about 1000°C for 2 - 5 minutes. The heaters were ampules made of spectrally pure graphite. The resultant product was investigated by x-ray diffraction, using powder Debye patterns with an RKD-57 camera and filtered copper radiation.

Almost all the samples obtained in the indicated pressure and temperature ranges were pure rhenium carbide with cubic face-centered structure of the NaCl type. Some of them contained admixtures of the hexagonal phase and of graphite. The fact that there were no metallic rhenium lines in all samples without exception, and most samples revealed likewise no graphite lines, gives grounds for assuming that the obtained carbide is close in composition to rhenium monocarbide. The unit-cell parameter of the new phase was 4.005 ± 0.002 Å, and the calculated density was 20.5 g/cm^3. The density measured pycnometrically was 19.5 ± 1.3 g/cm^3.

Rhenium carbide is metastable at atmospheric pressure. Annealing the samples in vacuum at 1000°C for two hours causes decay of the carbide and formation of a rhenium-carbon solid solution. A similar behavior was observed also for the hexagonal modification [1], the decay of which occurred when heated above 1200°C.

The superconducting properties of the cubic rhenium carbide was measured by a magnetic method. The critical temperature of the transition to the superconducting state is $T_c = 3.4 \pm 0.2$°K. The obtained data confirm the previously predicted tendency of the critical temperatures of cubic monocarbides of the transition metals of group VII (Tc, Re) to be lower than the isostructural carbides of the group VI metals (Mo, W) [2].

At the same time, it is well known that the critical temperatures of transition-metal carbides are strongly influenced by the composition of the sample (the molar ratio Me/C), which can greatly deviate from stoichiometric in the presence of a wide homogeneity range. This deviation leads to a considerable decrease of the critical temperature [3]. Since no exact analysis of the compositions of the cubic rhenium carbide synthesized under pressure was made, one cannot exclude the possibility that the obtained samples deviate from stoichiometric composition. In this case, higher critical temperatures should be expected for the carbide with the higher carbon content.

In conclusion, the authors are deeply grateful to Academician L.F. Vereshchagin for taking part in a discussion of the results and to L.G. Boiko for help with measuring the critical temperatures.

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INFLUENCE OF INTERFERENCE ON THE INTENSITY OF TRANSITION X-RADIATION IN A LAYERED MEDIUM

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The transition radiation produced when a charged particle passes through a layered medium has attracted much attention in connection with its possible use to identify particles at ultrahigh energies [1].

Of greatest importance in the use of transition radiation is the determination of the dependence of the radiation intensity of the particle Lorentz factor $\gamma = E/mc^2$. Such measurements were performed in [2 - 4] up to $\gamma = 8 \times 10^3$. The result revealed a linear [2, 3] or even stronger [4] growth of the radiation intensity. Such a dependence agrees with the predictions of the theory of transition radiation [5]. However, as shown in [6, 7], allowance for the interference that arises in layered media at higher values of γ can in principle limit strongly the growth of the radiation intensity.

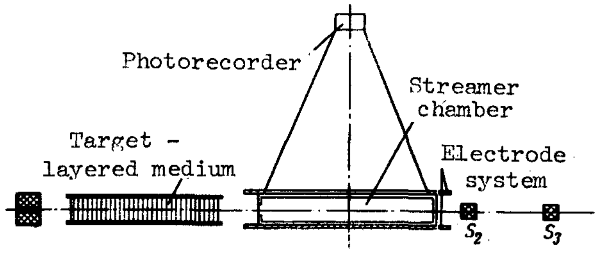

Fig. 1. Experimental setup.

The purpose of our study was to measure the intensity of the transition radiation both at relatively low energies, $\gamma = 10^3$, and at the Lorentz-factor value $\gamma = 6 \times 10^4$ at which an appreciable influence of the interference is predicted.

The measurements were made with the electron accelerator of our Institute at 500 MeV, and with the electron beam of the accelerator of the Institute of High Energy Physics at 31 GeV. The transition-radiation detector was a streamer chamber filled with a gas mixture 75% Ne + 25% Xe + 0.02% I_2 [3, 7]. The streamer chamber was fed from a high-voltage generator through a Bloomline shaping line, the construction of which is described in [9, 10]. The experimental setup is shown in Fig. 1.

The source of the transition radiation was a layered medium consisting of 1100 mylar films 20 μ thick. The gap between films was 0.8 mm. In addition, the radiator used with the accelerator of the High Energy Physics Institute was a layer of foamed plastic 1.5 m thick (density $\rho = 0.06$ g/cm^3). To determine the background due to the bremsstrahlung and the δ-electrons produced by the primary particle in the chamber, measurements were performed with an equivalent target of the compressed layered medium. Figure 2 shows several photographs of typical events in the streamer chamber.

The reduction of the photographs consisted of counting the number of electrons produced in the chamber gas or by the γ quanta of the transition radiation or the bremsstrahlung, or by the particle itself (δ-electrons), and

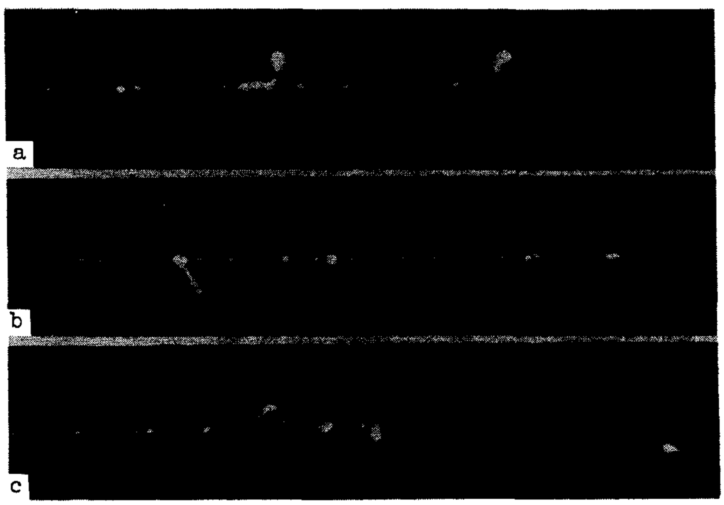

Fig. 2. Photographs of typical events in the streamer chamber.

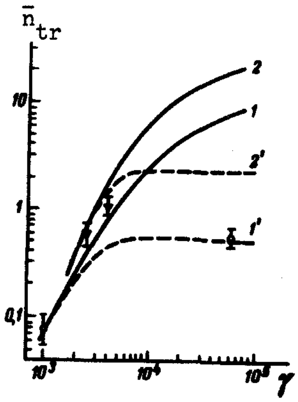

Fig. 3. Intensity of transition radiation vs. the Lorentz factor γ: triangles - data of [3], circles- our data.

determining their ranges. Under the conditions of our experiments, it was impossible to separate the photoelectrons from the δ-electrons, since both were produced directly on the particle track.

The measurements yielded the mean values of the photo- and δ-electrons, which are listed in the table.

The theoretical values of $\bar{n}_{tr}$ were calculated with (a) and without (b) allowance for the interference.

It follows from the measured ranges of the photoelectrons and δ-electrons that in our case we have registered only γ quanta of energy $E \gtrsim 35$ keV. By taking the threshold energy into account, we can compare our results with the theory.

Figure 3 shows the calculated dependence of the radiation intensity on the particle Lorentz factor without allowance for the interference (solid curves) and with allowance (dashed curves). Curves 1 and 1' correspond to the conditions of our experiment, and curves 2 and 2' to the conditions of [3]. In the calculation we took into account the absorption of the radiation in a layered medium and the efficiency of its registration in the streamer chamber. The same figure shows our experimental results and those of [3]. From a comparison of the theory with experiment it follows that near the values $\gamma \lesssim 4 \times 10^3$ the experimental data are in sufficiently good agreement with the theory that does not take interference into account. In this case the radiation intensity increases linearly, within the limits of errors. The radiation intensity obtained in our experiment at $\gamma = 6 \times 10^4$, however, is smaller by more than one order of magnitude than the value predicted by the theory [5]. This means that at high values of γ the interference of the radiation plays the decisive role. In this case, the measurement result agrees well with calculations by Garibyan's formula, in which the influence of interference is taken into account.

We can thus conclude that the dependence of the radiation intensity on the Lorentz factor γ is nonlinear in a wide range. At low values of γ, the intensity of the radiation increases linearly with γ, but saturation sets in already at $\gamma = 10^4$.

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Lorentz factor γ	Layered medium $\bar{n}_{lm}$	Equival. $\bar{n}_{eq}$	Foamed plastic $\bar{n}_f$	Transition radiation $\bar{n}_{tr}=\bar{n}_{lm}-\bar{n}_{eq}$	Theory $\bar{n}_{tr}$ a	Theory $\bar{n}_{tr}$ b
10^3	0,997 ± 0,019	0,918 ±0,017	——	0,079 ±0,025	0,07	0,07
$6 \cdot 10^4$	1,36 ±0,07	0,79 ±0,07	1,57 ±0,13	0,57 ±0,10	0,51	8,7

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TEMPERATURE SHIFT OF LAMB DIP IN METHANE AT $\lambda = 3.39\ \mu$

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We report here observation of a temperature shift of the Lamb dip in a low-pressure molecular gas. As shown in [1], a sharp decrease of the impact shift of the Lamb dip is observed at low pressures. This has made it possible to observe the temperature shift of the dip, which coincide in magnitude and sign with the shift due to the transverse Doppler effect. These experiments can therefore be regarded as the first observation of the influence of relativistic effects on the shape of the absorption line of a molecule[1)] and on the frequency reproducibility of gas lasers.

Owing to the relativistic time contraction, the emission frequency or the resonant absorption frequency of the moving atom (molecule) experiences an additional red shift that depends on the absolute velocity. The emission frequency ω received by an immobile observer is given by the known expression:

$$\omega = \omega_0 \frac{\sqrt{1 - \left(\frac{v}{c}\right)^2}}{1 - \frac{v_z}{c}}$$

where ω_0 is the emission frequency of the immobile atom, v is the absolute velocity of the atom, v_z is the projection of the velocity on the observation direction, and c is the speed of light.

Under the conditions of our experiment, the width of the Lamb dip is much smaller than the Doppler width. At the line center, the standing-wave field interacts with the atoms having $v_z \ll \bar{v}$, where $\bar{v} = [2kT/m]^{1/2}$ is the characteristic thermal velocity of the atom, k is Boltzmann's constant, T is the gas

[1)] The temperature shift of the γ-quantum frequency, connected with the transverse Doppler effect, was observed earlier in [2, 3] with the aid of the Mossbauer effect.