

## **Astronomy Vision Statement for the next 5-10 years**

**Motivation:** Astronomy has made transformational advances in our understanding of the Universe in the past decade: thousands of exoplanets, including Earth-size planets, are being discovered and characterized; the discovery of gravitational waves with an electromagnetic counterpart of GW 170817 and extragalactic neutrinos has launched the advent of the new field of multi messenger astronomy; new discoveries using all sky surveys to search for transient phenomena have created a field called time-domain astrophysics, which is revolutionizing almost all fields of astrophysics from exoplanets to compact objects, such as white dwarfs, neutron stars, black holes and supernovae. New multi-wavelength all-sky and pencil-beam deep surveys using Einstein's results on gravitational lensing, which produces natural telescopes will map the structure formation of the universe from the cosmic dark ages to the present time and probe the nature of enigmatic dark matter and dark energy. Significant advances in computational power have enabled better theoretical modeling and improved data analysis through the use of modern high performance computing and data analytics such as GPU computation and machine learning. OU Astronomers competed successfully for three observational programs in Cycle 1 of the James Webb Space Telescope, a 10 Billion dollar endeavor, which is scheduled for launch in Oct, 2021. The next 10 years will see major advances in astrophysics with the first light of powerful ground- and space-based telescopes (Vera Rubin Observatory, James Webb Space Telescope, Athena, Nancy Roman Space Telescope), and the first generation of extremely large telescopes (E-ELT, TMT, GMT). **The HLD Astrophysics group seeks to be on the cutting edge of all of these advances.**

Complementary to the above, data science is becoming increasingly important with careers in data science comprising one of the fastest growing employment opportunities today. Astronomy has always been a data-driven and data-rich field; with the recent investments in new resources expected to produce vast amounts of data, the situation has become critical. For example, the Vera Rubin Observatory is expected to generate 20 TB of data per night. Sophisticated data analysis methods are required to deal with these large data sets. More astronomers are taking advantage of advances in computational and statistical techniques in order to tackle difficult problems using advanced data analysis and modeling techniques.

In the advent of this new data driven era in Astronomy, a concentration in data-intensive astronomy would strategically strengthen (1) the astronomy group, (2) the HLD Physics & Astronomy Department and (3) the College of Arts and Sciences. Though members of the group are already using advanced data analytics methods in their research, **we seek to establish the Astronomy group as a leading force in this data revolution through a series of strategic hires.** In addition, exposure to data analytics techniques would help our undergraduate and graduate students as a degree in astronomy can lead students to successful data science careers in industry, as demonstrated by several recent graduates.

### **The Path Forward:**

- 1) HL Dodge Astrophysics Chair**

The OU astronomy group proposes to focus the upcoming Homer L. Dodge Chair search on acquiring the talent necessary to be a leader in the fields that are emerging. **The ideal candidate would incorporate modern techniques in their cutting edge research as a tool to leverage the upcoming astronomical data revolution.** The candidate would be encouraged to develop a plan to hire additional astronomy faculty to establish a “critical mass” in collaboration with the other members of the astronomy group.

## **2) Re-initiate OU’s PhD in Astrophysics**

To provide our students with additional career paths, **we aspire to re-institute OU’s PhD in Astrophysics program.** Coinciding with the launch of our data intensive astrophysics initiative, this program would include coursework tailored to fit the growing needs of our students who wish to pursue both academic and non-academic career paths.

## **3) Enhance our data intensive IT support**

**Our group’s expansion into data intensive astrophysics will require support for our students and faculty** by IT personnel who are trained and cognizant of best practices involving storing and manipulating large datasets.

## **4) Expand and cement our institutional telescope access**

While OU’s astrophysics program has been boosted by our institutional membership to the APO 3.5m telescope, our observational facility requirements will increase as we expand our breadth to include data intensive astrophysics. **We therefore aspire to secure long-term support for our current observational facility, and expand the breadth and/or size of this commitment to meet the growing needs of our astrophysics students and faculty.**

## **5) Increase the diversity of our department**

**Our group is fundamentally committed to diversity in hiring and recruiting students.**

Studies of recent faculty hiring practices have shown that the fraction of underrepresented applicants is enhanced when job advertisements are broader in scope. *Because the field of data-intensive astronomy touches many subfields from solar system science to cosmology, this strategic direction enables such broadly scoped job advertisements.* We will make regular efforts to participate in conferences that engage underrepresented groups, and reach out to applicants from underrepresented groups individually during and before searches and when contacting colleagues to advertise the posting, we will specifically ask for recommendations of candidates from underrepresented groups.

## **6) Astrophysics Seminar Series**

**The astrophysics group is seeking opportunities/funding for an astrophysics seminar series.** This is crucial for establishing new external collaborations for the astrophysics group members and enriching the academic environment. The seminar series will be especially beneficial to both undergraduate and graduate students, and will help them expand their knowledge base and make connections with outside collaborators. These interactions will help launch them into the next stage of their careers.