



**Department of Physics and Astronomy (P&A)
College of Natural Sciences and Mathematics
University of Toledo, Toledo, OH 43606
<http://www.utoledo.edu/nsm/physast/>**

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Welcome to our P&A undergraduate program



Dr. Sanjay. V. Khare

Professor and Chair

Department of Physics and Astronomy (P&A)

The University of Toledo, Toledo, OH-43606

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Important Topics of this Presentation

1. P&A Program Overview, Facilities, Skills
2. Our teaching quality is high
3. Physics and Astronomy are lucrative
3. In STEM areas UT is a great value
5. Our graduates are successful

<http://www.utoledo.edu/nsm/physast/index.html>



Department of Physics and Astronomy - Programs

What are Physics and Astronomy?

Physics is the study of the fundamental laws of nature and the structure of matter. It forms the basis for all other physical sciences and much of our high-technology.

Astronomy is the study of the universe beyond the earth, including current thought about the origins of the universe, the solar system, and life.



Undergraduate Programs

- B. A., B. S. in Physics
- B. A. in Astronomy
- Minor in Renewable Energy

Graduate Programs

- M. S., M. S. and E. in Physics
- Professional Science Master's in Photovoltaics (PSM-PV)
- Ph. D. in Physics: concentrations include atomic physics, astrophysics, material science and medical physics

Undergraduate Research

Opportunities exist for summer and academic year research, either for credit or student work: examples include astrophysics, photovoltaics, and computational physics.



Department of Physics and Astronomy

Areas of Research and Facilities



<http://www.utoledo.edu/nsm/physast/index.html>

Astrophysics

Stellar atmospheres and disks
Star clusters and star and planet formation
Very cool stars and hot planets
Interstellar gas chemistry and dust

Ritter Telescope and partnership in the Discovery Channel Telescope. Access to remote and space-based observatories including the Hubble Space Telescope.

Thin Films and Photovoltaics

Growth and properties of thin films
Development of efficient solar cells
Industrial collaboration and research

Extensive laboratory facilities in the Research-1 building on the SE corner of Main Campus, and labs in McMaster Hall.

Atomic and Molecular Physics

Atomic and molecular structure
Atomic and molecular interactions

Heavy ion accelerator in McMaster Hall.
Instrumentation Center in Wolfe Hall

Medical Physics – Radiation Oncology

Detection and imaging of cancer tumors
Radiation treatment of cancer

Facilities located in the new Dana Cancer Center on the Health Sciences Campus
State-of-the-art Simulation Center on HSC

Theory and Computational P & A

Low temp atomic collisions, surface physics, astrophysical computation

Department computer clusters, access to the Ohio Supercomputer Cluster and various national facilities

Physics and Astronomy offer excellent training for many Career Pathways

Students completing degree programs in Physics and/or Astronomy possess a unique combination of **skills** highly relevant to today's high-tech and quickly-changing professional landscape:



- **Broad physical science**
- **Mathematics**
- **Innovation through application of logic, scientific principles, and creative thinking**
- **Devising hypotheses, and testing them scientifically**
- **Analytical/numerical modeling**
- **Statistical Analysis**
- **Computing and software skills**
- **Measurement and observation**
- **Technical laboratory skills**
- **Team work and time management**
- **Fundamental systems thinking**
- **Tenacity to solve tough problems**

Our Teaching Style and Quality



Class sizes, for majors, typically range from 5 to 15! **Faculty attention to individual students is the norm not the exception.** Many of us practice interactive teaching techniques.

All junior, senior and major classes are taught by 24 full-time professors.

All are Ph.D.s with significant research experience and grants from National Science Foundation, DARPA, Dept. of Energy, Dept. of Education, Air Force, Navy, State of Ohio, Private Corporations

Five of them are fellows of the American Physical Society, two are fellows of the American Association for the Advancement of Science, four have prestigious endowed professorships, two are Distinguished University Professors

All of us have directed and supervised undergraduate research

Our undergraduates have performed research and published peer-reviewed journal articles with faculty, presented their research at conferences!

There are 7 technical staff members and over 55 graduate students pursuing a Ph.D. degree who interact with and supervise undergraduate researchers

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Community of P&A



This is a community of like minded, intellectual, curious, fun, sincere, diligent and focused group of students, faculty and staff.

There is a dedicated space with boards to work together on home-work assignments, hang out or chill, discuss physics and astronomy general topics and socialize. This is located on the 3rd floor of McMaster Hall.

There is a UT Students Green Fund, Ritter observatory and planetarium under-graduate student group of researchers. Other undergraduate researchers in condensed matter theory and experiment.

We have student researchers dedicated to full time research in summer. Additionally students also perform research throughout the year. They present their work at least twice a year in the department.

We have an active Society of Physics Students chapter. They do movie nights, outings, gatherings, night-sky observation, study groups, competitions.

We have annual department holiday party, a fall and spring picnic, summer REU program talks, colloquiums, astro-physics bag lunch, lunches and dinners with external speakers.

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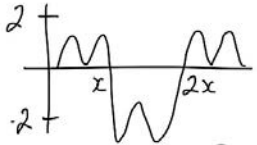
P&A degree is lucrative



- Kiplinger Magazine's Best 10 Majors for a career: **Number 6 is Physicist!**

$$(a+b)^3 = (a-b)(a^2+2ab)$$

$$x+y-2 < 2$$



$$e = mc^2$$

$$\sum_{n=-m}^{\infty} x_n$$



$$E(\Delta) = E\left(\frac{np}{\sum x}\right)$$

$$\sin^3 x + \sin^2 x \cos x = ?$$

Starting salary: \$57,200

Mid-career salary: \$105,100

Annual online job postings: 72,732

Best related job: Physicist

Projected 10-year job growth: 11.3%

According to Payscale, other skills employees with B.S. in physics report using in their work include material science, strategic planning and C++ programming expertise.

<http://www.kiplinger.com/slideshow/college/T012-S001-best-college-majors-for-your-career-2015-2016/index.html>

B.S. or B.A. in P&A from UT

A great value for scholars



The Wall Street Journal report of January 2016:

- In our study, we looked at about 7,300 college graduates 10 years after graduation.
- For example, **we find no statistically significant differences in average earnings for science majors between selective schools and either mid-tier or less-selective schools.**
- Our findings are crucial for families to understand because **chasing a prestigious STEM degree can leave students burdened with huge amounts of unnecessary debt.**

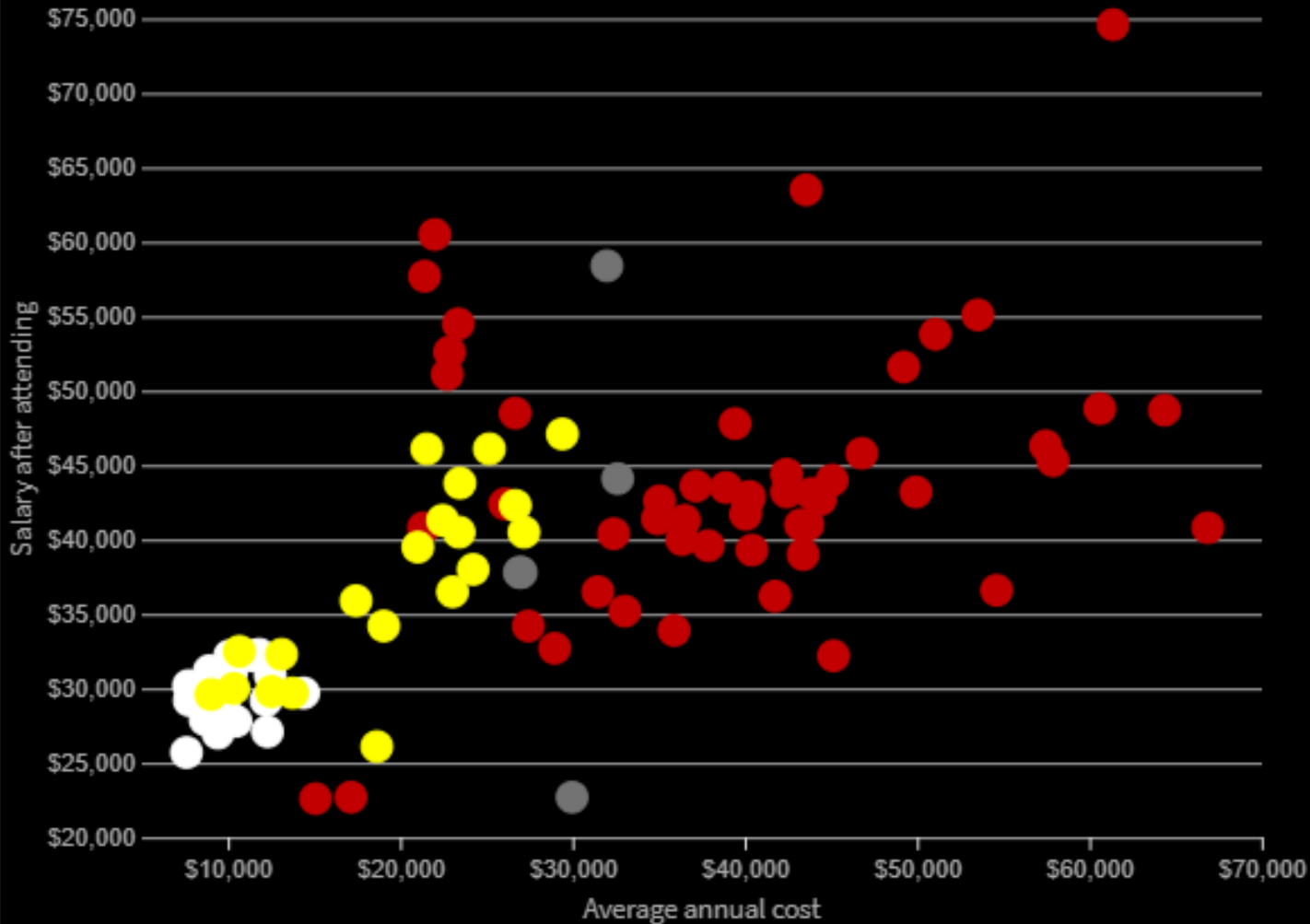
. Anecdotally we know several students who graduated from UT debt free and in rare cases made a **net profit over 4 years!**

<http://www.wsj.com/articles/do-elite-colleges-lead-to-higher-salaries-only-for-some-professions-1454295674>

Ohio higher-education institutions

Are students getting much bang for their buck?

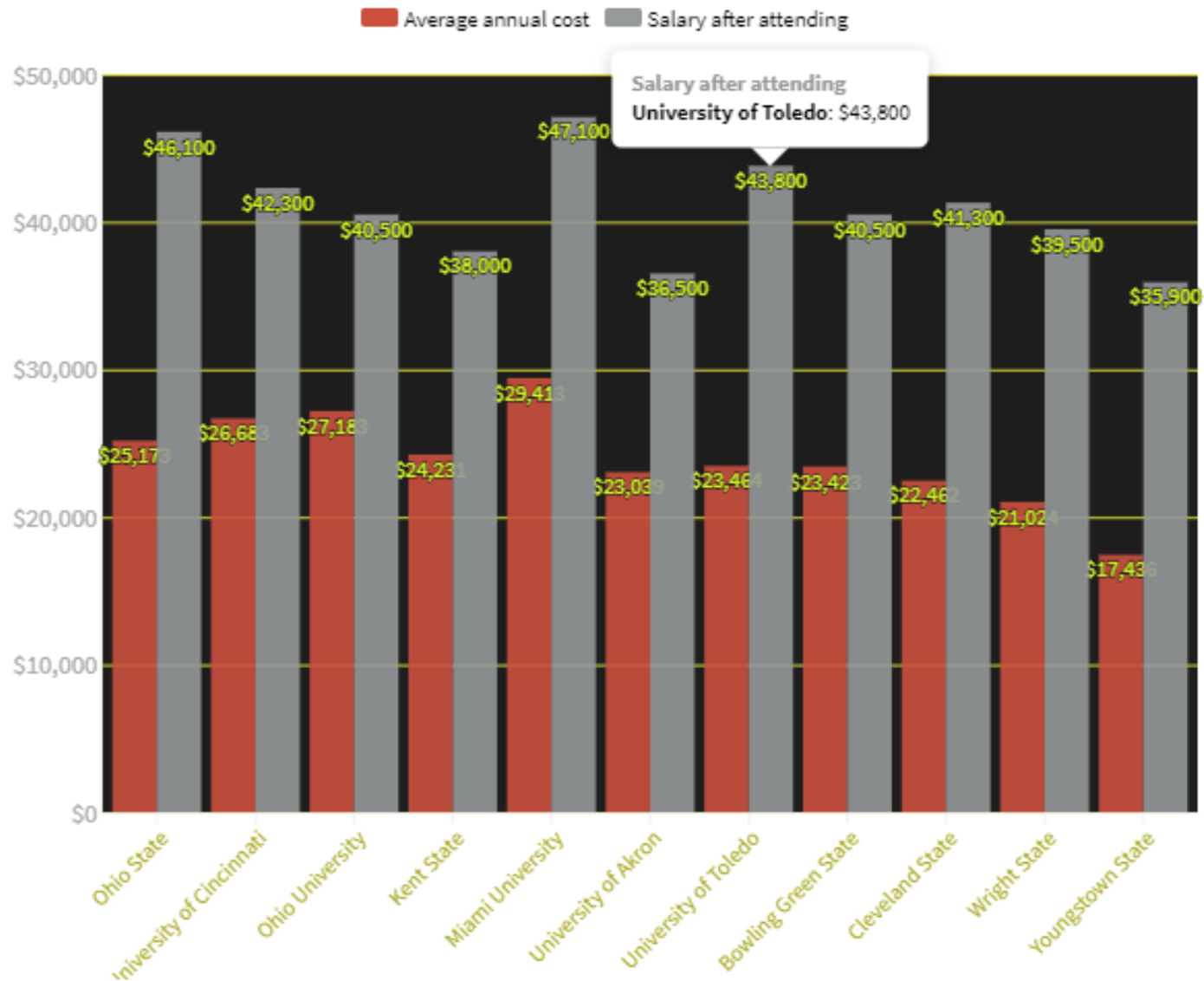
● Community college ● For-profit ● Private ● Public



Source: U.S. Department of Education

<https://www.toledoblade.com/local/education/2019/03/11/mercy-college-university-of-toledo-bgsu-give-graduates-return-on-investment/stories/20190308119>

Ohio's largest universities



Source: U.S. Department of Education

Five Successful Outcomes



Students completing degree programs in Physics and/or Astronomy possess the technical and soft skills to succeed in a variety of career options.

Five Pathways of UT Physics and Astronomy (P&A) B.S. and B.A. degree holders

Continue to a M.S. or Ph.D. degree program in **P&A** at UT

Go onto another prestigious M.S. or Ph.D. degree programs in **P&A**

Go to UT or other university for a, **non-P&A**, M.S. or Ph.D. or **professional graduate program** such as in medicine or law

Take up a **well-paying job** in business, industry or academia directly after degree completion

Start your **own business**

<http://www.utoledo.edu/nsm/physast/index.html>

Our successful B.S. graduates I



Craig Maloney, B.S. (Phys., 1998), did Ph.D. in Phys. at U. of California at Santa Barbara, is on the faculty of engineering at Carnegie Mellon U.

John Teufel, B.S. (Phys., 1999), did Ph.D. at Yale U. in Phys., works at National Institute of Standards and Technology in Maryland as a scientist

Chris Eck, B.S. (Astr., 1991), did Ph.D. at Oklahoma State U., works at Raytheon corporation

Nick Sperling, B.S. (Phys., 2005), did Ph.D. in our department, with specialization in medical physics, works as a medical physicist at UT

Steven Morgan, B.S. (Phys., 2003), did M.S. in Civil Engineering at U. of Colorado at Boulder, founded and owns a company improving energy efficiency of buildings, retro-fitting of energy saving infrastructure

Ryan Zeller, B.S. (Phys., 2008), did M.S. at UT in Physics with specialization as a Professional in Photovoltaics, and became a co-owner of a solar installation company Shadeplex

Our successful B.S. graduates II



Steven Selman, B.S. (Phys., 1986), did M.D. with specialization in Urology, works at UT Health Science Campus.

Brian Bollinger, B.S. (Phys., 1999), did Law School at Case Western Reserve U., practices Patent Law, uses his B.S. in Physics

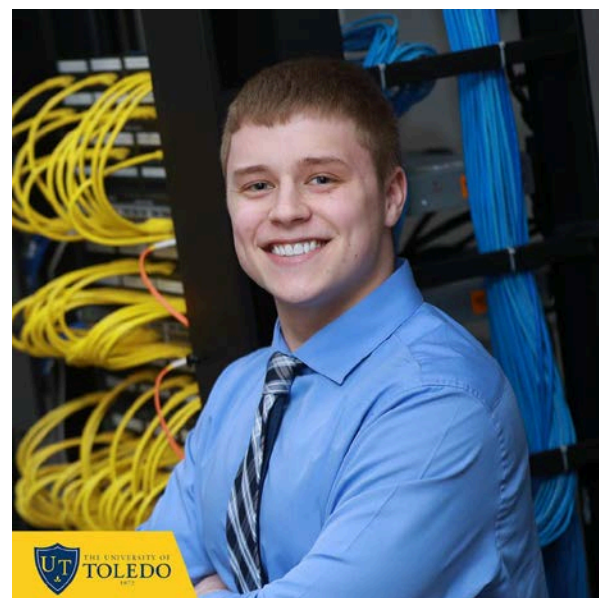
Sean O'Brien, B.S. (Astr., 1991), directly got hired at the Einstein Planetarium at the National Air and Space Museum in Washington D.C.

Katie Hoepfl, B.S. (Phys., 2011), directly got hired at First Solar in Perrysburg, Ohio

Levi Gorrell, B.S. (Phys., 2005), directly got hired at Woods Hole Oceanographic Institute, in Massachusetts

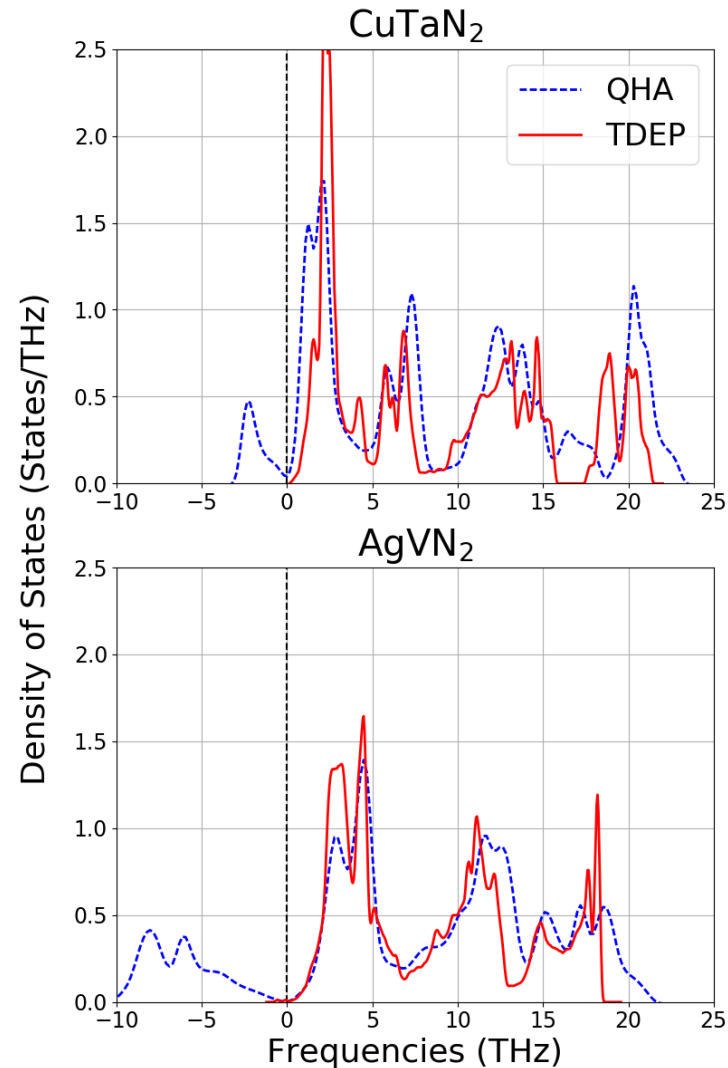
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Nathan Szymanski, senior in B.S. Physics, Winner of the Barry Goldwater National Award



Dynamical Stabilization in Delafossite Nitrides for Solar Energy Conversion, N. J. Szymanski, S. V. Khare, J. of Materials Chemistry, 6, 20852 (2018).

Published two other papers as well. Did REU and NWU.



Employers of UT P&A graduates

Oceanography Institute, MA
Plasma display industry
U.S. Patent Bureau in D.C.
RHK Tech, Troy MI
Horiba Scientific, Edison, NJ
Exponential Consulting Co.,
Owings Mill, MD
Atmospheric & Environmental
Research, DC
First Solar, Toledo, OH
Xunlight, Toledo, OH
Solar Business Group, CA
Space Telescope Science Institute,
MD
PrimeStar Solar in Denver, CO
Link-Quest Inc, San Diego CA
Corning, East Asia
Ohio Bureau of Criminal
Investigation, OH

Wright-Patterson Air Force Base, Dayton,
OH
Apache Point Observatory, NM
Lam Research, Silicon Valley, CA
MV Systems, Wheatridge CO
Beckman Coulter, Inc., Ft. Collins CO
Wachovia (a bank), NC
EMC Corporation, OH
Crutchfield Corp (Charlottesville, VA)
Logos Technologies in Washington DC
Ball Aerospace in Dayton, OH
Summa Health, Kent, OH
Raytheon, Tampa, FL
EMCORE Photovoltaics Albuquerque, NM
Einstein Planetarium – NAS Museum, DC
Hayden Planetarium – NYC, NY
NASA Glenn and other centers, USA

Choose Ohio First Scholarship!



For high school graduates from Ohio who are Ohio residents with GPA 3.0+.

Committed to completing a BS or BA in Physics and Astronomy (P&A) at UT.

Renewable for 3 more years if maintaining a GPA 3.0+ while following a BS or BA in P&A.

Up to \$4500 of scholarship per year. Needs to be matched by other UT scholarships which are not Choose Ohio First.

We have about 13 scholarships this year 2019-2020!

Contact Sanjay V. Khare, Chair of Physics and Astronomy at the University of Toledo, sanjay.khare@utoledo.edu

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Warm Welcome to New Scholars!



We all welcome you to join in our past successes!

In the Physics and Astronomy Department at UT you will be joining a team geared for success and add your name to this list of self-fulfilled alumni!

Your success is our success!

We want to motivate, encourage, nurture, support and direct your talents and hard work to launch you to lofty career heights and personal fulfillment!

We look forward to seeing you in fall 2019!

Thank You!

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