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A New Way to Detect Neutrinos

J. A. de Wet

Box 514, Plettenberg Bay,6600, South Africa
jadew@global.co.za

Abstract

In this paper we will analyse the very high frequencies shown in Fig. 1 in the wave function of ^{15}N which is believed to be associated with the short-lived level $^{15}N+\gamma \rightarrow {}^{14}N$+n could be caused by low-frequencyγ neutrinos n that not only provide heat but also rapidly decay to the ground state $^{14}N + n$. There is also a large frequency loss that would cause the drop in temperature shown in Figs.2,3 which was recorded on a cylinder containing approximately 1.5 liters of ^{15}N at atmospheric pressure.Not only does this provide a simple method of recording low-frequency neutrinos which pass through the Earth,but also confirms the derivation of the wave function which was done by a top-down method not accessible to conventional calculations that presuppose a Lagrangian with postulated interactions between nucleons. Finally the cooling of ^{15}N by neutrinos at the right frequency could be used to supercool the liquid at near to absolute zero.

Mathematics Subject Classification: 20C35, 21R05, 81V35

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1 Introduction

According to Bahcall [2] approximately 10^{11} solar neutrinos cross every cm^2 of the Earth's surface every second. That is an awful lot of neutrinos but only 2.8 counts a day are detected by the BOREXINO experiment [11] registering neutrinos with energies between 5 and 16.3MeV.This experiment is conducted in a large tank of borated liquid scintillator (200 tons of ^{11}B) immersed in 2.10^6 liters of pure water. If this is a cube,then to hold this amount of water the edges of the tank would have to be 104.4 m implying a surface area of $12 \times 10^4 cms^2$ compared with only $170 cms^2$ for the surface area of the test cylinder of pure ^{15}N .

N^{15} has very short-lived energy levels of 9.1 and 9.155 MeV arising from the decay of ^{15}C ie.

$$^{15}N + \gamma \rightarrow ^{14} N + n \tag{1}$$

that decay to the ground state[1].These are believed to be the levels associated with the wave function of Fig.1 calculated by de Wet [5] that shows a very high frequency which could be in phase with neutrinos with coherent γ ray frequency. When the level decays there will be an entropy loss accompanied by a temperature drop greater than any heat associated with the levels. Such a drop has been measured by a Lufft Opus 10 with 2 sensors, one of which recorded the ambient temperature very close to the cylinder of ^{15}N while the other was affixed directly onto the surface of the cylinder itself.

A typical observation running over a few days a month appears in Fig.2. Here there is a peak at night which could only be due to a coherent neutrino burst passing right through the Earth. This is accompanied by some heating shown in Fig.3 on the extreme right.

The number of atoms in the test cylinder holding 1.5 liters of pure ^{15}N at room temperature and 1 bar is close to 4.4×10^{22} so vastly more can be excited to cause a temperature drop of up to 5 degrees Centigrade in Fig.2 than be recorded by the BOREXIMO experiment that would require 73×10^4 days just to find one neutrino.

Because Ref.[5] is difficult to find a summary of the steps used to find the wave function of ^{15}N is given in the Appendix.

2 Conclusion

This note provides experimental evidence supporting a new method of calculating the wave function of Fig.1 using a top-down approach without a Lagrangian.It also suggests a powerful and easy way of recording low-frequency neutrinos which could possibly be used to supercool liquid ^{15}N near absolute zero.

3 Appendix

More than 100 years ago Hudson [9]showed how the equation of the Kemmer surface,that yields a quadrupole, may be found by insisting on Lorentz invariance alone.Or, in other words, by finding irreducible representations of center D of the quaternion or Dirac ring which is equation (2) below. Actually the idea of also associating a particle with these representations goes back to Dirac [7],Eddington [8],Biedenharn ([3] Ch.4),and Wigner [12].In fact,Kahan [10] states in his Preface that " Particles may be said to be representations of the Lorentz Group,just as the electron may be said to be the equation of Dirac " In this way we begin with the fundamental modular 2-form

$$\frac{1}{4}\Psi = (iE_4\psi_1 + E_{23}\psi_2 + E_{14}\psi_3 + E_{05}\psi_4)e \tag{2}$$

which is a minimal left ideal on D describing spin about x_1 [4].Here e is a primitive idempotent and E_{23}, E_{05} are spin and isospin operators through the angles ψ_2, ψ_4 while E_{14} is a parity vector along x_4 thus completing triality. The identity operator iE_4 signifies rotations mod2π.

Eddingtons E-numbers,which are isomorphic to quaternions,are mapped into the 4×4 Dirac matrices by

$$\gamma_\nu = iE_{0\nu}, E_{\mu\nu} = E_{\rho\mu}E_{\rho\nu} = -E_{\nu\mu}, E^2_{\mu\nu} = -1, \mu < \nu = 1, \ldots, 5. \tag{3}$$

And two more representations of (2) may be obtained by a cyclic interchange of 1,2,3 to cover the spin about x_2, x_3.

Then a many nucleon representation in the enveloping algebra $A(\gamma)$ may be found by constructing the tensor product of (2) by itself.The basis elements are the $4^A \times 4^A$ matrices

$$E^l_{\mu\nu} = E_4 \otimes \cdots \otimes E_4 \otimes E_{\mu\nu} \otimes E_4 \otimes \cdots \otimes E_4 \tag{4}$$

with $E_{\mu\nu}$ in the l-th position and $E^l_{\mu\nu}, E^{l+1}_{\mu\nu}$ commutative.The irreducible representations,or minimal left ideals,are

$$\Psi^A = \sum C_{[\lambda]}P_{[\lambda]} \tag{5}$$

where $[\lambda] = [\lambda_1\lambda_2\lambda_3\lambda_4]$ labels each row of the matrix Ψ^A and $\lambda_1+\lambda_2+\lambda_3+\lambda_4$ is a partition of the atomic number A and we have adopted the canonical labeling $N = \lambda_1 + \lambda_2, Z = \lambda_3 + \lambda_4$ for the number of protons and neutrons while

$$s = \frac{1}{2}(A - 2(\lambda_2 + \lambda_3)), p = \frac{1}{2}(2(\lambda_2 + \lambda_4) - A)) \tag{6}$$

for spins and parities.P_λ is a projection operator of the same form as (2) and the physics is provided by the coefficient

$$C_{[\lambda]} = i^{\lambda_1} \sum (E^1_{23} \ldots E^{\lambda_2}_{23} E^{\lambda_2+1}_{14} \ldots E^{\lambda_2+\lambda_3}_{14} E^{\lambda_2+\lambda_3+1}_{05} \ldots E^{A-\lambda_1}_{05}) \tag{7}$$

which by virtue of the isomorphism between Dirac algebras and the exterior product is a 3-form in the centralizer D.

To find a Hodge decomposition of (7)we write it

$$C_{[\Lambda]} = i^{\Lambda_1}\sigma_0^{\Lambda_2}\pi_0^{\Lambda_3}T_0^{\Lambda_4} - \sum_\lambda i^{\lambda_1}\sigma_0^{\lambda_2}\pi_0^{\lambda_3}T_0^{\lambda_4} \tag{8}$$

where $[\Lambda] = [\Lambda_1\Lambda_2\Lambda_3\Lambda_4]$ is the ground state and σ_0, π_0, T_0 are the de Broglie operators

$$\sigma_0 = (E^1_{23} + \cdots + E^A_{23}) = 2is, \pi_0 = (E^1_{14} + \cdots + E^A_{14}) = 2ip,$$
$$T_0 = (E^1_{05} + \cdots + E^A_{05}) = i(Z - N) = 2T_3 \qquad (9)$$

which underlie (5).The summation contains all of those terms arising from repeated indices,eg $E^k_{23}E^k_{23}, E^k_{23}E^k_{14}, E^k_{23}E^k_{05}$ and $E^k_{14}E^k_{05}$ etc.that yield a single term by (3).

In the case of $^{15}N, [\Lambda] = [4434]$ and after some work it can be shown that the decomposition,with T_0 =-i is

$$C_{[4434]} = \frac{1}{144}((\sigma_0^7 + \pi_0^7) + 4(\sigma_0\pi_0^6 + \sigma_0^6\pi_0) + 12(\sigma_0^5\pi_0^2 + \sigma_0^2\pi_0^5) + 18(\sigma_0^3\pi_0^4 + \sigma_0^4\pi_0^3)$$
$$+281(\sigma_0^5 + \pi_0^5) + 842(\sigma_0^4\pi_0 + \pi_0\sigma_0^4) + 1692(\sigma_0^3\pi_0^2 + \sigma_0^2\pi_0^3) + 20089(\sigma_0^3 + \pi_0^3)$$
$$+403729(\sigma_0^2\pi_0 + \sigma_0\pi_0^2) + 315000(\sigma_0 + \pi_0))(10)$$

from which the eigenvalues may readily be obtained for any state $[\lambda_1\lambda_2\lambda_3\lambda_4]_k = [\lambda]_k$ characterized by $\lambda_3 + \lambda_4$=P=7 and $\lambda_1 + \lambda_2$=N=8 with spin $is = \sigma_0$ and parity $ip = \pi_0$ given by (6)

The normalized eigenvalues are, for the states $[\lambda]_k$

$$A = (76, 83/8(2), 22/7(2), 92/35, 101/56(2), 1(3), 3/7(3), 3/8(3), 0(2)) \qquad (11)$$

where degeneracies are shown in brackets and the ground state [4434] has the eigenvalue 92/35.

The matrices σ_0, π_0 in (10) are $4^A \times 4^A$-dimensional but may be expressed in terms of the generators σ_i, π_i

$$\sigma_i = E_N \otimes^P \gamma_i +^N \gamma_i \otimes E_P, \pi_i = E_N \otimes^P \gamma_i -^N \gamma_i \otimes E_P, i = 1, 2, 3 \qquad (12)$$

after a fibration of the $4^A \times 4^A$ representations of E_{23}, E_{14} consisting of all those states which have the same quantum numbers of spin,parity and charge. Here $^P\gamma_i, ^N\gamma_i$ are the (P+1)-,(N+1)-dimensional Lie operators of so(3)and E_P, E_N are (P+1)-,(N+1)-dimensional unit matrices [6] while σ_i may be recognized as the well-known angular momentum matrix for a coupled system of P protons and N neutrons and π_i is a parity operator.In this way a Yang-Mills field is introduced with connections on a fiber bundle.

If we now specialize to rotations about the z-axis with $2\sigma_1 = \sigma_0, 2\pi_1 = \pi_0$ in(9) then (10) becomes

$$M = \frac{1}{72}((E_N \otimes (35\gamma_P^7 + 2818\gamma_P^5 + 60461\gamma_P^3 + 315009\gamma_P)$$
$$+\gamma_N^2 \otimes (15\gamma_P^5 + 1110\gamma_P^3 + 19895\gamma_P)$$
$$+\gamma_N \otimes (9\gamma_P^3 + 571\gamma_P) + 5\gamma_N^6 \otimes \gamma_P) \qquad (13)$$

where now $\gamma_P = 2({}^P\gamma_1), \gamma_N = 2({}^N\gamma_1)$.

To find the wave function we need to exponentiate a subspace m of M which is a complex projective space P^3 characterized by

$$m = \begin{bmatrix} 0 & X \\ -X^T & 0 \end{bmatrix} \tag{14}$$

where X is a real bisymmetric matrix with rows labeled by $[\lambda]_k = [\lambda_1\lambda_2\lambda_3\lambda_4]_k$ and m is a Kaehler manifold. The eigenvalues of λ_k of X are precisely those of (11)which justifies the fibration (12) and canonical labeling (6).

Then exponentiation may be achieved by means of the exponential for matrices [6].Because (14) defines a complex space there is a decomposition into $sin\lambda_k t, cos\lambda_k t$ terms.Here λ_k are the eigenvalues of (11), not to be confused with the state labels although there exists a one-to-one correspondence. The coupling constants are readily found for a particular state $[\lambda]$ so we find the normalized wave function

$$\begin{aligned} X/sin(9t/16) = \frac{1}{4096}&(360sin(3t/7) + 1400sin(t) + \\ &81sin(92t/35) + 400sin(22t/7) + 1225sin(76t)) \end{aligned} \tag{15}$$

for^{15}N,where the oscillations corresponding to the eigenvalues 3/8,101/56 and 82/8 all have zero coefficients and degeneracies have been ignored. The factor sin(9t/16)comes from a translation of the eigenvalues during normalization and introduces a twist that does not affect our conclusions.It is apparent that there is a giant resonance sin(76t)that belongs to the energy levels of equation (1).

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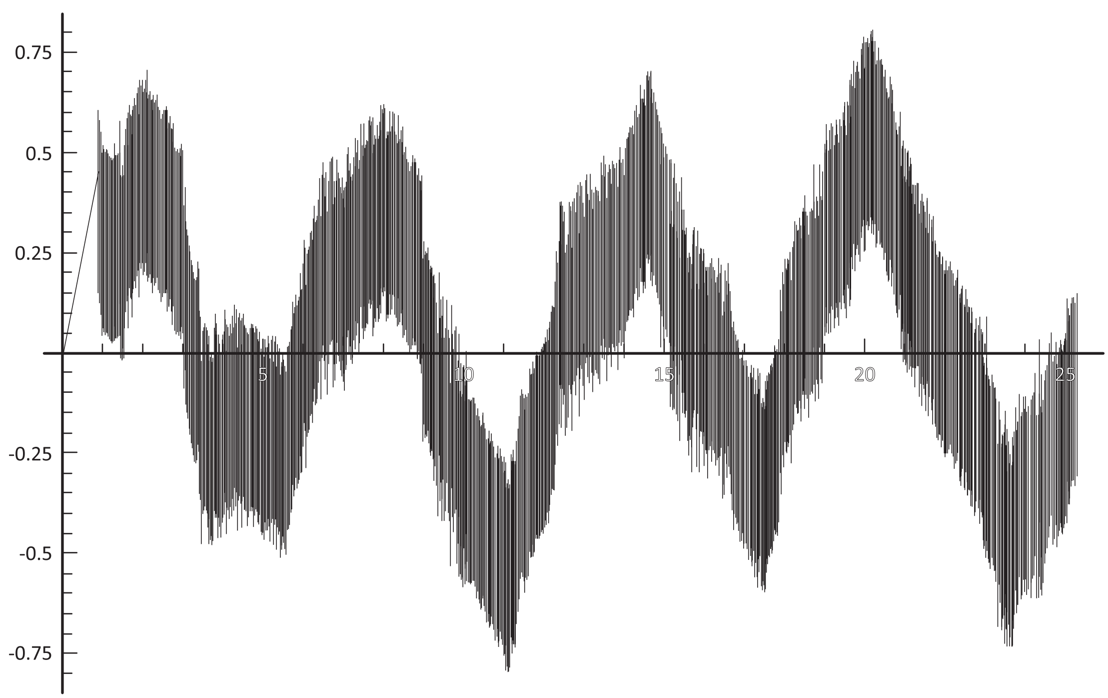

Fig. 1

Figure 1: Wave Function of ^{15}N

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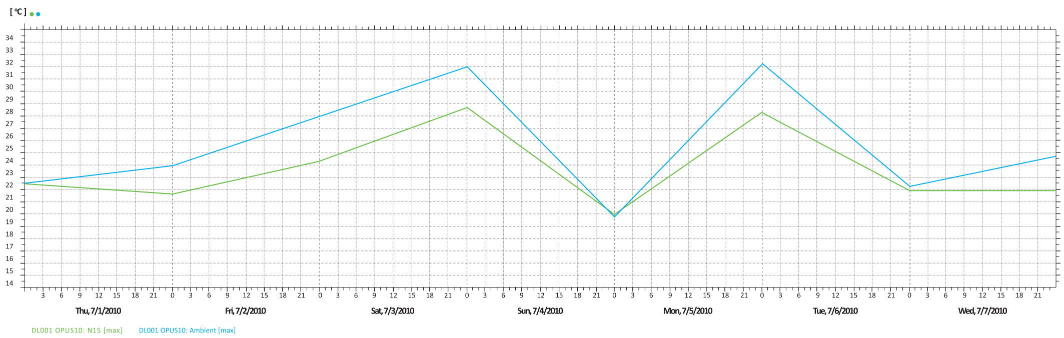

Fig. 2

Figure 2: A temperature drop over 5 days

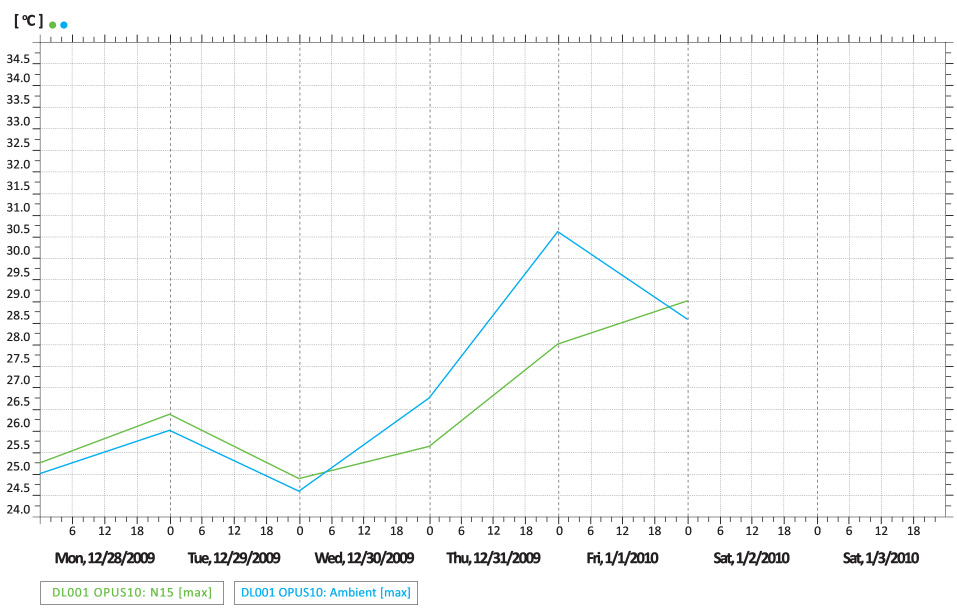

Fig. 3

Figure 3: A temperature drop followed by heating