the binding energies of heavier nuclei would increase linearly with the number of particles, or that a particularly stable α-particle would exist, without retaining the Majorana operator.)

(v) Good results for the binding energies of H_3 and He_3 can be obtained by the present method when the parameters are adjusted to fit the binding energy of the deuteron; at the same time maintaining consistency with the results of reference 1.

These results, which were obtained independent of the recent work of Present,[6] are consistent with his results, but represent somewhat greater generality, in that allowance is made for a region of strong repulsion between the particles.

All of these calculations arose through our numerous discussions with Professor P. M. Morse, to whom we are indebted.

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Ionization Potentials of Free Radicals

Measurements of the ionization potentials of certain polyatomic molecules by a molecular beam method have already been reported.[1] These measurements have now been extended to include the free radicals CH_3 and C_2H_5. The free radicals were formed in the source by the thermal decomposition of the corresponding tetra-alkyl leads.[2] The beam of free radicals, defined in the usual way by source and image slits, was received in a specially designed ionization gauge. This form of detector has been found more suitable for use with free radicals than the Kingdon cage previously employed.[1]

Curves relating anode potential and positive ion current were obtained, the voltage scale being calibrated against methyl iodide, I.P. = 9.489 volts.[3] Extrapolation of these curves to meet the voltage axis gave: I.P. (CH_3) = 11.1 volts, I.P. (C_2H_5) = 10.6 volts; the estimated limits of error being ± 0.5 volt.

It is possible to form an indirect estimate of the ionization potential of CH_3 on the basis of existing experimental data. Hogness and Kvalnes[4] and Hipple and Bleakney[5] have determined the appearance potential of CH_3^+, formed by electron bombardment of CH_4, as 15.5 and 14.7 volts, respectively. Norrish,[6] from a consideration of thermal and spectroscopic data, obtains 4.5 volts as the energy of the C–H bond. Direct subtraction of the bond energy from the appearance potential yields 11 volts (H. and K.) or 10.2 volts (H. and B.) for the ionization potential of CH_3, in substantial agreement with our directly determined value.

Mulliken's theoretical estimate is 8.5 volts.[7] He suggests that this value may be brought into line with the appearance potential data by assigning some 2 volts internal or kinetic energy to the products of the reaction $CH_4 \rightarrow CH_3^+ + H$. It appears from our results, however, that a few tenths of a volt at most can be accounted for in this way.

A full account of our experiments will appear elsewhere.

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The Shortest Continuous Radio Waves

An investigation was undertaken to determine the practical short wave limit for electromagnetic waves produced by vacuum tubes. Stable continuous waves of 0.64 cm wave-length were produced by means of a split anode magnetron operating in the electronic mode of oscillation. The wave-length was measured to within one percent by an echelette grating spectrometer, which has been described in previous papers.[1] The receiver was an iron pyrite crystal connected to a sensitive galvanometer.

The table gives information concerning the construction and operation of three microray tubes designed to operate at wave-lengths below 2 cm. R_a is the anode radius in cm, L is the distance in cm from the shorting bar on the Lecher frame to the filament, V is the anode potential in volts, H is the magnetic field strength in oersteds, and λ is the wave-length in cm.

Tube No.	R_a	L	V	H	λ
1	0.045	0.99	830	6,600	1.87
2	0.035	0.75	1350	9,900	1.22
3	0.019	0.38	1200	24,000	0.64.

The tube producing the shortest wave-length (No. 3) produced about 4×10^{-9} ampere in a crystal detector placed at the focus of the receiving mirror, and at a distance of 15 meters from the tube. In order to obtain the magnetic field necessary to operate tube No. 3, the elements were enclosed in an envelope whose outside diameter was 0.45 cm.

It may be concluded that continuous electromagnetic waves may be produced as short as 6 mm by means of a split anode magnetron, and that the lower limit is determined by the strength of the magnetic field which it is practicable to obtain. The tubes will operate with sufficient stability and output to serve as sources of electromagnetic radiation for many researches in this wave-length region.

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