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# Momchil Velkovsky

**Professional experience**

**2009-present: Research Assistant Professor,** Department of Physics & Astronomy, Vanderbilt University, Nashville, Tennessee

Teaching graduate and undergraduate courses in the Department of Physics & Astronomy, Vanderbilt University:

- Phys116 A – introductory course for non-physics majors, taught since Spring 2009 semester
- Phys 226 W – Lab course for advanced undergraduate students, taught the Spring 2014 and 2015 semesters
- Phys 370 - Quantum Field Theory, Spring 2009 and Fall 2011, Spring 2012 semesters (two semester version)
- Phys 360 B – Cosmology, Fall 2010 semester

Managed the Physics and Astronomy department web pages

**2013 Outstanding Undergraduate Teaching Award,** Department of Physics & Astronomy, Vanderbilt University

**2003-2008: Research Assistant Professor,** Department of Physics & Astronomy and the Vanderbilt Institute for Integrative Biosystems Research and Education (VIIBRE), Vanderbilt University, Nashville, Tennessee

Worked with Prof. John Wikswo and the VIIBRE group on the development of dynamic metabolic models, needed to understand the vast amount of fast metabolic rate data from live cells perturbed with toxins and internal metabolites, obtained with the Multianalyte Microphysiometer (MMP). Developed software for data reduction of the MMP. Created a universal approach to thin enzyme electrodes, using an analytic diffusion-reaction model, and applied this to the MMP to allow the conversion of amperometric measurements into cell consumption and excretion rates. Applied the model to interpret data from the VIIBRE Nanophysiometer.

Worked with the Heavy Ion Group on the conversion of the PHENIX simulation software to object-oriented framework.

Worked as a system administrator of the Vpac cluster, 2007-2008.

**1999 – 2003 Post-Doctoral Research Associate,** Experimental Heavy Ion Group, State University of New York at Stony Brook, Stony Brook, New York

Participated in the PHENIX experiment at the Relativistic Heavy Ion Collider (RHIC) at the Brookhaven National Laboratory. Involved in the analysis of K-short in Year 2 PHENIX data. Worked with the Offline Software Group and wrote scripts on the computing infrastructure, and maintenance of PHENIX software. Installed and applied open source tools needed for the PHENIX infrastructure, configured and maintained Apache, Samba and MySQL severs. As a rebuild manager was responsible for automatic rebuilds of all the PHENIX software, testing and quality control, including builds and tests with Insure++. Responsible for the maintenance and the backups for the main Objectivity Federation database. Served as a PHENIX liaison to the RHIC Computing Facility (RCF), helping to solve the day-to-day

problems between this unique data-intensive experiment and RCF.

**1997 – 1999 Post-Doctoral Research Associate,** Nuclear Theory Group, Physics Department, Brookhaven National Laboratory
Upton, New York

Studied the properties of nuclear matter at very high densities. Together with E. Shuryak, T. Schaeffer and R. Rapp proposed an instanton induced quark matter color-superconducting phase. Several of our papers are cited widely (the first one with **600 citations**).

**1993-1997 Graduate Research Assistant**, Nuclear Theory Group, Department of Physics, State University of New York at Stony Brook, Stony Brook, New York

Studied the detailed mechanism of the high temperature phase transition in Nuclear Physics. Studied the role of the instantons and instanton molecules for the phase transition. Proved that their density does not change significantly until the transition point. Later this was demonstrated through Lattice Gauge Simulations. Published 4 papers.

**1991-1993 Graduate Teaching Assistant,** Department of Physics, State University of New York at Stony Brook, Stony Brook, New York

Laboratory instructor and teaching assistant for various physics courses.

**1991 Graduate Assistant,** University of California at Riverside, Riverside, CA

Studied an extension of the Standard Model with a large N representation of the Higgs sector. Published a paper with Dr. J. Wudka., Laboratory instructor and teaching assistant for various physics courses.

**1986-1990 Research and Teaching Assistant**, Theoretical Physics Division, University of Sofia, Sofia, Bulgaria

Studied Lattice Gauge Models by Monte Carlo Simulations and Mean Field analysis. Grader, taught the recitation sections of courses given by the Division of Theoretical Physics.

**1980-1982 Bulgarian Army draft**

Bricklayer, mason, concrete worker.

## Education

**1991- 1997 Graduate Student**, **Ph.D. in Physics - May 1997**
State University of New York at Stony Brook, Stony Brook, New York

Dissertation: "The Role of the Instantons in the QCD Phase Transitions", Advisor: Prof. Edward Shuryak

**1991 Graduate Student in Physics**
University of California at Riverside, Riverside, California

Advisor: Dr. Jose Wudka

**1982-1987 Undergraduate Student, M.Sc. in Physics - June 1987**
University of Sofia, Sofia, Bulgaria

Masters' Thesis: " Studies of the Phase Structure of the Lattice Abelian Higgs Model", Advisors: Dr. Ivan Zlatev and Dr. Asen Ilchev

Valedictorian for the 1987 Physics Faculty graduates.

Winner of the 1982 and 1983 Bulgarian National College Olympiad in Physics.

**1976-1980 High School Student, 29th School, Sofia, Bulgaria**

5th place -1980 Bulgarian National Physics Olympiad (high school)

**Theoretical publications prior to 2000**

1) ON THE CHARGED D = 3 U(1) HIGGS LATTICE MODEL.
By A. Ilchev, M. Velkovsky (Sofiya U.),. 1989.
Published in Bulg.J.Phys.16:457-460,1989

2) A LARGE N STANDARD MODEL.
By Momchil Velkovsky, Jose Wudka (UC, Riverside),. UCRHEP-T87, Jan 1992. 19pp. Published in Nucl.Phys.B399:349-363,1993

3) ON THE HIGGS INDUCED CONTRIBUTION TO BARYON NUMBER VIOLATION AT VERY HIGH-ENERGIES.
By M. Velkovsky, Edward V. Shuryak (SUNY, Stony Brook),. 1993.
Published in Phys.Lett.B304:281-284,1993

4) THE INSTANTON DENSITY AT FINITE TEMPERATURES.
By Edward V. Shuryak, M. Velkovsky (SUNY, Stony Brook),. SUNY-NTG-94-11, Mar 1994. 14pp. Published in Phys.Rev.D50:3323-3327,1994, e-Print Archive: hep-ph/9403381

5) A MEAN FIELD APPROACH TO THE INSTANTON INDUCED EFFECT CLOSE TO THE QCD PHASE TRANSITION.
By M. Velkovsky, Edward V. Shuryak (SUNY, Stony Brook),. SUNY-NTG-95-20, Mar 1996. 31pp. Published in Phys.Rev.D56:2766-2777,1997, e-Print Archive: hep-ph/9603234

6) INSTANTONS AND QCD PHASE TRANSITIONS.
By Momchil Stoychev Velkovsky (SUNY, Stony Brook),. UMI-97-36180-mc (microfiche), 1997. 124pp. Ph.D. Thesis.

7) QCD WITH LARGE NUMBER OF QUARKS: EFFECTS OF THE INSTANTON - ANTI-INSTANTON PAIRS.
By M. Velkovsky, Edward V. Shuryak (SUNY, Stony Brook),. SUNY-NTG-96-37, Mar 1997. 11pp. Published in Phys.Lett.B437:398-402,1998, e-Print Archive: hep-ph/9703345

8) DIQUARK BOSE CONDENSATES IN HIGH DENSITY MATTER AND INSTANTONS.
By R. Rapp (SUNY, Stony Brook), Thomas Schafer (Washington U., Seattle), Edward V. Shuryak (SUNY, Stony Brook), M. Velkovsky (Brookhaven),. SUNY-NTG-97-30, Nov 1997. 4pp. Published in Phys.Rev.Lett.81:53-56,1998, e-Print Archive: hep-ph/9711396
TOPCITE = 500+

9) MEAN FIELD, INSTANTONS AND FINITE BARYON DENSITY.
By Momchil Velkovsky (Brookhaven),. Apr 1998. 7pp.
To be published in the proceedings of Workshop on QCD at Finite Baryon Density: A Complex System with a Complex Action, Bielefeld, Germany, 27-30 Apr 1998. Published in Nucl.Phys.A642:58-64,1998
e-Print Archive: hep-ph/9807215

10) HIGH DENSITY QCD AND INSTANTONS.
By R. Rapp (SUNY, Stony Brook), Thomas Schafer (Princeton, Inst. Advanced Study), Edward V. Shuryak (SUNY, Stony Brook), M. Velkovsky (Brookhaven),. SUNY-NTG-99-04, IASSNS-HEP-99-40, Apr 1999. 43pp. Published in Annals Phys.280:35-99,2000
e-Print Archive: hep-ph/9904353
TOPCITE = 100+

**Publications as a member of the PHENIX collaboration 2000-2003**

11) CENTRALITY DEPENDENCE OF CHARGED PARTICLE MULTIPLICITY IN AU - AU COLLISIONS AT S(NN)**(1/2) = 130-GEV.
By PHENIX Collaboration (K. Adcox et al.). Dec 2000. 6pp.
Published in Phys.Rev.Lett.86:3500-3505,2001
e-Print Archive: nucl-ex/0012008

12) FIRST RESULTS FROM RHIC-PHENIX.
By PHENIX Collaboration (K. Adcox et al.). 2001.
Prepared for International Symposium on Nuclear Physics (ISNP2K), Trombay, Mumbai, India, 18-22 Dec 2000. Published in Pramana 57:355-369,2001

13) MEASUREMENT OF THE MID-RAPIDITY TRANSVERSE ENERGY DISTRIBUTION FROM S(NN)**(1/2) = 130-GEV AU + AU COLLISIONS AT RHIC.
By PHENIX Collaboration (K. Adcox et al.). Apr 2001. 6pp.
Published in Phys.Rev.Lett.87:052301,2001
e-Print Archive: nucl-ex/0104015

14) OVERVIEW OF PHENIX RESULTS FROM THE FIRST RHIC RUN.
By PHENIX Collaboration (W.A. Zajc et al.). Jun 2001. 15pp.
To appear in the proceedings of 15th International Conference on Ultrarelativistic Nucleus-Nucleus Collisions (QM2001), Stony Brook, New York, 15-20 Jan 2001. Published in Nucl.Phys.A698:39-53,2002
e-Print Archive: nucl-ex/0106001

15) SUPPRESSION OF HADRONS WITH LARGE TRANSVERSE MOMENTUM IN CENTRAL AU+AU COLLISIONS AT S(NN)**(1/2) = 130-GEV.
By PHENIX Collaboration (K. Adcox et al.). Sep 2001. 6pp.
Published in Phys.Rev.Lett.88:022301,2002
e-Print Archive: nucl-ex/0109003

16) CENTRALITY DEPENDENCE OF PI+ / PI-, K+ / K-, P AND ANTI-P PRODUCTION FROM S(NN)**(1/2) = 13-=GEV AU+AU COLLISIONS AT RHIC.
By PHENIX Collaboration (K. Adcox et al.). Dec 2001. 6pp.
Published in Phys.Rev.Lett.88:242301,2002
e-Print Archive: nucl-ex/0112006

17) TRANSVERSE MASS DEPENDENCE OF TWO PION CORRELATIONS IN AU+AU COLLISIONS AT S(NN)**(1/2) = 130-GEV.
By PHENIX Collaboration (K. Adcox et al.). Jan 2002. 6pp.
Published in Phys.Rev.Lett.88:192302,2002
e-Print Archive: nucl-ex/0201008

18) MEASUREMENT OF SINGLE ELECTRONS AND IMPLICATIONS FOR CHARM PRODUCTION IN AU+AU COLLISIONS AT S**(1/2)(NN) = 130-GEV.
By PHENIX Collaboration (K. Adcox et al.). Feb 2002. 6pp.
Published in Phys.Rev.Lett.88:192303,2002
e-Print Archive: nucl-ex/0202002

19) NET CHARGE FLUCTUATIONS IN AU+AU INTERACTIONS AT S**(1/2) = 130-GEV.
By PHENIX Collaboration (K. Adcox et al.). Mar 2002. 6pp.
Published in Phys.Rev.Lett.89:082301,2002
e-Print Archive: nucl-ex/0203014

20) EVENT-BY-EVENT FLUCTUATIONS IN MEAN P(T) AND MEAN E(T) IN S(NN)**(1/2) = 130-GEV AU+AU COLLISIONS.

By PHENIX Collaboration (K. Adcox et al.). Mar 2002. 10pp.
Published in Phys.Rev.C66:024901,2002
e-Print Archive: nucl-ex/0203015

21) FLOW MEASUREMENTS VIA TWO PARTICLE AZIMUTHAL CORRELATIONS IN AU+AU COLLISIONS AT S(NN)**(1/2) = 130-GEV.
By PHENIX Collaboration (K. Adcox et al.). Apr 2002. 6pp.
Published in Phys.Rev.Lett.89:212301,2002
e-Print Archive: nucl-ex/0204005

22) MEASUREMENT OF THE LAMBDA AND ANTI-LAMBDA PARTICLES IN AU+AU COLLISIONS AT S(NN)**(1/2) = 130-GEV.
By PHENIX Collaboration (K. Adcox et al.). Apr 2002. 6pp.
Published in Phys.Rev.Lett.89:092302,2002
e-Print Archive: nucl-ex/0204007

23) CENTRALITY DEPENDENCE OF THE HIGH P(T) CHARGED HADRON SUPPRESSION IN AU+AU COLLISIONS AT S(NN)**(1/2) = 130-GEV.
By PHENIX Collaboration (K. Adcox et al.). Jul 2002. 26pp.
Published in Phys.Lett.B561:82-92,2003
e-Print Archive: nucl-ex/0207009

24) HEAVY ION COLLISIONS AT COLLIDER ENERGIES: INSIGHTS FROM PHENIX.
By PHENIX Collaboration (A. Drees et al.). 2003.
Prepared for International Conference on Physics and Astrophysics of Quark - Gluon Plasma (ICPAQGP 2001), Jaipur, India, 26-30 Nov 2001.
Published in Pramana 60:639-650,2003

25) PHENIX DETECTOR OVERVIEW.
By PHENIX Collaboration (K. Adcox et al.). 2003. 16pp.
Published in Nucl.Instrum.Meth.A499:469-479,2003

26) PHENIX CENTRAL ARM TRACKING DETECTORS.
By PHENIX Collaboration (K. Adcox et al.). 2003. 26pp.
Published in Nucl.Instrum.Meth.A499:489-507,2003

27) PHENIX ON-LINE AND OFF-LINE COMPUTING.
By PHENIX Collaboration (S.S. Adler et al.). 2003. 14pp.
Published in Nucl.Instrum.Meth.A499:593-602,2003

28) MID-RAPIDITY NEUTRAL PION PRODUCTION IN PROTON PROTON COLLISIONS AT S**(1/2) = 200-GEV.
By PHENIX Collaboration (S.S. Adler et al.). Apr 2003. 6pp.
Published in Phys.Rev.Lett.91:241803,2003
e-Print Archive: hep-ex/0304038

29) SUPPRESSED PI^0 PRODUCTION AT LARGE TRANSVERSE MOMENTUM IN CENTRAL AU+ AU COLLISIONS AT S(NN)**1/2 = 200 GEV.
By PHENIX Collaboration (S.S. Adler et al.). Apr 2003. 6pp.
Published in Phys.Rev.Lett.91:072301,2003
e-Print Archive: nucl-ex/0304022

30) ELLIPTIC FLOW OF IDENTIFIED HADRONS IN AU+AU COLLISIONS AT S(NN)**(1/2) = 200-GEV.
By PHENIX Collaboration (S.S. Adler et al.). May 2003. 6pp.
Published in Phys.Rev.Lett.91:182301,2003
e-Print Archive: nucl-ex/0305013

31) J / PSI PRODUCTION IN AU AU COLLISIONS AT S(NN)**(1/2) = 200-GEV AT THE RELATIVISTIC HEAVY ION COLLIDER.
By PHENIX Collaboration (S.S. Adler et al.). May 2003. 11pp.
Published in Phys.Rev.C69:014901,2004
e-Print Archive: nucl-ex/0305030

32) SCALING PROPERTIES OF PROTON AND ANTI-PROTON PRODUCTION IN S(NN)**(1/2) 200-GEV AU+AU COLLISIONS.
By PHENIX Collaboration (S.S. Adler et al.). May 2003. 6pp.
Published in Phys.Rev.Lett.91:172301,2003
e-Print Archive: nucl-ex/0305036

33) ABSENCE OF SUPPRESSION IN PARTICLE PRODUCTION AT LARGE TRANSVERSE MOMENTUM IN S(NN)**(1/2) = 200-GEV D + AU COLLISIONS.
By PHENIX Collaboration (S.S. Adler et al.). Jun 2003. 6pp.
Published in Phys.Rev.Lett.91:072303,2003
e-Print Archive: nucl-ex/0306021

34) J / PSI PRODUCTION FROM PROTON PROTON COLLISIONS AT S**(1/2) = 200-GEV.
By PHENIX Collaboration (S.S. Adler et al.). Jul 2003. 6pp.
Published in Phys.Rev.Lett.92:051802,2004
e-Print Archive: hep-ex/0307019

35) SINGLE IDENTIFIED HADRON SPECTRA FROM S(NN)**(1/2) = 130-GEV AU+AU COLLISIONS.
By PHENIX Collaboration (K. Adcox et al.). Jul 2003. 69pp.
Published in Phys.Rev.C69:024904,2004
e-Print Archive: nucl-ex/0307010

36) IDENTIFIED CHARGED PARTICLE SPECTRA AND YIELDS IN AU+AU COLLISIONS AT S(NN)**1/2 = 200-GEV.
By PHENIX Collaboration (S.S. Adler et al.). Jul 2003. 32pp.
Published in Phys.Rev.C69:034909,2004
e-Print Archive: nucl-ex/0307022

37) HIGH P(T) CHARGED HADRON SUPPRESSION IN AU + AU COLLISIONS AT S(NN)**1/2 = 200-GEV.
By PHENIX Collaboration (S.S. Adler et al.). Aug 2003. 22pp.
Published in Phys.Rev.C69:034910,2004
e-Print Archive: nucl-ex/0308006

38) MEASUREMENT OF NONRANDOM EVENT BY EVENT FLUCTUATIONS OF AVERAGE TRANSVERSE MOMENTUM IN S(NN)**(1/2) = 200-GEV AU+AU AND P+P COLLISIONS.
By PHENIX Collaboration (S.S. Adler et al.). Oct 2003. 6pp.
Published in Phys.Rev.Lett.93:092301,2004
e-Print Archive: nucl-ex/0310005

39) KAON PRODUCTION IN S(NN)**(1/2) = 200-GEV AU - AU COLLISIONS MEASURED WITH THE PHENIX EXPERIMENT AT RHIC.
By PHENIX Collaboration (M. Velkovsky for the collaboration). 2004.
Prepared for 7th International Conference on Strangeness in Quark Matter (SQM 2003), Atlantic Beach, North Carolina, 12-17 Mar 2003.
Published in J.Phys.G30:S187-S192,2004

**Publications on mathematical modeling of microbiodevices**

40) The Engineering Challenges of BioNEMS: The Integration of Microfluidics, Micro and Nanodevices, Models, and External Control for Systems Biology
John P. Wikswo Ales Prokop, Franz Baudenbacher, David Cliffel, Bela Csukas, and Momchil Velkovsky,
Published in IEE Proc. Nanobiotech.(2006)153:81-101

41) Modeling the measurements of cellular fluxes in microbioreactor devices using thin enzyme electrodes
Momchil Velkovsky, Rachel Snider, David E. Cliffel and John P. Wikswo
Published in J.Math.Chem.(2011)49:251-275

**Talks and Presentations**

Extracting Metabolic Fluxes from Measurements with a Multianalyte MicroPhysiometer, Poster at the Biophysical Society 49$^{th}$ Annual Meeting, Long Beach, California, February 12-16, 2005

Kaon production in Sqrt($s_{NN}$ ) = 200 GeV Au-Au collisions measured with the PHENIX experiment at RHIC, Program of 7th International Conference on Strangeness in Quark Matter, Atlantic Beach, North Carolina, March 12-17 2003

Reviving the Strong Coupling Expansion: Baryon Junctions and Other "Resonances" Presentation at workshop: "Baryon Dynamics at RHIC", BNL, March 28-30, 2002

Is the Gravitational Scale in Reach? A talk at the Joint APS/JPS Fall meeting, Hawaii, Oct.2001

Open Source Tools in PHENIX. Presentation at the CHEP2000 conference in Padua, Italy, February 2000.

Vacuum Energy in Large $N_f$ QCD and Instanton Molecules. Talk at the workshop "QCD at Finite Baryon Density",November 1998, Brookhaven National Laboratory, USA

Mean Field, Instantons and Finite Baryon Density.
Talk at the workshop "QCD at Finite Baryon Density"
April 1998, Bielefeld, Germany .
A seminar on the same topic was given at BNL in July 1998.

Does QCD know about iron? A seminar given at BNL in July 1997.

The Role Of The Instantons For The QCD Phase Transitions.
Talks given in January 1997 at BNL, February 1997 at LANL and March 1997 at the University of Maryland.

A Mean Field Approach To The Instanton Induced Effect Close To The QCD Phase Transition. 1996 Fall Meeting of the APS Division of Nuclear Physics, 2-5 October 1996, Cambridge, Massachusetts.
A talk on the same topic was given at the BNL-Columbia-Stony Brook meeting on April 28, 1996, Stony Brook, New York.

On The Instanton Induced Baryon Number Violation.
Division of Theoretical Physics, University of Sofia, June 1993, Sofia, Bulgaria