

Center for High Technology Materials

Arash Mafi, Ph.D.

Director

2018 Annual Review Of Category 3 Research Centers/Institutes | Submitted to OVPR on 03/29/2019

CHTM Mission Statement

The mission of CHTM is to create and sustain a culture of excellence to promote research and education in photonics, microelectronics and nanoscale materials and devices and their applications; foster interaction between UNM, federal laboratories, industry; and promote an entrepreneurial spirit for economic development with a regional focus but of global importance.

CHTM is committed to training the next generation of scientists, engineers, discoverers and entrepreneurs who can combine their technical training and critical thinking with excellent interpersonal and communication skills to become leaders of the 21st century.

Our core strengths are:

- Research, creativity and innovation,
- Interdisciplinary education, training and outreach,
- Entrepreneurship and economic development.

We will continue to invent and discover disruptive technologies that can be scaled to develop innovative advanced manufacturing initiatives to create self-sustaining wealth based economies to leave the earth a better place than we found it.

CY 2018 Goals And Status

- **Continue to remain a pillar for transformative interdisciplinary research and education in photonics, microelectronics and nanoscale materials and devices at UNM.**
- **Start the process of hiring two new faculty members.**
- **Acquire new critical equipment for Nano-Fab user facility: Purchase, install, and make available for Nano-Fab a state-of-the-art XRD: critical for MOCVD and MBE operations. Purchase gas sensing and flood sensing system to replace the outdated systems to improve CHTM safety.**
- **Obtain a Magnetic Property Measurement System (MPMS).**
- **Reorganize and optimize CHTM staff operation.**
- **Maintain a balanced budget aligned with CHTM mission.**
 - **Consolidate and reorganize laboratory space, convert unused storage space to functioning laboratory space.**
- **Complete upgrading the network to comply with the main campus IT requirements.**

All the above goals have been met.

Membership of Advisory Committee

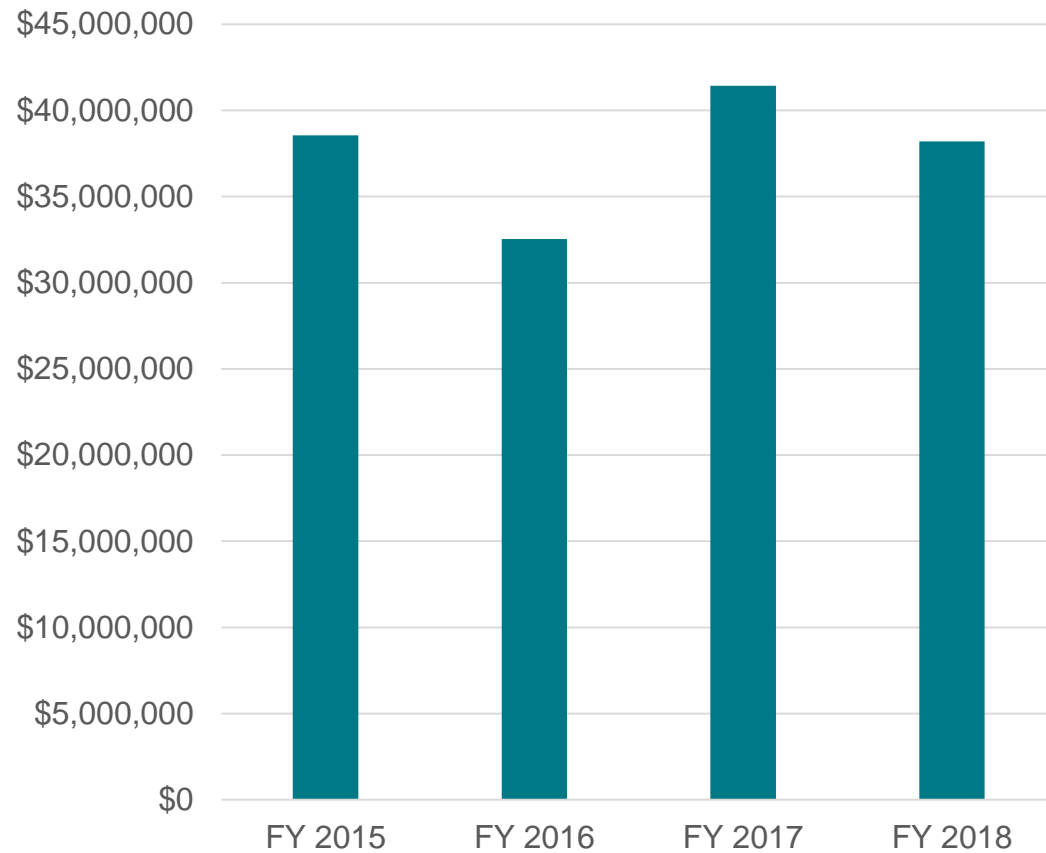
- Associate Deans for Research
 - College of Arts & Sciences (Turner)
 - School of Engineering (Schamiloglu)
- Department Chairs
 - Electrical and Computer Engineering (Devetsikiotis)
 - Physics and Astronomy (Rand)
 - Chemistry and Chemical Biology (Rack)
 - Mechanical Engineering (Shen)
- CEO of STC.UNM (Kuuttila)
- Director of Center for MicroEngineered Materials (Garzon)
- No annual review was held in CY2018. Instead approval for, and process of hiring of, CHTM director through national search provided campus wide input into CHTM operations and direction.

CY 2018 Highlights

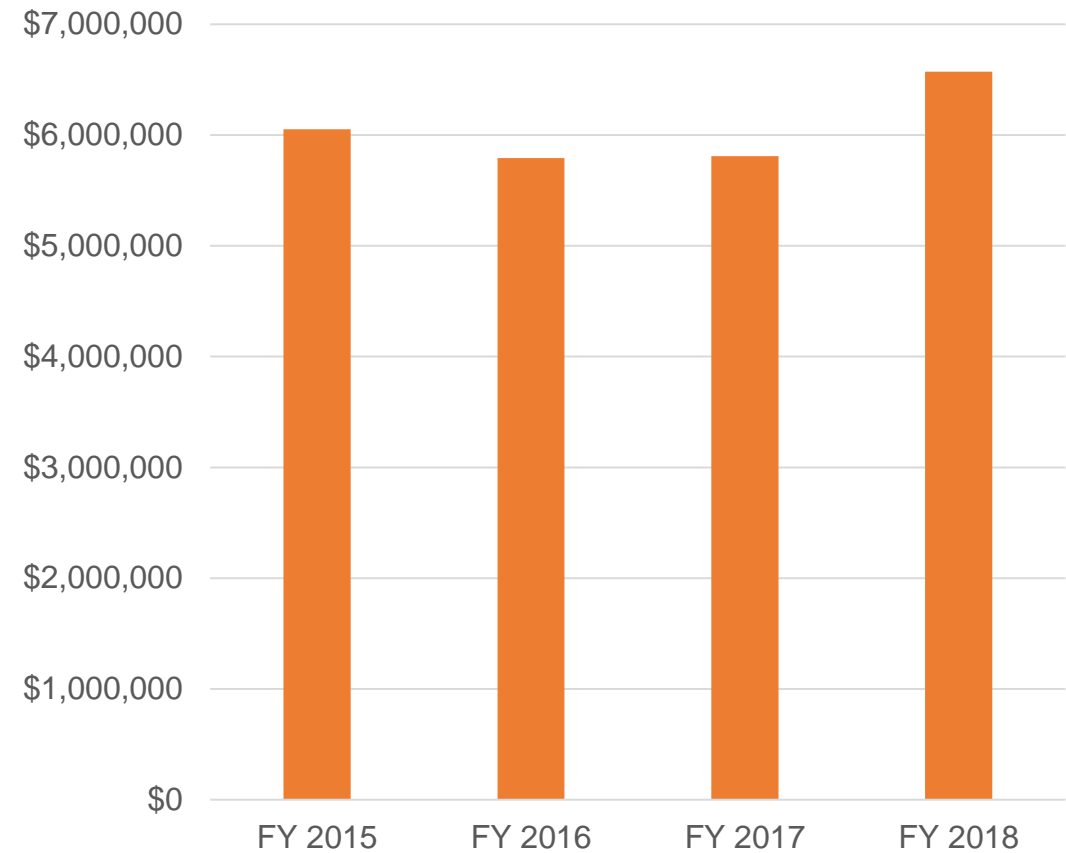
- Nationwide Director search: Mafi was appointed as the Director on 2/18
- CHTM Federal Research Award Highlights:
 - NSF award on Quantum Information Tech. (PI Osinski, Mafi, Balakrishnan), \$750K
 - DTRA award on OnChip Radiation Detection (PI Osinski, Hecht, Zarkesh-ha), \$1.75M
 - NSF award on MRI acquisition of a Magnetic Property Measurement System, MPMS (PI Kirk, Acosta, Feezell, Cavallo, Laraoui)
 - RPI ARPA-E subaward on Reflected Light Sensing (PI Brueck, Zarkesh-ha), \$800K
- Faculty Accolades:
 - Osinski became an IEEE Life Fellow
 - Acosta is awarded Google Daydream Research Award; Cottrell Scholars Award; NIBIB Trailblazer Award for early career investigators
- Joint CHTM-LANL Quantum Materials Seminar series
- Joint CHTM-Sandia Seminar series
- 217 patents have been issued to CHTM since its inception
- Major reorganization of technical and administrative staff functions

Proposals & Awards

Proposals

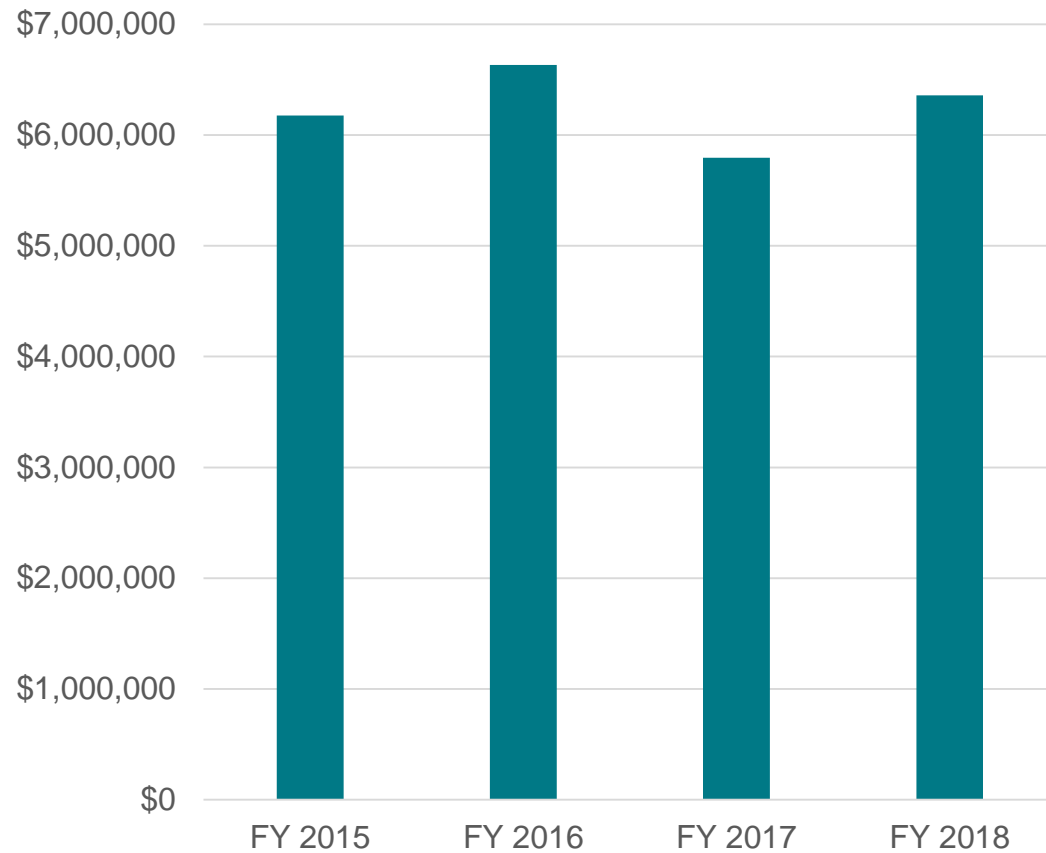


Awards

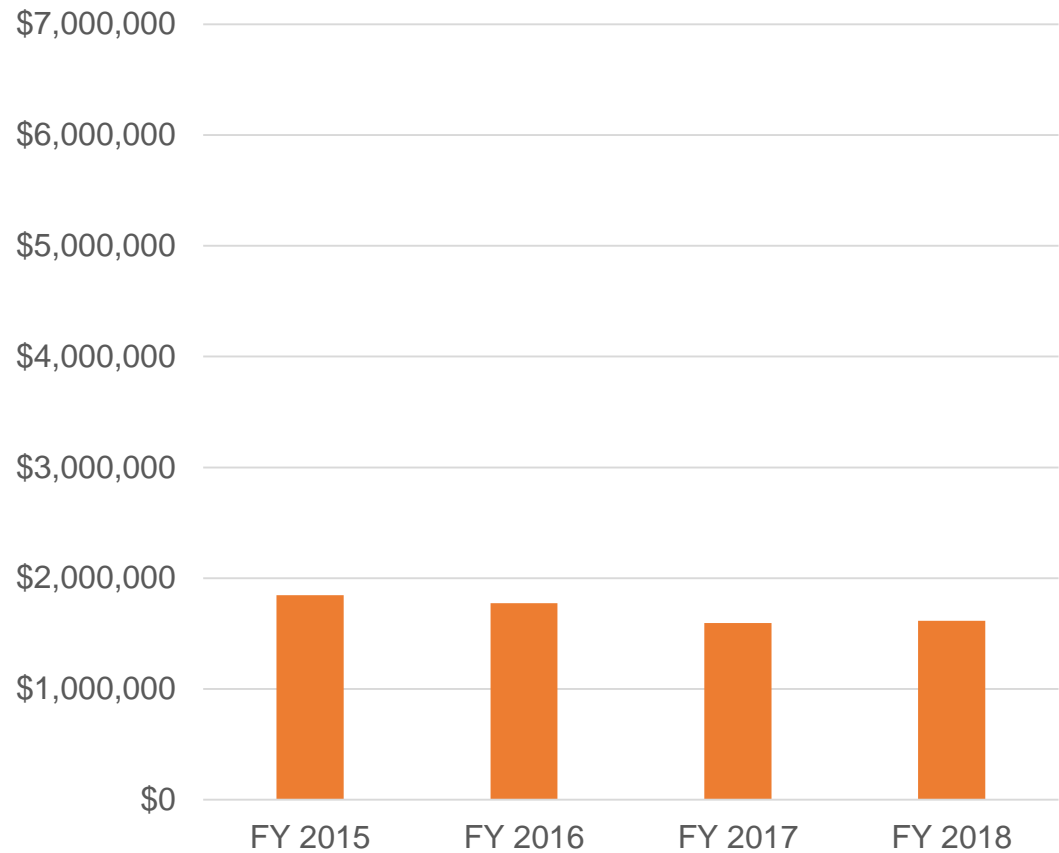


Research Expenditures and F&A

Expenditures



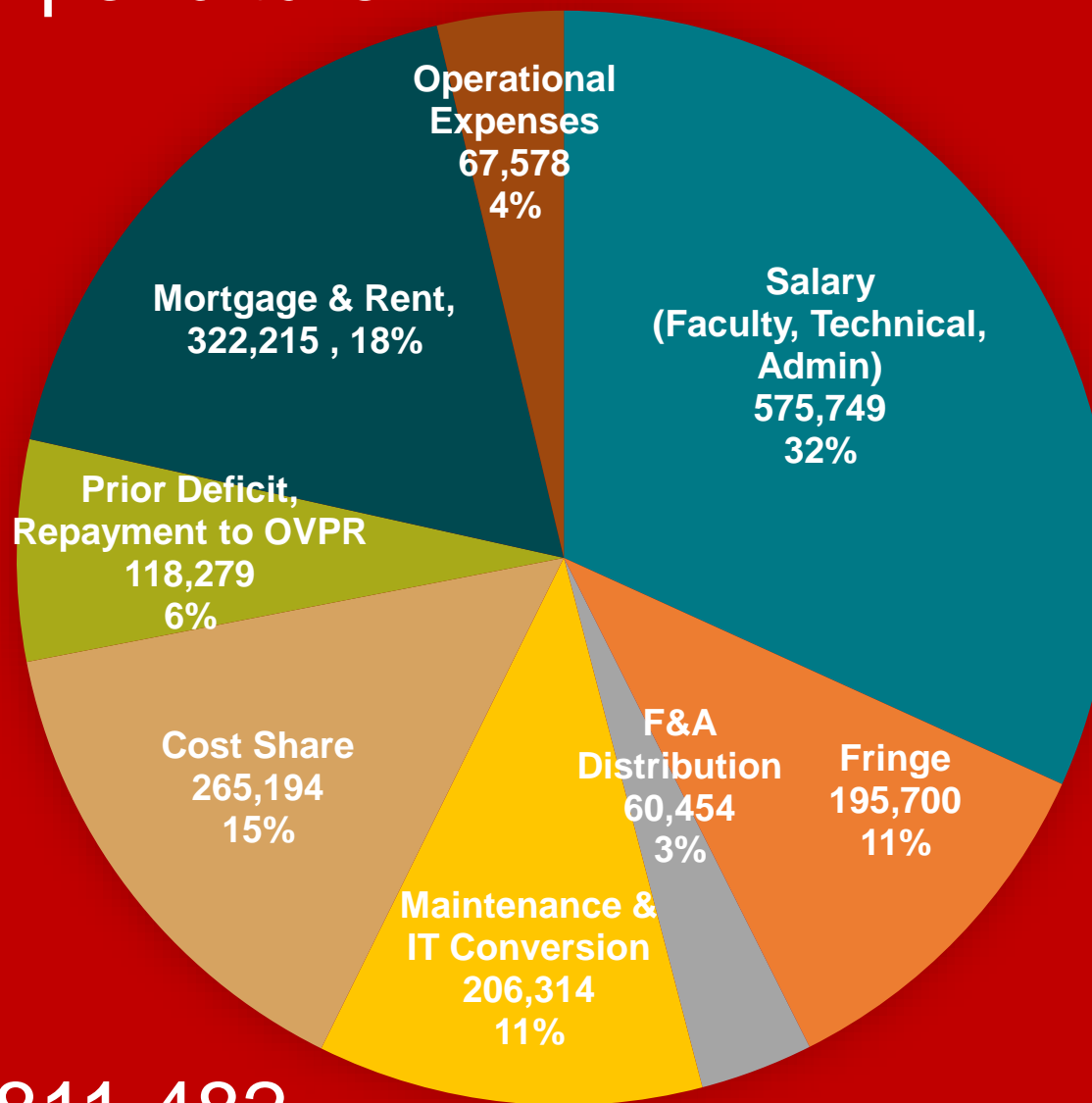
F&A



FY 2018 Sources of Revenue

- F&A Return: \$968,404
- VPR Maintenance and SAC: \$222,800
- Cleanroom Usage: \$430,186
- Operational Revenue: \$55,576
- Wafer Sales: \$5,950

Center Expenditure Details



Total: 1,811,482

Research Center Impacts

- Nano-Fab/cleanroom: 24/7 access & support to UNM, local companies/startups, National Labs (DoE & DoD)
 - Nano-Fab hosts ECE474/574 Microelectronics Processing
 - Provides Summer high school cleanroom hands-on training
- CHTM provides resources for campus (especially South Campus)
 - CHTM supports CMEM, AML/Sandia Labs, and MTTC facilities and research infrastructure
 - CHTM hosts equipment demos by companies open to entire campus, national labs, local companies
 - CHTM facilities host start-up Armonica Tech: DNA Nanopore Sequencing Technology
- NSF ERCs; Part of MURI on high power lasers; collaborates with UNM Hospital on a “Smart Lighting” testbed in an inpatient room; remains a leader in semiconductor device fabrication
- Extensive Outreach: The students, staff and faculty of the CHTM ERCs interacted with over 4000 pre-college teachers, students and their families during 2018 in 36 events. Many CHTM labs also take high school students and REU students – Prof. Osinski has 4 REAP students; Prof. Cavallo hosted REU and HS students; and QESST hosted 2 HS students, 2 REUs, 1 teacher; NASCENT had 1 HS; Prof. Jackson participated in the Role Models Matter outreach event held at Explora and presented to 30 students.

Return On Investment

- CHTM research resulted in 6 Ph.D. and 9 M.S. degrees in 2018
 - CHTM currently hosts 53 graduate students on Research Assistantships. Several other graduate students work at CHTM through other forms of support.
 - CHTM currently supports 8 undergraduate students.
- CHTM core faculty (17 total, 3 retired) published 74 peer reviewed journal articles (149 including conferences), many more from affiliated faculty
- CHTM faculty received 43 awards for a total of \$6,572,220
- 12 patents were awarded to CHTM core faculty in 2018
- Industry engagement
 - 2 STTR subcontracts; 3 small business industry contracts; 1 new startup

- Diverse interdisciplinary research
- Dedicated faculty lines
- State-of-the-art user facility (including Nanofab /cleanroom), available 24/7
- Strong sharing culture, providing opportunities to others at UNM and New Mexico
- Well-trained and professional technical and administrative staff: providing services to CHTM, CMEM and SNL
- CHTM provides a gateway to collaboration with National Labs, especially AFRL, UNM leader in safety!

STRENGTHS

- Fluctuations in operational funding from year to year
- No annual designated capital funding for renewal and replacement of major facility components
- No I&G lines for staff
- STEM department rankings at UNM have been declining, affecting the quality of our graduate students
- Lack of direct state support, difficulty in obtaining cost share

WEAKNESSES

- Future faculty hiring at CHTM
- Growing optoelectronics and photonics market and opportunities; emerging national quantum initiatives
- Expanded collaboration with national labs
- CHTM can lead and champion initiatives at UNM South Campus, e.g. in energy saving, Safety, IT services, and facilities and maintenance

OPPORTUNITIES

- Imminent failure of 22-years-old facility infrastructure; e.g., heating, cooling, and roofing systems
- Faculty retention has been an ongoing issue. The main reason is that UNM faculty salaries are not competitive nationally. If faculty leave CHTM, they are difficult to replace due to shortage of startup funds

THREATS



Looking Ahead To 2019

- Integrating the new faculty hires into CHTM
- Expanding high-impact and visible research
- Significant grant/contract opportunities, Center-wide awards
 - Potential opportunities include MURI; National Quantum Initiative
- Expanding relationship with AFRL, Sandia Labs, and LANL
- Expanding research space by creative management of storage space
- Encouraging CHTM Staff to expand duties and responsibilities to improve research and education support at CHTM and enable Staff career growth opportunities
- Develop an infrastructure funding master plan with UNM PPD

Summary

CHTM will continue to create and sustain a culture of excellence to promote interdisciplinary research and education; foster interaction between UNM, federal laboratories, industry; and promote an entrepreneurial spirit for economic development in New Mexico.

CHTM will remain committed to providing a diverse interdisciplinary research access point to UNM and New Mexico.