Curriculum Vitae – Sergey Postnikov

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E-mail: postsergey@gmail.com
Birth: March 06, 1982, Saint-Petersburg, Russia
Languages: Russian, English, Spanish, (French)

Education

- **2003 - 2010:** Ph.D. in Physics,
  Ohio University, USA;
  DISSIRTATION topic:
  TOPICS IN THE PHYSICS AND ASTROPHYSICS OF NEUTRON STARS:
  1) Thermal and transport properties of a non-relativistic quantum gas interacting through a delta-shell potential;
  2) Transport properties of a Yukawa fluid;
  3) Toward a model-independent equation of state of neutron star matter;
  4) Tidal Love numbers of neutron and self-bound quark stars.
  Successful oral defense on November 13, 2009.
  Degree conferred on March 20, 2010.
  http://etd.ohiolink.edu/view.cgi/Postnikov Sergey A.pdf?ohiou1259174094

- **1999 - 2003:** Bachelor degree in physics,
  Novosibirsk State University, Russia;
  DIPLOMA with **Honors**;
  Qualification thesis topic:
  NUMERICAL CALCULATION OF CHROMATISM FOR ACCELERATORS WITH STRONG TRNASVERSE COUPLING;
  Rating: Excellent

- **1997 - 1999:** Specialized Scientific Study at the Center for Physics, Mathematics, Chemistry and Biology Education of Novosibirsk State University (NSU), Russia

Academic Positions

- **2010 - 2015:** Postdoctoral Research position at the Instituto de Astronomía, Universidad Nacional Autonoma de México, México D.F., México
- **2005 - 2010** Research Assistant at the Department of Physics and Astronomy, Ohio University, Athens, Ohio, USA

Teaching Positions

- **2011 - 2013:** Teacher of experimental on-line special course for high school in Russian, Specialized School of Nogliki city, 10 Sovetskaya str., Nogliki, Sakhalin island, Russia
  http://astrokurs.ucoz.ru/
- **2003 - 2005:** Teaching Assistant at the Department of Physics and Astronomy, Ohio University, Athens, Ohio, USA
  taught physics labs and done grading

Honors and Awards

1. **2003: Special Budker Scholarship** awarded jointly by the Novosibirsk State University and the Budker Institute of Nuclear Physics
2. **2002: Third Prize Diploma** at the 8th All-Russian Scientific Conference for the best presentations;
   Title of presentation: *Spectral Distribution Analysis of Radiation Emanated by a Glow Discharge in Helium*
3. **2001: Second Prize Diploma** at the Student Conference of Scientific Research Term Papers;
   Title of presentation: *Spectral Distribution Analysis of Radiation Emanated by a Glow Discharge in Helium*
4. **2001: First prize Diploma** at the Student Conference of Scientific Research Term Papers on Molecular Physics;
   Title of presentation: *Analysis of Scattering of a Positive Ions Beam in Rarefied Gas*
5. **1999: Laudatory Diploma** from the Specialized Scientific Study Center of NSU for outstanding achievements in studying math and physics
6. **1999: Diploma** in the 37th National Student Scientific Conference, school section;
   Title of presentation: *Brachistochrone and its properties*
7. **1999: Diploma** in the 37th National Student Scientific Conference, School section;
   Title of presentation: *Determining Cocoa Butter and its Substitutes in Chocolate by the Method of Chromatography-Mass Spectrometry*

8. **1997: Second Prize Diploma** in All-Siberian School Chemistry Competition.

9. **1997: First Prize Diploma** in the Chemistry Olympiad for Physics, Mathematics and Chemistry competition among the schools of the eastern zone of Russia.

Publications

1. *Nonparametric Study of the Evolution of the Cosmological Equation of State with SNeIa, BAO, and High-redshift GRBs*,
S. Postnikov, M. G. Dainotti, X. Hernandez and S. Capozziello
The Astrophysical Journal **783**, 126 (2014).
arXiv:1401.2939 [astro-ph.CO]

2. *Thermal and transport properties of a non-relativistic quantum gas interacting through a delta-shell potential*,
S. Postnikov and M. Prakash
International Journal of Modern Physics E **22**, 1330023 (2013).
arXiv:1307.5439 [nucl-th]

3. *Transport Properties of a Non-Relativistic Delta-Shell Gas with Long Scattering Lengths*,
S. Postnikov and M. Prakash;
From Nuclei to Stars, Festschrift in Honor of Gerald E. Brown (ed. Sabine Lee), World Scientific Publishing, Singapore, 367-378 (2011).

4. *Tidal Love numbers of neutron and self-bound quark stars*,
S. Postnikov, M. Prakash and J. M. Lattimer
Phys. Rev. D **82**, 024016 (2010).
arXiv:1004.5098v1 [astro-ph.SR]

5. *Shear viscosity of the outer crust of neutron stars: ion contribution*,
O. L. Caballero, **S. Postnikov**, C. J. Horowitz and M. Prakash,
Phys. Rev. C **78**, 045805 (2008).
arXiv:0807.4353v2 [astro-ph]

6. *The Pervasive Role of the Nuclear Symmetry Energy in the Structure and Evolution of Neutron Stars*,
M. Prakash, James Lattimer, **Sergey Postnikov** and Andrew Steiner,
Proceedings of Science (2008).
PoS(NIC X)065

7. *The unprecedented optical outburst of the quasar 3C 454.3*,
M. Villata, C. M. Raiteri, ..., **S. Postnikov**,... (88 authors of WEBT Collaboration),
Astronomy & Astrophysics **453**, 817-822 (2006).

8. *Neutrino emission in the hadronic synchrotron mirror model: The Orphan TeV flare from 1ES 1959+650*,
A. Reimer, M. Böttcher, and **S. Postnikov**,
Astrophysical Journal, **630**, 186 (2005).
arXiv:astro-ph/0505233v2

9. *Hadronic Synchrotron Mirror Model for Orphan TeV Flares in Blazars*,
M. Böttcher, and **S. Postnikov**,
Bulletin of the American Astronomical Society, **36**, 1203 (2004).

Papers in Preparation

1. *Toward a model independent equation of state for neutron star matter*
S. Postnikov, A. Steiner, M. Prakash and J. M. Lattimer
(For the Astrophysical Journal)

2. *Evaporation from surfaces of newly born strange quark matter stars and in binary mergers*
S. Postnikov and D. Page
(For the Astrophysical Journal)

Abstracts of Published and On-going Work

- *Tidal Love numbers of neutron and self-bound quark stars*,
S. Postnikov, M. Prakash and J. M. Lattimer
Phys. Rev. D **82**, 024016 (2010).
arXiv:1004.5098v1 [astro-ph.SR]

Abstract

Gravitational waves from the final stages of inspiraling binary neutron stars are expected to be one of the most important sources for ground-based gravitational wave detectors. The masses of the components are determinable from the orbital and chirp frequencies during the early part of the evolution, and large finite-size (tidal) effects are measurable toward the end of inspiral, but the gravitational wave signal is expected to be very complex at this time. Tidal effects during the early part of the evolution will form a very small correction, but during this phase the signal is relatively clean. The accumulated phase shift due to tidal corrections is characterized by a single quantity related to a stars tidal Love number. The Love number is sensitive, in particular, to the compactness parameter M/R and the stars internal structure, and its determination could provide an important constraint to the neutron star radius. We show that Love numbers of self-bound strange quark matter stars are qualitatively different from those of normal neutron

stars. Observations of the tidal signature from coalescing compact binaries could therefore provide an important, and possibly unique, way to distinguish self-bound strange quark stars from normal neutron stars. Tidal signatures from self-bound strange quark stars with masses smaller than $1M_\odot$ are substantially smaller than those of normal stars owing to their smaller radii. Thus tidal signatures of stars less massive than $1M_\odot$ are probably not detectable with Advanced LIGO. For stars with masses in the range $12M_\odot$, the anticipated efficiency of the proposed Einstein telescope would be required for the detection of tidal signatures.

- *Shear viscosity of the outer crust of neutron stars: ion contribution*,
  O. L. Caballero, **S. Postnikov**, C. J. Horowitz and M. Prakash,
  Phys. Rev. C **78**, 045805 (2008).
  arXiv:0807.4353v2 [astro-ph]

Abstract

The shear viscosity of the crust might have a damping effect on the amplitude of r-modes of rotating neutron stars. This damping has implications for the emission of gravitational waves. We calculate the contribution to the shear viscosity coming from the ions using both semianalytical methods that consider binary collisions and molecular dynamics simulations. We compare these results with the contribution coming from electrons. We study how the shear viscosity depends on density for conditions of interest in neutron star envelopes and outer crusts. In the low-density limit, we find good agreement between results of our molecular dynamics simulations and those of classical semianalytic calculations.

- *The Pervasive Role of the Nuclear Symmetry Energy in the Structure and Evolution of Neutron Stars*,
  M. Prakash, James Lattimer, **Sergey Postnikov** and Andrew Steiner,
  Proceedings of Science (2008).
  PoS(NIC X)065

Abstract

The multifaceted role of the density dependent nuclear symmetry energy in the nuclear astrophysics involving neutron stars is highlighted. Efforts toward a model independent determination of the dense matter equation state through a deconstruction of the neutron star structure equation utilizing the masses and radii of several individual neutron stars are described. The need for observational data of both measurements for the same star is stressed.

- *Neutrino emission in the hadronic synchrotron mirror model: The Orphan TeV flare from 1ES 1959+650*,
  A. Reimer, M. Böttcher, and **S. Postnikov**,
  Astrophysical Journal, **630**, 186 (2005).
  arXiv:astro-ph/0505233v2

Abstract

A challenge to standard leptonic synchrotron self-Compton (SSC) models is the so-called orphan TeV flares, i.e., enhanced very high energy (VHE) γ-ray emission without any contemporaneous X-ray flaring activity, that have recently been observed in TeV blazars (e.g., 1ES 1959+650). In order to explain the orphan TeV flare of 1ES 1959+650 observed in 2002 June, the so-called hadronic synchrotron mirror model has been developed. Here relativistic protons are proposed to exist in the jet and interact with reflected electron synchrotron radiation of the precursor SSC flare. If the reflector is located in the cloud region, time shifts of several days are possible between the precursor and the orphan flare. The external photons, blueshifted in the comoving jet frame, are able to excite the $\Delta(1232)$ resonance when interacting with protons of Lorentz factors γ'_p 103-104. The decay products of this resonance include charged pions, which, on decay, give rise to neutrino production during the orphan flare. In this paper we calculate the expected neutrino emission for the 2002 June 4 orphan TeV flare of 1ES 1959+650. We compare our results with the recent observations of AMANDA-II of a neutrino event in spatial and temporal coincidence with the orphan flare of this blazar. We find that the expected neutrino signal from the hadronic synchrotron mirror model is insufficient to explain the claimed neutrino signal from the direction of 1ES 1959+650.

- *The unprecedented optical outburst of the quasar 3C 454.3*,
  M. Villata, C. M. Raiteri, ..., **S. Postnikov**,... (88 authors of WEBT Collaboration), Astronomy & Astrophysics **453**, 817-822 (2006).

Abstract

Context. The radio quasar 3C 454.3 underwent an exceptional optical outburst lasting more than 1 year and culminating in spring 2005. The maximum brightness detected was $R = 12.0$, which represents the most luminous quasar state thus far observed ($M_B \approx -31.4$).
Aims. In order to follow the emission behavior of the source in detail, a large multiwavelength campaign was organized by the Whole Earth Blazar Telescope (WEBT).
Methods. Continuous optical, near-IR and radio monitoring was performed in several bands. ToO pointings by the Chandra and INTEGRAL satellites provided additional information at high energies in May 2005. Results.The historical radio and optical light curves show different behaviors. Until about 2001.0 only moderate variability was present in the optical regime, while prominent and long-lasting radio outbursts were visible at the various radio frequencies, with higher-frequency variations preceding the lower-frequency ones. After that date, the optical activity increased and the radio flux is less variable. This suggests that the optical and radio emissions come from two separate and misaligned jet regions, with the inner optical one acquiring a smaller viewing angle during the 2004-2005 outburst. Moreover, the color-index behavior (generally redder-when-brighter) during the outburst suggests the presence of a luminous accretion disc. A huge mm outburst followed the optical one, peaking in June-July 2005. The high-frequency (37-43 GHz) radio flux started to increase in early 2005 and reached a maximum at the end of our observing period (end of September 2005). VLBA observations at 43

GHz during the summer confirm the brightening of the radio core and show an increasing polarization. An exceptionally bright X-ray state was detected in May 2005, corresponding to the rising mm flux and suggesting an inverse-Compton nature of the hard X-ray spectrum.
*Conclusions.*A further multifrequency monitoring effort is needed to follow the next phases of this unprecedented event.

- *Hadronic Synchrotron Mirror Model for Orphan TeV Flares in Blazars*,
M. Böttcher, and **S. Postnikov**,
Bulletin of the American Astronomical Society, **36**, 1203 (2004).

Abstract

Very-high-energy gamma-ray flares of TeV blazars are generally accompanied by simultaneous flaring activity in X-rays. The recent observations by the Whipple collaboration of an "orphan" TeV flare of 1ES 1959+650 (without simultaneous X-ray flare) is very hard to reconcile with standard leptonic SSC model routinely and usually very successfully employed to explain the SED and spectral variability of TeV blazars. In this paper, we suggest an alternative scenario in which the "orphan" TeV flare may originate from relativistic protons, interacting with an external photon field supplied by electron-synchrotron radiation reflected off a dilute "synchrotron mirror" located at a few pc from the central black hole. While the external photons will be virtually "invisible" to the co-moving ultrarelativistic electrons in the jet due to Klein-Nishina effects, their Doppler boosted energy is high enough to excite the Delta resonance from relativistic protons with Lorentz factors of 10^3 - 10^4. This model is capable of explaining the "orphan" TeV flare of 1ES 1959+650 with plausible parameters, thus constraining the number and characteristic energy of relativistic protons in the jet of this blazar.

- *Transport properties of a non-relativistic delta-shell gas with long scattering lengths*,
S. Postnikov and M. Prakash;
To appear in Festschrift for Gerry Brown, ed. Sabine Lee (World Scientific, Singapore).

Abstract

The coefficients of diffusion, thermal conductivity, and shear viscosity are calculated for a system of non-relativistic particles interacting via a delta-shell potential $V(r) = -v\,\delta(r - R)$ when the average distance between particles is smaller than R. The roles of resonances and long scattering lengths including the unitary limit are examined. Results for ratios of diffusion to viscosity and viscosity to entropy density are presented for varying scattering lengths.

- *Thermal and transport properties of a non-relativistic quantum gas interacting through a delta-shell potential*
S. Postnikov and M. Prakash,
International Journal of Modern Physics E

Abstract

This work extends the seminal work of Gottfried on the two-body quantum physics of particles interacting through a delta-shell potential to many-body physics by studying a system of non-relativistic particles when the thermal De-Broglie wavelength of a particle is smaller than the range of the potential and the density is such that average distance between particles is smaller than the range. The ability of the delta-shell potential to reproduce some basic properties of the deuteron are examined. Relations for moments of bound states are derived. The virial expansion is used to calculate the first quantum correction to the ideal gas pressure in the form of the second virial coefficient. Additionally, all thermodynamic functions are calculated up to the first order quantum corrections. For small departures from equilibrium, the net flows of mass, energy and momentum, characterized by the coefficients of diffusion, thermal conductivity and shear viscosity, respectively, are calculated. Properties of the gas are examined for various values of physical parameters including the case of infinite scattering length when the unitary limit is achieved.

- *Toward a model independent equation of state for neutron star matter*
  S. Postnikov, A. Steiner, M. Prakash and J. M. Lattimer
  (To be submitted soon)

Abstract

We develop a theoretical approach to reconstruct the equation of state (EOS) that can incorporate the inherent observational errors in the data (masses and radii) of individual neutron stars. A Bayesian analysis is used to constrain the EOS. If the errors are large, the reconstructed EOS would lie in a band in the pressure-energy density plane. With more observed stars and progressively smaller errors, a unique, curve could be obtained. In our analysis, we take advantage of the behavior of the squared adiabatic speed of sound. An easy to use software tool kit is also being prepared.

- *Evaporation from newly born strange quark matter stars and in binary mergers*
  S. Postnikov and D. Page
  (To be submitted soon)

Abstract

We consider the effects of hadron evaporation at the surface of a hot strange quark matter star. This process results in the rapid production of a cloud of nucleons (and leptons from mesons decay), whose size strongly depends on microphysical details of the evaporation. The intensity of the evaporating flux affects the flavor content of the surface and creates a feedback on the flux. It also affects the electrosphere and therefore proton reabsorbtion. This process has important consequences for possible formation of an atmosphere, and a wind, during the birth of a strange star. Observationally this scenario is very distinct from the bare strange star case. Moreover, in a binary merger involving a strange star,

the hot quark matter lost by the strange star is likely to evaporate into baryons. This will affect the equation of state at the moment of merging and ejection of strangelets/baryons from tidal tails.

Seminar talks

- **2014, September 26:** Seminar talk, NTC-CEEM, Indiana University, Bloomington, IN, USA:
  Sky3D4P grid based simulations of quantum nuclear pasta

- **2014, August 29:** Seminar talk, NTC-CEEM, Indiana University, Bloomington, IN, USA:
  A liaison between Neutron Star observations and Nuclear Matter

- **2014, January 31:** Seminar talk, Department of Physics, McGill University, Montreal, Quebec, Canada:
  Evolution of the cosmological equation of state with SNeIa, BAO and high redshift GRBs

- **2013, November 7:** Seminar talk, Department of Physics, Washington University in St. Louis, MO, USA:
  Non-parametric study of cosmological equation of state using SN-Ia, BAO and high redshift GRBs

- **2013, October 10:** Seminar talk, Department of Astronomy, Boston University, Boston MA, USA:
  Non-parametric evolution study of cosmological equation of state with SNeIa, BAO and GRBs

- **2013, July 17:** Seminar talk, Department of Physics and Astronomy, Ohio University, Athens OH, USA:
  Study of Dark Energy equation of state using SN-Ia, BAO and empirical tight GRB correlation

- **2013, February 25:** Seminar talk at DAEC, Instituto de Astronomía, UNAM, México D.F., México:
  Study of Dark Energy equation and tight GRB correlation

- **2012, October 11:** Seminar talk at NTC, CEEM, Indiana University, IN, USA:
  Study of the change of the dark energy equation of state in the light of GRBs

- **2012, March 01:** Seminar talk at DAEC, Instituto de Astronomía, UNAM, México D.F., México:
  Sequential Bayesian analysis and dependence of cosmological equation of state on redshift

- **2011, February 24:** Seminar talk, Instituto de Ciencias Nucleares, UNAM, México D.F., México:
  Maximally model independent equation of state for neutron star matter

- **2010, November 22:** Seminar talk (JINA visitor), MSU, East Lansing, MI, USA:
  TOWARD A MODEL INDEPENDENT EQUATION OF STATE FOR NEUTRON STAR MATTER

- **2010, August 11:** Colloquium talk, Instituto de Astronomía, UNAM, México D.F., México:
  Tidal Love numbers of neutron and self-bound quark stars

- **2009, February 19:** Theory Group at Physics Division, Argonne National Labolatory, Argonne, Illiois, USA:
  The Equation of State of Neutron Star Matter from Observational Masses and Radii through the Inversion of TOV Equations

- **2009, January 8-11:** The Institute for Nuclear Theory at the University of Washington, Seattle, WA, USA:
  The Equation of State of Neutron Star Matter from Observational Masses and Radii through the Inversion of the TOV Equations

Conferences and Workshops

- **2014, June 16-19:** NUCLEI SciDAC collaboration meeting, Santa Fe, NM, USA:
  Density Functional quantum Pasta Calculations. Grid based MADNESS & Sky3D4P.

- **2013, September 6-7:** 26th Midwest Theory Get-Together, Argonne National Laboratory, Chicago, IL, USA:
  Modeling nuclear pasta with EDF and overlapping spheres

- **2011, July 16- August 5:** Seminar talk at INT Program 11-2b: *Astrophysical Transients: Multi-messenger Probes of Nuclear Physics*, INT, Seattle, WA, USA:
  Maximally model independent equation of state for neutron star matter

- **2011, July 11-15:** Talk at Conference: *Physics of Neutron Stars - 2011*, Saint-Petersburg, Russia:
  Maximally model independent equation of state for neutron star matter

- **2011, March 24-25:** XIX Reunión Anual de la División de Gravitación y Física Matemática, SMF, IPN and CINVESTAV-IPN, México D.F., México

- **2010, November 8-12:** XIII Latin American Regional IAU Meeting, Morelia, Michoacán, México

- **2009, May 18-21:** Poster at Workshop: *Defining the Neutron Star Crust(CRUST09): X-ray Bursts, Superbursts and Giant Flares*, Santa Fe, New Mexico, USA:
  Love number of a Neutron Star

- **2009, May 18-21:** Poster at Workshop: *Defining the Neutron Star Crust(CRUST09): X-ray Bursts, Superbursts and Giant Flares*, Santa Fe, New Mexico, USA:
  Love number of a Neutron Star

- **2009, May 14:** Poster at the 2009 Engage & Explore Student Research and Creative Activity Fair, Ohio University, OH, USA:
  Love number of a Neutron Star

- **2008, October 19-23:** Contributed talk at the Annual Fall Meeting of the Division of Nuclear Physics, American Physical Society, Oakland, CA, USA:
  Transport properties of nucleons

- **2008, August 17-19:** Poster at the Lead Radius Experiment (PREX) Workshop and Neutron Rich Matter in the Heavens and on Earth, Thomas Jefferson National Accelerator Facility, Newport News, VA, USA:
  Shear viscosity of the outer crust of neutron stars: ion contribution

- **2007, November 27:** Seminar at the Ioffe Physico-Technical Institute, Saint-Petersburg, Russia:
  Transport properties of a non-relativistic quantum gas interacting through a delta-shell potential

- **2007, June 25-29:** Talk at workshop on "The Neutron Star Crust and Surface", Institute for Nuclear Theory, University of Washington, Seattle, WA, USA:
  Transport properties of a non-relativistic dilute Yukawa liquid

- **2006, July 23 - August 5:** Talk at the 18th National Nuclear Physics Summer School, Indiana University, Bloomington, IN, USA:
  The second virial coefficient and transport properties of a non-relativistic gas of particles interacting via a delta-shell potential

- **2006, May 16:** Poster at the 2006 Engage & Explore Student Research and Creative Activity Fair, Ohio University, OH, USA:
  The second virial coefficient of a non-relativistic gas of particles interacting via a delta-shell potential

- **2005, October 7-8:** 18th Annual Midwest Nuclear Theory Get-Together, Argonne National Laboratory, Chicago, IL, USA:
  Hadronic Synchrotron Mirror Model for "orphan" TeV flares in blazers

- **2004:** Work presented by M. Böttcher at the 8th HEAD Meeting, New Orleans, LA, USA:
  Hadronic synchrotron mirror model for the "orphan" TeV flare of 1ES 1959+650
  BAAS, **Vol. 36**, no. 4, 38.03

- **2001:** *The studying of scattering of ions on molecules of rarefied gas*,
  S. Postnikov, S. Suslov, A. Zolkin

The 7th all-Russian scientific conference of physics students and young scientists, page 337 (2001)

- **2001:** *The studying of scattering of ions on molecules of rarefied gas*,
  S. Postnikov, S. Suslov, A. Zolkin
  Materials of the XXXIX international scientific student conference, page 16 (2001)

- **2003 - 2005:**
  7 presentations at the Astrophysical Institute Seminars at Ohio University, Athens, OH ,USA

- **2005 - 2008:**
  6 presentations at the Institute of Nuclear & Particle Physics Seminars at Ohio University, Athens, OH ,USA

- **2005 - 2008:**
  3 posters presented in the Open House annual events of the Institute of Nuclear & Particle Physics, Ohio University, Athens, OH ,USA

Astronomical Observations at the Kitt Peak National Observatory, AZ, USA

1. **2007, March 5th - March 9th**
   Monitoring the optical flux activity of AGN's,
   with graduate student M. Joshi
   MDM 1.3 m telescope

2. **2005, June 25th - July 1st**
   Monitoring the optical flux activity of AGN's,
   with Prof. M. Böttcher
   MDM 1.3 m telescope

Astronomical Observations with Great Ohio Telescope, OH, USA

1. **2006, April 28th**
   Period-Color Distance Estimation from the Eclipsing Contact Binary CC Com,
   0.25 m Great Ohio Telescope
   http://www.phy.ohiou.edu/~tss/ASTR410/Postnikov06/postnik.htm

Courses of programming taken

1. **2008, February 5-6**
   Parallel Programming with MPI,
   Science and Technology Support
   Ohio Supercomputer Center
   Columbus, OH 43212
   USA

2. **2011, January 24-28**
   Programming of GPUs (Programación de GPUs),
   Instituto de Ciencias Físicas
   UAEM
   Cuernavaca, Morelos 62251
   México

References

1. Prof. M. Prakash (Dissertation Advisor)
   Department of Physics and Astronomy
   Ohio University, Athens, Ohio 45701, USA
   Phone/Fax: (740) 593-1716 / (740) 593-0433
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2. Prof. Dany Page
   Instituto de Astronomía
   Universidad Nacional Autonoma de México, México D.F, 04510
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3. Prof. M. Böttcher
   Department of Physics and Astronomy
   Ohio University, Athens, Ohio 45701, USA
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4. Prof. D. Phillips
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   Ohio University, Athens, Ohio 45701, USA
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5. Prof. J. Lattimer
   Department of Physics and Astronomy
   State University of New York at Stony Brook, Stony Brook, NY 11794-3800, USA
   Phone/Fax: (631) 632-8227 / (631) 632-1745
   e-mail: lattimer@astro.sunysb.edu

Overview of Research Interests

Nuclear Astrophysics:

Equation of state of stellar (supernova, neutron star & white dwarf) matter
Neutron stars: composition, structure and evolution
Rotational properties
Inferences from experimental & observational constraints
Neutrino signals from stars, supernovae and AGN's
X-ray and gamma-ray bursters
Binary star mergers – Gravity wave detections

Strong Interaction Physics:

Many–body theories for hadronic matter
Strange quark matter
(Cold and hot dense matter)
Transport properties
(Bulk & shear viscosities, thermal conductivity, diffusion, etc.)
Superfluidity in dense matter

Nuclear Theory:

Fundamental symmetries
Symmetry energy
Effective field theories
Density functional approach to nuclear properties
Nuclei far off stability

Cosmology:

Nature of dark matter and dark energy
Structure of the universe
Galaxy and cluster formation, and their evolution
Theories of gravity – AdS CFT, f(R), MOND

Research Statement

The research projects that I undertook toward my Ph.D. degree, and the experience I acquired during my postdoctoral position at IA-UNAM, have taught me the interplay between microphysical ingredients and macrophysical phenomena. Examples include the role of the dense matter equation of state in the structure of neutron stars, and the influence of transport properties (viscosities and thermal conductivity) of the surface layers of a neutron star during its thermal evolution. Also, the evaporation of hot strange matter after its formation and in binary mergers have fascinated me. During the course of these works, a few hitherto unsolved projects have emerged. A few future projects that I wish to pursue are highlighted below.

1. The techniques that I have developed to invert the general relativistic structure equations to yield a model independent equation of state (EOS) of neutron star matter will be extended to include data from nuclear physics experiments. I am developing a software tool-kit that astronomers can easily use to establish the equation of state of neutron star matter as more data become available.

   From the nuclear experimental side, once the symmetry energy as a function of neutron-proton asymmetry is established, constraints on the equation of state of neutron star matter at moderate densities (near saturation density) can be easily incorporated. The software kit I am developing will incorporate constraints from all available nuclear data.

   I was recently alerted to the fact that my scheme can also be applied to reconstruct the EOS $w(z)$ (adiabatic parameter as a function of the redshift) of Dark Energy from observational cosmology (SNe Ia, GRBs, ...). Work on this front is in progress.

2. I would like to investigate the transport properties of the inhomogeneous phases encountered in low-density neutron matter exhibiting pasta-like phases. I wish to establish possible anisotropic features due to the complex liquid-crystal-like properties of the pasta phase using a semi-analyical analysis. Results from these methods can then be compared with those from molecular dynamical simulations that use the Green-Kubo formalism.

3. Microphysics of evaporation from hot strange quark matter: Besides simplistic formula involving the separation energy and the flux-tube fission model, there is no other detailed model of hadrons evaporating from the surface of a self-bound strange quark matter star. These models give vastly different rates, which stems from the high sensitivity to the inferred separation energy. The intensity of the evaporating flux affects the flavor content of the surface and creates a feedback on the flux. It also affects the electrosphere and therefore proton reabsorpsion. I wish to develop consistent microscopic dynamical model of hadron evaporation within the context of the MIT bag model.

4. Recently, I have become interested in cosmological issues concerning the nature of dark matter and dark energy. Other topics that fascinate me include the structure of the universe, galaxy and cluster formation, and their subsequent evolution.

Although I have some expertise in numerical work, I would like to extend my capabilities to large-scale numerical calculations through the use of super-computers. I firmly believe that my broad interest and training in theoretical physics will aid me in forming productive collaborations on forefront topics in nuclear physics and nuclear astrophysics. I also wish to utilize the training I have received in astronomical observations to identify theoretical projects in which predictions can be compared with data.

I enjoy teaching physics. I will be glad to assist or teach graduate and undergraduate courses. I have been a "Teaching Assistant" and look forward to an opportunity to gain more teaching experience.