**GENERAL INFORMATION**

Program sponsor: Princeton Environmental Institute

Position number: E1GOL2

Project title: Unattended Flow Monitor for Gas Centrifuge Enrichment Plants

Organization/research group: Woodrow Wilson School Program on Science and Global Security

Primary location(s) of internship: Los Alamos National Laboratory, New Mexico

Additional cities and/or countries to be visited (if applicable): n/a

**Note:** If this internship is located in a country with an International SOS risk rating of High or Extreme, final candidates must participate in a travel review process overseen by the Travel Oversight Group (TOG), and obtain safety guidance prior to departure. The University reserves the right to revoke support and funding for travel at any time there has been a significant deterioration in the safety and security conditions surrounding travel arrangements, or in the sector of the country, or countries, where travel is to occur.

**FACULTY SPONSOR(s)/HOST INFORMATION**

Name(s): Robert J. Goldston

University Department(s): Astrophysical Sciences

E-mail: rjg@princeton.edu

Phone: 609 369 0279

Website:

**INTERNSHIP/RESEARCH PROJECT INFORMATION**

Internship/project description:

One of the main challenges for nuclear non-proliferation is the fact that large Gas Centrifuge Enrichment Plants can be rapidly reconfigured to produce large quantities of highly-enriched uranium for use in nuclear weapons. A key to preventing this is to have unattended monitoring systems that can report to the International Atomic Energy Agency (IAEA) in real time on the flows of uranium hexafluoride gas in piping within the plants, since these flows must be significantly modified to produced highly-enriched uranium. We have developing a non-intrusive method to measure these flows, as required by enrichment plant operators. If the surface of a pipe is heated by only a few watts, the temperature rise on the pipe's surface, as it turns out, is strongly dependent on the mass flow rate in the pipe, even for very tenuous gases. We will test this in a specially designed set-up at the Los Alamos National Laboratory this summer.

Student's role and responsibilities:

An undergraduate student would participate in measurements on the experimental set-up at LANL, as well as work with LANL staff on advanced computational simulations of turbulent mass and heat flow within the pipe, as well as heat flow within the pipe metal, and to the outside world through insulation.
**Internship/project learning objectives:**
The student will gain understanding of turbulent heat flux and its simulation, as well as experimental instrumentation and control. The experiment will be in its early phases, so they will also learn about how such experiments are optimized to provide clear scientific results.

**PROGRAM REQUIREMENTS**

**Academic background and any course pre-requisites:**
A course that included understanding of turbulent fluid flow would be valuable. If the student were to take AST 309, they would gain knowledge of the role of Gas Centrifuge Enrichment Plants in nuclear proliferation.

**Technical skills:**
No special skills are needed.

**Additional training(s):**
Appropriate safety training will be provided at Los Alamos

**Equipment:**
Student should bring their own laptop.

**Physical demands:**
None.

**Language abilities/competencies (if applicable):** n/a

**Please list any other information you would like to share with potential applicants about the internship/project:**
This experiment, if successful, could lead to tests in a Gas Centrifuge Enrichment Plant in Capenhurst, England, and ultimately to installation by the IAEA in facilities around the world... including Iran. Selected student will be required to complete lab safety training prior to the start of the internship.

**INTERNATIONAL TRAVEL REQUIREMENTS** (if applicable)

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<thead>
<tr>
<th>Visa(s) required?</th>
<th>Research permit/pass required?</th>
<th>Immunizations required?</th>
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<tr>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
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**INTERNSHIP/PROJECT SUPERVISOR(S)**

**Name and title of primary supervisor:** Rollin Lakis
**Email:** rlakis@lanl.gov
**Phone:** (505) 665-9814

**Name and title of additional supervisor, if applicable:** n/a
**E-mail:** Phone:

**PROGRAM DATES AND FUNDING INFORMATION**

<table>
<thead>
<tr>
<th>Weekly Stipend: $500</th>
<th>Number of Positions Available: 1</th>
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<tbody>
<tr>
<td>Tentative Start Date (mm/dd/yyyy): flexible</td>
<td>Number of Weeks: 8-10</td>
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<tr>
<td>Tentative End Date (mm/dd/yyyy): flexible</td>
<td>Note: PEI funding is for full-time work, 35 hours per week minimum, and for a period of at least 8 continuous weeks.</td>
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**Application Deadline:** January 11, 2019