The Physics 595 Research Initiative
University of Illinois at Urbana-Champaign

Request for Proposals

The Department of Physics at the University of Illinois at Urbana-Champaign (PHYS/UIUC) announces an intensive 1-year program to provide opportunities for talented graduate students to participate in research. Prospective participants are invited to submit proposals for research projects for the 2023 program.

Project Summary “white papers” are due by 5:00 P.M. CST, April 14, 2023. Full proposals are due by 5:00 P.M. CST, April 21, 2023. Proposals submitted after the deadline will not be considered.

The Initiative
The PHYS/UIUC Phys 595 research program provides resources to enable graduate students to undertake research projects in experimental, theoretical, and computational physics. Of particular interest are projects in condensed matter physics, materials science, theoretical biophysics, theoretical astrophysics, and experimental particle and nuclear physics. Proposed research projects should offer interesting, meaningful research that can be conducted without extensive background knowledge, in a 1-year time frame, and with a broad mix of appropriate techniques and methodologies. An ideal project will offer the student a chance to develop expertise in a particular area while learning techniques applicable to many areas.

Objectives of the Program
- Provide students with a meaningful experience in a first-class research environment.
- Enable students to work closely and directly with practicing researchers.
- Encourage students to develop their own “research literacy,” including familiarity with the literature, oral and written communications skills, time management, and teamwork skills.

Terms
Grants are for a 1-year period, beginning August 1, 2023. Grantees are required to provide a final presentation and a written report that:
- Summarize activities and results as they relate to the proposed objectives.
- Discuss the significance of the results.
- Recommend avenues for future work.
Grantees will participate in programmatic activities and group meetings during the 1-year grant period. Grantees are encouraged to participate in research-group and departmental seminars and colloquia.

Budget and Budget Justification
A maximum of $25,500 may be requested, of which $5,000 must be a student stipend. Other eligible expenses are equipment, materials and supplies, telecommunications, travel, publication/dissemination of results, and institutional overhead.

Institutional overhead is to be calculated at a rate of 52 percent of the modified total direct cost (MTDC) base. Student stipends and equipment costs are to be excluded from the MTDC.
A narrative budget justification of no more than one page must be included in the proposal.
Elements of the Physics 595 Proposal

Criteria
Proposals submitted under this RFP will be peer-reviewed, using the National Science Board merit review criteria. Review panels will present recommendations for awards to the Associate Head for Graduate Programs, Professor S. Lance Cooper. Selection criteria include:
- Overall scientific and technical merit of the project.
- Feasibility.
- Qualifications, capabilities, and experience of the applicant.
- Realism of the proposed project costs.
- The potential of the project to improve the student’s knowledge and skills.
- The inclusion of specific evaluation mechanisms for measuring the success of the proposed project.

Proposals
Proposals may be no longer than 9 pages and should include the following:
- Cover page—maximum one page.
- Project summary, including explicit statements regarding the “intellectual merit” and “broad impact” of the proposed work—maximum one page.
- Project narrative, including a comprehensive description of the problem to be studied, expected outcomes and how they will be measured, and a discussion of the project’s potential contribution to the applicant’s graduate education—maximum 5 pages.
- References cited—do not count toward total page limit.
- Budget and justification (use the budget categories mentioned above under “Budget”)—maximum one page.
- Proposer’s curriculum vitae—maximum one page.

Submission
Deliver an electronic copy of your proposal to S. Lance Cooper (scooper@illinois.edu), by 5:00 P.M. on Friday, April 21, 2023.

Proposal Timeline
- Project Summary ‘white paper’ submitted by Friday, April 14, 2023.
- Written proposals submitted by Friday, April 21, 2023.
- Assigned proposals will be sent to students starting on Monday, April 24, 2023.
- Awards announced by Friday, May 5, 2023.
- Project implementation to start August 1, 2023.

For further information about this RFP, contact:
S. Lance Cooper, Department of Physics
227 Loomis Laboratory of Physics
217-333-2589 • scooper@illinois.edu.

The University of Illinois at Urbana-Champaign is an equal employment opportunity employer. Proposals from women and minorities historically underrepresented in science and engineering are particularly welcome.
Requirements of the Physics 595 Proposal

Phys 595 Proposal Cover Sheet (1 page)

Cover Page (1 page)

Today  ➔  Project Summary (1 page) ('white paper’ due on April 14)

Project Narrative (5 pages)

Next class  ➔  Budget and Budget Justification (1 page)

References Cited (no limit, but keep ~ 1 page)

Next class  ➔  Curriculum Vitae (1 page)

Full proposal due 5 pm on April 21
Proposal for implementing the diffusion Monte Carlo method in investigations of few-electron systems

Ko, Wing Ho

Contact Information:

Wing Ho Ko
Loomis Laboratory of Physics
University of Illinois at Urbana-Champaign
1110 W. Green St.
Urbana, IL 61801, USA
Phone: +1-217-332-4226
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Project Summary

The application of *ab initio* methods in calculating electronic structures is an important aspect of theoretical condensed matter physics, and its importance is currently growing as the need for understanding novel materials increases. The goal of this proposed project is to investigate one *ab initio* electronic structure method known as the diffusion Monte Carlo (DMC) method. To achieve this goal, an undergraduate student will write computer programs to apply the DMC method in calculating the ground-state energies of various few-electron systems.

The project is expected to produce results that can be cross-examined with those produced for the same systems using different methods. It is also expected to produce results for comparisons between different implementations of the DMC method.

This proposed project has substantial intellectual merit for the following reasons: it provides a better understanding of the electronic structures of various few-electron systems; it gives insights for improving the DMC algorithm, without using too many computational resources; and it reveals the strengths and weaknesses of the DMC method as compared to other electronic structure methods. This project will benefit from the capabilities of the proposer, who has experience in working on similar projects. It will also benefit from the institution where the project will be carried out, where experienced faculty members in computational physics (e.g., Prof. Richard Martin and Prof. David Ceperly) can provide an extensive network for help and discussion.

The proposed project will have broader impact on the community for the following reasons: the student will acquire the skill of writing computer programs to solve physical problems and will be introduced to important concepts in theoretical physics; the results of the project will be disseminated in the form of a research proceeding, a senior thesis, a talk given in the annual undergraduate research symposium at the University of Illinois, and a talk given at the American Physical Society March 2006 meeting; attractive visualizations that can be used for educational purposes will also be produced.
This section summarizes the goals, motivations, methods to be used, and expected results in your project – this should include data and diagrams!

You should be able to generate this quickly from your already-completed introduction, procedure, and results sections!
A Good Project Narrative Should Answer These Questions (also for Research Statement in fellowship and job applications)

1. What research do you propose to do?

2. Why is this research important?

3. Why are you ideally suited to conducting this research (e.g., because of your access to personnel, experiences, and/or unique facilities)?

4. How do you plan to accomplish this research?

5. How will you know if the research is successful?

6. What is the timeline for the research?

7. What will be the benefits to the scientific community if the research is successful?
This section summarizes (in table form) your requested budget, and provides a brief justification as to why the items requested are needed for your project.

### Budget

The main component for the budget of the proposed project is the student stipend. A student stipend of $4000 is requested.

Most computational resources required for the completion of the proposed project are available through the Engineering Work Stations (EWS) maintained by the Campus Information Technologies and Educational Services (CITES) of the University of Illinois. The resources provided include compilers (e.g., GCC for C/C++) for compiling computer codes, high-level computer programs (e.g., Microsoft Excel and Mathematica) for analyzing the data, and computer storage space. However, since a large amount of data is expected to be generated, additional storage space for computer data is required; $150 fund is requested for such storage space. The storage may take the form of computer hard disk, CD-ROMs, and/or storage space in network servers.

To disseminate the results obtained in the proposed project, $600 is requested for one student’s travel, to give a talk at the American Physical Society (APS) 2006 March meeting at Baltimore, MD.

The requested fund for the items listed above is summarized in the table below:

<table>
<thead>
<tr>
<th>Item</th>
<th>Request fund (institutional overhead excluded)</th>
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<tbody>
<tr>
<td>Student stipend</td>
<td>$4000</td>
</tr>
<tr>
<td>Storage space for computer data</td>
<td>$150</td>
</tr>
<tr>
<td>Student’s travel to APS March meeting</td>
<td>$600</td>
</tr>
</tbody>
</table>

With a 43 percent institutional overhead applied to the storage space and to student travel, the total budget requested for the proposed project is $5072.50.
References Cited


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EDUCATION
2001–Present: University of Illinois at Urbana-Champaign, Urbana, IL, USA
Bachelor of Science in Physics with honors expected in May 2005
Bachelor of Science in Mathematics with honors expected in May 2005
Overall GPA: 4.0
2000: Hong Kong Certification of Education Examination
A in English Language (Syllabus B), Biology, Chemistry, Physics, Mathematics,
Additional Mathematics, and Economics
B in Chinese Language and Religious Studies
1995–2001: Diocesan Boys’ School, 131 Argyle Street, Mongkok, Hong Kong

EMPLOYMENT
2002–Present: Mentor (Mathematics), Netmath Distance Education Program, Department
of Mathematics, University of Illinois at Urbana-Champaign, Urbana, IL, USA
Summer 2004: REU (Research Experience for Undergraduates) at the University of
Illinois under Prof. Richard Martin, investigating the application of quantum Monte
Carlos methods on few-electron systems

MEMBERSHIPS AND ACTIVITIES
Vice Chairman, Science Society, Diocesan Boys’ School, 2000–2001
Chairman, Astronomy Club, Diocesan Boys’ School, 2000–2001
Member, Phi Eta Sigma National Society, University of Illinois Chapter, 2002
Participant, Physics Van, University of Illinois at Urbana-Champaign, 2002–Present
Treasurer, Physics Society, University of Illinois at Urbana-Champaign, 2003–Present

AWARDS AND HONORS
Dean’s List, College of Liberal Arts and Sciences, University of Illinois at Urbana-
Champaign, Fall 2001–Spring 2004
James Scholar, College of Liberal Arts and Sciences, University of Illinois at Urbana-
Champaign, Fall 2001–Spring 2004
Salma Wannan Memorial Award, Department of Mathematics, University of Illinois at
Urbana-Champaign, 2004
Undergraduate Outreach Achievement Award, Physics Department, University of Illinois
at Urbana-Champaign, 2004
Lorella M. Jones Summer Research Fellowship, Physics Department, University of Illinois
at Urbana-Champaign, 2004