axial direction (that is, the same component of magnetic moment in the direction of the field). The ray is then sent through a homogeneous magnetic field, the direction of which is changing with time (for example, a rotating field). After the ray has passed this rotating field, it goes through a second inhomogeneous field. This last field serves to determine whether all the atoms still have the same orientation (in which case they would be deviated towards the same side) or whether some of them have been re-oriented (*umgeklappt*).

The proportion of re-oriented atoms to those having the original orientation depends upon the ratio of the Larmor period, T_l, to the period of rotation of the field, T_f. If T_f is large compared with T_l, that is, if the atom completes many Larmor precessions during the interval required for an appreciable change of field direction—then the process is an adiabatic one and no re-orientation occurs. If an appreciable fraction of the atoms is to be re-oriented, T_f and T_l must be of the same order of magnitude.

Under usual experimental conditions, $T_f >> T_l$; that is to say, the adiabatic case is realised, and no re-oriented atoms are observed. In order that the non-adiabatic case may be realised, the Larmor period T_l must be made as large as possible (that is, very weak fields must be employed), and T_f must be as small as possible. We have succeeded in producing these non-adiabatic conditions in the following manner. The ray passed through a region enclosed in an iron shield where there existed a very weak magnetic field, constant in space and in time. Its strength was a few tenths of a gauss. The variation of the field with time was brought about by causing the ray in its course through the shielded region to pass close to a wire. Atomic ray, wire, and lines of force were at right angles to one another. When a current flowed through the wire, its magnetic field was superposed upon the constant field inside the iron shield. In this way the field was made inhomogeneous in space, and atoms which passed near the wire experienced a change of field direction from point to point; this was equivalent to a variation of the field with time.

We found that with weak currents through the wire (that is, with no appreciable rotation of the field) there were no re-oriented atoms—just as was the case with a strong field (the adiabatic case). But when the constant field was only a few tenths of a gauss, and when the current in the wire was so adjusted that the field of the wire in the region where it was traversed by the ray was also of this order of magnitude, a noticeable part of the atoms (as much as one-third) was re-oriented. The number of re-oriented atoms, and the dependence of this number upon (1) the current in the wire, (2) the distance of the ray from the wire, and (3) the velocity of the atoms, agreed with the theoretical prediction.[1]

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Hamburg, Aug. 15.　　　O. STERN.

[1] P. Güttinger, *Z. Phys.*, **73**, 169; 1932; and E. Majorana, *Nuovo Cim.*, Nr. 2, 1932; where the theory is still better adapted to our experimental conditions.

Fundamental Frequencies of the Group SiO₄ in Quartz Crystals

THE particular properties of quartz crystals (SiO_2), as compared to those of carbon dioxide (CO_2) have led Sir William Bragg to the conception of considering a quartz crystal as one single molecule.

An analogous constitution is shown by the polymeric homologue series of silica esters, the Raman spectra of which I have recently investigated.[1] It has been observed that in these compounds four characteristic scattered frequencies must be attributed to the group SiO_4. Of these frequencies two are independent of the degree of polymerisation, while the other two show a continuous shift with the degree of polymerisation. The line 642 cm.$^{-1}$ of the monomeric ester which is shifted so far as 518 cm.$^{-1}$ is a conspicuous example of the last mentioned behaviour. The latter corresponds to a line of the decameric ester.

Making use of the above mentioned results, the fundamental frequencies of the SiO_4 group in quartz can be located. The results are seen from the following table.

	ν_1	ν_2	ν_3	ν_4
ν cm.$^{-1}$	502	800	1062–1086	1170–1208
$\lambda\mu$	19·92	12·5	$9\cdot4_1$–$9\cdot2_1$	8·54–8·28

With the aid of these four fundamental frequencies, the entire ultra-red spectrum of quartz below 10μ can be interpreted as a system of combination bands of the second to the fourth order. Attempts to determine the fundamental frequencies and to arrive at a system of combination bands have been made by Plyler[2] and Parlin.[3] The frequencies assumed by them differ partly from those arrived at above and consequently the values of the frequencies of the combination bands calculated by them agree less well with those observed than in our case.

A more detailed paper will appear in the near future.

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　　　Nov. 5.

[1] J. Weiler, *Helv. phys. Act.*, **5**, 302; 1932.
[2] E. K. Plyler, *Phys. Rev.*, **33**, 48; 1929.
[3] W. A. Parlin, *Phys. Rev.*, **34**, 81; 1929.

Spectrum of Cosmic Radiation

IN the note published by me in NATURE of September 24 under the above title, I find I made a numerical error in the observed limits of the 'soft band'. The observed and calculated values should be:

n	1	2	3	4	5	6
$h\nu$ (calc.)	475	160	80	48	32	23
$h\nu$ (obs.)	~450*	~180	~100	~50	(~30)	~25

Thus, the observed values given under $n = 4$ and $n = 6$ (not 5 and 7 as stated before) are the limits of the 'soft band'. They are estimated approximatively from its penetrating power, measured by Prof. R. A. Millikan[1] in comparison with that of γ-rays of thorium C″, the observed ratio being between 12 and 6.[†] The value ~ 30 million volts is an average, being at the same time the energy of formation of helium: $h\nu = 0\cdot032\ H.c^2$.

With this correction the agreement becomes more complete, the lack of the observed value under $n = 4$, noted in the preceding letter, having disappeared.

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　　　Oct. 17.

* The probable value of the 'iron constituent'.
† The energy of γ-rays of thorium C″ being 2·5 million volts, the ratio 6 corresponds—from the Klein-Nishina formula—to 25 million volts.
[1] R. A. Millikan, NATURE, **128**, 709, Oct. 24, 1931.