

Science Undergraduate Laboratory Internships (SULI)

Summer 2022 - Application for: Denis Furletov

APPLICANT PROFILE

General Applicant Information

First Name: Denis

Middle Name:

Last Name: Furletov

Previous Last Name(s):

Primary Email Address: denis.furletov@gmail.com

Alternate Email Address 1: dfurletov@wm.edu

Alternate Email Address 2:

ORCID: [0000-0002-2238-8857](https://orcid.org/0000-0002-2238-8857)

Current Address

Primary Phone Number: 757-753-9789

Alternate Phone Number:

Citizenship/Languages/Eligibility Information

I will be 18 years of age or older by the time the internship begins: Yes

Are you a U.S. Citizen? No

Are you a Lawful Permanent Resident? Yes

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EDUCATIONAL BACKGROUND

Academic Information

Are you currently attending a community college or 2-year college?

No

Current academic status:

Freshman

If you are selected as a participant in this DOE program, will you receive academic credit from your university/college for participating?

No

Undergraduate Institution Information

College/University Country: United States and U.S. Territories

College/University State/Province/Territory:

Virginia

College/University Name: College of William and Mary

College/University Address: Sadler Center, 200 Stadium Dr

College/University City: Williamsburg

College/University Zip Code: 23187-8795

Expected/Declared Major:

- Physical Sciences - Physics
- Computer Sciences and Information Technology

Minor and/or Concentration Expected/Declared:

Mathematics

Expected Degree From This College/University:

Bachelor's

Expected/Completed Graduation Date:

June / 2025

Transcript: Academic Transcript.pdf

Does this institution provide grades? Yes

GPA Scale: 4.0

Total Attempted Credits: 15.00

Total Earned Credits: 15.00

Total Quality Points: 57.20

GPA: 3.81

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Science, Technology, Engineering and Mathematics (STEM) Courses

Course Title: Data Structures

Course Number: CSCI241

Enrollment Status: Recently Completed

Course Title: Discrete Structures of CSCI

Course Number: CSCI243

Enrollment Status: Planning to Enroll

Course Title: General Physics I - Honors

Course Number: PHYS101H

Enrollment Status: Recently Completed

Course Title: General Physics II Honors

Course Number: PHYS102H

Enrollment Status: Planning to Enroll

Course Title: General Physics II Lab

Course Number: PHYS102L

Enrollment Status: Planning to Enroll

Course Title: General Physics-Lab

Course Number: PHYS101L

Enrollment Status: Recently Completed

Course Title: Linear Algebra

Course Number: MATH211

Enrollment Status: Planning to Enroll

Course Title: Multivariable Cal/Sci & Math

Course Number: MATH213

Enrollment Status: Recently Completed

Course Title: Reading@Russia

Course Number: CSCI100

Enrollment Status: Recently Completed

Course Title: Stellar Astronomy & Cosmology

Course Number: PHYS172

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Enrollment Status: Planning to Enroll

Awards or Honors

Award Title: AP Scholar with Distinction

Month & Year Received: June / 2021

Awarding Institution: College Board

Award Title: Advanced Studies Diploma

Month & Year Received: June / 2021

Awarding Institution: Tabb High School

High School Graduation or GED

Date of High School Graduation or GED: June / 2021

Country: United States

City: Yorktown

State/Province/Territory: VA

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WORK EXPERIENCE & SKILLS

Work Experience

Name of Place of Employment or Activity:	Highschool JLab Mentorship
Dates of Employment or Activity:	From 9/1/2020 To 5/1/2021
Hours Per Week:	5.0
Primary Duties:	Designing/Programming model for machine learning in Keras for particle tracking in GlueX experiment
Tasks Performed:	design outline for data preprocessing code model for keras interpret results and change model to improve results

Professional Associations

Are you a member of any professional organizations?	Yes
Professional associations you are affiliated with:	Society of Physics Students

Computer Skills

Computer related skills:	Languages: C++/C, Java, Python, HTML/CSS, Javascript, Shell. OpenCV for image recognition/manipulation Keras in Python JupyterNotebook for Machine learning of Particle Tracking Geant4 and ROOT to reconstruct and run simulations for Keras. Knowledge of Linux, Windows, and Mac OS. Raspberry Pi and Arduino experience (with various sensors and electronics) 3D Printing/Designing (CAD)
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Laboratory/Technical Skills

Experience with advanced laboratory techniques or equipment:	Multimeter, Oscilloscope, Soldering Iron, CAD, LTSpice for circuits.
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PROGRAM INFORMATION

Eligibility

Have you previously participated in 2 SULI appointments? No

Previous DOE Internship/Fellowship or Lab Activity Experience

Have you ever had an internship/fellowship with the Department of Energy or any of its National Laboratories (such as SULI, CCI, VFP) or attended an activity at one of the National Laboratories (such as a Mini-Semester or Sustainable Research Pathways)? No

Availability

What is the earliest date you can begin your internship? 6/1/2022

When do you need to complete your internship? 8/20/2022

First Choice Host DOE Laboratory

DOE Laboratory: Thomas Jefferson National Accelerator Facility (TJNAF)

First Choice Research Area: Nuclear Physics

Second Choice Research Area: Computer Science and Technologies

Third Choice Research Area: High Energy Physics

Second Choice Host DOE Laboratory

DOE Laboratory: Brookhaven National Laboratory (BNL)

First Choice Research Area: High Energy Physics

Second Choice Research Area: Computer Science and Technologies

Third Choice Research Area: Particle Astrophysics

Relatives Employed at DOE Laboratories

Are you a relative of an employee at the proposed host DOE laboratories? Yes

Name: Sergey Furletov

Relationship: Father

DOE Laboratory: Thomas Jefferson National Accelerator Facility (TJNAF)

Name: Yulia Furletova

Relationship: Mother

DOE Laboratory: Thomas Jefferson National Accelerator Facility (TJNAF)

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ESSAYS

Research Experience:	<p>Last year when I was a senior in High School, I had a JLab mentorship. My mentor worked in the GlueX experiment and we focused on analyzing its data. This experiment's detector has a wire chamber of 24 stereo layers which return a hit at a position when a particle flies through it. The method of reconstructing the track when there were many tracks in one data set is called a Kalman filter. This method takes up lots of CPU resources and runs for a long time. Thus, the main idea was to reconstruct a track using machine learning, and thereby be less CPU intensive or at least shift it to a GPU. Using Python with Keras for the machine learning training, I initially worked with simplified, generated data. I used various neural networks: Deep Neural Network (DNN), Convolutional Neural Network (CNN), Recurrent Neural Network (RNN), etc. - to compare performance and see which input/output shapes are best. This simplified data was in the (x,y,z) coordinate system, by inputting the previous point's position coordinates and momentums, predict the next point in the track. After learning the basics I switched to using real data from the detector. This data was less intuitive, since it was not in the cartesian system, it had various input parameters given for each layer in the detector. Then I used an RNN approach, feeding in the parameters for each layer, and retrieving recursively, then outputting the parameters that describe the track. The work would take longer than the mentorship lasted, but we learned that in general RNNs work well for next hit prediction. I continued a similar project over the summer. Using Geant4 to generate a set of tracks and then using a GNN (Graph Neural Network) to predict the parameters of a tracks without knowing each track beforehand, which is what I am still working on.</p>
Research Interests:	<p>In High School, I was very interested in science classes, especially physics, and am now planning to major in it in college. In my senior year in High School, I applied for a mentorship at JLab, and since then became interested in particle physics. In mentorship, I joined a group that was working on the application of machine learning for particle physics analysis. Through this mentorship I learned more about machine learning and its connection with physics, and would like to continue in this area. I've been learning to use Monte Carlo simulation using Geant4 and data processing with ROOT, to run simulation for my machine learning projects and wish to work on improving various algorithms using neural networks.</p> <p>In addition to my enjoyment of programming and sciences, in my free time I like doing engineering and hands on work, mainly robotics. I was part of an FRC Team (FIRST Robotics Competition) and that is when I began learning programming. On that team, I worked on creating my own target detection and positioning system for the robot using a Raspberry Pi running OpenCV library receiving data from a camera. Currently, I am one of the mentors of that team.</p> <p>I would also love to apply my machine learning and engineering knowledge for experimental physics and detector designs.</p>
Personal Experience:	<p>I've always loved the STEM field and enjoyed every single STEM class I've taken so far. I took most, if not all, STEM AP Classes offered by my High School, and am continuing to advance my knowledge in college.</p> <p>Neural networks and machine learning are expanding in every field, and I believe applying it to parts in physics would advance a lot of the fields of research.</p> <p>I have a lot of experience in programming, which I began learning heavily in 9th grade, by applying it to computer vision on the robot in my FRC Team (FIRST Robotics Competition). The two languages I know the best are Python and C++ (C style). I also have experience in mechanical work in FRC/FTC (FIRST Tech Challenge) which is similar to FRC just lower scale. I designed most of the robot parts in FTC, and used CAD to 3D print various parts. I also used microcontrollers such as Arduinos and Raspberry Pis to control various parts of other robots and their sensors. I believe my experience will transfer well to the research in SULI.</p>
Professional Goals:	<p>I am hoping to make my career in research physics. I believe for the career in research, an internship would be most similar to the real field. It would allow me to understand more of what the field is and what I need to focus on and learn in college. I'm interested in physics with computer science and engineering, which is similar to what all of these laboratories provide. I hope throughout this internship to better my experience in those fields. Experimental physics seems to be the best place to apply all three of these subjects in unison. This internship will allow me to use all of my skills to work on large scale problem solving. I am planning to obtain a Ph.D. in physics and work in research. Furthermore, I would learn more about computers and robotics as a hobby as I have done so far. Since currently I am only a freshman in college, my knowledge of nuclear and particle physics is limited, I am hoping to learn more on the subject through this internship and also improve my machine learning understanding to be able to apply it to more problems.</p>

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RECOMMENDATIONS

Recommendation 1: **First Name:** David
Last Name: Lawrence
Email: davidl@jlab.org
Status: Received 1/5/2022

Recommendation 2: **First Name:** Eric
Last Name: Walker
Email: eric.l.walker@nasa.gov
Status: Received 1/5/2022

The College of William and Mary -- Web Transcript

931072939 Denis Furletov
Jan 11,2022 11:38 am

 This is a Web self-service transcript for student use. Courses which are in progress may also be included on this transcript.

[Transfer Credit](#) [Institution Credit](#) [Transcript Totals](#) [Courses in Progress](#)

Transcript Data

STUDENT INFORMATION						
Name : Denis Furletov						
Curriculum Information						
Current Program						
Bachelor of Arts						
College: Faculty of Arts and Sciences						
Major and Department: Undeclared, Undergraduate Advising						
***Transcript type:WEB is NOT Official ***						

TRANSFER CREDIT ACCEPTED BY INSTITUTION						
-Top-						
Fall 2021: Advanced Placement Credit						
Subject	Course	Title	Grade	Credit Hours	Quality Points	R
CHEM	103	General Chemistry I	T	3.000		0.00
CHEM	103L	General Chemistry Lab I	T	1.000		0.00
CSCI	141	Computational Problem Solving	T	4.000		0.00
ENGL	1XX	Transfer Elective Course	T	3.000		0.00
MATH	111	Calculus I	T	4.000		0.00
MATH	112	Calculus II	T	4.000		0.00
			Attempt Hours	Passed Hours	Earned Hours	GPA Hours
Current Term:			0.000	0.000	19.000	0.000
						Quality Points
						GPA
						0.00

Unofficial Transcript

INSTITUTION CREDIT						
-Top-						
Term: Fall 2021						
Additional Standing: Dean's List						
Subject	Course	Level	Title	Grade	Credit Hours	Quality Points
CSCI	100	UG	Reading@Russia	A	4.000	16.00
CSCI	241	UG	Data Structures	A	3.000	12.00
MATH	213	UG	Multivariable Cal/Sci & Math	B+	4.000	13.20
PHYS	101H	UG	General Physics I - Honors	A	3.000	12.00
PHYS	101L	UG	General Physics-Lab	A	1.000	4.00
Term Totals (Undergraduate)						
			Attempt Hours	Passed Hours	Earned Hours	GPA Hours
Current Term:			15.000	15.000	15.000	15.000
Cumulative:			15.000	15.000	15.000	15.000
						Quality Points
						GPA
						3.81

Unofficial Transcript

TRANSCRIPT TOTALS (UNDERGRADUATE)						
-Top-						
			Attempt Hours	Passed Hours	Earned Hours	GPA Hours
Total Institution:			15.000	15.000	15.000	15.000
Total Transfer:			0.000	0.000	19.000	0.000
Overall:			15.000	15.000	34.000	15.000
						Quality Points
						GPA
						3.81

Unofficial Transcript

COURSES IN PROGRESS						
-Top-						
Term: Spring 2022						
Subject	Course	Level	Title	Credit Hours		
CHEM	150	UG	Great Discoveries			4.000
MATH	211	UG	Linear Algebra			3.000
PHYS	102H	UG	General Physics II - Honors			3.000
PHYS	102L	UG	General Physics-Lab			1.000
PHYS	172	UG	Stellar Astronomy & Cosmology			3.000

Unofficial Transcript

SULI PROGRAM APPLICATION RECOMMENDATION FOR DENIS FURLETOV

Recommender Contact Information

- **First Name:** David
- **Last Name:** Lawrence
- **Title:** Dr.
- **Department:** CST
- **Institution/Organization:** Jefferson Lab
- **Telephone:** 757-746-6697
- **Email:** davidl@jlab.org

Applicant Information

Association

Describe your relationship to the applicant, including how long you've known the applicant, where, and in what capacity.

I have known Denis for several years through his parents who are both colleagues of mine. However, I was first able to work closely with him during the 2020-2021 academic school year while mentoring him on his senior project for High School. The project lasted for several months (most of the academic year) where we had regular, weekly meetings.

Applicant Comments

Please provide substantive comments about the applicant's education, training, aptitude, or promise relevant to the SULI program. Include any relevant additional detail or perspective regarding the applicant's research experience or equivalent experience on complex projects, including the level of independence or other factors that would contribute to the applicant's ability to make an excellent contribution to the SULI program.

Denis is a very gifted young man. I have worked with a number of students in the past ranging from Middle School to PhD graduate students. I have no hesitation in placing Denis in the top 1%. He is very quick to pick up on new concepts. He does an excellent job of working independently, yet is still able to collaborate well within a group. He communicates very well and is eager to do work on projects and tasks assigned to him. The specific project he worked on dealt with training an A.I. regression model to reproduce charged particle tracking parameters from data taken as part of the GlueX experiment. It was a complex problem and Denis came into it with basically no knowledge of the tools he needed to work on it. Tensorflow, Jupyterhub, and Google Collaboratory as well as the Linux Command Line interface are all things he had to first learn and then apply in order to make progress on the project. He worked on architecting several different model types including MLP(Multi-layer Perceptron) and LSTM (Long Short-term Memory). I have worked with SULI students at JLab in the past. There is absolutely no doubt in my mind that Denis will thrive in that environment and be very successful in that program.

Applicant Rating

In comparison to other undergraduate students, please rate the applicant relative to his/her peers on the following qualifications:

	Do Not Know	Below Average	Average	Above Average	Superior
Analytical and Mathematical					X
Experimental Research					X
Overall Academic					X
Initiative and Self Reliance					X
Motivation toward Scientific Career					X
Originality of Thought					X
Emotional Maturity					X
Ability to Work with Others				X	
Potential for Leadership				X	
Oral Communication Skills				X	
Written Communication Skills				X	

SULI PROGRAM APPLICATION RECOMMENDATION FOR DENIS FURLETOV

Recommender Contact Information

- **First Name:** Eric
- **Last Name:** Walker
- **Title:** Chief Engineer for Test Operation Excellence
- **Department:** Research Directorate
- **Institution/Organization:** NASA Langley Research Center
- **Telephone:** 757-604-2845
- **Email:** eric.l.walker@nasa.gov

Applicant Information

Association

Describe your relationship to the applicant, including how long you've known the applicant, where, and in what capacity.

Denis was a student on the NASA Knights FIRST Robotics Competition Team (FRC 122) from 2018-2021 and is now one of the team Mentors. I have been a mentor on 122 since the 2019 season and am now a lead mentor for the team. Denis was one of the students that I worked with one-on-one during my first three years as a mentor. The team met about once a week in the fall and 4-5 times a week in the spring during the active build and competition seasons. FRC 122 is a community based robotics team that meets at one of the Virginia governor's schools and draws top tier students from across 5 school districts (up to 45 minutes away). Denis was working on the programming team and was specifically responsible for the computer vision system for the competition robot. My role was initially as a programming and mechanical mentor and has grown to be one of the lead mentors for FRC 122.

Applicant Comments

Please provide substantive comments about the applicant's education, training, aptitude, or promise relevant to the SULI program. Include any relevant additional detail or perspective regarding the applicant's research experience or equivalent experience on complex projects, including the level of independence or other factors that would contribute to the applicant's ability to make an excellent contribution to the SULI program.

Denis is well above average from an academic perspective. He has taken advanced courses throughout high school and has demonstrated a good understanding of physical and mathematical principles from his ability to apply those principles to solve practical problems. In addition, Denis can work independently with little direction. Once he understands what is needed, he does the research and develops a solution. For example, Denis developed a computer vision (CV) system for FRC 122 that was built from base components and a Raspberry Pi. He also developed the software portion of the CV system by incorporating open-source libraries such as OpenCV.

Denis works well with others as evidenced by efforts undertaken to integrate the CV system into the robots main control system to assist in short term fully autonomous control or in an augmented user assisted mode like range finding and targeting. He is also demonstrated his leadership by returning as a team mentor during his first year of College at William and Mary.

Aside from his technical skills, Denis is easy to work with, well-mannered, respectful, and even tempered. He approaches problems with a tenacity to find a reasonable solution and will keep pressing until it is workable. Denis does not easily declare defeat. He also has a way of presenting the problem and solution so that others can understand why the solution works.

Denis is well respected by the other mentors and his peers because he is willing to put in the time and effort it takes to get things done. I am honored that he has continued to remain involved with our robotics team. Denis is a highly capable individual and would be an asset to the SULI program. He has my full recommendation.

Applicant Rating

In comparison to other undergraduate students, please rate the applicant relative to his/her peers on the following qualifications:

	Do Not Know	Below Average	Average	Above Average	Superior
Analytical and Mathematical					X
Experimental Research					X
Overall Academic					X
Initiative and Self Reliance					X
Motivation toward Scientific Career					X
Originality of Thought					X
Emotional Maturity					X
Ability to Work with Others					X
Potential for Leadership				X	
Oral Communication Skills				X	
Written Communication Skills				X	