REFERENCES

1. *Fedorov V.V., Lapin E.G., Voronin V.V.* Preprint PNPI-1993, NP-51-1994, Gatchina, 1994. 9 p. //PNPI Research Report 1992—1993, Gatchina, 1994. P.31.
2. *Fedorov V.V., Lapin E.G., Voronin V.V., Sumbaev O.I.* //Pis'ma ZhTF, 1995. V.21. No 21. P.50.
3. *Fedorov V.V., Voronin V.V. and Lapin E.G.* Preprint LNPI-1644, Leningrad, 1990. 30p. //J.Phys., 1992, V.G18. P.1133.
4. *Altarev I.S. et al.* //Phys.Lett., 1992. V.B276. P.242. Preprint PNPI-2055, NP-28-1995. Gatchina, 1995.
5. *Thompson D.* //Nucl.Instr.Meth., 1989. V.A284. P.40. *Smith K.F. et al.* //Phys.Lett., 1990. V.B234. P.191.
6. *Forte M.* //J.Phys., 1983. V.G9. P.745.
7. *Baryshevskii V.G., Cherepitsa S.V.* //Izvestiya Vuzov SSSR, ser. fiz., 1985. V.8. P.110.

COMPTON SCATTERING ON PROTONS BELOW PION PRODUCTION THRESHOLD: PROJECT OF EXPERIMENTAL DETERMINATION OF ELECTRIC AND MAGNETIC POLARIZABILITIES OF THE PROTON

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A new method is proposed for experimental determining the energy dependence of the differential cross section of elastic γp-scattering in the photons energy range from 20 to 120 MeV with a precision better than 1% in relative measurements. Such measurements should provide in a model-independent way the electric, $\overline{\alpha}$, and magnetic, $\overline{\beta}$, polarizabilities of the proton with errors of $\leq 0.5 \times 10^{-4}$ fm^3. This accuracy can be achieved with untagged bremsstrahlung γ-quanta produced by a 130 MeV, 10 μA continuous electron beam in several hundred hours of beam time. The method provides effective rejection of background reactions by detecting the scattered photon in coincidence with the recoil proton. The scattered photons will be detected and their energy measured with a large NaI(Tl) total absorption spectrometer with an intrinsic resolution of a few percent. The energy of the recoil protons will be measured in a special high pressure (100 bar) hydrogen ionization chamber that serves also as a target ($\simeq 3 \times 10^{22}$ protons/cm^2). The shape of the incident photon spectrum will be determined with the same NaI(Tl) spectrometer by detecting the events of elastic scattering on free electrons.

The scheme of the proposed ionization chamber (IC) and some parameters of the anode signals [1] are given in Fig. In order to keep the background caused by the Compton electrons and the e^+e^--pairs on an acceptable level, the anode of the IC is divided into twenty 2.5 mm wide strips separated by 0.1 mm gaps. The anode strips are directed along the tracks of the recoil protons. The kinematics of the reaction $\gamma + p \to \gamma' + p'$ in the investigated range of photon energies is such that, for fixed scattering angle $\theta_\gamma \pm \Delta\theta_\gamma$, the emission angle of the recoil protons $\theta_p(E_p) \pm \Delta\theta_p(E_p)$ practically does not depend on the photon energy E_γ, while $\Delta\theta_p \simeq (1/2)\Delta\theta_\gamma$. The value $\Delta\theta_\gamma = \Delta\varphi_\gamma$ is $\pm 5°$ for the chosen solid angle of the γ-

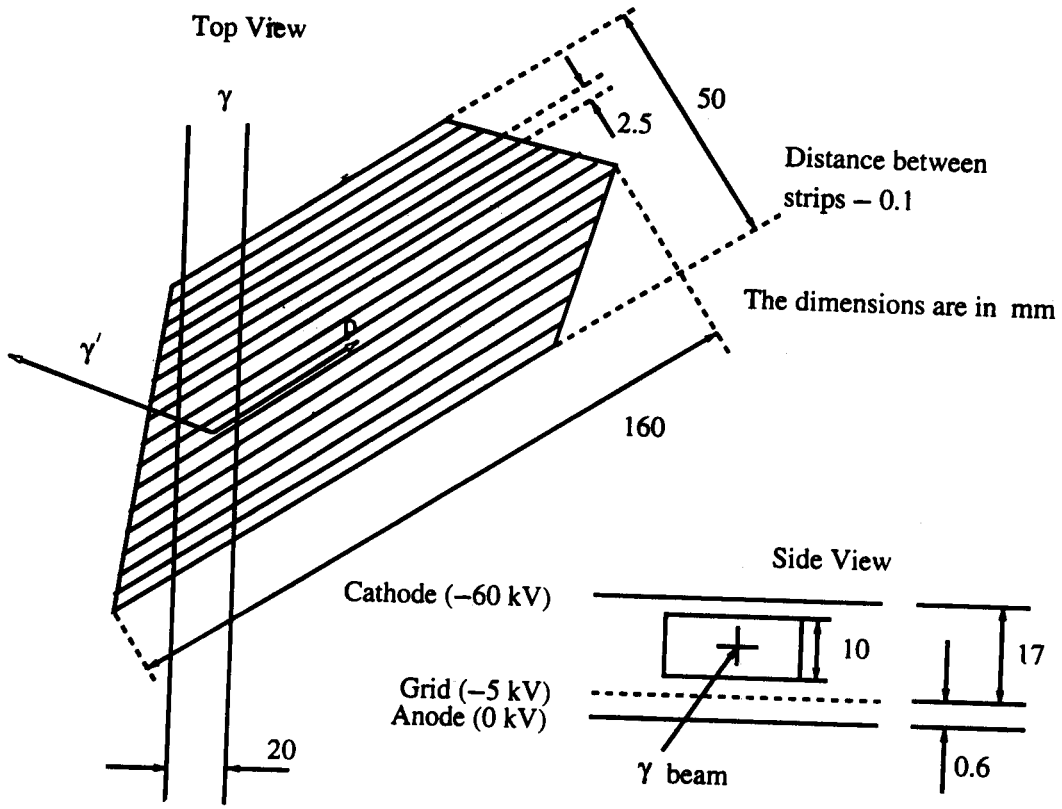

Fig. Layout of the ionization chamber electrodes (p=100 bar, E=32 kV/cm)

The ranges of protons	R_p =(0.25 – 40) mm	
The energies of protons	E_p =(0.4 – 8.2) MeV	
The drift velosity	v_{drift} = 0.5 mm/100 ns	
The duration and amplitude of signals	Δt_{min} = 80 ns	i_0 = (0.4–8.0) MeV/80 ns
	Δt_{max} = (100–800) ns	i_0 = (0.4–1.0) MeV/100 ns

The drift time of the electron component track from cathode to anode is about 2 μs.

The energies of γ-rays E_γ:	(15–70) MeV	Scattering angles:	$\theta_\gamma = 130°$
	(20–90) MeV		$\theta_\gamma = 90°$
	(30–120) MeV		$\theta_\gamma = 60°$

-spectrometer $\Delta\Omega$=0.025 sr. Note that the reaction plane is parallel to the planes of the IC electrodes. For the energy ranges of the incident photons (30–120) MeV, (20–90) MeV and (15–70) MeV and for scattering angles 60°, 90° and 130°, respectively, the recoil proton energies are within the range 0.4 to 8.2 MeV. The ranges of these recoil protons in hydrogen at the pressure of 100 bar are (0.25–40) mm. The projections of the recoil proton tracks to the anode plane cover only one or two strips while the ionization produced by the background electrons is subdivided between many anode strips. So the ratio of the background signal to the useful one is reduced. The shape of the anode current signals is to be analysed over a period of time (T$\sim$4 μs) from the moment of a trigger pulse up to the drift time of the most remoted tracks to the anode plane; flash ADCs scanning the current in 10 ns bins will be used for this purpose.

The maximum length of the track projection on the direction perpendicular to the anode plane for $\varphi_\gamma = 5°$ is $R_{max}\cdot\sin\varphi_\gamma \simeq 3.5$ mm, where R_{max} is the maximum range of the recoil protons. For vertical size of the incident γ-ray beam of 10 mm, the minimum distance between the cathode and the grid should be 17 mm. The distance between the anode and the grid is equal to 0.5 mm. The minimum pulse duration (for tracks parallel to the anode plane) Δt_{min} is 80 ns and the amplitudes of the current signals (in energy units) are (0.4–8.0) MeV/80 ns; the maximum pulse durations Δt_{max} are (100–800) ns and the corresponding amplitudes are (0.4–1.0) MeV/100 ns (recombination coefficient is $k \simeq 0.8$ at the 100 bar pressure and the electrical field of 25 kV/cm).

The background anode current due to gas ionization by the Compton electrons and e^+e^--pairs was estimated assuming a continuous bremsstrahlung beam with the energy flux

$$W = \int_0^{E_{\gamma\,max}\simeq 100MeV} [dN(E_\gamma)/dE_\gamma]E_\gamma dE_\gamma \simeq 4\times 10^{12}\ \mathrm{MeV/s}$$

passing through the 6 cm length of the IC (sensitive volume). Here $dN(E_\gamma)/dE_\gamma$ is the energy spectrum formed after "filtration" of the incident bremsstrahlung produced in the target-radiator; $E_{\gamma\,max}$ is the maximum energy of the bremsstrahlung spectrum. The estimated average background ionization current of IC determines the energy threshold for detection of the recoil protons to be 400 keV. Then in 450 hours of the beam time about 10^6 events at each scattering angle ($\theta_\gamma = 60°$ and $\theta_\gamma = 135°$) will be obtained. This will provide statistical errors in determination of $\overline{\alpha}$ and $\overline{\beta}$ on a level of $\pm 0.3\times 10^{-4}$ fm^3.

The requirements to an experimental apparatus and procedure for ensuring acceptable systematic errors of measurements were determined also.

The project was presented on the International Conference in Jülich, 1994 [2].

REFERENCES

1. *Petitjean C.C. et al.* //Muon Catalyzed Fusion 5/6 (1990/91) P.261.
2. *Chizhov V.P.* Proceedings of the International Conference on Physics with GeV-Particle Beams, Forshungscentrum Jülich, Germany, 22-25 August 1994 (World Scientific, 1995) P.268.