UNIVERSITY OF CALIFORNIA, ACADEMIC SENATE

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Mary Gauvain
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Chair of the Assembly of the Academic Senate
Faculty Representative to the Regents
University of California
1111 Franklin Street, 12th Floor
Oakland, California 94607-5200

April 28, 2021

MICHAEL T. BROWN
PROVOST AND EXECUTIVE VICE PRESIDENT
UNIVERSITY OF CALIFORNIA

Re: Approval of UCLA Master of Quantum Science and Technology (QST)

Dear Michael,

In accordance with the *Universitywide Review Processes For Academic Programs, Units, and Research Units* (the "Compendium"), and on the recommendation of CCGA, the Academic Council has approved UC Los Angeles' proposal to establish a Master of Quantum Science and Technology self-supporting graduate and professional degree program (SSGPDP).

Because this is a new degree title, and the Assembly of the Academic Senate is not meeting within 30 days of CCGA's approval, Council must approve the program per Senate Bylaw 125.B.7.

I am enclosing CCGA's report on its review of the new program, and respectfully request that your office complete the process of obtaining the President's approval.

Sincerely,

Mary Gauvain

Mary Gauvain, Chair
Academic Council

cc: Academic Council
UCLA Senate Director de Stefano
IRAP Analyst Procello

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COORDINATING COMMITTEE ON GRADUATE AFFAIRS (CCGA)
Amr El Abbadi, Chair
amr@cs.ucsb.edu

ACADEMIC SENATE
University of California
1111 Franklin Street, 12th Floor
Oakland, California 94607-5200

March 8, 2021

ACADEMIC SENATE CHAIR MARY GAUVAIN

Dear Chair Gauvain:

At its March 3 meeting, the Coordinating Committee on Graduate Affairs (CCGA) voted 10-0-2 to approve a proposal from the UCLA campus for a Master of Quantum Science and Technology (QST).

The QST program prepares students for research and development in the fields of quantum technology. Students in the QST program will learn the foundations of quantum mechanics, quantum computing, quantum information, and quantum devices, they will learn how to work in the laboratory with quantum optics, quantum sensing and materials, and quantum devices, and they will learn the algorithms, languages, and tools of quantum computing. A distinguishing feature of the QST program is the significant laboratory component, which will help establish UCLA as the premier educator of quantum scientists.

Quantum Information Science (QIS) is a burgeoning field at the cutting edge of research, technology, and education. It brings together scientists that traditionally worked in different areas, such as atomic, molecular, and optical, condensed matter, and high-energy/nuclear physics, as well as engineers, chemists, computer scientists, and mathematicians.

The reviewers noted that program was of high quality, rigorous, had a well thought out curriculum, and indicated that the laboratory courses were a particular strength. They also indicated that the set of faculty teaching in the program is large (drawn from several UCLA departments) and highly qualified to teach the courses. These faculty were described as top-notch in their research fields and to be strongly interested in education and pedagogy.

Diversity will be addressed through financial scholarships (in years one and two, one 50% scholarship along with smaller awards; and in following years, two 50% scholarships along with smaller awards; this was clarified with the proposers, as a different plan also occurs in the proposal) and recruiting (i.e., direct outreach by participating faculty to nearby institutions; advertising to URM-focused societies). A member of the Department of Physics & Astronomy's Committee on Diversity, Equity, and Inclusion (DEI) will serve on the program's Recruitment and Admissions Committee, and the department's DEI committee will assess success in recruitment and retention. The proposers also indicated that they have recently received funding through an NSF Quantum Leap Challenge Institute Award to recruit Lubi Lenaberg, who is an Evaluation and Assessment Program Manager (UC Santa Barbara), to evaluate the program's performance in Equity, Diversity, and Inclusion. Finally, the proposers do acknowledge that the initial diversity of the applicant pool is likely to be limited, as it is restricted to BS Physics

graduates. They indicate that as the program grows, they plan to explore expanding the applicant pool to include Mech./Elect. Engineering and Chemistry. CCGA appreciates the proposer's current efforts at increasing the diversity of their students, and strongly encourages the program to review and further expand the applicant pool requirements once they have established the program.

As you know, CCGA's approval is the last stop of the Academic Senate side of the Systemwide review and approval process except when the new degree title must be approved by the President, under delegated authority from The Board of Regents. I submit this for your review and have enclosed the Lead Reviewer's report. Please do not hesitate to contact me if you have further questions regarding the proposal.

Sincerely,

Amr El Abbadi
CCGA Chair

cc: Robert Horwitz, Academic Senate Vice Chair
CCGA Members
Hilary Baxter, Academic Senate Executive Director
Michael LaBriola, Academic Senate Assistant Director
Chris Procello, Academic Planning and Research Analyst
Susan Ettner, UCLA Interim Graduate Dean
April de Stefano, UCLA Senate Executive Director
Estrella Arciba, UCLA Senate Analyst

PARTHO GHOSH
PROFESSOR
DEPARTMENT OF CHEMISTRY AND BIOCHEMISTRY
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TO: CCGA

FROM: Partho Ghosh, Lead Reviewer

DATE: 23 February 2021

RE: Review of Master of Quantum Science and Technology (QST) Self-Supporting Graduate Professional Degree Program

Description of the Program
The proposal is for a one-year, full-time, self-supported Master of Quantum Science and Technology (QST) degree at UCLA. The topics to be studied include quantum computing, optics, sensing, and materials. The program will be housed in the Department of Physics & Astronomy and involve several other departments (Chemistry & Biochemistry, Computer Science, Electrical and Computer Engineering, and Mathematics). Nine courses during the academic year (36 units) followed by a 9-week internship during the following summer quarter (in the laboratory of a QST faculty member or a QST-related company) are required for the Master's degree. The 9-week internship will be followed by a presentation and an oral exam. The academic-year coursework includes three hands-on laboratory courses, which the proposers and reviewers noted as a distinguishing feature of the program. The program expects to have 16 students per year for the first two years and then 24 in the third year and 32 thereafter, and to be self-supporting by the third year.

Overall Opinion of the Reviewers
Four external reviewers, two from UC and two from outside UC, provided critiques of the program. The reviewers brought up several issues, which were relayed to the proposers and resulted in two rounds of questions and answers with the proposers.

Reviewers:

A. Brian DeMarco, University of Illinois Urbana-Champaign, Department of Physics, Associate Head for Undergraduate Physics Programs (Suggested by Proposers)
B. Eliot Kapit, Colorado School of Mines, Department of Physics and Astronomy, Quantum Engineering Program Director
C. David Weld, UCSB, Department of Physics (Suggested by Proposers)
D. Dan Stamper-Kurn, University of California, Berkeley, Department of Physics (Suggested by Proposers)

Overall, the four reviewers were enthusiastic about the program (A, "I strongly support this excellent proposal"; B, "overall I think it's excellent"; C, "the proposal is well-thought-out,

timely, and highly likely to succeed; it has my unqualified support"; D, "I am strongly supportive of this proposal"), and concluded that the program meets a critical workforce gap that currently exists in academia and industry.

Quality and academic rigor of the program
The reviewers noted that program was of high quality, rigorous, had a well thought out curriculum, and indicated that the laboratory courses were a particular strength. Reviewers C and D concluded that the laboratory component distinguished this program from similar ones at other universities and on-line options, thus enabling this program to fill a unique niche.

Adequacy of the size and expertise of faculty to administer the program
The reviewers indicated that the set of faculty teaching in the program is large (drawn from several UCLA departments) and highly qualified to teach the courses. These faculty were described as top-notch in their research fields and to be strongly interested in education and pedagogy.

Adequacy of the facilities and budgets
The facilities were viewed by the reviewers as meeting the needs of the program, although reviewers C and D indicated that the description of the laboratory courses needed further detail. The proposers responded to this critique by indicating that currently taught quarter-long undergraduate laboratory courses at UCLA would serve as templates for the proposed laboratory courses, and in some cases the proposed laboratory courses would use the same equipment as currently taught laboratory courses. They also noted that the laboratory courses, once initiated by faculty members, would be coordinated by an Academic Program Director, a full-time staff position that will be filled by a PhD physicist with industry experience.

Reviewers C and D reported that they considered the budget to be reasonable, while reviewer A thought a well-developed business plan was lacking. UCPB noted that the indirect costs appeared sufficient to cover costs, although the margin between expenses and revenues was considered to be narrow and would be problematic if enrollments did not meet expectations. That said, the reviewers did not view a lack of enrollment as a potential concern.

UCPB also raised a concern about whether the $80K budget for faculty compensation was adequate. Faculty will receive 20% of their annual salary with a cap of $40K for classes with SSDP students only, which will be taught on overload basis; and 10% of annual salary for an extra section for SSDP students within the regular courseload. The proposers clarified that the Academic Program Director will oversee all laboratory courses and the internship course (QST 597), and that only two courses will be taught on overload basis, thereby allaying this concern.

Plan to support state mission
Reviewers A and D noted that the program will be beneficial to the stated supported mission. New courses will be developed, which will be available to state-supported programs. A $300,000 investment in laboratory equipment will be made, and this equipment will likewise be available to state-supported programs. In addition, the program will provide 50% support to a student affairs staff position, making it possible for state-supported programs to add a 50% staff position.

Applicant pool and placement prospects for the graduates
The proposers envision two applicant pools. The first are engineers who are at companies in close proximity UCLA, such as Boeing, Google, HRL, Northrop Grumman, and Raytheon, all of which apparently already have quantum science groups. The second are undergraduate students. While the reviewers agreed that there was a sufficient applicant pool, concerns were raised by reviewers A, B, and C regarding expectations of the background required of applicants.

The proposers stated that applicant to the program would be assumed to have an understanding of elementary college level quantum mechanics equivalent to two quarters or one semester of the topic. The concern of the reviewers was that this expectation would create a large hurdle for this interdisciplinary program. Students coming from disciplines other than Physics (e.g., Computers Sciences or Electrical Engineering or Chemistry) are unlikely to have this background, and thus the pool of applicants would be dominated by Physics majors. The proposers acknowledged this limitation and responded that they would initially accept only BS Physics graduates, but over time expand to Mechanical and Electrical Engineering and Chemistry majors. They stated that for the inclusion of non-Physics majors, they plan to host a summer boot camp and to provide mentoring and tutoring. They also plan, as one reviewer suggested, to have a standardized exam in the application process through which applicants can judge their own readiness for the program. The proposers indicated that they would not recruit Computer Sciences majors at any time, since such majors would be unlikely to have the foundations for success in the program.

Reviewers B, C, D expressed the high likelihood of placement possibilities for graduates of the program. Quantum science technology is an emerging and rapidly growing field. Reviewer D noted that Microsoft and Intel among other established companies as well as startups are "clamoring for talented workers," and that the "job market is going to be very hot" for graduates of the proposed program.

Diversity
Diversity will be addressed through financial scholarships (in years one and two, one 50% scholarship along with smaller awards; and in following years, two 50% scholarships along with smaller awards; this was clarified with the proposers, as a different plan also occurs in the proposal) and recruiting (i.e., direct outreach by participating faculty to nearby institutions; advertising to URM-focused societies). A member of the Department of Physics & Astronomy's Committee on Diversity, Equity, and Inclusion (DEI) will serve on the program's Recruitment and Admissions Committee, and the department's DEI committee will assess success in recruitment and retention. The proposers also indicated that they have recently received funding through an NSF Quantum Leap Challenge Institute Award to recruit Lubi Lenaberg (https://csep.cnsi.ucsb.edu/people/lenaburg), who is an Evaluation and Assessment Program Manager (UC Santa Barbara), to evaluate the program's performance in Equity, Diversity, and Inclusion.

Due to the background required of applicants, the proposers acknowledge the diversity of the applicant pool is likely to be limited. The proposes indicated that this a general problem for similar programs, and the proposers are hopeful that once their program is established and

additional data from similar programs become available, they will be in a better position to admit students from a broader background.

Conclusions

The program is excellent and meets an emerging need. The major issue that this program faces is a structural one, and that is the diversity of an applicant pool that has sufficient training to pursue graduate study in quantum sciences and technology. The majors that this program aims to draws from have among the least diverse student bodies. The proposers are aware of this and hope to remedy this, but at the moment, there are no ready solutions.