Research Statement

Vesselin G. Gueorguiev, Ph.D.

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4/21/2017

Short phrase description of my professional interests:
Theoretical Physics, Astrophysics, and Cosmology

RESEARCH INTERESTS:
Group theoretical methods in physics and their applications to many-body systems; the geometrical and mathematical foundations of Classical Mechanics, Quantum Mechanics, General Relativity and Cosmology; application of Non-Commutative geometry to Quantum field Theory in physics.

ACADEMIC EXPERIENCE
Books and Monographs: 1; Article publications and preprints: 50;
Conference presentations/participations/posters/invited talks: 48; abstracts: 11.
According to the ResearchGate.net Citation Report (as of Feb 2nd, 2017):
there are more than 436 citations to papers with my contributions and at least 11 papers with more than 10 citations.

Published in Journals such as: Physical Review Letters, Physical Review C, Astroparticle Physics, American Journal of Physics, International Journal of Modern Physics E, The European Physical Journal A, Journal of Physics A, Journal of Physics G, Journal of High Energy Physics, Revista Mexicana de Fisica, Physics of Elementary Particles and Atomic Nuclei

Books and Monographs
V. G. Gueorguiev, "Mixed-Symmetry Shell-Model Calculations in Nuclear Physics," LAP LAMBERT Academic Publishing AG & Co. KG (2010) [ISBN #978-3-8383-9286-8].

Brief Bio:
M.S. in Nuclear and Particle Physics from Sofia University, Sofia, Bulgaria;
Thesis Title: "q-Analog of $A_{\text{m-1}} \oplus A_{\text{n-1}} \subset A_{\text{mn-1}}$"

PhD in Nuclear Physics form Louisiana State University, Baton Rouge, LA, USA;
Dissertation Title: "Mixed-Symmetry Shell-Model Calculations in Nuclear Physics"

NATO fellow at Consejo Superior de Investigaciones Científicas, Madrid, Spain;
Research fellow at Lawrence Livermore National Lab, Livermore, CA, USA;
Physics Lecturer/Instructor at the School of Natural Sciences and the School of Engineering at University of California, Merced, CA, USA;
Physics & Astronomy Lecturer at California State University Stanislaus, Turlock, CA;
Assistant Professor - Sichuan University -Pittsburgh Institute, Chengdu, China;

Current Affiliations: member of the Institute for Advanced Physical Studies, Sofia, Bulgaria and the Ronin Institute, USA.

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Some relevant external links:
Academia.edu: https://ronininstitute.academia.edu/VesselinGueorguiev
ResearcherID: A-9679-2009 (http://www.researcherid.com/rid/A-9679-2009)
ResearchGate: https://www.researchgate.net/profile/Vesselin_Gueorguiev2
INSPIRE HEP: http://inspirehep.net/author/profile/V.G.Gueorguiev.1

DESCRIPTION OF CURRENT RESEARCH TOPICS:

- Investigation of exactly solvable many-body problems and the application of such solutions in the analyses of fundamental interactions and systems such as atomic nuclei and other complex many-body systems. A two-body interaction is often sufficient ingredient for the description of A-body systems since three- and more particles rarely come in close proximity simultaneously. However, based on the Chiral-Perturbation theory approach to the effective nuclear interaction, it has been shown that three-nucleon interactions in the structure of light nuclei are important. Some of my current research projects aim at exploring the A-body interactions paradigm; in particular, the role of the three- and four- nucleon QCD derived effective interactions in nuclei; as well as charting the limits of applicability of the exactly solvable extended A-body pairing interaction to nuclei and other complex systems.

- Research on the Lagrangian formulation for the reparametrization-invariant embedding of d+1 dimensional manifolds (d-brains) into m-dimensional target spaces and possible quantization procedures of these systems. Some important reparametrization-invariant systems are general relativity, string theory, and the familiar relativistic particle in external electromagnetic and gravitational fields. The proper-time parameterized classical trajectory of relativistic particle is a one-dimensional object, thus a 0-brain (only time-like points). String theory can be viewed as two-dimensional extended object having one special and one time-like dimension, thus a type 1-brain manifold with embedding in a bigger m-dimensional target spaces. The go of my research is to understand the physically relevant framework; to classify the Lagrangians and their structure that result in reparametrization-invariant models; to quantify the notion of time for reparametrization-invariant systems and its role for their quantization.

- Studies about the early Universe by using classical model for the expansion during the radiation-dominated epoch based on the gravitational repulsion of the Reissner-Nordstrom geometry. This mechanism assumes that the Universe is a two-component van der Waals gas. The first component is a gas of ultra-relativistic "normal" particles described by an equation of state of an ideal quantum gas of massless particles. The second component consists of "unusual" particles (namely, either with ultra-high charge or with ultra-high mass) that provide the important mechanism of expansion due to their interaction with the "normal" component of the gas. The goal is to relate this model to the problem of dark matter and dark energy in modern cosmology.

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Peer Review Publications with more than 10 citations

- V. G. Gueorguiev, W. E. Ormand, C. W. Johnson, J. P. Draayer, "Mixed-mode shell-model theory for nuclear structure studies," Phys. Rev. C **65**, 024314 (2002), (nucl-th/0110047).

- V. G. Gueorguiev, Jerry P. Draayer, Calvin W. Johnson, "SU(3) symmetry breaking in lower fp-shell nuclei," Phys. Rev. C **63**, 014318 (2001) (21 December 2000) (6 pages), (nucl-th/0009014).

- V. G. Gueorguiev, A. R. P. Rau and J. P. Draayer, "Confined one-dimensional harmonic oscillator as a two-mode system," American Journal of Physics **74** (5) 394 (2006).

- Petr Navratil, V. G. Gueorguiev, J. P. Vary, W. E. Ormand, and A. Nogga, "Structure of A = 10 -13 nuclei with two- plus three-nucleon interactions from chiral effective field theory," Phys. Rev. Lett. **99**, 042501 (2007), (nucl-th-0701038).

- P. Navratil, V. G. Gueorguiev, J. P. Vary, W. E. Ormand, A. Nogga and S. Quaglioni, " Light nuclei from chiral EFT interactions," Few-Body Systems **43**, 129 (2008).

- J. Dukelsky, V. G. Gueorguiev, P. Van Isacker, S. Dimitrova, B. Errea, and S. Lerma H., "Exact Solution of the Isovector Neutron-Proton Pairing Hamiltonian," Phys. Rev. Lett. **96**, 072503 (2006).

- F. Pan, V. G. Gueorguiev, and J. P. Draayer, "Algebraic Solutions of an Extended Pairing Model for Well-Deformed Nuclei," Phys. Rev. Lett. **92**, 112503 (2004).

- Ricardo Marquez, Vesselin G Gueorguiev, Carlos F. M. Coimbra, "Forecasting Global Horizontal Irradiance Using Sky Cover Indices," Contribution to the 2011 Energy Sustainability Conference, August 07-10, 2011, Washington, DC, (ESFuelCell2011-54551) - ASME Journal of Solar Energy Engineering Conf. Proc. ES2011 (2011), (DOI: 10.1115/ES2011-54551).

- K. D. Sviratcheva, A. I. Georgieva, V. G. Gueorguiev, J. P. Draayer and M. I. Ivanov, "Deformations of the fermion realization of the sp(4) algebra and its subalgebras," J. Phys. A: Math. Gen. **34** (40) p.8365 (2001), (nucl-th/0104051).

- S. Drenska, A. Georgieva, V. Gueorguiev, R. Rousev and P. Raychev, "Unified Description of the low lying states of the ground bands of the even-even nuclei in a symplectic classification scheme," Phys. Rev. C **52** (4) p.1853 (1995).

- J. Escher, L. Ahle, L. Bernstein, J. Burke, J. A. Church, F. Dietrich, C. Forssén, V. Gueorguiev and R. Hoffman, "Surrogate nuclear reactions: an indirect method for determining reaction cross sections", J. Phys. G **31,** S1687 (2005).