Nomination for

Dr. Sonya Bahar
Associate Professor of Biophysics
503e Benton Hall

Governor's Award for Excellence in Teaching

Nominated by: Dr. Bruce A. Wilking
Professor of Astronomy and Chairperson
Department of Physics & Astronomy
503h Benton Hall

TABLE OF CONTENTS

College of Arts and Sciences

Bruce A. Wilking
Professor and Chairperson
Department of Physics & Astronomy
1 University Boulevard
St. Louis, Missouri 63121

Telephone (314)-516-5081
FAX (314)-516-6152
e-mail bwilking@umsl.edu

April 22, 2010

To whom it may concern;

It is my sincere pleasure to nominate Dr. Sonya Bahar for the Governor's Award for Excellence in Teaching. What makes this nomination unique is that, in addition to being an outstanding teacher, Dr. Bahar is one of the premier research scientists on the UMSL campus. Her research program in neuroscience and epilepsy are funded by an NSF CAREER grant. In 2007, she was one of 20 young scientists nationwide invited to the White House to receive the Presidential Early Career Award for Scientists and Engineers. In 2008, she received the Innovation Award from the St. Louis Academy of Science. It is clear from the letters by her students that her research interests inspire her teaching.

Dr. Bahar has developed and taught a wide range of physics courses and been instrumental in the upgrade of our physics teaching labs. Dr. Bahar's teaching record at UMSL mainly includes the introductory physics sequence for life science majors: Basic Physics 1011 and 1012. As these courses involve weekly laboratory exercises, Dr. Bahar has become heavily involved in upgrading and changing the labs and has undertaken a complete rewriting of the P1011 and P1012 lab manuals. In 2005, she was the first faculty member to teach our Department's "First Year Experience" course Windows on Physics (P1099). The organization and methods she developed for this course have been adopted by the faculty members who followed. She also has developed and taught two upper level courses. The Biophysics of Imaging (P4347) is the capstone course she designed for students in the Medical Physics Option. She also designed and teaches a popular graduate level course entitled Nonlinear Dynamics and Stochastic Processes (P5345). She is highly regarded by her students for her engaging lectures, her enthusiasm for the subject matter, and her accessibility outside of class.

In addition to classroom teaching, she has served as a research mentor for numerous students including high school students in the STARS program, undergraduate students in physics and biology, and graduate students working toward a Master's or doctoral degree in physics. Two of her STARS high school students received the Solutia Award for Research Excellence in Research for their research papers. In 2009-2010 alone, three of her doctoral students completed their degrees. As the letters attest, Dr. Bahar's mentoring does not end with the research projects. She stays in touch with her students and generously gives them, as Dr. Nathan Dees describes, *"career advice and professional tutelage"*.

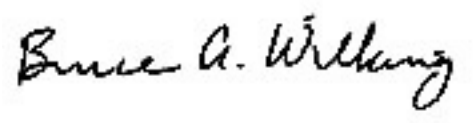
Since 2007, Dr. Bahar has served as the Undergraduate Advisor for all physics majors which typically number 35. All physics majors must speak with an advisor before they are allowed to

register which places a heavy burden on the Undergraduate Advisor. Dr. Bahar has done an excellent job giving proper advice to our majors and steering them on the right path.

Dr. Bahar has generously given of her time to the University community through her participation in various forums to discuss and improve teaching. Soon after Dr. Bahar arrived on campus, she became involved with the New Faculty Teaching Scholars (NFTS) program. Since completing the program in 2005-2006, she has served as a speaker/panelist at several workshops sponsored by the Center for Teaching and Learning on "Preparing for Promotion and Tenure" and "TA/RA Professional Development". She also spoke at the NFTS Retreat in 2009 and participated in a panel discussion of NFTS at the Board of Curators meeting in 2008.

In closing, Dr. Sonya Bahar has clearly demonstrated effective teaching and commitment to high standards of excellence in student learning and success, effective advising, and service to the University community. For these contributions and her passion for teaching, I strongly recommend Dr, Sonya Bahar for the Governor's Award for Excellence in Teaching.

Sincerely,



Bruce A. Wilking, Professor and Chairperson

III. Statement of Teaching Philosophy

Sonya Bahar

A general philosophy of teaching must apply to teaching at all levels, ranging from outreach to high school students to mentoring of postdoctoral fellows. However, since the institutional styles of dealing with undergraduate and graduate students differ so widely in external form, and the students differ significantly in their maturity, preparation and goals, I will discuss teaching of undergraduates and graduate students separately below.

Undergraduate Teaching

Despite new trends in teaching, I continue to believe that a standard "chalk lecture" format is a very powerful tool for communicating knowledge to undergraduate students. The success of this format depends also on the energy, personality and engagement of the instructor. Chalk lectures can be excruciatingly dull. Or, if the instructor continually varies her format between theory and examples, often turning to the students to ask them questions (and waiting till they answer!), and presents the material with enthusiasm rather than in a monotone, a chalk lecture can be a very valuable teaching tool. Of course, this traditional lecture style must be varied, and new teaching strategies constantly incorporated into the curriculum, in order to keep the students actively engaged in promoting their own learning process. Active learning strategies mixed with a traditional lecture style can both present the students with the full complement of the material they need to gain from the course, and ensure that they teach themselves, as well as more passively learning by listening. Having students do regular homework assignments is a rather traditional form of active learning; students can also be challenged and deeply awakened by being asked to respond to questions that puzzled philosophers and natural scientists hundreds

of years ago. This latter approach, which I use as much as possible, places the students in the position of those who literally risked their lives to develop the science of physics and thereby accomplishes three goals: (1) to make them realize that, even if it is mathematical, science is far from dry, (2) to appreciate how difficult it is to answer basic questions about how the world works, and (3) to begin to question their understanding of the world around them, which is, of course, the beginning of physics, of philosophy, of knowledge, and of freedom.

I do expect a certain amount of self-motivation and maturity from the students. I do expect that it should be their responsibility to study on their own, or with classmates, and to come to see me well in advance of their exams if they have questions. In return for these expectations, I offer the students my time and energy, and am always willing to help students outside class if they have questions or need additional help with the material.

Graduate Teaching and Advising

My philosophy for the teaching of graduate courses is similar in principle to what I described above for the teaching of undergraduates, though with the added factors of the greater independence and maturity of the students, and greater flexibility in the course material, which should incorporate new advances in the field, journal articles “hot off the press”, and, whenever possible, connections to the students’ own research topics.

Where graduate teaching becomes uniquely different from undergraduate teaching is in the one-on-one teaching relationship between a PhD student (or, to a lesser extent, a postdoctoral fellow) and their advisor. This teaching and mentoring relationship is absolutely critical.

When my PhD advisor, Dr. Phil Knauf, handed me his notes and comments after one of my thesis committee meetings back in the early 1990s, I noticed a remark scrawled in the top

margin in his perennial blue ink, evidently a note to himself rather than to me: “nudge, don’t shove”. He had been trying to convince me to “let go” of a portion of my thesis project which was becoming increasingly murky and unpublishable, and move to a new experimental design. Even as a graduate student, I deeply appreciated that approach. Striking a balance between encouraging and advising a creative young person, and giving them space to develop their own creativity, is absolutely essential. It is particularly difficult to do this when each student/advisor relationship is different. I can see this clearly in my current research group, where every one of my graduate students has a very different personality and working style. It is very important for an advisor to be able to relate to the students as creative individuals, while at the same time helping to direct them in projects that are *both cutting-edge* and *feasible*, that will lead to publications and will help the student advance in their own career, while developing their creativity and helping them to learn how rigorously and carefully science must be done. One must respect the fundamental intellectual freedom of young scientists, while training them to work with a simultaneous respect for both detail and for the big picture, and enabling them to navigate the shark-infested waters of the job hunt and the scramble for a share of the ever-shrinking pot of funding dollars. A good advisor must be able to do *all these things at once*. I am not sure whether I succeed, but I constantly keep my own experiences as a grad student and postdoc who needed to be “nudged, not shoved” in the back of my mind in order to remind myself of the importance of this delicate and complex balance.

IV. Evidence Supporting Nomination

Evidence supporting the nomination of Dr. Sonya Bahar for the Governor's Award for Teaching Excellence comes from my nomination letter (Sec. I), her course evaluations (Sec. VII), and the letters from her students and a professional colleague (Sec. VIII). Here I will focus on the comments from the letters.

Dr. Peggy Cohen, Professor and Associate Provost for Professional Development, Director of the Center for Teaching & Learning, attended Dr. Bahar's 8 am Physics 1012 class last month. As her letter relates, she has been well acquainted with Dr. Bahar's interest in teaching and was instrumental in helping with the educational component of Dr. Bahar's NSF CAREER grant. She notes that Dr. Bahar has developed "pedagogical content knowledge" which helps her anticipate questions and concepts with which the students will struggle. Dr. Cohen lists several supports for student learning she observed, many designed to focus the student's attention on physics. This is not an easy task at 8 am. In summary, Dr. Cohen states:
"You capture the interest of these biology and chemistry majors with your energy, enthusiasm, and humor. You challenge them to understand the "beauty of mathematics". You structure class time, labs, and assignments to insure their success. I observed how you inspired students to discover the excitement and adventure you derive from your discipline."

The letters from former students who took the Physics 1011/1012 courses with Dr. Bahar confirm that her teaching style is effective and engaging. Words like "enthusiastic", "knowledgeable", "friendly", "approachable", and "welcoming" appear repeatedly in these letters. As Kimberly Bolin explains:
"Dr. Bahar has an enthusiasm for the topics she teaches that is unmatched by anyone I've ever met. She is so excited about what she's teaching that her students tend to catch the excitement and it shows in the time and effort they put forth to understand the material."
Another technique she employs is using examples to which the students can relate. Dianne Salem states:
"Dr. Bahar is a down-to-earth professor and explains the subject in a way where [it] could be related to our daily lives with real world examples and at times used humor to keep the class interesting but never distracting".

Every letter from a Physics 1011/1012 student mentions how committed Dr. Bahar is to student learning and how generous she is with her time outside of class. This is especially important for adult students like Mari Lynne Teter who credits Dr. Bahar with giving her confidence to master the concepts in physics. Her comments are typical:
"She truly wanted every student to succeed…..She was one of the most accessible professors I have ever had. Her door was always open and she routinely offered extra study and tutoring sessions to any student who required additional help."
And her commitment to students does not end with teaching them physics. Dr. Lincoln Lim is one of many students she has helped with career advice:
"When I was caught in a career option dilemma, Dr. Bahar reserved time on her busy schedule to provide guidance. Dr. Bahar spends time with students maneuvering critical paths to approach solutions…"

In her more advanced classes, such as graduate-level Physics 5345 (Non-Linear Dynamics and Stochastic processes), the same qualities that make Dr. Bahar a popular teacher with non-physics majors draw praise from the physics graduate students. Words like "passion", "energy", "thorough understanding", "approachable", and "atmosphere of acceptance and learning" are used by students in her graduate course. Dr. Nathan Dees describes her use of demonstrations, her own computer simulations, videos, and journal articles to teach difficult concepts. In her lecture on the geometry of fractal strange attractors, she brought pastry dough so the students could visualize the stretching and folding of particle trajectories. As Dr. Dees states in his letter, these techniques insured *"that students of all learning styles and interests should take away new information from every class."* On her course evaluation for P5345 in W2006, an anonymous student commented:

"Dr. Bahar is very enthusiastic, and makes a dry subject quite entertaining. She is also especially open to questions and being helpful."

V. List of Courses Taught (2004-2010)

Winter, 2010
Physics 1012: Electricity and Magnetism

Fall, 2009
Physics 1011: Mechanics

Winter, 2009
Physics 1012: Electricity and Magnetism
Physics 4347: Biophysics of Imaging
Physics 6400: Special Problems

Fall, 2008
Physics 1011: Mechanics

Winter 2008
Physics 1012: Electricity and Magnetism
Physics 5345: Nonlinear Dynamics and Stochastic Processes
Physics 6400: Special Problems

Fall 2007
Physics 1012: Electricity and Magnetism

Winter, 2007
Physics 1011: Mechanics

Fall 2006
Physics 1012: Electricity and Magnetism
Physics 1099: Windows on Physics

Winter, 2006
Physics 1011: Mechanics
Physics 5345: Nonlinear Dynamics and Stochastic Processes

Fall, 2005
Physics 1012: Electricity and Magnetism
Physics 1099: Windows on Physics
Physics 4381: Directed Readings

Winter, 2005
Physics 1011: Mechanics

Fall 2004
Physics 1012: Electricity and Magnetism

VI. Selected Syllabi

Physics 1012	Winter 2010

Lectures: Tuesday & Thursday, 8:00 to 9:15 am, Stadler 104
Labs: Benton 336
Tuesday, 12:30 to 2:20 pm, Shakya Premachandra (sspwx7@umsl.edu)
Tuesday, 2:30 to 4:20, Shakya Premachandra
Thursday, 12:30 to 2:20 pm, Nandita Nag (nnfff@umsl.edu)
Thursday, 2:30 to 4:20, Nandita Nag

Textbook: Physics (4/e), James S. Walker, Pearson/Addison-Wesley (2008)

Course Instructor:

Dr. Sonya Bahar, bahars@umsl.edu
Office B503e, Tel. x7150 (314-516-7150)
"Official" Office Hours: Tuesday & Thursday 10 am – 11 am (B503e)
(You are also welcome to call or email me to make an appointment for another time.)

Grade Breakdown:

Midterm I 20%
Midterm II 20%
Final 20%
Homework 20%
Lab 20 %

Grade scale:

92-100 A ☺	**72-77.99 C**
90-91.99 A-	**70-71.99 C-**
88-89.99 B+	**68-69.99 D+**
82-87.99 B	**62-67.99 D**
80-81.99 B-	**60-61.99 D-**
78-79.99 C+	**below 60 F ☹**

Grades will not be curved. (Sorry.)

Calculators: YES! Be sure to use one that has trig functions.

Cheat Sheets: Sort of. I will provide a "universal crib sheet" containing all the equations you will need for each exam. The point here is that in science nobody *really* has to MEMORIZE every equation, the point is to **understand** them. As we go through the lectures I will point out what equations will be on the "crib sheet", and I will post the crib sheet on MyGateway as the course progresses, so you can use it as a study guide.

Exam Format: The exams will be approximately 50% multiple choice / short answer, 50% problems. I will post a sample exam (with solutions) on MyGateway a week or two before each test.

Makeup exams: for a truly valid excuse, believable story of car trouble, flu, etc., makeup midterm exams will be given. Of course, makeups will not be identical to the original exam.

Homework: There will be homework assignments (to be turned in and graded) for each chapter. **The ethics of physics homework:** you MUST TRY to solve the problems on your own. If you have trouble, you may discuss the problems with your classmates (or with me, of course). You may get ideas from your classmates about how to solve the problems, but you may NOT copy directly from anyone else's work. This comes from the way science is done "for real" – you can always talk to other people to get ideas from them – that is essential to how research is done – but you may not plagiarize. If you are really confused about a homework problem, come talk with me and I will give you some hints to point you in the right direction.

HOMEWORK MUST BE WRITTEN LEGIBLY. I will take points off if I can't decipher your homework. If you have bad handwriting, then type your homework!

Don't confuse homework points with exam points! The *total homework grade* (total homework points earned over points possible) *will count as one exam grade*. Since you will have about 8 homeworks of about 20 points each, this means that a "homework point" is worth less than an exam point – so if you calculate your grade based on "total points", you will get an incorrect estimate.

Late homeworks: Once I post the solutions on MyGateway (usually right after the class when they are due), I will **not** accept late homeworks.

Exam coverage: Midterms are 1 hour and 15 minutes. Though the midterms are not officially cumulative, if you have forgotten everything we learned in Chapters 19-22, you will have a hard time solving problems in Chapters 23-25. (In other words, the CONCEPTS are cumulative.) **The final exam IS cumulative**, though there will be more emphasis on the material we've covered since the second midterm (about 50% new material, 50% from MTI & MT2).

Homework and Exam Grading: I will do my best to get graded homeworks and exams back to you within a week.

Lab: Your lab Teaching Assistant (TA), will teach and grade the lab portion of the course. S/he will give me your grade at the end of the term. Your lab grade will make up 20% of your total grade.

- Lab reports must be typed.

- Your lab report must be original. **You will receive an automatic zero if you simply turn in a copy of your lab partner's report.**
- Each lab will be graded out of 100 points. Your average grade on the labs will be the final grade for the lab portion of the class. The lab reports will typically be graded as follows:
  - ✓ Objective/Procedure: 15%
  - ✓ Data/Calculations/Analysis: 35%
  - ✓ Questions 40%
  - ✓ Conclusions 10%
- Labs will be due the next time your lab section meets after the experiment. No late labs will be accepted.
- Makeup labs. Labs must be made up within one week of a missed lab, and only if you have a valid (e.g., medical) excuse.

❖ **READ THE BOOK:** The material I cover in class will relate directly to what is in the textbook. You should take good notes in class, but also read each chapter either before or after (or both) the corresponding lectures. (Some people may find it more useful to read the textbook chapter before, some after – do whatever helps you understand the material best.) Reading the book is NOT a substitute for coming to class, but it IS important.

❖ **DO PRACTICE PROBLEMS.** Try some of the problems we've covered in lecture yourself, without looking at your notes! Can you recreate the solutions the way I did them in class? This is a really good way to study for exams.

❖ Have trouble remembering what units go with what variable? Try flash cards, as if you were memorizing material for a biology class.

❖ **TAKE NOTES:** You should take good notes during class, so you can review the material later. This sounds trivial but it is really important! If you miss class, GET THE NOTES from someone! **Note that there may be some material we cover in class that is not in the book. Anything I cover in lecture is fair game on the exams.**

- o **Don't miss class. The more you come to class, the better you will do.**
- o **No text messaging in class. I mean it.**
- o **CHEATING on an exam will result in a grade of zero. I am required to report any incident of cheating to Academic Affairs.**

Breakfast: *Yes, this is 8 AM. It is fine if you bring something to eat during class.*

Ask questions! The point of the next few months is for you to learn some interesting science….and for me to convince you that physics is fascinating and exciting… and even useful! Hopefully we'll both be successful.

IMPORTANT NOTE FOR STUDENTS WITH DISABILITIES: If you have any disability that might require extra accommodation, **PLEASE** come and talk with me. UMSL has various aids that may be able to make things easier for you. I want to make sure the class is equally accessible to everyone, so if you have **any** concern, large or small, definitely come and talk to me about it!

Week 1 (Jan 19 & 21): Chapter 19 – Electric Charges, Forces & Fields
NO LAB THIS WEEK (Read Lab 0!)

Week 2 (Jan 26 & 28): Chapter 19 - Electric Charges, Forces & Fields
EXPERIMENT 1: Coulomb's Law

Week 3 (Feb 2 & 4): Chapter 20 – Electric Potential & Electric Potential Energy
EXPERIMENT 2: Equipotential Surfaces and Electric Fields

Week 4 (Feb 9 & 11): Chapter 21, Sections 21-1 and 21-2 (Current, Ohm's Law)
EXPERIMENT 3A: Ohm's Law

Week 5 (Feb 16 & 18): Chapter 21, Sections 21-3 to 21-5
(Resistors in Series and Parallel, Kirchhoff's Rules)
EXPERIMENT 3B: Resistors in Series and Parallel

Week 6 (Feb 23 & 25): Special Topic – Neurons!
EXPERIMENT 3C: Kirchhoff's Rules

Week 7 (Mar 2 & 4): Chapter 21, Sections 21-6, 21-7 (RC Circuits)
Midterm I (Thursday March 4)
No 1012 labs this week (2112 lab does Joule Heating)

Week 8 (Mar 9 & 11): Chapter 22 -- Magnetism
EXPERIMENT 5: AC Voltages, Frequency and the Use of the Oscilloscope

Week 9 (Mar 16 & 18): Chapter 22 -- Magnetism
EXPERIMENT 6: Magnetic Field Induced by a Current-Carrying Wire

Week 10 (Mar 23 & 25): Chapter 23 – Magnetic Flux & Faraday's Law
Experiment 7: RC Circuits

Week of Mar 30 & April 1 Spring Break!

Week 11 (Apr 6 & 8): Chapter 23 – Magnetic Flux & Faraday's Law
Midterm II (Thursday April 8)
No 1012 labs this week (2112 lab does RLC circuits)

Week 12 (Apr 13 & 15): Chapter 25 – Electromagnetic Waves
Chapter 14 – Waves & Sound
No lab

Week 13 (Apr 20 & 22) Chapter 26 – Geometrical Optics
Experiment 9: Reflection & Refraction

Week 14 (Apr 27 & 29) Chapter 28 – Interference and Diffraction
Experiment 10: Diffraction, Wavelength, and Atomic Line Spectra

Week 15 (May 4 & 6): Chapters 29/30 – A Quick Taste of Special Relativity & Quantum Mechanics
Experiment 11: Optics? (New lab under development, stay tuned…)

Final Exam– May 11 (Tuesday), 7:45-9:45 am, Stadler 104

Physics 5345 Nonlinear Dynamics

9:30 to 10:45 am,
Benton 241 Tuesday,
Benton 243 Thursday

S. Bahar, x7150, bahars@umsl.edu

Scope of course: The course will provide an introduction to nonlinear dynamics and chaos at the beginning graduate level. We will follow the Strogatz text, but will also add supplementary material from other texts (Goldbeter's *Biochemical Oscillations*, Pikovsky/Rosenblum/Kurths Synchronization, etc.) and from fundamental "historical" papers introducing basic concepts of nonlinear dynamics, including a discussion of chaos control (Ditto, Spano, Schiff, Collins), stochastic phase synchronization, and applications of chaos in biological systems.

Text: Steven H. Strogatz, *Nonlinear Dynamics and Chaos with Applications to Physics, Biology, Chemistry and Engineering.*

Other recommended texts:
James Gleick, *Chaos*;
Goldbeter, *Biochemical Oscillations*;
Pikovsky/Rosenblum/Kurths *Synchronization: a Universal Concept in Nonlinear Sciences.*

Supplementary material: we will discuss "historical" texts in the history of nonlinear dynamics, and applications to biophysical systems; these will be provided as pdf files.

Grading: Each student will be given a project consisting of the numerical integration and analysis of a nonlinear system (the Lorenz system, the Rossler system, etc.) The project will be worth 50% of your final grade. Smaller homework assignments will make up another 25% of your grade, and the final exam the last 25%.

Tentative Syllabus

Tuesday January 15 – Strogatz Ch. 2, Flows on the Line, Stability
Assignment: Read Strogatz Chapter 1
Thursday January 17 – NOVA Film – "CHAOS"

Tuesday January 22 – Strogatz Ch. 2, Flows on the Line, Stability
Thursday January 24 – Strogatz Ch. 3, Types of Bifurcations

Tuesday January 29 – Strogatz Ch. 3, Types of Bifurcations
Thursday January 31 – Strogatz Ch. 4, Flows on the Circle

Tuesday February 5 – Strogatz Ch. 4, Flows on the Circle
Thursday February 7 – Strogatz Ch. 5/6 Linear Systems and the Phase Plane

Tuesday February 12 – Strogatz Ch. 5/6 Linear Systems and the Phase Plane
Thursday February 14 – Strogatz Ch. 7 Limit Cycles

Tuesday February 19 – Strogatz Ch. 8/ Goldbeter Bifurcations, Nullclines, Chemical Oscillations
Thursday February 21 – Biochemical Oscillation examples – Goldbeter

Tuesday February 26 – No chaos in the phase plane!!!!!!!!! Ever!!!!!!!
Thursday February 28 – The Lorenz System

Tuesday March 4 – The Lorenz System / Poincaré sections

Thursday March 6 – Lorenz System continued

Tuesday March 11/ Thursday March 13 – NO CLASS / APS MARCH MEETING

Tuesday March 18 – Logistic Map, Cantor Set, Fractals, other maps, the mystery of Chossat and Golubitsky
Thursday March 20 – Logistic Map, Cantor Set, Fractals, other maps, the mystery of Chossat and Golubitsky

Tuesday March 25 / Thursday March 27 – NO CLASS / UMSL SPRING BREAK –

Tuesday April 1 – Chaos Control – OGY, Ditto and Spano, Magnetic Ribbon
Thursday April 3 – Chaos Control in the Heart

Tuesday April 8 – Anti-Control of Chaos in the Brain / The Debunking Thereof
Thursday April 10 – Synchronization examples – theory, Arnol'd tongues, etc.

Tuesday April 15 – Synchronization – Schaffer, Anischenko examples, Paddlefish
Thursday April 17 – Synchronization & Stochastic Resonance

Tuesday April 22 – Survey of other topics – "complexity"
Thursday April 24 – Survey of other topics – Stuart Kauffman?
Friday April 25 – Wolfgang Pauli's birthday

Tuesday April 29 – Survey of other topics, review
Thursday May 1 – Projects due, **Final Exam**