TABLE II

Nucleus	μ
Mg^{25}	-0.855 ± 0.002
Ca^{43}	1.317 ± 0.003
Sr^{87}	-0.0924 ± 0.0009
Ba^{135}	$+1.8370\pm0.0008$
Ba^{137}	$+0.9364\pm0.0009$

has been taken from the value obtained in the present work. The spins of the nuclei investigated in the present work have been taken from reference 7. The ratio of the resonance frequencies in Ba^{137} and Ba^{135} is found to be 1.1187 = 0.0003. The sign of the magnetic moments is determined from the Millman effect.[8] The sign of the magnetic moment of Ca^{43} was not determined. The chief source of error in these measurements is the instability in the detected intensity of the atomic beams and the spread of values of the magnetic field which arises in the remagnetization of the magnet which produces the homogeneous field.

The value of the Sr^{87} magnetic moment, which we have obtained earlier,[4] has been refined in the present work by virtue of the more exact calibration of the uniform magnetic field. In order to exclude systematic errors use was made of two electromagnets, each of which was calibrated independently. The results obtained with each magnet are the same.

All values of the magnetic moments obtained by the MBMR method in the present work agree with the values obtained by nuclear induction (within the limits of the quoted errors).[9-12]

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ON THE CROSS SECTION FOR COMPOUND-NUCLEUS FORMATION BY CHARGED PARTICLES

A. D. PILIYA

Leningrad Physico-Technical Institute, Academy of Sciences, U.S.S.R.

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In considering nuclear reactions it is often necessary to evaluate the cross section for the formation of a compound nucleus. In the nonresonance region at comparatively large energies, this cross section is satisfactorily determined by the well known formula[1]

$$\sigma_c = \frac{\pi}{k^2} \sum_{l=0}^{\infty} (2l+1) \frac{4s_l KR}{\Delta_l^2 + (KR + s_l)^2}, \qquad (1)$$

where k and K are the wave numbers of the particles inside and outside the nucleus; R is the radius of the nucleus;

$$s_l = kR / (G_l^2 + F_l^2),$$

$$\Delta_l = kR (G_l G_l' + F_l F_l') / (G_l^2 + F_l^2) \text{ with } r = R,$$

where $F_l(r)$ denotes the regular solution of the radial equation, while $G_l(r)$ is the irregular solution at zero.

The use of Eq. (1) is inconvenient for charged particles at large values of the Coulomb parameter $\eta = Z_1 Z_2 e^2/\hbar v \gg 1$. In the present communication we obtain for σ_c a closed expression, valid under the condition that the particle energy is lower than or very little higher than the Coulomb barrier.

In this case the following expressions[2] hold for the radial Coulomb functions

$$F_l(r) = (2\eta)^{1/6}\, v\,[(2\eta)^{-1/3}(\eta + \sqrt{\eta^2 + (l + 1/2)^2} - kr)],$$
$$G_l(r) = (2\eta)^{1/6}\, u\,[(2\eta)^{-1/3}(\eta + \sqrt{\eta^2 + (l + 1/2)^2} - kr)], \qquad (2)$$

where v and u are Airy[3] functions. These functions are related to Bessel functions of order $\frac{1}{3}$ in the following manner:

$$\left.\begin{matrix} u(t) \\ v(t) \end{matrix}\right\} = \sqrt{\frac{\pi}{3} t}\left\{I_{-1/3}\left(\frac{2}{3} t^{3/2}\right) \pm I_{1/3}\left(\frac{2}{3} t^{3/2}\right)\right\}, \quad t > 0,$$
$$\left.\begin{matrix} u(t) \\ v(t) \end{matrix}\right\} = \sqrt{\frac{\pi}{3} |t|}\left\{J_{-1/3}\left(\frac{2}{3} |t|^{3/2}\right) \mp J_{1/3}\left(\frac{2}{3} |t|^{3/2}\right)\right\}, \quad t < 0.$$

Since the Airy functions vary substantially when the magnitude of their argument changes by an amount on the order of unity, the root in the arguments of the functions (2) can be expanded in powers of $(l + \frac{1}{2})^2 \eta^{-2}$, retaining only the linear term. Furthermore, it is permissible to change in (1) from summation with respect to l to integration with respect to the variable t:

$$t = (l + 1/2)(2\eta)^{-4/3} + z_0, \qquad z_0 = (2\eta)^{-1/3}(2\eta - kr),$$
$$\sum_{l=0}^{\infty}(2l + 1)\ldots \rightarrow (2\eta)^{4/3}\int_{z_0}^{\infty} dt\ldots$$

For the evaluation of the integral thus obtained, we note that the quantities $u'(t)/u(t)$, $v'(t)/v(t)$, and $u(t)v(t)$ vary very slowly with t in comparison with $u^{-2}(t)$, [indeed, $u^{-2}(t)$ determines a substantial range of t] and they can be regarded as constants, with $t = z_0$. Now, changing to a new variable of integration, $x = v(t)/u(t)$, and noting that

$$v'(t)\,u(t) - v(t)\,u'(t) = 1, \qquad u^{-2}dt = dx,$$

we get

$$\sigma_c = \frac{8\pi\eta}{k^2}\left(\frac{k}{K}\right)\int_0^{x_0}\frac{dx}{(1 + x^2)}\left[\left(1 + \frac{\alpha x}{1 + x^2}\right)^2 + \left(\frac{\beta + \gamma x^2}{1 + x^2}\right)^2\right]^{-1},$$

where

$$\alpha = k/(2\eta)^{1/3} K u(z_0)\, v(z_0), \qquad \beta = u'(z_0)\, k / u(z_0)(2\eta)^{1/3} K;$$
$$\gamma = v'(z_0)/v(z_0)(2\eta)^{1/3} K.$$

Expanding the integrand in powers of $k/(2\eta)^{1/3}K$ and retaining only the first two terms, we have finally

$$\sigma_c = \frac{8\pi\eta}{k^2}\left(\frac{k}{K}\right)\left\{\tan^{-1}\frac{v(z_0)}{u(z_0)} - \frac{k}{(2\eta)^{1/3}K}\,\frac{v(z_0)}{u(z_0)\,[u^2(z_0) + v^2(z_0)]}\right\}.$$

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THE ENERGY OF A COMPRESSED IMPERFECT FERMI GAS

D. A. KIRZHNITS

P. N. Lebedev Physics Institute, Academy of Sciences, U.S.S.R.

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We consider a uniform degenerate Fermi gas whose particles interact according to a short-range law [two-body potential $V(r_{12})$, range of the forces a]. The mean distance between the particles is assumed small compared to a. There are no restrictions imposed upon the magnitude of the interaction, and we assume only that the Fourier transform of the potential $\nu(q)$ exists. The properties of such a simple model are of interest for the problem of nuclear matter where $\xi \sim 3$ or 4 (see below) and also for some astrophysical problems.

We evaluate in the following the energy ϵ per single fermion, which depends on the dimensionless "compression parameter"* $\xi = ap_0 \gg 1$ and "coupling constant" $\alpha = \nu(0)/a$. Here $p_0 = (3\pi^2\rho)^{1/3}$ is the Fermi momentum, and ρ the number density of the particles.

It is well known that the kinetic energy of the nonrelativistic gas is equal to $\epsilon_0 = 3p_0^2/10$. In the Hartree-Fock approximation the interaction energy corresponds to the first order of perturbation theory in α. Its non-exchange part is equal to

$$\varepsilon_1 = (\rho/2)\int V d\mathbf{r} \sim \alpha\xi p_0^2. \qquad (1)$$

The magnitude of the exchange term

$$\varepsilon_2 = -(8\pi^3\rho)^{-1}\int d\mathbf{p}_1 d\mathbf{p}_2 \nu(\mathbf{p}_1 - \mathbf{p}_2), \quad p_{1,2} < p_0,$$

depends on the behavior of V at small r. If $V(0)$ is finite,

$$\varepsilon_2 = -V(0)/2 \sim \alpha p_0^2/\xi^2 \ll \varepsilon_1. \qquad (2)$$

To estimate the correlation energy (i.e., the higher terms of perturbation theory) we consider that the transition from the n-th to the n+1-st