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Theoretical Study of Nuclear Density Distributions and Elastic Electron Scattering Form Factors of Some Proton Halo Nuclei (^{17}Ne and ^{8}B)

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Abstract
Theoretical investigation of proton halo-nucleus (^{8}B and ^{17}Ne) has revealed that the valence protons are to be in pure $(1p_{1/2})^1$ orbit for ^{8}B and $(1d_{3/2})^2$ orbit for ^{17}Ne. The nuclear matter density distributions, the elastic electron scattering form factors and (proton, charge, neutron and matter) root-mean square (rms) are studied for our tested nuclei, through an effective two-body density operator for point nucleon system folded with two-body full correlation operator's functions. The full correlation (FC's) takes account of the effect for the strong short range repulsion (SRC's) and the strong tensor force (TC's) in the nucleon-nucleon forces. The effective two-body density operator is produced and used to derive an explicit form for ground state two-body nucleon density distributions (2BNDD's) applicable for proton – rich halo nuclei and Fortran 95 programs are utilized to obtain theoretical values of our calculation. The effect of the TC's and SRC's on the ground state also calculated. 2BNDD's obtained within the two- frequency shell model (TFSM) approach, the elastic charge scattering form factors *F(q)*'s of proton halo nuclei are studied through Plane Wave Born Approximation (PWBA) .

Keywords: Two-body full correlation operators; proton -rich exotic nuclei; two-frequency shell model

دراسة نظرية لتوزيعات الكثافة النووية وعوامل التشكل للاستطارة الالكترونية المرنة لبعض نوى الهالة الغنية بالبروتونات (^{17}Ne,^{8}B)

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الخلاصة
كشفت الدراسة النظرية للتحقق من النوى الغنية بالبروتونات (^{8}B ، ^{17}Ne) و ان بروتون الهالة لنوة ^{8}B من الاكثر احتمال تواجده في $(1p_{1/2})^1$ وان بروتونا الهالة لنواة ^{17}Ne تتواجد في $(1d_{3/2})^2$. ومن الممكن استنتاج الكثافة النووية الفعال ذو صيغة الجسيمتين المحسوبة (التي تأخذ بنظر الاعتبار تأخذ بنظر الاعتبار تأثير كل من القوة التنافرية الشديدة ذات المدى القصير والقوة التنزورية التجاذبية الطويلة المدى) والمعتمدة على نموذج القشرة ثنائي التردد للنوى الغريبة تظهر سلوك ذيل(امتداد) طويل لتوزيع الكثافة النيوكلونية بسبب بروتونات التكافؤ و يمثل خاصية المميزة لنوى الهالة . يتفق اتفاقا جيدا مع النتائج العملية والبيانات المجهزة .ومن الواضح الفرق الكبير بين النتائج المحسوبة للابعاد النووية البروتونية والابعاد النووية النيوترونية مما يؤكد التصرف الغريب لنوى الهالة الغني بالبروتون ان التأثير الكلي (التي تأخذ بنظر الاعتبار تأخذ بنظر الاعتبار تأثير كل من القوة التنافرية الشديدة ذات المدى القصير والقوة التنزورية التجاذبية الطويلة

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المدى) للكثافة النووية الفعال ذي صيغة الجسيمين يزداد بزيادة العدد الكلي A وجعل قيم الكثافة النووية ذات التأثيرالكلي اقرب الى النتائج العملية . يعتمد عامل التشكل على عدد بروتونات التكافؤ وعلى ثابت المتذبذب التوافقي b والذي افترض (في حالة النوى الهالة تساوي معدل قيمة الخاصة بالقلبb_c والهالة b_v)

Introduction

To have a comprehensive knowledge of the halo mechanism formation in loosely bound nuclei; it is important to scrutinize the proton halo structures which were not constrained on as compared to the neutron halo structures [1]. Halo nuclei have much larger sizes than other nuclei with a same number of protons and neutrons. This is, because of the probability distribution of one or two nucleons in halo nuclei extend to much larger distances than that of the rest of the nucleons [2]. The nucleon density distribution is one of the most essential quantities in nuclear structure which was calculated experimentally over a huge range of nuclei. This interest in $\rho_m(r)$ is related to the basic bulk nuclear characteristics such as the shape and size of nuclei, their binding energies, and other quantities which are connected with $\rho_m(r)$. Besides, the density distribution is an important object for experimental and theoretical investigations since it plays the role of a fundamental variable in nuclear theory [3].The inclusion of short range and tensor correlation effects is a difficult problem chiefly for the microscopic theory of nuclear structure. Several methods were proposed to treat complex tensor forces and to describe their effects on the nuclear ground state [4, 5].

A simple phenomenological method for introducing dynamical short range and tensor correlations was presented by Dellagiacoma et al. [6]. In that method, a two-body correlation operator was introduced to act on the wave function of a pair of particles. A similar phenomenological method which includes dynamical short range and tensor correlation effects was followed in the two-body density of a finite spherical nucleus to describe double closed shell nuclei, was discussed by Traini et al. [7]. An effective two-body density operator for point nucleon system folded with the full two-body correlations was produced and used to derive an explicit form for ground state two-body charge density distributions (2BCDD's) by Hamoudi et al. [8], that operator was applied for various closed and open shell nuclei. A simple effective nucleon-nucleon interaction for shell-model was calculated by Fiase et al.[9] and applied in the sd shell is derived from the Reid soft-core potential folded with two-body correlation functions which take account of the strong short-range repulsion and large tensor component in the Reid force. While a basic measurement provided by Al-khalili et al.[10] for the root mean square matter radii of halo nuclei in constructing, constraining, and assessing by theoretical models of halo structures, which consider the static density corrections to Glauber model calculations of reaction cross sections of such nuclei at high energy. The ground-state properties such as the neutron, proton and matter densities and the associated rms radii of proton-rich halo nuclei are calculated by Abdullah [11] using single-particle radial wave functions of Woods-Saxon (WS) potential. The ^{17}Ne nucleus is described as two protons outside of a deformed core. The Microscopic Cluster Model (MCM) is used by Hwash [12] to describe the three-body system ^{15}O+ p +p with Jacobi coordinates. This model strongly exhibits the Coulomb effect and therefore it is used to explore the role of the Coulomb effect in proton halo formation. The pygmy and giant dipole resonances in proton-rich nuclei ^{17,18}Ne are investigated by Xinxing et.al [13] with a fully self-consistent approach. The properties of ground states were calculated using the Skyrme Hartree–Fock with the Bardeen–Cooper–Schrieffer approximation to take into account the pairing correlation.

The aim of the present work is to study the effects of short range correlations $f(r)_{SC}$ and tensor correlations $f(r)_{TC}$ on the ground state two body nucleon density distributions, rms radii and elastic electron scattering form factors for proton-rich halo nuclei.

Theory

The one body density operator could be transformed into a two-body density form by the following transformation [14]

$$\hat{\rho}^{(1)}(\vec{r}) = \sum_{i=1}^{A} \delta(\vec{r} - \vec{r}_i) \tag{1}$$

$$\hat{\rho}^{(1)}(\vec{r}) \Rightarrow \hat{\rho}^{(2)}(\vec{r})$$

i.e.

$$\sum_{i=1}^{A}\delta(\vec{r}-\vec{r}_i)\equiv\frac{1}{2(A-1)}\sum_{i\neq j}\left\{\delta(\vec{r}-\vec{r}_i)+\delta(\vec{r}-\vec{r}_j)\right\} \tag{2}$$

where $\delta(\vec{r}-\vec{r}_i)$ is Dirac delta for position vector of particle i

A further useful transformation can be completed by the coordinates of the two – particles, $\vec{r}_i$ and $\vec{r}_j$, to be in terms of that relative position vector $\vec{r}_{ij}$ and center – of – mass $\vec{R}_{ij}$ coordinates [15], i.e.

$$\vec{r}_{ij}=\frac{1}{\sqrt{2}}(\vec{r}_i-\vec{r}_j) \tag{3a}$$

$$\vec{R}_{ij}=\frac{1}{\sqrt{2}}(\vec{r}_i+\vec{r}_j) \tag{3b}$$

Subtracting and adding (3a) and (3b) we obtain

$$\vec{r}_i=\frac{1}{\sqrt{2}}(\vec{R}_{ij}+\vec{r}_{ij}) \tag{3c}$$

$$\vec{r}_j=\frac{1}{\sqrt{2}}(\vec{R}_{ij}-\vec{r}_{ij}) \tag{3d}$$

Introducing eq's (3c) and (3d) into eq. (2) yields

$$\hat{\rho}^{(2)}(\vec{r})=\frac{\sqrt{2}}{(A-1)}\sum_{i\neq j}\left\{\delta\left[\sqrt{2}\,\vec{r}-\vec{R}_{ij}-\vec{r}_{ij}\right]+\delta\left[\sqrt{2}\,\vec{r}-\vec{R}_{ij}+\vec{r}_{ij}\right]\right\} \tag{4}$$

where the following identities [8] have been used

$$\delta(ax)=\frac{1}{|a|}\delta(x) \quad \text{(for one – dimension)}$$

$$\delta(a\vec{r})=\frac{1}{|a^3|}\delta(\vec{r}) \quad \text{(for three –dimension)}$$

i.e.

$$\hat{\rho}^{(2)}_{ch}(\vec{r})=\frac{\sqrt{2}}{2(A-1)}\sum_{i\neq j}\left\{\delta\left[\sqrt{2}\,\vec{r}-\vec{R}_{ij}-\vec{r}_{ij}\right]+\delta\left[\sqrt{2}\,\vec{r}-\vec{R}_{ij}+\vec{r}_{ij}\right]\right\} \tag{5}$$

Finally, an effective two-body charge density operator (will be used with uncorrelated wave functions) can be formed by folding the operator of eq. (5) with the two-body correlation functions $\tilde{f}_{ij}$ as

$$\hat{\rho}^{(2)}_{eff}(\vec{r})=\frac{\sqrt{2}}{2(A-1)}\sum_{i\neq j}\tilde{f}_{ij}\left\{\delta\left[\sqrt{2}\,\vec{r}-\vec{R}_{ij}-\vec{r}_{ij}\right]+\delta\left[\sqrt{2}\,\vec{r}-\vec{R}_{ij}+\vec{r}_{ij}\right]\right\}\tilde{f}_{ij} \tag{6}$$

In this paper a simple model form of the two-body full correlation operators of Ref.[8] will be adopted, i.e.

$$\tilde{f}_{ij}=f(r_{ij})\Delta_1+f(r_{ij})\left\{1+\alpha(\mathrm{A})S_{ij}\right\}\Delta_2 \tag{7}$$

It is obvious that this equation includes two kinds of correlations:

(a) The two-body short rang correlations (2BSRC's) obtainable in the first term of eq. (7) and symbolize by $f(r_{ij})$. At this point Δ_1 is a projection operator on the space of all two-body functions with the exception of ${}^3S_1$ and ${}^3D_1$ states. Indeed, the SRC's are central functions of the separation between the pair of particles which reduce the two-body wave function at short distances. Where the repulsive core forces the particles apart, and heals to unity at large distance where the interactions are tremendously weak. A simple model form of two-body SRC's is known by [8]

$$f(r_{ij}) = \begin{cases} 0 & for\ r_{ij} \le r_c \\ 1 - \exp\left\{-\mu(r_{ij} - r_c)^2\right\} & for\ r_{ij} > r_c \end{cases} \tag{8}$$

where r_c (in fm) is the radius of a fitting hard core and μ =25 fm^{-2} [8] is a correlation parameter.

(b) The two-body tensor correlations (2BTC's) presented in the second term of eq.(7) are introduce through the strong tensor component in the nucleon-nucleon force, the 2BTC's have the longer range. Here Δ_2 is a projection operator onto the $^3S_1$ and $^3D_1$ states only. However, eq. (7) can be rewritten as

$$\tilde{f}_{ij} = f(r_{ij}) \sum_{\gamma} \left\{ 1 + \alpha_\gamma(\mathrm{A}) S_{ij} \right\} \Delta_\gamma \tag{9}$$

the sum γ , in eq. (9), is over all reaction channels , S_{ij} is the typical tensor operator, produced by the scalar product of a second-rank operator in intrinsic spin space and coordinate space and is distinct by

$$S_{ij} = \frac{3}{r_{ij}^2} (\vec{\sigma}_i . \vec{r}_{ij})(\vec{\sigma}_j . \vec{r}_{ij}) - \vec{\sigma}_i . \vec{\sigma}_j \tag{10}$$

while $\alpha_\gamma(\mathrm{A})$ can be define as the strength of tensor correlations and it is non zero just in the $^3S_1 - {}^3D_1$ channels.

As the halo nuclei is oversized and easily broken system consisting of a compact core plus a number of outer nucleons loosely bound and Specially extended far from the core, it is suitable to separate the ground state density distribution of equation (6) into two parts, one is connected with the core nucleons and the other one with the halo nucleons, so the matter density distribution for the whole halo nucleus becomes [16]:

$$\rho_m(\mathrm{r}) = \overset{core}{\underset{p+n}{\rho}}(r) + \overset{halo}{\underset{p(n)}{\rho}}(r) \tag{11}$$

The normalization condition of the above ground state densities is given by:

$$g = 4\pi \int_0^\infty \rho^g(\mathrm{r}) \mathrm{r}^2 d\mathrm{r} \tag{12}$$

Here $\rho^g(\mathrm{r})$ represents one of the following densities: matter, charge, core, halo densities. The rms radii of corresponding above densities are given by:

$$\left\langle r^2 \right\rangle_g^{1/2} = \frac{4\pi}{g} \int_0^\infty \rho^g(r) r^4 d\mathrm{r} \tag{13}$$

Elastic electron scattering form factor from spin zero nuclei **(***J*=0**)**, can be determined by the ground – state charge density distributions (CDD). In the Plane Wave Born Approximation (PWBA), the incident and scattered electron waves are well thought-out as plane waves and the CDD is real and spherical symmetric, therefore the form factor is simply the Fourier transform of the CDD. Thus [17, 18]

$$F(q) = \frac{4\pi}{qZ} \int_0^\infty \rho_o(\mathrm{r}) Sin(q\mathrm{r})\, \mathrm{r}\ d\mathrm{r}\, F_{fs}(q) F_{cm}(q) \tag{14}$$

where $F_{fs}(q)$ the finite nucleon size and $F_{cm}(q)$ the center of mass corrections. $F_{fs}(q)$ is considered as free nucleon form factor and assumed to be the same for protons and neutrons. This correction takes the form [18].

$$F_{fs}(q) = e^{-0.43q^2/4} \tag{15}$$

The correction $F_{cm}(q)$ removes the specious state arising from the motion of the center of mass when shell model wave function is employ and set by [17] .

$$F_{cm}(q) = e^{q^2b^2/4A} \tag{16}$$

where A is the nuclear mass number.

Results and Discussion

The halo nuclei have produced much excitement and many hundreds of papers while its discovery in the mid-1980s. Proton halo nuclei are not fairly as remarkable in terms of the scope of their halo, due to the confining Coulomb barrier which holds them closer to the core. Nevertheless, examples include ^8B and ^{17}Ne have been studied here. The nuclear ground state properties of halo nuclei have been calculated using the effect of full correlation functions (i.e. the TC's and the SRC's) by TFSM. In TFSM, the calculations are based on using different model spaces for the core and the extra halo proton [18, 19]. The single particle harmonic oscillator wave functions are employed with two different size parameters b_c, b_v.

The nuclear properties which include matter, proton, neutron, charge densities and the associated rms radii are programmed by Fortran 95 power station. Elastic electron scattering form factors for these nuclei are studied through combining the charge density distribution with the PWBA.

Table-1 show some properties of our tested nuclei, while Table-2 displays the values of the harmonic oscillator size parameter b_c and b_v utilized in the present calculations for the selected exotic nuclei and the calculated rms matter radii for core [^7Be and ^{15}O] and exotic nuclei [^8B, and ^{17}Ne] , using the full correlation (i.e r_c = 0.5fm and α =0.1). Table (3) shows the calculated and experimental charge rms radii in (fm) with full correlation and determining the difference between them. The neutron and proton rms radii calculated when the full correlation (α= 0.1, r_c =0.5fm) and without correlation (α= 0, r_c =0 fm) as in Table (4). The full correlation rms can be written as:

$$\langle r^2 \rangle_{FC's} = \langle r^2 \rangle_{r_c=0.5,\alpha=0.1} - \langle r^2 \rangle_{r_c=0,\alpha=0}$$ (for proton ,neutron and charge)

Table 1- Some properties of exotic ^8B and ^{17}Ne nuclei

Exotic nuclei $^A_ZX_N$	J^π	Halo Type[20]	Half-Life Time[20] $\tau_{1/2}$ ms
$^8_5B_3$	2^+	1p Halo	770
$^{17}_{10}Ne_7$	$1/2^-$	2p Halo	109.2

Table 2-Parameters for b_c and b_v utilized in the TFSM of the present study together with the calculated and experimental rms radii of ^8B and ^{17}Ne exotic nuclei.

Exotic nuclei	Core nuclei	rms matter radii for core nuclei (fm) $\langle r_m^2 \rangle^{1/2}$		rms matter radii for halo nuclei (fm) $\langle r^2 \rangle_m^{1/2}$	
		Calculated Results	Experimental Results[21]	Calculated Results	Experimental Results[21] [22]
^8B	^7Be	2.3318	2.33±0.01	2.6281	2. 6±0.02
^{17}Ne	^{15}O	2.3691	____	2.89	2.84±0.23

Table 3-Calculated and experimental charge rms radii in (fm) for ^{8}B and ^{17}Ne exotic nuclei.

Exotic nuclei	Size parameter (b)	$\langle r_{ch}^2\rangle^{1/2}$ rc=0,α=0	$\langle r_{ch}^2\rangle^{1/2}$ rc=0.5,α=0.1	$\langle r_{ch}^2\rangle^{1/2}_{exp}$ [23]	$\langle r^2\rangle^{1/2}_{FC's} = \langle r^2\rangle^{1/2}_{r_c=0.5,\alpha=0.1} - \langle r^2\rangle^{1/2}_{r_c=0,\alpha=0}$
^{8}B	2.0	2.8447	2.8281	2.82(6)	-0.0166
^{17}Ne	1. 94	2.9923	2.9460	2.90±0.07	-0.0463

Table 4-Parameters for b_p and b_n utilized in the present study protons , nutrons rms in (fm) for ^{8}B and ^{17}Ne exotic nuclei.

Exotic nuclei	size parameter (fm)	$\langle r_p^2\rangle^{1/2}_1$ rc=0.5,α=0.1	$\langle r_p^2\rangle^{1/2}$ r_c=0,α=0	$\langle r_p^2\rangle^{1/2}_{exp}$ [23],[24]	$\langle r_p^2\rangle^{1/2}_{FC's}$ r_c=0.5,α=0.1	$\langle r_n^2\rangle^{1/2}$ r_c=0.5, α=0.1	$\langle r_n^2\rangle^{1/2}$ r_c=0,α=0	$\langle r_n^2\rangle^{1/2}_{exp}$ [23],[24]	$\langle r_n^2\rangle^{1/2}_{FC's}$
^{8}B	b_P = 1.85 b_n = 1.72	2.5397	2.5562	2.53±0.13	-0.0165	2.3151	2.3275	2.31±0.05	-0.0124
^{17}Ne	b_P =1.81 b_n =1.83	2.7826	2.7957	2.79±0.07	-0.0131	2.6933	2.6936	2.69±0.07	-0.0003

1. ^{8}B nucleus

One of candidates for a proton- halo nucleus ^{8}B (J,T=2^+,1) is accepted to be of the core ^{7}Be (J,T=$3/2^-$,1/2) plus one loosely bound proton (J,T=$1/2^-$,1/2) surrounding the core . A value of the oscillator size parameter b_c = 1.79 fm is chosen for the core ^{7}Be , which gives the rms nucleon radius equal to 2.3318 fm , while the one hole (one proton halo) in ^{8}B is assumed to be in a pure $1p_{1/2}$ with occupation probabilities 0.25 and oscillator size parameter b_v =3.14 fm is used to give the rms nucleon radius equal to 2.6281 fm . The experimental and calculated nucleon rms radii for this nucleus are displayed in Table-2. It is clear from this table that the obtained results are in a reasonable accordance with experimental data within quoted error for ^{8}B. 2BNDD's (ρ_m) (in fm^{-3}) of the ground state are plotted versus r (in fm) as shown in Figure-1. The dashed curve represent 2BNDD's without correlation (i.e r_c = 0 and α =0) with one oscillator size parameter (b =2.46fm), when $r_c \neq 0$ and $\alpha \neq 0$, the dash-dot represent 2BNDD's for the core ^{7}Be (proton + neutron) with oscillator size parameter (b_c =1.79 fm) while dash-double dot represent 2BNDD's for the one valance proton with oscillator size parameter (b_v =3.14 fm) and the solid curve represent the total calculation for the core nucleons and the one halo proton , The long tail is due to the outer halo one proton.

The filled circles are fitted matter densities taken from [22] for Gaussian - Gaussian (G-G) parameterization as a fitted density of ^{8}B nucleus, while the shaded curve is represent the experimental matter density[23,24]. This figure gives the conclusion that the halo phenomenon in ^{8}B is connected to the outer one proton and matter densities but not to the core nucleons.

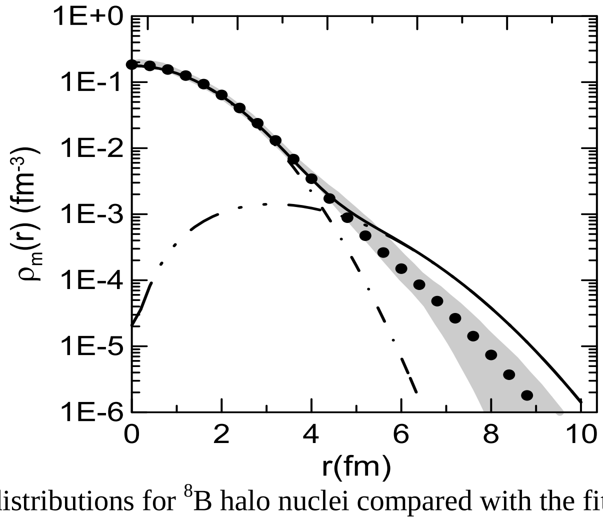

Figure 1-Matter density distributions for ^{8}B halo nuclei compared with the fitted matter density.

In Figure -2, a graph is plotted for elastic form factor versus q (in fm^{-1}) for ^{8}B calculated with PWBA. the solid curve represent the form factor for 2BCDD's with ($F_{fs}(q) \neq 0$ $F_{cm}(q) \neq 0$) and oscillator size parameter (b =1.6 fm) , the dash curve represent the form factor for 2BCDD's with correlation and oscillator size parameter (b =1.6 fm) and ($F_{fs}(q) = 0$ $F_{cm}(q) = 0$) i.e the finite nucleon size and the center of mass corrections not take in to account. The form factor is dependent on detailed properties of the one proton halo and the difference in $F_{cm}(q)$ which depends on the mass number and the size parameter b(is assumed in this case equal to the average of b_c and b_v).

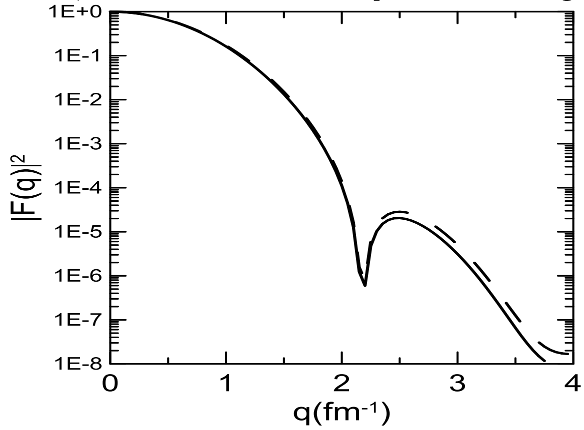

Figure 2-Calculated elastic charge form factor for proton – rich halo nuclei ^{8}B

2. ^{17}Ne nucleus

The ^{17}Ne (J,T=1/2$^-$,3/2) is two-proton Borromean halo nucleus[25] composed of the core is formed by coupling the core ^{15}O (J,T=1/2$^-$,1/2) plus two loosely bound protons (J,T= 0$^+$ 1) surrounding the core. The ^{15}O is assumed to be in ($1p_{1/2}$) with occupation probabilities 0.75 . The value of the oscillator size parameter b_c =1.59 fm is chosen for the core ^{15}O, which gives the rms nucleon radius equal to 2.369129 fm, while the two protons in ^{17}Ne are assumed to be in a pure ($2s_{1/2}$) with occupation probabilities 0.5 and b_v =3.2 fm is used to give the rms nucleon radius equal to 2.89 fm. The experimental and calculated nucleon rms radii for this nucleus are displayed in Table (1).

Figure-3 shows 2BNDD's (ρ_m) (in fm^{-3}) of the ground state are plotted versus r (in fm). The dashed curve represent 2BNDD's without correlation (i.e r_c = 0 and α =0) with one oscillator size parameter (b =2.3 fm), when $r_c \neq 0$ and $\alpha \neq 0$, the dash-dot represent 2BNDD's for the core ^{15}O (proton + neutron) with oscillator size parameter (b_c =1.79 fm) while dash-double dot represent 2BNDD's for the valance neutrons with oscillator size parameter (b_v =3. 14 fm) and the solid curve represent the total calculation for the core nucleons and the valance neutron .The long tail is due to the outer halo two - protons ,and the shaded curve represent the experimental matter densities taken from Ref. [25] . This figure gives the conclusion that the halo phenomenon in ^{17}Ne is connected to the outer protons and nucleons densities but not to the core nucleons density.

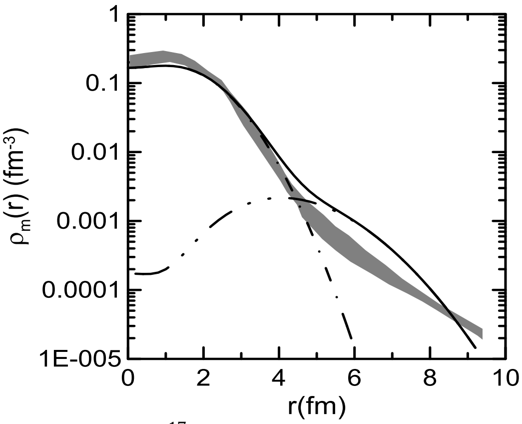

Figure 3-Matter density distributions for ^{17}Ne halo nuclei compared with the experimental matter density

The elastic electron form factor versus q (in fm^{-1}) for ^{8}B calculated with PWBA as shown in Figure-4. The solid curve represent the form factor for 2BCDD's with ($F_{fs}(q) \neq 0$ $F_{cm}(q) \neq 0$) and oscillator size parameter (b =1.94 fm) , the dash curve represent the form factor for 2BCDD's with correlation ($F_{fs}(q)=0$ $F_{cm}(q)=0$) and oscillator size parameter (b =1.94 fm), i.e the finite nucleon size and the center of mass corrections not take in to account . The form factor is dependent on detailed properties of the two protons halo and the difference in $F_{cm}(q)$ which depends on the mass number and the size parameter b (is assumed in this case equal to the average of b_c and b_v).

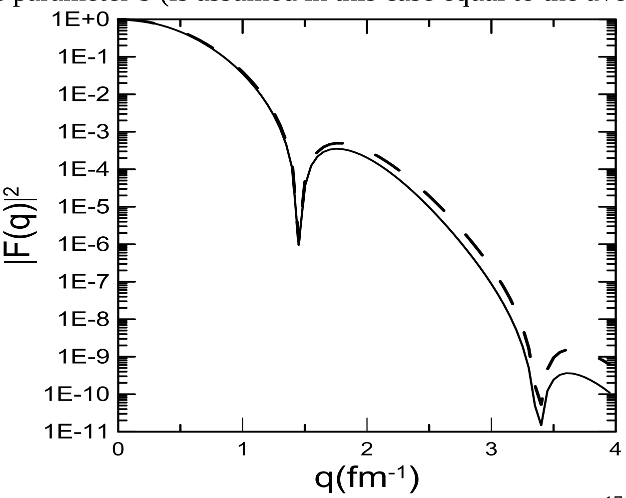

Figure 4- Calculated elastic charge form factor for proton – rich halo nuclei ^{17}Ne.

Conclusions

Theoretical investigation of proton halo-nucleus (^{8}B and ^{17}Ne) has revealed to that the valence protons are to be in pure $(1p_{1/2})^1$ for ^{8}B and $(1d_{3/2})^2$ for ^{17}Ne . In the present work, it is achievable to conclude that the calculated 2BNDD' s with FC's for our exotic nuclei exhibit a long tail(r > 6 fm) behavior because of the valance protons which are considered as a distinctive feature of halo nuclei.
The results of 2BNDD's with FC's which based on the two- frequency shell model approach are a good agreement with those of the fitted and experimental data. It is clear that the difference between the calculated proton and neutron rms radii also indicates a definite degree of proton halo structure. The effect of FC's on the 2BNDD's and $\langle r^2 \rangle^{1/2}$ is increase as increasing the mass number A and making them closer to those of experimental data. The form factor is dependent on detailed properties of the proton halo and the difference in $F_{cm}(q)$ which depends on the mass number and the size parameter b (is assumed in this case equal to the average of b_c and b_v).

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