~ 13 mev threshold. Our data on Ge radioactivity is also in good agreement with the values obtained for As γ–emission after irradiation in the 22–mev betatron.[4]

The short–lived radiation from Zr ($T_{1/2}$ = 100 ± 1.0 m sec, E_γ = 0.24 ± 0.02 mev) can be assigned to an isomeric transition of Nb^{90m} [reaction (p, n) with threshold ~ 12 mev], because our values for the half–life and energy of the transition are in good agreement with the corresponding values for Nb^{90m} ($T_{1/2}$ = 10–20 m sec, E_γ=0.250 mev) which result from the β^+ –decay of Mo^{90} [5].

When Zr was irradiated, in addition to the radioactivity with $T_{1/2}$ = 10.0 ± 1.0 m sec we detected a shorter–lived activity with $T_{1/2}$ ~ 0.6 m sec as well as a longer–lived activity with $T_{1/2} > 10^{-1}$ sec.

Our earlier article[1] reports the isomeric radioactivity which results from the irradiation of cadmium with fast protons ($T_{1/2}$ = 40 ± 10 m sec). In connection with the abstract,[6] which reports isomeric radioactivity in indium ($T_{1/2}$ = 45 ± 10 m sec, E_γ = 0.312 ± 0.010 mev) after irradiation with 22–mev γ–rays, it can be assumed that the radioactivity which we had observed in cadmium was the isomeric radioactivity of indium resulting from a (p, n) or $(p, 2n)$ reaction on a cadmium isotope.

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Negative Ions of Silicon, Germanium, Tin and Lead

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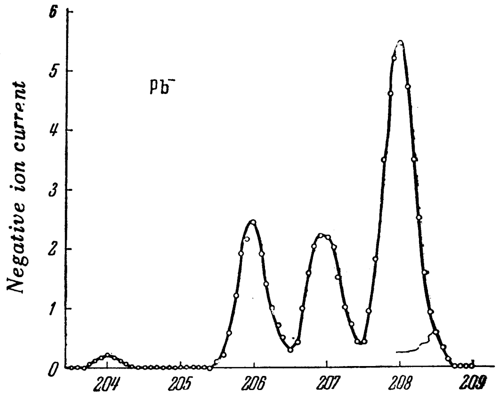
IN continuing the study of negative atomic ion production we looked for such ions of elements in the right–hand column of the fourth group of the periodic table. For one of these elements, carbon, negative ions had been found[1,2]. In the present work we established the existence of negative atomic ions of the remaining elements in the subgroup IV *B*: Si, Ge, Sn and Pb.

The negative ions were produced in an ion source through the interaction of an electron beam with molecules of a halide of the element under investigation. We also obtained negative ions by "charge exchange", that is, by the transfer of an extra electron from donor ions to atoms of the investigated substance[3]. For the purpose of analyzing and recording the negative ions, we used a magnetic mass spectrometer with resolving power sufficient to separate the isotopes of lead. In order to obtain the line intensities needed for measurements of the negative ion spectrum, it was necessary to maintain a higher vapor density of the working substance in the ion source than had been sufficient for the recording of positive pions, and also to use stronger electron currents in the ionization chamber. Both of these factors somewhat reduced the resolving power of the mass spectrometer for negative ions.

We now outline the experimental details and results for the individual elements.

Silicon. The ion source contained $SiCl_4$ vapor. The electron energy in the ionization chamber was 60 ev and the electron beam current was 6 mA. In the negative ion spectrum we observed the following groups of lines: Si^- (28,29,30), Cl^-, $SiCl^-$, Cl_2^-, $SiCl_2^-$, $SiCl_3^-$ and $SiCl_4^-$. The Si^- lines were easily identified by comparison with the Cl^-(35,37) lines and from the peak ratios for the isotopes with masses 28, 29 and 30. The dissociation and ionization of $SiCl_4$ molecules by electron impact was studied by Vought[4]; for low $SiCl_4$ vapor density in the ion source the negative ion spectrum revealed only Cl^- and $SiCl_2^-$ ions. Bates [5], who by extrapolating the electronic binding energy in isoelectronic sequences of atoms and ions calculated the electron affinity of a number of light elements, gives 1.7 ev for this quantity in Si.



Germanium. For this element we tested the possibility of producing negative ions by "charge exchange" between negative antimony ions and germanium atoms. The source was equipped with two vaporizers: one for the volatilization of germanium and the other for the vaporization of antimony. The germanium vapor at $< 5 \times 10^{-4}$ mmHg pressure consists principally of atoms;[6] therefore it could be expected that the process of "charge exchange" would produce negative atomic ions of germanium. When the ion source chamber contained only germanium vapor negative ions were not observed. When the source also contained antimony vapor we detected negative ions of this element (Sb^-, Sb_2^-, Sb_3^-) and Ge^- ions (70,72, 73, 74, 76). The Ge^- lines were identified by comparison with the Sb^- (121, 123) lines and by the relative intensities of the individual isotopes.

Tin. The ion source contained $SnCl_4$ vapor. Negative ions were produced by 80 ev electrons in a 4 mA electron current. The negative ion spectrum contained, in addition to Cl^- and Cl_2^- ions, the ions Sn^-(112, 114, 116, 117, 118, 119, 120, 121, 124), $SnCl^-$, $SnCl_2^-$, $SnCl_3^-$ and $SnCl_4^-$.

Negative Sn^- ions were also obtained by "charge exchange" of negative bismuth ions and tin atoms. But it was not possible to resolve all of the tin isotopes in the mass spectrometer.

Lead. The working substance in the ion source was PbI_2 vapor. The electron energy was 40 ev and the electron current 2 mA. The negative ion spectrum contained the lines of I^-, Pb^- (204, 206, 207, 208), I_2^-, PbI^- and PbI_2^-. The Pb^- ions were identified by comparison with the I ions and by the relative isotopic intensities. The Figure shows the mass spectrogram of Pb^- ions obtained by plotting different ion energies with constant magnetic field strength of the analyzer. The Figure shows that the lead isotopes are well resolved and the height of the individual peaks corresponds to the relative isotopic abundances in ordinary lead.

We also performed an experiment to obtain Pb^- ions by "charge exchange" between antimony ions and lead atoms. When lead and antimony vapor were simultaneously introduced into the ion source the negative ion spectrum revealed a broad line for Pb^- ions which were not resolved into isotopes.

The atoms of C, Si, Ge, Sn and Pb which form the Iv *B* subgroup of the periodic table possess two *p*—electrons in their outer electron shells. The electron affinity of these elements must be attributed, as for the elements of groups V, VI, and VII, to the existence of an incomplete group of equivalent *p*—electrons into which the extra electron is introduced.

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Peculiarities of Cerenkov Radiation in Anisotropic Media

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THE problem of Cerenkov radiation in anisotropic media has been discussed in a series of articles[1-6]. Here we turn our attention to those interesting peculiarities that were not pointed out in the enumerated articles. For the sake of simplicity we consider these peculiarities in the case of a charge moving along the optic axis of a uniaxial dielectric crystal.

Taking the *z* axis along the velocity we obtain, according to Ref. 2, the Fourier component of the