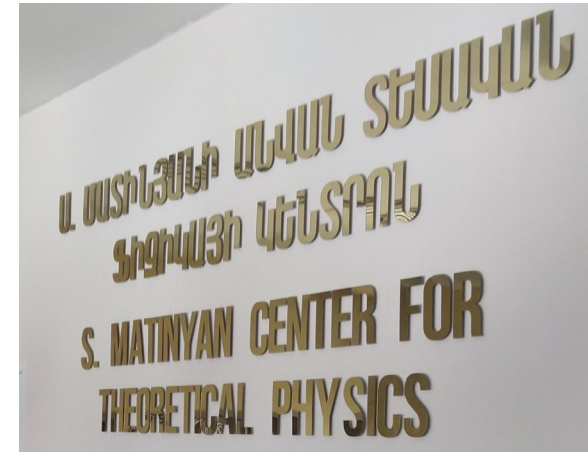
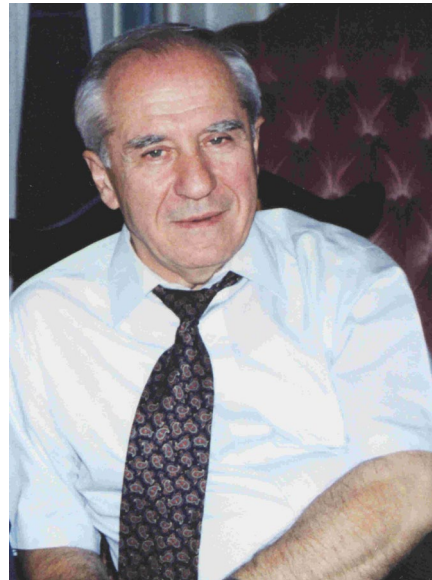


Theory Division: Status Report 2020



The Division was created and developed in the past under the leadership of **Sergei Matinyan (1931-2017)**

This was made possible by running a **PhD program**, by recruiting students with outstanding abilities for theoretical research, selected each year through **stringent entrance examinations**

Structure:

- Department consists of **47** scientist including:
- **16** Leading scientific researchers
- **6** Senior scientific researchers
- **19** Scientific researchers
- **6** Trainee/Physicist (temporary position for students)

- At the same time in means of scientific degree Department consists of:
- **14** Doctors of Phys.-math. Science
- **27** Ph.Ds (Candidate of Phys.-math. Science)

The dominant directions of investigation in the Department are

- **High energy phenomenology -8 publication**
- **Quantum field theory, String theory and integrable models – 19 publication**
- **Statistical physics, condensed matter physics, radiation theory, interdisciplinary physics -15 publication**

Department of
Theoretical Physics

Main
Drectios

Theoretical Particles
Physics, QCD, SM and
Related Phenomenology
(hep-ph)

Theoretical/
Mathematical High
Energy Physics
(hep-th)

Theory of Condensed
Matter and
Interdisciplinary
Applied Physics
(cond-mat, quant-ph)

Quantum field
theory
Supersymmetry,
String/M theory

Integrable
Models in QFT
and Stat. Mech

Statistical systems and
condensed matter,
Interdisciplinary Science ,
Quantum Informatics



HEP
Experi
ments

Current Achievements

Members of Department:

- publish about **40-50 articles** in international journals every year.
- participate in **8-10** international conferences and workshops and
- organize **1-2 local** conferences and workshops per year.
- During last 3 years 7 PhD theses were defended, and also our students get several Bachelors and Master Diploma
- Members of Department during last decade(s) succeeded in obtaining grants from INTAS, SCOPES, FP7, Volkswagen foundation, Humboldt Foundation, HORIZON 2020, DARPA, NSF and other sources.

Grants of Armenian State Committee of Science

- I. **11** winners of Top 100 scientists grant
- II. **9** projects of thematic funding
- III. **3** project of bilateral thematic funding

Teaching and work with students and young scientists in region.

- The Department is acknowledged as the **ICTP Affiliated Centre in Armenia** (ICTP project AF-04)
- **Regional Doctoral Program on Theoretical and Experimental Particle Physics sponsored by Volkswagen Foundation**

International Collaborations

Matinyan Center for Theoretical Physics researchers collaborate across disciplines and across the globe. Among the most active collaborators are:

- Albert Einstein Institute, Potsdam, Germany
- CERN, Geneva
- Bern University, Germany
- University of Rome Tor Vergata, Italy
- Manchester University, UK
- Perth University, Australia
- University of Bologna, Italy
- National Center for Scientific Research DEMOKRITOS, Greece
- Leipzig University, Germany
- Bonn University, Germany
- Freie University Berlin, Germany
- Institute of Theoretical Physics, Saclay, France
- ICTP, Italy
- JINR, Russia
- University of Santiago de Compostela

Կոնֆերանսներ, Գիտաժողովներ և Սեմինարներ

A. Sedrakyan

- 1. Workshop: "Renormalization and Universality in Conformal Geometry, Dynamics, Random Processes, and Field Theory":
Simons Center, Stony Brook University, February-April 2020.
- Talk title: Non-critical strings: Link to QHE and geometry of disorder
- 2. Anderson Localization-2020, August 21-31, Japan, 2020.
- Talk title: Geometry of disorder.
- **Zoom seminars:**
- 1. Harvard University, CMT seminar, March 26, 2020.
- Title of talk: Geometry of Disorder: Plateau Transitions in Quantum Hall Effect
- 2. Two lectures on Matrix models and non-critical strings in Simons Center at Stony Brook University: March-6, March 13
- 3. Started series of seminars on quantum computing in YerPhI. One seminars in December 2020.
- Talk title: Kitaevs toric code
- Have participated in about 5 seminars via Zoom organized in Harvard, Rutgers and University of California, Davis.
- Zoom working discussions:
- Multiple discussions with my groups in Turino (Italy), Wuppertal (Germany), Augsburg(Germany) and Ohio University

Դ. Վարախանյան

- 1) 19.05.20 ՄՀՄԻ /Դուբնա ՌԴ/ ՏՖԼ-ում ներկայացրել եմ սեմինար՝ The algebraic Bethe ansatz for the low dimensional orthogonal and symplectic group
- 2) 08.01.21 Ս.Ն.Մատինյանի 90-ամյակին նվիրված գիտաժողովին ներկայացրել եմ զեկույց՝ “Հանրահաշվական Բեթե Անզաց ցածր չափողականության օրթոգոնալ և սիմփլեկտիկ խմբերի համար”
- 3) Արմեն Ալլահվերդյանի և Դավիթ Պետրոսյանի հետ համատեղ երեքշաբթի և ուրբաթ օրերին վարում ենք “Քվանտային Ֆիզիկայի և Տեխնոլոգիաների Խմբի աշխատանքային սեմինարը:

Դ. Սահակյան

- 1.Իոֆֆեի անման ինստիտուտում, Սանկտ Պետերբուրգ,
- Ինֆորմացիոն թերմոդինամիկան և Էվոլյուցիայի տեսությունը
- 2. Բարդ համակարգերի տեսությունը, Երեվան, Ձեռնարկությունների հիմնադրամ

Ռ. Մանվելյան

- Երկու շաբաթը մեկ մասնակցում է Չումով՝ Australia-Korea-Japan-Russia-Europe Higher Spin Gravity online-club.

Publications of last years (2020)

- [1]. [Hrachia M. Asatrian](#), [Hrachya H. Asatryan](#), [Artyom Hovhannisyan](#), [Ulrich Nierste](#), [Sergey Tumasyan](#), [Arsen Yeghiazaryan](#). Penguin contribution to width difference and CP asymmetry in B_q anti B_q Mixing at order α_s^2 . Phys. Rev. D (2020) 102, 033007-1-033007-12.
- [2]. [Hrachia M. Asatrian](#), [Christoph Greub](#), [Javier Virto](#). Exact NLO Matching and Analyticity in $b \rightarrow s \ell \ell$. JHEP 04 (2020), 012-0 - 012-34
- [3]. G.H. Arakelyan, Yu.M. Shabelski, A.G. Shuvaev. "Multiplicity distribution of gluons in pQCD". Eur.Phys.J. C80, 592, (2020); arXiv: 2003.03275 [hep-ph]
- [4]. On the physics potential to study the gluon content of proton and deuteron at NICA SPD By A. Arbuzov et al.. arXiv:2011.15005 [hep-ex]. arXiv:2006.05342 [hep-ph]. [5]. Antiproton over proton and $K^+ K^-$ over $K^+ K^+$ multiplicity ratios at high \sqrt{s} in DIS By COMPASS Collaboration (G.D. Alexeev et al.). arXiv:2003.11791 [hep-ex]. 10.1016/j.physletb.2020.135600. Phys.Lett. B807 (2020) 135600.
- [6]. Contribution of exclusive diffractive processes to the measured azimuthal asymmetries in SIDIS By COMPASS Collaboration (J. Agarwala et al.). arXiv:1912.10322 [hep-ex]. 10.1016/j.nuclphysb.2020.115039. Nucl.Phys. B956 (2020) 115039.
- [7]. Azimuthal asymmetries of charged hadrons produced in high-energy muon scattering off longitudinally polarised deuterons By COMPASS Collaboration (C. Adolph et al.). arXiv:1609.06062 [hep-ex]. 10.1140/epjc/s10052-020-7762-8, 10.1140/epjc/s10052-018-6379-7. Eur.Phys.J. C78 (2018) no.11, 952, Erratum: Eur.Phys.J. C80 (2020) no.4, 298.
- [8]. Probing the linearly polarized gluons in unpolarized proton with heavy-quark pair production, By N. Ya Ivanov, A.V. Efremov, O.V. Teryaev. arXiv:1911.09742 [hep-ph]. 10.1088/1742-6596/1435/1/012011. J.Phys.Conf.Ser. 1435 (2020) no.1, 012011.
- [9]. M. Karapetyan, R. Manvelyan and R. Poghossian, "Cubic Interaction for Higher Spins in AdS_{d+1} space in the explicit covariant form," Nuclear Physics B, 2020, 950, 114876, . arXiv:1908.07901 [hep-th], doi:10.1016/j.nuclphysb.2019.114876, 05503213.
- [10]. M. Karapetyana, R. Manvelyan, and R. Poghossian // On Cubic Interaction for Higher Spins in AdS_{d+1} / Physics of Particles and Nuclei Letters, 2020, Vol. 17, No. 5, 696–700, Scopus, 10.1134/S1547477120050192, 1547-4771, 1531-8567.
- [11]. M. Y. Avetisyan and R. L. Mkrtchyan, Universality and Quantum Dimensions, Physics of Particles and Nuclei Letters, 2020, Vol. 17, No. 5, pp. 784–788, ISSN 1547-4771, DOI: 10.1134/S1547477120050040
- [12]. R.L.Mkrtchyan, Chern-Simons theory with the exceptional gauge group as a refined topological string, Physics Letters B, Volume 808, 10 September 2020, 135692, <https://doi.org/10.1016/j.physletb.2020.135692>

- [13]. M. Y. Avetisyan, R. L. Mkrtchyan, On $(ad)^n(X_2)^k$ series of universal quantum dimensions, *J. Math. Phys.* **61**, 101701 (2020); doi: 10.1063/5.0007028, <https://doi.org/10.1063/5.0007028>
- [14]M. Y. Avetisyan, R. L. Mkrtchyan, X_2 series of universal quantum dimensions, *J. Phys. A: Math. Theor.* (2020) *Volume 53, Number 4*, 045202, <https://doi.org/10.1088/1751-8121/ab5f4d>
- [15]. D. Fioravanti, H. Poghosyan and R. Poghossian,
- “ T , Q and periods in $SU(3)$ $\mathcal{N}=2$ SYM,” *JHEP* **03** (2020), 049
- doi:10.1007/JHEP03(2020)049, [arXiv:1909.11100 [hep-th]].
- [16]. H. Poghosyan, “Recursion relation for instanton counting for $SU(2)$ $\mathcal{N}=2$ SYM in NS limit of Ω background,” [arXiv:2010.08498 [hep-th]].
- [17]. F. Fucito, J.F. Morales, R.Poghossian, The Chiral Ring of $N=2$ in Eight Dimensions, arXiv:2010.10235
- [18]. Riccardo Conti, Hrant Topchyan , Roberto Tateo , and Ara Sedrakyan--Geometry of random potentials: Induction of two-dimensional gravity in quantum Hall plateau transitions, *PHYSICAL REVIEW B* **103**, L041302 (2021)
- [19]. N. Charles, I. A. Gruzberg, A. Klümper, W. Nuding, and A. Sedrakyan--Critical behavior at the integer quantum Hall transition in a network model on the kagome lattice, *PHYSICAL REVIEW B* **102**, 121304(R) (2020)
- [20]. A. Sedrakyan, A. Sinner, and K. Ziegler--Deformation of graphene sheet: Interaction of fermions with phonons,Arxiv:2007.08372-Submitted to Phys.Rev. B, Letters
- [21]. H.Babujian ,R.Poghossian and G.Savvidy, Correlation Functions of Quantum Artin System. *Universe*, 607009 (2020).
- [22]. Zhyrair Gevorkian, Mher Davtyan, **Armen Nersessian**, *Extended symmetries in geometrical optics*, *Physical Review A*, **101** (2020), 023840
- [23]. Evgeny Ivanov, **Armen Nersessian**, Stepan Sidorov, Hovhannes Shmavonyan, *Symmetries of deformed supersymmetric mechanics on Kahler manifolds*, *Physical Review* (2020) D, **101**, 025003
- [24]. Sergey Krivonos, **Armen Nersessian**, Hovhannes Shmavonyan, *Geometry and integrability in $N=8$ supersymmetric mechanics*, *Physical Review D*, **101** (2020) 045002
- [25]. Evgeny Ivanov, **Armen Nersessian**, Stepan Sidorov, *Quantum $SU(2/1)$ supersymmetric C^N Smorodinsky--Winternitz system*, *Journal of High Energy Physics* **0121** (2021), 015 arXiv:2009.14273 [hep-th]
- [26] D.Karakhanyan, R.Kirschner, “Spinorial R operator and Algebraic Bethe Ansatz” *Nucl.Phys.B*951 (2020) 114905
- [27] D.Karakhanyan, “Spinor Representations of Orthogonal and Symplectic Yangians” *Physics of Particles and Nuclei Letters*, 17(5), (2020) 794-802 DOI 10.1134/S1547477120050180

- [28]. H. Arian Zad, R. Kenna and N. Ananikian, Magnetic and thermodynamic properties of the octanuclear nickel phosphonate-based cage, *Physica A* 538 (2020)122841, DOI:10.1016/ j. physa.2019.122841.
- [29]. H. A. Zad, N. Ananikian, M. Jaščur, Single-ion anisotropy effects on the demagnetization process of the alternating weak-rung interacting mixed spin-(1/2, 1) Ising-Heisenberg double saw-tooth ladders, *Physica Scripta* 95 (9) (2020) 095702, DOI: 10.1088/1402-4896/aba663.
- [30]. H. Arian Zad, A. Trombettoni, N. Ananikian, Spin-1/2 Ising-Heisenberg Cairo pentagonal model in the presence of an external magnetic field: Effect of Landé g factors, *EPJ B*93 (11) (2020) 200, DOI: 10.1140/epjb/e2020-10213-4.
- [31]. A.E. Allahverdyan, Work Extraction from Fluid Flow: The Analog of Carnot's Efficiency, *Phys. Rev. Lett.*125, 064503 (2020).
- [32]. S. G. Babajanyan, A. E. Allahverdyan, and Kang Hao Cheong, Energy and entropy: Path from game theory to statistical mechanics, *Phys. Rev. Research* 2, 043055 (2020).
- [33]. A.E. Allahverdyan, Observational nonidentifiability, generalized likelihood and free energy, *International Journal of Approximate Reasoning*, 125, 118-138 (2020).
- [34]. S.G. Babajanyan, A.V. Melkikh and A.E. Allahverdyan, Leadership scenarios in prisoner's dilemma game, *Physica A*, 545, 123020 (2020).
- [35]. E Vardanyan, E Koonin, DB Saakian Analysis of Finite Population Evolution Models Using a Moment Closure Approximation *Journal of the Physical Society of Japan* 90 (1), 014801
- [36]. E Vardanyan, E Koonin, DB Saakian, *Journal of the Physical Society of Japan* 89 (10), 104802, Fixation Probability of a Mutant in the Wright–Fisher Model under Strong Selection and Fluctuating Fitness Landscape
- [37]. E Vardanyan, DB Saakian The analytical dynamics of the finite population evolution games, *Physica A: Statistical Mechanics and its Applications*, 124233
- [38]. DB Saakian, E Vardanyan, T Yakushkina, Evolutionary model with recombination and randomly changing fitness landscape, *Physica A: Statistical Mechanics and its Applications* 541, 123091
- [39]. DB Saakian, E Vardanyan, The mutator model with asymmetric transitions, *Physica A: Statistical Mechanics and its Applications* 545, 123500 landscapes also, for asymmetric transition rates. Actually, the asymmetry of transition (mutation) rates is an important characteristic of evolutionary dynamics.
- [40]. Esther Jodar, Josh Lofy, Vladimir Gasparian, Zhyrair Gevorkian, Faraday and Kerr Effects in Right and Left Handed Films and Layered Materials, 2020, *Reviews on Advanced Materials Science*, 59(1), 243-251.
- [41]. Zhyrair Gevorkian , K. Avjyan , L. Matevosyan, et al, Determination of the complete set of optical parameters of micron-sized polycrystalline $\text{CH}_3\text{NH}_3\text{PbI}_3\text{-xCl}_x$ films from the oscillating transmittance and reflectance spectra, 2020, *Materials Research Express*, 7, 016408, <https://doi.org/10.1088/2053-1591/ab5c46>.

- [42]. Zhyrair Gevorkian, Mher Davtyan, Discrete spectrum Radiation from a charged particle moving in a medium with Maxwell fish eye refraction index profile, 2020, Phys.Rev.A, **102**, 003500.
- [43]. M.A. Aginian, M. Chung, G.S. Harutyunyan, A.V. Margaryan, K.-J. Moon, M.A. Tumanyan, Non-exciting wakefield structured bunches in one-dimensional plasma model, Resource-Efficient Technologies, 2020, 3, 1–14