Mittelman Observatory at Middlebury College

Engaging and Inspiring Liberal Arts Students to Investigate the Universe from Vermont

Middlebury College

Mittelman Observatory

Overview

Astronomy and observatories have been part of the Middlebury College academic mission since its founding in 1800. Recent efforts to further enhance observational astronomy have led to substantial upgrades at the College's Mittelman Observatory. These changes have created new opportunities for students in the areas of education, research, and outreach, engaged the broader community, and encouraged new and creative collaborations. These developments have enhanced Observatory stewardship, stimulated innovative and interdisciplinary uses of astronomy as part of a classic liberal arts education, and increased the Observatory's ability to engage and inspire students from across the College to explore and learn about the Universe under dark Vermont skies.

A History Spanning Two Centuries

Observational astronomy has a history at Middlebury going back to the 19th century. From the College's earliest days, astronomy was a core part of the third-year curriculum.[1] In fact, the College's Old Chapel, completed in 1836, was "crowned with an octagonal Greek Revival cupola that functioned as the college's first observatory"[2] and there is reference to "the observatory for the new chapel".[3] Over the last two centuries, astronomical observatories have observed the skies from various locations across campus in support of the College's academic mission.

Curricular Observing, Warner Science Hall, 1949

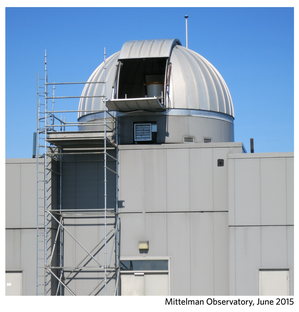
Planning, Design, & Equipment

The College's newly-constructed interdisciplinary science building — McCardell Bicentennial Hall — opened in 1999. Atop this building a modern, robust observatory was planned during the design phase which included provisions for a 20-foot diameter dome and 3,000 square feet of open roof deck space atop the seven-story building. During both design and commissioning of the Observatory, particular attention was paid to both thermal considerations and accessibility. The Observatory's current 24″ telescope was installed in the dome in February 2001. Various permanently-mounted and mains-powered telescopes have resided on the roof deck, currently including an 8″ and two 11″ telescopes.

Mittelman Observatory, McCardell Bicentennial Hall, October 2012

Upgrades & Modernization

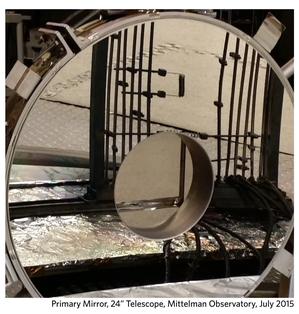
However, a decade and a half of pursuing its mission as the College's gateway to the Universe meant that the Observatory was necessarily exposed to the elements of New England. Meanwhile, substantial developments in telescope, instrument, and software technologies evolved which were substantially driven by the amateur astronomy community, as well as advances in communications and networking technologies.



Mittelman Observatory, June 2015

So, the Observatory implemented a set of upgrades that transformed its equipment, and especially its 24″ telescope, taking advantage of recent technological and engineering developments, replacing old, outdated, worn, and underperforming components, and preparing for the adoption of new observing modes, including remote and autonomous capabilities.

From hardware to software, and mechanical to electrical, multiple core components of the Observatory were successfully upgraded as part of this 2015 Upgrades Program.



Primary Mirror, 24″ Telescope, Mittelman Observatory, July 2015

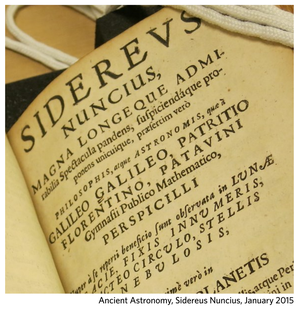
- The 24″ telescope was upgraded with a modern control system, digital motor controllers, absolute encoders, modified instrument support infrastructure, and motorized optical tube covers.
- The dome was upgraded with a modern control system and slip ring electrical conductors.
- The primary and secondary mirrors of the 24″ telescope were re-aluminized for the first time, thereby improving the mirror performance and telescope light-collecting efficiency.
- The primary and secondary CCD cameras were replaced with more modern, quantum-efficient instruments supporting higher data transfer rates.
- The wide-band and narrow-band filters were replaced and upgraded.

Additionally, a wide variety of other accessories and auxiliary components were improved, upgraded, or replaced, including the one 8″ and two 11″ telescopes permanently mounted on the roof deck, solar and planetary observing equipment, and environmental monitoring equipment.

These Observatory upgrades have substantially increased telescope use and observing time. Although the core upgrades have now been completed, additional upgrades continue to further enhance the capabilities, performance, and program diversity without affecting the availability of the Observatory for curricular, research, and outreach activities.

Curricular Opportunities

Middlebury has a small but active astronomy faculty within the physics department. An introductory astronomy course is usually offered annually that is designed for non-majors, includes a laboratory component that includes use of the Observatory. A rigorous upper-level cosmological physics course for physics majors is typically offered biennially. An ancient astronomy course has been offered every several years and is also designed for non-majors. While neither a major nor a minor is currently offered in astronomy, and no separate astronomy department exists, the Observatory broadly and creatively engages students beyond the formal curriculum.



Ancient Astronomy, Sidereus Nuncius, January 2015

Student Research Opportunities

Varied student astronomy research opportunities exist at Middlebury. Within a curricular context, physics majors pursue required senior project work and possible thesis work that optionally involves work with astronomy faculty and can potentially involve Observatory use. Independent research projects, both curricular and through work study positions, explore various observational fields, make broad use of data taken from ground and spaced-base observatories, and can potentially involve use of the Observatory. Current areas of interest include black holes, quasars, active galactic nuclei, and cataclysmic variables. Numerous summer opportunities also exist through Middlebury's membership in the Keck Northeast Astronomy Consortium.

Independent Study, Fireworks Galaxy, October 2016 (Roo Weed '18.5)

Outreach Programming

The Observatory welcomes about a thousand people annually as part of its outreach efforts through a wide variety of programming. These events have included both nighttime stargazing and daytime solar observing and have involved students, faculty, and staff of the College, local schoolchildren, local retirees, and the public. The Observatory often holds events for special celestial phenomena, including the September 2015 total lunar eclipse and the August 2017 partial solar eclipse. In addition to these events and tours, the Observatory welcomes numerous prospective students and alumni for individual tours and informal discussion throughout the year.

Solar Eclipse, Outreach Observing, Mittelman Observatory, August 2017

Multilingual Stargazing

The Middlebury campus is transformed into an even more linguistically diverse community every year during the summer months when its Language Schools are in session. These linguistic and cultural programs serve immersive learners in about a dozen languages who join the numerous summer science student researchers on campus. Because of this diversity, summer outreach programs broadly engage this unique multilingual community in a variety of languages beyond English, which have included Chinese, French, German, Hebrew, and Spanish to date.

24″ Telescope, Mittelman Observatory, July 2018 (Brett Simison)

Personnel

The Observatory and astronomy efforts at the College are primarily motivated by two individuals, including a single faculty member who teaches both astronomy and non-astronomy physics courses and a dedicated manager of the Observatory who works closely with faculty and students both in physics and more broadly across disciplines.

Mittelman Observatory, McCardell Bicentennial Hall, Middlebury College, Champlain Valley & Green Mountains, April 2015

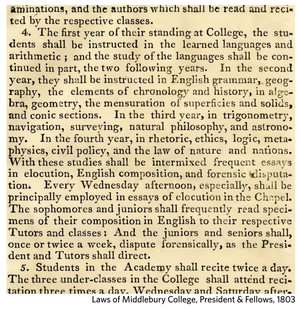
Liberal Arts Collaborations

The Observatory blends the high-tech equipment and instrumentation typically associated with larger universities with the collaborative learning atmosphere of a liberal arts college. Although formal curricular opportunities within astronomy may be modest, the Observatory interacts broadly with departments, programs, facilities, and subject matter across the College. Curricular, extracurricular, informal engagement, project work, and other opportunities have intersected the Animation Lab, Biology, the Center for the Arts, Classics and Classical Studies, Comparative Literature, Computer Science, Educational Studies, Environmental Studies, Film and Media Culture, the First Year Seminar program, Geology, History, History of Art and Architecture, the Language Schools, the Library, the Museum of Art, the Posse STEM program, Religion, the School of the Environment, the Science Library, and Special Collections and Archives.

Mittelman Observatory, April 2015

Interdisciplinary Projects

Students have engaged in a variety of projects at the Observatory. Below are some current and recent highlights.



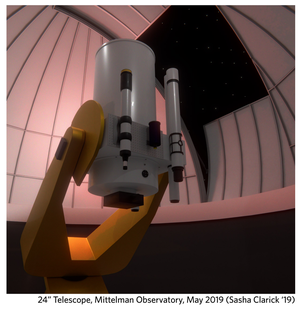
aminations, and the authors which shall be read and recited by the respective classes.

4. The first year of their standing at College, the students shall be instructed in the learned languages and arithmetic; and the study of the languages shall be continued in part, the two following years. In the second year, they shall be instructed in English grammar, geography, the elements of chronology and history, in algebra, geometry, the mensuration of superficies and solids, and conic sections. In the third year, in trigonometry, navigation, surveying, natural philosophy, and astronomy. In the fourth year, in rhetoric, ethics, logic, metaphysics, civil policy, and the law of nature and nations. With these studies shall be intermixed frequent essays in elocution, English composition, and forensic disputation. Every Wednesday afternoon, especially, shall be principally employed in essays of elocution in the Chapel. The sophomores and juniors shall frequently read specimens of their composition in English to their respective Tutors and classes: And the juniors and seniors shall, once or twice a week, dispute forensically, as the President and Tutors shall direct.

5. Students in the Academy shall recite twice a day. The three under-classes in the College shall attend recitation three times a day. Wednesday and Saturday after-

Laws of Middlebury College, President & Fellows, 1803

- A History of Art & Architecture major is working on a historical research project regarding the Observatory and astronomy at the College over the last two-plus centuries. This has uncovered many items in both the College's own archives as well as those of other local institutions. This project is expected to culminate in a physical exhibit with an online counterpart.
- A Sociology & Anthropology major is working on an art project involving creative artistic visualizations and paintings of exoplanets that are rooted in existing scientific knowledge and scholarship to-date, including concepts of circumstellar orbits and habitable zones. This project is expected to culminate in a physical exhibit with an online counterpart.
- A Physics major is working on a computer animation project involved modeling and animating the Observatory, including telescope axes of motion, dome motion, optical light paths, imaging instrumentation, and the general Observatory environment. This project is expected to culminate in an animation with both outreach and curricular uses, including astronomy and optics courses.



24″ Telescope, Mittelman Observatory, May 2019 (Sasha Clarick '19)

- A trio of Theatre majors worked on a senior thesis project involving the production and performance of a dramatic stage play involving astronomy and stargazing, collaborating with the Observatory on authenticity, language, terminology, and equipment use.
- A Computer Science major worked on advanced digital image processing and created some of the fantastic imagery has been obtained with the Observatory and which is displayed as part of its curricular and outreach programs to inspire students and visitors. The student also created the imaging processing manual that we now use for our introductory astronomy class.

Eagle Nebula, Mittelman Observatory, August 2016 (Jacob Brady '17)

- A Geology major worked extensively as part of the outreach program to augment terrestrial geology studies with an increased familiarity with astronomy and planetary science.
- An eventual Molecular Biology & Biochemistry major worked on an equipment inventory project, outreach programming, and a research project — all as part of community project work while studying at a local high school. The student was subsequently admitted to the College and continues to be affiliated with the Observatory.

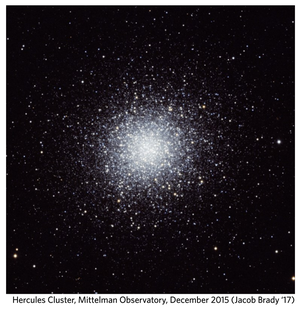
Undergraduate Students

At the intersection of curricular, research, and outreach activities are the students of the College who are central to the Observatory's mission. While students have opportunity to use the Observatory for curricular and research purposes as well as informal stargazing events, they form an integral part of the Observatory's outreach program, helping leads its community engagement efforts. Furthermore, student projects have a substantial degree of independence, investment, and self-direction while traversing a variety of interdisciplinary areas across the institution.

Solar Eclipse, Mittelman Observatory, August 2017

A Holistic Approach to Engagement

The Observatory's level of student engagement and degree of openness and accessibility has meant that the Observatory, both as a facility and a set of varied programming, seeks to be broadly welcoming and accessible, promoting a diversity of students, inclusivity in participation, and equity in involvement. While physics majors and STEM students are welcome, so too are those pursuing study in the non-science liberal arts. This approach allows the Observatory to uniquely embody the institution's core foundation in the liberal arts, a focus on experiential learning, and a fostering of a spirit of intellectual curiosity and inquiry among the entire student body.



Hercules Cluster, Mittelman Observatory, December 2015 (Jacob Brady '17)

External Collaborations

The Observatory and astronomy efforts at the College often involve collaboration with others. Individual scientists and research groups often work with, and visiting scholars occasionally meet with, faculty and students. Additional external collaborations have involved partner institutions of the Keck Northeast Astronomy Consortium whose goals include the promotion of astronomy research among its students and the fostering of faculty and student interaction between campuses. Other collaborations have involved HUT Observatory and its outreach efforts as well as the Center for Backyard Astrophysics and its citizen science initiatives.

Symposium, Keck Northeast Astronomy Consortium, September 2018

Visiting Scholars & Scholarly Visits

Students are actively provided opportunities to interact with visiting scholars, through formal talks, informal discussions, casual meetings, and shared meals. Additionally, nearby institutions afford substantial opportunity to seek out other scholars elsewhere across New England.

Remote & Autonomous Technologies

The Observatory has leveraged remote and autonomous observing technologies and distant sites to pursue observational flexibility. While Vermont skies are dark, New England weather can occasionally impede local telescope use, especially in the case of classically scheduled or time-critical student projects. The Observatory is automating its 24″ telescope in Vermont and is currently observing with a 20″ telescope in New Mexico.

Dark Sky Appreciation

The breadth of engagement across the College and the local town has allowed substantial opportunity to engage and educate on matters related to environmental light pollution and the preservation of the heritage of our dark Vermont skies. This is strongly aligned with the College's mission and values.

Acknowledgments

The outreach, curricular, and research programs at Mittelman Observatory, and the continued upgrades of the 24″ telescope, could not have been as successfully undertaken without the involvement and generosity of the Mittelman Family Foundation. The Foundation has made an immediate and pronounced impact upon both students and the community here at Middlebury through its philanthropic support for astronomy and the Observatory. These contributions help insure that additional generations of Middlebury students will be able to learn about and explore the Universe.

References

[1] President & Fellows, Laws of Middlebury College, 1803, p. 9.
[2] Andres & Johnson, Buildings of Vermont, 2014, p. 126.
[3] Merrill, Semicentennial Sermon, 1841, p. 22.

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http://go.middlebury.edu/observatory

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