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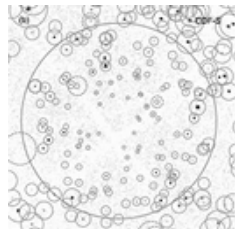


Image on the left displays false-color image of the deep exposure of the Chandra X-ray Observatory in the southern field (CDF-S). The image on the right displays the circled resolved point sources and extended sources that are removed from this field to determine the spectrum of the remaining unresolved X-ray background. Note that the two panels have different orientations. To read more on the search for matter in the unresolved x-ray background, view the Research Spotlight written by Kevork Abazajian.



On November 1, 2006, a special tea was held in honor of the departments Outstanding Teaching Assistants. Visit the Graduate Blog section to view the photo album and list of winners.

University of Maryland-Physics has 6% of the country's notable physics teachers. In a recent pamphlet from the American Association of Physics Teachers, celebrating 75 years since its founding, 75 of the nations notable teachers were interviewed. The following faculty were mentioned and interviewed in the pamphlet:

Richard Berg
Sylvester Gates
John Layman
William Phillips
Edward Redish

Visit the News Section to view more faculty awards, honors and recognitions.

Professor Xiangdong Ji has just returned from traveling to Beijing, China, where he attended the Inaugural Ceremony of the High-Energy Physics Center. To view more information about his visit or other events, visit the Recent Events section.

This month's Alumni Spotlight highlights the UMD journey of Alumnus Matthew LaHaye. LaHaye graduated with a PhD from Maryland in 2005.

Physics Phun Phact:

Physics Science Tech Bill Norwood's daughter documented her 30 day journey of eating nothing but raw food. She made a film that was released this summer called "Supercharge Me...30 Days Raw" where she shows how raw food benefited her health. The article highlighting her work was featured in the November 9th issue of the Diamondback and is entitled "University Alum. Goes Raw for 30 Days."



DEPARTMENT OF
PHYSICS
UNIVERSITY OF MARYLAND



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RESEARCH SPOTLIGHT

The Search for Dark Matter in the Unresolved X-ray Background

By: Kevork N. Abazajian

The Search for Dark Matter in the Unresolved X-ray Background

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xFigure 1 Figure 2

Figure 1: False-color image of the deep exposure of the Chandra X-ray Observatory in the southern field (CDF-S).
Figure 2: The (circled) resolved point sources and extended sources that are removed from this field to determine the spectrum of the remaining unresolved X-ray background. (Note that the two panels have different orientations.)

Dark matter dominates the dynamics of the growth of cosmological large-scale structure as well as the dynamics of galaxy formation. Over seventy years from its inferred existence due to its gravitational properties by the astronomer Fritz Zwicky, the identity of the dark matter remains unknown. One clue may come from differences in the number of substructures from large scales to small scales. This has motivated the search for lighter dark matter particle candidates than previous searches, which can damp small-scale structure.

A candidate light particle that reduces small-scale structures is a neutrino-like particle that has no standard interactions, but can be produced in the early universe with its small coupling with the standard neutrinos, often described as a “sterile neutrino” (Dodelson & Widrow, 1994). The same coupling for its production requires a decay mode of the sterile neutrino into a photon and the standard neutrino with which it is coupled. The decay photon is monoenergetic and has X-ray energies. This has allowed the use of contemporary X-ray observatories such as NASA’s Chandra X-ray Observatory for a previously unintended purpose: the search for the signature of a dark matter candidate.

The Chandra X-ray Observatory was deployed by the Space Shuttle Columbia in July 1999. It is now on a highly elliptical orbit, reaching 64,000 km away from the Earth before returning to 320 km at closest approach. One mission of the observatory is to determine the source of the diffuse X-ray background, which was first detected on rocket flights in the 1960’s. Using a total of 3 megaseconds of observations, Hickox & Markevitch (2006a,b) showed that the diffuse background comes from resolved X-ray sources and galaxies resolved in the Hubble Deep Field.

The energy spectrum of the unresolved X-ray diffuse background in this observation was employed to either detect or constrain the X-ray photons in the decay of the sterile neutrino dark matter candidate (Abazajian et al., 2006). X-ray flux is expected to originate from sterile neutrino decays in the dark matter halo of the Milky Way along the line of sight of the observation. Since no line-like decay feature was seen and the decay rate increases with the particle mass, this observation places a constraint on the leading production model for the candidate sterile neutrino dark matter particle to not have a mass of more than 5.7 keV. This and other observations in the X-ray constrain much but not all of the parameter space of the sterile neutrino candidate. The lightest particle masses and couplings of this candidate remain viable, but may be probed by observations with quantum X-ray calorimeters or the proposed Constellation-X Observatory (Abazajian, Fuller, & Tucker, 2001), which would either exclude this candidate, or detect its signature decay.

Continued on next page

References:

- K. N. Abazajian, G. M. Fuller, and W. Tucker, *Astrophys. J.*, 562, 593 (2001); astro-ph/0106002.
K. N. Abazajian, M. Markevitch, S. M. Koushiappas, and R. C. Hickox, submitted to *Phys. Rev. D*; astro-ph/0611144.
S. Dodelson and L. M. Widrow, *Phys. Rev. Lett.*, 72, 17 (1994); astro-ph/9303297.
R. C. Hickox and M. Markevitch, *Astrophys. J.*, 645, 95 (2006a); astro-ph/0512542.
R. C. Hickox and M. Markevitch, in prep., (2006b).

Dr. Abazajian is an assistant professor of Physics for the University of Maryland. He is a member of the Elementary Particle research group. Feel free to contact him at, kev@umd.edu .



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ALUMNI SPOTLIGHT

Q & A with Alumnus Matthew LaHaye

Matthew LaHaye grew up just outside of Rochester, NY. He received his PhD, in Physics, from UMD in 2005. The following are his responses to questions regarding his physics journey:

What schools do you attend and what degrees did you obtain?

I received my BS in physics and philosophy from the State University of NY at Albany (SUNY). Graduated in 1999. I received my PhD in physics from the University of Maryland, College Park in 2005---my PhD thesis project was titled "The Radio-Frequency Single-Electron Transistor Displacement Detector," and advised by Keith Schwab. I actually worked in the quantum computing group at the Laboratory for Physical Sciences (LPS).

What led you to the University of Maryland?

Several things: (1) The size of the physics department; I wasn't entirely sure which direction to pursue in grad school, so I was looking for a school with a physics department offering a broad range of research. (2) The ranking of the department; I knew it was among the best physics departments in the nation. (3) The close proximity of UMCP to DC; Washington was one of my favorite cities and still is; there's so much history and energy.

Where do you currently work?

After graduating from Maryland, I accepted a postdoctoral scholarship at Cal Tech in Pasadena, CA, working with Professor Michael Roukes' nanomechanics group. My main responsibility is in leading the quantum nanomechanics experimental effort. We're currently investigating the coupling of nanomechanical devices to solid-state orbits. The whole point is to use the qubits to prepare and observe non-classical behavior in what are essentially macroscopic degrees of freedom, e.g. the center of mass motion of a rod consisting of billions of atoms. It's really fundamental research directed ultimately toward testing quantum mechanics in a new limit.

Do you enjoy it?

I do. At this point in my life, it's right where I want to be: working in a stimulating environment with a large degree of freedom.

What advice would you give current students?

Remain open-minded and well informed. You're going to meet a lot of people from all across the spectrum; if you want, each encounter can be an opportunity to learn something valuable about the world you live in.

If you are interested in contacting Matthew LaHaye, please send your messages to the Editor, who will be happy to forward your questions and comments.



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GRADUATE BLOG



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UP NEXT

December Colloquia:
December 05 - David Spergel
[Click here to view the entire colloquia schedule.](#)

December 14-20 Final Exams

December 21 - Winter Commencement
Clarice Performing Arts Center
10:00

December 25-29 University Closed

January 11-13 Physics is Phun
Making Waves
Physics Department Lecture Halls
7:00-8:45



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NEWS

Awards & Honors

Sarah Eno was awarded the University's Graduate Research Board Award. Dr. Eno plans to use the GRB to help lead the search for new particles at the LHC. Having a UMD member not only participate, but also lead this project will be an extraordinary accomplishment.

Sylvester Gates was awarded the 2006 AAAS Award for Public Understanding of Science and Technology. Dr. Gates was honored for his sustained and career-long contributions to the public understanding of physics.

Erin Rericha, UMD post doc, won one of the Burroughs Welcome Career Award for her research regarding the interface of physics and biology. The award is worth \$500,000 over five years. This fellowship will cover the next, up to, two years of her post doctoral training jointly, with Wolfgang Losert and Carole Parents at the National Cancer Institute. In addition, it will provide three or more years of funding toward her faculty startup.

In the News

Daniel Lathrop was quoted in NOVA on October 24, 2006. He spoke about the magnetic field that surrounds and protects the Earth.

Rajarshi Roy was quoted on C-SPAN 2, on October 16, 2006, speaking about the North Korea Nuclear test and policy effects of the six nation talks.

Alumna, Tanja Horn's PhD thesis paper appeared in the Physics Review Letters this past November. A story also appeared on the JLAB website at www.jlab.org.



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RECENT EVENTS

- Professor Xiangdong Ji has just returned from traveling to Beijing, China from November 8-26 (one of many in connection with his Chinese Travel Award and Chang Jiang Chair Visiting Professorship), where he attended the Inaugural Ceremony of the High-Energy Physics Center.
To view the article visit: <http://enews.pku.edu.cn/news.php?s=164689099>
- Professor Ho Jung Paik gave public lectures entitled, "Einstein's Relativity and the Expanding Universe" at Stanford University on October 21 and at the Atlanta Korean Community Center on November 19. These talks are part of the outreach program to the Korean Communities carried out by the Association of Korean Physicists in American, of which Professor Paik is the current president. The events were covered by several Korean newspapers, TV and radio. On November 18, 2006. He also gave an invited lecture at a meeting of the Korean American Scientists and Engineers Association with the title "Einstein's Unfinished Symphony: Deep Cosmic Voice of Gravitational Waves."
- On Wednesday, November 1, 2006, the Department of Physics held a Special Tea honoring the department's Outstanding Teaching Assistants. Faculty, staff and students attended the event, held in the lobby, to show TA's their appreciation.

Tyrell Johnson was awarded the 2005-2006 Ralph D. Myers Teaching Assistant Award in recognition of his outstanding teaching performance. Ryan Artuso and Peter Redl, both, received runner up.
The following students received honorable mention:

Paul Bach
Beatriz Burrola-Gabilondo
Kimberly Glass
Elizabeth Lockner
Eric Montgomery
Viktor Nagg
Sogee Spinner
Shudong Xiao



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LETTER FROM THE CHAIR

Dear Colleagues,

I am honored, as I've always been, to be a part of this establishment which has already embarked on another remarkable year. With so many people striving for the department's excellence, it's no wonder why we are such a successful institution.

My term, as chair, began this past summer just as the University of Maryland, the National Institute of Standards and Technology (NIST) and the National Security Agency (NSA) announced the creation of the Joint Quantum Institute (JQI). This exciting new venture promises to cultivate outstanding research collaborations between our institutions.

In addition to JQI, all of our research groups and centers are exploring a wide variety of physics topics, which consistently produce outstanding results. In fact, the faculty have had another impressive year of accomplishments. Among the numerous awards that our faculty have received this past year are the NSF CAREER Award, the Alfred P. Sloan Award, the Fulbright Award for the Dublin Institute for Advanced Studies, the Ralph E. Powe Junior Faculty Award and the 2006 Nobel Prize by Adjunct Professor and Goddard Scientist, John C. Mather. Their hard work has brought international recognition to the department and the University.

Additionally, this past year, the Physical Sciences Complex (PSC) was given highest priority on the university's campus improvement initiative. We have made excellent progress in our plans for this state-of-the-art facility and were given two-years worth of planning money. Construction is slated to begin in January of 2009 and occupancy is scheduled for 2011---if not sooner! We are extremely excited about the PSC which will provide the type of facility needed to conduct high-level experiments. The PSC is critical in transforming the University of Maryland from a competitor to a national leader.

I am writing you, today, to affirm your connection to the Department of Physics. Your support will provide our students with state-of-the art equipment, scholarships and several other academic initiatives. Should you have any questions, about how you can make a financial contribution to the department, please contact the chair's office staff at 301-405-5945.

Regards,

Andrew Baden
Professor and Chair





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EDITOR'S NOTE

Dear Readers,

I would like to give you my best wishes for a Pleasant Holiday Season and a Happy New Year! This past year has been exciting and it has been a pleasure highlighting the department's research, alumni, awards, honors and events. Please send in all of your news, so that we can continue to inform others of your accomplishments.

This past month, many of our TAs were awarded at the special tea ceremony. To view images from the event, visit the Graduate Blog section. Also, Sylvester Gates was awarded the 2006 AAAS Award of Public Understanding of Science and Technology and Alumna Erin Rericha was awarded the Burroughs Welcome Award.

In addition to awards and honors, our faculty remain hard at work. Professor Xiangdong Ji has just returned from traveling to Beijing, China, where he attended the Inaugural Ceremony of the High-Energy Physics Center. Professor Kevork Abazajian wrote this month's Research Spotlight, regarding his research on Elementary Particles.

And the excitement does not end there! We still have a long list of things to look forward to before the end of the semester. Visit the Up Next section to plan for all of our upcoming events, including the December colloquium given by David Spergel.

Best,
Carole





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CONTACT US

The Photon Online is the official University of Maryland-Physics online newsletter. We release an issue monthly to highlight researches, alumni, awards, honors and events. The views and opinions of our readers are valued; please contact us with any questions, ideas or comments.

The Photon Online

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