

Optics Observatory Conversion: From Solar to Stellar

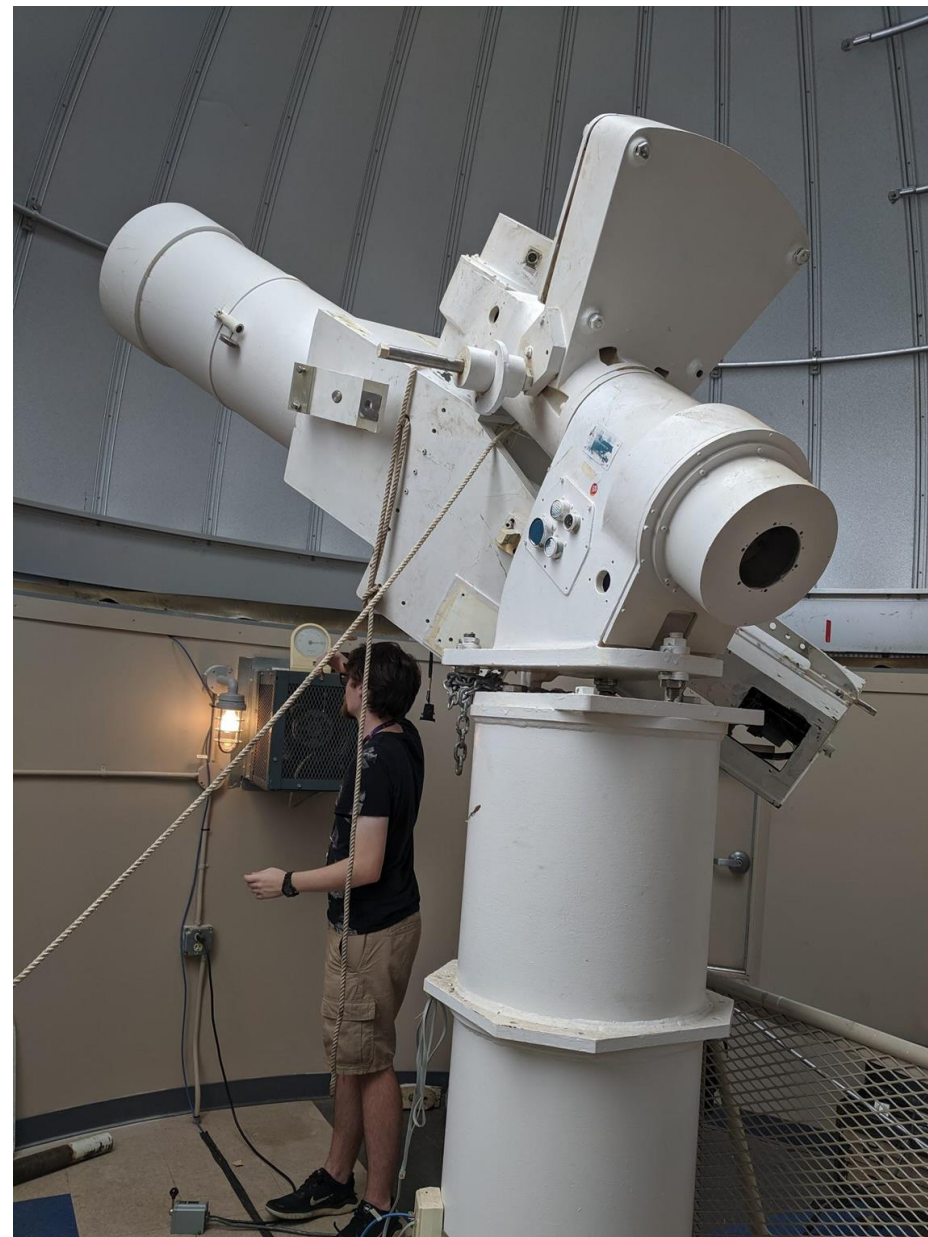
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The UAH Astronomy Club has greatly increased its observational capabilities over the past year with the conversion of the Optics Building's Solar Observatory into a traditional nighttime observatory. The Marshall Space Flight Center Vector Magnetograph was partially disassembled and stored, making way for the installation of already-owned Astronomy Club equipment in its place. The observatory now houses a Celestron C11 Schmidt-Cassegrain telescope with a SBIG STF-8300M CCD as its primary instrument. The observatory system has been automated through the INDI observatory control system, allowing for the observation of multiple different targets without human intervention. This new system has resulted in vastly reduced setup and shutdown times for observation, significantly more overall observing time, far improved image quality, and overall increased ease of access to astronomical observation.

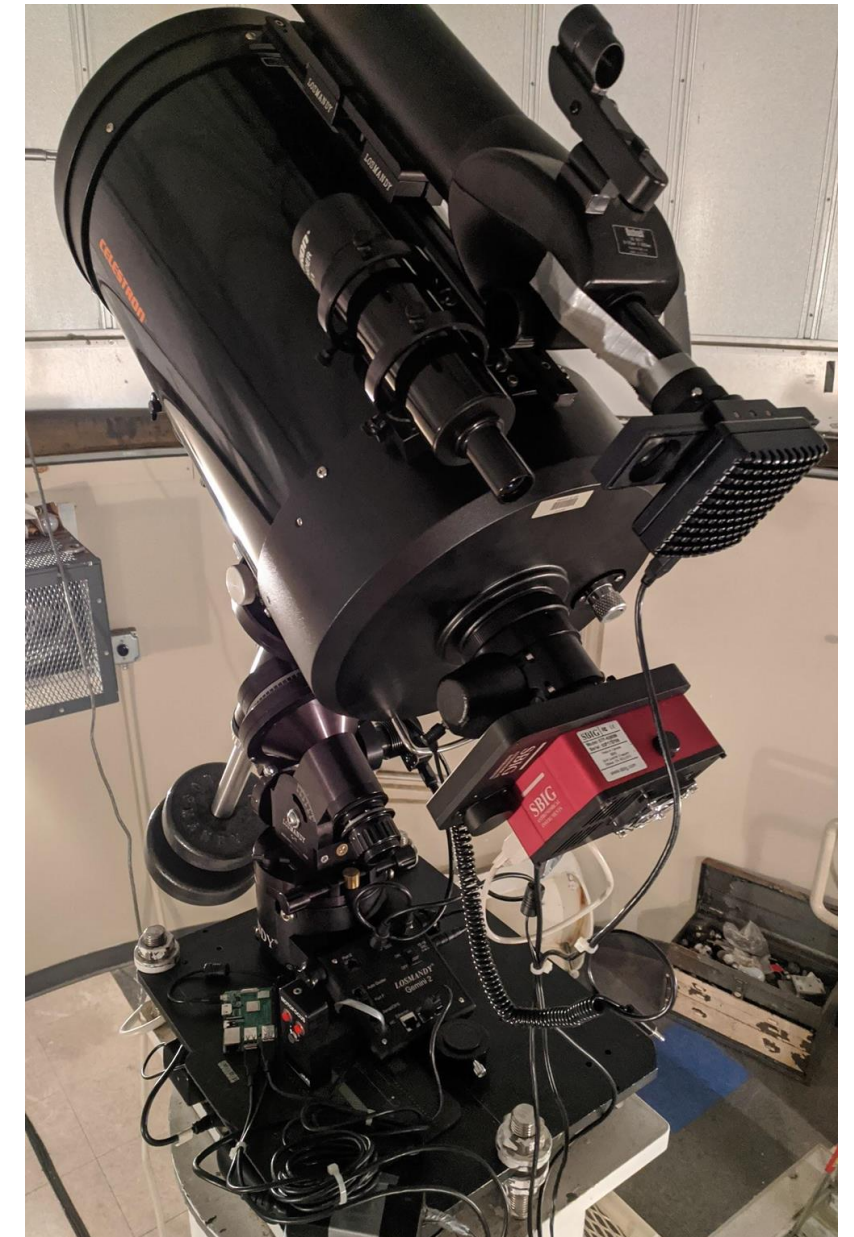
The MSFC Vector Magnetograph

- Marshall Space Flight Center Vector Magnetograph (VM) installed in Optics Building observatory in 2005.
- Telescope and instruments fell into neglect and disrepair over the following decade.
- Restoring VM to operation was considered, however restoration would have been:
 - Complex - Telescope communication and custom component replacement would be a challenge.
 - Tedious - Every piece of the scope would require cleaning, including all optics.
 - Of little scientific value - High-resolution full-disk vector magnetograms provided continuously by Solar Dynamics Observatory.



Astronomy Club Observing Assets

- Losmandy Gemini G-11 German Equatorial Mount
- Celestron C-11 Schmidt-Cassegrain Telescope
- SBIG STF-8300M CCD
- Filters:
 - Imaging: R, G, B, H α , OIII
 - Sloan Digital Sky Survey (Photometric): g', r', i'
- Meade Deep-Sky Imager CCD
- Bushnell Refracting Telescope
- Raspberry Pi 3B+



Observatory Conversion

Timeline

- 2018-2019
 - Experimentation and refinement of observing techniques with C-11 telescope on tripod-mounted Losmandy G-11 mount.
 - Familiarization with and certification on Von Braun Astronomical Society Swanson Observatory
- September 2019 - November 2019:
 - Disassembly and storage of VM
 - Acquisition and installation of G-11 mount adapter plate and pier
- November 8, 2019
 - Installation of G-11 mount, C-11 telescope, computer control system, and CCD camera.

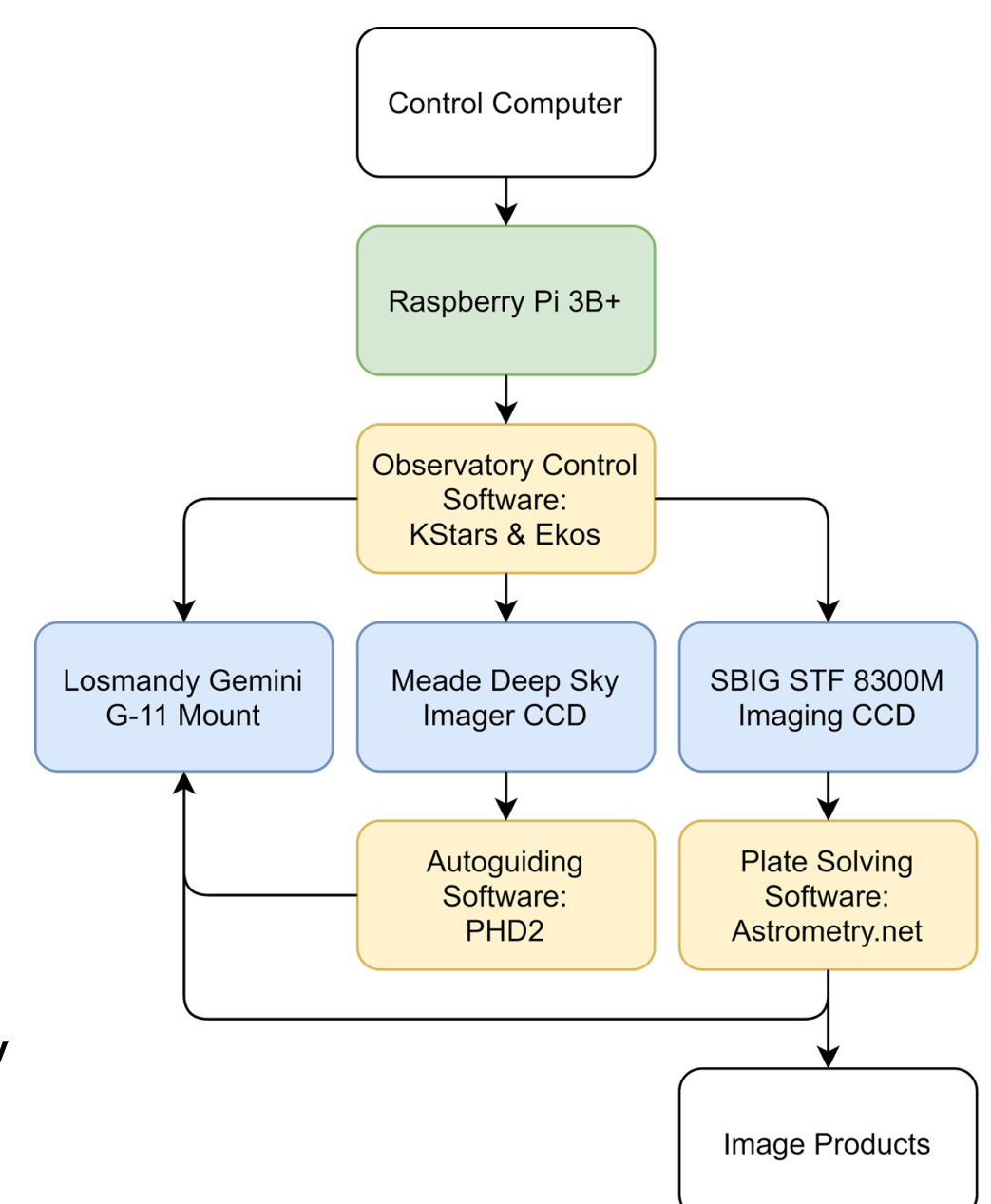
Observations

- November 11, 2019 - First light
 - Transit of Mercury
 - Custom solar filter used
- November 2019 - Present
 - Continuing night-sky observations
 - Iterative improvement of observatory systems

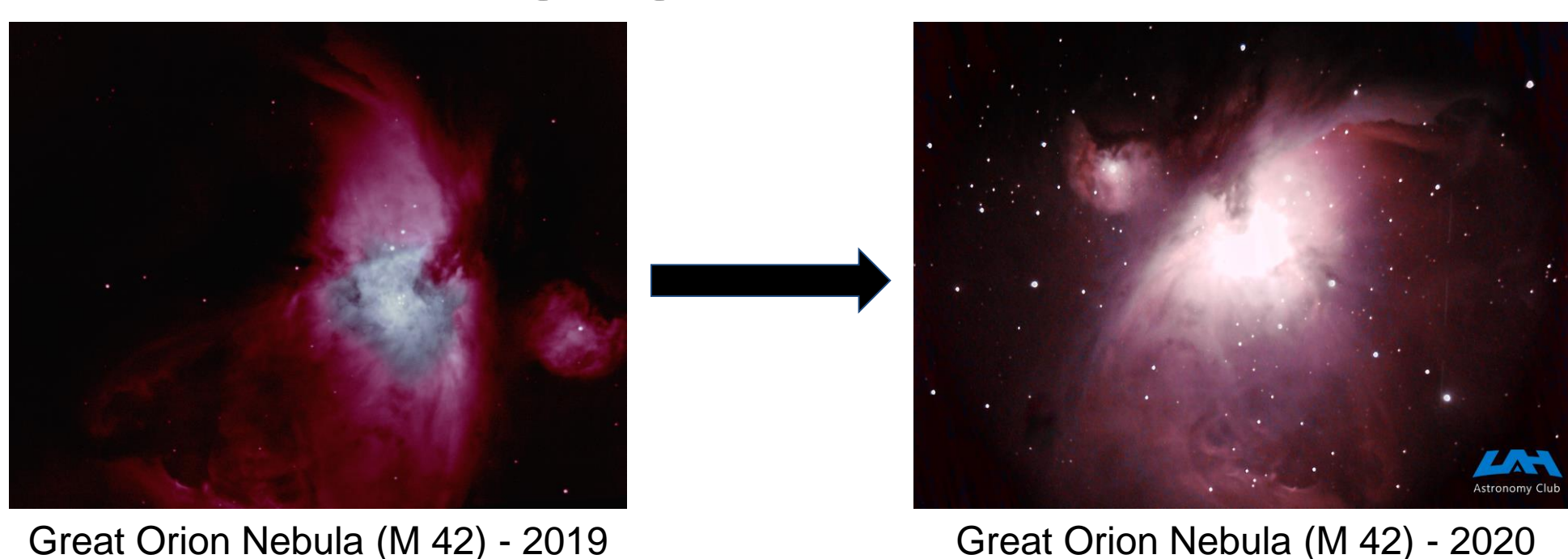
Observing Improvements

- Decreased setup and teardown time
- Polar alignment now to within ~1 arcminute of North Pole
- Reliably increased exposure times
 - ≤ 1 minute $\rightarrow \geq 2$ minutes
- Permanent setup allows for previously impossible iterative improvement.
- Winter thermal shocks decreased for optical components & observing team.

Observatory Control Scheme



Imaging Improvement



Future Upgrades

- Improved G-11 mount gearbox
 - High-precision pre-loaded worm gears
 - Will reduce periodic tracking error
- Off-axis autoguiding system
 - Will allow for exposures exceeding 10 minutes
 - Will allow dithering for less noise in processed images
- Larger filter wheel
 - Easy access to more filters for observing
- Computer control for:
 - Focusing
 - Dome rotation
 - Shutter operation

Acknowledgements

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KStars - Jason Harris, Author
Jasem Mutlaq, Current Maintainer
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PHD2 - Open PHD Guiding development team
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Additional Information

A deeper dive into this observatory conversion process can be found here \rightarrow

