Division of Computer Science

Mathematics and Physics Laboratory Group

Toshiro Watanabe
Professor

Michio Honma
Professor

Katsutaro Shimizu
Senior Associate Professor

Hiroshi Kihara
Senior Associate Professor

Takao Maeda
Senior Associate Professor

Kazuto Asai
Senior Associate Professor

Shigeru Watanabe
Senior Associate Professor

Akira Fujitsu
Senior Associate Professor

Masayuki Yamagami
Senior Associate Professor

Takahiro Tuchiya
Associate Professor
Summary of Achievement

Refereed academic journal


The fundamental theorem on coalgebras asserts that coalgebras are locally finite in the case where the ground ring is a field. We prove the local finiteness theorem of corings under the semihereditary condition on the base algebra and the projectivity condition on a coring. This result generalizes not only the fundamental theorem on coalgebras but also Hazewinkel’s result on the local finiteness of coalgebras over a principal ideal domain and Bergman’s unpublished result on the local finiteness of corings over a semisimple Artinian rings.


A connected space is called a C0-space if its rational cup product is trivial. A characterizing property of C0-spaces is obtained. This property is used to calculate the algebraic K0-group K0(CF(X)) of the ring of continuous functions for infinite dimensional complexes X.


Let \( E(X) \) be the set of homotopy classes of self-homotopy equivalences of a space \( X \). The set \( E(X) \) is a group by composition of homotopy classes. We study the group \( E(X \wedge^m) \) for the m-fold smash product \( X \wedge^m \). We show that the two obvious homomorphisms \( \phi : Sm \to E(X \wedge^m) \) and \( \psi : E(X)^m \to E(X \wedge^m) \) define a bigwed \( \Psi : E(X)^mSm \to E(X \wedge^m) \) for any space \( X \), where \( E(X)^mSm \) is the semi-direct product of the product group \( E(X)^m \) by the symmetric group \( Sm \). We show that in most cases the homomorphism \( \phi : Sm \to E(X \wedge^m) \) is a monomorphism and the kernel of \( \Psi \) is isomorphic to the kernel of \( \psi \). The injectivity of \( \Psi \) is established for the complex projective n-space \( CP^n(n \geq 2) \), and hence, \( E((CP^n)^m) \) contains a subgroup isomorphic to \( \{\pm1\}^mSm \). Sufficient conditions for \( \Psi \) to be injective are obtained for the Eilenberg-MacLane complex \( K(A^r, n) \) where \( A \) is a subring of \( Q \) or a ring \( Z/k \) \( k \geq 2 \) and \( A^r \) is the free \( A \)-module of rank \( r \). From this result, we
see that $E(K(A',n)A^m)$ contains a subgroup isomorphic to $GLr(A)^mSm$ in many cases.

In this work we have studied $T_z = +2 \rightarrow +1$, Gamow-Teller (GT) transitions in the $^{48}\text{Ti} (^{3}\text{He}, t) ^{48}\text{V}$ charge-exchange reaction at 140 MeV/nucleon and 0° at the Research Center for Nuclear Physics, Osaka. From the high-resolution facility, consisting of a high-dispersion beamline and the Grand Raiden spectrometer, the spectrum had an energy resolution of 21 keV, among the best achieved. Individual GT transitions were observed and GT strength was derived for each state populated up to an excitation energy of 12 MeV. The total sum of the $B$(GT) strength observed in discrete states was 4.0, which is 33% of the sum-rule-limit value of 12. The results were compared with the results of shell-model calculations carried out with the GXPF1J interaction. The measured $B$(GT) distribution was also compared with that obtained in the $^{48}\text{Ti} (^{3}\text{He}, t)$ $^{48}\text{V}$ reaction and this predicted spectrum was compared with the measured one.

The quadrupole transition rate for the $4^+ \rightarrow 2^+$ transition of $^{58}\text{Ni}$ was determined from an application of the recoil distance method with the Gamma-Ray Energy Tracking In-beam Nuclear Array (GRETINA). The present result of
Summary of Achievement

the $B(E2; 4^+_1 \rightarrow 2^+_1)$ was found to be $50^{+11}_{-6} \text{e}^2\text{fm}^4$, which is about three times smaller than the literature value, indicating substantially less collectivity than previously believed. Shell model calculations performed with the GXPFF1A effective interaction agree with the present data and the validity of the standard effective charges in understanding collectivity in the nickel isotopes is discussed.


Recent experimental results have confirmed a possible reduction in the Gamow-Teller (GT+) strengths of pf-shell nuclei. These proton-rich nuclei are of relevance in the deflagration and explosive burning phases of SNe Ia. While prior GT strengths result in nucleosynthesis predictions with a lower-than-expected electron fraction, a reduction in the GT+ strength can result in a slightly increased electron fraction compared to previous shell model predictions, though the enhancement is not as large as previous enhancements in going from rates computed by Fuller, Fowler, and Newman based on an independent particle model. A shell model parametrization has been developed that more closely matches experimental GT strengths. The resultant electron-capture rates are used in nucleosynthesis calculations for carbon deflagration and explosion phases of SNe Ia, and the final mass fractions are compared to those obtained using more commonly used rates.


We propose a gravitational energy momentum tensor which has been misunderstood for a hundred years.


“The classical special functions have various interesting properties and applications. Some generalizations for them are also considered. For example, the sequence of the Humbert polynomials is a generalization of the sequence of the Legendre polynomials. In this paper, the authors focus on the Humbert
polynomials and the generalized Hermite polynomials, and show that they have deep relations with the generalized hypergeometric functions.”.


Accepted at 4 Apr. 2017. Stochastic Processes and their Applications is known as a Quality one journal by SJR indicator.


We investigate low-frequency octupole vibrations of rotating superdeformed (SD) and hyperdeformed (HD) states in 36Ar, 40Ca, and 44Ti. We performed cranked RPA (random phase approximation) calculation using Skyrme energy density functional. We emphasized the role of Nilsson orbits originated from high-j orbits for lowering octupole vibrational excitations at high-spin states. This may indicate instability from vibration to static reflection-asymmetric shape in SD and HD states.


We have developed a new computer code for the quasiparticle random phase approximation (QRPA) calculations with Skyrme energy density functional. By using this code, we emphasized the role of pairing and collective rotation for K=0 quadrupole excitations in 34Mg and 36Mg. This is a unique phenomenon that can emerge only in atomic nuclei as finite quantum systems.

**Unrefereed proceedings of an academic conference**


Summary of Achievement


Academic society activities

“Reviewer : Mathematical Reviews published by the American Mathematical Society”

Advisor for undergraduate research and graduate research

Thesis Advisor: M. Honma

Thesis Advisor: M. Honma

Thesis Advisor: M. Honma

“Thesis Advisor: S. Watanabe”

“Thesis Advisor: S. Watanabe”,


“Thesis Advisor: S. Watanabe”,


“Thesis Advisor: S. Watanabe”,


Others


The article is concerned with polynomials $g(x)$ whose graphs are
Summary of Achievement

Contributions related to syllabus preparation

[k-asai-101-074-02:2016] Preprepare syllabi for the following classes: CSC07 Advanced Graph Theory (Graduate School) CSA13 Algebraic Systems and Combinatorics (Graduate School) M06 Complex Analysis F03 Discrete Systems (partial contribution) M01 Linear Algebra I (partial contribution) M08 Applied Algebra (partial contribution)


Preparation of course examination to measure comprehension


[yamagami-101-074-08:2016] Transfer admission test [Physics], Creation of exam problems
[yamagami-101-074-09:2016] Transfer admission test [Physics], Scoring

Contribution related to the creation of the annual schedule

Summary of Achievement

Contribution related to the selection of library or textbook materials


Advisor of a student club or circle

[k-asai-101-074-06:2016] Keion (music circle)
[shimizu-101-074-03:2016] I am a supervisor of a comic club

Other significant contribution toward university planning, management, or administration

[k-asai-101-074-07:2016] Providing great amount of problems to the entrance examination in mathematics. (Approx. 40% of the general entrance examination for 2017) Participate in the committees for the creation and selection of the entrance examination, and also participate in marking of examination papers of the entrance examination.


Contributions related to regional education

[t-maeda-101-074-02:2016] Advisor of SSH (super science highschool) of Aizu Gakuho highschool