Curriculum Vitae

Muslema Pervin

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Education:

- Florida State University, Tallahassee, Florida, USA, 2000-2005
  Ph. D. in Physics, Summer 2005
  Major Professors: Dr. Simon Capstick, Dr. Winston Roberts
  Thesis title: "Semileptonic Decay of Heavy Baryons in a Constituent Quark Model"
- Southern Illinois University, Carbondale, Illinois, USA, 1999-2000
  In M. S. program. Transferred to Florida State University
- University of Dhaka, Dhaka, Bangladesh, 1992-1993 (Academic Year)
  M. Sc. in Physics, 1997
  Thesis supervisor: Professor L. M. Nath
  Thesis title: "CP Violation in Neutral Kaon Decays and the Standard Model"
- University of Dhaka, Dhaka, Bangladesh, 1989-1992 (Academic Year)
  B. Sc. with Honors in Physics, 1994

Honors and Prizes

- National University Grants Commission (UGC), Bangladesh Fellowship, 1998-1999

  The UGC fellowships are awarded every year on a nationwide competitive basis for doing graduate level research with a professor working in a publicly funded university in Bangladesh. The competition is based on academic results and the quality of the submitted research proposal. Only 2-4 fellowships per year distributed over all Physics disciplines.
- Dhaka University Honors Scholarship, Bangladesh, 1992-1993

  The scholarship is given to the top few students who achieve a first class Honors B. Sc. degree. In my year it was awarded to the top 10% of all Honors students in physics.

Employment Experience:

- Postdoctoral Research Fellow:
  Physics Division, Argonne National Laboratory, Illinois
  2006-Present
  Nuclear Structure and Reactions: Electroweak transitions in light nuclei.
  Hadronic Physics: Spectra of strange baryons and multi-heavy baryons.

- Research Fellow:
  University Grants Commission, Dhaka, Bangladesh
  1998-1999
  Nuclear Structure: Two-pion exchange three-nucleon potential.

Graduate Research Experience:

- Research Assistant:
  Department of Physics, Florida State University, Tallahassee, Florida
  2002-2005
  Hadronic Physics: Semileptonic decay of baryons in a quark model.

- Research Assistant:
  Department of Physics, Southern Illinois University, Carbondale, Illinois
  Summer, 2000
  Nuclear Physics.

- M. Sc. Research:
  Physics Department, University of Dhaka, Dhaka, Bangladesh
  1995-1997
  Particle Physics: CP violation in neutral K and B meson systems within the Standard Model of electroweak interaction.

Teaching Experience

- Adjunct Professor;
  Department of Physics, Florida State University, Tallahassee, Florida
  Fall, 2005

- Teaching Assistant:
  Department of Physics, Florida State University, Tallahassee, Florida
  2000-2001

- Teaching Assistant:
  Department of Physics, Southern Illinois University, Carbondale, Illinois
  1999-2000

Publications in Refereed Journals

[1] M. Pervin, W. Roberts, *Strangeness -2 and -3 Baryons in a Constituent Quark Model*,Phys. Rev. C77,025202 (2008), ArXiv:0709.4000.
Cited 1 time.

[2] M. Pervin, S. C. Pieper, R. B. Wiringa, *Quantum Monte Carlo Calculations of Electroweak Transition Matrix Elements in $A = 6, 7$ Nuclei*, Phys. Rev. C76, 064319 (2007), ArXiv:0710.1265.
Cited 1 time.

[3] M. Pervin, W. Roberts and S. Capstick, *Semileptonic Decays of Heavy Omega Baryons in a Quark Model*, Phys. Rev. C74, 025205 (2006).
Cited 2 times.

[4] M. Pervin, W. Roberts and S. Capstick, *Semileptonic Decays of Heavy Lambda Baryons in a Quark Model*, Phys. Rev. C72, 035201 (2005).
Cited 6 times.

[5] K. Kabir, T. K. Dutta, M. Pervin, L. M. Nath, *The Role of $\Delta(1232)$ in Two-pion Exchange Three-nucleon Potential*, Int. J. Mod. Phys. E9, 157 (2000).
Cited 2 times.

[6] M. Pervin, N. Ahsan, K. Kabir, L. M. Nath, *Standard Model and CP Violations in Neutral K- and B-meson Systems*, J. Phys. G24, 1693 (1998).
Cited 1 time.

Proceedings Publications, Refereed

[1] M. Pervin, W. Roberts and S. Capstick, *Baryon Spectra and Semileptonic Decay in a Constituent Quark Model*, J. Phys. Conf. Ser. 69:012040, 2007, http://www.iop.org/EJ/toc/1742-6596/69/1.

Paper Submitted

[1] W. Roberts, M. Pervin, *Heavy Baryons in a Quark Model*, ArXiv:0711.2492, submitted to Int. J. Mod. Phys. A.

[2] W. Roberts, M. Pervin, *Hyperfine Mixing and the Semileptonic Decays of Double-Heavy Baryons in a Quark Model*, ArXiv:0803.3350, submitted to Int. J. Mod. Phys. A.

Citations of Paper

[1] Quantum Monte Carlo calculations of light nuclei.
Steven C. Pieper (Argonne, PHY) . Nov 2007. 35pp.
Lecture notes for International School of Physics 'Enrico Fermi': Course 169: Nuclear Structure far from Stability: New Physics and New Technology, Varenna, Italy, 17-27 Jul 2007, e-Print: arXiv:0711.1500 [nucl-th] http://www.slac.stanford.edu/spires/find/

[2] Heavy baryons in a quark model.
W. Roberts (Florida State U.) , Muslema Pervin (Argonne, PHY) . JLAB-THY-07-751, Nov 2007.
e-Print: arXiv:0711.2492 [nucl-th]
http://www.slac.stanford.edu/spires/find/hep?c=PHRVA,C77,025202

[3] Heavy baryons in a quark model.
W. Roberts (Florida State U.) , Muslema Pervin (Argonne, PHY) . JLAB-THY-07-751, Nov 2007, e-Print: arXiv:0711.2492 [nucl-th]

[4] Strangeness -2 and -3 baryons in a constituent quark model.
Muslema Pervin (Argonne, PHY) , Winston Roberts (Florida State U.) . JLAB-THY-07-728, Sep 2007.
Published in Phys.Rev.C77:025202,2008, e-Print: arXiv:0709.4000 [nucl-th]
http://www.slac.stanford.edu/spires/find/hep?c=PHRVA,C72,035201

[5] Measurement of Ratios of Fragmentation Fractions for Bottom Hadrons in p anti-p Collisions at s**(1/2) = 1.96-TeV.
By CDF Collaboration (T. Aaltonen et al.) FERMILAB-PUB-08-021-E, Jan 2008.
Long author list - awaiting processing.
e-Print: arXiv:0801.4375 [hep-ex]

[6] Heavy baryons in a quark model.
W. Roberts (Florida State U.) , Muslema Pervin (Argonne, PHY) . JLAB-THY-07-751, Nov 2007.
e-Print: arXiv:0711.2492 [nucl-th]

[7] Diquarks and Lambda(b) —¿ Lambda(c) weak decays.
Hong-Wei Ke, Xue-Qian Li, Zheng-Tao Wei (Nankai U.) . Oct 2007. 23pp.
Published in Phys.Rev.D77:014020,2008, e-Print: arXiv:0710.1927 [hep-ph]

[8] Strangeness -2 and -3 baryons in a constituent quark model.
Muslema Pervin (Argonne, PHY) , Winston Roberts (Florida State U.) . JLAB-THY-07-728, Sep 2007.
Published in Phys.Rev.C77:025202,2008, e-Print: arXiv:0709.4000 [nucl-th]

[9] Measurement of the Relative Fragmentation Fractions of anti-B Hadrons.
Karen Ruth Gibson (Carnegie Mellon U.) . UMI-32-28001, FERMILAB-THESIS-2006-09, Jun 2006.
Ph.D. Thesis. Ph.D. Thesis (Advisor: Manfred Paulini).

[10] Semileptonic decays of heavy omega baryons in a quark model.
Muslema Pervin (Florida State U. and Argonne, PHY) , W. Roberts (Florida State U. and Old Dominion U. and Jefferson Lab and Dept. of Energy, Div. Nucl. Phys.) , S. Capstick (Florida State U.) . JLAB-THY-06-480, Mar 2006.
Published in Phys.Rev.C74:025205,2006, e-Print: nucl-th/0603061
http://www.slac.stanford.edu/spires/find/hep?c=PHRVA,C72,035201

[11] The Nambu-Jona-Lasinio model of light nuclei
A.N. Ivanov, H. Oberhummer, N.I. Troitskaya, M. Faber (Vienna, Tech. U.) . Jun 2000.
Published in Eur.Phys.J.A7:519-535,2000, e-Print: nucl-th/0006049

[12] On the Delta-Delta component of the deuteron in the Nambu-Jona-Lasinio model of light nuclei
A. N. Ivanov, H. Oberhummer, N. I. Troitskaya and M. Faber
Published in Eur.Phys.J.A8:129-134,2000, e-Print: nucl-th/0006050

[13] On the Delta-Delta component of the deuteron in the relativistic field theory model of the deuteron
A.N. Ivanov, H. Oberhummer, N.I. Troitskaya, M. Faber (Vienna, Tech. U.) . Dec 1999, e-Print: nucl-th/9912032

[14] Neutron-proton radiative capture, photo-magnetic and anti-neutrino disintegration of the deuteron in the relativistic field theory model of the deuteron
A.N. Ivanov, H. Oberhummer, N.I. Troitskaya, M. Faber (Vienna, Tech. U.) . Aug 1999, e-Print: nucl-th/9908080

[15] Quark mass matrices and observable quantities.
D. Falcone (Naples U.) . DSF-T-99-14, May 1999.
Published in Mod.Phys.Lett.A14:1989-2001,1999, e-Print: hep-ph/9905316

Seminars

[1] *Quantum Monte Carlo Calculations of Electroweak Transitions in Light Nuclei*,
January 31, 2008, Nuclear Theory seminar at Argonne National Laboratory.

[2] *Electroweak transitions in light nuclei and in hadrons*,
January 31, 2007, Theory Group Seminars, Jefferson Lab, VA.

[3] *Electroweak transitions in light nuclei and in hadrons*,
January 26, 2007, Friday Theory Seminar at the NSCL, MSU.

[4] *Some Aspects of Semileptonic Decay of Baryons in a Quark Model*,
March 3, 2005, Nuclear Physics seminar at Indiana University.

[5] *Some Aspects of Semileptonic Decay of Baryons in a Quark Model*,
February 1, 2005, Nuclear Theory seminar at Argonne National Laboratory.

[6] *Form Factors and Rates of Semileptonic Decay of* Λ *Baryons*,
November 12, 2004, Nuclear Physics seminar at Florida State University.

[7] *Some Aspects of Semileptonic Decay of* Λ *Baryons in a Quark Potential Model*,
October 15, 2004, Theory seminar at Thomas Jefferson National Accelerator Facility, Newport News, VA.

[8] *Semileptonic Decay of Baryons in a Quark Potential Model*,
April 4, 2003, Nuclear Physics seminar at Florida State University.

Contributed Talks

[1] *Heavy Baryons in a Quark Model*,
October 13, 2007, contributed talk at DNP meeting of American Physical Society.

[2] *Quantum Monte Carlo Calculations of Electroweak Transitions in Light Nuclei*,
October 11, 2007, contributed talk at DNP meeting of American Physical Society.

[3] *Ab-initio Calculations of Electroweak Transitions in Light Nuclei*,
October 5, 2007, Midwest Theory Get-Together,
Argonne National Laboratory.

[4] *Ab-initio Calculations of Electroweak Matrix Elements*,
October 26, 2006,
contributed talk at DNP meeting of American Physical Society.

[5] *Baryon Spectra and Semileptonic Decay in a Constituent Quark Model*,
October 22, 2006,
contributed talk at GHP meeting of American Physical Society.

[6] *Ab-initio Calculations of Electroweak Matrix Elements*,
October 13, 2006, Midwest Theory Get-Together,
Argonne National Laboratory.

[7] *Some Aspects of Semileptonic Decay of Baryons*,
April, 2005, contributed talk at April meeting of American Physical Society.

[8] *Semileptonic Decay of Baryons in a Quark Model*,
June 18, 2003, At Hampton University Graduate Studies (HUGS), Thomas Jefferson National Accelerator Facility, Newport News, VA, June 2-20, 2003.

[9] *Semileptonic Decay of Hadrons*,
August 9, 2002,
Nuclear Physics Summer School, St. John's College, Santa Fe, NM.

Computer Skills

- Language: Fortran77.
- Experience with parallel computing.
- Software: Mathematica (Including Experience with High Energy Physics Instruction (HIP), and Feyncalc packages), Maple, Mathcad, Microsoft Office, HTML.
- Platform: Red Hat Linux, Microsoft Windows.

Services

- 2006 - 2007: Co-organizer for the weekly seminar for the Nuclear Theory Group at Physics Division, Argonne National Laboratory.
- 2004 - 2005: Organizer for the weekly Nuclear Theory Journal Club at Physics Department, Florida State University.

Professional Affiliation

- Member: American Physical Society
- Member: Topical Group of Hadronic Physics

Extra Curricular Activities

- 2003 - 2004: President of Bangladesh Student Association, at Florida State University.
- 2000 - 2002: General secretary of Bangladesh Student Association, at Florida State University.

Research Interests

As a theoretical nuclear physicist I am interested and involved in many aspects of theoretical physics. The breadth of my research interests and expertise includes the structure and reactions of light nuclei, hadronic spectra and semileptonic decay of baryons, and CP violation within the framework of the Standard Model. I am also very keen to get involved in nuclear astrophysics projects, such as the calculation of the rates of nuclear reactions of astrophysical interest.

Nuclear Structure, Reactions and Nuclear Astrophysics

One of the primary areas of my current research is the *ab-initio* calculations of electroweak matrix elements of light nuclei. The variational Monte Carlo (VMC) and Green's function Monte Carlo (GFMC) techniques are powerful tools for calculating properties of light nuclei. These methods in combination with the Argonne v_{18} (AV18) two-nucleon and Illinois-2 (IL2) three-nucleon potentials, reproduce the energies of many bound and narrow states in nuclei up to A= 12. They have also been applied to calculate properties beyond the structures of nuclei, such as, radiative capture cross sections and electroweak matrix elements. We (myself, R. B. Wiringa and S. C. Pieper) are now exploring some nuclear electroweak transitions, using the GFMC technique and the AV18 + IL2 potential for nuclei with A=6 to 10. The matrix elements for some of these transitions have previously been calculated using the VMC technique and the AV18 + Urbana-IX potential. However, GFMC wave functions are better approximations to the true wave functions, and the potential has been updated. We therefore expect that the new results for these transitions should be more reliable. So far we have applied the GFMC method to calculate electroweak matrix elements in A=6, 7 nuclei.In general the GFMC improves the previous VMC results. The work has been published in Physical Review C.

We are now applying the GFMC method to additional off-diagonal matrix elements for nuclei with A=8. Of particular interest are the weak decay processes $^8\mathrm{Li}(\beta^-)^8\mathrm{Be}^*$ and $^8\mathrm{B}(\beta^+)^8\mathrm{Be}^*$ and numerous M1 and E2 transitions. The electroweak transitions for A=8 are more challenging because many involve transitions from a big component of an initial state to a small component of a final state wave function. In addition some of the physical states have significant isospin mixing. Hence these transitions are a stringent test of the wave functions and dynamics.

We are also working to include the meson exchange current contribution which can make $10 - 20\%$ corrections to the M1 matrix elements. We have also made calculations of B(E2) transition rates for states in $^{1}0$Be in support of a scheduled ATLAS experiment at Argonne Nat'l Lab.

In the near future I also expect to start working with K. M. Nollett at ANL on scattering problems in GFMC. The first calculations of nucleus-nucleon scattering using GFMC for the case of ^{5}He (neutron+alpha) solved as a five-body system has been completed by K. M. Nollett, S. C. Pieper and R. B. Wiringa. We wish to continue to more complicated scattering cases such as proton-alpha scattering (inclusion of long-range Coulomb effects), neutron-^{6}He scattering, and alpha-alpha scattering (nucleus-nucleus scattering).

The combination of problems mentioned in the previous two paragraphs is leading toward completely *ab initio* calculations of important astrophysical capture reactions, which require the calculation of a transition matrix element between an initial scattering wave function and a final bound-state wave function. There are several interesting reactions that should be accessible to us. Some are very difficult or impossible to measure in laboratory experiments, but are important for big bang nucleosynthesis, solar neutrino production, and as seeds for the r-process.

Hadronic Physics

Along with the nuclear structure and reaction physics, I am also involved in research in hadronic physics. The project of my Ph.D. research focused on the semileptonic decay of heavy baryons. Using a nonrelativistic quark potential model we have calculated the form factors and decay rates of Λ and Ω baryons involving a heavy (b or c) quark decaying into another heavy or light Λ and Ω or into a nucleon. Our project examined decays to excited daughter baryons, in addition to decays to ground states. We have also compared our analytic model form factors with the Heavy Quark Effective Theory (HQET) predictions for both heavy to heavy and heavy to light transitions at leading order in the inverse quark mass.

With Prof. W. Roberts, I studied the multistrange (cascades and Ωs) baryon spectrum using a non-relativistic quark model. The study of hyperon properties can provide important insight to two questions of crucial interest to hadronic physicists. The first of these is 'what are the relevant degrees of freedom in a baryon', and is in some sense subsumed in the second, 'what is the mechanism of confinement?'.

In order to understand the symmetries and dynamics of the strong interaction, the expected multiplet structure of the baryons must be established experimentally, and details of their excitation spectrum are crucial. The experimentally known states ($\Xi(1318)$, $\Xi(1530)$, $\Xi(1823)$ and $\Omega(1672)$) are well reproduced by our model, while we predict the mass and spin-parity assignments for a number of the less-well-known states, such as the $\Xi(1690)$. The predictions for the spin-parity for multistrange baryons are very useful since even for the 'well-known' states, many of the quantum numbers have still not been measured until very recently.

We examined the spectrum of baryons containing heavy quarks using the quark model. The model gave masses for the known heavy baryons that are in agreement with experiment, but for the doubly-charmed baryon Ξ_{cc} reported by the Selex Collaboration, the model prediction is too heavy. However, that state needs to be confirmed, as a number of experiments (like BELLE, and BABAR collaborations) that have searched for it have failed to confirm the Selex result. When applied to the heavy cascade (Ξ_Q) spectrum, the model was used to determine the sextet-antitriplet mixing in the known states, and mixing was found to be small for the lowest lying states. In contrast with this, sextet-antitriplet mixing in the Ξ_{bc} states was found to be large. We also examined heavy-quark spin-symmetry multiplets, and found that many states in the model can be placed in such multiplets.

The baryon wave functions obtained from a nonrelativistic quark model developed in previous work will be applied to calculate the form factors describing the semileptonic decays of double-heavy baryons. This project includes calculation of decays from ground state double-heavy baryons to both ground and excited states of of baryons containing two heavy quarks, as well as those containing one heavy quark. In addition to obtain the decay widths, this calculation will also provide us important information about the symmetries of the double-heavy baryon wave functions. Our recent calculation indicates that hyperfine mixing in the wave function can lead to semileptonic decay rates that are significantly suppressed compared with the rates obtained using unmixed wave functions, in some cases. Polarization observables of these decays will also be examined using this quark model.

While I am thoroughly enjoying my work on nuclear structure and reactions and on hadronic physics and, I am aware of the extraordinary times in which we are living. The commissioning of new facilities all over the world to study neutrino physics, the understanding of the creation of chemical elements in the cosmos, dark

matter and dark energy are just a few of the reasons for scientists to be excited. I am eager to participate in this extraordinary journey.