CURRICULUM VITAE (Abbreviated Version)

Name: Serguey Todorov PETCOV (PETKOV)

The transcription PETKOV of my name spelled in Cyrillic alphabet as ПЕТКОВ was made by certain administrative authorities (which issued my international passport and ID card). This was done after I have published a number of articles in English language with transcription PETCOV of my family name. So, I kept PETCOV as name related to my scientific activity and PETKOV as my "administrative" family name.

Date of birth: 20.7.1950

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UNIVERSITY EDUCATION

- Master in Theoretical Particle Physics: 1973, Moscow State University, Moscow, USSR.

- Ph. D. degree: 1977 Laboratory of Theoretical Physics, Joint Institute of Nuclear Research, Dubna, USSR (Ph. D. thesis advisor Prof. S.M. Bilenky).

POSITIONS HELD

- 1977 - 1984: Assistant Professor "2nd Degree", Institute of Nuclear Research and Nuclear Energy (INRNE), Bulgarian Academy of Sciences (BAS), Sofia.
- 1984 - 1987: Assistant Professor "1st Degree", INRNE, BAS, Sofia.
- 1987 - 2000: Associate Professor, INRNE, BAS, Sofia.
- 1979: Post-doctoral Fellow Associate, CERN, Geneva, 1979.
- 01/12/1982 - 01/10/1983: "Visiting Scientist" (SLAC, FERMILAB, BNL, LBL Berkeley) U.S.A.
- 09/09/1990 - 31/10/1994: Visiting "Primo Ricercatore", INFN, Trieste, Italy.
- 01/11/1994 - 31/10/2002: Associate Professor at SISSA, Trieste.
- 01/11/2002: Full Professor at SISSA, Trieste, since 01/11/2002.

CURRENT POSITION

2001 – : Full Professor, SISSA, Trieste, Italy.

Administrative Positions and Responsibilities

- 2001 - 2007: Head of Theoretical Particle Physics Sector of SISSA.
- 2001 - 2007: member of the Council (SENATO) of SISSA (the highest governing body of SISSA).

- 2004: Co-founder of the Astro-Particle Physics (APP) Group/Sector of SISSA.

- 2012 - 2015: Deputy Head of Theoretical Particle Physics Sector of SISSA.

- 2007 - 2012: Member of the Commission for Hiring of SISSA.

- 2012 - 2014: Member of the Commission for Research of SISSA.

Short Term (at least 1 month) Visiting Research or Professor Positions:

- CERN, Geneva, Switzerland : 1986 (3 months), 1989 - 1990 (4 months).

- University of Heidelberg, Germany, 1986 (4 months).

- CEA Saclay, C.N.R.S. (Univ. de Paris XI, VI, VII) and College de France, Paris, France: 1988 (2 months), 1990 (6 months), 1999 (2 months), 2000 and 2003 (2 months).

- Yukawa Institute of Theoretical Physics, Kyoto University, Kyoto, Japan, 2004 (3 months) and 2007 (1 month).

- Kavli Institute of Theoretical Physics, Univ. of California, Santa Barbara, CA, U.S.A., participant in the Program "Neutrinos: Data, Cosmology and the Planck Scale" 2003 (1 month).

Other Scientifically Important Visits, Participation in Research Programs:

- 2013: Kavli Institute of Theoretical Physics, Univ. of California, Santa Barbara, CA, U.S.A.

- 1998, 2000, 2004, 2007 and 2015: Aspen Center for Physics, Aspen, Colorado, USA.

Prizes and Recognitions:

- 2011: Recipient of Pontecorvo Prize for the year 2010 for "Fundamental contribution to the investigation of neutrino propagation in matter, $\mu \to e + \gamma$, $\mu \to 3e$ processes and Majorana properties of neutrinos" (the Prize is awarded annually since 1995 by the Joint Institute for Nuclear Research (JINR) in Dubna, Moscow, Russia).

- November 2013: Inter-Academy Seoul Science Forum Speaker, title "Prospects in Neutrino Physics", Seoul, S. Korea.

- 2007: George Marx Memorial Lecturer, Hungarian Physical Society.

- 1991 and 1995: Reviewer/Reporter for the Nobel Committee for Physics upon requests of the Committee).

- 1992 - 2004: Made nominations (each year of the period) for the Nobel Prize for Physics (upon requests of the Nobel Committee for Physics).

- 2002: Invited guest of the Nobel Committee for Physics for the Nobel Award Ceremony and Festivities (December 7-14, 2002, Stockholm, Sweden).

Honorary Scientific Positions:

- Since 2007: "Associate Researcher", IPMU, University of Tokyo, Tokyo, Japan.

- 2008 - 2013: Honorary title "Visiting Professor" of University of Durham, Durham, UK.

- Since 2000: "Scientific Associate ", INRNE, BAS, Sofia.

- Since 2017: "Visiting Scientist", TH Department, CERN, Geneva, Switzerland.

Scientific Output

- About 290 publications, of which 71 in Phys. Lett. B, 28 in Nucl. Phys. B, 20 in JHEP, 3 in Phys.Rev.Lett., 1 in Rev. Mod. Phys., 32 in Phys. Rev. D.

- About 120 invited talks at international conferences.

- Citations (by 01/05/2020): The inspirehep.net web site lists uninterrupted production since my Ph. D. with about 290 publications cited over 17380 (50820) times with PDG RPP citations excluded (included), with a Hirsch-index of 77 (79)
(data from: http://inspirehep.net).

- In the last 10 years my articles have citation rate of about 700 (550) cites/year with PDG RPP (self) cites excluded (data from: http://inspirehep.net).

- 2010 - 2019: Following an invitation by PDG, I have written together with Prof. K. Nakamura (IPMU, Univ. of Tokyo, Japan) the review article on "Neutrino Masses, Mixing and Oscillations" for all editions (electronic and published in journals – altogether 10) of Review of Particle Physics published by PDG in the indicated period.

- According to PDG, the review article "Neutrino Masses, Mixing and Oscillations" we have written with K. Nakamura for Review of Particle Physics was downloaded from the PDG web site 68363 times in the period December 2013 - February 2016.

Notable Scientific Results

1. I proposed (with D.R.T. Jones) in 1979 the Vector Boson Fusion (VBF) mechanism of Higgs boson production in $e^+ - e^-$ collisions (Phys. Lett. B84 (1979) 137). Later the idea was extended to p – p collisions. About (7-10)% of the Higgs bosons are produced at LHC via the VBF mechanism.

2. In 1980 I discovered (with S.M. Bilenky and J. Hosek) a new source of CP violation (CPV) in particle physics – the Majorana phases of the lepton mixing matrix (Phys. Lett. 94B (1980) 495).
In 2006 I have shown (with S. Pascoli and A. Riotto) that these phases (and the leptonic Dirac CPV phase) can provide (in leptogenesis) the requisite CP violation for the generation of the observed baryon asymmetry of the Universe (Nucl. Phys. B774 (2007) 1 and Phys. Rev. D75 (2007) 083511).

3. In 2001 I proposed (with my student M. Piai) a novel method of neutrino mass ordering (spectrum) determination using reactor neutrinos (Phys. Lett. B533 (2002) 94). This led to the construction of JUNO experiment in China (by international collaboration with strong Italian participation, with a cost of 300 million US Dollars), which is based on this method.

4. I discovered in 1998 a new mechanism of (maximal) enhancement (at small mixing angles) of the transitions between electron and muon (tauon) neutrinos crossing the Earth core (Earth mantle-core (parametric) or NOLR enhancement, Phys. Lett. B434 (1998) 321, (E) ibid. B444 (1998) 584), and explored it further with M. Maris and M. Chizhov (hep-ph/9810501, Phys. Rev. Lett. 83 (1999) 1096 (hep-ph/9903399) and Phys. Rev. D63 (2001) 073003 (hep-ph/9903424)). This enhancement can, and most likely will, be used in future large scale high statistics experiments studying atmospheric neutrino oscillations to

get information, in particular, about the properties (density, composition) of the Earth core.

5. I have shown in 1988 (with P.I. Krastev, Phys. Lett. 205B (1988) 84) that the magnitude of CP violation effects in neutrino oscillations is controlled by the rephasing invariant associated with the Dirac phase of the lepton mixing matrix (which is analogous to Jarlskog invariant of the quark sector). There are indications from the current neutrino oscillation data that CP violation indeed takes place.

6. In 1986 I have pointed out (with P. Langacker et al.) that CPT (CP) invariance does not hold in neutrino oscillations taking place in ordinary matter (the Earth, the Sun), although all fundamental interactions are known to respect the CPT symmetry (Nucl. Phys. B282 (1987) 589). In the same article it was proven that the flavour neutrino oscillations taking place in matter do not depend on the Majorana phases present in the Pontecorvo-Maki-Nakagawa-Sakata (PMNS) neutrino mixing matrix. The same result was shown to hold in the case of flavour neutrino oscillations taking place in vacuum in Phys. Lett. 94B (1980) 495. These results led to the important conclusion that the studies of oscillations between flavour neutrinos cannot provide information about the nature - Dirac or Majorana - of neutrinos with definite mass.

7. I have pointed out in 2002 (with S. Pascoli, Phys. Lett. B544 (2002) 239) that the measurement of the neutrinoless double beta decay effective Majorana mass can provide unique information about the type of spectrum neutrino masses obey (which is still undetermined).

8. In 1988 I found a simple and very precise analytic description of the flavour conversion of solar (electron) neutrinos taking place in the Sun (Phys. Lett. 200B (1988) 373 and ibid. 207B (1988) 64). It was used practically in all analyses of the solar neutrino data until about 2000 - the advent of powerful PCs.

9. I have shown that charged lepton flavour violation (CLFV) processes $\mu \to e + \gamma$, $\mu \to 3e$, etc. in the minimally extended Standard Model with right-handed neutrinos and neutrino Dirac (lepton charge conserving) mass term are suppressed by Glashow-Iliopoulos-Maiani type mechanism, which renders their rates unobservably small (Yadernaya Fizika 25 (1977) 641 (Sov. J. Nucl. Phys. 25 (1977) 340; 25, 698 (E) (1977))). Building on this result I have shown (with S.M. Bilenky and B. Pontecorvo, Phys. Lett. 67B (1977) 309) that the CLFV processes can have observable rates in gauge theories with heavy neutral leptons (heavy Majorana neutrinos).

10. I have put forward in 1991 (together with M. Guzzo and A. Masiero, Phys. Lett. 260B (1991) 154) the idea of existence of non-standard neutrino interactions (NSI) of a certain type (flavour diagonal but flavour non-conserving NSI). The search for NSIs is an integral part of a program of research in neutrino physics, which extends beyond 2035).

11. I have developed the concept of Pseudo-Dirac neutrinos (Phys. Lett. 110B (1982) 245).

12. I have shown that in a large class of theories of lepton flavour based on non-Abelian discrete symmetries, the Dirac phase in the PMNS lepton mixing matrix satisfies an exact sum rule by which it is expressed in terms of the lepton mixing angles and certain fixed parameters which depend on the employed symmetry (Nucl. Phys. B892 (2015) 400), and have explored further (together with I. Girardi, A. Stuart and A.V. Titov) this result (I. Girardi et al., Nucl. Phys. B894 (2015) 733, Eur. Phys. J. C75 (2015) 345, Nucl. Phys. B902 (2016) 1, Nucl. Phys. B911 (2016) 754). The result implied that the sufficiently precise measurement of the Dirac phase in the PMNS mixing matrix, together with an

improvement of the precision on the lepton mixing angles θ_{12}, θ_{13} and θ_{23}, can provide unique information about the possible existence of new fundamental symmetry in the lepton sector. The potential of current and future experiments (T2HK, T2HKK, DUNE) to test the validity of the indicated sum rule for the Dirac phase in the PMNS matrix and thus test the validity of the non-Abelian discrete symmetry approach to the lepton flavour problem has also been investigated (with S.K. Agarwalla, S.S. Chatterjee and A.V. Titov in Eur. Phys. J. C78 (2018) 709, and with A.V. Titov in Phys. Rev. D97 (2018) 115045).

13. I have developed (with my current and former Ph.D. students P.P. Novichkov, J.T. Penedo and A.V. Titov) the formalism of the finite modular groups Γ_4, Γ'_4, Γ_5 as well as of the generalised CP (gCP) symmetry combined with finite modular symmetries (Γ_2, Γ_3, Γ_4, Γ_5, Γ'_4), which were needed for the application of the new modular invariance approach to the fundamental (lepton and quark) flavour problem in particle physics, and constructed (with my collaborators) viable lepton flavour models based on the indicated symmetries (Nucl.Phys. B939 (2019) 292 (arXiv:1806.11040); JHEP 1904 (2019) 005 (arXiv:1811.04933); JHEP 1904 (2019) 174 (arXiv:1812.02158); JHEP 1907 (2019) 165 (arXiv:1905.11970); arXiv:2006.03058 (submitted for publication)).

Recent Research Interests

- Modular Invariance Approach to (Lepton, Quark) Flavour Problem in Particle Physics.

- Discrete Symmetry Theories of Lepton/Quark Mixing and CP Violation and their Tests.

- Fundamental Problems in Neutrino Physics (origin of neutrino masses and mixing, the nature (Dirac or Majorana), mass spectrum of massive neutrinos, leptonic CP Violation, neutrino related beyond the Standard Model Physics, charged lepton flavour violating processes, theory and phenomenology of neutrino oscillations, etc.).

- Leptogenesis Generation of Baryon Asymmetry of the Universe (BAU).

Organisation of Scientific Meetings

Organiser/co-organiser of about 20 international conferences/workshops in Germany, USA, Belgium, France, Italy, Sweden, South Africa, Japan, Bulgaria. Most recently was the principal organiser of the Int. Workshop "Prospects of Neutrino Physics" at Kavli IPMU, Japan (04/2019) and am principal co-organiser of a programme and Int. Workshop "Neutrinos, Flavour and Beyond", Capri, Italy (06/2021).

Supervision of Graduate Students

1994 - 2019: at SISSA supervised 13 and mentored 2 Ph.D. students (6 non-Italian).

1999 - 2019: supervised 3 Master students (Univ. of Trieste (1) and Trento (2)).

Supervision and Mentoring of Post-doctoral Fellows

2001 - 2019: supervised 14 postdocs (of German (3), Indian (2), Japanese (3), American (1), Austrian (1), Spanish (3) and Taiwanese (1) Nationalities) at SISSA.

External Referee (Ph.D. and habilitation theses):

- of 17 Ph. D. theses (in Italy, France, Spain, UK, Sweden, India);

- of 2 theses of d'Habilitation 'a Diriger des Recherches (France).

Teaching

1992 - present (every year): Theory of Electroweak and Strong Interactions, advanced (60-90 hours) course for SISSA Ph.D. students in Theoretical Particle and Astro-Particle Physics.

1996: Neutrino Physics (advanced), Dept. of Physics, Univ. of Dortmund, Germany.

1997: Neutrinos Beyond the Standard Theory (advanced), ENS, Paris, France.

1988 - 2017: lectured at 27 International Schools of Elementary Particle and High Energy Physics in Italy, France, Austria, Portugal, Greece, Bulgaria, Brazil, Slovakia, Singapore, The Netherlands, Switzerland, Spain, China, Vietnam, Croatia, S. Korea and Japan (e.g., CERN-JINR Schools in 1988, 2003, 2014 and 2015).

Reviewing Activities (Summary)

- 1991 and 1995: Reviewer/Reporter for the Nobel Committee for Physics.

- Served as

i) Project Referee for the USA, Swiss (3 times), Portuguese, French and Czech Nat. Science Foundations, Danish Independent Research Fund (2 times), for the UK Royal Society, British Council and Leverhulme Trust, and for the JSPS (2 times) and MEXT of Japan;

ii) Member of the Evaluation Committee of the Center for Quantum Universe, Okayama Univ., Japan (2010, 2015);

iii) Member/External Referee of 20 Hiring/Promotion Commissions (of Universities or Research Institutes in Europe (10), USA (3), Australia (1), India (4) and Pakistan (2)). More specifically, was a member of 8 Hiring/Promotion Commissions of Italian Universities, and External Referee for the Tenure Commissions of Dept. of Phys. Univ. of Wisconsin, USA, and The Niels Bohr Inst., Copenhagen, Denmark, for the Academic Promotion Comm. of Dept. of Phys of UCLA and Iowa State Univ., USA, of School of Phys., Univ. of Melbourne, Australia, of Harish-Chandra Res. Inst. and Physics Res. Lab. (Ahmedabad), India (4 times), for the hiring Commission of Univ. of Edinburgh (UK), for the TWAS (ICTP) Membership Commission.

iv) External Referee: Served as External Referee for the Distinguished Academics Awards Committee of The University of Melbourne, Melbourne, Australia (2017).

v) External Referee: - for the China (10^6 US Dollars) Future Science Prize (2017, 2019) and the POSCO TJ Park Science Prize (180000 US Dollars), S. Korea.

2018 – present: Member of the International Scientific Advisory Committee of JUNO (3×10^8 US Dollars) experimental project (being realised in China by international collaboration with strong Italian participation).

- Served as member of the Commission for the PITAGORUS Scientific Achievement Prize of the Bulgarian Ministry of Research and Education (2018).

- Serves as a member of the International Advisory Committees of the International Conference on Neutrinos and Dark Matter (since 2015) and of the International Workshop "Neutrino Telescopes" (since 2013).

- Serves as a referee for the journlas: Physical Review Letters, Physical Review D, EPJ

C, Physics Letters B, JHEP, JCAP, Nuclear Physics B, etc.

Funding ID:

- 2014 - 2017: PI (Coordinator), Trieste node of the of the MIUR COFINANZIAMENTO Project on Theoretical Astroparticle Physics.

- 2009 - 2012: PI, Trieste node of the of the MIUR (Italy) COFINANZIAMENTO Project on Matter-Antimatter Asymmetry, Dark Matter and Dark Energy in the Era of LHC.

- 2006 - 2008: PI, Trieste node of the of the MIUR (Italy) COFINANZIAMENTO Project on Fundamental Constituents of the Universe.

- 2004 - 2006: PI, Trieste node of the of the MIUR (Italy) COFINANZIAMENTO Project on Astroparticle Physics.

- 2016 - 2020: PI, Trieste node of the European Research Network "INVISIBLESplus".

- 2016 - 2020: PI, Trieste node of the European Research and Training Network "ELUSIVES".

- 2012 - 2016: PI, Trieste node of the European Research and Training Network "INVISIBLES".

- 2006 - 2010: PI, Trieste node of the European Research and Training Network "UniverseNet".

- 2005 - 2009: Head of the of the MIUR (Italy) Internazionalizzazione Program on "Fundamental Interactions and the Early Universe" between SISSA and the Yukawa Institute of Theoretical Physics (YITP), Kyoto, Japan.

- 2000 - 2004: PI, Trieste node of the European Network on Supersymmetry and the Early Universe.

- 1993 - 1995: PI, Trieste node of the European Network on Flavourdynamics.

- 2001 - 2003: PI, SISSA sub-node of the Trieste node of the MIUR (Italy) COFINANZIAMENTO project on Theory and Phenomenology of Elementary Particles.

- 2001 - 2020 (each year of the period): PI of the SISSA Unit of the INFN Research Network Grants "Astroparticle Physics".