the present experiment, however, these approximations should be valid, since the calculated collision broadening is much less than the Doppler broadening, and each line of the multiplet is calculated to be strongly self-reversed.

The experimental points $I(n)/I(0)_{exp}$, $0.7 \times 10^{14} \leq n \leq 15 \times 10^{14}$ cm^{-3} were fitted to the $I(n)/I(0)_{calc}$ of Eq. (1) with A_ϱ, A_γ, A_a, $K_\gamma x_\gamma$, $K_a x_a/n$, B, and C as independent parameters, using an iterative search routine on an IBM-709 computer. Convergence of fit was obtained for each of the resonance lines at several combinations of parameters. Of these, only one set was consistent with the requirements that the oscillator strengths be approximately in the ratio 5:3:1 for 1302, 1305, and 1306 Å, respectively, and that B and C each be about the same for the three lines. The values of these parameters and the associated physical quantities are given in Table I.

Since an atom makes only about 10^5 collisions between the formation region and the absorption cell, the results in Table I are calculated on the assumption that the $J = 2, 1, 0$ lower states are populated according to statistical weights. It a Maxwellian distribution is assumed, the calculated oscillator strengths increase by only 35%, but the standard deviation of the best fit increases by a like amount.

Theoretical values for gf have been calculated by Garstang[4] to be 0.23, 0.14, and 0.046 for the three transitions, using a value of $\sigma^2 = 0.15$ for the radial integral. These numbers are about 25% greater than the experimentally determined values but could be brought into agreement by a not unreasonable reduction of σ^2 to 0.11. On the other hand, experimental error is estimated at about 25%, limited largely by the possibility of appreciable quantities of atoms in the metastable states or in transient distributions other than that assumed.

This improved technique of analysis is being applied to the previous data on nitrogen. With the assumption of a strongly self-reversed Voigt profile, an improved fit can be obtained yielding $\sum gf = 0.53$, which is consistent with theory.[2] Details of these studies applying to measurements of resonance absorption in oxygen and nitrogen will be reported soon.

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[1]C. E. Fairchild and K. C. Clark, Phys. Rev. Letters 9, 100 (1962).

[2]P. S. Kelly and B. H. Armstrong, Phys. Rev. Letters 9, 426 (1962). Conversations with Dr. Armstrong have been appreciated.

[3]J. Kaplan, W. J. Schade, C. A. Barth, and A. F. Hildebrandt, Can. J. Chem. 38, 1688 (1960).

[4]R. H. Garstang, Proc. Cambridge Phil. Soc. 57, 115 (1961). Conversations with Dr. Garstang have been appreciated.

ANALYTIC SCF OSCILLATOR STRENGTH FOR THE OI $2p^4(^3P)$ - $2p^33s(^3S)$ TRANSITION*

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A direct measurement of the oscillator strength of the OI $2p^4(^3P)$ - $2p^33s(^3S)$ transition has recently been reported by Prag and Clark.[1] Since the value they obtained is slightly lower than the estimate suggested by Garstang[2] (mainly on the basis of the Coulomb approximation[3]) and since no Hartree-Fock value has been reported to date (due to the previous unavailability of a Hartree-Fock wave function for the ^3S upper state), it is appropriate to present the results of our analytic Hartree-Fock computations for this transition. In spite of the fact that these results were obtained in strict LS coupling, our theoretical value is in closer agreement with the Prag-Clark experimental result than is Garstang's suggested value.

For this multiplet, our value of the radial dipole integral σ^2 is 0.0974. This yields an (absorption) f number of 0.0303 and is substantially smaller than the value $\sigma^2 = 0.15$ suggested by Garstang. It is also in relatively closer agreement with the experimental value $\sigma^2 = 0.11$ obtained by Prag and Clark.

The wave functions used for the $1s^22s^22p^4(^3P)$ and $1s^22s^22p^33s(^3S)$ states of neutral oxygen were obtained by use of computer programs designed by Roothaan and his co-workers.[4] The programs are based on the expansion method for self-consistent-field solutions to the wave equation. Our wave functions represent exact solutions to the restricted Hartree-Fock equations to at least

three figures, possibly more.

The ground-state ^3P wave function has been reported previously[5]; wave functions for all excited states of the configurations $1s^2 2s^2 2p^n (3s, 3d)$ ($n = 0, 1, 2, 3$) of O and N have been computed and are being prepared for publication.

In view of Garstang's careful and extensive discussion of this OI transition, we would like to note some additional calculations we have performed. We computed the σ^2 value using our ^3P ground-state function and our ^5S wave function for the $3s$ electron. The value 0.1052 obtained confirms the value 0.11 obtained by Garstang using the Hartree, Hartree, and Swirles function and Nicklas and Treanor's function, respectively, for these two states.[2] The results show that, as one might expect, the value of σ^2 is relatively insensitive to the difference between the ^5S and ^3S wave functions. In addition, for the $2p$ - $3s$ transition (neglecting coupling) we have obtained the value $\sigma^2 = 0.15$ from the Hartree-Fock-Slater (HFS) wave functions computed by one of us.[6] Our experience in comparing values of σ^2 obtained from HFS wave functions with more accurate values (theoretical and experimental) indicates that for transitions involving excitation of a $2p$ electron they are somewhat too large. The ratio of positive to negative contributions to the integral for the analytic SCF functions is 10.1, indicating that while some cancellation does occur in the integration, it is not severe.

Finally, we would like to point out that the value of σ^2 for the NI $2p^2 3s (^4P)$ - $2p^3 (^4S)$, reported in an earlier paper,[7] was listed incorrectly as 0.12. The correct value is $\sigma^2 = 0.131$ and this value leads to the f number of 0.10 as quoted in that paper.

[1]A. B. Prag and K. C. Clark, preceding Letter [Phys. Rev. Letters 12, 34 (1964)].
[2]R. H. Garstang, Proc. Cambridge Phil. Soc. 57, 115 (1961).
[3]D. R. Bates and A. Damgaard, Phil. Trans. Roy. Soc. London A242, 101 (1949).
[4]C. C. J. Roothaan and P. Bagus, Methods in Computational Physics (Academic Press, Inc., New York, 1963), Vol. 2.
[5]C. C. J. Roothaan and P. S. Kelly, Phys. Rev. 131, 1177 (1963).
[6]P. S. Kelly (to be published).
[7]P. S. Kelly and B. H. Armstrong, Phys. Rev. Letters 9, 426 (1962).

ENERGY GAP IN FINITE NUCLEI CALCULATED IN THE SLAB MODEL*

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Impressive success has been achieved in understanding the nuclear energy gap and associated phenomena in terms of the Belyaev[1] adaptation of the superconducting theory to finite nuclei. The calculations, however, generally employ simplified internucleonic potentials, with a few adjustable parameters empirically fitted to a large quantity of nuclear data. On the other hand, calculations for infinite nuclear matter, utilizing "realistic" internucleonic potentials, have shown that the energy gap is very small or nonexistent.[2-4] In order to bridge the difference between these two approaches, we have performed calculations for the energy gap of a finite system with internucleonic potentials which reproduce singlet, s-wave scattering data.

To simulate a finite nucleus, we have used a slab model in which the system is of infinite extent in the x and y directions, but is confined to a region of thickness L in the z direction. The basis functions for the system are taken to be the product of plane waves in the x and y directions, and standing waves (vanishing outside the slab) in the z direction. The energy gap is found from the BCS[5] integral equation

$$\Delta_{\vec{k}} = -\frac{1}{2} \sum_{\vec{k}'} \frac{\{\vec{k} - \vec{k} \mid V \mid \vec{k}' - \vec{k}'\} \Delta_{\vec{k}'}}{(\hat{\epsilon}_{\vec{k}'}{}^2 + \Delta_{\vec{k}'}{}^2)^{1/2}}, \qquad (1)$$

where $|\vec{k}\}$ denotes a state described above and $|-\vec{k}\}$ is the time-reversed state of $|\vec{k}\}$. In this work, $\hat{\epsilon}_{\vec{k}}$ is represented by the effective mass approximation

$$\hat{\epsilon}_{\vec{k}} = (\hbar^2/2m^*)(k^2 - k_F{}^2). \qquad (2)$$

The $\sum_{\vec{k}'}$ in Eq. (1) is properly replaced by in-