

## Goddard Leave Summary

This is a brief summary of my activity on my Goddard Fellowship leave from NYU for the Spring Term and Summer of 2005. I spent this leave at the Massachusetts Institute of Technology, where I was hosted by the MIT Kavli Institute for Astrophysics and Space Research.

Before I begin, I would like to thank the Kavli Institute and its director, Jackie Hewitt, for hospitality, a spacious office, and technical support, Arlyn Hertz for providing wonderful administrative support, and the faculty at MIT, especially Max Tegmark (my official host), Ed Bertschinger, Paul Schechter, and Scott Burles for providing an enjoyable, productive, and distracting research environment for my stay.

### Research

Almost all of my research presently is related to the evolution of galaxies. I am concentrating on the rates and modes by which galaxies build up mass by merging and accretion.

In this area, most of my research during the leave was on the subject of galaxies that are undergoing, or have recently undergone, a significant burst of star-formation. These galaxies are post-merger candidates, and our work has shown that we can use them (and rudimentary stellar evolution) to determine relatively precise “event rates” (merger rates, we hope). With collaborators, I wrote a short paper on the possible causation mechanisms for the star-bursts, by looking at the statistical properties of the galaxy environments. We found that we could rule out several non-merger origins for the bulk of the bursts (including tidal stresses and IGM shocks), improving the prospects for interpretation of the post-starburst galaxies as post-merger galaxies, and the “event rate” as a merger rate.

I mentored and supervised NYU graduate student Morad Masjedi (who accompanied me at MIT on my leave) in his completion of his most significant piece of research to date, a measurement of the correlation function (clustering) of galaxies at extremely small scales, and the interpretation of that clustering in the context of galaxy–galaxy mergers.

I started discussions with MIT faculty member Scott Burles regarding his new project (of which I will be a part) of extremely massive spectroscopy made possible by a proposed prism modification to the IMACS instrument at the Magellan Observatory. This will allow Masjedi’s project and projects like it to be pushed to higher redshifts.

During the Spring semester, I visited Kitt Peak to observe some extremely low-mass companions to the Milky Way, as part of my group’s program of studying the very lowest masses in the mass function. This work is very interesting at present, both because the mass function shows a huge discrepancy between theory and observation, and because these low-mass objects are constantly accreting onto the Milky Way; they represent the near-future accretion material for our own Galaxy. Masjedi and I reduced the observations; they have been analyzed by NYU postdoc Beth Willman; and they appear to show mass segregation and tidal distress for these objects; both effects will lead to a better understanding of this accretion process.

With my NYU group I applied for and obtained time on the *Spitzer Space Telescope* to

perform spectroscopy and imaging in the mid-infrared on the lowest-mass galaxies known in the local Universe. By the end of the Summer semester, some of these data were starting to arrive.

I started a project on automated detection of gravitational lenses with Roger Blandford's group at the Stanford Linear Accelerator Center.

I was invited to give reviews of low-redshift galaxy evolution at two large, international conferences. I was pleased to take the opportunity of my leave to travel extensively (see below).

Finally, I timed my leave at MIT to coincide with a long-term visit to the MIT Computer Science Artificial Intelligence Laboratory by my collaborator Sam Roweis (Department of Computer Science, University of Toronto). He and I are working on an enormous project to manage large data sets. We made significant progress on this project which, in the short term, will rid the astronomical world of the need to log, determine, or store astrometric "world coordinate systems" in astronomical imaging. For more information, point your browser to "<http://astrometry.net/>". MIT was an ideal place to foster this interdisciplinary, inter-institutional, and international collaboration.

## Invited lectures

Aside from my regular travel to the American Astronomical Society Meeting in San Diego and an informal talk at MIT, here is a list of invited talks I gave while on my leave:

2005 February 3: Harlow Shapley Lectures (supported by the American Astronomical Society), Texas Tech University, Lubbock TX

2005 February 10: Astrophysics Colloquium, McGill University, Montreal QC

2005 March 1: Invited review at the "Cosmology with Clusters of Galaxies" meeting, Kona HI

2005 March 8: Harvard Center for Astrophysics Theoretical Astrophysics Seminar, Cambridge MA

2005 March 14: Astrophysics Colloquium, University of Virginia, Charlottesville VA

2005 March 22: Stanford Linear Accelerator Center Kavli Institute for Theoretical Physics Astrophysics Tea Talk, Palo Alto CA

2005 June 20: Invited review at "The Fabulous Destiny of Galaxies: Bridging Past and Present", Marseille, France

I also declined two invitations, one to give a review of survey science at the SLAC Summer Institute workshop, and one to give a review at the Schloss Ringberg (Germany) workshop on "Distant Clusters of Galaxies".

## Service

As hard as I tried to irresponsibly ignore all non-research commitments, I did agree to be the chair of one of the panels that made the time allocations for Cycle 2 of the *Spitzer Space Telescope*, during one very hard week in April. I also participated in NYU's faculty and postdoc recruitment processes, which netted NYU one new faculty member in astrophysics

and netted my group one new postdoc.

## Publications

Here are the publications I started or contributed to significantly during my leave:

- Adelman-McCarthy, J. K. *et al*, 2006, The Fourth Data Release of the Sloan Digital Sky Survey, *Astrophys. J., Supp. Ser.* [in press].
- Hogg, D. W., Masjedi, M., Berlind, A. A., Blanton, M. R., Quintero, A. D., & Brinkmann, J., The environments of post-starburst galaxies, *Astrophys. J.* [submitted].
- Willman, B. *et al*, Willman 1: A Galactic satellite at 40 kpc with multiple tidal tails, *Astrophys. J.* [submitted].
- Hogg, D. W., Constraints on galaxy formation and evolution from observations of the low-redshift Universe, [in preparation].
- Masjedi, M. *et al*, The very small-scale clustering of luminous red galaxies, [in preparation].
- Quintero, A. D., Berlind, A. A, Blanton, M. R., & Hogg, D. W., Galaxy properties as a function of clustocentric distance, [in preparation].
- Roweis, S., Hogg, D. W., & Masjedi, M., Automated Astrometry I: Blind determination of image pointing, rotation, and scale, [in preparation].