

# Application Summary

## Competition Details

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**Competition Title:** 2021 Faculty Award for Academic Outreach

**Category:** Institutional Awards - CTL

**Award Cycle:** 2021

**Submission Deadline:** 02/28/2021 11:59 PM

## Application Information

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**Submitted By:** Chandra Raman

**Application ID:** 5929

**Application Title:** Chandra Raman

**Date Submitted:** 02/28/2021 12:52 PM

## Personal Details

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**Applicant First Name:** Chandra

**Applicant Last Name:** Raman

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**Phone Number:** (404) 441-2263

### Primary School or Department

School of Physics

**Primary Appointment Title:** Professor

## Application Details

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### Proposal Title

Chandra Raman

February 27, 2021

Center for Teaching and Learning  
Georgia Tech

Re: Academic Outreach Faculty Award Nomination letter for Chandra Raman

Dear Award Selection Committee:

I am very pleased to nominate Professor Chandra Raman for the Academic Outreach Faculty Award this year. Chandra is a passionate teacher and researcher who has made tremendous strides in connecting university research to the K-12 community. In addition to giving lectures and participating in symposia with local area middle students and teachers, he has been a strong and active participant in the CEISMC GIFT program, where he won the Paul A. Duke GIFT Mentor Award last year. To me this is an indication that his activities are having a strong impact in the community outside of Georgia Tech, a key aspect of this award.

I should mention that Chandra's area of research, quantum physics, is growing in importance at Georgia Tech with new faculty hires and initiatives planned. In 2018 Congress passed the National Quantum Initiative in 2018 which aims to "expand the number of researchers, educators, and students with training in quantum information science and technology to develop a workforce pipeline". In my view, Chandra's K-12 outreach and efforts to bring research to the public are an excellent way to serve this national mission—by creating quantum physics research traineeships and, more broadly engaging with middle and high school teachers and students, he is raising the awareness of "quantum" as a career choice for STEM students at the high school level, which is critical for Georgia Tech's future success in this area. He also engages extensively in undergraduate research in his laboratory, having participated in the School of Physics summer REU program, and several of his students have received PURA (Presidential Undergraduate Research Awards).

Chandra is very passionate about inclusivity and equity in all aspects of university life. As an example of this, our department nominated him for the 2020 Ralph and Jewel Gretzinger Moving the School Forward Award for his efforts to improve the gender diversity in hiring on the campus. He has also served as a mentor to several of our graduate students to help them address mental health and disability issues affecting their classwork. As the supporting material clearly shows, he brings this inclusive vision to his outreach efforts, aiming always to create a warm and welcoming environment for visitors to his laboratory.

In summary, Chandra is a leader in outreach and an ideal candidate for this award. He has my highest recommendation for it. Please do not hesitate to contact me if you have any questions,

Sincerely,



Michael F. Schatz  
Professor and Interim Chair

## **Nomination of Professor Chandra Raman for Faculty Award for Academic Outreach 2021**

1. (Page 1) Nomination Letter—Professor Michael Schatz, Interim Chair, School of Physics, Georgia Tech
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4. (Pages 7-8) Letter of Support by Rajini Sundararaj, Physics/Environmental Science Teacher at Martha Ellen Stilwell School of the Arts
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## Chandra Raman Academic Outreach Statement

I love explaining complex science in terms that a beginner can grasp. Whether I am teaching introductory courses in Physics such as Electricity and Magnetism and Modern Physics, or engaging undergraduates in research in my laboratory (I have supervised 21 in my tenure at GT), I find the experience exhilarating and fun. Outreach to K-12 schools is a real passion of mine, and Georgia Tech has given me great opportunities to engage in it through lectures and videoconferences, as well as lab tours and summer internships for teachers. As a faculty member trying to balance the daily demands of research and teaching, I find outreach to be a breath of fresh air. I strive to make my outreach activities as impactful and engaging as possible. As an example of this, in 2020 I won the Paul A. Duke GIFT (Georgia Intern Fellowships for Teachers) Program Mentor Award from CEISMC for mentoring a high school teacher summer intern, Rajini Sundararaj, and her rising senior student, Keshawn Kelley, from Stilwell School of the Arts in Clayton County, Georgia, a school with a significant underrepresented minority population in STEM. This activity has had a ripple effect on the school and community and is especially suited to this award. Keshawn, who is a young African American man who participated through Georgia Tech's R.E.A.L. program (Research, Experiment, Analyze and Learn), taught me a lot during the summer about his experiences both inside and outside the classroom. At the end of the internship, he wrote to me an email that said

*“First, I would like to say thank you for mentioning me on your lab website. It is such an honor to be displayed and associated with your work in and out of the lab. Secondly, I would like to, once again, thank you for the opportunity to work with you and your amazing graduate research team. Although you could have easily decided not to, you opened your lab and office to Mrs. Raj and I to allow us to gain experience beyond our usual learning environment. For this reason, I would like to let you know how appreciative I am for your consideration. Your intellectual character and kindness made this summer such a wonderful experience.”*

For my part I felt the experience was humbling, as I realized how important it was to create an inclusive, welcoming environment to influence a person's journey through science. It resonated with my own experiences as an ethnic and racial minority, a first-generation immigrant to Los Angeles, which is a city with many parallels to Atlanta. For instance, I was the first member of my high school to attend Caltech, although it was only 25 miles away from my hometown. This experience made me especially invested in outreach in order to bridge the gap between the K-12



**Figure 1:** (A) A photo of me with Rajini Sundar, a high school teacher summer intern who visited the Raman Lab for 7 weeks in 2019, taken at the end-of-summer GIFT celebration luncheon, where CEISMC featured our lab in a special “highlights” video—see <https://youtu.be/4dGzgggYins>. (B) High school rising senior Keshawn Kelley socializing with members of the Raman Lab during one of several “group lunches”. (C) Keshawn’s poster presentation on the Doppler Effect as observed in atomic vapors.

community and research endeavors at Georgia Tech. I often serve on Institute and College level committees at Tech where I aim to bring a greater focus on inclusivity that can address this issue.

**Undergraduate Research.** I have been very fortunate to train a number of talented undergraduates during my time at Georgia Tech (21 in all), many of whom have gone on to graduate school and several of whom have received prestigious PURA (President Undergraduate Research Awards). Most recently, since 2016, I have had 6 students working on projects related to quantum physics research, including work on lasers, Bose-Einstein condensation, direct digital synthesis of radiofrequency waveforms and electronics. Of the 6 most recent students, 2 were women, one received a PURA, and another participated through the School of Physics REU program and presented a poster based on her research in the SURE Research Symposium at UT Austin in 2018. A third student, prior to attending graduate school, became a physics high school teacher in the Rockdale Magnet School in the Atlanta area.

**Summer Research Experience.** Summer internships are a key opportunity to bring the ideas and concepts of university research into the larger community. In 2019 I sponsored a particularly impactful summer research internship in partnership with CEISMC (see Figure 1 above). As shown below, my activities have created a ripple effect through the school system and are especially relevant for this award's criteria, since they i) made a significant impact on both the teacher and her students, ii) produced multiyear benefits and iii) reached beyond the Georgia Tech laboratory.

As has been mentioned earlier, Rajini and Keshawn spent 7 weeks in the Raman Lab through the GIFT and the R.E.A.L. programs of CEISMC. At the farewell luncheon, CEISMC featured our lab in a special "highlights" video where they interviewed Rajini—see <https://youtu.be/4dGzgggYins>. The impact of this internship period has been immediately felt in the Stillwell School—Keshawn's summer project earned him first place in his division at the Clayton County Science and Engineering Fair held in February 2020, advancing both him and another student to the state fair held in Athens where they won two further awards—the NASA Earth System Science and UGA Physics & Astronomy Department Awards. They also received invitations to compete in the International Science and Engineering Fair held in Anaheim, California from May 10-15, 2020. Far from being a one-off activity, my outreach efforts through Georgia Tech have continued to impact the school after the internship--from my interactions with Rajini through the year, I discovered that two more students from her school have also advanced to the state fair and international competition. Through developing demonstrations in the course of this internship, Rajini also developed an action plan for incorporating them into the classroom setting as part of an effort to meet the Georgia Standards of Excellence (GSE) and Next Generation Science Standards (NGSS).

What was the key to my lab's success in this outreach effort? I believe there were two factors--i) we adopted a new framework that broke down traditional ideas about a summer research experience, and ii) my group participated intensively in the internship in order to make it impactful. I describe these two below.

- i) In a traditional approach to summer research, visitors might work on a specialized, mini-project that facilitates a particular experiment ongoing in the lab. By contrast, we decided to create, in this 7-week mentorship program, a more curriculum-centered experience for the instructor. In this way we could best connect the NSF-funded research going on in my laboratory with classroom activities that high school students can engage with, particularly those incorporating low-cost materials. To do so, we focused on developing a few simple demos that explain the physics *behind* our laboratory experiments. For example, to help explain the Doppler effect in the interaction of light with atoms, we developed a project exclusively dealing with how the Doppler effect is manifested in the natural world. In this way we could connect the students back in the school with the lab research without needing all the Georgia Tech lab equipment to

be present. For instance, we created a demo utilizing sound waves emitted and received by two smartphones, with an audio spectrum analyzer app that could detect changes in sound frequency due to motion of the source (a graduate student running with the phone, for instance). Another example paralleled the Coriolis-induced phase shift of atomic matter waves under rotation through mechanical deflection of a ball on a rotating disk. A third example utilized an air gun to shoot pellets through a cardboard tube, a parallel to how atoms emerge from a capillary array in an atomic beam oven, a common device in our laboratory. Rajini also developed a simple electronic circuit incorporating an amplified piezo microphone that displayed sound waves on an oscilloscope and planned to teach the students to build this circuit in her science class.

- ii) A second reason for the success was the intensity of my group's participation. I decided the outreach effort had to be thoroughly integrated in my lab's research, so we set up weekly meetings between the visitor and her summer high school intern and myself similar to weekly meetings I have with my graduate students. These meetings supplemented the visitors' daily interactions with graduate students in the lab where a) the physics was explained in depth, and b) ideas for demos were tested with lab instruments. Many ideas were shared between our group and the summer visitors and the overall experience was very rewarding for both.

I also decided to use the opportunity presented by Rajini's presence on the campus to expose her to introductory physics being taught over the summer and arranged with the course instructor, Eric Murray, for her to visit his lecture. The idea was to identify and to address potential curricular gaps between high school and college physics, particularly relevant for students coming from under-privileged backgrounds. This idea is a seed that I plan to expand upon for future outreach opportunities and has the potential to greatly impact our undergraduate physics teaching.



**Figure 2: A student from Renfroe Middle School's 7<sup>th</sup> grade discovers for herself how polarizers work while other students and the teacher look on. I gave a presentation on what one might find in a typical laser laboratory during the 2019 Science Showcase.**

**Direct Outreach to Middle Schools.** I routinely engage in K-12 outreach activities, particularly at the middle school level where students are just beginning to gain an appreciation of science. For example, as a Decatur area resident I am particularly well plugged into the City Schools of Decatur system for local "Science Showcase" Symposia. I am a quantum physicist who uses laser cooling to produce ultralow temperature gases that are only a millionth of a degree above absolute zero. I was asked to give a presentation about my job to the students, which I entitled "The coldest places in Georgia". Most of the students had never heard of laser cooling before, so I gave them demonstrations of typical items from a laser laboratory. In one demo, I aimed a laser pointer down at a DVD disc, with air freshener spray creating a spectacular light show emanating from the DVD surface, which acts as a diffraction grating. However, the most effective demos were where the students could explore the science on their own, for example, seeing how the transmission of light through crossed polarizers depends on their relative orientation (see Figure 2 to the left).



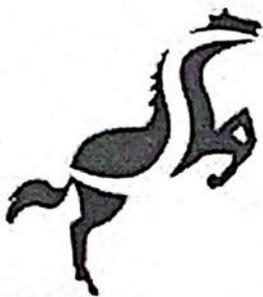
**Figure 3:** Screenshots from a virtual science lecture I gave to an 8<sup>th</sup> grade class in Ellijay, Georgia that used elements from my research laboratory such as high power lasers, thus integrating teaching and research.

For schools that are too remote to visit, I have engaged in videoconference lectures through the D2D Discovery Program. The screenshots from Figure 3 above show a science lecture that I gave to an 8<sup>th</sup> grade class at Clear Creek Middle School in Ellijay, Georgia, a town located 1½ hours north of Atlanta. It emphasizes how I use demonstrations both from my own experimental research as well as from the outside world to convey key concepts--in the lecture I was explaining Rayleigh scattering from air molecules using light from a powerful solid-state laser from my lab and how it depends on the laser polarization. K-12 outreach has changed the way I teach undergraduates and graduates at Georgia Tech, too, as I find out how to make connections that help students to appreciate science, to want to learn more, in addition to enabling their mastery of core concepts.

**Integration of Research and Education.** I have several federally funded research grants falling under the umbrella of the National Quantum Initiative (NQI), which aims to make the United States a global leader in quantum information science and its technology applications. Key to this effort is creating a quantum-smart future workforce, for which a bottom-up approach is needed to train K-12 students in quantum physics. As a key player on the campus in this educational effort, I have partnered with CEISMC to bring middle and high school teachers to my lab for periodic tours (see Figure 4 below for an example from Project Change: STEM Teacher @ Tech Day, March 10, 2020 as part of the Atlanta Science Festival) where they can see quantum physics in action. It has been particularly rewarding for me to interact with these teachers on these visits, to learn what they do and do not teach their students and to see them become excited about potential research internship opportunities in this area. Through these outreach efforts, I believe we will begin to see a greater interest in quantum science and engineering as a career choice for Georgia Tech incoming undergraduates in the future.



**Figure 4:** As part of the Atlanta Science Festival, middle and high school teachers discover quantum science in the Raman Lab during guided tours and demonstrations for Project Change: STEM Teacher @ Tech Day, March 10, 2020.



# Martha Ellen Stilwell School of the Arts

2580 Mt. Zion Parkway • Jonesboro, Georgia • 30236 • (770) 472-2838

**Dr. Michael Robinson, *Principal***  
**Tomeka Crum, *Assistant Principal***  
**Tanya Kirk, *Assistant Principal***  
**Yumeko Simmons, *Lead Counselor***

February 26, 2021

To the Academic Award Outreach Committee:

It is my honor and privilege to write a recommendation letter for Professor Dr. Chandra Raman. I am Rajini Sundararaj, a physics and environmental science teacher at Stilwell School of the Arts. One of my high school students and I were presented with the opportunity to work directly with Dr. Raman and his graduate team at the Georgia Institute of Technology through the Georgia Intern Fellowship for Teachers (GIFT) program during the summer of 2019. My experience with the GIFT program has been tremendous and Dr. Raman's generosity and dedication to community outreach has played a large role in this.

During my internship, my goal was to translate what is studied in Dr. Raman's experimental research lab, regarding the fundamental properties of atoms in their atomic, optical, and molecular work, into teaching modules that focus on physics principles such as the Coriolis effect and Doppler effect.

By learning more about Dr. Raman's research and its implications on society, I gained the resources I need to expose my high school students to the real-world implications of the concepts they learn in class every day. More specifically, I also implore them to understand the fundamental concepts that play an important role in developing the functional atomic sensor, which is studied in Dr. Raman's lab. While teaching the Doppler effect and the Coriolis Effect, my experience in Dr. Raman's lab allows me to show students that these concepts are used in navigational systems, satellites, and weather patterns that directly impact their lives. Furthermore, I have developed hands-on lab activities and computer simulations for my students that allow them to better understand and investigate atom-light interactions at the nano kelvin regime.

Additionally, I was given the opportunity, arranged by Dr. Raman, to attend an insightful physics lecture class which highlighted the wide margin between high school physics and college level physics. I am grateful to Dr. Raman for providing me the opportunity to identify this pervasive issue among many college students who feel unprepared to take on the rigor of larger institutions after attending under-resourced high schools. Aiming to make their transition to college seamless and resolve this problem within my high school, I incorporate rigorous and challenging project-based lessons that expand students' critical thinking and evidence-based research studies in my classroom. I also integrate college preparation into my senior students' activities to ensure they are equipped to take on the next stage of their academic journeys.

My work with Dr. Raman has also encouraged me to show my students just how fluid and innovative the physics and physical science-related fields actually are. Often, general class instruction fails to show students the importance of what they learn beyond the classroom, making students unable to envision a future for them in STEM fields like physics. By working with Dr. Raman and his graduate students and using them as positive examples, I have been able to expose my students to various professional careers, both in academia and industry, to inspire my students to expand their interests and pursue their STEM passions.

Dr. Raman strives to establish long-lasting connections through his outreach initiatives. This is exemplified by our regular interactions where he shared valuable insights and strategies to help motivate my students to apply their physics knowledge to advanced fairs and competitions. It is Dr. Raman's continued follow-up, mentorship and guidance that helped encourage my students to compete and become finalists in the regional, state, and international science and engineering competitions. He has truly made a ripple in the interest and opportunity that awaits students through scientific investigation and competition.

Finally, my summer experience with Dr. Raman helped me to create academically rigorous and authentic classroom instructions that empower students and develop the knowledge, skills, and abilities they will need for their career.

I strongly believe that Dr. Raman's high work ethic, thoughtful approach in addressing educational inequities, and dedication to improving accessibility to scientific pursuits make him an excellent choice for this Academic Award. He has my highest recommendation, without reservation. Please feel free to contact me at \_\_\_\_\_ should you wish to discuss the matter further. I would be happy to expand on my recommendation.

Sincerely,

*Rajini Sundararaj*

Rajini Sundararaj

rajini.sundararaj@clayton.k12.ga.us

Physics/Environmental Science Teacher

Georgia Science Chief Officers STEM program Advisor

Martha Ellen Stilwell School of the Arts

Clayton County Public Schools



# Martha Ellen Stilwell School of the Arts

2580 Mt. Zion Parkway • Jonesboro, Georgia • 30236 • (770) 472-2838

**Dr. Michael Robinson, Principal**  
**Tomeka Crum, Assistant Principal**  
**Tanya Kirk, Assistant Principal**  
**Yumeko Simmons, Lead Counselor**

February 25, 2021

To whom it may concern,

It is with great honor that I provide this recommendation letter on behalf of Professor Dr. Chandra Raman, of the College of Physics at Georgia Institute of Technology. Although I have not worked directly with him, I have had the privilege of seeing the impact Dr. Raman has made on the lives of our students and members of our faculty. I am the principal of Martha Ellen Stilwell High School of the Arts, and in turn, one of our teachers, Ms. Rajini Sundararaj, and our student, Keshawn Kelly, who had the opportunity to work at Dr. Raman's lab in 2019 through Georgia Intern-Fellowships (GIFT) for Teachers and the R.E.A.L. (Research, Experiment, Analyze, and Learn) program at Georgia Tech, sponsored by the National Science Foundation. The R.E.A.L. involves metro Atlanta high schools in order for them to experience and conduct research with mentors at Georgia Tech.

Dr. Raman conducted an outstanding mentorship with our high school student and our teacher through his outreach program during a 5-week period at the GA Tech lab facilities. Dr. Raman guided the design of their experiment: **"Using Doppler Effect and Collimation to Study Atomic Behavior"**. He also assisted them throughout their project in collecting data, analyzing the graphs, and drawing their conclusion. He exposed our student to various STEM-related hands-on activities that otherwise he would not have had the chance or resources to experience. The impact of his actions reached more than just the two individuals he worked directly with, through their sharing of their experience and accomplishments to the science faculty and students at our school.

With Dr. Raman's perseverance and motivation towards our high school students, he helped them to win the regional level science fair award in 2019. With the score they received at the regional level, they were recommended and accepted to move upwards, competing at the state level (Georgia Science and Engineering Fair 2020). They were even invited to present and compete at the International Science and Engineering Fair (ISEF 2020) competition, which was unfortunately cancelled, due to the pandemic. However, this accomplishment inspired our student body and we now have two student pairs advancing to both the state level competition and the international competition!

Dr. Raman always goes far and beyond to highly motivate students and he commits himself wholly to help them. He has been inspiring our students throughout this year by encouraging them to participate in various science competitions. He has consistently demonstrated great intellect, a highly impressive work ethic, actively volunteers his time to assist others when he is able to, possesses an ambitious drive to pursue and accept academic challenges, and encourages those he works with to, as well. He has been a pleasure to work with the past years and I hope to continue working with him in the future summer internships. He holds all of the traits expected of an outstanding mentor and would be a wonderful choice of your prestigious award.

I recommend him without hesitation, pause or reluctance. He has proven to go above and beyond whether everyone is watching or not and gives back to his community by participating in these educational opportunities for students of all backgrounds. Dr. Raman is an extraordinary person and an exceptional mentor worthy of the highest of praises.

Sincerely,

Dr. Michael Robinson  
Principal

Martha Ellen Stilwell High School of the Arts  
[michael.robinson@clayton.k12.ga.us](mailto:michael.robinson@clayton.k12.ga.us)