First Name: **Gabriel**	*Middle Name:*	*Last Name:* **Casabona**

Doctoral University: **Columbia University**

Univ. Preference 2:

Univ. Preference 3:

Advisor: **Robert Fisher**

Advisor's Institution: **University of Massachusetts Dartmouth**

Academic Status: **Master's Degree Student**

Terms in Doctoral Program: **----**

Date Degree Expected: **05/2025**

Department: **Physics**

Discipline: **Computational Astrophysics**

Applicant Reported Information						**Official Transcript**	
Institutions	*Department*	*Academic Discipline*	*Dates of Attendance*	*Degree*	*Reported GPA*	*Trans Recv'd*	*Trans GPA*
Columbia University	Physics	Computational Astrophysics	08/2019 - 05/2025	PhD			
University of Massachusetts Dartmouth	Physics	Astrophysics	09/2017 - 05/2019	Masters	3.6	Yes	3.63
Florida International University	Physics	Physics	08/2011 - 05/2017	Bachelors	2.9	Yes	2.90
			-	None			
			-	None			
			-	None			

Letters are received either online or by mail.

References	**Institution**	***Email***	***Status - Online***	***Received by Mail***
Robert Fisher	University of Massachusetts Dartmouth	robert.fisher@umassd.edu	Submitted	
Gaurav Khanna	University of Massachusetts Dartmouth	gkhanna@umassd.edu	Submitted	
David Kagan	University of Massachusetts Dartmouth	david.kagan@umassd.edu	Submitted	

DOE CSGF Application - Traditional Track

Name: Gabriel Casabona

Academic Status

Current Academic Status: **Master's Degree Student**

Have you completed any academic credit towards your computational science/engineering doctoral degree? **No**

If yes, how many terms have you completed? (exclude summer) **----**

Official transcripts from every listed institution are a required component of the application including your Fall 2018 transcript, if applicable.

Doctoral Institution (Institution where you plan on completing your computational science and engineering doctorate or first choice doctoral university):

Institution	*Start Date*	*Expected End Date*	*Department*	*Academic Discipline*	*GPA*	*Degree*
Columbia University	08/2019	05/2025	Physics	Computational Astrophysics		PhD

Department Chair at Doctoral Institution:

First Name	*Last Name*	*Email*
William	Zajc	waz1@columbia.edu

Other Doctoral Institution Choices (Answer only if not currently at doctoral institution)

			Department Chair Information	
Institution	*Department*	*Academic Discipline*	*Name*	*Email*

Name: Gabriel Casabona

Research Statements

This information is vital to the overall evaluation of your application.

Field of Interest and the Role of Computational Science

a. *In terms a general audience would understand, describe an important, outstanding scientific or engineering challenge in your field of interest where computational science can play an important role. (1/3)*
b. *Describe the particular science or engineering problem that you would like to pursue in your research. What would be the impact on the field and/or on science, engineering and/or society in general if this challenge could be successfully addressed? (2/3)*

The recent discoveries of mergers of black hole binary systems (BHBH), beginning with GW150914, and the binary neutron star system (NSNS), GW170817, have broadened our understanding of fundamental questions in physics. These questions include: What are the astrophysical sources of gravitational waves? What are the sites of r-process element production? What are the multimessenger electromagnetic (EM) counterparts to gravitational wave events,and in what bands (optical, infrared, X-ray, gamma ray) do they occur? Although BHBH and NSNS mergers have only been observed to date, black hole-neutron star (BHNS) mergers are also expected to naturally be produced by similar astrophysical production channels. In particular, BHNS are promising candidates for short gamma-ray bursts as well as LIGO sources of gravitational waves.

The primary goal of this proposed research effort is to undertake a detailed and systematic study of self-consistent three-dimensional simulations of BHNS mergers, and predict their expected EM counterparts, nucleosynthetic yields, and gravitational wave forms. A central issue at the heart of the problem is the determination of the quantity and composition of matter ejected from the system, since it is this matter which does not fall into the black hole, and will be observable to astronomers following up on a LIGO-VIRGO trigger. Consequently, I will be modeling all major mechanisms which give rise to the ejecta -- the tidal tail, neutrino-driven winds, as well as magnetized outflows and jets. A key new facet of my proposed research is a novel treatment of the development of the magnetorotational instability (MRI) in the disk using adaptive mesh refinement.

Use of Computational Science in your research

a. *What is the most complex calculation you have run on a high performance machine as part of your research experience? Or if you haven't run a high performance computing system, tell us about the most complex computational problem you've tackled. (1/2)*
b. *Imagine if you were given access to resources 100 times more powerful than what you have had access to. What would that enable you to do, and what do you perceive the mathematical/computer science challenges to be? (1/2)*

In my current research group, focused on Type Ia Supernovae (SNe Ia),
I am a research assistant working in collaboration with Professor Robert Fisher. Research topics range from detonation profiles to nucleosynthetic yields. SNe Ia are thermonuclear explosions believed to occur from the nuclear burning of carbon in white dwarfs.

As important as SNe Ia are, the mechanism of detonation is still unknown. My current research has been in exploring a possible mechanism for detonation motivated by the double degenerate channel. The goal of this research is to determine what role turbulence plays in the detonation of carbon in electron-degenerate matter. This was done by performing 3-dimensional simulations to capture the physics of turbulence. The FLASH4 hydrodynamics code was implemented and the simulations were performed on the XSEDE supercomputer Stampede2. Simulations began with a quiet background of carbon/oxygen fuel being driven to steady-state turbulence, with nuclear burning then activated.

Each simulation saw an increase in temperature by about an order of magnitude before nuclear burning was turned on, caused by Kolmogorov's theory of turbulence. At $t \approx 15$ ms, a hot spot is formed in which nuclear burning develops supersonically, initiating detonation. Analysis of these simulations show that turbulent dissipation dominates nuclear energy generation by over 20 orders of magnitude. This leads to the conclusion that turbulently-driven detonation can occur within the distributed burning regime. These results are outlined in my co-authored peer-reviewed paper submission to The Astrophysical Journal.

Access to a more powerful machine would greatly increase the productivity of my research. More computational cores means a faster run time. The biggest challenge I see facing is in regards to the I/O, since increasing data points also increases the need to better I/O techniques. There can also be some race conditions if the codes are not parallelized properly.

Name: Gabriel Casabona

Program of Study

Listed are the courses in science and engineering, applied mathematics, and computer science that you agreed to take on your proposed Program of Study.

University: Columbia University

Course number	Course Title	Credit hours	Term and Year	Grade	Academic Level
Science/Engineering					
		S	Fall		G
PHYS G8041	Topics in General Relativity	3S	Fall 2019		G
PHYS GR6011	Astrophysics	3S	Fall 2020		G
Mathematics and Statistics					
MATH GR8255	PDE in Geometry	4S	Fall 2019		G
PHYS G8050	Advanced Mathematical Methods In Physics	4.5S	Fall 2019		G
Computer Science					
EAS 520 *from University of Massachusetts Dartmouth*	High Performance Computing	3S	Fall 2018	B	G
PHYS G6080	Scientific Computing	3S	Fall 2019		G

I have read this program of study and affirm that, in my opinion, it satisfies the fellowship program requirements. This POS has been approved by my advisor, **Robert Fisher**, and I understand that, if offered a fellowship, my advisor and I are required to sign this page and send it to the Krell Institute.

Student's signature _____ Date _____

Graduate Advisor: **Robert Fisher**
Graduate Advisor's Institute: **University of Massachusetts Dartmouth**
Graduate Advisor signature _____ Date _____

Krell Institute (Office use only) _____

Krell Institute, Attn: DOE CSGF Coordinator
1609 Golden Aspen Drive, Suite 101, Ames, IA 50010
Phone: 515-956-3696, Fax: 515-956-3699, csgf@krellinst.org

Name: Gabriel Casabona

Course Description

:

PHYS G8041: Topics in General Relativity

Topics to be discussed include Hawking radiation and black hole thermodynamics, singularity theorems, and cosmology.

PHYS GR6011: Astrophysics

The basic physics of high energy astrophysical phenomena. Protostars, equations of stellar structure; radiative transfer theory; stellar nucleosynthesis; radiative emission processes; equations of state and cooling theory for neutron stars and white dwarfs, Oppenheimer-Volkoff equation; Chandrasekhar limit; shocks and fluids; accretion theory for both disks and hard surfaces; black hole orbits and light bending.

MATH GR8255: PDE in Geometry

Parabolic flows have become a central tool in differential geometry in recent years. One of the main problems is to understand the formation of singularities. In this course, I will give an introduction to the subject, starting with the simplest example of the curve shortening flow in the plane. We will then discuss the main a-priori estimates for mean curvature flow in higher dimensions, such as the convexity estimate, the cylindrical estimate, and the pointwise gradient estimate. Finally, we plan to present recent results concerning singularity formation for fully nonlinear curvature flows.

PHYS G8050: Advanced Mathematical Methods In Physics

Topics selected on the basis of current research problems.

EAS 520: High Performance Computing *from University of Massachusetts Dartmouth*

Course covers an assortment of topics in high performance computing (HPC). Topics will be selected from the following: parallel processing, computer arithmetic, processes and operating systems, memory hierarchies, compilers, run time environment, memory allocation, preprocessors, multi-cores, clusters, and message passing.

PHYS G6080: Scientific Computing

Computational techniques for scientific problems with emphasis on practical applications and effective programming. Review of computers, programming, floating-point numbers, and numerical stability. Survey of basic numerical algorithms and numerical subroutine libraries and their application to scientific problems.

Name: Gabriel Casabona

Other Planned Courses

Listed are the other courses you plan to take that you believe are particularly pertinent to your proposed or current research in the areas of Mathematics, Science and Engineering, and Computer Science.

Course number	Course Title	Credit hours	Term and Year	Grade	Academic Level
Science/Engineering					
MTH 551	Differential Geometry	3S	Spring 2019		G
PHY 510-01	Stellar Astrophysics	2S	Spring 2019		G

Name: Gabriel Casabona

Course Description

MTH 551: Differential Geometry

Analysis of curves and surfaces. Frenet-Serret formulae. Fist and second fundamental forms for surfaces, Gaussian and mean curvature, theorems of Meusnier and Rodriques and the Gauss-Bonnet theorem are also studied.

PHY 510-01: Stellar Astrophysics

An advanced treatment of a special topic in physics with an emphasis on recent developments. The subject matter varies according to the interests of the instructor and the students.

Name: Gabriel Casabona

Completed Courses

Please list up to six courses you have completed that are particularly pertinent to your proposed or current research in the areas of Mathematics, Science and Engineering, and Computer Science. Please do not list entry level science/engineering or mathematics courses like Calculus I.

Course number	Course Title	Credit hours	Term and Year	Grade	Academic Level
EAS 520	High Performance Computing	3S	Fall 2018	B	G
PHY 521	Computational Physics	3S	Fall 2017	B+	G
PHY 565	General Relativity	3S	Fall 2017	A	G

Name: Gabriel Casabona

Course Description

EAS 520: High Performance Computing

An advanced treatment of a special topic in physics with an emphasis on recent developments. The subject matter varies according to the interests of the instructor and the students.

PHY 521: Computational Physics

Application of computational techniques to computer simulations in physical science and engineering. The course covers physical concepts such as realistic projectile motion, planetary systems, nonlinear dynamics, chaos and fractals, and electromagnetic and quantum systems. The course exposes students to numerical algorithms and methods such as solutions to optimization, quadrature, fast Fourier transform, and boundary value problems, and gives hands-on experience in programming and computer simulations.

PHY 565: General Relativity

General Relativity for beginning graduate and advanced undergraduate students. This course covers the basic principles an applications of Einstein's General Relativity, the preeminent theory of gravitation. Topics include: Tensor analysis in flat and curved spacetime; Einstein's Equivalence Principle; geodesic and field equations; black hole, gravitational wave and cosmological spacetimes.

Name: Gabriel Casabona

Program of Study

Describe how the courses listed in your planned program of study would help prepare you to address the challenges you have described in questions 1 and 2. Discuss your rationale for choosing these courses.

The courses in my planned program of study, along with the courses taken at my current institution, are chosen specifically to help me in computation. There are many pieces to being a computational physicist that are not taught in traditional physics courses. By learning these topics from leaders in the field, I will have the advantage of having a higher set of problem solving techniques compared to my peers.

Name: Gabriel Casabona

Programming Languages and Models

List (four at most) the programming languages and programming models with which you have experience. Provide a sentence that describes how you use them.

1. Programming Language/Model: **Python**
Python is used for data analysis and visual representation.

2. Programming Language/Model: **Fortran**
Fortran is used in the main code base I use, FLASH.

3. Programming Language/Model: **C**
In my HPC course, all problems were solved using C99.

4. Programming Language/Model:

What are the programming languages that you intend to use in your research?

Python, Fortran, C

Name: Gabriel Casabona

List of Publications

Papers

Mozumdar, P., Fisher, R., & Casabona, G (Jul 2018). Carbon Detonation Initiation in Turbulent Electron-Degenerate Matter. arXiv:1807.03786 (in submission to ApJ)

Talks

Casabona, G (Mar 2019). Detonation Initiation in Type Ia Supernovae.
APS March 2019. Boston, Massachusetts

Casabona, G (Nov 2018). Carbon Detonation Initiation in Turbulent Electron-Degenerate Matter.
APS New England 2018. University of Massachusetts Dartmouth

Casabona, G (Apr 2018). Carbon Detonation Initiation in Turbulent Electron-Degenerate Matter.
APS April 2018. Columbus, Ohio

Posters

Casabona, G (Jan 2019). Detonation Initiation in Type Ia Supernovae.
223 rd Meeting of the AAS. Seattle, Washington

Casabona, G (Nov 2018). Carbon Detonation Initiation in Turbulent Electron-Degenerate Matter.
APS Bridge/NMC Conference 2018. Stanford University

Casabona, G (Jul 2018). Carbon Detonation Initiation in Turbulent Electron-Degenerate Matter.
IHPCSS. Technical University of Ostrava, Czech Republic

Name: Gabriel Casabona

Laboratory and Research Experience/Other Employment

Begin with current or most recent employment. Please include employer, dates employment started and ended, position, and nature of work.

University of Massachusetts Dartmouth, Physics Department, 07/2018 - 05/2019, Research Assistant

Academic Awards and Honors - *Include undergraduate and graduate honors (if applicable).*

FIU Dean's List: Spring 2013, Spring 2016

Extracurricular Activities - *Include technical societies and service organizations.*

Society of Physics Students
Physics Honors Society (ΣΠΣ)
American Astronomical Society
National Society of Black Physicists

Name: Gabriel Casabona

Additional Comments

DOE CSGF Reference Form

Applicant's Name : **Gabriel Casabona**

Name: **Robert Fisher**

Title: **Associate Professor of Physics**

Institution: **University of Massachusetts Dartmouth**

Email: **robert.fisher@umassd.edu**

Address: **University of Massachusetts Dartmouth, Physics Department**
285 Old Westport Road
North Dartmouth Ma 02740

UMass | Dartmouth
COLLEGE OF ENGINEERING

Physics Department

11/1/2018

Dear Colleagues :

I am writing in strongest possible support of the application of Gabriel Casabona for a Department of Energy Computational Science Graduate Fellowship. I have known Gabriel since the fall of 2017, when he joined our physics department as a M.S. student and I became his M.S. thesis advisor. Gabriel is an outstanding young scientist carrying out groundbreaking fundamental research in the nuclear astrophysics of Type Ia supernovae. As a scientist with six years of postdoctoral experience at both a NNSA laboratory and a DOE-supported research center, as well a co-recipient of a DOE Certificate of service, I can assert that Gabriel has acquired precisely the scientific and high-performance computational skillset that makes him an outstanding candidate for a DOE fellowship program. Furthermore, as a person of color, Gabriel will also serve as a shining role model for future generations of young computational scientists from all backgrounds. **I am confident that Gabriel's excellence will rank him among your most deserving candidates for a DOE CSGF fellowship**.

Allow me to briefly comment on the importance and scope of Gabriel's research. While crucially important for modern cosmology, and the basis of a Nobel Prize in Physics awarded in 2011, we still do not know what types of stellar systems produce Type Ia supernovae. Mounting observational evidence favors a model, referred to as the double-degenerate channel, in which merging carbon-oxygen white dwarf binaries produce the characteristic signatures of Type Ia supernovae. However, from the theoretical side, the detonation mechanism for such a binary white dwarf system remains a mystery. A key problem at the heart of this mystery is how the nuclear burning within white dwarfs accelerates from a slow, subsonic burning front, or *deflagration*, into a rapid, supersonic burning front: a *detonation*. Decades of effort by researchers have sought to elucidate the mechanism by which such a *deflagration to detonation transition* takes place, but to date, it is has never been demonstrated to arise in a realistic three-dimensional simulation under conditions typical of white dwarf interiors.

University of Massachusetts Dartmouth ▪ College of Engineering ▪ www.umassd.edu/engineering/phy
285 Old Westport Road ▪ North Dartmouth ▪ MA 02747-2300 ▪ 508.999.8354 ▪ 508.999.9115 (fax)

For his M.S. thesis, Gabriel is undertaking three-dimensional local simulations of turbulent nuclear burning using the astrophysical fluid dynamics code FLASH, under conditions typical of the electron degenerate material of white dwarfs. His investigations are motivated by our understanding of the merging white dwarf double-degenerate channel, but are undertaken on the length scales left unresolved in global simulations of white dwarfs, which are crucial for the deflagration to detonation transition. Intermittency is a fundamental feature of turbulence, and such turbulent fluctuations in temperature arise naturally within all major channels of Type Ia supernovae. Moreover, because the carbon nuclear burning rate is highly sensitive to temperature (in excess of T^{20}!), the nuclear burning rate within these turbulently-heated hot spots greatly exceeds that of the background and can lead to a detonation. *Gabriel's "zoomed in" simulations carried out on the NSF XSEDE supercomputer Stampede2 allow him to achieve extremely high resolution, several orders of magnitude finer than the most highly-resolved global three-dimensional simulations of Type Ia supernovae. The results may be potentially transformative for both our understanding of double-degenerate Type Ia supernovae, as well as other major channels of Type Ia supernovae.* Gabriel is a co-author on our first peer-reviewed publication, submitted to *The Astrophysical Journal* (Fisher, Mozumdar, and Casabona, arXiv:1808.03786), and has presented his research at four international and national meetings to date. Furthermore, I expect that during the completion of his M.S. thesis this year, he will have a second, lead-authored publication further investigating the implications of this new detonation initiation mechanism for models of Type Ia supernovae.

Allow me also to briefly compare Gabriel to another outstanding student, Peter Jumper, who I had the fortune of mentoring in a joint research project during his undergraduate career. Peter was a recipient of the NSF GRFP award and fellowships from several major research universities, all of which he ultimately declined to accept a Connaught International Fellowship from the University of Toronto. Peter was also a finalist for the APS Apker Prize — a highly prestigious category of eight physics students derived from a yearly pool of approximately 8,000 graduating physics B.S. majors. Gabriel's research and analytic skills compare favorably to Peter's at a similar stage of their careers. Gabriel is, however, tremendously more mature as an individual, and a much more natural leader. **In other words, Gabriel is a highly-promising candidate for a DOE CSGF.**

In summary, Gabriel is an outstanding student whose M.S. thesis research is likely to have a major impact on our understanding of the physics of turbulent detonation initiation, so critical to the problem of Type Ia supernovae. He has developed a remarkable level of expertise in high-performance computational methods, worthy of an advanced computational science Ph.D. student. He has excellent communication skills, and works very well in a group environment. In summary, Gabriel is an outstanding candidate for a DOE CSGF. **You have the opportunity to make a potentially transformative impact — not only on the field of nuclear astrophysics and DOE-related computational science, but upon future generations of young scientists, who will look to Gabriel as beacon and a role model.**

Sincerely,

Robert Fisher
Associate Professor of Physics
Graduate Program Director
University Massachusetts Dartmouth

DOE CSGF Reference Form

Applicant's Name : **Gabriel Casabona**

Name: **Gaurav Khanna**

Title: **Professor**

Institution: **University of Massachusetts Dartmouth**

Email: **gkhanna@umassd.edu**

Address: **285 Old Westport Rd**
UMass Dartmouth
Dartmouth MA 02747

UMass | Dartmouth
COLLEGE OF ENGINEERING
Physics Department

Letter of Recommendation for Fellowship Program for Gabriel Casabona

I'm overjoyed to write in support of Gabriel's application to your fellowship program. I'll start by making a comment about our institution and our Physics program. The ***University of Massachusetts at Dartmouth*** is a growing doctoral research institution with an enrollment of nearly 9,000 students. The Physics program has approximately 50 undergraduate students and 20 graduate (MS & PhD) students. The department is amongst ***the top BS and MS degree granting Physics departments in the nation***, according to recent APS reports. A stated goal of the university is to further strengthen the research infrastructure of the campus and increase student involvement in faculty research. As a result, several new research active faculty have been hired campus-wide and new doctoral programs are being developed. In addition, the Physics department resides within the College of Engineering here thereby giving the Physics students unique access to resources that may not be available to traditional Physics departments that are usually under an Arts and Sciences administration.

Gabriel Casabona is currently enrolled in our Physics MS program. He is ***one of the most dedicated and driven students that I have seen here*** at UMass Dartmouth. Gabriel has taken a wide variety of courses during his time here, ranging from *Quantum Mechanics* to *Computational Physics* and has always received excellent grades; I'm convinced that he will do exceedingly well in any top graduate program. Gabriel took my *General Relativity* course in which we used Carroll's textbook and not only did he perform well on solving problems, exams etc., he took time to process and absorb the conceptual subtleties of the subject. I would say that his understanding of the course material is very good. He appears to have ***excellent learning habits, always going above and beyond the requirements of the course***.

Since I have only just begun involving Gabriel in one of my smaller research projects (this would be a secondary project; his primary is in stellar astrophysics with my colleague Dr. Fisher), I can't directly comment much on his research ability quite yet. He certainly has the basic ingredients necessary to make an excellent researcher. He is curious and he ponders over ideas that are being conveyed to him. In addition, ***he has very strong analytical, mathematical and programming skills***. I'd especially like to make note of his strong scientific programming skills and interests. I am therefore completely convinced that he will do well in any top graduate program and therefore I fully support his application. I am also confident that he will work very well in a team or collaborative environment, which is something that is very crucial for a good researcher. His interests appear to lie in the overlapping domains of relativity and astrophysics, especially in the context of ***multi-messenger astronomy and astrophysics***.

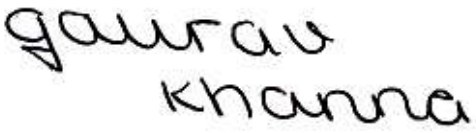
A few other remarks are worth making. Gabriel is an APS Bridge Program student in our MS program. Given his disadvantaged background (from an urban area, worked multiple jobs, has made significant sacrifices in life) he came in knowing that he would need to fully dedicate himself to his academics, and

since the beginning he has been performing at 200%. He has excelled on every aspect of his responsibilities (coursework, TA duties, helping Dept. outreach, etc.) performing well beyond expectations. He has demonstrated beyond doubt, that he has exceptionally high level of motivation and perseverance to pursue a career in physics.

Finally, I would like to comment on his ability to communicate effectively and to assist in the teaching of undergraduate courses, which is important for most graduate programs. I have no hesitation at all in saying that he will perform that important task very well. I'm certain that undergraduates at any institution will feel comfortable interacting with him and they will find him very approachable. He has excellent communication skills and the patience that is necessary to convey abstract concepts such as those in basic Physics and Engineering.

In summary, I very highly recommend Gabriel Casabona for your research fellowship program. I would rank him ***in the top 5% of all the students I have taught*** so far. Please do not hesitate to contact me for more information.

Sincerely,



Gaurav Khanna (*short bio included below*)
Professor, Physics Department
Co-Director, Center for Scientific Computing & Visualization Research
University of Massachusetts Dartmouth
North Dartmouth MA 02747
508-910-6605
gkhanna@umassd.edu

Dr. Khanna is a Professor in the Physics Department at the University of Massachusetts Dartmouth. He works on a variety of challenging problems in theoretical and computational physics. This primary research project is related to the coalescence of binary black hole systems using perturbation theory and estimation of the properties of the emitted gravitational radiation. This research is of relevance to the NSF LIGO laboratory and the upcoming space-borne missions that are just beginning to make direct observations of this radiation. Dr. Khanna has extensive parallel and scientific computing experience, and has detailed knowledge of a variety of computer architectures. He has published over 70 research papers in top international journals and secured over a million-dollars in research funding to date.

Dr. Khanna obtained his doctoral degree from Penn State University in 2000 and his undergraduate degree from Indian Institute of Technology, Kanpur (India) in 1995.

DOE CSGF Reference Form

Applicant's Name : **Gabriel Casabona**

Name: **David Kagan**
Title: **Full-time Lecturer**
Institution: **University of Massachusetts Dartmouth**
Email: **david.kagan@umassd.edu**
Address: **285 Old Westport Road**

Dartmouth MA 02747

UMass | Dartmouth
DEPARTMENT OF PHYSICS

Dr. David Kagan
Title: Full time Lecturer
Department: Physics

Wednesday, January 9th, 2019

To Whom It May Concern

Gabriel Casabona is a talented and dedicated physics student, who is engaged in fascinating research that is helping to shed light on our understanding of supernovae. I believe Gabriel has demonstrated the potential to be an outstanding Ph.D. student and I enthusiastically recommend him to be a recipient of the DOE's Computational Science Graduate Research Fellowship.

I interacted closely with Gabriel last spring when he took my graduate Quantum Field Theory course (PHY 510) and was the head Teaching Assistant for the introductory physics laboratories that I oversee as part of the undergraduate physics sequence. Gabriel did very well in the course, earning an A-. The material is among the most challenging that physics students encounter and I was impressed with Gabriel's evident hard work and his ability to successfully carry out difficult calculations that are the bread-and-butter of such a course. Most important, through incisive questions, comments, and aiding his fellow students, Gabriel showed that he has the ability to grasp some of the toughest concepts encountered in physics.

Gabriel, as the head TA for undergraduate mechanics labs, is responsible for more than simply making sure that the labs are running well. I worked together with him on refining the lab activities and developing new material to address difficulties that undergraduates commonly encounter when taking the introductory physics sequence. He is a truly gifted communicator and teacher, and has made many fruitful contributions toward improving our physics labs. He also often stayed late, working with students from my intro mechanics course, helping them with homework, lecture material, and assigned readings. Students have told me that his help was invaluable to them. I've also been impressed with the very positive rapport he tends to rapidly develop with those around him.

While I'm not directly engaged with Gabriel's research work, I've found talking with him about it to be immensely stimulating. He gave what I consider to be the best presentation at the New England APS meeting—I include in this comparison the professors who presented. I

College of Engineering •
University of Massachusetts Dartmouth • 285 Old Westport Road • North Dartmouth • MA 02747-2300
Ph: 580.999.8000 • Email: dkagan@umassd.edu

UMass | Dartmouth
DEPARTMENT OF PHYSICS

Dr. David Kagan
Title: Full time Lecturer
Department: Physics

believe his work to be quite impressive and look forward to learning more from him as he continues to pursue his research interests.

Through his time here at UMass-Dartmouth Gabriel has shown much promise as a physicist. He is actively engaged in high-quality research, he is passionate about the subject, and he is an excellent teacher and collaborator. I reiterate that Gabriel would be an outstanding choice for this fellowship.

Sincerely,

David Kagan

College of Engineering •
University of Massachusetts Dartmouth • 285 Old Westport Road • North Dartmouth • MA 02747-2300
Ph: 580.999.8000 • Email: dkagan@umassd.edu