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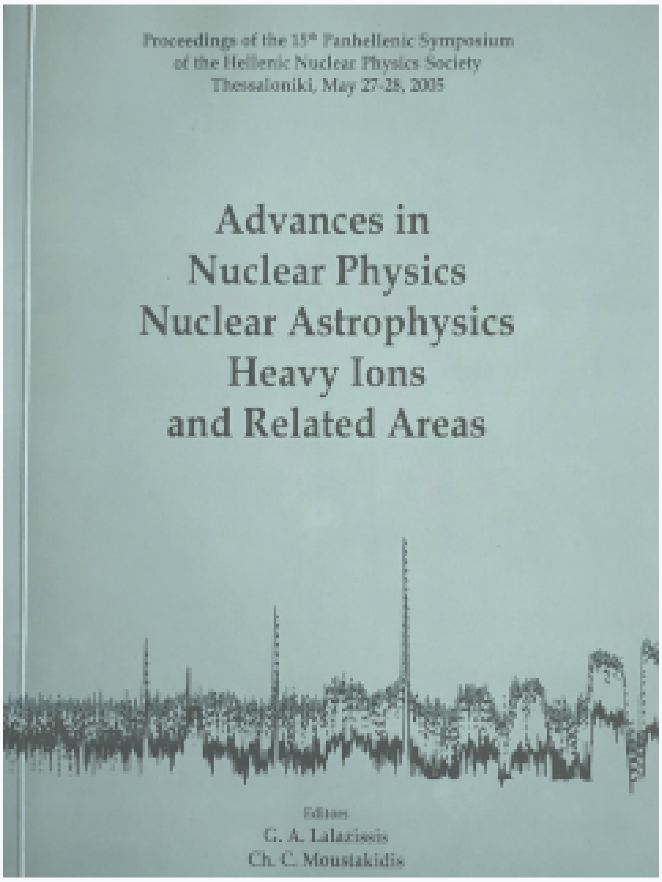

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On the observation of geo-neutrinos: the case of the $^{13}C(\alpha,n)^{16}O$ reaction[1]

S. Harissopulos,[a] A. Lagoyannis,[a] H. W. Becker,[b] J. W. Hammer,[c] C. Rolfs,[d] and F. Strieder[d]

[a]*Tandem Accelerator Facility, Institute of Nuclear Physics, NCSR "Demokritos", POB 60228, 153.10 Aghia Paraskevi, Athens, Greece*

[b]*Dynamitron-Tandem-Laboratorium, Ruhr-Universität Bochum, Universitätsstrasse 150, 44801 Bochum, Germany*

[c]*Institut für Strahlenphysik, Universität Stuttgart, Allmandring 3, 70569 Stuttgart, Germany*

[d]*Institut für Physik mit Ionenstrahlen, Ruhr-Universität Bochum, Universitätsstrasse 150, 44801 Bochum, Germany*

Abstract

The absolute cross section of the $^{13}C(\alpha,n)^{16}O$ reaction has been measured at E_α = 0.8 to 8.0 MeV with an overall accuracy of 4%. The precision is needed to subtract reliably a background in the observation of geo-neutrinos, e.g. in the KamLAND detector.

[1] Work published as Rapid Communication in Phys. Rev. C 72, 062801(R) (2005)

Realistic Calculations for Direct Cold Dark Matter detection rates

T. S. Kosmas

Theoretical Physics Division, University of Ioannina, GR-45110 Ioannina, Greece

Abstract

We investigate the scattering of the cold dark matter (CDM) candidate LSP (Lightest Supersymmetric Particle) off nuclei. We have worked out a representation of the LSP-nucleus scattering problem where the nuclear-structure aspects have been separated from the particle-physics aspects. We have computed the associated event rates for the ^{23}Na, ^{71}Ga, ^{73}Ge and ^{127}I CDM detectors by using: (i) the nuclear shell model in realistic model spaces by employing microscopic effective two-body interactions [1] and (ii) the microscopic quasi-particle phonon model (MQPM) [2,3]. In the first case, large-scale computations had to be performed in order to achieve convergence of the results. The relevance of the spin-dependent and coherent channels for the event rates is discussed, from both the nuclear-structure and the SUSY-model viewpoints.

In order to see the differences in the nuclear inputs, we have compared the two nuclear models (MQPM [2,3] and nuclear shell model [1]), in the computation of the event rates for the ^{71}Ga, ^{73}Ge and ^{127}I targets. we have found that the form factors, relevant in the coherent-channel scattering, are quite independent of the used nuclear model. In the case of the spin-dependent incoherent channel the two used nuclear models gave notably different results, especially in the case of ^{127}I. This opens a way to speculations about the claimed detection of the annual modulation signal by the DAMA experiment.

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Measurement of (n, xnγ) reaction cross-sections using in-beam γ-ray spectroscopy

Stevan JOKIC,[a] Strahinja LUKIC,[a,b] Mila PANDUROVIC,[a] Nada CITAKOVIC,[a] Paule BAUMANN,[b] Stephane HILAIRE[c] Jasmina JEKNIC,[d] Erwin JERICHA,[e] Maelle KERVENO,[b] Crristian L. MIHAILESCU[f] Andreas PAVLIK,[g] Arjian PLOMPEN[f] Gerald RUDOLF[b]

[a] *VINCA Institute of Nuclear Sciences, P.O BOX 522 Y-1101 Belgrade, Serbia and Montenegro*

[b] *Insitut de Recherches Subatomiques 23 rue de Loess BP 28 F-67037 Strasbourg cedex, FRANCE*

[c] *Centre detudes de Bryeres-le- Chatel (CEA-DAM) BP 12-91680 Bruyeres- le Chatel, FRANCE*

[d] *Faculty of Science and Mathematics, University of Nis Visegradska 33, 18000 Nis, Serbia Montenegro*

[e] *Atominstitu Vienna University of Technology Stadionallee 2, A-1020 Wien, Austria*

[f] *Institute for Reference Materials and Measurments (IRMM) Retieseweg, B-2440 Geel, Belgium*

[g] *Institut fur Isotopenforschung und Kernphysik Universitat Wien Boltzmanngasse 3, A-1090 Wien, Austria*

Abstract

New concepts in nuclear reactor technology require precise neutron reaction data in intermediate and high energy range. At present, experimental and evaluated nuclear data, particularly for (x,xn) reactions, are very scare. Moreover, real discrepancies exist between different databases. The lack of experimental data is essentially due to the difficulty to measure (n,xn) reactions. No universal method applicable to all isotopes exists. One of the possible methods in beam γ-ray spectroscopy and neutron time of flight technique on white neutron beams. This method was applied at the GELINA white neutron beam facility in Geel, Belgium.

The Contribution of the Experimental Area Gamma Rays and Atmospheric Neutrons in the CAST Detectors Background

Ilias Savvidis

Aristotle University of Thessaloniki, CAST Collaboration

Abstract

The CERN Axion Solar Telescope (CAST) experiment is taking data at CERN, using a decommissioning LHC magnet, looking for solar axions through the conversion into photons inside the magnetic field. Because of few events which are expected in the photon detectors, the background of the experimental area plays an important role. In the present work the contribution of the atmospheric neutrons and the gamma rays of the CAST environment has been measured, using BF_3 and Germanium detectors. The interaction of the atmospheric neutrons with He^3, which will be the filling gas of the magnet for the CAST Phase II, has been also tested.

Plunger Lifetime Measurements in ^{102}Pd

G. Lalyva, [a] A. Spyrou, [a] M. Axiotis, [a] S. Harissopulos, [a] A. Dewald, [b] A. Fitzler, [b] O. Moller, [b] B. Saha, [b] A. Linnemann, [b] R. Vlastou, [c] D.R. Napoli, [d] N. Marginean, [d] C. Rusu, [d] D.L. Balabanski, [e] and R. Julin [f]

[a] *Institute of Nuclear Physics, NCSR "Demokritos", POB 60228, 153.10 Aghia Paraskevi, Athens, Greece*

[b] *Institut fur Kernphysik, Universitat zu Koln, Zulpicherstr. 77 50937 Koln, Germany*

[c] *National Technical University of Athens, Zographou Campus, 15780 Athens, Greece*

[d] *INFN, Laboratori Nationali di Legnaro, Legnaro, Italy*

[e] *Dipartimento di Fisica Universit degli Studi di Camerino, Camerino, Italy, and Faculty of Physics, University of Sofia, BG-1164 Sofia, Bulgaria*

[f] *Department of Physics, University of Jyvaskyla, POB 35, 40014 Jyvasklyla, Finland*

Abstract

Recently, an intense experimental effort has been devoted to the search of empirical proofs of critical-point symmetries in nuclear structure. These symmetries describe shape-phase transitions and provide parameter-free predictions (up to over all scale factors) for excitation spectra and B(E2) values.

This contribution reports on our recent plunger-lifetime measurements in ^{102}Pd using the ^{92}Zr (^{13}C,3n)^{102}Pd reaction at 48 MeV, which we have performed by means of the GASP spectrometer at the Laboratori Nazionali di Gegnaro (LNL), Italy. According to our results the ^{102}Pd nucleus is so far the best know paradigm of the E(5) critical point symmetry. Plans for further lifetime measurements aiming at searching for nuclei resembling the Z(5) critical-point symmetry proposed recently by the "Demokritos" Nuclear Structure Theory Group will also be presented.

Updated nuclear reaction rates of the proton-proton chain at low (astrophysical) energies

T. E. Liolios

Hellenic Military University, Hellenic Army Academy
Department of Physical Sciences, Vari 16673, Attica, GREECE

Abstract

REACLIB is one of the most comprehensive and popular astrophysical reaction rate libraries. However, its experimentally obtained rates for light isotopes still rely mainly on the Caughlan & Fowler (1988) compilation and have never been updated despite the progress in many relevant nuclear astrophysics experiments. Moreover, due to fitting errors REACLIB is not reliable at temperatures lower than $10^7 K$.

In this work we establish the formalism for updating the obsolete Caughlan-Fowler experimental rates of REACLIB. Then we use the NACRE compilation and results from the LUNA experiments to update some important charged-particle induced rates of REACLIB focusing on the proton-proton chain. The updated rates (available also in digital form) can now be used in the low temperature regime (below $10^7 K$) which was forbidden to the old version of REACLIB.

An estimate of the hardness for neutral alkali clusters

B.A. Kotsos and Th.C. Ganetsos

Department of Electronics of Technological Education Institute of Lamia, Lamia 35100, Greece

Abstract

In the present work, the hardness for neutral alkali clusters (Li, Na, K) is studied and analytic expressions are obtained, based on the spherical jellium background model (SJMB) and using an approximate density scheme. It is shown that for relatively more stable metallic clusters (those with magic numbers of atoms), the chemical hardness $n \equiv (I - A)/2$ too is relatively larger

On the structure of magic nuclei

L.A.Kaliambos

Institute of Larissa Komninon 15 Larissa 41223 Greece

Abstract

Considerable charge distributions in nucleons determined by the magnetic moments, interact electromagnetically in order to create nuclei, in which the p-n bonds form rectangles and closely packed parallelepipeds, providing an excellent description of magic nuclei. Such interactions differ fundamentally from the central potential and the effects of the Pauli principle of the elecronic confingurations, responsible for the development of the Fermi gas, nuclear shell, and collective models. In a systematic analysis of the magic mumbers one may observe that unlike the regular electron orbital structure, the magic nuclei are only special arrangements among various formations.