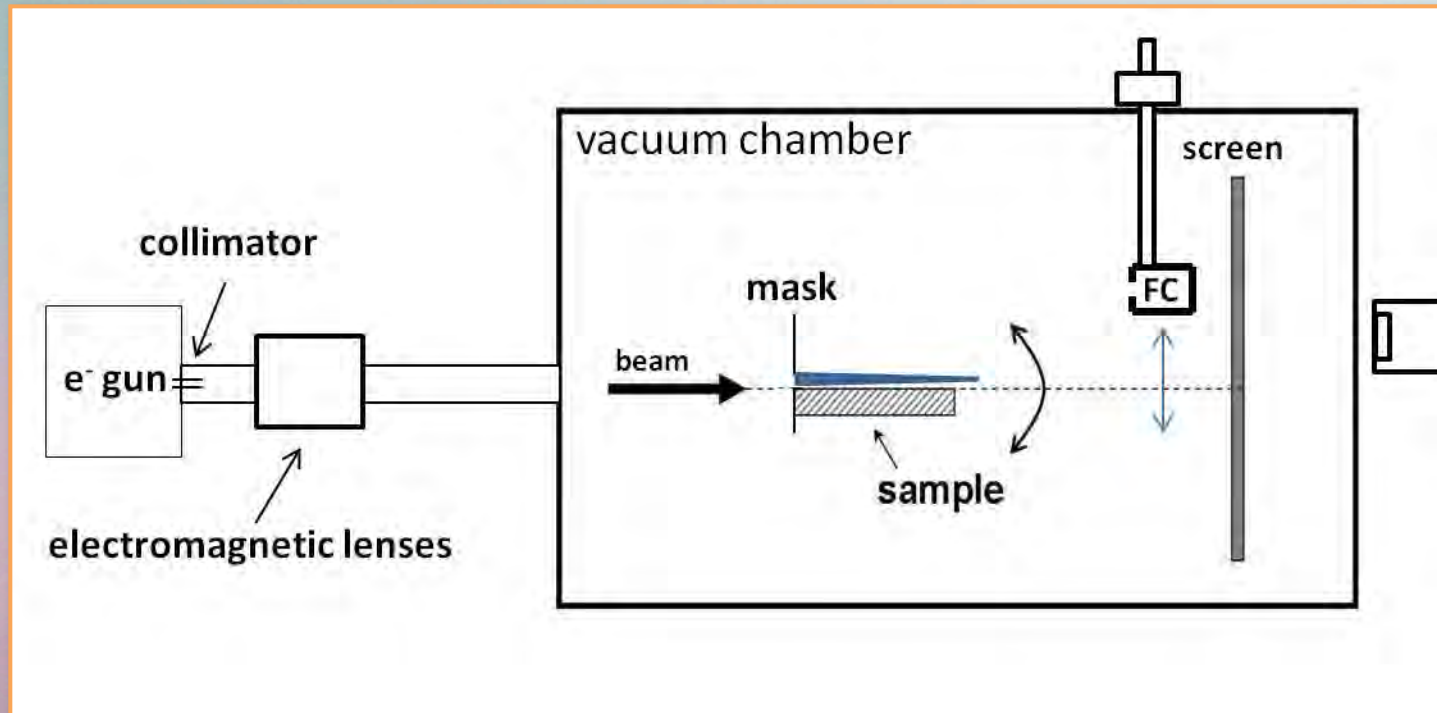
Characteristic guiding angle ψ_c for 800 and 1000 eV.

Energy (eV)	Guiding angle ψ_c
800	$0.67^\circ \pm 0.40^\circ$
1000	$0.33^\circ \pm 0.05^\circ$

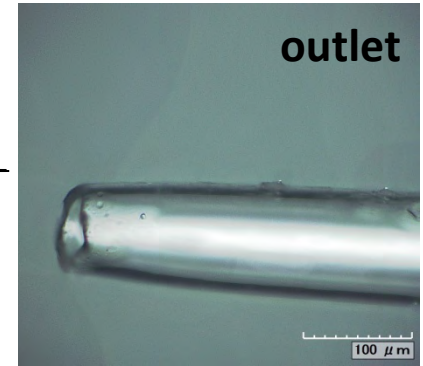
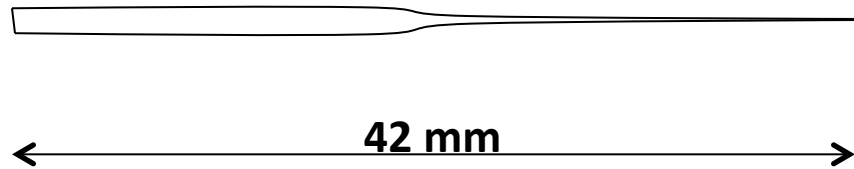
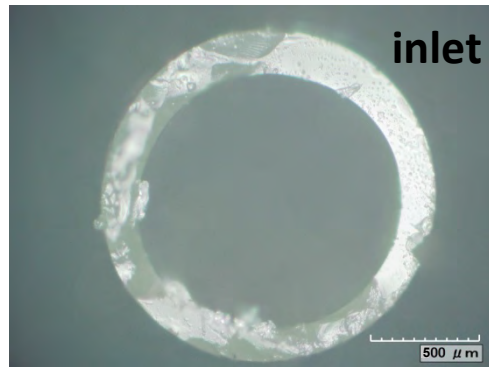
Tapered channels... scheme of experiments

Energy 10 keV

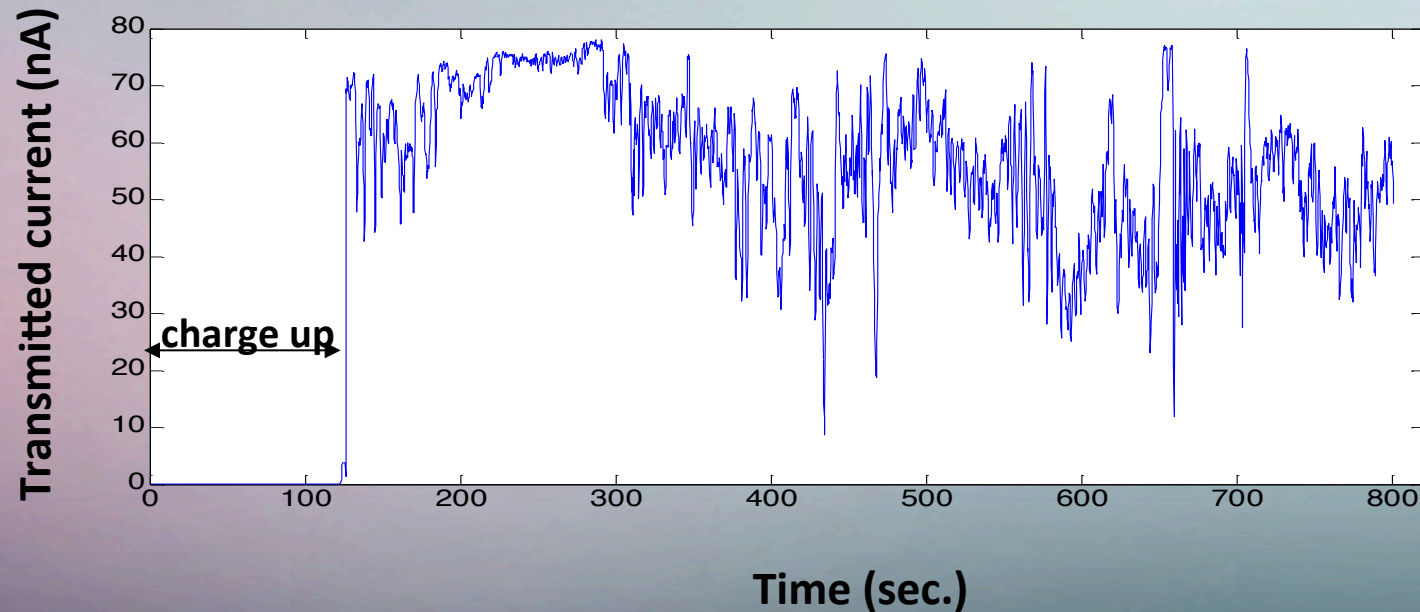
Incident beam current is 350 nA with FWHM=1.9 mm and angular divergence less than 0.28°



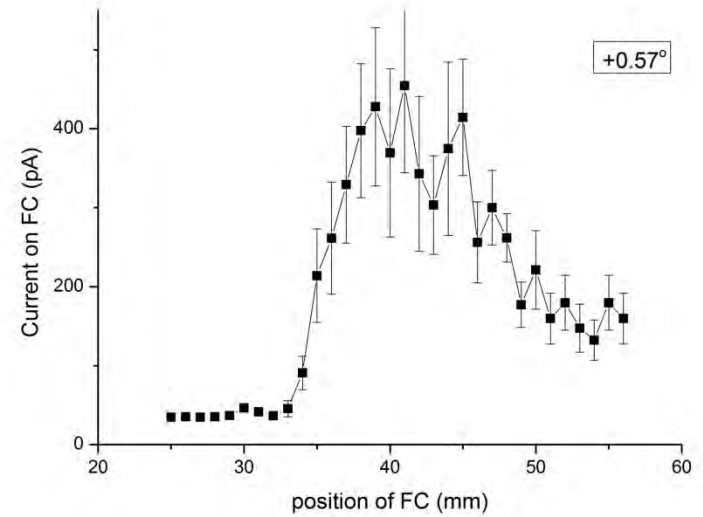
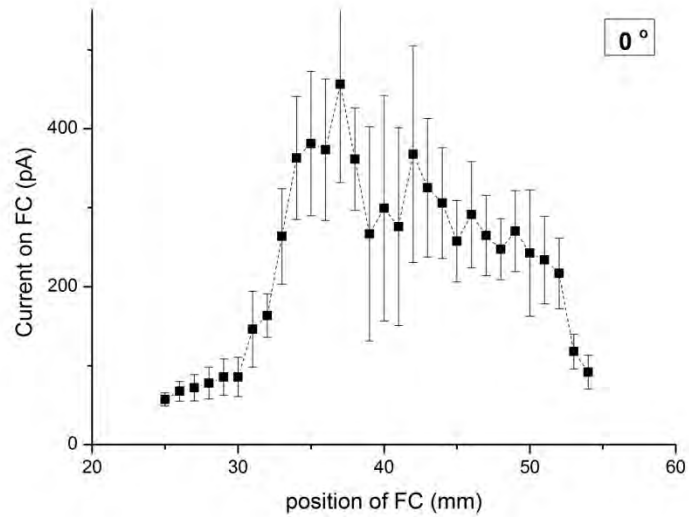
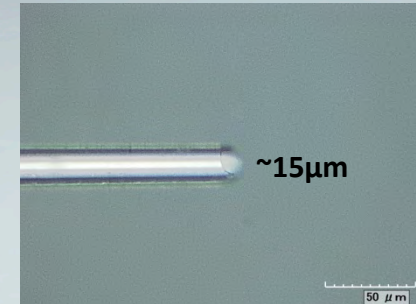
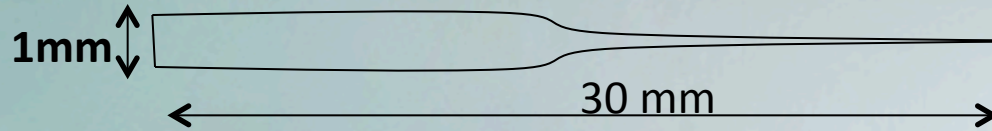
Tapered channels...Time dependence



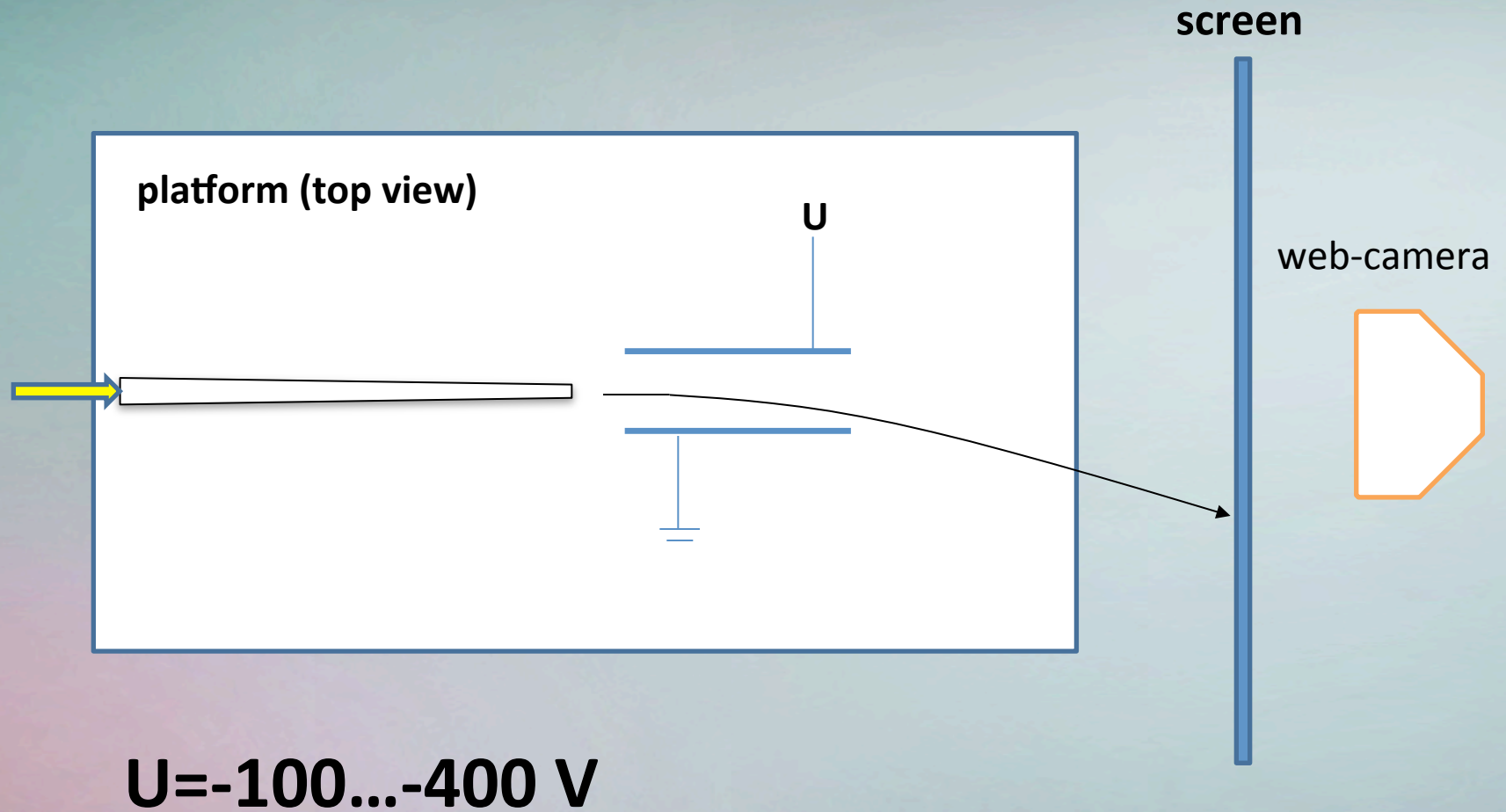
The current on the mask is ~ 300 nA



Tapered channels...



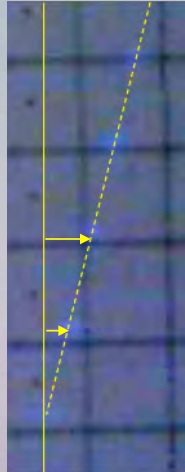
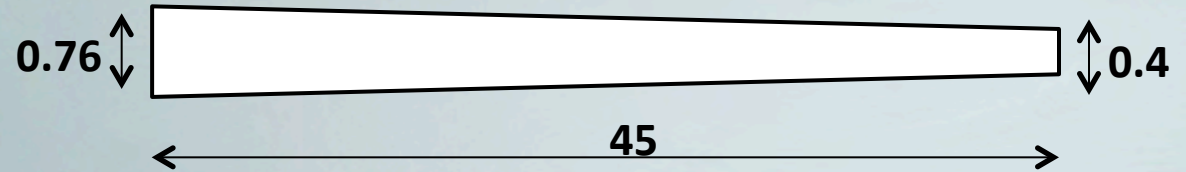
Tapered channels...Visualization



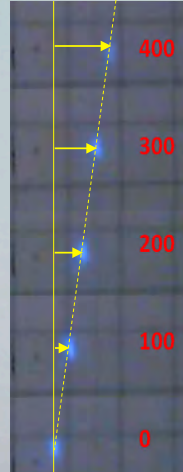
Tapered channels...

Geometric opening angle –
1.78 deg.

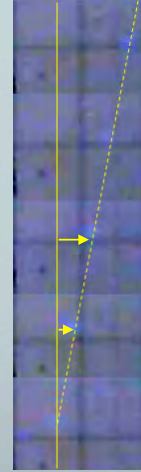
Aspect ratio ~ 77



-1.14 deg.

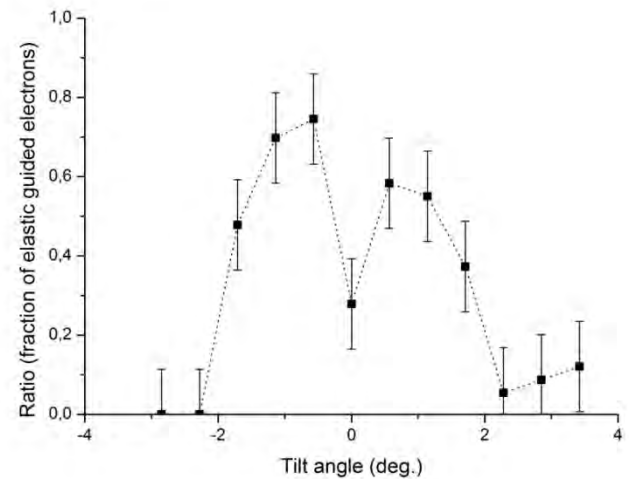
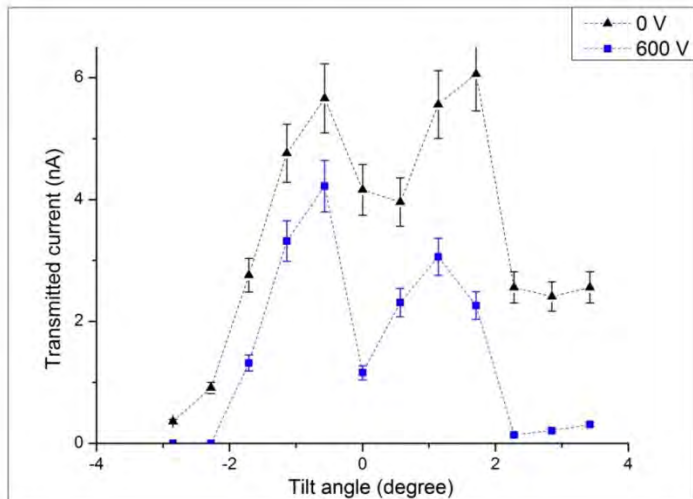
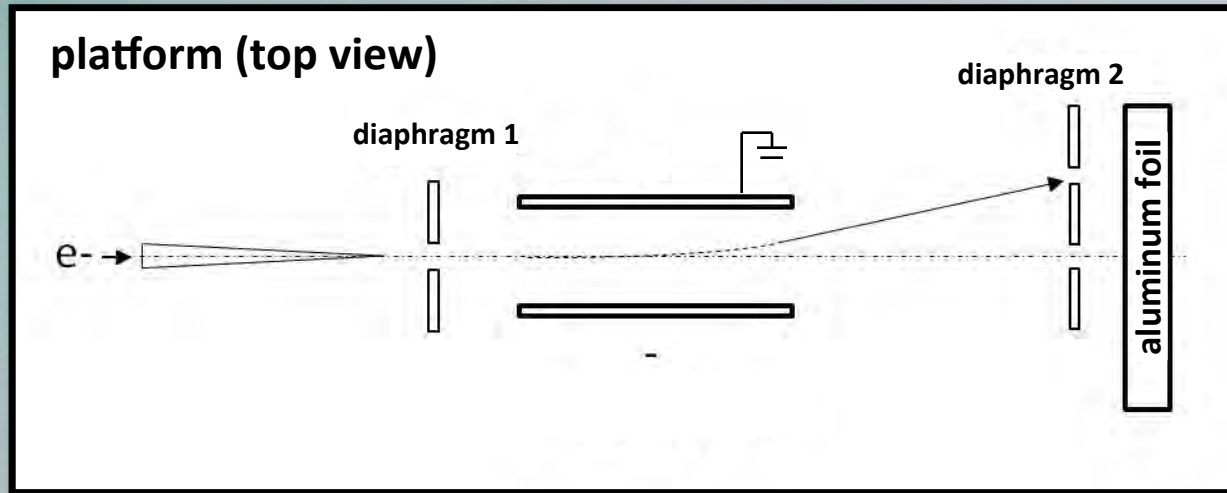


0 deg.



1.14 deg.

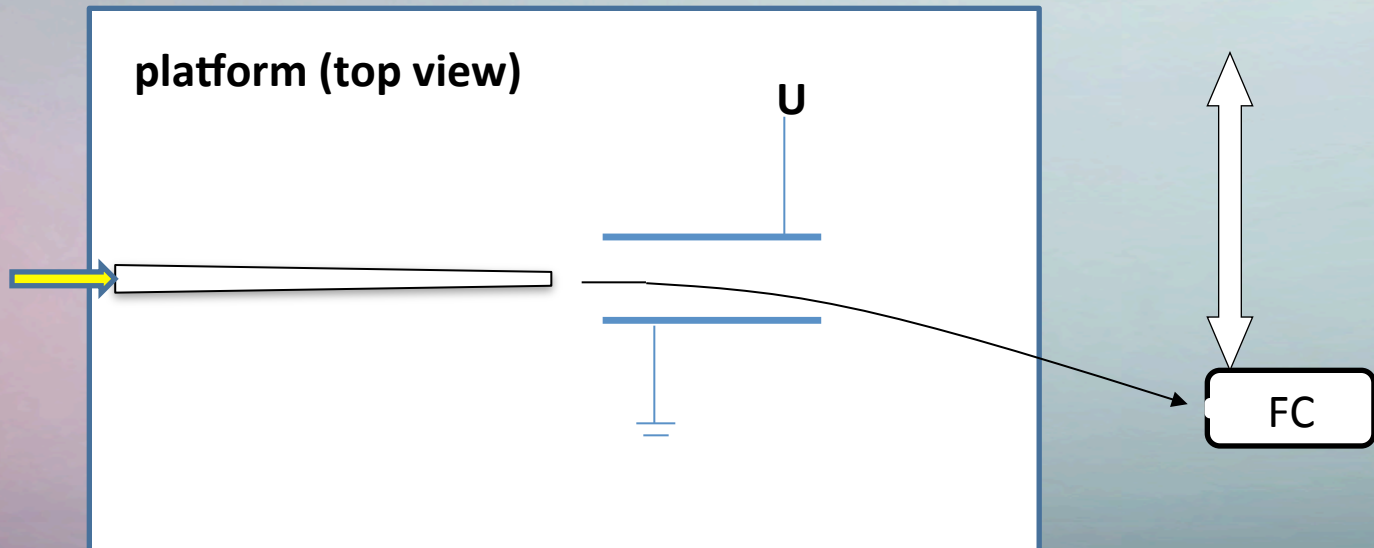
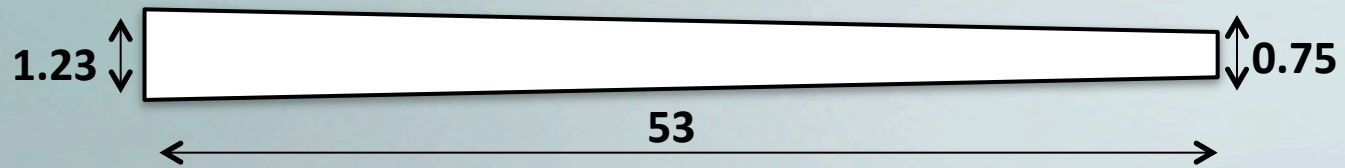
Tapered channels...



Tapered channels...

Geometric opening angle – 2.14 deg.

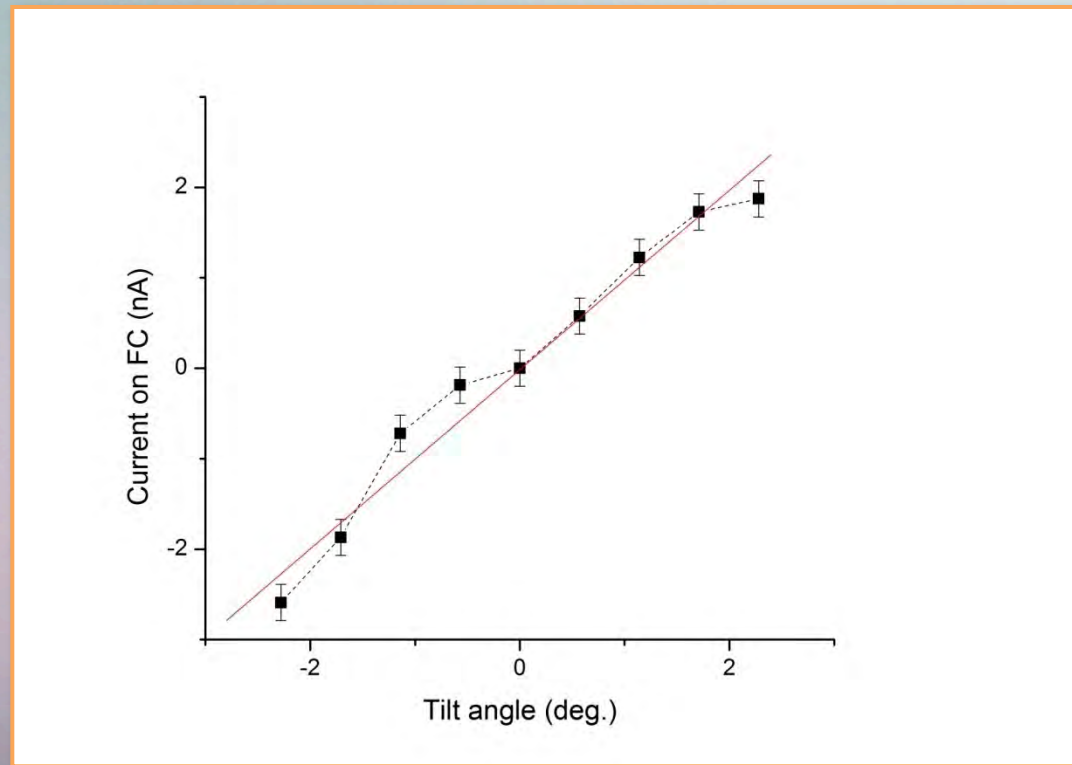
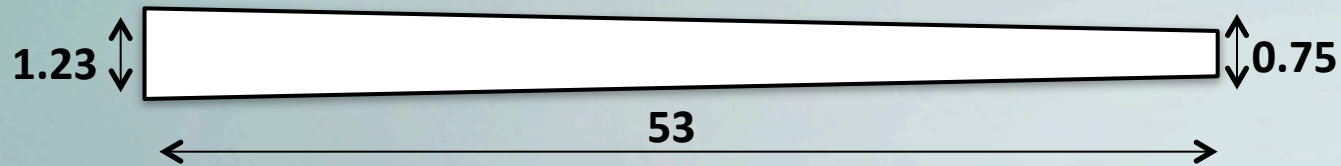
Aspect ratio ~ 53



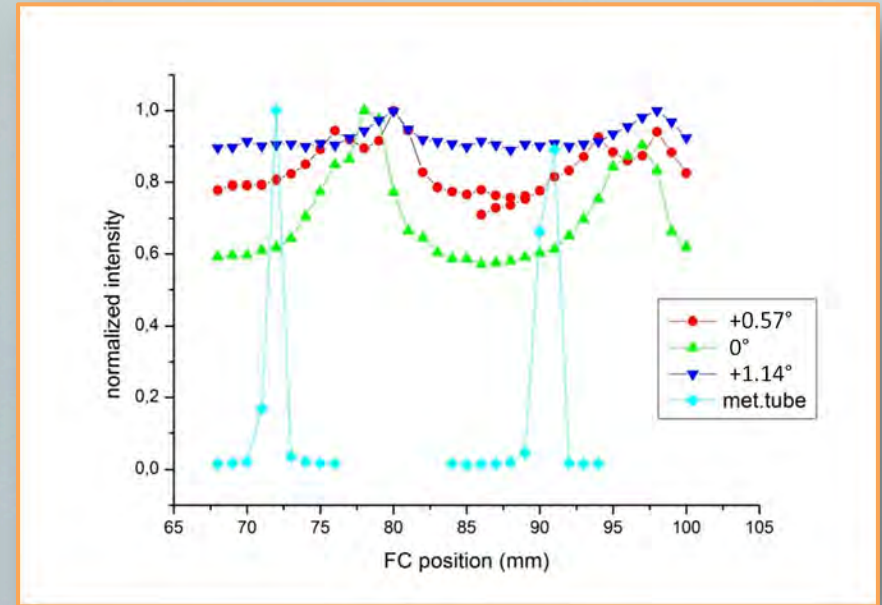
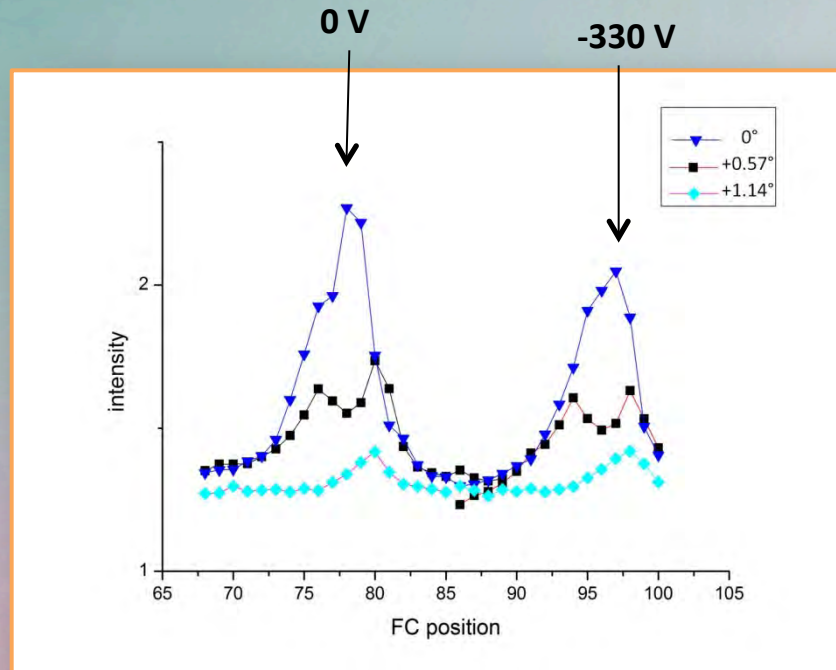
Tapered channels...Guiding of 10 keV

Geometric opening angle – 2.14 deg.

Aspect ratio ~ 53



Tapered channels...



The distance between the peaks and their width is approximately the same for different tilt angles!!!

Conclusions

- Elastic processes take place in tapered glass capillaries within the guiding of the beam of electrons.
- The study presented the energy spectrum and intensity of the guided beam of 10 keV electrons depending on the tilt angle of the tapered glass tube with respect to the beam axis.
- Experimental results showed not only the possibility to guide electrons using macro size tapered channels, but also the focusing capability of the channels.