CURRICULUM VITAE
MICHELE D. THORNLEY

CURRENT POSITION:
Assistant Professor
Department of Physics & Astronomy
Bucknell University
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EDUCATION:

Ph.D. (Astronomy) May 1997, University of Maryland, College Park. Dissertation: "Dynamical Influences in Flocculent Galaxies: An Examination of Structure and Star Formation". Advisor: Dr. Lee G. Mundy.

M.S. (Astronomy) December 1994, University of Maryland, College Park.

B.S. (Physics, with Honors) May 1990, University of Puget Sound.

APPOINTMENTS:

- Visiting Astronomer, Observatoire de Bordeaux, June 2005.
- Visiting Astronomer, Space Telescope Science Institute, 2003-04.
- Assistant Professor, Department of Physics, Bucknell University, 2000-present.
- Jansky Postdoctoral Research Fellow, National Radio Astronomy Observatory, Charlottesville, VA, 1998-2000. Academic Host: Dr. Paul Vanden Bout.
- Alexander von Humboldt Research Fellow, Max-Planck-Institut fuer extraterrestrische Physik, Garching bei Muenchen, Germany, 1997-1998. Academic Host: Dr. Reinhard Genzel.
- Graduate Research Assistant, Laboratory for Millimeter-wave Astronomy, Department of Astronomy, University of Maryland, College Park, 1994-1996.
- Graduate Teaching Assistant, Department of Astronomy, University of Maryland, College Park, 1990-1993.

SERVICE:

- Member, Renewing Small Telescopes for Astronomical Research (ReSTAR) Committee, 2007-.
- Member, National Radio Astronomy Observatory Users Committee, 2003-2006 (Chair: 2006).

PROFESSIONAL SOCIETIES:

- American Astronomical Society
- American Institute of Physics
- International Astronomical Union

RESEARCH INTERESTS:
My research focuses on the development and evolution of large-scale structure in external galaxies, and in particular how that structure is related to the star formation process on kiloparsec scales. My research utilizes observations of external galaxies over a wide range of wavelengths, from radio to optical wavelengths. In particular, I study the morphology and kinematics of molecular gas, atomic gas, and interstellar dust in nearby galaxies, in order to explore their relationship to star formation and the overall distribution of stellar mass in galaxies.

GRANTS
JPL/NASA (ID 1224769/1407), P.I. R. Kennicutt, plus 15 co-investigators: "SINGS: Spitzer Infrared Nearby Galaxies Survey", $117,500 (2000-2007).

TEACHING & OUTREACH:
As of the end of the 2006-2007 academic year, my teaching experience includes:

- Seven semesters of Introductory Astronomy (ASTR101/102: two-semester sequence, lecture and laboratory, 80-90 students enrolled per semester.) The laboratory component of this course includes a sequence of night-sky observing labs that incorporate 8-inch Meade LX200 telescopes and SBIG CCD cameras.
- Five semesters of Introductory Physics (PHYS 211/212: two-semester sequence, laboratory and recitations, 25-60 students per semester.)
- Two semesters of Electromagnetic Theory I (PHYS 333: intensive problem solving lecture course for physics, engineering and mathematics majors, approximately 10-12 students each time the course is offered.)
- One semester of Astrophysics (ASTR401/PHYS401: rigorous introduction to astrophysics for junior and senior physics, engineering, and mathematics majors, approximately 10-15 students each time the course is offered.)
- One semester of Modern Optics (PHYS303: upper-division elective course for physics majors, approximately 5-10 students each time the course is offered.)

In addition, I have been actively involved with Bucknell Observatory public outreach activities, which bring approximately 500-1000 visitors to the Observatory each year. These activities involve biannual Observatory Open Houses, as well as numerous visits by Girl and Boy Scout troops, and local elementary and middle school classes.

RECENT AND ONGOING SURVEY PROJECTS:
Most of my recent research efforts have been influenced by one or more of the following collaborations.

- **BIMA SONG**: The BIMA CO Survey of Nearby spiral Galaxies
  (co-P.I.'s T. Helfer, M. Regan, M. Thornley)
  BIMA SONG is a survey of the molecular gas distributions in a sample of 44 nearby spiral galaxies, using both the Berkeley-Illinois-Maryland Association (BIMA) Millimeter Array (now part of CARMA) and the NRAO 12m telescope (now operated by Steward Observatory). This collaboration incorporated the efforts of 9 scientists at 6

different institutions. All of the final maps and data cubes have now been made available to the public in an online catalog via the NASA/IPAC Extragalactic Database (NED). Analysis exploring different aspects of the data is still ongoing, by both survey team members and members of the community accessing the database. Two Ph.D. dissertations were completed with significant use of BIMA SONG data, and two Bucknell undergraduate students have been involved in research for this project.

- **SINGS**: Spitzer Infrared Nearby Galaxies Survey
  (PI: R. Kennicutt)
  I am one of the original 15 co-investigators for SINGS, one of the six Spitzer Legacy projects. The Spitzer Legacy projects were each given a large amount of observing time on the Spitzer Space Telescope in return for the responsibility of producing a large database of general utility to the astronomical community. With SINGS we are studying all aspects of the star formation process in 75 galaxies from a mid-infrared wavelength perspective. The aim of the project is to provide a "dust-free" perspective with which multiwavelength observations of various aspects of the star formation process, from formation to interaction with the surrounding environment, can be compared and cross-calibrated. In particular, I am involved in the mid-infrared imaging part of the program (using IRAC and MIPS), and in the comparison of Spitzer data with data at other wavelengths (particularly radio and millimeter). Through a succession of data releases through the Spitzer Science Center, the majority of SINGS data are now accessible to the general astronomical community. This project is in its final year of grant funding, and now involves more than 30 scientists at 14 institutions in the US and Europe.

- **THINGS:** The HI Nearby Galaxies Survey
  (PI: F. Walter)
  A complementary project to SINGS, THINGS provides a measure of the distribution of atomic hydrogen emission at the highest possible angular and spectral resolution possible over the disks of 34 nearby galaxies, using data taken with multiple configurations of the Very Large Array (VLA). To maximize the spatial and dynamical resolution implied by these observations, the sample includes the nearest actively starforming members of the SINGS sample. Observations are now complete, and analysis and database construction are now ongoing.

SUPERVISED UNDERGRADUATE RESEARCH:

- Dustin Bambic, REU student at NRAO Charlottesville (1999). Project: "NGC 7331: Examining Density Wave Contributions in Flocculent Galaxies."
- Richard Magee, SINGS research student (2001). Currently: graduate student at the University of Wisconsin, Madison. Project: "Nearby Galaxies in the Near Infrared."
- Richard Cool[*], REU student at Bucknell University (2001). Currently: NSF graduate fellow at the University of Arizona. Project: "Search for H_2O masers in protostellar disks."

[*] Co-advised with Prof. Jack Gallimore, Bucknell University.

- Courtney Spohn-Larkins, Buckell Research Student (2002). Currently: graduate student at Colorado State University. Project: "Radial Structure in Molecular and Stellar Disks of BIMA SONG Galaxies."
- Christopher Wolfe*, REU student at Bucknell University (2003). Currently: graduate student at Lehigh University. Project: "Candidate protostellar disks in NGC 2071 IRS 1 and IRS 3."
- Heather Beck*, REU student at Bucknell University (2003). Currently: graduate student at the University of Virginia. Project: "Rotation of a H_2O maser disk in Cepheus A."
- Esther Chapman, REU student at Bucknell University (2006). Project: "The Relationship of Atomic Gas and Aromatic Emission in SINGS Spirals."

SELECTED REFEREED PUBLICATIONS:

Calzetti, D., Kennicutt, R. C., Engelbracht, C. W., Leitherer, C., Draine, B. T., Kewley, L., Moustakas, J., Sosey, M., Dale, D. A., Gordon, K. D., Helou, G. X., Hollenbach, D. J., Armus, L., Bendo, G., Bot, C., Buckalew, B., Jarrett, T., Li, A., Meyer, M., Murphy, E. J., Prescott, M., Regan, M. W., Rieke, G. H., Roussel, H., Sheth, K., Smith, J. D. T., & **Thornley, M. D.**, Walter, F. 2007, *The Calibration of Mid-Infrared Star Formation Rate Indicators*, Astrophysical Journal, accepted (astro-ph/0705.3377).

Cannon, J.M., Walter, F., Armus, L., Bendo, G. J., Calzetti, D., Draine, B. T., Engelbracht, C.W., Helou, G., Kennicutt, R. C., Jr., Leitherer, C., Roussel, H., Bot, C. ,Buckalew, B. A., Dale, D. A. , de Blok, W. J. G. , Gordon, K. D. , Hollenbach, D. J. , Jarrett, T. H., Meyer, M. J., Murphy, E. J., Sheth, K., & **Thornley, M. D. 2006**, *The Nature of Infrared Emission in the Local Group Dwarf Galaxy NGC 6822 as Revealed by Spitzer*, Astrophysical Journal, 652, 1170.

Regan, M.W., **Thornley, M.D.**, Vogel, S.N., Sheth, K., Draine, B. T., Hollenbach, D. J., Meyer, M., Dale, D. A., Engelbracht, C. W., Kennicutt, R. C., Armus, L., Buckalew, B., Calzetti, D., Gordon, K. D., Helou, G., Leitherer, C., Malhotra, S., Murphy, E., Rieke, G. H., Rieke, M. J., & Smith, J. D. 2006, *The Radial Distribution of the Interstellar Medium in Disk Galaxies: Evidence for Secular Evolution*, Astrophysical Journal, 652, 1112.

Murphy, E. J., Helou, G., Braun, R., Kenney, J. D. P., Armus, L., Calzetti, D., Draine, B. T., Kennicutt, Jr., R. C., Roussel, H., Walter, F., Bendo, G. J., Buckalew, B., Dale, D. A., Engelbracht, C. W., Smith, J. D. T. & **Thornley, M. D.** 2006, *The Effect of Star Formation on the Far-Infrared-Radio Correlation within Galaxies*, Astrophysical Journal Letters, 651, 111.

Thornley, M.D., Braine, J., & Gardan, E. 2006, *Infrared Dust Emission in the Outer Disk of M51*, Astrophysical Journal Letters, 651, 101.

Cannon, J. M., Smith, J.-D. T., Walter, F., Bendo, G. J., Calzetti, D., Dale, D. A., Draine, B. T., Engelbracht, C. W., Gordon, K. D., Helou, G., Kennicutt, Jr., R. C., Leitherer, C., Armus, L., Buckalew, B. A., Hollenbach, D. J., Jarrett, T. H., Li, A., Meyer, M. J., Murphy, E. J., Regan, M. W., Rieke, G. H., Rieke, M. J., Roussel, H., Sheth, K., & **Thornley, M. D.** 2006, *Warm Dust and Spatially Variable Polycyclic Aromatic Hydrocarbon Emission in the Dwarf Starburst Galaxy NGC 1705*, Astrophysical Journal, 647, 293.

Murphy, E. J., Braun, R., Helou, G., Armus, L., Kenney, J. D. P., Gordon, K. D., Bendo, G. J., Dale, D. A., Walter, F., Oosterloo, T. A., Kennicutt, Jr., R. C., Calzetti, D., Cannon, J. M., Draine, B. T., Engelbracht, C. W., Hollenbach, D. J., Jarrett, T. H., Kewley, L. J., Leitherer, C., Li, A., Meyer, M. J., Regan, M. W., Rieke, G. H., Rieke, M. J., Roussel, H., Sheth, K., Smith, J. D. T., & **Thornley, M. D.** 2006, *An Initial Look at the Far-Infrared-Radio Correlation within Nearby Star-forming Galaxies Using the Spitzer Space Telescope*, Astrophysical Journal, 638, 157.

Calzetti, D., Kennicutt, Jr., R. C., Bianchi, L., Thilker, D. A., Dale, D. A., Engelbracht, C. W., Leitherer, C., Meyer, M. J., Sosey, M. L., Mutchler, M., Regan, M. W., **Thornley, M. D.**, Armus, L., Bendo, G. J., Boissier, S., Boselli, A., Draine, B. T., Gordon, K. D., Helou, G., Hollenbach, D. J., Kewley, L., Madore, B. F., Martin, D. C., Murphy, E. J., Rieke, G. H., Rieke, M. J., Roussel, H., Sheth, K., Smith, J. D., Walter, F., White, B. A., Yi, S., Scoville, N. Z., Polletta, M., & Lindler, D., *Star Formation in NGC 5194 (M51a): The Panchromatic View from GALEX to Spitzer*, Astrophysical Journal, 633, 871.

Sheth, K.,Vogel, S.N., Regan, M.W., **Thornley, M.D.,** & Teuben, P.J. 2005, *Secular Evolution via Bar-Driven Gas Inflow: Results from BIMA SONG*, Astrophysical Journal, 632, 217.

Cannon, J.M., Walter, F.; Bendo, G.J., Calzetti, D., Dale, D.A., Draine, B.T., Engelbracht, C.W., Gordon, K.D., Helou, G., Kennicutt, R.C., Jr., Murphy, E.J., **Thornley, M.D**., Armus, L., Hollenbach, D.J., Leitherer, C., Regan, M.W., Roussel, H., Sheth, K. 2005, *Spitzer Observations of the Supergiant Shell Region in IC 2574*, Astrophysical Journal Letters, 630, L37.

Regan, M.W., **Thornley, M.D.**, Bendo, G.J., Draine, B.T., Li, A., Dale, D.A., Engelbracht, C.W., Kennicutt, R.C., Jr., Armus, L., Calzetti, D., Gordon, K.D., Helou, G., Hollenbach, D.J., Jarrett, T.H., Kewley, L.J., Leitherer, C., Malhotra, S., Meyer, M., Misselt, K.A., Morrison, J.E., Murphy, E.J., Muzerolle, J., Rieke, G.H., Rieke, M.J., Roussel, H., Smith, J.-D.T., & Walter, F. 2004, *Spitzer Infrared Nearby Galaxies Survey (SINGS) Imaging of NGC 7331: A Panchromatic View of A Ringed Galaxy*, Astrophysical Journal Supplements, 154, 204.

Gordon, K.D., Pérez-González, P. G., Misselt, K. A., Murphy, E. J., Bendo, G. J., Walter, F., **Thornley, M. D.**, Kennicutt, R. C., Jr., Rieke, G. H., Engelbracht, C. W., Smith, J.-D. T., Alonso-Herrero, A., Appleton, P. N., Calzetti, D., Dale, D. A., Draine, B. T., Frayer, D. T., Helou, G., Hinz, J. L., Hines, D. C., Kelly, D. M., Morrison, J. E., Muzerolle, J., Regan, M. W., Stansberry, J. A., Stolovy, S. R., Storrie-Lombardi, L. J., Su, K. Y. L., &

Young, E. T. 2004, *Spatially Resolved Ultraviolet, Hα, Infrared, and Radio Star Formation in M81*, Astrophysical Journal Supplements, 154, 215.

Smith, J.-D.T., Dale, D. A., Armus, L., Draine, B. T., Hollenbach, D. J., Roussel, H., Helou, G., Kennicutt, R. C., Jr., Li, A., Bendo, G. J., Calzetti, D., Engelbracht, C. W., Gordon, K. D., Jarrett, T. H., Kewley, L., Leitherer, C., Malhotra, S., Meyer, M. J., Murphy, E. J., Regan, M. W., Rieke, G. H., Rieke, M. J., **Thornley, M. D.**, Walter, F., & Wolfire, M. G. 2004, *Mid-Infrared IRS Spectroscopy of NGC 7331: A First Look at the Spitzer Infrared Nearby Galaxies Survey (SINGS) Legacy,* Astrophysical Journal Supplements, 154, 199.

Willner, S. P., Ashby, M. L. N., Barmby, P., Fazio, G. G., Pahre, M., Smith, H. A., Kennicutt, R.C., Jr., Calzetti, D.; Dale, D.A., Draine, B. T., Regan, M.W., Malhotra, S., **Thornley, M. D.**, Appleton, P. N., Frayer, D., Helou, G., Stolovy, S., & Storrie-Lombardi, L. 2004, *Infrared Array Camera (IRAC) Observations of M81*, Astrophysical Journal Supplements, 154, 222.

Kennicutt, Jr., R.C., Armus, L., Bendo, G., Calzetti, D., Dale, D.A., Draine, B.T., Engelbracht, C.W., Gordon, K.D., Grauer, A.D., Helou, G., Hollenbach, D.J., Jarrett, T.H., Kewley, L.J., Leitherer, C., Li, A., Malhotra, S., Regan, M.W., Rieke, G.H., Rieke, M.J., Roussel, H., Smith, J.-D.T., **Thornley, M.D**., & Walter, F. 2003, *SINGS: The SIRTF Nearby Galaxies Survey*, Publications of the Astronomical Society of the Pacific, 115, 928.

Helfer, T.T., **Thornley, M.D.,** Regan, M.W., Wong, T., Sheth, K., Vogel, S.N., Blitz, L., & Bock, D.C.-J. 2003, *The BIMA Survey of Nearby Galaxies (BIMA SONG) II. The CO Data*, Astrophysical Journal Supplements, 145, 259.

Gallimore, J.F., Cool, R.J., **Thornley, M.D**., & McMullin, J. 2003, *Expansion of the R4 H_2O Maser Arc near Cepheus A HW2*, Astrophysical Journal, 586, 306.

Sheth, K., Vogel, S.N., Regan, M.W., Teuben, P.J., Harris, A.I., & **Thornley, M.D**. 2002, *Molecular Gas and Star Formation in Bars of Nearby Spiral Galaxies*, Astronomical Journal, 124, 2581.

Regan, M.W., **Thornley, M.D**., Helfer, T.T., Sheth, K., Wong, T., Vogel, S.N., Blitz, L., Bock, D. C.-J. 2001, *The BIMA Survey of Nearby Galaxies. I. The Radial Distribution of CO Emission in Spiral Galaxies*, Astrophysical Journal, 561, 218.

Thornley, M.D., Forster Schreiber, N.M., Lutz, D., Genzel, R., Spoon, H.W.W., Kunze, D., & Sternberg, A. 2000, *Massive Star Formation and Evolution in Starburst Galaxies: Mid-Infrared Spectroscopy with the ISO Short Wavelength Spectrometer*, Astrophysical Journal, 539, 641.

Sturm, E., Lutz, D., Tran, D., Feuchtgruber, H., Genzel, R., Kunze, D., Moorwood, A.F.M., & **Thornley, M.D.** 2000, *ISO-SWS Spectra of Galaxies: Continuum and Features*, Astronomy & Astrophysics, 358, 481.

Lutz, D., Kunze, D., Spoon, H.W.W., & **Thornley, M.D**. 1998, *Faint [O IV] Emission from Starburst Galaxies*, Astronomy & Astrophysics Letters, 333, L75.

Thornley, M.D., & Mundy, L.G. 1997, *Dynamic and Stochastic Influences on Spiral Structure in the Flocculent Spiral NGC 4414*, Astrophysical Journal, 490, 682.

Thornley, M.D., & Mundy, L.G. 1997, *Are Flocculent Spirals Devoid of Density Waves? Gas Morphology and Kinematics in NGC 5055*, Astrophysical Journal, 490, 682.

Wilson, C.D., Walker, C.E., & **Thornley, M.D**. 1997, *The Density and Temperature of Molecular Clouds in M33*, Astrophysical Journal, 483, 210.

Thornley, M.D. 1996, *Uncovering Spiral Structure in Flocculent Galaxies*, Astrophysical Journal Letters, 469, L45.

Thornley, M.D., & Wilson, C.D. 1995, *Molecular Gas in the Inner 3.2 Kpc of NGC 2403: Star Formation at Subcritical Gas Surface Densities*, Astrophysical Journal, 447, 616.

Thornley, M.D. & Wilson, C.D. 1994, *Constraining the Influence of Star Formation on the Lowest ^{12}CO Line Ratios in M33*, Astrophysical Journal, 421, 458.

Tacconi, L. J., Tacconi-Garman, L. E., **Thornley, M**., van Woerden, H. 1991, *CO observations of southern S0 galaxies*, Astronomy & Astrophysics, 252, 541.

INVITED PRESENTATIONS:

2004: *Molecular Gas in Spiral Galaxies*, for the 4th Cologne-Bonn-Zermatt Symposium, The Dense Interstellar Medium in Galaxies, Eds. S.Pfalzner, C. Kramer, C. Staubmeier, A. Heithausen, Springer Proceedings in Physics, Vol. 91., 109 (Berlin, Heidelberg: Springer)

2003: *Molecular Gas and Star Formation in Nearby Galaxies*, for the annual April Meeting of the American Physical Society, Bulletin of the American Physical Society, Vol. 48, no. 2, p.82.

2001: *Molecular Gas in Spiral Galaxies: Implications for Galaxy Evolution from BIMA SONG*, in Galaxy Disks and Disk Galaxies, eds. J.G. Funes, S. J. and E. M. Corsini, ASP Conference Proceeding Vol. 230, 369 (San Francisco: Astronomical Society of the Pacific).

2001: *Molecular Gas and Star Formation in Nearby Spiral Galaxies*, in Science with the Atacama Large Millimeter Array, ed., A. Wootten, ASP Conference Proceeding Vol. 235, 291 (San Francisco: Astronomical Society of the Pacific).

SELECTED CONFERENCE PRESENTATIONS:

Chapman, E. , **Thornley, M.D.**, & The SINGS team, 2006, *The Relationship of Atomic Gas and Aromatic Emission in SINGS Spiral Galaxies,* American Astronomical Society meeting, 209, 15.03.

Wong, T. & **Thornley, M.D.** 2003, *Molecular Gas and Star Formation in Nearby Galaxies,* in Star Formation at High Angular Resolution, Eds: M. Burton, R. Jayawardhana, T. Bourke, International Astronomical Union Symposium 221, 119

Thornley, M. D., Spohn-Larkins, C. J. L., Regan, M. W., Sheth, K. 2003, *Radial Structure in Molecular and Stellar Disks of BIMA SONG Galaxies*, American Astronomical Society meeting, 201, 13.17.

Sheth, K. Vogel, S.N., Teuben, P.J., Harris, A.I., Regan, M.W., **Thornley, M.D.,** & Helfer, T.T. 2002, *Comparing Molecular Gas and Star Formation Properties in the Central Regions of Barred and Unbarred*, in Disks of Galaxies: Kinematics, Dynamics and Peturbations, eds. E. Athanassoula, A. Bosma, and R. Mujica, ASP Conference Proceeding, Vol. 275, 263 (San Francisco: Astronomical Society of the Pacific).

Bambic, D., **Thornley, M. D**. 1999, *NGC 7331: Examining Density Wave Contributions in Flocculent Galaxies*, American Astronomical Society Meeting, 195, 07.07.

Thornley, M.D., Schreiber, N.M.F., Spoon, H.W.W., Genzel, R., Lutz, D., Kunze, D. 1999, *30 Doradus as a Nearby Infrared Guide to Starbursts*, in New Views of the Magellanic Clouds, eds. Y.-H. Chu, N. Suntzeff, J. Hesser, & D. Bohlender, IAU Symposium 190, 247.

Thornley, M. D., Vogel, S. N., Helfer, T. T., Blitz, L., Bock, D. C.-J., Harris, A., Regan, M. W., Sheth, K., Wong, T. 1998, *A BIMA SONG Exploration of Interarm Molecular Gas in M51*, American Astronomical Society Meeting, 193, 28.01.

PRIMARY COLLABORATORS :
(*Recent & Present, in alphabetical order*)

Jonathan Braine (Observatoire de Bordeaux), Daniela Calzetti (University of Massachusetts, Amherst), Jack Gallimore (Bucknell University), Robert Kennicutt (University of Cambridge), Michael Regan (Space Telescope Science Institute), Kartik Sheth (IPAC), Fabian Walter (Max-Planck-Institut für Astronomie), Tony Wong (University of Illinois, Urbana-Champaign)

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