In the asymptotic region $s \rightarrow \infty$, Eq. (7) takes the form

$$\tau_{as}^{\pm}(q'^2, q^2, \nu, E) = \frac{1}{s}\int_0^s d\nu \int_0^\infty Q_{as}^{\pm}\left(\frac{\nu}{s}, q'^2, u', E\right) \frac{\tau_{as}^{\pm}(q'^2, u', \nu, E)}{(E^2 - m^2 - u')\sqrt{u' + m^2}}\, du',$$

$$Q_{as}^{\pm}(x, u, u', E) = \int \frac{\theta(u' - ux - \nu_1 x/(1-x))\, U^{\pm}(E, \nu_1)}{(1-x)^{1/2}(u' - ux - \nu_1 x/(1-x))^{1/2}}\, d\nu_1. \quad (8)$$

This equation has a solution of the form

$$\tau^{\pm}(q'^2, q^2, \nu, E) = \tau_{\alpha}^{\pm}(q'^2, q^2, E)\, \nu^{\alpha(E)}. \quad (9)$$

Here the function τ_α satisfies the equation

$$\tau_{\alpha}^{\pm}(u, s, E) = \int R_{\alpha}^{\pm}(u, u', s, E) \frac{\tau_{\alpha}^{\pm}(u', s, E)}{(E^2 - m^2 - u')\sqrt{u' + m^2}}\, du'.$$

$$R_{\alpha}^{\pm}(u, u', s, E) = \int U^{\pm}(E, \nu)\, d\nu \int_0^1 \frac{dx \cdot x^{\alpha}}{(1-x)^{1/2}} \frac{\theta(u' - ux - \nu x/(1-x))}{[u' - ux - \nu x/(1-x)]^{1/2}}. \quad (10)$$

From Eq. (10) we can determine the eigenfunction τ_α and the eigenvalue α, which is a function of E. For $E^2 < m_1^2$ the function $U(E, \nu)$ is real and, consequently, α is real.

Inserting (9) into (6) we obtain for large values of s

$$T(q'^2, q^2, s, E) = s^{\alpha(E)} \tau_{\alpha}(q'^2, q^2, E) \frac{[1 + e^{-i\pi\alpha(E)}]}{\sin \pi\alpha(E)}. \quad (11)$$

We can also obtain similar results directly from Eq. (1) by going over to partial waves.[3]

The authors express their deep gratitude to Academician N. N. Bogolyubov for discussion of the results.

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Translated by E. Marquit
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NEUTRON-NEUTRON TOTAL CROSS SECTION AT 8.3 GeV

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Submitted to JETP editor January 12, 1963

J. Exptl. Theoret. Phys. (U.S.S.R.) **44**, 1411-1412 (April, 1963)

THE neutron-neutron total cross section was measured at the proton synchrotron of the Joint Institute of Nuclear Research from the attenuation of a neutral beam under conditions of good geometry ($\theta/2 = 0.228°$).

As a neutron detector we used a telescope consisting of scintillation counters and a Cerenkov counter with complete absorption in lead glass. The detector recorded only those neutrons which, in interactions in an aluminum converter 10 cm thick, produced secondary particles (mainly neutral and charged pions) whose energy release in the Cerenkov-counter radiator was somewhat greater than the threshold energy. The energy thresholds of the neutron counter were calibrated from measurements of the energy of accelerated protons in the accelerator and with an electron beam. A system of fast discriminators with a resolving time of 1.0 μsec was used for the pulse-height analysis of the Cerenkov-counter output. A second identical system of discriminators permitted simultaneous counts of random coincidences. As a monitor we used a telescope consisting of three scintillation counters.[1] The neutron-neutron cross section was measured by the difference method with 50.01- and 55.60-g/cm^2 targets of H_2O and D_2O.

To decrease the effect of fluctuations in the measuring equipment and in the accelerator during the measurements, the ordinary and heavy water targets were exposed alternately for approximately 10—12 cycles of accelerator operation.

The experimentally obtained value of the n-n total cross section at an effective energy of about 8.3 GeV is

$$\sigma_{nn} = 31.5 \pm 1.7 \text{ mb}$$

The error is statistical.

Glauber[2] showed that the cross section for the interaction of high-energy particles with deuterons should be less than the sum of cross sections for free neutrons and protons. In order to obtain the true value for the total n-n cross section, it is necessary to take into account the effect of the screening of the neutron by the proton in the deuteron. The correction for screening is very small for energies of the order of several hundred MeV when the de Broglie wavelength of the incident particles is large and when diffraction scattering does not lead to the formation of a shadow. For incident particle energies of the order of 1 GeV and above, the de Broglie wavelength of the particles is already much smaller than the interaction region, and the approximation of geometric optics is applicable here. Of course, the greater the inelastic cross section, the greater the screening effect. If the distance between nucleons in the deuteron is assumed to be much greater than the interaction region, we obtain the following expression for the total cross sections:

$$\sigma_{nd} = \sigma_{nn} + \sigma_{np} + 4\pi k^{-2} \operatorname{Re}[f_{nn}(0) f_{np}(0)] \langle r^{-2} \rangle, \qquad (1)$$

where f_{mn} and f_{np} are the scattering amplitudes and $\langle r^{-2} \rangle$ is the mean value of the inverse of the square of the distance between the proton and the neutron in the deuteron. This expression can be simplified if it is assumed that the scattering amplitude at high energies is purely imaginary. Then $f(0) = ik\sigma/4\pi$, and substitution into (1) yields

$$\sigma_{nd} = \sigma_{nn} + \sigma_{np} - \frac{1}{4\pi} \sigma_{nn}\sigma_{np} \langle r^{-2} \rangle.$$

The quantity $\langle r^{-2} \rangle$ can be calculated theoretically if the deuteron wave function is known. Depending on the specific choice of this function, the values of the correction obtained by Glauber were -4.5, -5.7, and 7.2 mb.

The value of the correction for screening can also be estimated from the known experimental values of σ'_{nn}, σ_{pp}, and σ_{np}, σ'_{pn} measured at the same energy (σ' is the total nucleon-nucleon cross section without allowance for the correction due to screening in the deuteron). From the conditions of charge symmetry of the nuclear forces (if the electromagnetic interaction is neglected) the value of σ_{pp} should be equal to σ_{nn} (for free nucleons). It thus follows that $\sigma_{pp} - \sigma'_{nn} = \sigma_{nn} - \sigma'_{nn}$.

In [3] it has been shown that, within the limits of error, $\sigma_t(pp)$ is constant in the 10—20 GeV/c energy interval and is equal to 39.5 ± 1 mb. Substitution of the experimental values of the total cross sections σ_{pp} and σ'_{nn} yields the correction due to screening: $\delta\sigma = 39.5 - 31.5 = 8$ mb, which is good agreement with the value 7.2 mb obtained by Glauber for a potential of the form $V(r) \sim \lambda(e^{\lambda r} - 1)^{-1}$.

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Translated by E. Marquit
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SUPERCONDUCTIVITY OF GALLIUM NITRIDE

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Submitted to JETP editor January 29, 1963

J. Exptl. Theoret. Phys. (U.S.S.R.) 44, 1413-1415 (April, 1963)

It is well known that among the nitrides of transition metals there are superconductors with reasonably high transition temperatures. [1] Nitrides of non-transition elements have not yet been investigated. The present work deals with a study of the superconductivity of the nitrides of two non-transition metals, gallium and indium.

The nitrides were prepared by direct nitration of the metals and by reaction of the oxides with ammonia. [2] In this way, we obtained both nitrides which were almost exactly stoichiometric, corresponding to the formulas GaN and InN, and compounds containing oxygen impurity.

X-ray diffraction analysis of the stoichiometric compounds showed that their lattices were hexagonal, of wurtzite type, with parameters in good agreement with the published data:

	a, Å	c, Å	c/a	
GaN:	3.182	5.173	1.626	present work
InN:	3.540	5.706	1.611	present work
GaN:	3.180	5.166	1.622	[3]
InN:	3.540	5.705	1.611	[4]

The superconductivity of GaN and InN was determined by a magnetic method using powder samples. To obtain the temperature dependence of the critical field, the magnetic moment of the samples was measured as a function of the magnetic field at several constant temperatures.