Center for High Technology Materials

Arash Mafi, Ph.D.

Director

2020 Annual Review Of Category 3 Research Centers/Institutes | Submitted to OVPR on 02/15/2021

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 2020 Goals And Status

- Continue to remain a pillar for transformative interdisciplinary research and education in photonics, microelectronics, and nanoscale materials and devices at UNM. (successful)
- Expanding high-impact collaborative research; encouraging & enabling faculty to submit large collaborative proposals; increasing the number of such proposals. (successful)
- Expanding relationship with AFRL, Sandia Labs, and LANL. (successful)
- Preparing the grounds for the establishment of the Directed Energy Center of Excellence; and the Quantum Materials and Technologies Laboratory. (ongoing/successful)
- Starting the process of hiring a new faculty in directed energy lasers. (ongoing, planned for 21-22)
- Expanding research space at CHTM by creative management of storage space. (successful)
- Encouraging CHTM Staff to expand duties and responsibilities to improve research and education support; enable Staff career growth opportunities. (impacted by covid19)
- Develop an infrastructure funding master plan with UNM Facilities Management. (pending the 100% I&G status request for the CHTM building, justification request submitted to OVPR)
- Establish an external industrial advisory board for CHTM. (delayed due to covid19)

Membership of Advisory Committee

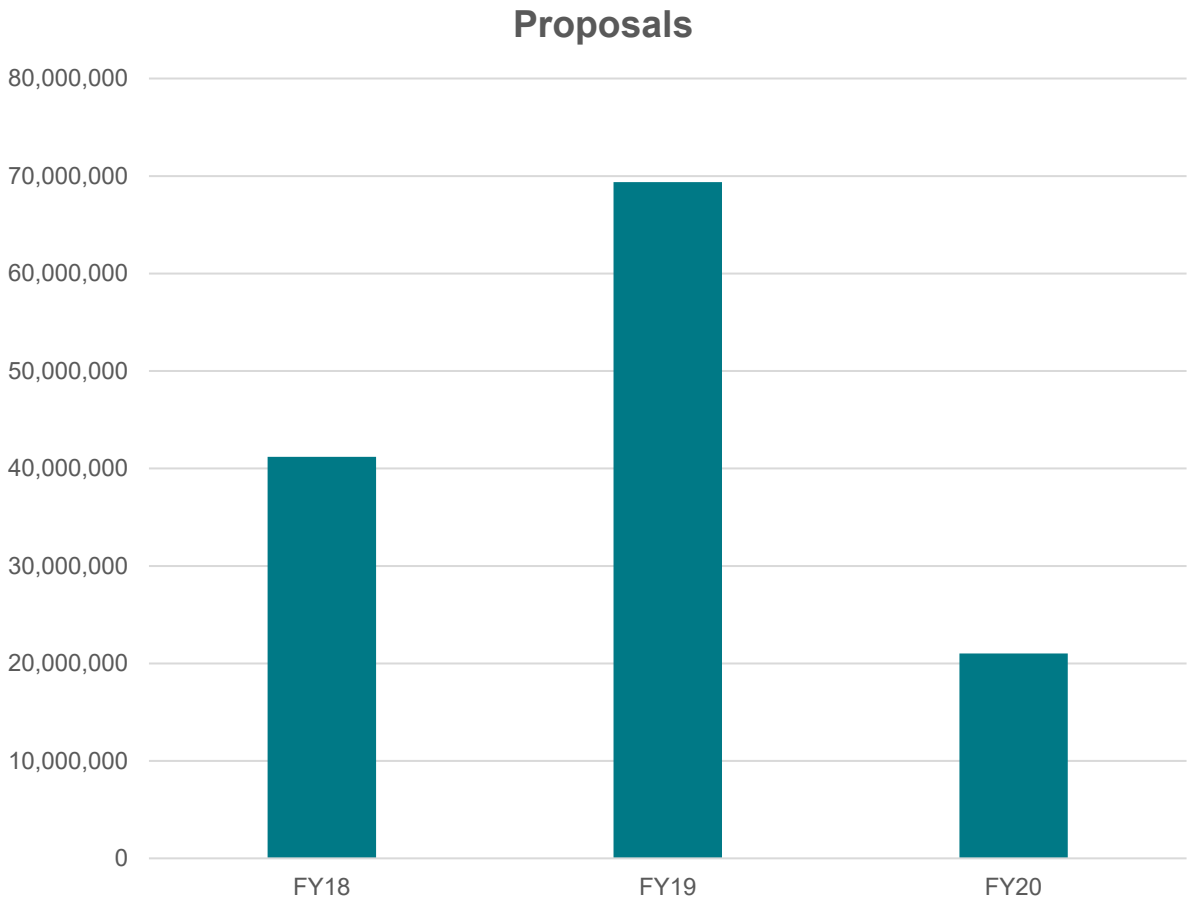
- Associate Deans for Research
  - College of Arts & Sciences (Turner)
  - School of Engineering (Schamiloglu)
- Department Chairs
  - Electrical and Computer Engineering (Devetsikiotis)
  - Physics and Astronomy (Rand)
  - Chemistry and Chemical Biology (Edwards)
  - Mechanical Engineering (Shen)
- CEO of STC.UNM (Kuuttila)
- Director of Center for MicroEngineered Materials (Garzon)

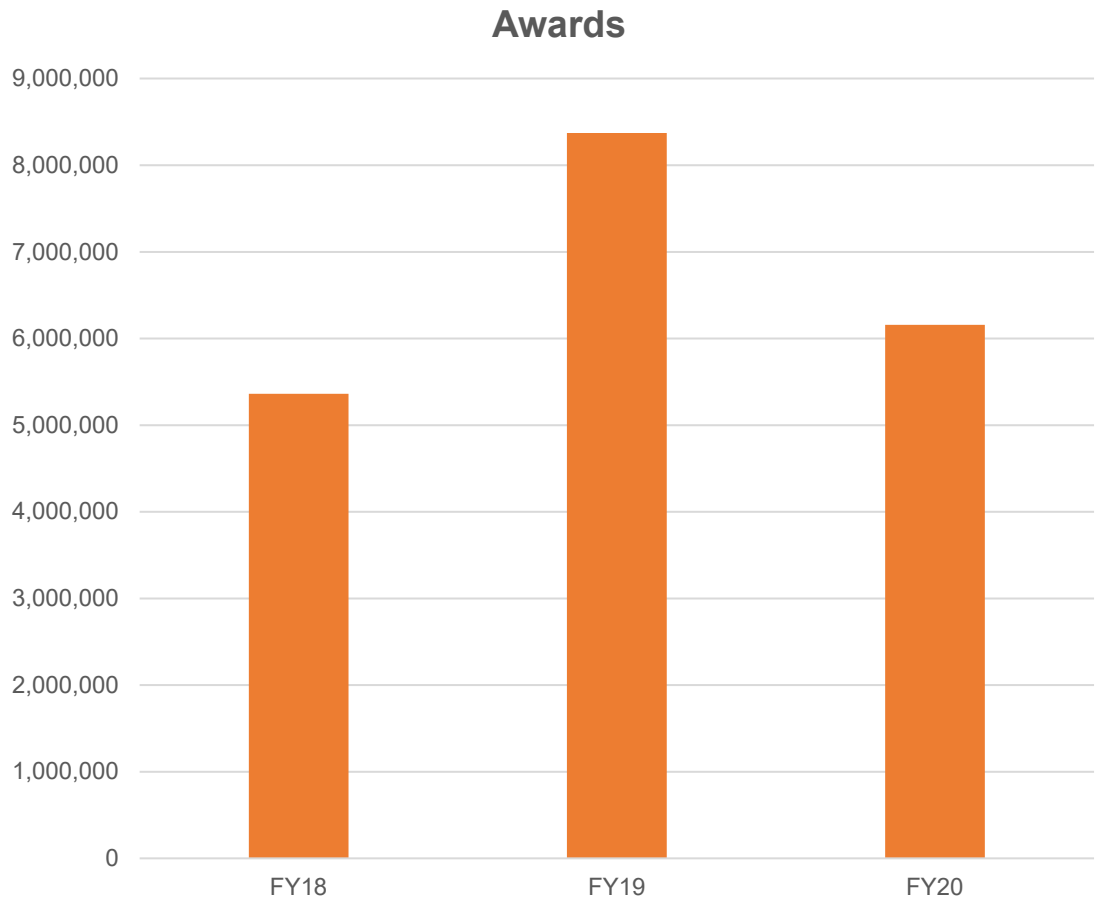
CHTM annual review was held on 4/8/2021. Mafi was reappointed as the Director for another three-year term beginning in January 2021.

CY 2020 Highlights

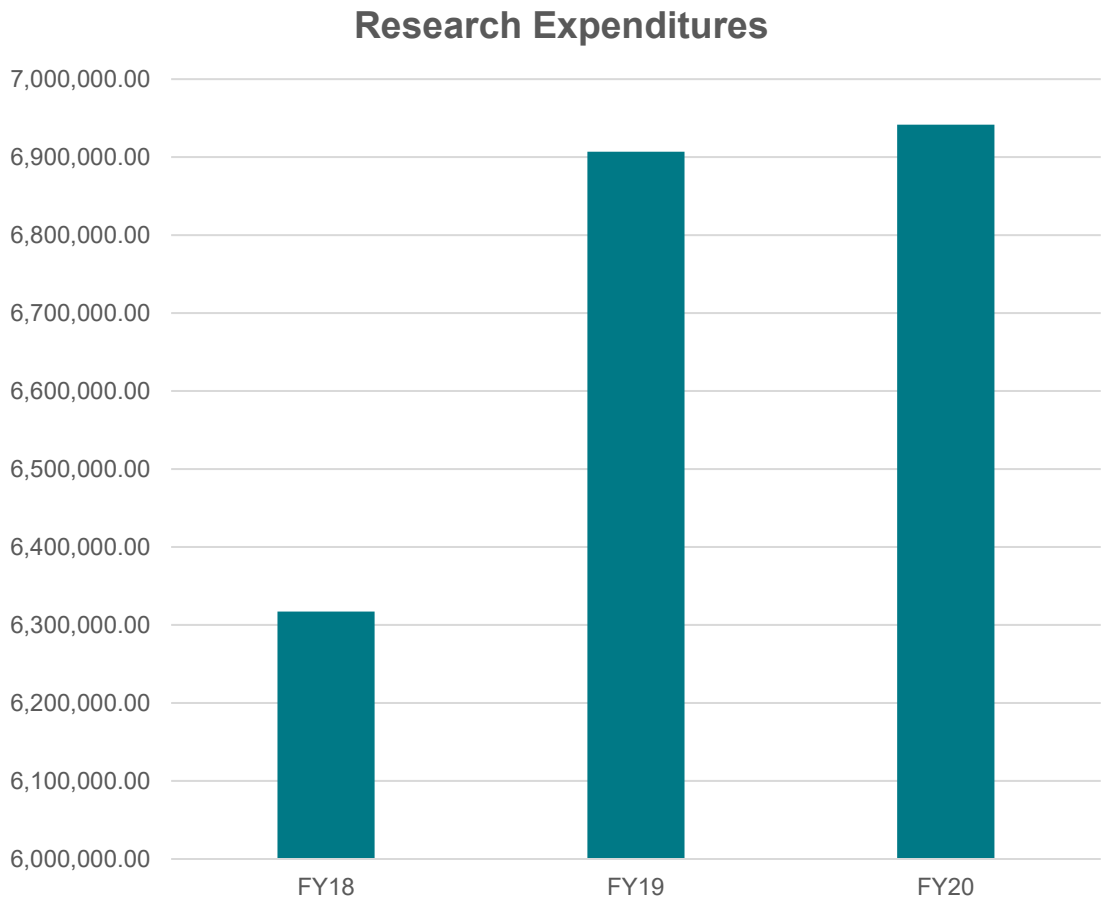
- All eight CHTM faculty lines are filled (Acosta, Busani, Cavallo, Drake, Feezell, Jain, Mafi, Osinski).
- Licensing revenues from CHTM patents, $51.5 million in 2020.
- CHTM's request for funds to establish a Quantum Technologies and Materials was approved as part of the General Obligation Bond C (Public Education) in the November 2020 vote.
- CHTM Federal Research Award Highlights:
  - NIH award for NMR Microscope Quantum Sensors (PI Acosta), $2.12M
  - DoD award for Multifunctional Flexible Piezoelectric Materials (PI Jackson), $658K
  - NSF CAREER award on Picoliter NMR Quantum Sensors (PI Acosta), $650K
  - Industry award on Efficient Green and Yellow LEDs (PI Feezell), $560K
  - LANL award on Synthesis and Spectroscopy of Quantum Dots (PI Osinski). $312K
- Faculty Accolades:
  - Distinguished Professor Osinski selected as an SPIE Community Champion for his outstanding volunteerism with the Society; Professor Acosta won NSF CAREER award. Professor Sang M. Han became an AVS Fellow; and his company, Osazda Energy, a solar energy company, has received a $1.25 million grant from the U.S. DOE. Professor Drake was selected at UNM for the 2020 Women in STEM awards.
- 8 patents awarded to CHTM core faculty in 2020; total of 234 since the inception of CHTM.

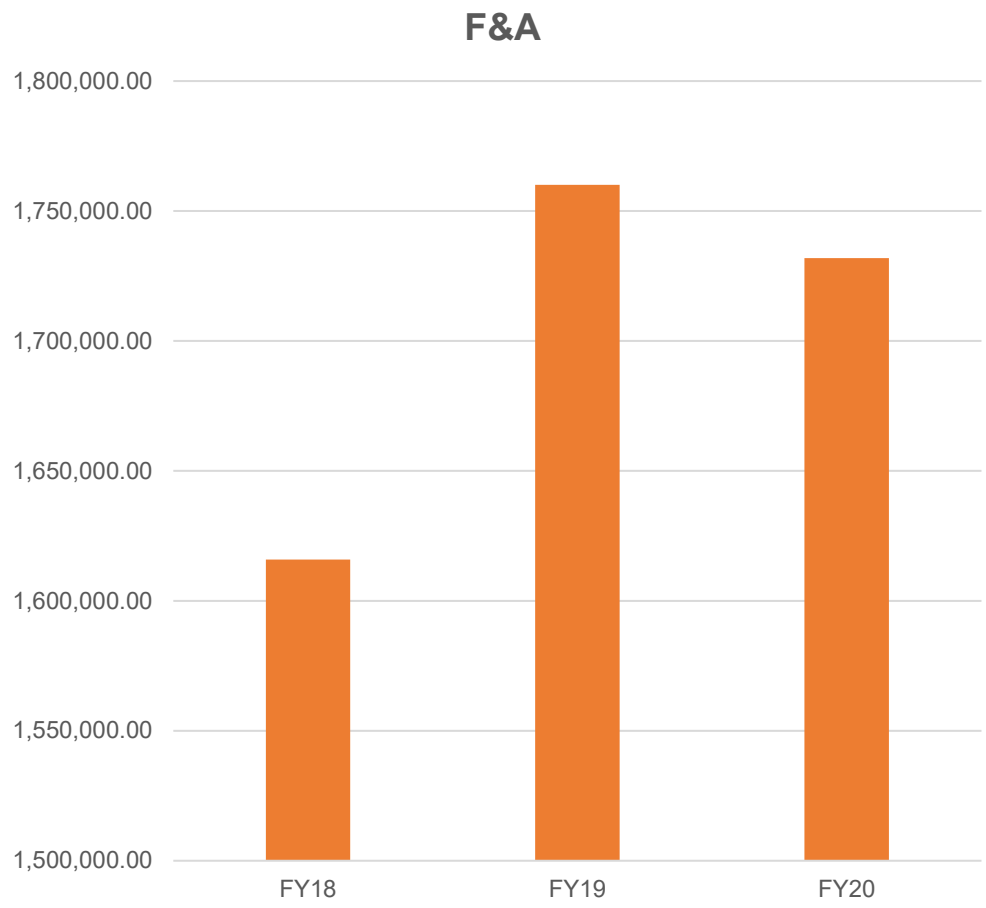
Proposals & Awards



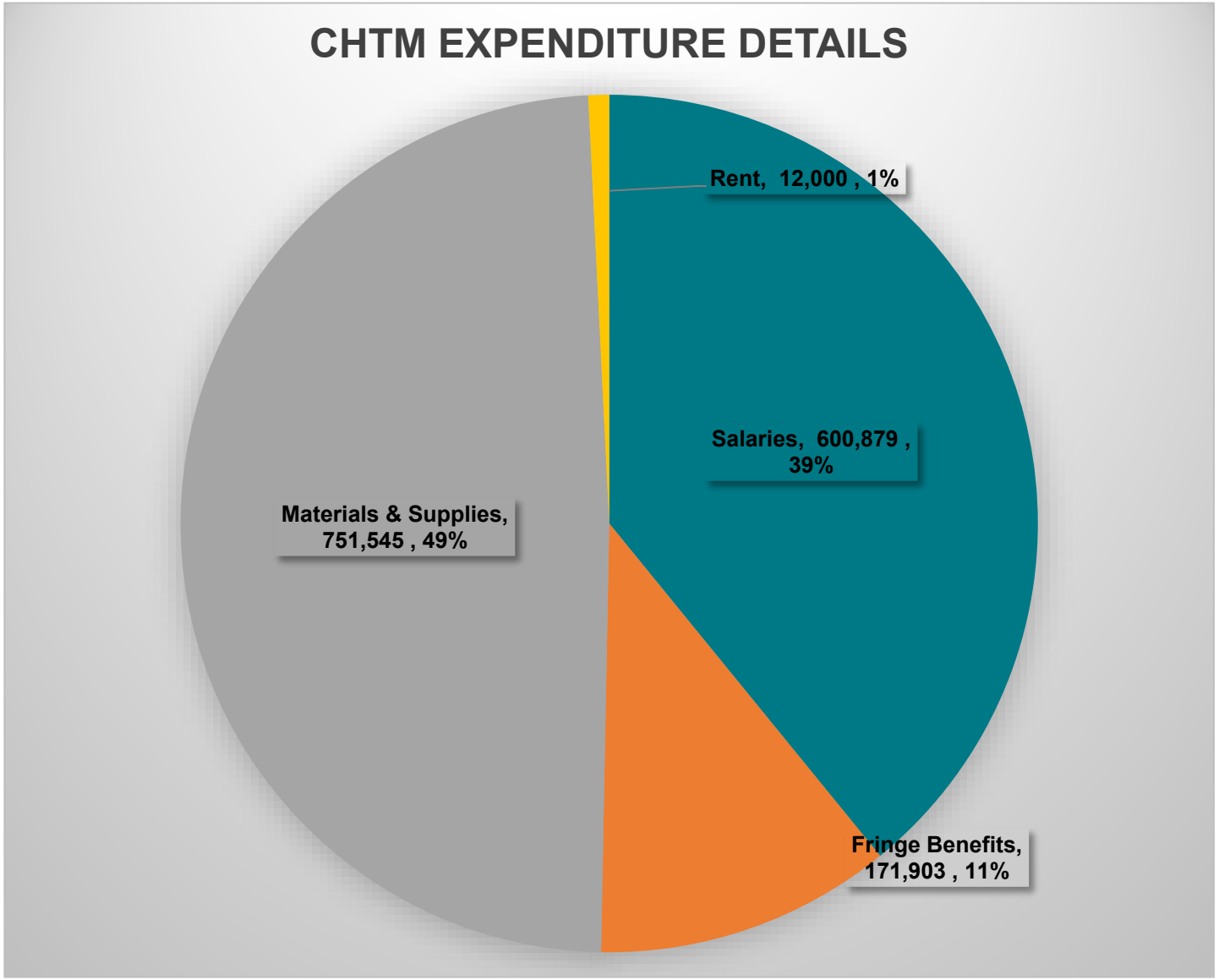


Research Expenditures and F&A





FY20 Sources of Revenue	
F&A Return	$ 1,047,549
VPR Pullback	$ (51,206)
Cost Share	$ (98,715)
Service Centers	$ 315,995
Other	$ 94,306
Support from OVPR	$ 572,901
FY19 Reserves	$ 1,106,476
Total Revenue	$ 2,987,307



Research Center Impacts

- CHTM core faculty (17 total, 1 retired) published 63 journal articles (113 including conferences), many more from affiliated faculty
- CHTM: is partner in two active NSF ERCs; is part of a DoD MURI award on high power lasers; remains a leader in semiconductor device fabrication; is engaging AFRL to establish a Directed Energy Center of Excellence; is establishing a Quantum Technologies and Materials Laboratory at CHTM.
- Nano-Fab/Cleanroom: 24/7 access & support to UNM, local companies, National Labs (DoE & DoD)
  - Nano-Fab hosts ECE474/574 Microelectronics Processing
- Outreach: Prof. Busani mentored students from AIMS & E. Mountain high school. Profs. Mafi & Drake led a virtual STEM outreach at Desert Ridge middle school. Prof. Acosta designed a take-home optics lab.
- CHTM provides classroom space for multiple courses including NSMS 419, ECE 420, ME 461, ECE 471, ECE 474L, ECE 564, ECE 572, ECE 574L, ECE 576, ECE 581.
- 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
  - CHTM hosts the Emergency Operations Commend Center for UNM Police.

Return On Investment

- CHTM research resulted in 5 Ph.D. and 8 M.S. degrees in 2020.
  - CHTM currently hosts 56 graduate students, 43 on Research Assistantships. Several other graduate students work at CHTM through other forms of support.
  - CHTM currently supports 9 undergraduate students.
- CHTM core faculty (17 total, 1 retired) published 63 journal articles (113 including conferences), many more from affiliated faculty
- CHTM faculty received $6,157,814 in research awards in 2020.
- 8 patents awarded to CHTM core faculty in 2020; total of 234 since inception, making it 35% of UNM patent portfolio (38% licensed).
- Industry engagement
  - Substantial funding from industry (large and small businesses); 1 STTR subcontract; 1 SBIR subcontract, 2 direct industry contracts.
  - Industry uses the nanofab facilities for a fee and collaborates with CHTM faculty.
  - 16 companies have been spun-off (CHTM faculty and student started) and many mor companies have been assisted since the inception of CHTM.

STRENGTHS

- Diverse interdisciplinary research
- Eight 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/AML
- CHTM provides a gateway to collaboration with National Labs, especially AFRL, UNM leader in safety!

WEAKNESSES

- 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
- Lack of direct state support, difficulty in obtaining cost share
- Diversity of faculty and students

OPPORTUNITIES

- Future faculty recruitment at CHTM
- Growing optoelectronics and photonics market and opportunities; emerging national quantum initiatives
- Potential to lead in directed energy and quantum technologies and materials
- 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

THREATS

- 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
- Faculty hiring process at CHTM, especially regarding its 8 dedicated faculty lines are not formalized at UNM
- Continued problems with roofing, needs funds to replace

Looking Ahead To 2021

- Continuing with the process of hiring a new faculty in **directed energy lasers**
- Establishing **bylaws** for the management and operation of CHTM (approved by OVPR and Deans of SOE and A&S)
- Expanding high-impact **collaborative research**; encouraging & enabling faculty to submit large collaborative proposals; increasing the number of such proposals
- Expanding relationship with AFRL, Sandia Labs, and LANL
- Establish the **Directed Energy Center of Excellence**
- Establish the **Quantum Technologies and Materials Laboratory**
- Expanding research space at CHTM by creative management of storage space
- Encouraging CHTM Staff to expand duties and responsibilities to improve research and education support; enable Staff career growth opportunities
- Develop an **infrastructure funding master plan** with UNM Facilities Management
- Establish an **external industrial advisory board** for CHTM

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.