

# Ashish Kalakuntla

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**UNIVERSITY :** Massachusetts Institute  
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## SUMMARY :

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MIT student double majoring in Physics and Computer Science with extensive physics and mathematics research experience. Possesses significant leadership ability, impressive results at national competitions, and a willingness to help others learn and improve.

## EDUCATION :

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### **2019 – date BS in Physics**

Massachusetts Institute of Technology

Classes included Quantum Physics 1 & 2, Statistical Physics 1, Relativity, Physics 2 & 3, Classical Mechanics II, Linear Algebra, and Differential Equations

### **2020 - date BS in Computer Science and Engineering**

Massachusetts Institute of Technology

Classes included Design and Analysis of Algorithms, Introduction to Algorithms, Computation Structures, Introduction to EECS via Embedded Systems, Probability and Random Variables, and Fundamentals of Programming

## RESEARCH EXPERIENCE :

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### **2019 – 2021 MIT Particle Physics UROP**

Our analysis consisted of looking at Central Exclusive Production (CEP) phi mesons that arise from the collision of protons and Pb. These phi mesons are produced when the two colliding protons/lead nuclei remain intact after the collision, but one emits a virtual photon that interacts with a "Pomeron" from the other to produce the phi meson. We worked on measuring the ratio of how often this process occurs between the lead and proton collisions vs. the lead and lead collision to get an idea of if gluon saturation is occurring in this process. This analysis consisted of processing data from the LHCb detector using ROOT to find the yields for our signal (CEP phi mesons) while filtering out background in the various collision permutations.

### **2017 – 2019 UNLV High-Pressure Physics Lab (HiPSEC), Las Vegas, NV**

- Studied phonons and other topics of condensed matter physics
- Constructed laser-heating setup for high pressure samples
- Wrote a technical report on an independently-built laser reflectance system aimed at examining samples' spectral responses, a method that hadn't been expanded on in 5 years

## RESEARCH EXPERIENCE (CONT.):

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### 2017 – 2019 UNLV Mathematics Research, Las Vegas, NV

- Titled “Boyd’s Apollonian Packings”
- Generated never-before-seen images of specific circle packings due to novel hyperbolic geometry interpretation
- Submitted paper to Pi Mu Epsilon Undergraduate Journal

## WORK HISTORY:

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### 2017 – 2019 Instructor and Teaching Assistant

Las Vegas Math Circle, Las Vegas, NV

- Launched Southern Nevada Girls Math Tournament and acted as head problem-writer in order to inspire girls to pursue STEM
- Taught competition math to middle-school students every weekend, some of whom qualified for national competitions
- Oversaw math camps during winter, spring, and summer break, instructing students and honing their mathematics skill

### Aug 2019 College Application Workshop

RootSTEM Academy, Las Vegas, NV

- Organized a 4-hour long workshop with an attendance of over 30 students, complete with handouts and timelines
- Showcased the college application process with concrete information from Harvard’s released procedures, demystifying the process and guiding students to pursue their own interests

## HONORS & AWARDS:

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### 2015, 2017 USAJMO Qualifier (2015, 2017)

Top 200 in US for Mathematics

### 2018 USNCO Finalist (2018)

Qualified for National Chemistry exam

### 2018 Congressional Silver Medal (2018)

200 hours Public Service, 100 hours Development, 100 hours Fitness

### 2019 Science Olympiad Medalist (2019)

National medal in Material Science, Gold medals at prestigious invitationals

## LEADERSHIP ACTIVITIES:

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### 2015 – 2019 Mu Alpha Theta

2017 – 2019 President

- Organized school competitions
- Headed math tutoring services for every level of mathematics

## LEADERSHIP ACTIVITIES (CONT.):

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### 2015 – 2019 Science Olympiad

2018 – 2019 Study Captain

- Won medals in Astronomy, Optics, Chemistry Lab, and Material Science at national competitions
- Advised newer members with study resources and strategies

### 2015 – 2019 Mu Alpha Theta

2018 – 2019 Captain

- Led the team to 17<sup>th</sup> place at nationals (out of 60, NV record)
- Revamped our team by introducing new study tactics and practices that build off members' strengths

### 2015 – 2019 Mu Alpha Theta

2018 – 2019 Co-President

- Led team to multiple national tournaments with record results (9<sup>th</sup> at HMMT, 6<sup>th</sup> at CHMMC)
- Succeeded individually with 14<sup>th</sup> at HMMT and tied for 1<sup>st</sup> at BMT
- Trained members through practice sessions and guided studying

## MATHEMATICS PAPER ABSTRACT:

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The Apollonian circle packings are a class of packings known since ancient times, and have been highly recognized and analyzed by mathematicians following its conception. However, the original circle packing created by Apollonius of Perga is not the only configuration that results in a complete circle packing. A specific class of additional circle packings, in which the inversions that take one circle to another in the packing are perpendicular to 3 of the basis (vectors) circles, were detailed by David W. Boyd in his 1974 paper "A New Class of Infinite Sphere Packings". In this paper, Boyd uses polyspherical coordinates to find the matrices that correspond to these additional circle packings, 6 of which are 2-dimensional. Through a hyperbolic geometry interpretation of the circles in the circle packings as planes in the Poincare upper-half space model of the pseudosphere in Lorentz space, these matrices detail properties (separations, tangencies) between each of the planes (circles). This allows for illustrations of these circle packings that Boyd's interpretation was unable to provide.