

Astronomy News

Case Western Reserve University Department of Astronomy

2010/11

Harding and Morrison Named SDSS Architects



Dr. Paul Harding



Professor Heather Morrison

This fall, Observatory Manager **Paul Harding** and Professor **Heather Morrison** were named to "Architect Status" in the third phase of the Sloan Digital Sky Survey (SDSS) project. SDSS is a major international project surveying the sky and mapping out the distribution of stars and galaxies in our universe. It is one of the most influential projects in modern astronomy, revolutionizing many areas of astronomy and cosmology. Over 400 scientists are involved in the SDSS-III project, at more than 20 institutions spanning the globe, from the US to Europe, South America, and Asia. In the consortium, the status of a "Survey Architect" is reserved for those individuals who have made very significant contributions to the design, construction, execution and management of the project. Less than 20% of SDSS scientists achieve this status, and it is a sign not just of scientific expertise and capability, but also of professional leadership and development.

Harding's Architect status is based on his many contributions -- both scientific and technical -- to the success of all aspects of SDSS-III; in particular, his work on the engineering team developing the instrumentation critical for the survey. Harding has spent many days and nights on the mountain at Apache Point, New Mexico, where the SDSS telescope is housed, and has become an indispensable member of the on-site SDSS community there. In Morrison's case, her work with the SEGUE-II portion of the SDSS survey (see page 2) led to her award of Architect status. She is the SEGUE Survey Science Team Chair, and has made significant scientific contributions towards the SEGUE survey throughout its development.

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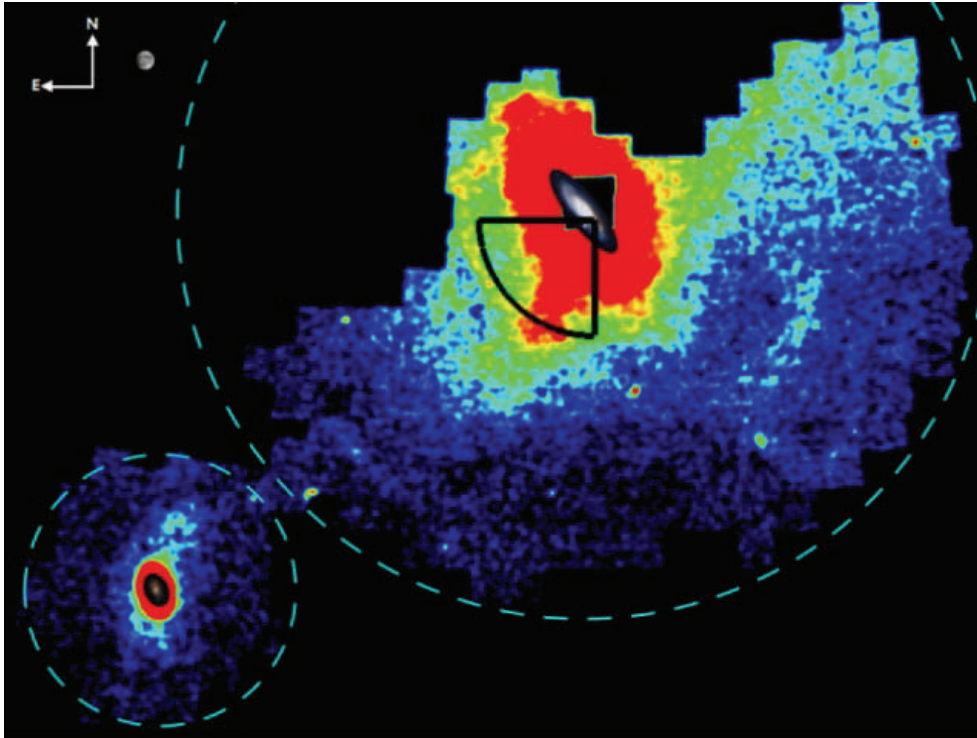
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Mapping the Milky Way's Halo



The halos of M31 and M33 as revealed by star count data (Alan McConnachie)

We know a great deal more about the outer reaches of the Andromeda galaxy, the nearest large spiral to our own Milky Way, than we do about the outer parts of our own Galaxy, despite the fact that Andromeda lies more than 2 million light years away. **Heather Morrison** was recently awarded a three year grant from the NSF to remedy this situation. The image shows the latest image of Andromeda's (M31's) halo, made by a group led by Scottish astronomer Alan McConnachie: note the better-known, bright parts of Andromeda are in the tiny region of the large galaxy right at its center, and this map stretches over an enormous distance, all the way to M31's satellite galaxy M33 (the Triangulum) at bottom left. Galaxy halos were once thought to be relatively unexciting places, but the M31 map shows a great deal of substructure in its halo, most obviously the Giant Stream stretching down and to the left from its center. These streams were formed when smaller galaxies fell into Andromeda and were torn apart by its gravitational tidal forces.

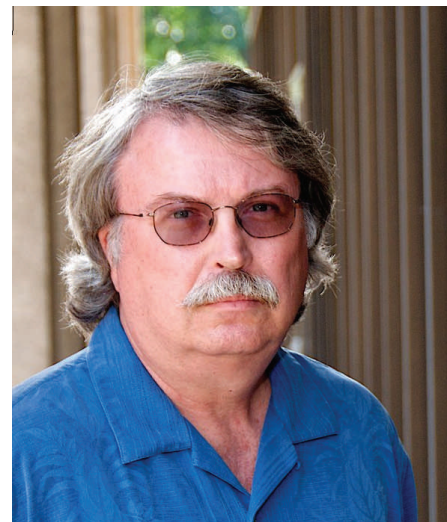
"It's likely that the outer halo of the Milky Way is similarly messy," says Morrison, "But we really don't know." It is a lot more difficult to survey the outer parts of our own Galaxy than other galaxies, because they cover the entire sky. Luckily Morrison and her collaborator **Paul Harding** have worked out how to use the SDSS-III BOSS survey of distant galaxies and quasars to survey a much larger part of the sky than was previously possible. The quadrant in the center of the image outlines the region of our halo which has been mapped so far; Morrison and Harding's new technique will make it possible to extend out five times further in distance. Because at that distance there are only a few halo stars per SDSS plate, their survey can "piggyback" on the much larger BOSS survey without ill effects. This will be the first time that our halo will be mapped out to such a large distance over a full quarter of the sky.

Morrison's grant will support her graduate student **Zhibo (Real) Ma**, who is currently working with Morrison and undergraduate **Bill Janesh** on the early data for these maps. "We will know surpassingly more about the infall history of our own Galaxy, and about its dark matter content, when we have all the data," says Morrison, adding that her piggyback survey was rated highly by the SDSS-III and NSF review panels. "Piggyback surveys are cheap!"

Research Notes

Distances to Stars

In studies of the structure of the Milky Way, one of the most difficult and fundamental problems is determining distances to individual stars. Without parallax, the problem reduces to measuring the absolute and apparent magnitudes (brightnesses) and the line of sight extinction. Except for the apparent magnitude, this is a daunting task, especially for objects kiloparsecs from the solar region. Professor **Earle Luck** and colleagues in the Ukraine have recently published work that helps alleviate this problem for a selected subset of stars. The stars, supergiants of near-solar temperature, are excellent probes of distant regions of Milky Way as they are intrinsically bright. The difficulty in using them as probes has been determining exactly how bright an individual supergiant is.



Professor R. Earle Luck

Using supergiants with known absolute magnitudes (Cepheids with known parallax), Professor Luck and his colleagues correlated criteria measured using high-resolution spectra, specifically line-ratios, with absolute magnitude. This means that for any star of this class the absolute magnitude can now be determined, provided a high-resolution spectrum is available. The line of sight extinction can be determined by comparing the observed and intrinsic color of a star, and prior work done by Professor Luck and the Ukrainian group yields a method to determine this intrinsic color of supergiants using the same spectrum that provides the absolute magnitude. Professor Luck's work is a part of a larger project to determine the 2D metallicity distribution in the Milky Way disk, and these new calibrations will allow many more stars to be folded into this determination, increasing the area and range of density covered by the survey. The next step in distance determinations for distant stars awaits Gaia, a space mission to be launched in 2012, whose mission is to determine the properties, including the distance, of over one billion stars.

Galaxy clustering in the Universe

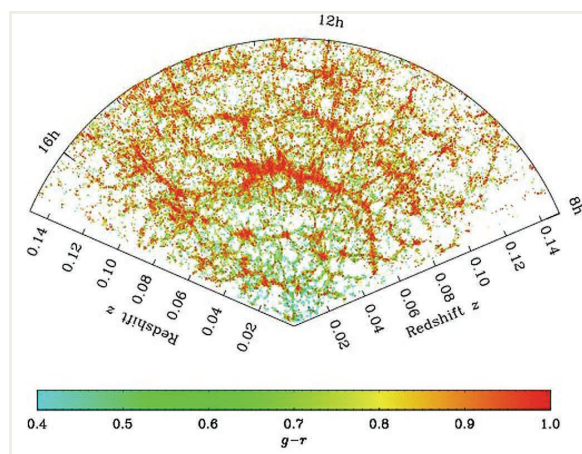


Professor Idit Zehavi

CWRU astronomer **Idit Zehavi** is the lead author on a paper studying galaxy clustering in the Sloan Digital Sky Survey. SDSS is an ambitious survey mapping a quarter of the sky and includes three-dimensional positions for about a Million galaxies, making it the largest existing galaxy redshift survey. The image shows the spatial distribution of galaxies in a slice from the survey. Each point represents a galaxy, color-coded by its intrinsic color.

Zehavi and collaborators have studied this distinct clustering pattern and its dependence on different galaxy properties. They find that the clustering

strength increases with galaxy luminosity, and that red (elliptical) galaxies exhibit stronger and steeper clustering than blue (spiral) galaxies. Interpreting the measurements sheds light on the relation between galaxies and dark matter and provides insight on the complex picture of galaxy formation. The paper is expected to be published in the *Astrophysical Journal* in the coming year.



Galaxies in the SDSS survey (Idit Zehavi)

Student Highlight: Lauren Nicholson



Lauren Nicholson (BS 2012), with Clyde Simpson (left) and Jason Davis

For the last year, I have been volunteering at the Cleveland Museum of Natural History in their astronomy department. In that year I've put in ~100 hours of work, been a part of many improvements and events, learned more about myself and my goals in life, and made a group of very close friends. Every Wednesday night, even in mid-January, you can find me at the Museum running the telescope and answering questions during the public observation time. Clyde Simpson (who never ceases to amaze me with the amount of knowledge he possesses about everything) taught me about the museum and Cleveland's history, not to mention how to use a sextant and artificial horizon.

I was also pulled into the planetarium, working with Jason Davis (who is in charge of shows and making everything miraculously work) and fellow volunteer Wayne Kriynovich, both of whom continue to look out for me. This summer was extremely exciting – we installed a brand new digital projection system! After tearing everything old out and putting in the new, we had a week to learn the code and get a show ready for the grand reopening – aack! We somehow finished, and this summer I also gave my first show rather than just running the computers. I much prefer being the pilot, though; the new system actually flies through the universe using the latest survey catalogs, and it's such a cool thing to be able to control space and fly several thousand times faster than the speed of light!

This side of astronomy is fundamental to dealing with the public, and although it took a lot of getting used to, I really enjoy my position at the museum. So much so, in fact, that I'm considering options besides my long-held goal of going to grad school... maybe I'll try teaching, or look into planetarium positions. Who knows? But the last year I've spent at the museum has opened many doors for me, and given me a chance to meet and get to know others in the Case Astronomy community. I'll continue to be up in the dome – with the necessary Under armor and wool socks, now that it's cold again – for as long as I'm here at Case. So, be sure to visit and say hi! **-Lauren**

Lauren Kahre Named Seyfert Fellow

Our 2010 Seyfert Fellowship was awarded to University of Alabama, Huntsville undergraduate student **Lauren Kahre**, who spent the summer in residence at CWRU working with Prof. Chris Mihos on analysis of deep imaging of the Virgo Cluster from the Burrell Schmidt and the Canada France Hawaii Telescope (CFHT). Lauren compared the locations of globular cluster candidates in Virgo with the spatial distribution of the diffuse intracluster light, searching for evidence of "intracluster globular clusters." As part of this work, Lauren developed advanced models of scattered light in the CFHT imaging, which will significantly improve the surface photometry from the Next Generation Virgo Survey, an international project (on which Mihos is a co-I) to map the Virgo cluster in exquisite detail using CFHT.

The Fellowship supports one undergraduate student each summer to come to Cleveland and work on cutting-edge astronomical research with CWRU faculty members. The Seyfert Fellowship is awarded based on a national competition each spring.

The Fellowship's namesake, Dr. Carl Seyfert (1911-1960), was a Cleveland-born astronomer who worked on a variety of subjects, including stellar and galactic astronomy and astronomical instrumentation. Dr. Seyfert was also a member of the Warner and Swasey Observatory at Case Western Reserve University from 1942-1946, where he used the Burrell Schmidt wide-field telescope to study the luminosity function of stars in the Milky Way.

The Seyfert Fellowship has been made possible by a generous contribution from CWRU Astronomy alumnus Dr. Anthony J. Wasilewski, whose doctoral thesis was based in part on Seyfert's pioneering work on active galaxies.



Summer 2010 undergraduate researchers: front row: Lauren Kahre (Seyfert Fellow), Lauren Nicholson (BS 2012); back row: Phoebe Stierhoff (BS 2011-ENGR), Chelsea Spengler (BS 2012), Daniel Lalich (BS 2012), Bill Janesh (BS 2011)

Both of these projects let me learn just how much work goes into data analysis and preparation and let me have extensive practice in computer code. I had a lot of fun, both working in the lab and hanging out with the other undergraduate students in the department. Aside from a trip up to Cedar Point (which was a blast), they showed me around the area and took me up to the Warner and Swasey telescope on-campus for a night. Thanks to everyone in the astronomy department for a fun and educational summer!

-Lauren Kahre

Frontiers of Astronomy Lectures Series

Since the 1920's the Department of Astronomy has sponsored a public lecture series entitled Frontiers of Astronomy. These public talks are presented at the Cleveland Museum of Natural History with the Cleveland Astronomical Society and the Cleveland Museum of Natural History as co-sponsors with the support of the Arthur S. Holden, Sr. Endowment. The 2009/10 series of five lectures drew more than 1450 attendees.



Cleveland Museum of Natural History

The 2010/11 lecture series kicked off this fall with lectures from Bill Cochran (UT Austin) on the Kepler mission to find extrasolar planets, from Charlie Lada (Harvard/CfA) on the formation of stars, and from Stacy McGaugh (Maryland) on gravity and cosmology. This spring we will have two more lectures in the series. On March 10, Betsy Barton (UC Irvine) will tell us about the search for distant galaxies, while on April 14, Nick Suntzeff (Texas A&M) will talk about cosmology and the origins of our Universe.

If you are in the Cleveland area, please consider attending these free public lectures. Check out our website: <http://astronomy.case.edu> for more information.

Chair's Space



Professor Chris Mihos

Welcome to the latest issue of Astronomy News, full of stories about the research, teaching, and outreach efforts of CWRU astronomers and students.

This past year has brought us a variety of new research opportunities, and we offer you a sampling of that research here. We are very proud of our Sloan Architects, Paul Harding and Heather Morrison, and you can read about their accomplishments in our cover story. The most recent issue of **art/sci** -- the magazine of the CWRU College of Arts and Sciences -- also featured a story about our research on star streams in the Milky Way and in the Virgo Cluster; if you missed it, you can find it online at <http://www.case.edu/artsci/artsci-fall-winter-2010/>

Our students continue to excel in many different ways. Of course they are actively involved in our research efforts, but this year we thought we'd also highlight some of the outreach activity they do. Undergraduate student Lauren Nicholson has been volunteering at the Cleveland Museum of Natural History, continuing a long tradition of collaboration between CWRU Astronomy and the Museum, and we are pleased to bring her story to you here.

The support of our friends and alumni plays a critical role in many of these activities, and we thank you very much for this help. We'd love to hear your own stories, get feedback on our newsletter, and find out what you'd like to see featured in upcoming issues. There are plenty of ways to connect with us. Our web home is at <http://astronomy.case.edu>, and now you can find us on Facebook as well (search on "CWRU Astronomy"). You can also drop us a note using the attached envelope, or send us an email at dept@astronomy.case.edu. Thanks much, and enjoy!

Alumni Updates

What they are up to, where they have gone . . .

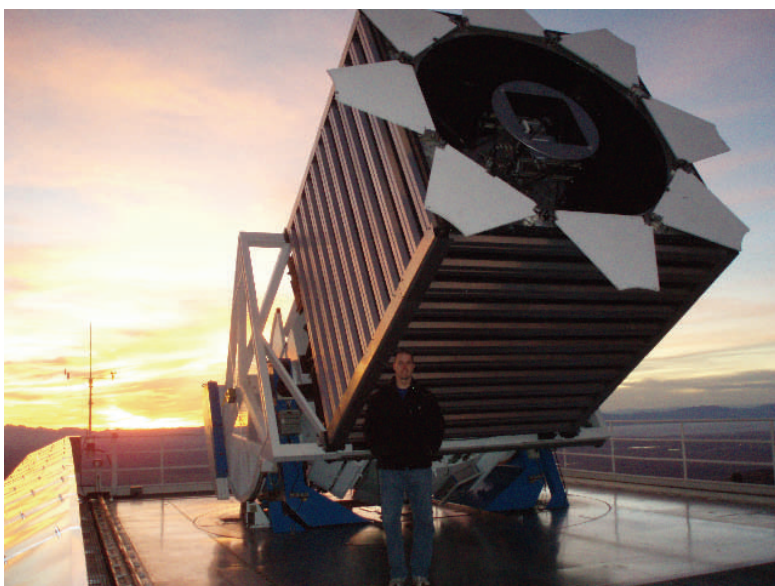


Dr. Craig Rudick

Craig Rudick (PhD 2010) finished his doctoral dissertation studying the intracluster light in galaxy clusters and moved to Switzerland with his family, where he is working with Dr. Marcella Carollo studying the properties of groups of galaxies in the local universe.

Colin Slater (BS 2009) is now in the Astronomy graduate program at the University of Michigan and writes: I'm working with Eric Bell on the Pan-STARRS project, which will use a 1.8 meter telescope to survey three quarters of the sky. We are going to be using the survey to search for Tidal streams and substructure in the Milky Way halo, and to use these structures to determine the aggregate properties of the dwarf galaxies that the halo was built from. This work is very similar to what I did at Case with Paul Harding and Heather Morrison, which gave me a great introduction to the field.

Santiago Patiri finished his term as a postdoctoral scholar at the CWRU Astronomy Department working with Prof. *Idit Zehavi*. He returned to his native Argentina to take an Associate Research Staff position at the Mendoza Center for Science and Technology funded by the Argentinean National Research Council. The Mendoza Center is also the home of CWRU Astronomy alumnus **Richard Branham (PhD 1977)**.



Dan Oravetz in front of the SDSS Telescope (Dan Oravetz)

Dan Oravetz (BS 2006) has worked at Apache Point Observatory, New Mexico as an Observer for the Sloan Digital Sky Survey since 2007. He is concurrently studying for his Masters degree in astrophysics at New Mexico State University. As well as observing with the 2.5m SDSS telescope he specializes in re-coating of the telescope mirrors at APO: this involves removing the mirror from the telescope and driving it (carefully!) to the aluminizing chamber at Kitt Peak in Tucson. Dan has now made this trip twice with the 2.5m mirror and once with the 3.5m mirror. Because of CWRU astronomy's ongoing membership in SDSS, Dan sees Paul Harding, our Observatory Manager, regularly.

Shu Guo, who has been the Astronomy Librarian since January 2009, is leaving us to join Central Michigan University in Mount Pleasant, Michigan as an Assistant Professor and Science Librarian. We thank Shu for all her work in our library and wish her best of luck in Michigan!

We want to hear from you!

Let us know about your job changes, awards, honors and life events. Please email your news and contact information updates to dept@astronomy.case.edu.

The SuperAstronomers Save the (April Fool's) Day!

April Fool's always brings strange things to the Astronomy Department, and this year was no different. With posters expertly drawn by **Andy Balko** (BS 2010), and a comic book sketched by **Liz Palmer** (BS 2011), April Fool's Day 2010 saw the evil Cosmo-Not (played by CWRU physicist Dan Akerib) arrive on campus to destroy CWRU Astronomy. Luckily, the SuperAstronomers showed up to thwart Cosmo-Not's dastardly plan! Read the comic yourself at <http://astronomy.case.edu/SuperAstronomers.pdf>.



*Dark Matter Dude,
Professor Mihos' alter ego*

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