Role of fluctuations in a thermal phase transition in a nucleus probed via the giant dipole resonance

Deepak Pandit,[1,*] Srijit Bhattacharya,[2] Debasish Mondal,[1] Balaram Dey,[3] S. Mukhopadhyay,[1,4] Surajit Pal,[1] A. De,[5] and S. R. Banerjee[6]

[1]*Variable Energy Cyclotron Centre, 1/AF-Bidhannagar, Kolkata 700064, India*
[2]*Department of Physics, Barasat Govt. College, Barasat, N 24 Pgs, Kolkata 700124, India*
[3]*Saha Institute of Nuclear Physics, 1/AF-Bidhannagar, Kolkata 700064, India*
[4]*Homi Bhabha National Institute, Training School Complex, Anushaktinagar, Mumbai 400094, India*
[5]*Department of Physics, Raniganj Girls' College, Raniganj 713358, India*
[6]*(Ex)Variable Energy Cyclotron Centre, 1/AF-Bidhannagar, Kolkata 700064, India*

(Received 6 November 2018; revised manuscript received 9 January 2019; published 19 February 2019)

We present an experimental investigation of thermal phase transition in atomic nuclei by measuring the γ rays from the decay of the giant dipole resonance in ^{169}Tm populated by using the reaction ^{4}He + ^{165}Ho. The systematic measurement confirms the prolate shape, similar to the ground-state value, till temperature $T = 1.23$ MeV. Moreover, the present data, together with the previous experimental studies, point towards the persistence of prolate shape with deformation similar to that of the ground state till $T = 1.5$ MeV. In addition, the emergence and evolution of thermal fluctuations observed directly in the experiment suggest that the sharp phase transition from prolate to near spherical at $T \approx 1.7$ MeV will not be evident experimentally due to statistical fluctuations owing to the finite size of the nucleus.

DOI: 10.1103/PhysRevC.99.024315

I. INTRODUCTION

The study of finite quantal systems is very fascinating as they possess the properties of both microscopic (separate quantum particles) and macroscopic sizes (large statistical systems). It is remarkable that finite systems having different physical nature can exhibit similar physical features [1]. For example, the shell effects, caused by the degeneracy of quantum spectra, exist in quantum dots, atomic nuclei, and metallic grains. In atomic nuclei, the shell effect creates small fluctuations in the total potential energy obtained from the liquid drop model [2]. Although, amounting to only about 1% of the total binding energy, it governs the variation of ground-state nuclear shapes along isotopic and isotonic chains [3], and is one of the driving effects in the production of superheavy elements [4]. When a shell is completely filled, it leads to strong shell effects manifested by the stability of the nuclei. However, when the shell is only partially filled, it breaks the spherical symmetry and the residual interactions among the valence nucleons drag the nucleus to a deformed ground state.

The quantum phase transition, an abrupt change in the state of a many-body system at zero temperature ($T = 0$) [5], is connected with the nuclear shape transition from spherical to deformed or from axially deformed to nonaxially deformed shapes [6]. Interestingly, the ground-state deformation of the nuclei, arising due to shell effects, can also be altered by increasing the excitation energy. The thermal excitations weaken the shell effects and act in the direction of decreasing the equilibrium deformation leading to a thermal phase transition from deformed to spherical shape [7]. Along with shape transition, the idea of phase transition in nuclear physics also involves vanishing of pairing correlations at excitation energies above a few MeV (superfluid to normal fluid transition), nuclear multifragmentation in the Fermi energy domain (liquid to gas phase transition), and deconfined state of quark-gluon-plasma in the ultrarelativistic region. However, it should be emphasized that in small finite systems at finite T, the thermal fluctuations are expected to be large and could play a decisive role in defining the properties of the system, particularly in the phase-transition region. For example, the studies of fluctuation on pairing effect have shown that the sharp phase transition from superfluid to normal fluid is effectively washed out [8–10]. The theoretical calculations, based on the mean-field theory for nuclear shape transition, often predict sharp phase transitions at finite temperature [11–14]. Intriguingly, when the effect of shape fluctuations is taken into account, it suggests a substantial smearing of the transition [15,16]. In this scenario, whether the T-driven phase transition will be evident experimentally still remains an open question.

One of the experimental probes to study the shapes and fluctuations of hot nuclei is the giant dipole resonance (GDR) [17–19]. It can be interpreted as the out-of-phase oscillation of the proton fluid against the neutron fluid and its cross section is characterized by a Lorentzian function having a strength (S_{GDR}), a centroid energy (E_{GDR}), and a width (Γ_{GDR}). The GDR strongly couples with the nuclear shape degrees of freedom. Hence, in the case of deformed nucleus, the GDR strength splits into different components with frequencies inversely proportional to the lengths of the principal axes, providing a direct information about the

*deepak.pandit@vecc.gov.in

Physics Letters B 789 (2019) 634–638

Contents lists available at ScienceDirect

Physics Letters B

www.elsevier.com/locate/physletb

S-shaped heat capacity in an odd–odd deformed nucleus

Balaram Dey [a,*], N. Quang Hung [b], Deepak Pandit [c], Srijit Bhattacharya [d], N. Dinh Dang [e], L.T. Quynh Huong [f,g], Debasish Mondal [c], S. Mukhopadhyay [c], Surajit Pal [c], A. De [h], S.R. Banerjee [i]

[a] Saha Institute of Nuclear Physics, 1/AF-Bidhannagar, Kolkata, 700064, India
[b] Institute of Fundamental and Applied Sciences, Duy Tan University, Ho Chi Minh City 700000, Viet Nam
[c] Variable Energy Cyclotron Centre, 1/AF-Bidhannagar, Kolkata, 700064, India
[d] Department of Physics, Barasat Govt. College, Barasat, N 24 Pgs, Kolkata, 700124, India
[e] Quantum Hadron Physics Laboratory, RIKEN Nishina Center for Accelerator-Based Science, RIKEN, 2-1 Hirosawa, Wako city, Saitama 351-0198, Japan
[f] Department of Natural Science and Technology, University of Khanh Hoa, Nha Trang City, Khanh Hoa Province 652124, Viet Nam
[g] Faculty of Physics and Engineering Physics, Vietnam National University Ho Chi Minh City – University of Science, Ho Chi Minh City 748355, Viet Nam
[h] Department of Physics, Raniganj Girls' College, Raniganj, 713358, India
[i] (Ex)Variable Energy Cyclotron Centre, 1/AF-Bidhannagar, Kolkata, 700064, India

ARTICLE INFO

Article history:
Received 30 October 2018
Received in revised form 30 November 2018
Accepted 4 December 2018
Available online 6 December 2018
Editor: V. Metag

Keywords:
Nuclear thermodynamics
Statistical model calculation
Pairing phase transition

ABSTRACT

We examine the thermodynamic properties of mass A ~ 200 nuclei utilizing angular momentum (J) gated nuclear level densities (NLDs) extracted in the excitation energy range of 2–15 MeV. Interestingly, the experimental NLDs are in good agreement with the results of a microscopic approach, which is derived based on the exact pairing plus the independent-particle model at finite temperature (EP + IPM), whereas the conventional Hartree–Fock BCS (HFBCS) and Hartree–Fock–Bogoliubov plus combinatorial method (HFBC) fail to describe these data. Consequently, the thermodynamic properties of those nuclei at finite angular momentum have been extracted using the EP + IPM NLDs. While the heat capacities of ^{200}Tl, ^{211}Po and ^{212}At (near spherical nuclei) follow the trend as expected in odd–odd and even–odd masses, surprisingly an *S*-shaped heat capacity is found in odd–odd deformed nucleus ^{184}Re. It has been shown that this *S*-shaped heat capacity observed in ^{184}Re is caused by not only the breaking of nucleon Cooper pairs but also the change of pairing induced by deformation.

A long-standing problem in nuclear physics is the experimental observation of the pairing phase transition in atomic nuclei. Thermodynamic properties like superfluidity and pairing phase transition are well-established facts in infinite nuclear matter [1], e.g. the core of neutron star. The recent observation of rapid cooling of pulsars, e.g. Cassiopeia A, has been interpreted in terms of superfluidity and neutron triplet pairing [2]. However, these properties digress from infinite nuclear matter to finite nucleus due to the statistical fluctuations in the order parameter. Therefore, the gradual transition from strongly correlated paired states to unpaired ones in atomic nuclei may not be as evident as in infinite matters [1]. This induces a high degree of interests in the study of nuclear thermodynamics, especially in the energy domain of neutron binding. On the other hand, in finite nuclei it has been seen that the neutron pairing gap depends upon shell and subshell closures [3]. Again, new shell closures emerge and older ones disappear in exotic nuclei. Therefore, it will not be an exaggeration to say the role of shell effects on the nuclear pairing is highly important [4]. Although such theoretical studies were done in the past [5], yet experimental investigations are very rare in the existing literature. Similarly, the relationship between nuclear deformation and pairing has not been studied in much detail at higher excitation energies. Calculations within the relativistic mean field (RMF) [6], finite-temperature Hartree–Fock (FTHF) [7], Dirac-Hartree–Fock–Bogoliubov (DHFB) [8,9], etc., have been carried out in the past to understand the effect of deformation on pairing and nuclear thermodynamics. But experimental data are still very scarce in terms of the dependence of angular momentum and deformation on nuclear pairing.

* Corresponding author.
E-mail addresses: dey.balaram@gmail.com (B. Dey), nghunghtu@gmail.com (N. Quang Hung).

https://doi.org/10.1016/j.physletb.2018.12.007

Alokkumar De

Science and Technology Journal. Vol. 7 Issue: I ISSN: 2321-3388

Common Fixed Point Theorems on Multi-Valued Mappings in 2-Metric Space using T-Hardy Rogers Contraction Condition and F-Contraction

Dinanath Barman[1], Krishnadhan Sarkar[2]* and Kalishankar Tiwary[3]
[1,3]Department of Mathematics, Raiganj University, Raiganj, West Bengal, India–733134
[2]Department of Mathematics, Raniganj Girls College, Raniganj, Paschim Bardhaman, West Bengal, India–733158
E-mail: [1]dinanathbarman85@gmail.com, [2]*sarkarkrishnadhan@gmail.com, [3]tiwarykalishankar@yahoo.com

Abstract—In this paper we have introduced multi-valued 2-metrices on 2-metric space and have proved some fixed point theorems for multi-valued mappings on 2-metric space using T-Hardy and Rogers type contraction condition. We have also used F-contraction conditions, occasionally weakly compatible to prove the theorems.

Keywords: Weakly Compatible, CLRf-property, OWC-property, D-mapping

Mathematics Subject Classification: 47H10, 54H25

INTODUCTION

IIn 1922, Banach proved a fixed point theorem which is also known as Banach contraction theorem.This theorem has been generalized by various research workers in different spaces for point valued as well as multi valued mappings. It is Nadler (1969) who introduced the notion of multi-valued contraction mapping on metric spaces. Thereafter Joseph and Ramganesh(2013), Abdou(2016) have also worked on multi-valued mappings on metric spaces. Also Cho(2016), Jinakul et al. (2017) have worked on multi-valued mappings in b-metric spaces. Abdou (2016) introduced the notion CLRf –property and OWC-property. Djoudi and Khemis(2005) have introduced D -mappings in metric spaces. Gahler(1963) introduced the concept of 2-metric spaces. Abd El-Monsef et al. (2007) have worked on 2-metric spaces using multi-valued mappings and have defined δ. Various authors have used the notion of D, H, δ to obtain their results in metric spaces. In the present role we have used these symbols with their usual meanings to obtain our results in 2-metric space.

DEFINITIONS

Definition 2.1 [9]: Let X be a non-empty set and d: X × X × X ⟶ [0, ∞) be a real valued function which satisfy the following conditions:

1. For every distinct points x, y there is a point z in X such that d(x, y, z) ≠ 0;
2. d(x, y, z) = 0 if any two of three of x, y, z is equal;
3. d(x, y, z) = d{p(x, y, z)) for all x, y, z∈X and for all permutations p(x, y, z) of x, y, z;
4. d(x, y, z) ≤ d(x, y,w) + d(x,w, z) + d(w, y, z) for all x, y, z, w ∈ X.

Then d is called a 2-metric and (X, d) is called a 2-metric space.

We write X a 2-metric space unless otherwise stated. Here by CB(X) we mean the class of all nonempty closed and bounded subsets of X, by 2^X we mean the class of all non-empty compact subsets of X and by B(X) we mean the class of all bounded subsets of X.

http://dx.doi.org/10.47216/stj.2019.v07.i01.14

Krishnadhan Sarkar

IASLIC Bulletin, 64, 4, 2019, December, p. 250 - 255

Information Flow and Marketing System for Flower Traders of West Bengal : A Survey in Kolaghat Flower Market, Purba Medinipur

Bela Mondal[a] and Krishnapada Majumder[b]

Abstract

Purpose: *The main purpose of this survey is to understand the opinion of flower traders of West Bengal on the issues related to Floriculture Information System. To explore the marketing system of flowers in the district of Purba Medinipur in West Bengal the survey is conducted at Kolaghat Flower Market.*

Methodology: *A survey was conducted to investigate the ground reality of flower trading in Purba Medinipur district of West Bengal. By interview and live recording the data was collected.*

Findings: *Findings are drawn based on analysis of gathered data in the survey. The data related to the marketing pattern of flower traders, information flow in the flower market, day to day business strategy of flower traders, exploiting role of intermediaries, poor infrastructural condition of flower market are collected and presented in this paper.*

Value: *This paper tries to present the current scenario of flower markets in West Bengal which would help to develop Floriculture Information System in turn.*

Keywords: *Floriculture; Flower Trading; Marketing System; Flower Market; Kolaghat Flower Market; Purba Medinipur; West Bengal*

[a] Librarian, Raniganj Girls' College, Searsole Rajbari, Paschim Burdwan, Pin-713358, West Bengal, 8276844204 belajudy1188@gmail.com

[b] Retd. Professor, Dept. of Library and Information Science, Jadavpur University, Kolkata-700 032, West Bengal, India 7980914707 mkrishnapada2017@gmail.com

REVIEW OF RESEARCH
ISSN: 2249-894X
IMPACT FACTOR : 5.7631(UIF)
UGC APPROVED JOURNAL NO. 48514
VOLUME - 8 | ISSUE - 9 | JUNE - 2019

SPECIAL EDUCATION FACTS AND FIGURES IN INDIA: SOME ASPECTS TO BE CONSIDERED

Papai Mondal
Asst. Professor (Contractual) , Department of Education ,
Raniganj Girls' College Raniganj, West Bengal, India.

ABSTRACT:

Education of all children in various schools (Public, NGO etc.), including those with disabilities, continues to be an unresolved issue in many countries around the world. However, despite this, millions of children with disabilities continue to remain out of school or receive little or no education. Special education schools have certain norms and infrastructure which facilities the development of children with special needs. But all this was not available earlier, there were very few schools and people were largely unaware of them. Nobody knew how to take care of them. But India, for example, is an ancient country that adopted several laws and policies for its citizens with disabilities after gaining independence from British rule. Today, India legally requires the education of all children in schools.Literature review method is applied to investigate the expected effects in the study and importance of special education. This study represents that, the various issues, such as- Special education history, various types of disabilities, prevalence of special education, current challenges of special education including disabilities and future for people with disabilities in India. Thus, over the past four decades, India has moved gradually towards an Inclusive education model. This paper discusses the overall category of special childes including various ages and implementation of such a model related to the prevalence and incidence rates of disability in India. Finally, this study will play an important role, especially for those with disabilities who are involved in special education.

KEYWORDS: *Special Education, NGO, Unresolved, Legally, Disability.*

INTRODUCTION

Special education is the education which meets the need of those children who are different from average children either mentally, physically and or socially. The children may suffer from emotional disturbance, mental retardation, deafness, dumbness, blindness and any other ailments which hamper the intellectual growth of the individuals. According to Kirk and Gallagher (1986) - "When youngsters in the same classroom are remarkably different, it is difficult for the teacher to help them to reach their educational potential without some kind of assistance. The help that the schools devise for children who differ significantly from the normal is called special education" (Uddin 2017, p.19). Thus, through its name, it is capable of reminding us that it is somewhat different from the education meant for the general population of the students. It is well known fact that the purpose of education is to make sure that students of all abilities gain access to information, knowledge and skills which will prepare them to live their communities and also to

REVIEW OF RESEARCH
ISSN: 2249-894X
IMPACT FACTOR : 5.7631(UIF)
UGC APPROVED JOURNAL NO. 48514
VOLUME - 8 | ISSUE - 9 | JUNE - 2019

ICT & ASSISTIVE DEVICES FOR CHILDREN WITH SPECIAL NEEDS

Papai Mondal
Asst. Professor (Contractual) , Department of Education ,
Raniganj Girls' College Raniganj, West Bengal, India.

ABSTRACT:

At present, Information and Communication Technology (ICT) and Assistive Technology for specialized students are helping immensely in their education and daily living. The use of information and communication technologies (ICTs) in a special educational needs (SEN) environment has gathered accumulative evidence around it during the last decade (2008-2018). The optimum use of ICT and others technologies in special education system can propel the country to become a knowledge superpower. In many settings' ICT has become an important element of the learning and teaching process. This paper looks into the effectiveness of assistive technology for students with special needs in classroom setting and the setting of various situations. The objective of this study and other resources of the same characteristics is to promote knowledge, understanding, memory, language skills, logical reasoning and problem solving in everyday life. In this paper, I have found in analyzing the various types of secondary information (such as- textbooks, reference books, websites, journals etc.) that, different types of assistive technology are helping special students in many ways. So that ordinary students as well as special students are getting equal education.So that, they (special students) do not feel burdened with society in any way.

KEYWORDS: *ICT, Assistive Technology, SEN, Secondary, Burdened.*

INTRODUCTION

Information and Communication Technology is an extensional term for Information Technology (IT) that stresses the role of unified communications and the integration of telecommunications (Telephone Lines and Wireless Signals) and computers, as well as necessary systems, that enable users to access, store, transmit and manipulate information.

On the other hand, various assistive technical devices refer to the devices that are used for the daily life of special needs students. Specifically, with special needs learner's ICT and various assistive devices is used to support the development of reading and writing skills, but also as a tool to develop social relation skills. ICT supports children who find it difficult to access curriculum, perhaps due to physical, mental or just concentration problems. ICT can help, sometimes by using modified equipment but sometimes simply by the motivation it offers. But the benefits of ICT so much further than this and extend all the way to providing complete access for children who would otherwise be denied an education altogether.

Need of the study:

Every child is an individual and children with special educational needs are as different from each other as any other children,