Cancer Center at Illinois
UNIVERSITY OF ILLINOIS URBANA-CHAMPAIGN

2023 Seed Grant Program
Request for Proposals

DATES AND DEADLINES

- Proposal Due Date — March 24, 2023
- Award Notification — June 5, 2023
- Earliest Start Date — July 3, 2023

PROGRAM GOALS

The Cancer Center at Illinois (CCIL) is soliciting interdisciplinary team research proposals to initiate new collaborations and enhance existing collaborations among faculty. The aims of this seed grant program are to enable faculty teams to:

1. Develop novel cancer-focused research ideas that require the involvement of multiple cancer investigators from different disciplines.
2. Formulate either a hypothesis-driven or technology-focused research project that relates to one or ideally both of the CCIL research programs and their accompanying themes. *(See following descriptions of CCIL Programs)*.
3. Collect preliminary data or other relevant information to support a feasible approach for grant proposals to an NCI recognized funding agency.
4. Garner external funding for multi-investigator, program project level research projects using CCIL support as a catalyst.

The initiative will not provide interim or incremental support for existing research programs or projects. Projects should not anticipate additional internal funding after the seed funds are exhausted. We also encourage the use of CCIL Shared Resources as part of the project (*See following descriptions of CCIL Shared Resources*).

The CCIL anticipates funding up to ten (10) interdisciplinary research proposals during this cycle, based on the merit of the proposed projects, and their applicability to the goals of the CCIL.

Proposals that span the research themes of both of the CCIL research programs are of particular interests well as those that advance the work of one of CCIL's current research Working Groups: *Cancer and Microbes; Environmental Effects on Cancer; Genomic Diagnostics; Immunological Systems, Pets to People; Photoacoustics; Robotics and Interoperative Assessments; and Tumor Microenvironment*. Other areas associated with cancer research will be considered.

RESEARCH TEAM ELIGIBILITY

Proposals must reflect substantive involvement of multiple investigators from different scientific disciplines and/or academic departments.

Projects should demonstrate substantive collaboration between CCIL members and must specifically address CCIL research program strategic themes (*see program descriptions*). Proposals should include a description of the innovative nature of the research and the team's capabilities, where the contribution of each collaborator's expertise is evident. ***At least two of the team members must be current CCIL members.***

Although not limited to these topics, the CCIL is particularly interested in proposals that:

- Seek to identify novel biological targets for anticancer therapy.
- Seek to identify and/or develop new anticancer compounds.
- Develop and use improved artificial intelligence and machine/deep learning algorithms for identifying patterns in image-based or numerical-based data for diagnostics.
- Develop multi-modal, multi-scale imaging approaches (including hardware, algorithms, modeling, and simulations) that connect molecular- and cellular-scale processes in carcinogenesis with clinical tumor-, tissue-, and body-scale imaging to be used for cancer screening, diagnosis, and monitoring.
- Develop robust and reliable collection, isolation, purification, and characterization processes for extracellular vesicles (including bioassays and analysis methods to determine vesicle content).
- Utilize large genomic or proteomic data sets to derive novel biomarker targets for cancer diagnostics.
- Involve the conception and development of novel biochemistry approaches for ultra-selective recognition of biomarker molecules, especially approaches that do not require enzymatic amplification.
- Develop novel engineered models of cancer.
- Advance the work of one of CCIL's current Working Groups: *Cancer and Microbes; Environmental Effects on Cancer; Genomic Diagnostics; Immunological Systems; Pets to People; Photoacoustics; Robotics and Interoperative Assessments; and Tumor Microenvironment*.

PRINCIPAL INVESTIGATOR ELIGIBILITY

Each project will identify a lead principal investigator (PI) who assumes organizational leadership for the project. A faculty member may only be PI on one submitted project. However, there is no limit to being a co-investigator on other projects. Applicants are strongly encouraged to include faculty at the Assistant Professor rank on their teams. Priority will be given to projects for which PIs are existing CCIL members. Preference will be given to investigators who have not previously received substantial CCIL research support funding.

FUNDING EXPECTATIONS AND RESTRICTIONS

Each research team may submit proposals for up to $200,000 for up to a 2-year period. Funds will be disbursed as follows: up to $75,000 in funding for Year 1 and up to $125,000 in support for Year 2.

Funding provided by the CCIL to launch research projects is expected to be catalytic. Projects will be expected to achieve milestones and to actively seek significant external support in the form of a multi-PI research proposal to NIH, NSF, DOD, or other federal agency, industry, or foundation. Progress reports will be required at key time points, which may affect continual funding.

Year 2 funds will be released only upon the successful completion of the stated goals and metrics outlined in Year 1, which must include a collaborative proposal submission that is at least at the R01 level. A National Cancer

Institute (NCI) submission is **HIGHLY** preferred. The Cancer Center at Illinois must be listed as the institute of record for the submission.

Project costs may include UIUC supplies, staff time, and research facility use fees. Funds to be sent to other institutions or organizations must receive prior approval from the CCIL. Funds cannot be used for any part of tenure track faculty salaries.

REPORTING REQUIREMENTS

Funded projects should be prepared to provide monthly progress update meetings to the CCIL leadership/administration. Two written reports are required: (1) Year 1 Progress Report and (2) Final Project Report. Each should highlight the collaborative nature of the research, as well as address progress made toward the specific goals, milestones, and metrics. Each project PI is required to present at the CCIL Annual Retreat (on the progress of Phase 1 and Final Project).

PROPOSAL PREPARATION

Format: Proposals should not exceed seven (7) pages (single space, 0.5-inch margins, Arial 11-point font, including figures and tables). Guidelines and the maximum number of pages for each section are described below. Supplemental attachments are not permitted.

Coversheet/Title Page: This page must include the project title, the names of the research team members and their primary affiliations (indicate the lead PI), their contact information, and the funding amount requested. *(1 page)*

Proposal Content:

Section 1. Project Abstract (1 page)

- Limit length to 30 lines or less of text
- Include the project's broad, long-term objectives and specific aims
- Include a description of the research design and methods for achieving the stated goals
- Write in plain language, so even a non-scientist can understand the importance of the project

Section 2. Project Narrative (3 pages)

- Describe the research project and its cancer relevance, including its potential for broad impact. Please note the review criteria listed below
- Discuss how the proposed activities will leverage existing strengths across CCIL programs and themes
- Include a statement of the potential translational application of the research being proposed
- Describe the role and qualifications of the PI, co-investigators, and other members of the team for whom funding is requested

Section 3. Project Milestones (1 page)

- Provide a list of scientific and organizational milestones over the 2-year period

- Identify the specific goals and metrics for Phase 1 and for the completed project
    - Year 1 milestones must include significant progress toward developing a project proposal to an NCI recognized funding agency. Submission of collaborative publications is highly encouraged.
    - Year 2 milestones should include submission of collaborative publications. Submission of additional collaborative proposals is highly encouraged. The CCIL may assist the team, when feasible, in assembling the proposal and obtaining external reviews prior to submission.
    - Evidence of substantive collaboration (*including periodic joint meetings, workshops, and publications*) must be prominent in the proposal and details presented in the Year 1 progress report.

Section 4. References cited (1 page; include titles of papers)

Section 5. Budget and Budget Justification (1 page)
Provide a budget estimate, with narrative justification, that does not exceed 75,000 in funding for Year 1 and up to $125,000 in support for Year 2. Estimates should be divided into major expense categories (e.g., personnel, equipment/use fees, supplies, support). Anticipated utilization and costs of CCIL Shared Resources should be specified. Expenses for use of external shared resources in lieu of campus facilities must be specifically identified, justified, and approved.

Indirect costs and salaries for the PIs are not permissible.

REVIEW CRITERIA

Reviewers will evaluate each criterion on a scale of 1-9, consistent with the common practice for NIH applications.

Significance*:* Does the project address an important problem or a critical barrier to progress in the field? Is there a strong scientific premise for the project? If the aims of the project are achieved, how will scientific knowledge or technical capabilities be improved? How will successful completion of the aims change the concepts, methods, technologies, treatments, services, or preventative interventions that drive the field of cancer research? How will this project contribute to the CCIL scientific program(s), and support and advance the goals of the CCIL?

Investigator(s)/Research Team: Are the PIs, collaborators, and other researchers well suited to the project? If the PI is an Early Stage Investigator and/or in the early stages of their independent career, do they have appropriate experience and training? For this collaborative project, do the investigators have complementary and integrated expertise that spans the themes of the CCIL programs?

Innovation**:** Does the proposal seek to shift current cancer research paradigms by utilizing novel theoretical concepts, approaches or methodologies, instrumentation, or interventions?

Approach**:** Are the overall strategies, methodologies, and analyses well-reasoned and appropriate to accomplish the specific aims of the project? Have the investigators presented strategies to ensure a rigorous and unbiased approach, as appropriate for the work proposed? Are potential problems, alternative strategies, and benchmarks for success presented?

Milestones: Are milestones provided that ensure a high likelihood of progress? How likely is the formulation and submission of a multi-PI project application to a funding agency?

ADDITIONAL QUESTIONS?

Refer to our *Frequently Asked Questions* handout.

PROGRAM DESCRIPTIONS

Cancer Measurement Technology and Data Science (CMD) Program

Program Leaders: Stephen Boppart and Brian Cunningham

The CMD program inspires fundamental advances in measurement technologies and data science, harnessing them to accelerate cancer research and provide clinical information faster, earlier, and when needed. The CMD program's activities involves fundamental investigations into measurement and data sciences, engineering of novel technologies *(i.e., imaging and molecular measurement devices) and data tools (i.e., big data, simulation, and interventional tools),* advancement of integrated systems for point of care deployment, and development of protocols, policies, and simulation tools. The program also emphasizes introduction of concepts from other diseases to benefit cancer-related research and applications, as well as translation of cancer-inspired technologies to other diseases and applications.

Strategic Theme 1: Imaging

Bringing imaging diagnostics, especially rapid and molecularly inspired to the patient

Traditionally, diagnostic imaging is conducted in a specialized laboratory. Here, the goal is to bring diagnostic imaging closer to the patient and add information that goes beyond traditional capabilities via innovative molecular contrast, increased information content, and use of computing. The activities to advance this theme will:

- Inspire fundamental advances in theory and computational methods to enhance imaging, including higher performance of traditional clinical tools and development of new capabilities.
- Drive optical imaging technology to greater information content, faster imaging, and clinical use.
- Enable real-time, intraoperative imaging systems.
- Enable new technologies for pathology, including the development of stain-free, slide-free molecular digital histopathology and technologies for imaging the microenvironment.
- Generate the "*imaging connectome*" – foundational sets of transformations across imaging modalities, imaging physics, and imaging scales.

Strategic Theme 2: Molecular Measurement

Realizing molecular measurement technologies for early detection, treatment monitoring, and personalized therapy

Increasingly, cancer molecular analyses are revealing new biomarkers that can illuminate disease-driving mutations. Similarly, clinical studies are showing how specific biomarkers can be used to quantify the effects of chemotherapy or surgery on a tumor. Making fundamental scientific progress towards ultra-sensitive, ultra-selective, and multiplexed biosensor technologies, we envision minimally invasive, simple, frequent, and inexpensive monitoring of the cancer transcriptome. Our approach to liquid biopsy will enable routine surveillance for early detection, tailoring therapy selection to the genomic characteristics of an individual's disease and monitoring for recurrence. The goal of this theme is to utilize genomic biomarker testing in support of managing cancer through a combination of early detection, personally tailored treatment, and rapid therapy modification to shifting genomic characteristics via:

- Fundamental progress in enhanced sensing mechanisms with single molecule precision and ultra-high selectivity. We will also emphasize the development of microfluidic devices for automated extraction and

pre-concentration of nucleic acids, exosomes, and protein targets from complex sample media (*whole blood, urine, saliva, and/or stool*) as standalone technologies and adjuncts to measurement technologies.
- Development of assay methods and instrumentation to enable analysis that can be performed in point of care settings.
- Tools for monitoring the pre-cancer human transcriptome to establish personalized baselines that also inform upon the genomic effects of nutrition, behavior (exercise), and the environment.
- Association of cancer genomic response with biomarkers that measure co-morbidities (heart disease, infectious disease, liver disease) and the microbiome.
- Bringing technologies for measurements to the patient. These will include rapid point-of-care personalized detection of cancer and point-of-administration sensing of drug efficacy and wearable sensors for continuous cancer surveillance and treatment response monitoring.

Strategic Theme 3: Computational Biology and Engineering

Democratizing molecular analysis, diagnosis, and decision making by enabling state of the art computing and artificial intelligence

Computational approaches and methods undergird a significant portion of research within the CCIL. We will focus on advances in computational methods, hardware to support these efforts and the development of software for wide use in basic research and cancer applications. Our computational methods and technologies can broadly improve capabilities in modeling, measurement, and analysis. In particular, hardware advances are augmented and enhanced when computation, new performance, reliability, consistency, and accuracy are realized. Our approach is to co-develop hardware and computing systems that will revolutionize not only the availability of data, but also our capabilities to transform data to knowledge, and knowledge to diagnosis and decision making. We will also use our expertise in computing to drive collaborations that would otherwise not be possible. Activities in this theme include:

- Fundamental advances in computing, statistics, and applied mathematics that can be applied to cancer.
- Development of machine learning and artificial intelligence algorithms to provide actionable information through analysis of biomarkers, complemented by data from medical imaging, population statistics, patient genome, environmental factors, and patient medical record. Predictive AI for personalized cancer therapies and guided interventions (e.g. in robotic surgeries) will also be emphasized.
- Development of big data to knowledge software and tools, including biomarker discovery and rapid assessment of molecular targets for drug discovery.
- Computational reconstruction methods, from imaging instruments to reconstructing biological structures.
- Novel methods to store, handle and curate data.

CMD Program and theme member information can be found here.

Cancer Discovery Platforms Bridging the Engineering-Biology Continuum (CDP) Program

Program Leaders: Timothy Fan and Brendan Harley

The guiding principle of the Cancer Discovery Platforms Bridging the Engineering-Biology Continuum (CDP) Program is to develop platforms to facilitate the study of pathophysiological processes linked to cancer progression, drug efficacy, and malignant cellular vulnerabilities through the use of sophisticated model systems. We aim to develop and characterize state-of-the art platforms that model the chaos and contextual complexity of the cancer microenvironment to accelerate the identification, targeting, and validation of new anticancer therapies. Fundamental scientific inquiry and early stage development of molecules, models, and methods form the foundation of our efforts in drug discovery and translation of these discoveries to industry, expediting their application to patients.

Strategic Theme 1: Pathways and Mechanisms

Enabling biological insight, focused on cancer pathways and mechanisms tied to outcome

It is essential to leverage strengths of the CCIL to elucidate targetable pathways linked to cancer pathophysiology. Our ongoing efforts will improve mechanistic insight regarding genetic mutations, RNA regulation, as well as receptor activation and signal transduction. There are significant opportunities to leverage approaches and platforms to investigate reciprocal relationships within the tumor microenvironment related to metabolism, immune targeting, and cellular crosstalk. We are focused on advancing:

- Fundamental studies on RNA biology that relate to cancer, including lncRNA.
- Metabolic dependencies, restrictions, and adaptations.
- Connecting nutrition, lifestyle, and microbiome to cancer biology and progression.
- Cancer-immune axis and immunotherapy.
- Identifying dynamics of reparative and malignant remodeling within the tumor microenvironment.

Strategic Theme 2: Drug Discovery

Accelerating therapeutic discovery by advancing synthesis, computational discovery and high-throughput screening

The University of Illinois has long-standing expertise in organic chemistry, including natural products chemistry. Increasingly sophisticated efforts to identify targetable pathways requires innovations regarding the efficient development of next generation precision therapies against cancer, including small molecules, immunotherapies, and designer nanoparticles. We envision the integration of high-throughput screening modalities with computationally-aided acceleration of drug design to identify novel single and combination therapies against cancer.

Major directions include:

- Fundamental research into organic synthesis relevant to cancer, including that of natural products.
- Discovery of new compounds by high throughput screening and optimization.
- Systems engineering and computational acceleration of drug discovery by modeling.
- Target development through genomic and proteomic interrogation of cancer cells and tissues.

- Innovate drug delivery strategies through engineering technologies, including nanotechnology approaches.

Strategic Theme 3: Natural and Model Systems

Developing model systems for cancer research through engineered, naturally occurring, and inducible constructs

Novel therapeutic approaches are traditionally studies in two-dimensional culture or using inbred mouse models. Our approach is to validate an entirely new development pipeline to accelerate the evaluation and validation of new therapeutic interventions. We are developing multidimensional platforms that replicate cellular and microenvironmental complexity of the tumor to identify patterns of progression, invasion and metastasis, and drug resistance essential for evaluating new therapeutic drugs. Spontaneously arising and inducible veterinary oncology large animal models and technologies to leverage primary patient specimens will accelerate the evaluation of novel drug compounds.

Major directions include*:*

- Use of large animal models (*e.g., companion animals and OncoPig) to accelerate drug development).*
- Develop and translate tumor models that facilitate spatial and temporal analysis of patient biospecimens via quantitative molecular diagnostics and molecular sensing platform technologies.
- Fundamental progress in engineered platforms, especially those that replicate vascular remodeling and angiocrine signaling in the tumor microenvironment.
- Biofabrication innovations pertaining to 3D printing, microfluidic patterning, and the use of adaptable biomaterial chemistries to replicate dynamic tissue environments.

CDP Program and theme member information can be found here.

SHARED RESOURCES DESCRIPTIONS

TUMOR ENGINEERING AND PHENOTYPING SHARED RESOURCE (TEP-SR):
The Tumor Engineering and Phenotyping Shared Resource (TEP-SR) supports and advances cancer research by enabling the systematic analyses of materials spanning the gamut of cancer research, from cells to engineered models. TEP-SR makes available materials derived from cancer cells and tissues, as well as in the design and engineering of predictive tissue model systems. The primary function of the TEP-SR is to enable studies involving cells, engineered tissues as in vitro models and in the efficient use of animal models that most faithfully recapitulate the biology of diverse human cancers. The three broad functions of the TEP-SR are to:

1. Maintain state-of-the-art facilities for cell and tissue evaluation utilizing standardized protocols that are subject to strict quality control measures for both *in vitro* and *in vivo* studies,
2. Ensure rapid availability of novel pre-clinical *in vitro* tissue cultures and *in vivo* tumor models for drug screening, toxicity, mechanobiology, and mechanistic studies using emerging fabrication techniques, including 3D printing, as required by the CCIL investigators, and
3. Train students and scholars in experiments utilizing the TEP-SR and to provide expert guidance in experimental design and analysis pipeline to maximize the cost-benefit ratio.

MULTIMODAL BIOMEDICAL IMAGING SHARED RESOURCE (MBI-SR)
The Multimodal Biomedical Imaging Shared Resource (MBI-SR) coalesces access to the highly complementary suites of imaging instrumentation at the Carl R. Woese Institute for Genomic Biology (IGB) and the Imaging Technology Group (ITG) at the Beckman Institute. The organization of the MBI-SR is specifically directed to serve as a one-stop portal to cater to the multiscale imaging needs of the cancer research community at Illinois with facile access to state-of-the-art imaging instrumentation, technical expertise in the equipment, training of researchers and graduate students in their use, and guidance in experimental protocols. The MBI-SR functions are to:

1. Provide convenient access and priority in service and usage to conventional and state-of- the-art multimodal imaging instrumentation and software tools that is cost-effective with rapid turn-around times.
2. Enhance the competitiveness of CCIL members in peer-reviewed funding and high impact publications through the provision of high quality and rapid scientific results.
3. Ensure the availability of experienced and skilled staff for hands-on training to increase data acquisition and processing efficiency and quality of experimental results.

MICRO & NANOTECHNOLOGY SHARED RESOURCE (MNT-SR)
The Micro and Nanotechnology Shared Resource (MNT-SR) provides high quality micro and nanofabrication capabilities that include the most modern methods, as well as state-of-the-art nanobiotechnology facilities for cancer research. The functions of the MNT-SR are to:

1. Enable device fabrication and sensor development to study the physical nature of cancer biology, make practical devices and instrumentation that allows detection, diagnosis and discovery in cancer.
2. Provide the necessary facilities and increase awareness in the CCIL community of the opportunities for cancer-related problem solving by leveraging and application of nanoscience methodologies.
3. Coordinate the acquisition of new high-end instrumentation utilizable for cancer research.

4. Offer CCIL members cost effective service, prioritization in research endeavors, and enhance competitiveness in obtaining peer-reviewed funding.

CARVER BIOTECHNOLOGY CENTER SHARED RESOURCE (CBC-SR):

The Carver Biotechnology Center Shared Resource (CBC-SR) provides state-of-the-art instrumentation and biologic-oriented expertise to CCIL members for the quantification of cellular processes pertaining to cancer research that span the genome-proteome-metabolome continuum. The CBC-SR is comprised of six core facilities: High Performance Biological Computing (HPCBio), DNA Services, Functional Genomics, Protein Sciences, Flow Cytometry, and Metabolomics. The services and technologies available are critical for the efficient performance and cross-cutting research conducted by CCIL members in both research programs.

The functions of the CBC-SR are to:

1. Provide CCIL members with access to the state-of-the-art instrumentation and highly trained personnel at the CBC.
2. Ensure a reduction in rates for services provided by the CBC-SR for CCIL members through CCSG direct support for service contracts on the most critical and widely used equipment and services.
3. Ensure long-term financial stability and CCIL-centric service growth within the CBC to offer cost-effective and essential resources for CCIL members.
4. Ensure that this facility, which is essential for CCIL member cancer-related activities, is responsive to their instrument, technology, and service needs via regular meetings of the CCIL Associate Director for Shared Resources with CBC-SR personnel and CBC Core Faculty Advisory Committee.