



# Joint Institute for Nuclear Astrophysics

## An NSF Physics Frontier Center



### *A note from the Director, Michael Wiescher*

Happy New Year. For many, the beginning of the new year is a time to reflect upon the accomplishments of the previous year and set goals for the future. JINA is nearing the end of its 2nd cycle, and as such, we are making preparations to extend the current cycle by 1 year, through a proposal to NSF. The coming year is also the year to request funding for a 3rd term extension of JINA. This proposal will formulate new research goals that were identified at the JINA sponsored Town Meeting during the fall of 2012. Members of the nuclear astrophysics community came together to reflect on what has happened in the field, discuss the current status, and make plans for goals in the near and long-term future. The results will be summarized in a white paper for the field of nuclear astrophysics but they will also provide the basis for opening new research directions for the JINA community. JINA seeks to continue its role as forum for the nuclear astrophysics community. While JINA will maintain its core mission to provide better experimental and theoretical data towards a better understanding of the chemical evolution of the universe, it plans to broaden its role by expanding its research initiatives to weak interaction processes in stellar and nuclear processes in dense matter. This effort has already started and we hope that we will be able to strengthen it through the involvement of a new groups of JINA researchers.

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[WWW.JINAWEB.ORG](http://WWW.JINAWEB.ORG)

Providing an intellectual center with the goal of enabling swift communication and stimulating collaborations across field boundaries, while at the same time providing a focus point in a rapidly growing and diversifying field

# The JINA Virtual Journals

Richard H. Cyburt, Timothy C. Beers, and Sam M. Austin

Nuclear astrophysics is made of many overlapping disciplines, spanning fields in Astronomy, Astrophysics and Nuclear Physics. In order to understand the origin of the elements, or the evolution and deaths of stars in galaxies, quite a broad base of knowledge is required. The Virtual Journals were created in order to meet the need for coverage of this broad-based information. The [JINA Virtual Journal](#) debuted in 2003, and reviews a broad realm of nuclear astrophysics, followed by the [SEGUE Virtual Journal](#) in 2006, focusing more on Galactic Chemical and Structural evolution.

Each week, the editors search arXiv.org and 38 refereed journals for newly published articles. Editors review the articles, flagging those that are relevant, given each VJ's selection criteria, and categorize them into their respective subjects (which are searchable by individual users). Once

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## Virtual Journal of Nuclear Astrophysics

JINA - Virtual Journal of Nuclear Astrophysics, 14 December 2012

Volume 10, Issue 50 (41 Articles)

[Search this issue...](#)

[Search all issues...](#)

**# 1 - A direct measurement of the heat release in the outer crust of the transiently accreting neutron star XTE J1709-267**

N. Degenaar, R. Wijnands, I. M. Miller

[arXiv:1212.1453 \[pdf, ps, other\]](#)

**# 2 - ARGOS II: The Galactic Bulge Survey**

K. Freeman, M. Ness, E. Wylie de Boer, E. Athanassoula, J. Bland-Hawthorn, M. Asplund, G. Lewis, D. Yong, R. Lane, L. Kiss, R. Ibata

[arXiv:1212.1541 \[pdf, ps, other\]](#)

**# 3 - ARGOS III: Stellar Populations in the Galactic Bulge of the Milky Way**

M. Ness, K. Freeman, E. Athanassoula, E. Wylie de Boer, J. Bland-Hawthorn, M. Asplund, G. F. Lewis, D. Yong, R. R. Lane, L. L. Kiss

[arXiv:1212.1540 \[pdf, ps, other\]](#)

**# 4 - ASTROD-GW: Overview and Progress**

Wei-Tou Ni

[arXiv:1212.2816 \[pdf\]](#)

**# 5 - Astrophysical tests of atomic data important for stellar Mg abundance determinations**

Lyudmila Mashonkina

[arXiv:1212.3192 \[pdf, ps, other\]](#)

*"The journal allows one to be up-to-date, even without being able to follow the ever increasing number of journals publishing manuscripts in the field of Nuclear Astrophysics. Thank you for the invaluable work!"*

## Upcoming Events

Jan. 7-11, 2013

PAN @ [IMSA](#) will include lectures from Jim Truran (U of C), Bec Shane (MSU) & Micha Kilburn (ND) and experimental equipment from ND, MSU, & QuarkNet.

Jan. 7, 2013

An [American competition](#) involving the skin of a pig. This year's competition has been deemed important by some at Notre Dame.

Jan. 9, 2013

[WaMPS](#) members visit Osborn High School in Detroit, MI.

Feb. 2, 2013

[Science Alive](#), South Bend, IN.

Feb. 6, 2013

Mini-PAN workshop for teachers at [HASTI](#) in Indianapolis, IN.

Spring 2013

Community Resource Volunteers return to NSCL for their 7th visit with marble nuclei activities.

**Save the date**

April 20, 2013

JINA members will participate in the NSCL Open House, which follows a week-long, campus-wide science festival at MSU.

## Outreach Update:

### Including ideas for you

Planning for summer camps may be a yearlong affair, but that doesn't mean JINA Outreach stops when the students return to the classroom. Laboratory tours, classroom visits, and after-school programs are staples in Lansing and South Bend during the school year.

### Science Festivals

In the fall, JINA and other Notre Dame STEM organizations participated in the 2nd annual Celebrate Science Indiana in Indianapolis, IN and Science Spectacular in Elkhart, IN. At CSI, the ND Chem Demo team stole the show with a floor-to-ceiling model carbon nanotube made from balloons. It started as just a hula hoop with each child adding a balloon. But as rings were completed it was hoisted a little higher, until the end of the day, when the nanotube was visible from every corner of the large warehouse.

Festivals are not only a great way to inspire young minds, but are also an excellent place for meeting other educators. An Indianapolis teacher was so enamored by the marble nuclei activity, she built a fragmentation box the very next week and requested marbles and a Chart of the Nuclides through our mini-grant program shortly after.

In the Spring, JINA will participate in the 21st annual Science Alive, hosted by the South Bend library system, and the 1st science festival at Michigan State University. JINA has already registered for the USA Science & Engineering Festival to take place in the spring of 2014 in Washington DC. They're serious about their early bird specials.

Are there any science festivals in your area? If you've participated, we'd like to hear about it. If you'd like to get involved, we can help!



*"Kids were telling me that they were excited to talk about science for a change."*



This group piece is on permanent display at NSCL.

### Art 2 Science

In South Bend, the JINA Art 2 Science program usually occurs in a school or community center as part of an existing after-school program. This fall, we partnered with REACH Art Studio in Lansing, MI in an effort to broaden relationships with local artists and the community. REACH hosts an after-school art program, Creative Connections, for students ages 7-12 who can not afford traditional art lessons. JINA provided ideas for science based projects, supplies, and scientists to explain the phenomenon that served as a focal point for each week's art project. The students signed up for an art program, but were thrilled by the added science component.

The new model was as successful as the school based programs in terms of student engagement. Students learned about astronomy, nuclear physics, and a little engineering as they created beautiful pieces of art. The students were so inspired by meeting scientists, they created fun nicknames to distinguish the two Zachs: "Mad Scientist Zach" and "Tattoo Zach".

We hope to duplicate this model in other cities, and in other art studios. Additionally, we are creating a series of lesson plans for use in any K-5 classroom that meet current educational standards.

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## Virtual Journal *(continued from page 2)*

the editors finish making their selections, the virtual journals are published. An email list server sends out an email notification to the nearly 400 subscribers informing them of the newly available selections from the Virtual Journals. Links to each selected article are presented; access is dependent on the subscriber's site licensing.

Please visit our webpage(s) to find out more information and to sign up for our notification service. Comments and questions are welcome.

## Town Meeting

JINA organized a Nuclear Astrophysics Town Hall Meeting on October 9-10, 2012 in Detroit, MI. 150 scientists participated and provided a wealth of material for a white paper laying out a vision for Nuclear Astrophysics. The meeting met the following goals:

- Identified compelling (and specific) open questions in nuclear astrophysics and the opportunities to address them in light of the ASTRO2010 and NP2010 decadal surveys and other developments in the field such as new accelerator facilities and observatories.
- Identified needs in nuclear physics, astronomy, and possibly other areas, as well as needs for cross-disciplinary activities to realize these opportunities.
- Generated a blue print (white paper) for the future of the field that can serve as input for various assessments and planning exercises, including the next NSAC Nuclear Science Long Range Plan.

Summaries from all working groups (as well as talks, tweets, etc) can be found on the [wiki](#).

## Up and Coming JINA Researcher Spotlight

Name: Zach Meisel

Age: 24

Hometown: Vermilion, Ohio

Education: B.S. Astrophysics – Michigan State University

Current Position: Graduate Research Assistant with Hendrik Schatz at Michigan State University

Favorite beverage: Milk



Q: When you were young, what did you want to be when you grew up?

A: When I was 10, I wanted to be a professional football player. But I'm 5' 9", 140 so that didn't work out.

Q: When did you decide to pursue astrophysics?

A: In high school I watched the Science Channel and read *A Brief History in Time*.

Q: What is your favorite aspect of your current job?

A: The variety. It's different from day to day, and month to month. Sometimes you're in the lab, other times you're at your desk. Some tasks involve more physics, while others are more like engineering.

Q: How is the Virtual Journal useful for you?

A: It's hard to keep up on the literature, so the VJ does  $\frac{3}{4}$  of the work finding the journal articles for me.

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## DIANA Hunts for Neutrons

### Exploring Neutron Background Flux in Deep Underground Labs

by Alexander Long

Deep underground in a salt mine near Carlsbad NM, a group of scientists stepped out of the mine shaft into a large cavernous room. Their headlamps illuminated the space around them as they loaded their equipment onto a transport before traveling to a rarely visited cut in the salt mine. The group was tasked to measure the radiation levels within the mine with a detector system designed specifically for that purpose. The scientists were exhausted after measuring radiation levels in a gold mine in South Dakota and then driving across country, but the setup had now reached its new home – at least for the next three months. New Mexico marked the latest stop on an exploratory project DIANA researchers have been working on for the past 2 years.

Why have these scientists been driving all over the country and descending thousands of feet into old, inactive mines, just to measure the amount of natural radiation? Let's see if the following thought experiment can help. Imagine you're outside on a chilly winter day, standing under the edge of a roof. You feel a drop of water

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## Up and Coming

(continued)

Q: Can you tell me a little about your research?

A: For my thesis project, we performed a time-of-flight mass measurement at the NSCL. Our focus was the neutron-rich nuclei in the Silicon to Zinc region. These masses will allow us to better understand heating from electron capture in the neutron star crust.

Q: How does JINA benefit you?

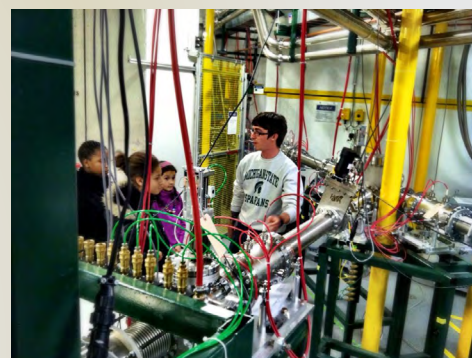
A: JINA allows me to have frequent contact with experts in the field, which would otherwise be much more difficult to obtain.

Q: Where do you see yourself in 5 years?

A: Hopefully doing a post-doc in astrophysics. I'm very interested in working in Germany at the Max Planck Institute.

Q: What about 20 years?

A: That's a long way away, but at the moment, I feel in 20 years I'd like to be doing research and probably some teaching.



JINA according to gizoogle.net

"Da overall scientific goal of JINA is ta study tha broad range of nuclear processes up in our universe dat control stellar evolution, trigger supanova events, n' lead ta thermonuclear explosions observed as novae, x-ray n' γ-ray bursts. Michael Wiescher, a Notre Dame nuclear astrophysicist n' winna of tha prestigious Bethe Prize of tha American Physical Society, serves as JINA's director." (Thanks to K. Smith for this gem)

## Outreach (continued from page 3)



*Thanks again for a great presentation. You both did a wonderful job and the boys that attended had a great time talking it up at our last Tuesday meeting.*

### Boy Scouts

Inspired by Chemistry students at MSU, JINA has begun to help Boy Scouts earn their nuclear science badges. First – yes, one of the many BSA badges is a [nuclear science badge](#). The requirements seemed daunting at first, but Alex Long and Micha Kilburn were able to facilitate the process for 10 scouts over a few short hours. Interactive lectures were supplemented with experiments, a tour of the NSL, and projects made from household goods. Although the scouts were disappointed in the lack of “things that go boom” as middle school boys are prone to be, we found ways to appease their explosive desires. Two of the scouts remarked that they wanted to be nuclear physicists when they grew up. We expect other scoutmasters to bring their troops in the future based on the success of the inaugural group.

If you live in the US, and would like to interact with local children in a meaningful way, consider hosting a BSA badge event at your institution. Not a nuclear scientist? Have no fear, with over [130 badges](#), including astronomy, chemistry, and electronics, there's a badge for (nearly) everyone. We can share our methods and supply lists for the nuclear science and astronomy badges.

Next on the list – convince the Girl Scouts to create a similar badge.

Want to write a featured article? Know a young researcher that would like to be interviewed? Have ideas for the crossword? Other ideas or tidbits you'd like to share? All “unauthored” articles are written by the [JINA Outreach Coordinator](#), and she welcomes your help!

## NSL Opens the Doors

In early November, the Nuclear Science Laboratory at Notre Dame held an open house prior to a home football game. The public lab tours were an extension of the [accelerator](#) dedication event which had been primarily for the Notre Dame community. The new accelerator will provide heavy-ion beams to the JINA funded St. George recoil separator to study astrophysical reactions in inverse kinematics. Prior to opening the doors, we had modest hopes that at least 100 people would turn out between 10 am and 1 pm, and were prepared to send tour guides (mostly JINA graduate students) outside to inform those tailgating about the opportunity to tour the lab. The plan was to start with an introduction to the lab every 15 minutes and then break the group in half if necessary for guided tours. The introduction provided a brief history of the NSL and discussed research goals, with an emphasis on nuclear astrophysics.

Perhaps inspired by the football team's success, many visitors were on campus that day. Much to our surprise, many of them had heard about the open house and were interested in nuclear physics. At 10 am, there were already 20 people in the conference room for the first round of tours. At 10:15, the room was packed for the 2nd round and had to be split into 3 groups for the actual tour.

In the end, the tours had to be extended almost 2 hours due to overwhelming demand by the enthusiastic public. Over 550 people toured the NSL facilities and learned about local JINA outreach activities. Sometimes there were more than 10 tours being given simultaneously, despite there being only 7 “tour stops.” At peak times, visitors were waiting in a line that stretched out into the hallway and we had to stall with LN2 demonstrations until tour guides were available. Scientists and football fans were able to share their mutual excitement in an unprecedented way. It was a winning day for Notre Dame, on and off the field.

## DIANA (continued from page 5)

as an icicle melts, and hold out your hand to feel the cool water. As you continue holding out your hand, you notice that on average, the icicle drips on your hand about once a second. You look up and see that the icicle actually has two dripping points, although one is much more infrequent, only releasing a drop once a minute. Without looking up, how can determine when the drop of water is from the main icicle, and when it originates in the slower one?

This is the task that faces nuclear astrophysics who want to measure low energy neutrons. On the Earth's surface, an area the size of your hand will experience cosmic radiation at an approximate rate of one per second. The detectors used to measure neutrons will experience the same radiation, which ends up drowning out the neutron signal. There are many possible solutions to the above thought experiment, such as adding a colored dye to one of the icicles, or looking for variations in the size of the drops. However, if you're only interested in the rare event, one solution would be to block the frequent drips. If you want to block cosmic radiation, the best solution is to head underground.

The DIANA (Dual Ion Accelerators for Nuclear Astrophysics) group is a multi-university collaboration working for a next-generation underground laboratory for nuclear astrophysics. There is an overlap between JINA researchers and the scientists working on DIANA as they have similar research goals. The main purpose behind the DIANA project is to investigate the low energy nuclear reactions that occur in stars using two relatively small particle accelerators. The reaction rates at stellar energies are extremely low and to investigate these reaction researchers need to reduce the background radiation as much as possible. This

demand for a low background environment prompted researchers to investigate deep underground labs across the U.S. which use 100s of meters of rock to act as a natural shielding for cosmic rays and other decay induced particles such as neutrons. By placing the DIANA project deep underground, radiation from cosmic rays can be suppressed by 6 orders of magnitude and reaction cross sections of interest to astrophysics can be measured that are currently inaccessible.

Previously, the background radiation flux has been measured at three underground sites: the Kimballton Underground Research Facility (KURF), an active limestone mine, the Soudan Underground Laboratory, an inactive iron mine, and the Sanford Underground Research Facility (SURF), an inactive gold mine. Currently, the detectors are deployed at the Waste Isolation Pilot Plant (WIPP) for comparison with the other locations, as the mine is located within a salt formation.

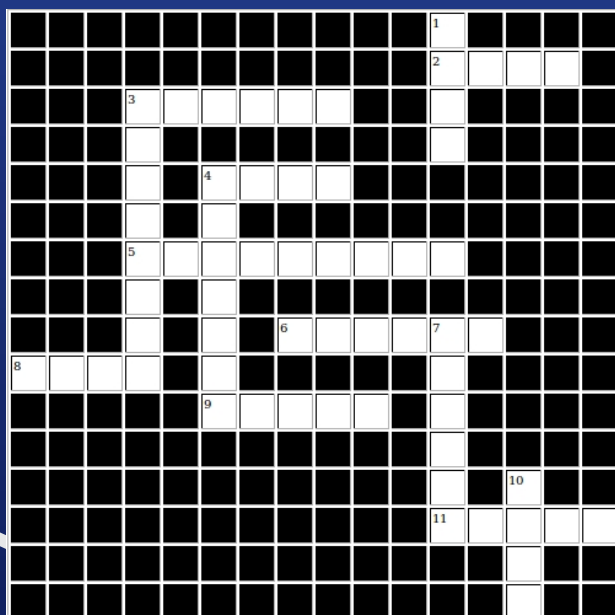
The background flux is measured with four  $^3\text{He}$  counters, two of which are placed in a moderating material of 10 cm and 5 cm depths, while the remaining two are left bare. With this setup, researchers have ability to detect background neutrons ranging from [1 to 10 MeV]. Through these survey measurements, researchers can choose the best possible site and depth for DIANA.





Stumped? Check JINA highlights and the Virtual Journal.  
First 5 people to send the completed (correct) puzzle to  
mkilburn@nd.edu will win a prize.

January 2013



#### Down

1. Proof-of-principle isotope for new Barbieri ab initio calculations with open-shells and three-nucleon interactions
3. Town Hall Meeting hashtag
4. \_\_\_\_ are cool. Seriously
7. Starting date of EMMI-JINA workshop (MMDDYY)
10. Two-neutron decay isotope recently observed with MoNA

#### Across

2. Level of Sandford Lab where neutron background levels were measured
3. Nucleosynthesis code used by Nova Framework
4. method of composition analysis with proton beams
5. Second r-process peak element
6. PAN application due date (MMDDYY)
8. Mass measurement isotope with insight for accreting neutron stars
9. Lagrangian particle code used by Hawley to model nucleosynthesis in white dwarf collisions
11. Neutron skin isotope

Already nostalgic for Christmas music?  
Fill the void with some physics humor

#### Member Institutions

[University of Notre Dame](#)  
[Michigan State University](#)  
[University of Chicago](#)

#### Participating Institutions

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[Hope College, MI](#)  
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