UNIVERSITY OF CENTRAL FLORIDA

Academic Strategic Plan

CREOL, The College of Optics and Photonics

Annual planning template for university strategic and spending alignment.

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UCF Academic Unit Plan

1. Goals and Aspirations

Complete the table and provide a narrative that summarizes your unit's goals over the next 5 years and how they align with the strategic plan. How will these goals move your national position over the next 5 years? This section should summarize the key points made in this presentation and indicate how your unit will increase its contribution to the university's Strategic Plan, its impact on all whom you serve and your place in state and national rankings by 2029.

	2022-23	2028-29[1]
Faculty T/TE	24.8	32
Instructors/Lecturers	0	3
Enrollment	268	647
BS Degrees Produced	21	100
MS Degrees Produced	20	50
PhD Degrees Produced	20	30
FTIC Retention (first to second)	100	100
4-Year Graduation Rate	25%	56%
3-Year Transfer Graduate Rate	100%	100%
3- Year MS Graduation Rate	36%	60%
6-Year PhD Graduation Rate	45%	55%
Annual Research Expenditures	$16.3M	$20.5M
# Post Docs	26.25	33

CREOL, The College of Optics and Photonics, is highly energized by UCF's goal to become Florida's Premier Engineering and Technology University. Our college will play a strong role in helping UCF to attain its goals, as the growing field of Optics and Photonics provides enabling technologies that reach into many fields of Science and Engineering. The job market for photonics graduates at all levels is very strong and our college gives UCF a unique strength in this burgeoning field. With this in mind, the college plans to not only grow its own academic programs at all levels, including the addition of a new undergraduate program, but to positively impact hundreds of students majoring in several science and engineering disciplines. We also plan to collaborate with other units at UCF to help grow research and graduate programs in Quantum information Science and Technology, Space Instrumentation, Optical Materials and in Biomedical Photonics. In doing so, we also plan to engage with the local community, especially through outreach to K-12 schools, to ensure that UCF's strength in Photonics is recognized by Central Florida's students, parents, and teachers as a preferred place for technology-minded students to obtain a first-class undergraduate education. We will continue to strengthen partnerships with industry to grow our online Masters program.

[1] Notes on table: Numbers assume that requests in this plan will be supported, with the exception of the Future Initiatives that are proposed at the end of the document. If all of those were funded, our faculty would grow to 38, instructors to 5, Research Expenditures to $29M. Note that growth in research expenditures and PhD graduates resulting from future initiatives and other hires proposed here will not reach full fruition until well after 2029. The research expenditure projections are based on 2022-23 numbers provided which are lower than ORC provides.

Our key goals over the next five years are to:

- Increase the number of bachelor's degrees awarded from around 30 to over 100 annually.
- Create a new bachelor's degree program in Optics and Photonics Technology.
- Substantially increase the number of students who declare as photonics majors at matriculation.
- Improve our 4-year graduation rate to over 50% within 5 years and to over 60% within 8 years.
- Grow the number of graduate degrees awarded from 40 to over 80 annually.
- Collaborate with other UCF programs to offer coursework in photonics that will impact between 100 – 200 undergraduate students and 50 – 100 graduate students per year.
- Build a new Photonics Training Center, by remodeling existing space, that will allow the expansion of our undergraduate programs and reduce time to graduation.
- Grow interdisciplinary research at UCF in several key areas:
    - Participate with COS and CECS in the development of a Center for Quantum Information Science and Engineering.
    - Collaborate with the College of Medicine toward the growth of Biomedical Photonics Research at UCF.
    - Continue working with COS and the Florida Space Institute to further grow Space Instrumentation research.
    - Collaborate with Materials Science and Engineering to strengthen UCF's footprint in Optical Materials research and education.
- Collaborate with CCIE, CECS and COS to increase engagement with local schools to enhance K-12 Science Education and grow our program.

The key goals related to research growth listed above are each described and budgeted in the future initiatives section of this plan, including faculty hires and the construction of a photonics training center. To achieve the remainder of our goals, we ask for moderate additional resources: two instructional faculty, two tenured/tenure-earning (T/TE) faculty, one K-12 outreach coordinator, and three additional support staff to accommodate the increased workload associated with academic program and research growth.

Rankings:

Despite the importance of photonics to our economy, there are less than 10 dedicated optics and photonics program in the United States. Consequently, there are no specific rankings for photonics programs. US News and World Report does have an Optics category within its Global Universities Rankings. We are number 8 in the US and are, by far, the highest-ranked university that has a standalone optics program. However, this ranking is based on high-impact

publications and citations and seems to be normalized to the number of “optics faculty” at each university. Any steps we made aimed at improving this ranking would probably not aid us in most of our key goals.

Why invest in CREOL, The College of Optics and Photonics: (related to strategic emphases)

We recognize that to become Florida’s Premier Engineering and Technology University, UCF must invest in many areas that are deserving of support. In our 5-year plans we are cognizant of this, and we aim to grow in areas that are also priorities for other parts of UCF.

Historically, the return on investment (ROI) for funds invested in our college has been high. Faculty hired in our college generate a significant level of external research funding (approx. $750,000 per faculty per annum in awards.) We also are home to the only faculty member to have been inducted to the National Academies while at UCF, and our faculty were the winners of the first Keck foundation grant at UCF. We believe that additional faculty members we have hired or will hire, will be strong additional candidates for induction to the National Academies. We have a large number of postdocs per faculty, we generate significant IP and patents, have generated many spinoff companies, and have strong engagement with industry through our industrial affiliates program. As it takes time for new hires to grow their programs, the return on planned investment will continue to grow beyond the projected $20.5M in research expenditures in 2029. Moreover, if all proposed Future Initiatives were funded, we anticipate annual expenditures of over $30M after 2029. Our proposed future initiatives are highly collaborative and would help UCF become a strong player in Quantum Science and Engineering, in Biomedical Research, and would continue our growth in Space Exploration and Instrumentation and Optical Materials. Also, what is not captured in our spreadsheet projections, is that the synergy our proposed hires will create a likelihood of attracting major research center funding such as DoD MURIs, NSF ERC or STC programs etc.

UCF Academic Unit Plan

Strategic Plan Priority #1 – Student Success and Well-being
Strategic Plan Priority #2 – Discovery and Exploration
Strategic Plan Priority #3 – Community and Culture

2. Current status and strategies

a. Current educational, research, public service, and partnership strategies.

Consider enrollment and student success strategies and how your strategies impact your unit's activities and performance.

Brief history and current status of college.

The College of Optics and Photonics (COP) is rooted in the founding of a research center, The *Center for Research in Electro-Optics and Lasers* (CREOL) in 1985 at UCF, at the behest of the local laser and electro optics industry, aided by a few faculty in the Departments of Physics and Electrical Engineering. Funding came from the state in 1986. Hiring began in earnest in 1987, with the recruitment of CREOL's first director and faculty were hired in the center with tenure in departments such as Physics, Electrical engineering. CREOL faculty had an interest in educating students, recruiting research students and taking responsibility for teaching the optics courses in the electrical engineering and physics graduate programs. The center name was soon tweaked to "*Center for Research and Education in Optics and Lasers"*. After a decade of growth, the School of Optics was formed as a graduate degree-granting unit that also became tenure home to the CREOL faculty. In 2004, the school became the College of Optics and Photonics. Due to the name recognition of CREOL in the Photonics Industry, the brand name *"CREOL, The College of Optics and Photonics"* has been used in our external marketing. In 2013, the college started an undergraduate degree, the Bachelor of Science in Photonics Science and Engineering (BSPSE), and subsequently accredited by ABET as an engineering program. This program is jointly offered with CECS.

Over the years the college, and the brand name of CREOL has become well-known in the field of Optics and Photonics, although there are no real rankings for Optics programs in the USA.

As of March 2024, the College has 25 tenured/tenure earning (T/TE) faculty with 100% appointments in the college, 4 T/TE with 50% or 33% Joint Appointees, and 4 Research Faculty. SIP and OE programs have resulted in four new T/TE faculty being hired in the past year, with 3 more expected to arrive in fall 2024, and three positions remaining to fill. Faculty are supported by 17 full-time administrative staff, covering all areas of finance, procurement, building management contract and grant support, HR and academic program support. The college has four endowed chairs (one vacant), two endowed professorships (one vacant), and a chair (Northrop Grumman) that currently carries no endowment. Additionally, five of our faculty hold Trustees Chairs.

Our current College Vision and Mission statements:

Vision

To be the world's leader in education, research, innovation and partnership in optics, lasers, and photonics.

Mission

- To provide our students, the State of Florida and the nation with high quality academic programs optics, lasers and photonics.
- To educate a diverse workforce for the state's and the nation's photonics industries and graduate schools, providing opportunities at all levels to individuals of every background, identity, and affiliation.
- To create and disseminate new knowledge and innovations in optics, lasers, and photonics by conducting, presenting, and publishing cutting-edge fundamental and applied research.
- To aid in the development of Florida's and the nation's knowledge-based and technology-based industries, and create, foster, and sustain mutually beneficial research collaborations and partnerships with industry.

Academic programs and student success strategies:

Currently, COP graduates approximately 35 BS, 25 MS and 20 PhD students per year. The BS program has been steadily growing, although Covid inhibited our recruitment and growth. The program was created in response to the strong job market for Photonics Engineers. Based on the Bureau of Labor Statistics employment projections for Photonics Engineers, there is an estimated annual need for 350 Photonics Engineers in Florida and 5000 nationally. Also, a 2023 Lightcast Program Report for CIP code 14.1003 Laser and Optical Engineering indicates that there are thousands of photonics jobs available in the state each year. The growth in Florida was higher than the national projection at 10.4% and there is a similar growing gap between postings and hiring that began in late 2020. These positions are currently filled mostly by electrical or mechanical engineering graduates, but photonics engineers are preferred for these jobs. Based on this data we have grown our program, and we have now reached our original goal of graduating between 30-40 students per year. Since being established in 2013, the Photonic Science and Engineering program has grown from an annual enrollment of 9 to about 165. As of Fall 2023, we have graduated 134 students, with average starting salary for our students at $70,000 to $75,000. Nearly every student has reported being hired in a related photonics industry or pursuing graduate school. Based on estimated needs, confirmed by observations of our graduates finding appropriate employment, it is clear that we should continue to grow the program. However, a limiting factor in our enrollment is that Optics and Photonics is not known to high school graduates as a distinct discipline and therefore most of our majors do not declare until they learn about it after they have been at UCF for a semester. For this reason, our incoming cohort is very small and consequently we see large fluctuations in our 4-year graduation rate. We have started to address this issue by recruiting via summer camps and starting outreach to teachers and guidance counsellors.

Our MS program enrollment has fluctuated and has historically been treated as an accessory to our PhD program. However, in the past three years, we have emphasized the benefits of a standalone MS degree in our recruitment and have increased the online availability of the program to meet the needs of working professionals. Consequently, we have seen some growth in the number of face to face and online MS students who do not intend to seek a PhD, including out-of-state students. However, the retention rate has been rather low, and we have been addressing this by increasing support from teaching assistants. The growth in our MS program has been intentionally gradual, anticipating that these student support issues need to be addressed before scaling up the program, which is planned over the next several years.

Our PhD enrollment has seen a decline in recent years. One reason has been in part because of difficulty in attracting international students. Another issue is that the cost of supporting PhD students has risen due to the rapidly rising cost of living in Orlando. At the same time the cost of Postdoctoral Scholars has decreased. As our faculty numbers grow, PhD enrollment will also grow, but we are actively considering ways to incentivize faculty to increase the number of PhD students per faculty member.

Research strategies:

CREOL has always been highly research-oriented, even after becoming a college and starting an undergraduate program. T/TE CREOL faculty are expected to be highly research active, typically teaching two courses per year, supervising (and supporting) several PhD students, publishing multiple refereed journal papers, and attracting external funding to support their research programs. A small number of faculty who are less active in research are expected to teach more, or assume additional service activities, but in all cases, faculty are expected to maintain significant research productivity. Consequently, our faculty are highly research-active, bringing in annual external research funding awards of approximately $750,000 per T/TE faculty. External research funding has grown in the past decade, but it appears that the past three highly successful years won't be replicated this year. Reasons include faculty departures, ending of some large programs, and delays in expected funding caused by federal budget issues.

Our recent strategy for growth in new areas was partly in response to the Strategic Investment Program, in which we were successful in gaining positions in Space Photonics, Semiconductor and Integrated Photonics, and AI. Operational Excellence funds have been and are being used to bolster these areas as well as other areas into which we wish to grow, including Quantum Information Science, Topological Photonics and AR/VR/XR systems.

Partnership strategies:

CREOL's roots in industry have continued and the college has a significant Industrial Affiliates Program, in which partner companies pay a membership fee, in part as philanthropy, but also to gain better engagement with our students and faculty. Typically, we have about 60 members in our affiliates program, although not all have paid dues regularly. As the partnerships spreadsheet shows, in the past two years, over 80 companies have provided us with significant resources in the form of memberships, research contracts, career fair fees, or equipment. The Affiliates Program has undergone some changes in the past two years, and the process is not yet complete. For example, we have developed career and internship fairs, both online and

virtual, that are small but provide high value for the companies and our students. We have also introduced sponsored industry days where one company visits the college on a particular day to meet students, faculty, etc. These changes attempt to reflect the differing ways in which companies wish to engage with us. We are in the process of hiring a new staff member, a director for Partnerships and Communications to help guide this process and further develop these partnerships, particularly with larger companies that have strong local presence.

b. How research efforts align with the Strategic Plan and the five areas of focus

Much of our research aligns well with UCF's present strategic plan. We have been growing in Space related research, including our involvement with the NSF-funded space photonics consortium, EPICA, which studies Space-compliant Photonic Integrated Circuits, with 11 major corporations as fee-paying participants. We also have a growing Astrophotonics group, which formed a major part of the SPICE SIP program and was recently funded to carry out an Air Force Research Labs Grand Challenge program on imaging debris in low earth orbit. We have one of the leading groups in creating the hardware required for AR/VR/XR displays, and this maps into UCF's Entertainment and Immersive Experiences emphasis. Our strongest overlap with the UCF Strategic plan is in Transformative Technologies and National Security, which probably represents over half of our research portfolio. In recent years, our college has had more annual Department of Defense and Homeland Security funding than any other college at UCF with emphasis in high power lasers, semiconductor photonics, communications, long-wave and mid-infrared technologies, advanced optical materials, nuclear scintillation detectors, imaging, sensing and advanced computing. Additionally, our college is involved in two optical material initiatives on sustainability addressing raw material shortage and domestic independence.

We also have some strong programs in Biomedical Photonics, which relate to the Health and Human Performance focus area. We have not grown this area in recent years due to a lack of clinical research faculty at UCF. However, we have been working closely with COM and are optimistic that UCF will become strong in clinical research. We believe that this will enable COM and CREOL to work together to become internationally renowned in Biomedical Photonics Research, allowing us to take advantage of the significant funding available in this field, as we describe under our future initiatives.

c. Existing or possible new programs and offerings which will flourish as part of the Premier Engineering and Technology LBR.

Complete the following tabs in the attached excel file: Priority #1 Stud.Success ; Priority #2 Disc & Explrtn ; Priority #3 Comnty & Culture.

Academic Program growth:

As UCF grows to become the State of Florida's Premier Engineering and Technology University, it is important that Photonics, one of UCF's most visible and well-established STEM programs, contributes to that growth. In response to the high demand for photonics engineers, and for engineers in other discipline with knowledge of photonics, we plan to grow all of our existing academic programs, to add a new Optics and Photonics Technology program, and to increase our impact in other programs by offering appropriate coursework and tracks in optics and

photonics.

Undergraduate Programs

As described in the introduction, data sources indicate a significant unmet need for graduates from optics and photonics programs, both at the state and national levels. We have grown our program considerably during its 10-year existence and have reached a point where more resources are needed to continue the growth necessary to address State and national needs for photonics engineers and technicians. In particular, we will have to offer classroom and laboratory sections that are larger and more frequent. While there are abundant classroom spaces, we are limited by teaching lab spaces, as well as by the instructors needed to teach these classes. Therefore, much of the faculty growth we propose is in Instructor/Lecturer positions. Our plan to renovate existing space to create a Photonics Training Center (PTC) will more than triple our teaching lab capacity and enable us to teach every core undergraduate course in both spring and fall semesters. In doing so we can grow our programs to graduate over 100 photonics bachelor's students per year.

The PTC will also allow us to address industry needs by developing a BS in Optics and Photonics Technology (BSOPT) program. The BSOPT curriculum will be more applied than the BSPSE, but will require less calculus, allowing college physics instead of calc-physics, more core engineering, applied coursework and laboratory time. It will be 120 hours and can be completed in 4 years, even for students who are non-calc-1 ready, and/or students who struggle in calc 1 or 2. This is expected to result in a >60% 4-year graduation rate, while still offering students an opportunity to pursue a career in Optics and Photonics. Our initial goal is to graduate 25 BSOPT majors per year by AY 28-29.

To ensure that we can sustain our program growth, we need to engage K-12 teachers and students more robustly, so that parents, students and teachers are aware of the outstanding Photonics program at UCF and the career opportunities our programs provide. We have started this effort by running Photonics Summer Camps for high school students, and these are popular. We have also run information sessions for teachers and school counselors. We participate in Introduction to Engineering courses at Valencia and Seminole State. However, we need to do more and need to add an outreach staff member to assist with this. This outreach person will develop programs for teachers, counselors and students, with the goal of increasing student participation in STEM locally and increasing awareness of our program statewide and to some extent, nationally. By improving marketing and outreach to K-12 students, parents and teachers, we plan to dramatically increase the number of students who come to UCF with the intent of pursuing a Photonics degree. Specifically, we set the goal of a 5-fold increase in the number of students who declare as photonics majors at matriculation, meaning that FTIC will grow from 10 to 50; and FCS transfers from 5 to 25. The outreach person will coordinate many activities with the UCF iSTEM office, but the primary goal will be to promote Photonics programs.

No matter how much our college grows, we can likely never meet the demands of the photonics job market. However, many of these jobs can be filled by electrical, computer, and mechanical engineers and UCF students in these programs could benefit from coursework in photonics, giving them a tremendous edge when competing for these jobs. By working with

other engineering programs, including Electrical, Computer, Mechanical and Materials, as well as Physics and Chemistry, we will offer coursework in photonics that will positively impact between 100 – 200 additional undergraduate students per year by adding optics and photonics to their curricula. In particular, we will develop a Photonics Track in the BSEE program and will work with Physics to boost participation in the Optical Physics track.

In summary, our goals for our undergraduate programs are to:

- Create a new bachelor's degree program in Optics and Photonics Technology that will allow students to graduate with excellent employment opportunity within 4 years.
- Grow the number of bachelor's degrees awarded from 21 in AY 22-23 to over 100 in AY 28-29 (75 in BSPSE and 25 in BSOPT). The number of undergraduates enrolled in our college will grow from 130 to 400.
- Build a new Photonics Training Center, by remodeling existing space, that will allow the expansion of our programs and reduce the time to graduation.
- Increase the number of students who declare as photonics majors at matriculation by a factor of 5.
- Increase the 4-year graduation rate in our college to over 50% within 5 years and to over 60% within 8 years.
- Offer coursework in photonics that will positively impact between 100 – 200 additional undergraduate students per year in other engineering programs, including Electrical, Computer, Mechanical and Materials, as well as Physics and Chemistry.
- Add specialization or tracks in Space Instrumentation and Optical Materials within our BSPSE program.

Graduate programs

We will also address the need for more qualified photonics scientists and engineers at the master's level by growing our **Master of Science** in Optics and Photonics program, with emphasis on improving and growing our online offerings. This program is aimed at working professionals who may have Bachelor's degrees in other disciplines such as Electrical engineering, Mechanical engineering, Physics, etc. We note that the planned increase in the number of graduates in our BSPSE program will also increase our pool of future local applicants to the MS program. However, we will proactively market our online MS degree both in-state and out-of-state. We plan to offer our core and other popular electives every semester, accommodating spring admissions and decreasing time-to-degree. We also plan to offer more MS-centered elective courses so that there will be additional options for our students, also helping completion in a timely manner. We will deploy instructors to develop fully online or mixed-mode courses where previously we have taught via streaming video. This online content can also be used by faculty who teach face-to-face courses. Within a few years, our instructors will enable the availability of the MS core fully online. We will modify graduate teaching assistant roles to serve as coaches for online student cohorts to increase their engagement. We

aim to grow our total master's enrollment to 120 by 2028 (from 24 in 2022, 38 in 2023) and by then we will be graduating 50 students with the MS degree in 2028-29. (In 2022-23, we graduated 20.)

Additionally, we will continue plans with the ECE department to offer a Photonics track in the MSEE program. The market for MSEE programs is much larger than for photonics, so from our perspective, this will allow us to offer photonics coursework to a much larger audience. From another perspective, adding a photonics specialization to the MSEE will provide a unique capability that will attract students.

We will pursue partnering with industry to coordinate internships for MS students. We have observed that increasing numbers of MS students now include an internship during their studies and it makes sense to integrate internships into our program so that we can make our program more attractive to prospective students.

Our **PhD program** will benefit mostly from the growth in photonics faculty, some of which is already happening now. Since most of our new faculty are hired to be research-active, we will require additional students in the PhD program to meet their research needs. We anticipate this growth will be moderate, and we expect to grow from about 20 graduates to 30 graduates per year. However, should all of the Future Initiatives proposed in this plan be funded, this number will increase further, eventually to almost 40 PhDs per year, although this additional growth in graduates will not occur until after 2029.

Unfortunately, the growth of our PhD program is currently impeded by the rapidly rising cost of living in the Orlando region, making our graduate stipend insufficient to meet the basic needs of our students. This problem is compounded by some federal funding agencies (e.g. NSF) not increasing the level of funding in single-investigator grants, presenting a severe challenge for our faculty to support needed increases in student Research Assistantships. We recently raised our minimum stipend to $30,000 per year, but even this is not sufficient to meet increases in cost of living. We are able to use our endowed fellowships to boost the support of a limited number of students. A path toward a more sustainable program would be for UCF to reinstate the in-state tuition waiver, either full or partial, for funded students. Full tuition waivers for all our current PhD students would cost approximately $500,000 per year. The need to increase support of PhD students is more critical given Florida's restrictions on recruiting many international students that we previously relied upon.

In summary, our goals for the graduate programs are to:

- Grow the Optics and Photonics MS from the current 20/year to 50/year.
- Increase course offering frequencies to increase 3-year graduation rate from the current 36% to 60%.
- Work with ECE to create a photonics track in the MSEE degree.
- Partner with other programs on campus to offer photonics courses or tracks within their MS programs for value added degrees.

Expansion of research programs:

As described earlier, most of our research programs align well with UCF's present strategic plan, and this includes the recent expansion via the SIP and OE programs in Space Instrumentation, Semiconductor Technologies, and AI. Our plans for the next 5 years are to complete the hires under these programs and to continue growth of research in collaboration with other units within UCF. We believe that, in many cases, collaboration with other units will bring greater impact than emphasizing programs that are unrelated to other parts of UCF. We are proposing four *Future Initiatives* in this plan that will expand UCF's research in 4 main areas: Quantum Information Science & Engineering (with COS & CECS); Biomedical Photonics (with COM); Space Photonics (with COS); and Optical Materials (with Materials Science and Engineering). These are all detailed in the Future initiatives section of this document.

In addition, in the coming 5 years, we propose to add two additional T/TE faculty in unspecified areas but aligned to UCF's Strategic priorities. Much like some of the recent OE hires, keeping hiring options open in broader areas will also allow us to be flexible so that we may pursue opportunities in growing new research areas, team with other parts of UCF, or hire certain strong individuals who may enhance our existing capabilities.

Should all these initiatives come to fruition, we estimate that annual research expenditures in the college will reach $29M in FY 29. As the faculty we hire become established this number is expected to grow further to well over $30M[2].

We are also planning to embark on closer research partnerships with leading High-Tech companies, in collaboration with other colleges and helped by the UCF foundation. One example is Northrop Grumman who is eager to partner with us for research, but also for talent development. This more holistic type of relationship may be a model for expanding research collaborations and opportunities in the next few years.

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[2] *Research Expenditures in the provided excel file are based on credits splits, which isn't normally captured this way. Per Sponsored Research's Cube report, CREOL's FY23 research expenditures are $17.2M. Our projections are based on keeping with the theme of data provided in this current metrics report.*

Strategic Plan Priority #4

Innovation and Sustainability

Strategic Plan Priority #4 – Innovation and Sustainability

3. Unit's strengths and weakness as related to resource allocation and utilization.

***Faculty** – What is your view of the size, mix (T/TT, NTE) strength and productivity of your faculty? **Operations** – What are the strengths and limitations of your non-faculty staffing and non-personnel funding levels (considering all funding sources available to your unit – ICR, Auxiliaries, Philanthropy, and E&G)? **Space** – Is your complement of space and facilities adequate to your current plans? Do they pose a limitation to your unit's goals over the next 5 years? In the narrative, provide a **full explanation of projected unspent funds**. Complete tab Priority #4 Innvtn & Sustain in the attached excel file.*

Faculty:

Currently our college is heavily weighted toward T/TE, research-oriented faculty with 25 T/TE faculty, four additional T/TE faculty that are fully joint appointments with other colleges, and 4 research faculty. We expect 3 additional T/TE faculty to join in fall 2024. We have one search underway for an instructor/lecturer, as well as three open T/TE positions and one imminent retirement. We have been successful in attracting philanthropic dollars, with four endowed chairs and two professorships, and five of our faculty have been awarded Trustee Chairs. Our faculty are highly productive in terms of funding, attracting approximately $750,000 per year per T/TE faculty. Production of publications, citations and patents is also high, as is the number of Post-Docs employed. As a predominantly graduate institution our student/faculty ratio is small and our production of MS and PhD graduates needs to be improved, as this plan addresses.

We have recently felt a need to grow our instructional faculty so that we can place stronger emphasis on curriculum development and can scale up our undergraduate program while maintaining quality.

Operations:

Support staff:

Over the last 10 years, our faculty has grown by 10 and our research funding has grown by at least 60%. However, our support staff has only grown by 2 (from 12 to 14) in that period, one of whom was hired without any additional budget being allocated, due to workloads required by SET. This increased pressure on staff will need to be relieved, especially as we have four new faculty, three open faculty searches and three additional faculty starting in fall 2024. Within our plan, we would like to hire at least three staff (Post Award Specialist, Budget Analyst and an HR Coordinator) to handle this growth. We cannot provide adequate support without these additions. We are asking to have these positions supported via E&G funds, and if funds are not available, we would have to resort to use of ICR, with negative consequences as described below.

We have had some faculty retirements recently, but those funds are being used for new hires not funded by SIP and OE, as well as to cover fringe benefits and salary. By FY2025, we

anticipate that over 95% of E&G funds will be spent on faculty and staff payroll. We will therefore rely upon our ICR to support annual expense such as ORCGS. ICR is also used to fund faculty startups, travel for colloquiums, dean's office travel, and student recruiting. If we must pay staff using ICR, we will be very limited in our ability to invest in startup for any new hires.

Our college generates just under $400,000 from endowment funds and an approximate $50,000 from the industrial affiliates program. However, endowment funds are restricted. 78% is for chairs and professorships, and the remaining 22% is for scholarships. Affiliates funding is fungible, but most of this goes to running the affiliates program. We are in the process of hiring a new staff member to run this program with the goal of creating stronger partnerships and increasing revenues.

Space:
Recent hires associated with SIP and OE have placed a strain on our available research space. Fortunately, due to some recent retirements and some senior faculty agreeing to reduce their lab space, we have accommodated all new hires so far, including the three who plan to start in August 2024. Subsequent hires will be more challenging, and we will need to introduce a more robust policy on determining transfer of space that we can use into the indefinite future as some programs grow and others decline. We have been collecting data to this end.

In the next five years, we believe we can apply this policy to accommodate the two remaining SIP and OE hires. The two new faculty hires requested in this plan will likewise be accommodated by asking senior faculty to give up a fraction of their space per the policy, although hiring new faculty who need particularly large spaces may be a challenge. Some of the future initiatives we have proposed will need additional space. The Quantum and Biomedical initiatives are predicated on additional space being fount, in the latter case at Lake Nona. On the other hand, the Photonics Training Center will provide an additional $1,000 sq.ft. of research space as this will free up research labs currently used for teaching. This will help with the Optical Materials and Space Photonics initiatives. Both of these initiatives will party use existing shared space and although the new faculty will need their own labs, their needs will be reduced by this.

Projected unspent funds:

E&G funds are at least 97% used each year.

SIP/OE funds that have been allocated are planned, but not all spent. Academic Affairs is aware and understands the plan in place.

C&G funds must be spent on research within the time frames and constraints of the individual contracts. They should not be confused with other dollars.

ICR has always been planned to support faculty hires/startup, occasionally retention packages. At present the balance is higher than normal, as we have new faculty starting soon and they will spend most of these funds. As mentioned above, we have recurring costs funded by ICR.

UCF Academic Unit Plan

Resource Utilization

Strategic Plan Priority #4 – Innovation and Sustainability

4. 10% Efficiency Exercise

In the schedule provided, show us how you would adjust your resource distribution to achieve progress in your academic and research metrics if you were asked to become 10% more efficient over the next 5 years. Complete tab Efficiency Schedule in the attached excel file.

In the efficiency schedule in the excel file, the E&G allocation has been reduced by 2.5% each year beginning FY26 through FY29 for a total of 10%. This results in a reduction of $980,000 compared to level funding. To accommodate this, we would have to eliminate some of the planned growth in instructors, T/TE faculty and administrative support staff. The instructors and support staff are essential to the future of the college, so the brunt of the cuts would fall on new faculty hires. We can also move some of our staff salaries to ICR, which would limit our ability to invest in new students through ORCGS fellowship program and would restrict future faculty startup funds. We can also cut expenses such as travel costs for visiting speakers, deans travel, marketing, student recruiting, but these savings would be small.

To cover the $980,000 deficit, we would have to cut new faculty hires ($300,000 saving), one instructor and one staff position ($215,000 saving). Non-salary costs such as marketing, travel, student assistants, etc. can be eliminated to save $100,000.) The remainder ($365,000) would have to be covered by transfer of salary costs to ICR. This will effectively reduce our ICR by 30-40% each year, which would result in a reduction of investment in new students through ORCGS fellowships, and the inability to build a reserve for startup funds to support new faculty hires when we have to replace existing faculty through departures or retirals.

Also, cutting faculty in our college will cut some of the most productive faculty at UCF and will result in loss of research funding, post docs, PhD students and overhead. It is unlikely that this productivity would be recovered by investing these funds elsewhere at UCF.

UCF Academic Unit Plan
Resource Utilization

Strategic Plan Priority #4 – Innovation and Sustainability

5. Future Initiatives

– In this section propose any new initiatives that will move your unit and UCF to a next level of prominence. These initiatives should have a bounded scope, a clear sense of quantitative and qualitative impact, a strong connection to the Plan and a well-argued case for resources. In addition to a short narrative, complete a sheet projecting the measures of success and the spending plan for each proposal (schedule provided). If you submit more than one initiative, please identify the priority ranking of each proposed initiative. Complete tab Future Initiatives in the attached excel file.

There are several Future Initiatives that the college plans to pursue, provided that resources are available. Many of these are collaborative efforts with other colleges, and several of these will appear in similar forms in other college's strategic plans.

Our first priority is the Photonics Training Center. As outlined in section 2.c., expanding our undergraduate programs is crucial for our growth in the next 5 years. The other initiatives are mostly research oriented. It was difficult to rank these. While we can always make hires in any of these areas, we believe it is more impactful to do so in collaboration with other parts of UCF. The Space and Materials initiatives build on existing resources and will not need significant new space. The Optical Materials initiative will expand optical materials work in our college to make it a signature component of the UCF photonics program.

Priority 1. Photonics Training Center.

Priority 2. Quantum Information Science & Engineering. (With COS & CECS.)

Priority 3. Biomedical Photonics. (Parallel to COM proposal.)

Priority 4. Space Photonics. (With COS.)

Priority 5. Optical Materials. (With MSE faculty.)

College of Optics and Photonics Future initiative 1:

Photonics Training Center

A high priority of the college is to create a large Photonics Training Center project by repurposing and remodeling an auditorium space that was shelled out, but never completed. This remodel will provide a large teaching laboratory suite that will allow significant growth of our undergraduate program and will also provide space for the creation of a new BS degree in Photonics Technology. This space (2300 gross sq.ft.) will also permit more frequent offering of all our undergraduate laboratory courses, resulting in an improvement in graduation rate. In addition to program growth, this space will also be used to house our senior design student laboratory. Presently, our teaching lab space is 650 sq. ft. and senior design space is 400 sq. ft. Senior design space is at capacity and our teaching lab is not large enough to permit teaching most core undergraduate courses more than one time per year. This new facility will more than double our BS in Photonic Science and Engineering program capacity, allowing us to reach or even exceed our goal of 75 graduates per year, while at the same time accommodating the planned 25 graduates per year in the proposed new BS in Optics and Photonics Technology.

Originally this space was designed to be an auditorium in a recent addition to the CREOL building. Upon completion of the addition, the space was only shelled out, and the interior was not completed. Although there would be some advantages to having an auditorium in the CREOL building, there is no shortage of auditorium space at UCF, while we are desperately short of teaching laboratory space, a need that will increase as our program grows. Therefore, the adaptation of this space to teaching laboratories will be a tremendous improvement to the use of the space, particularly as it currently sits idle. Additionally, the estimated cost of converting the space to teaching labs ($1M) is similar to the cost of competing it as an auditorium.

The Photonics Training Center will also be available during the summer for expansion of our Photonics Summer Camps for Middle and High school students, as well as programs for K-12 teachers. Currently we are only able to accommodate 20 participants per week and we could greatly expand that in the proposed Photonics Training Center. Therefore, this project primarily aligns with UCF's strategic plan goals for FTIC and transfer student graduation rates, and secondarily with strategic goals for research funding, and community engagement.

The increased capacity to graduate photonics majors is of interest to the Florida photonics industry and we believe this project will attract lab sponsorship from industry, as well as increased participation in the CREOL Industrial Affiliates program. These will enhance UCF's fundraising and endowment prospects and will increase the value of companies entering partnerships with UCF. Without the proposed Photonics Training Center, the program would be limited to around 60 graduates per year, unless we diminish the laboratory education component of the program, which is not a direction we wish to take.

In addition to the increased number of students, the construction of the Photonics Training Center will create efficiencies that will lead to reduced time to graduation and reduced waitlists as follows: Our current undergraduate lab accommodates 18 students per section This means that we have to offer multiple sections of each lab in a semester. This leads to some difficulty sticking with our policy of having faculty act as instructors for all sections of our lab courses,

owing to the long hours. Critically, it also means we do not have the time nor space to run all lab courses every semester. This may lead to increased time to graduation since students who miss a class for some reason may be delayed a whole year instead of just a semester. The creation of a larger space will allow for fewer, larger sections, providing time to offer all our classes in both fall and spring semesters, with some key classes also eventually being taught in summer, as our program grows.

This project will also free up some 1000 sq. ft. of lab space for research as existing teaching labs that currently occupy research-grade labs will be consolidated into the new facility. This will provide much-needed research laboratories to accommodate some of the planned growth in faculty. This space amounts to about 3% of the research lab space available in our building. Since we currently generate about $20M/year in external research dollars, we can make a linear projection that this additional space will generate an additional $600,000/year in research funding. With growth in our funding as we hire additional strong faculty one could estimate that this number be as much as $1M/year. A similar projection might be made for patents, publications, capacity for PhD students, etc.

The college has funded the initial design study but has limited funding to complete the project. We do plan to seek industry help in supporting the project by funding the buildout or supplying equipment.

The initial design study is shown below, the exact layout of the Training Center is yet to be determined, but will contain space for a teaching laboratory, for senior design hoteling space and for lab equipment storage.

Since this is an unfinished but existing space, there are several other possibilities for this space. One is to complete the auditorium as previously planned, but this does not address our needs for teaching lab space. Another possibility was to convert the auditorium to premium research lab space. In particular, a Space Photonics facility as part of the UCF-wide SPICE program was considered. This would be advantageous in helping to attract top faculty to that program. Some existing space photonics research labs could be moved there, making way for teaching labs. However, the buildout of research lab space is more expensive than teaching lab space of this type. Also, the current teaching and senior design labs in our building already occupy research lab space, so it makes much more economic sense to use these as originally-intended research space and build out less expensive teaching lab space.

Not funding the project will have two impacts:

- First, we will lose the opportunity to grow the photonics undergraduate program at a time when industry needs are high. This will also mean we cannot offer classes more than once a year, making it difficult to reduce time-to-graduation in our program.
- Second, we will leave a 2300 sq. ft. space empty and unusable in an otherwise crowded and productive building.

Cost:

The estimated cost is $1M for the construction and $300,000 to equip the lab. We plan to ask industry donors to sponsor the lab equipment. The college can also apply some indirect cost return to fund construction, but some assistance (approx. $500,000) would be needed to help get this project over the line.

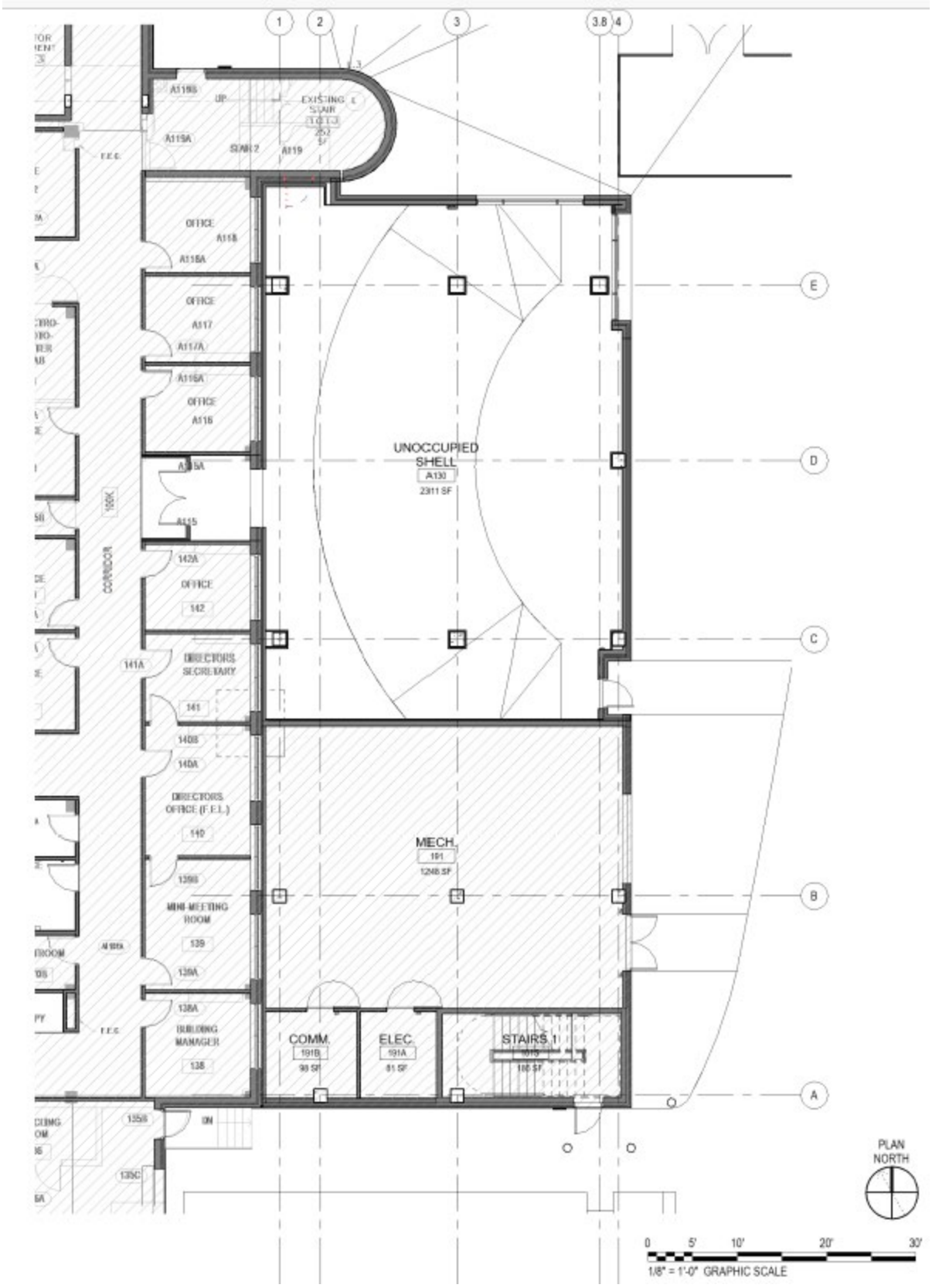
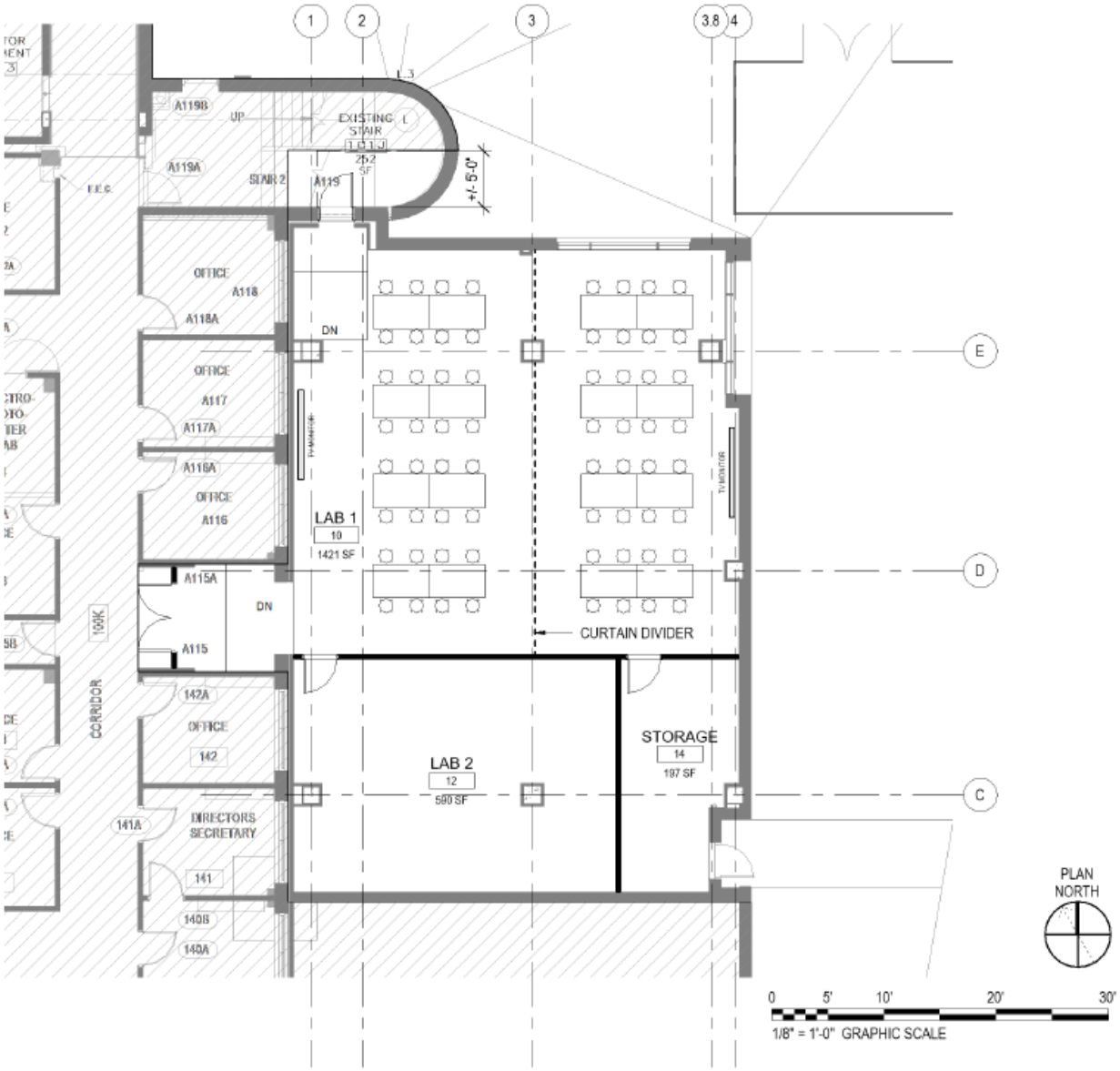


Figure 1: Original shelled-out auditorium space



OPTION 3 - UPDATED

Figure 2: Proposed Photonics Training Center floor plan after renovations

College of Optics and Photonics Future Initiative 2:

Quantum Information Science and Engineering Initiative

Note this proposal was co-written by faculty in COP, COS and CECS

Purpose

The College of Sciences, in partnership with the College of Optics and Photonics and the College of Engineering and Computer Science, seeks to create a *Quantum Information Science and Engineering Initiative* (QISE) at the University of Central Florida with the purpose to:

- Establish strong and competitive research and education programs in a critical and strategic area of science and engineering where UCF is not yet an active player at the national and international levels.

- Strengthen our research infrastructure to attract and retain superior QISE faculty talent by:
  - creating a hub laboratory (the Q-hub) to
    - host and support state-of-the-art quantum fabrication and characterization equipment;
    - attract graduate student talent who seeks a high-quality research environment;
    - enable greater opportunities for bringing external funding at the national-center level;
  - enhancing existing shared cleanroom microfabrication facilities to enable the fabrication of state-of-the-art quantum devices.

- Create education and training opportunities for our students to enter the quantum information science and technology workforce.

Major Thrusts

- ***Quantum Computation and Quantum Networking Platforms.*** This thrust aims to develop the critical building blocks for quantum computing and quantum communication architectures by employing integrated photonics, superconducting circuits, and transduction mechanisms between them. This includes:
  - Hyperentanglement of light in multiple degrees of freedom (temporal, spectral, spatial, and polarization) in integrated photonic platforms.
  - Development of superconducting circuits
  - Development of quantum transducers and hybrid superconducting/optical quantum devices.

- ***Quantum Computation and Quantum Networking Protocols.*** This thrust encompasses the development of protocols to initialize, control, manipulate, and read a range of quantum systems and to control communication amongst them. It also includes:
  - Development of ancillary tools and protocols for quantum information processing such as languages, compilers, and error correction codes.
  - Designing, implementing, and testing quantum algorithms.

- ***Quantum Workforce.*** This thrust focuses on educational activities encompassing:
  - Development of new curricula and educational programs to prepare undergraduate and graduate students for successful careers in quantum science and engineering, which will include:
    - Theoretical and experimental new courses open to a variety of majors.
    - A quantum optics graduate track.
    - A quantum information science and engineering interdisciplinary undergraduate minor.

A Strong Foundation

UCF is well-positioned to become a world leader in QISE. There are already extraordinary researchers in several areas and colleges around the university that provide UCF with a foundational base upon which one can build a national-level center in quantum information science and engineering.

- The COP is one of the few colleges in the nation devoted to optics and photonics and is in a unique position to advance quantum information processing in photonics because of its core strength and its comprehensive expertise and facilities in lasers, nonlinear optics, integrated photonics, and optical fiber technology.
- Current quantum-related research activities at UCF spread across several general areas: quantum optics for communication, computation, and metrology; molecular spin systems as hardware for quantum computation; topological quantum materials with potential applications to information processing; two-dimensional functional materials, both single-layer and composites, and spintronics. Thus, there is already a nurturing and friendly environment for QISE at UCF.
- ***The proposed QISE initiative at UCF would be very complementary to FSU's, which is more focused on quantum materials and other quantum technologies.***
- The university has made a sizable investment in optics and photonics research equipment and facilities in multiple locations around the university. Yet, the facilities are currently not sufficient or adequate for the level of quality and precision needed for fundamental and applied studies quantum information processing. The bar is rather high in this area because a much finer control of materials properties, device specifications, and experimental conditions is required in order for the research to be competitive at the national and international levels. New facilities will be required to complement and advance the ones already existing at UCF.

Current Challenges

UCF lacks the critical mass of faculty expertise and the research infrastructure in quantum information science and engineering to lead large collaborative projects and to have impact at the national and international levels. While we do have faculty actively working in quantum-related areas of research, except for a couple individuals we do not have faculty with experience, track record, or strong presence in quantum information processing. As a result, it has been hard to lead proposals in this area and to initiate competitive collaborative projects. We thus should seek to bring new faculty who could nucleate competitive groups and instigate new collaborations within UCF and with partnering institutions. These new hires should be at both senior and junior levels, with some being more science focused and other being more engineering and technology focused. They should be predominantly experimentalists, but theorists and computer scientists are also needed. The nature of our institution, the size and diversity of our faculty and our student body,

the variety of academic programs, the existence of a Central Florida industry corridor, and the potential collaboration with the quantum science initiative recently established by FSU and the National High Magnetic Field Laboratory, would enable unparallel opportunities for our institution in an area that will attract external funding and partnerships and will demand a well-trained workforce.

What is Being Asked

- RECURRING
  - 5 tenured/tenure-track faculty positions (junior and senior) with possible joint appointments in three sponsoring colleges:
    - 3 between COS and COP, possibly joint with CECS
    - 2 at CECS
  - 2 full-time shared instrumentation technicians
  - Administrative and operating costs:
    - Director (summer salary)
    - Administrative support
    - Collaboration activities-travel, conferences, etc.
    - Seed funding

- NON-RECURRING
  - Space
    - Initially, utilize existing cleanroom facilities in CREOL for the fabrication of high-quality silicon nitride nanophotonic structures to produce high-Q micro-resonators capable of generating strongly squeezed light.
    - Identify 1,200 NASF of shared Q-hub space in the research park including appropriate support offices for the measurement of squeezed in the "quantum regime".
    - Longer-Term-centralizing QISE offices and cleanroom/research lab spaces in the Research II Building, which is now in the planning phases
  - Infrastructure and Equipment Upgrades (see detail below)

Infrastructure and Equipment Upgrade

The following infrastructure and equipment upgrades are requested to be able to fabricate state of the art quantum devices in the existing UCF cleanrooms.

- Air handlers for cleanroom
- HEPA fan filters
- Liquid nitrogen tank
- Toxic gas cabinets and scrubbers
- Pulsed laser deposition system
- Laser lithography system
- Vacuum sealing oven
- Two LPCVD furnaces for 5" substrates

Justification: New air handlers, HEPA fan filters, and liquid nitrogen tank are necessary to keep maintaining any kind of work in the cleanroom; the toxic gas cabinets and scrubbers are needed to deal with the residuals from the low-pressure chemical vapor deposition (LPCVD) furnaces; The

pulsed laser deposition system is requested to develop high quality thin films with excellent control over the film thickness and interfacial properties which is critical in heterostructures and superconducting quantum devices; the laser lithography system is requested to replace old lithography tools enabling repeatability and resolution in quantum device fabrication; the vacuum sealing oven will enable packaging of quantum devices; the LPCVD furnaces are necessary to deposit low-loss silicon nitride films that will be used to produce ultralow-loss photonic waveguides and resonators to develop quantum sources.

IMPACT

Societal/Communal/Technological

Quantum information-based technologies are currently breaking long-standing limits in precision metrology and sensing, promising exponential speed-ups in computing, and demonstrating unparalleled security in communications and networking. The economic and societal impact of quantum information is likely to be as revolutionary as that of digital information, which started with the introduction of the transistor. From the engineering of new drugs to secure communications to logistics and planning, the new quantum technologies will improve medicine, commerce, and make industrial processes more efficient. Yet, progress will continue to be challenging, heavily relying on fundamental quantum science advances, and requiring meaningful collaboration among scientists and engineers in various disciplines. The results of such collaborations are expected to position UCF as a key contributor to this emerging technology. Quantum technology is expected to have a significant impact on a wide range of industries and sectors, including breakthroughs in fields such as drug discovery and development of new materials, secure and unbreakable communication for defense and financial sector uses, extremely precise sensors for navigation, medical imaging, and environmental monitoring, and artificial intelligence.

UCF is quickly falling behind other technology-focused, peer universities in the nation that have already started QISE programs. However, due to our size and our strong presence in quantum-related areas in sciences and engineering, we have a unique opportunity to not only catch up but surpass these other institutions. The initiative proposed here will allow for the coordination of all efforts in QISE and for an efficient use of resources. We expect a quick rise in recognition for UCF.

Sponsored Programs Growth and National Center Designation

QISE is a high-priority area for the federal government as well as for the private sector, guaranteeing that federally sponsored research funding will continue for the long term. Funding agencies such as NSF and the DOE have expressed strong interest in seeing regional collaborative efforts, particularly when involving minority-serving institutions. UCF would join FSU in strengthening QISE research in Florida. This collaboration would position these two institutions and the state of Florida to become highly competitive for a national-center designation within next 3-5 years, a designation that has eluded the southeastern United States, and Florida in particular.

Over the next 5-7 years, federal sponsored program funding should grow by $10-15M in annual research expenditures for QISE and up to $25M annually for national centers. Many of the new awards will be multi-investigator and multi-institutional.

Partnerships

The UCF QISE initiative will leverage existing connection between UCF faculty and their counterparts at FSU who are heavily involved in their recently funded $20M quantum science initiative. Faculty leaders at FSU have expressed interest in collaborating with UCF to establish the Central-North Florida quantum science corridor.

With several companies in Florida developing new quantum technology programs, opportunities for collaborations abound. Companies in the region are likely to focus their efforts on optics, laser, and photonic quantum technologies, as well as in simulation, quantum cybersecurity, and the development of quantum algorithms and protocols. Some companies are considering quantum technologies for applications in aerospace and in defense. A few examples are Northrop Grumman, Lockhead Martin, L3Harris, and BAE. These focused areas match the ones in this proposal.

Education, Training and Workforce Development

The QISE initiative will lead the evolution and expansion of quantum science and engineering education at UCF. New degree programs will be designed and implemented, including an interdisciplinary minor and a graduate track in quantum science. Some steps in this direction have already been taken. Faculty involved in the initiative have a plan for an interdisciplinary minor in quantum information processing in partnership with national laboratories and top-tier universities. Their plan could not move forward due to the lack of financial support and personnel. The new hires will provide much needed expertise for the implementation of new degrees, which will create additional synergy for interdisciplinary collaborations.

Based on some preliminary estimates, which include the current availability of faculty and teaching laboratories, the interdisciplinary minor in quantum information processing is projected to start with an enrollment of 12 students, and grow by 12 more students every year thereafter, reaching 60 students in five years. This projection already exceeds the number of degrees awarded in physics and optics & photonics, which are the two areas with most overlap with QISE at the moment. This estimate may actually be very conservative, as demand for education opportunities in QISE are very high. For instance, enrollment in an introductory course in quantum information processing taught by a COS faculty member went from 9 to 20 to 48 in just three years. Once additional QISE faculty are brought on board, it is likely that enrollment in the minor will further grow. We expect the main feeders to this interdisciplinary minor to be undergraduate programs in electrical and computer engineering, computer science, physics, and optics and photonics. However, the minor will be designed to be accessible to all STEM majors.

As more facilities are created and new experimental capabilities and research programs are developed by QISE faculty, we expect to be able to offer additional courses, both regular and short ones. These courses would also target professionals from the local industry. There is growing interest in providing (even minimal) education in QISE to the workforce, particularly by large companies that perceive “quantum” as being a potentially disruptive new technology to their business. There is not yet clear leadership in providing such a training in the nation and UCF could seize this opportunity.

We envision the development of graduate programs that would build on initial efforts focused on the creation of several graduate courses, cross-listed in the three colleges, to support the growth of research in various subareas of QISE. The long-term goal will be to create a stand-alone

interdisciplinary Ph.D. degree, starting with tracks in existing Ph.D. degrees, as has been done in other disciplines (e.g., the planetary science track in physics). These courses, programs and degrees will be offered by Physics, Electrical and Computer Engineering, Computer Science, and Optics & Photonics, with a common core bridging these disciplines.

Proposed Budget

	Year 1	Year 2	Year 3	Year 4	Year 5
RECURRING EXPENSES					
5 tenured/tenure-track faculty positions at $200K/year each	$600,000	$1,000,000	$1,000,000	$1,000,000	$1,000,000
2 laboratory/instrumentation technicians at $125k/year each		$250,000	$250,000	$250,000	$250,000
Operational/administrative costs	$100,000	$100,000	$100,000	$100,000	$100,000
Total	$700,000	$1,350,000	$1,350,000	$1,350,000	$1,350,000

	Year 1	Year 2	Year 3	Year 4	Year 5	Accumulated
NON-RECURRING EXPENSES						
Shared Cleanroom:						
Air handlers for cleanroom	$650,000					$650,000
HEPA fan filters	$100,000					$100,000
Liquid nitrogen tank	$100,000					$100,000
Toxic gas cabinets and scrubbers	$200,000					$200,000
					subtotal	$1,050,000
Equipment:						
Pulsed laser deposition system	$500,000					$500,000
Laser lithography system	$250,000					$250,000
Vacuum sealing oven	$250,000					$250,000
Two LPCVD furnaces for 5" substrates	$500,000					$500,000
					subtotal	$1,500,000
Startup packages:						
experimentalists at $1M each	$2,000,000	$1,000,000				$3,000,000
theorists at $300k each	$300,000	$300,000				$600,000
laboratory renovations at $500k each	$1,000,000	$500,000				$1,500,000
					subtotal	$5,100,000
Total	$5,850,000	$1,800,000	$0	$0	$0	$7,650,000

Total recurring cost: $1,350,000
Total nonrecurring cost: $7,650,000

Note this budget is for all colleges combined. In our spreadsheet we only call out the COP part of the budget.

College of Optics and Photonics Future initiative 3:

Biomedical Photonics

Note: This initiative is aligned with COM Initiative "Medical Innovation, Technology, and Engineering"

The College of Optics and Photonics has long identified Biomedical Research as a pathway to growing and broadening our research portfolio while also increasing our impact on the community. We do have two faculty who are heavily involved in biomedical research and about 4 others who are involved in exploratory and developmental research. We did plan to grow our biomedical photonics research program and we even have an unfilled endowed chair in this area, but we have not yet pursued this due to the lack of opportunities to engage with clinician scientists at UCF who have a significant research assignment. We understand the difficulties in moving this forward, but the potential ROI for this kind of activity is huge. As the table below, comparing life-sciences and other research expenditures at UCF with other SUS universities, our non life-sciences research is clearly strong, but there is potential for huge growth in research funding in the biomedical area.

This proposal very much depends on growth in Biomedical research occurring within COM, particularly the growth of Clinician Scientist researchers. Should this happen, we would like to be poised to help UCF to grow in this area, by leveraging CREOL's strong reputation in photonics research.

	2022 R&D expenditures*		
	Total	**Life Sciences**	**Others**
UF	$1,086M	$798M (73%)	$288M
USF	$405M	$204M (50%)	$201M
FSU	$356M	$68M (19%)	$288M
FIU	$282M	$67M (24%)	$215M
UCF	$221M	$33M (15%)	$188M

* Source: NSF

What we propose is:

To fill the currently-vacant FPCE Biophotonics Endowed Chair - Salary $250,000 + benefits

Hire two T/TE biophotonics faculty jointly with COM. At least one whose research area is in biomedical optics/imaging, light-based therapy & diagnostics in clinical settings – Salaries each

$200,000 Including Benefits (50% in COP, 50% in COM)

Startup: $2M for Chair, $1M each for joint faculty

Space – locate all of these faculty at Lake Nona

Impact:

Biophotonics is one of the key enabling technologies in biology, biomedical research and clinical applications. Strengths of CREOL in laser, fiber and imaging can significantly advance biophotonics, and bring big opportunities to UCF by increase in research funding and high visibility to the communities. It will also lead to synergetic growth in CREOL, (biomedical) engineering and medical school.

ROI: It is expected that after several years, the additional C&G generated because of this effort (and still assuming the hire of Clinician Scientists) should be $3M per year.

Investment:
Fill one endowed chair, hire two faculty jointly with COM with expertise in biophotonics in clinical settings

Recurring cost:

	Number	Salary+Benefits	Total	Notes
Chaired Faculty	1	$300k	$300k	COP
T/TE faculty	2	$200k	$400k	Split COP/COM
Total			**$700k**	(500k to COP, $200k to COM)

Non-Recurring cost:
Faculty startup: **$3.0M total.** $2M for Chair, $1M each for joint faculty (shared with COM)
Seed funding to encourage clinical projects: **$1M** ($500k/year for 2 years).

College of Optics and Photonics Future initiative 4:

Space Photonics

Note: This initiative is aligned with COS Initiative “Space Exploration Systems”

UCF has designated space systems and technologies as one of its five key areas for strategic growth. Essentially all space technologies face significant challenges in Size, Weight, and Power (SWaP), and photonic technologies enable critical advances in all three of these categories for applications ranging from space exploration, to remote sensing of/from space, to space/space-to-ground communications. Despite these advantages, Space Photonics remains a young and largely underdeveloped area – and CREOL at UCF is perfectly positioned to make a major push to establish itself as a world leader in this emerging field. **Our vision is to make UCF the leader in Space Photonics by developing technologies and training a skilled Florida workforce that will enable future space-based imaging, sensing, and communications for government, defense, and commercial applications.**

UCF’s key assets for this include:

- national leadership in photonics and optics research at CREOL, with key emerging technologies for applications in scientific missions and space defense systems
- recently initiated Laboratory for Space Photonics as part of the multi-disciplinary SPICE AEP program
- >$1M in Federal funding granted for Space Photonics activity to CREOL PIs, including collaborators in UCF Physics | Planetary Sciences and Florida Space Institute, since Fall 2022

Through SPICE, CREOL is in the process of hiring one Professor and one Lecturer in the Space Photonics area and launched a Laboratory for Space Photonics to provide the necessary space and instrumentation to design, build, test, and characterize photonics payloads planned for space missions. The Laboratory for Space Photonics includes two spaces - one dedicated to the research/production facilities for research projects.

To further advance UCF towards the goal of becoming the recognized leader in Space Photonics research and education, we request the addition of two additional tenure-track faculty positions in Space Photonics over the next 5 years. These faculty hires will focus on researchers developing Space Photonics payload and mission technologies to participate in the “Rocket Lab” being proposed in collaboration with Physics, Florida Space Institute, and CECS faculty. The Rocket Lab will focus on developing the capacity for UCF to regularly compete for awards from NASA in the space hardware sector. Specific areas of potential interest for faculty research include freeform optics fabrication/metrology, free space optical communication, novel sensor technologies, and others. Combined with the 2 proposed faculty hires in Physics, this campus-wide investment in space technology/systems research will cement UCF’s position as America’s Space University.

In addition, we plan to expand the educational initiatives in Space Photonics. Over the next 5 years, we plan to develop and offer a Certification in Space Photonics – a growing need for working professionals in the space and photonics industries. We also plan to add both an

undergraduate track in Space Photonics to the College of Optics bachelor degree program, and a specialization in Space Photonics to the M.S. program.

Investment:
Two faculty with expertise in instrumentation enabled by Space Photonics

Recurring cost:

	Number	Salary+Benefits	Total	Notes
Assistant Professor	2	$150k	$300k	
Total			**$300k**	

Non-Recurring cost:
Faculty startup: **$2.0M total.**

College of Optics and Photonics Future initiative 5:

Center of Excellence in Optical Materials Education and Research (EXOMER).

Optical materials play an enabling role in a diverse range of technologically critical areas that touch our everyday lives. We propose the establishment of a cross-college **Center of Excellence in Optical Materials Education and Research (EXOMER)**. Our goal is to build on and expand the expertise and reputation of UCF in this area and lead the region and nation with a defining program that serves UCF's near and long-term Strategic Plan. By strengthening and expanding existing resources in the design, processing and metrology of advanced optical materials and by formalizing an educational track to attract, educate and train traditional and industry-based students, this Center will grow its current research, scholarly productivity and the workforce that the defense and civilian sectors aggressively seek out. As no other academic institution within the US possesses the multi-disciplinary expertise in both optical material science and engineering that includes material processing, state-of-the-art material property measurement and performance assessment, UCF's EXOMER Center will fill a unique void that government agencies, as well as local, regional and national industries have come to rely on. The primary goal of this initiative is to better market UCF-based expertise across various units (including Optics and CECS-MSE) to enhance research fund sourcing, student attractivity and transform an existing, well-funded, research program into a 'pre-eminent' status. Current efforts at the CREOL Optical Materials Laboratory are focused on developing more sustainable, durable and cost-effective optics and on SWAP reduction, with specific examples including current DOD and DHS initiatives supporting lower-cost optical components and scalable solutions of scintillator media for National security applications. Further investment in this area will help support other UCF initiatives including Quantum Computing, Semiconductor, Hypersonics and Extreme Environments as well as Directed Energy. We believe that timely investment in manpower, infrastructure and experimental capabilities will transform UCF into a major academic center for optical material education and innovation.

Impact: EXOMER aims to raise the visibility of the Optics and Materials Science programs at UCF and attract new students and technical staff to UCF. Building on extensive support from local and regional government and industry partners, EXOMER will further elevate the means by which Optical Materials can become a signature program at UCF. This will enhance nationwide reputation in education and research, serving to further differentiate UCF and increase rankings across key metrics.

Proposed Plan: We envision a 5-year pathway to pre-eminence starting with a UCF Faculty Cluster, followed by a Florida Center of Excellence and a National Center of Excellence. Future expansion might lead to a UARC.

Education: We will create a dedicated 'Optical Materials' track focusing on key aspects of Optics, Photonics and Materials Science and Engineering that are not currently part of the existing Optics or MSE curricula. Initially building on certificate offerings (with adequate modification of existing graduate courses to undergraduate courses), the proposed 'Optical Materials' track will include:

- OSE 3052: Introduction to Photonics
- OSE ----: Intro to Light-Matter Interaction (UG version of Light-Matter Interaction OSE 5312)
- OSE ----: Introduction to Optical Materials (UG version of Materials for Optical Systems OSE 6313)
- OSE ----: Manufacturing Science of Optical Components
- EGN 3365: Structure/Property of Materials
- EMA 4413: Fundamentals of Electronic Materials
- EMA 5586: Photovoltaic Solar Energy Materials

After a few years, this curriculum will be strengthened to offer minors and majors for students enrolled in Optics or MSE. Another component of student training will seek to provide graduate fellowships named by industry, or agency partners, as well as UCF postdoc P3's to attract personnel (*e.g.* 5 per year, with match, for 5 years).

Personnel: Identified needs are in the areas of:
- CVD and powder synthesis to support optical materials development,
- Broadband infrared materials development to support IR glass fiber, ceramic and film efforts,
- New optical materials discovery (theoretical), data mining, ab-initio modeling of optical material to complement existing experimental expertise,
- Lecturer or Instructor to support undergraduate education in these areas

These technical areas support new and existing research and training needs and partnerships with local industry (LightPath Technologies, Lorad Chemical Corp., Mainstream Engineering, DRS, Jenoptik, L3Harris, Lockheed Martin).

Investment: These Faculty positions will require about $1M startup each and lab space. In addition, proper staffing will be critical to support research, education and marketing goals (including distributed learning to internal/external students).

Recurring cost:

	Number	Salary+Benefits
Faculty	3 (1 CREOL)	$200k
Instructor	2 (1 CREOL)	$150k
Total (CREOL)		$350k

Non-Recurring cost:
Faculty startup: **$1.5M total.**
Admin and Operational Costs: $400k