



ARCS® Foundation, Inc.
UNIVERSITY RELATIONS APPROVAL FORM A

***For approval of Departments/Programs including Multidisciplinary Programs
Within an ARCS Foundation Approved Institution***

In order to receive funding from ARCS Foundation, every department/program or multidisciplinary program is required to be approved by ARCS National through the National Board University Relations review and approval process.

- If the Department/Program or Institution housing it is ranked within the top 50 in the nation (see SUGGESTED RESOURCES FOR RANKING DEPARTMENTAL SUBMISSIONS, in the Appendix of this form), please complete **Section I**
- If the Department/Program or Institution housing it is **not** ranked within the top 50 in the nation (see SUGGESTED RESOURCES FOR RANKING DEPARTMENTAL SUBMISSIONS, in the Appendix of this form), please complete **Sections I and II**
- If this is a multidisciplinary program please complete the additional questions as indicated below. Please refer to the SUGGESTED RESOURCES FOR RANKING DEPARTMENTAL SUBMISSIONS, in the Appendix of this form, and as appropriate, please complete **Sections I and II**

This completed form, along with any attachments, must be submitted to the National VP, University Relations at least six (6) weeks prior to a National Board meeting. Incomplete forms cannot be considered.

CHAPTER:

Chapter VP University Relations or President:

Elizabeth Callander, President // Leslie Van Houten and Chris Simpson Brent, Co-VP's UR

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Date Approved by Chapter Board: August 31, 2021

Date of Submission to National VP, UR: September 29, 2021

NATIONAL:

Date and Resolution by National:

SECTION I

Basic Information

Name of Institution:
(Parent organization)

University of California, Merced

Name of Division:
(School, college, division, institute, if applicable)

School of Natural Sciences

Name of Department/Program or Multidisciplinary Program:
(Indicate if multidisciplinary and explain)

Physics

Institution Contact:

Marjorie S. Zatz

Title:

Interim Vice Chancellor for Research and Economic Development

Email:

mzatz@ucmerced.edu

Tel:

209-228-0085

Area of Study

1. Specify the ARCS approved Area(s) of Study, under which this discipline falls.

Physics

2. If the department/program or primary area of the multidisciplinary program does not fall within our approved Areas of Study, please provide the following information:

A. Demonstrate how it relates to the area(s).

NA

- B. If this is an entirely new area of study confirm that the research being done in the department/program or multidisciplinary program is “hard” or “bench” science and not comparative or clinical research. Cite examples. The degree-granting department must be a “hard” science. (Refer to Appendix)

NA

- C. Explain how this area of study supports the standards of excellence essential to the ARCS mission.

NA

Overview of Department/Program or Multidisciplinary Program

Provide an overview of the department(s)/program(s)

The Physics graduate program at UC Merced trains students to conduct and communicate independent research at the knowledge frontier, advancing fundamental understanding of the world and using physics to solve important problems in society. The expertise and perspectives required to address many important scientific and technological challenges, from renewable energy to advanced computation to human health, are not confined to single disciplines. Research in physics graduate studies spans the traditional disciplines of physics as well as related interdisciplinary areas. Emphasis areas include atomic, molecular and optical physics (AMO), condensed matter physics, biophysics, soft-matter physics, materials physics, astrophysics and astronomy, nanoscience and energy science.

UC Merced Physics faculty members are committed to student success and building a supportive and collaborative culture in the program with an emphasis on faculty and peer mentoring of graduate students and use of innovative teaching methods in the classroom. Students hail from a variety of backgrounds, not only those on the traditional path straight after the bachelor's degree, but also students who started at a community college, are returning to school after some time working, or have taken other nonlinear paths. The program is also committed to the success of underrepresented minorities and women in our department, with a high proportion of female faculty and graduate students who participate in Women in STEM activities.

Physics leads or participates in several federally funded centers on campus to promote education, research and training for underrepresented minorities, including the Center for Cellular and Biomolecular Machines (NSF), the Merced nAnonmaterials Center for Energy and Sensing (MACES), an NSF Research Traineeship program in Interdisciplinary Computational Graduate Education, and NIH Graduate Research Training Initiative for Student Enhancement program (G-RISE) focused on Interdisciplinary Biomedical Science and Technology (I-Bio-STeP) and the Consortium for High-Energy Density Science (NNSA) (see Appendix 2).

Facts, including ranking

1. How does this **institution** rank nationally among its peers? Give two rankings from different sources, including dates and names of the sources. Please reference the National Research Council and *The Chronicle of Higher Education* and other specific rankings for this multidisciplinary program application. (Refer to Appendix for other ranking sources.)

US News & World Report rankings:

#97 overall (2021) (First time in Top 100 schools; jumped 7 spots since 2019; jumped 68 spots in the last three years)
#40 among public institutions (2021)
#1 among public universities in Outperforming Expected Graduation Rates (2021)
#5 for Social Mobility (2021)
#8 for Economic Diversity (2021)

Times Higher Education Rankings:

Times Higher Education ranked UC Merced #3 among U.S. universities in the Young University Rankings; #57 in the world (2021). The Times Higher Education Young University Rankings list the world's best universities that are 50 years old or younger. The ranking includes institutions that were founded between 1971 and the present, UC Merced was founded in 2005.

2. How does this **department(s)/program(s)** rank nationally among its peers? Give two rankings from different sources, including dates and names of the sources. If the multidisciplinary program is not ranked, provide the rankings of the primary departments and any quantitative and qualitative comparative information for the program as a whole.

US News & World Report Rankings:

The Physics graduate program debuted at #146 in the *US News & World Report* rankings of Physics graduate programs in 2018. Physics rankings have not been updated since then and the program does not have another national ranking, but several faculty members have appointments in the School of Engineering and Physics faculty regularly collaborate with engineering colleagues and graduate programs. The School of Engineering has a *US News & World Report* ranking of #119.

Times Higher Education Rankings:

Times Higher Education ranked UC Merced #65 in the Young University for Physics and Astronomy Rankings (2020).

3. How old is the **department/program or multidisciplinary program** and why was it established?

The Physics graduate program was approved by the University of California in 2014. It was established as part of the founding vision of UC Merced to become an R1 university with an emphasis on STEM training and education.

Degrees Granted

1. Name the degrees awarded in the department/program or multidisciplinary program (e.g., Ph.D. in Chemistry).

PhD in Physics

2. For which of the degrees named above are you seeking degrees?

PhD in Physics

3. For each degree named in two, please indicate the number of degrees that are granted per year per faculty.

With 20 core faculty members and 8 students graduating from the Physics program in FY20, there were 0.4 degrees conferred per faculty last year.

4. For each degree named in two, please indicate the non-completion rate.

Physics PhD 7-year non-completion rate (3-year average): 27%

Physics PhD 8-year non-completion rate (3-year average): 21%

These non-completion rates are well below the national average. In the 2015 Doctoral Initiative on Minority Attrition published by the Council of Graduate Schools, it is noted that 54% of all students in all PhD fields, including U.S. citizens and permanent residents and temporary residents, did not complete their doctoral programs after seven years, and even after ten years 43% still had not completed their degrees. The non-completion rates were higher for underrepresented minorities.

The campus-wide goal is to reduce our PhD 7-year non-completion rate down to 35% in five years. The Physics graduate program is already at this target.

5. For each degree named in two, what is the average length of time a student invests to receive a Doctoral degree in the department/program or multidisciplinary program being considered (using data from the past 10 years, if available)?

Average years to Physics PhD degree: 5.8 years

Students

1. How many students are in the department/program or multidisciplinary program?

Fall 2020 PhD enrollment: 65

2. Explain the student mentoring effort and/or graduate support to enhance retention in the department/program or multidisciplinary program. Explain why if none is available.

At UC Merced, student success results from collaboration and shared responsibility among students, faculty staff and administration. With 48% of the Fall 2020 Graduate cohort being first-generation college students, the university understands that providing support, guidance, and resources that equip students to continue their educational journey is essential to their success. The Graduate Division provides a number of programs, mentorships and trainings including:

Academic Counseling – Graduate academic counseling is available to support students on their academic journey with in-person meetings, phone meetings and workshops. Areas of support

can include: one-on-one counseling, academic and personal support, developing effective communication skills, time-management strategies and work/life balance, overcoming self-doubt and imposter syndrome and facilitating good mentoring relationships and healthy research communities.

GRAD EXCEL – The GRAD-EXCEL program is designed to promote early success in first-year doctoral students through coaching and engagement with a community of advanced doctoral peer mentors. Each incoming doctoral student is guided by a GRAD-EXCEL Peer Mentor (matched by research discipline) as they acclimate to UC Merced and their graduate studies during their first academic year.

Competitive Edge Summer Bridge – This program is designed to ensure that first generation students or those from backgrounds typically underrepresented in higher education are better equipped to complete their degrees and go on to successful careers. Graduate students who participate in this program:

- Move to campus two months early for better acclimation
- Are placed in a cohort to build early support structures
- Begin work with advisors to get a head start on research techniques and projects
- Attend tailored workshops and seminars designed to give them a broad foundation of professional knowledge

Graduate Enrichment and Advancement Resources and Services (GEARS) – The Graduate Division's multi-track professional development series is designed to prepare students for success while at UC Merced and beyond. Our GEARS tracks are as follows:

- **Preparing Future Faculty** – Topics range from how to prepare for the academic interview, discussions of post-doctoral fellowship opportunities, making the transition from graduate student to faculty and how to thrive as faculty of color or international faculty.
- **Preparing Future Professionals** – This series allows students to explore business, government and non-profit sectors as potential career paths after graduation. Topics include how to choose between the academy and industry, how or if you should prepare for a postdoctoral position, the transition away from graduate school, and discussions of careers and opportunities in specific fields.
- **Grant and Fellowship Workshops** – Topics include preparing your application materials, what specific committees may be looking for, and how to best market yourself for particular opportunities. Appropriate for those working on pre-doctoral, dissertation, or post-doctoral fellowship applications or various grant applications.
- **Publishing Your Research** – This series of forums and workshops help scholars navigate the publication process and identify outlets for their scholarly work. Some sessions in this track are geared to specific fields, while others offer broader topics applicable to all students interested in publishing their research.
- **Dissertation Boot Camp** – Open to students working on dissertations, theses, articles, or grant/fellowship proposals, this intensive 4- to 6- day workshop helps to kickstart or revitalize students' writing process. As Boot Camp participants, students will work in a small cohort to support and motivate each other to meet their writing goals. In addition to lots of quiet writing time, Dissertation Boot Camp offers elective group sessions that address common pitfalls and issues that many students encounter, stress and time management, and dissertation and thesis formatting at UC Merced. Individualized writing help is also offered.
- **Grad Slam** – A UC-wide competition among graduate students in which students have three minutes to present their research in an interesting, informative manner. Grad Slam programming includes public-speaking workshops during the weeks leading up to the start of the multi-round competition. UC Merced's first-ever Grad Slam winner came this spring via Shayna Bennett, an applied mathematics graduate student.

Research Support – Students have access to funding and training opportunities through several associated research centers and programs including: (see Appendix 2)

- NSF Center for Cellular and Biomolecular Machines (CCBM)
- MACES research training program supported by NASA
- NIH G-RISE graduate training program (I-BioSTeP)
- Consortium for High-Energy Density Science (NNSA)
- NSF National Research Traineeship program on Intelligent Adaptive Systems.

Graduate Student Association (GSA) – The official student government of the graduate student population at UC Merced. Among many roles, the Association advocates on behalf of the graduate student population, organizes graduate student representation among various campus committees, encourages graduate student life, and organizes a small travel reimbursement award for graduate student presenters.

The Graduate Student Association of the University of California, Merced is established:

- To provide a forum where the matters of concern to graduate and professional students may be discussed
 - Where opinions on actions and proposals of the university administration and graduate groups may be expressed
 - Where proposals of the Administration and graduate groups may be initiated
 - To conduct programs and services of special interest to graduate students
3. On average, what financial assistance is available to each student? ARCS Scholar financial awards are unrestricted, and not to be included in the financial package awarded by the institution.

Nearly all ES PhD students receive 12 months of funding per year for each year that they are in the program. The 12-month total stipend is about \$30,000 per student, including remission of all tuition and fees except a small amount of campus-based fees (<\$500).

Additionally, nearly all PhD students are funded by the program for summer research.

Faculty

1. What is the size of the faculty? How many faculty members are in the department(s) or program(s) or will be engaging with the scholar(s) in the multidisciplinary program?

There are currently 18 active core members of the Physics graduate group who will be engaging with ARCS scholars.

2. What percentage of the faculty is full-time, part-time?

100% - All active core faculty are full-time

3. What is the faculty/student ratio for the department/program or multidisciplinary program?

With 65 graduate students currently enrolled and 18 core faculty members, the student/faculty ratio is 3.6.

4. Cite national awards received by current faculty teaching in the department(s)/program(s) or multidisciplinary programs in the past 5 years. (Additional rows should be added as needed.)

Faculty Name	Award
Dustin Kleckner	NSF CAREER Award
Bin Liu	NSF CAREER Award
Daniel Beller	NSF CAREER Award
Linda Hirst	Hilsum Medal awarded by the British Liquid Crystal Society
David Strubbe	Cottrell Scholar Award

5. Cite national offices held by current faculty teaching in this department(s)/program(s) in the past five years. (Additional rows should be added as needed.)

Faculty Name	National Organization	Office Held
Ajay Gopinathan	American Physics Society	Elected Fellow
Ajay Gopinathan	Research Corp for Scientific Advancement	Fellow

6. How many and what percentage of current faculty in this department(s)/program(s) hold research grants from the National Institutes of Health (NIH), the National Science Foundation (NSF) and/or other nationally-recognized scientific bodies?

Fifteen of the 18 core faculty members (83%) in Physics have current grants from national funding agencies.

7. How many current faculty have been elected to membership in the relevant organizations of: National Academy of Sciences; National Academy of Engineering; Institute of Medicine. (Additional rows should be added as needed.)

Faculty Name	Organization
Sarah Kurtz	National Academy of Engineering

8. List the 15 most important current grants, including amounts, dates of funding, funding agency and role of faculty member (e.g., PI or Co-PI).

NIH, "G-RISE at UC Merced," Ajay Gopinathan PI, \$3,590,850 (2021-2026).

NSF, "CREST Center for Cellular and Biomolecular Machines," Ajay Gopinathan Co-PI, \$4,998,764 (2016-2021).

NASA, "MACES renewal: Energy Harvesting, Efficiency and Storage," Sayantani Ghosh Co-PI, \$1,779,996 (2020-2022, two-year renewal of \$5M grant).

NSF, "CAREER: Geometries of Topological Defects in 3D Active and Passive Nematics," Daniel Beller PI, \$434,001 (2021-2026).

NSF, "CAREER: Self-Organization of Micro-Particles with Light and Sound," Dustin Kleckner PI, \$446,632 (2021-2026).

NSF, "CAREER: Symmetry-based Microfluidics and Perturbation-free Micromanipulation of Swimming Microorganisms," Bin Liu PI, \$411,510 (2020-2025).

Dept of Energy, "Consortium for High Energy Density Studies (CHEDS)," David Strubbe PI, \$910,680 (2018-2021).

Air Force Office of Scientific Research, "Theory of Light-induced Structural Changes in Opto-electronic Organic Mats," David Strubbe PI, \$390,000 (2019-2022).

NSF, "Dynamic Barriers to Swimming Agents in Complex Fluid Flows," Kevin Mitchell PI, \$390,000 (2018-2022).

NSF, "Optoelectromechanical Interface in Hybrid Quantum Networks: Nonreciprocal State Conversion and Pulse Shaping," Lin Tian PI, \$390,492 (2017-2021).

NSF, "Self-mixing Active Fluids," Linda Hirst PI, \$624,833 (2019-2022).

DOD Defense Threat Reduction Agency, "Quantum-Enhanced Motion Sensing Using Entangled Spins in Quantum Dots," Michael Scheibner PI, \$1,748,615 (2019-2021).

Air Force Office of Scientific Research, "Optoelectronic Properties of Strain-Engineered Germanium Dots," Michael Scheibner PI, \$625,899 (2018-2021).

NSF, "Collaborative Research: Surfing the Order Parameter: Assembling Nanoparticle Structures through Phase Transitions in Liquid Crystal Solvents," Linda Hirst PI, \$423,240 (2020-2022).

NIH, "Do Cargo Membrane Fluidity and Microdomain Formation Impact Motor Protein-Based Mobility?," Jing Xu PI, \$494,373 (2019-2022).

9. State the number of published articles per faculty attributed to the department(s)/program(s) under consideration during the past two years (provide full citations for 10 examples, underlining and bolding faculty names) as well as the number of articles published by the department/program's faculty in the journals "Nature", "Science" and the journals that constitute the top three peer reviewed publications in your field/s during the past two years. Cite 10 examples.

Physics faculty members each published about 3 articles per year during the past two years. They also have six publications in *Nature*, *Science*, or the top three journals in their fields in the last two years. Ten examples are as follows, including those from top journals in the field.

Shi, H., Quint, D. A., Grason, G. M., **Gopinathan, A.**, & Huang, K. C. (2020). Chiral twisting in a bacterial cytoskeletal polymer affects filament size and orientation. *Nature communications*, 11(1), 1-12.

Tan, A. J., Roberts, E., Smith, S. A., Olvera, U. A., Arteaga, J., Fortini, S., ... & **Hirst, L. S.** (2019). Topological chaos in active nematics. *Nature Physics*, 15(10), 1033-1039.

Guerrero, E., & **Strubbe, D. A.** (2020). Computational generation of voids in a-Si and a-Si: H by cavitation at low density. *Physical Review Materials*, 4(2), 025601.

Dugar, P., **Scheibner, M.**, & **Chien, C. C.** (2020). Geometry-based circulation of local photonic transport in a triangular metastructure. *Physical Review A*, 102(2), 023704.

Wilson, J. O., Quint, D. A., **Gopinathan, A.**, & **Xu, J.** (2019). Cargo diffusion shortens single-kinesin runs at low viscous drag. *Scientific Reports*, 9(1), 1-12.

Anton-Solanas, C., Waldherr, M., Klaas, M., Suchomel, H., Harder, T. H., **Cai, H.**, ... & Schneider, C. (2021). Bosonic condensation of exciton-polaritons in an atomically thin crystal. *Nature Materials*, 1-7.

Pershin, Y. V., **Chien, C. C.**, & Di Ventra, M. (2021). The Fourier signatures of memristive hysteresis. *Journal of Physics D: Applied Physics*, 54(24), 245302.

Weirich, K. L., **Dasbiswas, K.**, Witten, T. A., Vaikuntanathan, S., & Gardel, M. L. (2019). Self-organizing motors divide active liquid droplets. *Proceedings of the National Academy of Sciences*, 116(23), 11125-11130.

Pate, J. M., Goryachev, M., Chiao, R. Y., **Sharping, J. E.**, & Tobar, M. E. (2020). Casimir spring and dilution in macroscopic cavity optomechanics. *Nature Physics*, 16(11), 1117-1122.

Duclos, G., R. Adkins, D. Banerjee, M. S. E. Peterson, M. Varghese, I. Kolvin, A. Baskaran, R. A. Pelcovits, T. R. Powers, A. Baskaran, F. Toschi, M. F. Hagan, S. J. Streichan, V. Vitelli, **D. A. Beller** and Z. Dogic (2020). "Topological structure and dynamics of three-dimensional active nematics." *Science* 367(6482): 1120-1124.

If this is a Multidisciplinary Program, please complete the following:

1. Provide a listing of multi-investigator grants and their size and source of funding relating to this department(s)/program(s).

NA

2. What entity gives the degree? (What does the diploma say?)

NA

3. Are there recruitment efforts in common between the multidisciplinary program and related departments/programs? If so, what are they?

NA

4. If the Multidisciplinary Program involves more than one university or institute, please name all participating entities.

NA

- a. Are all institutions participating approved by ARCS?

NA

- b. Please confirm that the degree-granting university is approved by ARCS.

NA

SECTION II

Additional questions to be completed if the department(s)/program(s) or Institution housing it is/ are **not** ranked within the top 50 in the nation. Many of these questions are answered in regard to the institution.

1. Is the doctoral degree regularly awarded from this institution in the sciences, engineering, and/or medicine? Please state the number of degrees granted for each area, what degrees they are, and from what departments for the past 3 years.

Total PhDs Awarded from 17-18, 18-19, and 19-20

Cognitive and Information Sciences: 12

Applied Mathematics: 9

Chemistry and Biochemistry: 7

Physics: 23

Quantitative and Systems Biology: 25

Bioengineering: 5

Electrical Engineering and Computer Science: 18

Materials and Biomaterials Science and Engineering: 6

Mechanical Engineering: 11
Environmental Systems: 18

2. What are the top three science, engineering and/or medical research departments at the institution?

Environmental Systems, Cognitive & Information Sciences, Physics

3. Indicate the total expenditures at the institution for research activities in fields relevant to the department(s).

FY 20 - \$3,101,000. This includes UC Merced federal and non-federal expenditures in the field of physics for FY 2020, as reported by the University of California Office of the President in the National Science Foundation's Higher Education Research and Development survey FY 2020.

4. Indicate the total expenditures in the department(s)/programs for research activities in the fields of science, engineering, and medicine.

FY 2020 - \$43,421,000 (for institution in fields of science, engineering, medicine). This includes federal and non-federal research expenditures in all fields except "non-S&E fields" for FY 2020, AS REPORTED BY THE University of California Office of the President in the National Science Foundation's Higher Education Research and Development Survey FY 2020.

Attachments

Please list attachments

Appendix 1. List of Program Faculty

Appendix 2. Description of Library, Laboratories, Institutes and Research Centers

Appendix 1

List of Program Faculty

Listing of Physics Graduate Core Faculty 2020-21

Daniel Beller, Assistant Professor
Hui Cai, Assistant Professor
Chin Chun Chien, Associate Professor
Kinjal Dasbiswas, Assistant Professor
Sayantani Ghosh, Professor
Ajay Gopinathan, Professor
Linda Hirst, Professor
Dustin Kleckner, Assistant Professor
Bin Liu, Assistant Professor
Sarah Loebman, Assistant Professor
Kevin Mitchell, Professor
Anna Nierenberg, Assistant Professor
Michael Scheibner, Associate Professor
Jay Sharping, Associate Professor
David Strubbe, Assistant Professor
Lin Tian, Professor
Roland Winston, Professor
Jing Xu, Associate Professor

Appendix 2

Description of Library, Laboratories, Institutes and Research Centers

Campus Buildings, Offices and Research Space

Classroom & Office Building 1

Classroom & Office Building 1 is a 3-story, 105,435 gross square-foot building with classrooms, offices, and laboratories. COB was awarded LEED Gold Certification in March of 2008. The building is located in the core section of campus. The COB also houses a performance auditorium with high-quality acoustic features, a system for state-of-the-art sound and lighting equipment and backstage rooms for performers, musical and performance equipment and general storage.

Classroom & Office Building 2

Classroom & Office Building 2 is a 3-story, 88,505 gross square-foot building located in the core section of campus. COB2 has LEED Platinum certification. COB2 provides approximately 51,000 assignable square feet of flexible classroom, academic support, research and office space.

Science & Engineering Building 1

SE1 is a 4-story plus basement, 212,344 gross square-foot building located in the core section of campus. The SE1 building was awarded LEED Gold certification in February of 2009. The building includes laboratories, laboratory support space, teaching laboratories and offices and administrative office space for the PI and named senior personnel. Faculty members are assigned space in modern collaborative inter-disciplinary suites equipped with state of the art equipment. Sophisticated shared equipment is located in dedicated rooms within a suite with similar research needs or across-suites to encourage efficient utilization of resources and foster inter-disciplinary interactions.

Science & Engineering Building 2

Science & Engineering Building 2 is a 3-story plus basement and roof, 131,279 gross square-foot facility overlooking the next phase of campus development. The building opened in 2014. It provides space for the School of Engineering Dean suite, School of Natural Sciences and School of Engineering faculty offices, graduate student and trainee offices, research and instructional laboratories, and core facilities. Architectural features include several significant outdoor spaces, such as a pedestrian plaza; a solar-panel shaded promontory that can serve as an event venue; and a porch for outdoor learning opportunities. In addition to offices and labs on the upper levels, breakout rooms with adjacent balconies will provide collaboration space featuring sweeping vistas of the undeveloped landscape and future campus expansion.

Lab 2A: Sustainability Research & Engineering

Lab 2A: Sustainability Research & Engineering is a 4-story plus basement, 179,937 gross square-foot building. It is one of three teaching and research buildings that anchors the new Academic Quad as part of the 2020 Project campus expansion initiative. The building consists of four floors above grade with a partial basement. This basement nestles into UC Merced's existing topography and links the laboratory to the shaded loading dock.

Within the building, the wet/dry laboratories are organized around modular planning principles that will enable the configuration of the building to evolve over time. At the intersection between research and class laboratories, building users will find conference rooms, break rooms, and colloquy spaces arranged to bring people together across divisions and departments to create dynamic learning environments.

The architectural expression of the building builds on the contextual legacy of UC Merced's initial buildings with the use of materials familiar to the Valley, but employed in service of the functional needs of the building. Primary exterior building materials consist of cast-in-place architectural concrete, corrugated metal, and high-performance glazing—all materials that can be found throughout existing University buildings. Colored cement plaster is used as a highlight in select locations at the ground floor and exterior stairs.

Lab 2B: Arts & Computational Sciences

Lab 2B: Arts & Computational Sciences is a 3-story plus basement, 113,364 gross square-foot building. This building creates a relationship between the Academic Quad on its northern side and the natural landscape to the south.

Active program is clustered around activity nodes and interconnected outdoor spaces. These features ease wayfinding, and foster impromptu meetings and collaboration for students, faculty and staff. Exterior circulation articulates the pedestrian experience at the ground and upper levels facing the Academic Quad. This allows all levels of the building to participate in the campus experience, and helps the building display its function. Balconies and exterior gathering spaces denote major pedestrian pathways.

Lab 3A: Biomedical Sciences and Physics

Lab 3A is a 302,173 gross square-foot building. It is one of three teaching and research buildings that anchor the new Academic Quad as part of the 2020 Project campus expansion initiative. The building consists of five floors above grade with a partial basement. This basement nestles into UC Merced's existing topography and links the laboratory to the shared loading dock.

3A BSL-3/ABSL-3

The BSL-3/ABSL-3 facility occupies the new Lab 3A-Biomedical Sciences and Physics building (part of the Merced 2020 initiative).

The facility contains three laboratory rooms and two animal holding rooms with adjoining procedure rooms. Each lab room contains a Class II A2 and Class II B2 safety cabinet. One lab room has a glove box. The animal holding rooms contain two biocontainment rodent racks and a Class II A2 in the procedure space.

The facility contains the necessary equipment to perform animal infections, process tissues and cells, and prepare samples for analysis, prior to fixation and/or storage. Shakers and incubators are available for fungal growth and longer-term cellular stimulation experiments.

3A2: Greenhouse

The Greenhouse is a 2,560 gross square-foot research greenhouse adjacent to the Lab 3A building. Designed by Skidmore, Owings and Merrill, it was completed in Fall 2020 as part of the campus expansion. The building has been sited in a location well-suited for future expansion as funding becomes available.

Access to plant-growth facilities is essential for the controlled, hands-on research carried out by many UC Merced faculty members and students. The potential for research performed in this facility includes areas such as food and water security, biodiversity, climate change, renewable energy, and ecosystems.

Kolligian Library

Kolligian Library is a 4-story, 215,961 gross square-foot building that houses the campus library and meeting rooms in the four-story east wing, and administrative offices and student services space in the three-story west wing. Additionally, executive campus leadership and administration, a large public gathering space and common dining area, and the campus bookstore are located within the building. The library has 17 group meeting rooms, and dedicated study space as well as library instructional space. As part of the University of California, UC Merced Library shares resources with other campuses and has developed much of its electronic collection in conjunction with the California Digital Library (CDL). The library offers 48 laptops for instruction, 10 public workstations that visitors can use to access library information online, and two high resolution book scanners.

Major Equipment

Students, researchers, and faculty have access to major equipment at UC Merced in the following shared, centralized facilities:

Imaging and Microscopy Facility

The Image and Microscopy Facility is a laboratory that provides essential resources around the clock for faculty members, students and researchers in the area of light and electron microscopy. This laboratory provides an infrastructure that can serve campus researchers in the physical sciences, biological sciences and engineering, with a particular focus on nanotechnology. The IMG hosts optical, Scanning and Transmission Electron Microscopes, Wide Angle X-ray Diffraction, X-ray Photoelectron Spectroscopy, in addition to equipment for preparing specimens for examination. The objective is to provide high-end, state-of-the-art instrumentation to campus members at a modest cost.

Stable Isotope Laboratory

The Stable Isotope Laboratory at UC Merced includes two ThermoFisher Delta V Plus isotope ratio mass spectrometers (purchased in 2014) each with Conflo IV interfaces. Both have collectors for measuring hydrogen, oxygen, carbon, nitrogen, and sulfur isotopes; one of the instruments includes the collectors for measuring ³³S and ³⁶S. Peripheral devices include the TCEA and a GC Isolink with RSH autosampler equipped for carbon, nitrogen, and hydrogen isotope measurements, along with a Costech elemental analyzer with a zero blank autosampler. In addition, the laboratory includes a Sartorius microbalance, freeze drier, muffle furnace, ovens, solvent storage freezer, refrigerator, standard gases, Labconco drying system, and analytical balances.

Natural Reserve System

The UC Natural Reserve System is a library of ecosystems throughout California. Most of the state's major habitat types are represented, from coastal tidepools to inland deserts, and lush wetlands to redwood forests. No other network of field sites can match its size, scope, and ecological diversity. The NRS offers outdoor laboratories to field scientists, classrooms without walls for students, and nature's inspiration to all.

Environmental Analytical Laboratory

The Environmental Analytical Laboratory (EAL) is one of core facilities supported by the Office of Research and Economic Development. The EAL is equipped with an array of state-of-the-art instrumentation and sample preparation equipment located at S&E I Room 201 (partial space) at the UC Merced main campus. It offers rapid and accurate measurements in environmental materials—including water, soil and biological samples—for major and trace elements, selected chemical species, nutrients and stable isotopes to meet a wide range of analytical needs in support of diverse research and education programs in environmental, chemical, biological, the Earth systems, ecological sciences and engineering. A list of major instruments and their capabilities is included below:

Environmental Analytical Laboratory (EAL) Instrument Capabilities
Office of Research & Economic Development, UC Merced

Instruments Available	Compounds or Elements Analyzed	Sample Types	Concentration Range
ICP-OES	Typical metals: K, Na, Ca, Mg, Fe, Mn, Al, Cu, Zn, As, S, P, Si, and more	multi-element capabilities and high dynamic ranges	mid-ppb to ppm level
ICP-MS	Typical metals: K, Na, Ca, Mg, Fe, Mn, Al, Pb, Cu, Zn, As, Sr, Se, Cs, U, Hg and more	multi-element speed with high sensitivity and dynamic ranges	sub-ppt to ppm level
GF-AA	Typical Elements: Na, K, Ca, Mg, Fe, Mn, Cu, Zn, As	single element analysis, relatively high sensitivity, small sample size required	sub-ppb level
Multiwave digestion	Acid digestion of solid samples for metal analysis	soil, sediments, biological samples	
Ion Chromatography	Major cations: Li, Na, K, Ca, Mg, NH ₄	Lake, river, snow, drinking, & wastewater, soil extracts	sub-ppb to ppm level
Ion Chromatography	Major anions: F, Cl, Br, NO ₃ , SO ₄ , PO ₄ . Small organic acids including acetate, formate, MSA	Lake, river, snow, drinking, & wastewater, soil extracts	sub-ppb to ppm level
Flow Injection Analyzer	Nutrients: NO ₃ , NH ₄ , orth-PO ₄ , SO ₄ , SiO ₄ , TKP and TKN	river, snow, drinking, wastewater, soil extracts	sub-ppb to ppm level
TOC Analyzer	DOC or NPOC, TN and IC in solution samples	river, snow, drinking, wastewater, soil extracts, sediments, soils	mid-ppb to ppm level
Water isotope analyzer	² H and ¹⁸ O isotopes in liquid samples	any water-based samples	
Mercury Analyzer	Total Hg & Methyl-Hg	Liquid and solid samples for total Hg; Liquid samples for Methyl-Hg.	sub-ppt to ppm level

Please contact Dr. Liying Zhao for any inquiry at 209 233 1728 or via Email: lzha04@ucmerced.edu
Physical address: Science & Engineering Building I, Room 201, University of California, Merced, 5200 North Lake Road, Merced, CA 95343

Rapid Prototyping Lab

It includes Replicator Z18 3D Printer capable of creating objects as large as 12×12×18 inches out of ABS/PLA plastic, Form 2 3D Printers capable of creating features as fine as 25 microns out of a variety of material properties (e.g., high-temperature, tough, flexible), and 1,000 DPI 30 Watt Laser Cutters that can accommodate objects up to 12×16" and cut through and engrave upon a variety of materials (e.g., paper, plastics, acrylic, leather, wood). The lab has many smaller Afinia, Creator Pro, Makergear 3D Printers; Logitech, MakerBot 3D Scanners; Othermill

CNC Mills. It also has soldering workstations equipped with 21 Velleman soldering irons, test equipment and electronics tools. This facility is located in the main campus and open to all School of Engineering faculty and students, providing that they compensate for the materials used in the project (\$0.15-0.50 per gram) and pay an hourly rate of \$10.00 for prepping 3D Printers and post-processing 3D printed parts.

Machine Shop

The machine shop is located on the 1st floor of the SRE building. It has a HAAS VF2 CNC milling machine, HAAS TL1 CNC Lathe, and two Tormach PCNC1100 CNC Milling Machine. The new SRE machine shop is expected to be up and running soon. The machine shop has a manual machine shop located in SE 1 Rm #143. There are also three Bridgeport manual mills, three Leblonde Manual lathes, a Vertical Band saw, a Horizontal band saw, a Drill Press, a Belt sander, a Mini CNC Machine, a Pedestal Grinder, one MIG welder, one TIG welder, and various types of precision Measuring devices.

Illumina MiSeq

With support from the University of California Office of the President, UC Merced's School of Natural Sciences has invested in an Illumina MiSeq to facilitate Next-Generation Sequencing as a shared faculty resource. This instrument is currently overseen by Prof. Carolin Frank, with day-to-day management and support provided by Lolo Cardenas.

In collaboration with individual labs, the core provides sequencing for smaller scale projects (i.e. on an Illumina MiSeq) as well as quality control and library preparation for larger-scale sequencing projects at other UC core facilities (i.e. on the Illumina HiSeq). The core has developed expertise in targeted gene sequencing, metagenomics, small genome sequencing, targeted gene expression, and amplicon sequencing, and maintains the following equipment; an Illumina MiSeq, a 2100 Agilent BioAnalyzer, a Qubit fluorometer, and a Covaris M220 focused ultrasonicator.

Nuclear Magnetic Resonance (NMR) Facility

The facility provides access to Nuclear Magnetic Resonance Experiments for the UC Merced community and others and houses several major NMR instruments at two sites, on-campus and at Castle, including 400 MHz, 500 MHz and 600 MHz NMR spectrometers, a Horiba Fluorolog 3 fluorimeter, a Bruker Vertex 70 FT-IR spectrometer with a diamond crystal ATR accessory, a high resolution Thermo Electron Exactive Plus LC-MS for detecting small molecules, and a Q Exactive quadrupole Orbitrap LC-MS for high resolution detection of macromolecules.

Sierra Nevada Research Institute

The mission of the Sierra Nevada Research Institute (SNRI) is to discover and disseminate new knowledge that contributes to sustaining natural resources and promoting social well-being in the San Joaquin Valley and Sierra Nevada regions of California, and related regions worldwide, through integrated research in the natural, social and engineering sciences.

The mission of the Sierra Nevada Research Institute is accomplished through:

- Collaborative, multidisciplinary, fundamental research conducted by faculty, students, staff and affiliated scientists in natural sciences, engineering, and social sciences.
- Strong interactions with related research units within the UC system and close collaborative relations with scientists and managers at national laboratories, and local, state and federal agencies, including the National Park Service.

- Connecting objective, science-based data and information with public and private stakeholders.

The Sierra Nevada Research Institute is organized around an Environmental Systems model. A particular emphasis is on the physical and biological connections that exist between the Central Valley and Sierra ecosystems. Through these balanced research efforts, the Sierra Nevada Research Institute serves as a source of objective scientific information for public policy makers as California faces the growing challenge of sustaining the integrity and quality of its resources into the future.

Through the Sierra Nevada Research Institute our students and faculty have access to a variety of biological field stations in Yosemite, Sequoia, and Kings Canyon National Parks. In May 2004, Yosemite National Park and the Sierra Nevada Research Institute dedicated the first of these stations, located in Wawona. The Wawona station gives logistical support for academic field research and outreach activities in Yosemite National Park. In addition, the Virginia Smith Trust Reserve adjacent to the UC Merced campus provides additional sites for research.

UC Merced faculty currently affiliated with the Sierra Nevada Research Institute are working on climate change and ecosystem health, contaminant transformations in soils and aquatic systems, development of environmental sensors, hydrologic processes in the Sierra Nevada, nutrient transport in agricultural and natural systems, water and air quality in the Valley basin and Sierra Nevada Range, and computational ecology and biodiversity.

Health Sciences Research Institute

The Health Sciences Research Institute (HSRI) was established in June 2012 as UC Merced's second Organized Research Unit, with the aim of fostering world-renowned research with student involvement and community engagement.

San Joaquin Valley regional health issues include asthma, obesity, diabetes, cancer, hypertension, heart disease, risky teen behaviors, teen tobacco use, sexually transmitted diseases, hepatitis, and many others.

HSRI has more than one hundred affiliated faculty members across UC Merced's three schools (Engineering, Natural Sciences, and Social Sciences, Humanities & Arts) covering a range of health and medical research. HSRI also allows Graduate Student Members, Clinical Affiliate Members and Community Affiliate Members as part of its commitment to diversity and inclusiveness. The opportunities to address the growing and complex health issues of the San Joaquin Valley and beyond require inter- and multidisciplinary team and, as such, HSRI members are organized by primary research interest:

- Health Disparities
- Environmental Health
- Biomolecular Research
- Biosimulation and Modeling
- Cancer Control and Prevention
- Immunity and Infectious Diseases
- Basic & Behavioral Neuroscience, Learning and Development
- Health Decision Making

HSRI members are also engaged in research on evaluation and effectiveness research, and public health systems and services research. HSRI's collaborative multidisciplinary research clusters and community emphasis provide an opportunity to rapidly develop, test, and disseminate new ways of improving health and delivering healthcare. This will help establish UC

Merced as a world-renowned research university while improving the health of the people in the San Joaquin Valley.

University of California Advanced Solar Technologies Institute

The University of California Advanced Solar Technologies Institute (UC Solar) is a multi-campus, multidisciplinary research institute made up of faculty from the University of California's Merced, Berkeley, and Santa Barbara campuses. Headquartered at UC Merced, UC Solar creates technologies that make solar energy systems more efficient, more affordable, and the best choice for the people of California and the world. In addition, UC Solar educates and develops tomorrow's solar energy leaders and entrepreneurs.

Initial UC Solar research areas include advancing the state-of-the-art in solar concentration (for photovoltaic and thermal systems), employing nanotechnology in both collector/concentrator and device structures, and developing new devices that capture usable energy in the UV portion of the solar spectrum.

Through collaboration with industry and other stakeholders, UC Solar researchers are challenged to create solar technologies that can be brought to the marketplace quickly. UC Solar researchers partner with industry participants through the UC Solar Industry Consortium, which attracts companies that design, produce, implement, manage and invest in solar technologies.

Spatial Analysis Research Center

The goal of the Spatial Analysis Research Center (SpARC) Centralized Research Center is to add value and capabilities to UC Merced's existing and planned research, teaching, administrative, and community outreach efforts in the area of spatial analysis and spatial science. Many UC Merced faculty are engaged in spatial sciences including historians and archaeologists, social and cognitive scientists, engineers, computer scientists, environmental scientists, and biologists. SpARC's mission extends across all three academic Schools and has connections with the Sierra Nevada Research Institute, the Great Valley Center, Yosemite National Park, the Center for the Study of Health Disparities, and the Division of Administration. SpARC aims to foster new intellectual collaboration, stimulate new sources of funding, further innovative and original research, supply research techniques and services to faculty groups, perform services and outreach to the public and support student learning.

CREST Center for Cellular and Biomolecular Machines (CCBM)

CCBM was established with a \$5 million grant from the National Science Foundation and brings together more than a dozen faculty members from multiple units across campus, including bio-engineering, physics, chemistry and chemical biology, materials science and engineering. Researchers are studying how biological matter like proteins or cells come together to perform specific tasks, in hopes of eventually being able to engineer and develop innovations ranging from designer cells and tissue to novel diagnostic and therapeutic devices. The CCBM also hosts an integrated, interdisciplinary training program for graduate students that emphasizes physical and biological components and research and training experiences for undergraduate and high school students to enhance the recruitment of underrepresented minorities into STEM research.

Merced Nanomaterials Center for Energy and Sensing (MACES)

MACES was founded in 2015 through a \$5 million grant from NASA. The center promotes inno-

vative and collaborative research in functional nanomaterials for energy and sensing for NASA missions, while simultaneously addressing terrestrial needs for early disease diagnosis and for clean and renewable energy. The center also aims to increase participation of underrepresented and underprivileged undergraduate and graduate students, educating a new generation of STEM workforce trained in multidisciplinary material research environment with solid foundations and excellent problem-solving skills.

Interdisciplinary Computational Graduate Education Program (NRT ICGE)

The UC Merced Interdisciplinary Computational Graduate Education (ICGE) program is an Innovations in Graduate Education National Research Training program funded by the National Science Foundation. The program aims to enhance student success and reduce graduate student attrition rates in the computational sciences, particularly for underrepresented minorities and first-generation students.

NIH Graduate Research Training Initiative for Student Enhancement (G-RISE) Program – Interdisciplinary Biomedical Science and Technology (I-BioSTeP)

The goal of the Graduate Research Training Initiative for Student Enhancement (G-RISE) program is to develop a diverse pool of scientists earning a Ph.D., who have the skills to successfully transition into careers in the biomedical research workforce. The goal of UC Merced's G-RISE program, called I-BioSTeP is to produce highly trained workers in biomedical research to help identify and solve pressing biological problems.

Consortium for High Energy Density Science (CfHEDS)

The goal of the Consortium for High-Energy Density Science (CfHEDS) is to create and sustain a workforce pipeline to NNSA National Laboratories by increasing the number of students interested in science, by developing new scientists and by building improved scientific educational and research capacity. This will be accomplished at three minority-serving undergraduate institutions, enabling them to develop scientists who are well prepared to work in the NNSA-critical field of High Energy Density Science (HEDS).