- An explanation of any relevant background you have in category theory or any of the specific projects areas

During my training years I have attended theoretical physics and mathematical courses (quantum field theory, dynamical systems, differential geometry, group theory, etc.) which made me familiar with abstract tools and reasoning. Professionally, at the beginning of the career, I had a brief encounter with category theory while collaborating at two articles [6, 7] about quantum Yang-Baxter equations and its applications in physics. Later on, I have found out about alternative derivations methods of our results using braided categories. Nowadays I am affiliated to the Theoretical Physics Department of IFIN-HH (the largest research institute in Romania) and I participate in the activities of the general seminar and the dedicated Geometry & Physics seminar [8].

From another strand, the experience of working in the field of data analysis in a large scientific collaboration (700 authors) like LHCb from CERN made me acquainted with statistics and programming languages. Writing in Python (mostly) and C++ in a continuing changing environment led me to the idea of abstracting the way we are writing code and we are representing concepts. Thus, I have become interested in studying different programming paradigms like flow based programming [9] and functional programming. The main goal would be to have a domain specific language to represent the workflow in an experimental environment like LHCb, both from the system operating and physics analysis point of views and thus to automatize chains of processes.

These experiences and also my general interests pointed me to general lectures on category theory, readings on which I am at different stages of completion. Those are a general introduction to category for scientists [1], some applications [2, first chapters], [3, first part] or some broader readings like [5, started several times]. My interest on the topic comes from different directions seeing category theory as a unifying language between domains. Although I don't have a working level experience on category theory I have the reading level and the motivation to make out the best from the participation at Adjoint School, ACT 2019.

[1] D. Spivak, *Category theory for scientists*
[2] D. Spivak, *Seven Sketches in Compositionality: An Invitation to Applied Category Theory,* arxiv:1803.05316
[3] B. Milewski, *Category Theory for Programmers*
[4] Elie M. Adam, Systems, *Generativity and Interactional Effects*, MIT PhD thesis.
[5] J. Baez, M. Stay, Physics, *Topology, Logic and Computation: A Rosetta Stone,* arXiv:0903.0340
[6] F. Nichita, B. Popovici, *Yang-Baxter operators from (G, θ)-Lie algebras,* Rom. Reports in Physics, Volume 63, Number 3, 2011, arxiv:1011.2072
[7] F. Nichita, B. Popovici, *Some Results on the Yang-Baxter Equations and Applications,* Rom. Journal of Physics, Volume 53, 9-10, 2008
[8] Geometry and Physics seminar, Department of Theoretical Physics, IFIN-HH, 2013 – 2018
[9] Flow based programming, https://en.wikipedia.org/wiki/Flow-based_programming

-- The date you completed or expect to complete your Ph.D. and a one-sentence summary of its subject matter.

I completed PhD in high energy physics affiliated to University of Bucharest, Romania and LHCb experiment at CERN in 2013. The thesis analyzed the experimental data for the cross-section production of b-quark in the channel $\Lambda_b \to J/\Psi \Lambda_0$ and developed a Python software stack for similar decay channels.

-- Order of project preference

1. Simplifying quantum circuits using the ZX-calculus, Miriam Backens
2. Traversal optics and profunctors, Bartosz Milewski
3. Toward a mathematical foundation for autopoiesis, David Spivak
4. Partial evaluations, the bar construction, and second-order stochastic dominance, Tobias Fritz
5. Complexity classes, computation, and Turing categories, Pieter Hofstra
6. Formal and experimental methods to reason about dialogue and discourse using categorical models of vector spaces, Mehrnoosh Sadrzadeh

-- To what extent can you commit to coming to Oxford (availability of funding is uncertain at this time)

I am able to cover my expenses with the participation at the Oxford conference and school.

PERSONAL INFORMATION

Bogdan Paul Popovici

- (Romania)
- popobog@theory.nipne.ro
- https://www.linkedin.com/in/bogdan-popovici-4320851b

POSITION

Candidate for participation at Adjoint School, ACT 2019

WORK EXPERIENCE

Oct 2005–Present

Researcher (permanent position, researcher 2013 - present, assistant researcher 2005 - 2013)

Horia Hulubei National Institute of Physics and Nuclear Engineering, Magurele (Romania)

- Member of Department of Theoretical Physics.
- Responsible of the scientific seminar of the department.
- Interests: quantum field theory, statistics, data analysis, machine learning

2013 - present

- Organizer of outreach activities in the institute.

2013 - 2016

Deputy team leader for LHCb-Ro group participant in LHCb (Large Hadron Collider Beauty) experiment at CERN, Geneva. www.nipne.ro/dpp/Collab/LHCb

2007 - 2017 Member of LHCb collaboration

- My work comprise analysing the data from the experiment, writing visualisation code and statistical interpretation of the data. Fields of interest are the Standard Model of elementary particles and perturbative quantum chromodynamics, strange quark production etc.
- Author, as member of the collaboration, of about 250 articles.
- Other activities: group coordinator, student advisor, writing scientific proposal for national and international projects.
- Working stages within LHCb experiment at CERN, 26 stages, about 380 days

2015–Present

Research Fellow

University of Bucharest, Research Center in Atomic Physics and Astrophysics

- Research activities in particle physics
- Participation in educational projects
- Managing funds and writing proposals

EDUCATION AND TRAINING

2007–2012

PhD in Elementary Particle Physics

University of Bucharest, Bucharest (Romania)

Thesis's title: **Production studies of Lambda$_b$ baryons at LHCb**

The measurement of Lambda$_b$ -> J/Psi Lambda^0 production at LHCb was done, it concerns the phenomenology of b quark production and perturbative QCD predictions.

A general Python package for data analysis extensible to other similar data analyses.

Oct 2009	**ESF research grant**

Paris XI, Orsay (France)

Working stage on 'Quantum Geometry and Quantum Gravity'

2006–2008	**Master courses**

Politehnica University, Bucharest (Romania)

Master courses in *Dynamical systems, geometry and optimizations*

Oct 2006–Nov 2006	

Working stage on LHCb experiment at IN2P3, LAL, Orsay (France)

1997–2002	**Bachelor's degree, Physics**

University of Bucharest

- bachelor degree in applied nuclear physics and enginering
- Activities at Student's League of Physics Faculty, (vice-president 1998-2000) and at the university level, (vice-president 1999-2000)

Oct 2000–Sep 2001	**Exchange Erasmus student**

Oersted Laboratory, Copenhagen University (Denmark)

General physics and mathematical courses as an Erasmus student.

1993–1997	**Baccalaureat**

Liceul Mihail Kogalniceanu, Vaslui (Romania)

Mathematics and physics class

PERSONAL SKILLS

Mother tongue(s)   Romanian

Foreign language(s)

UNDERSTANDING		SPEAKING		WRITING
Listening	Reading	Spoken interaction	Spoken production	
English				
C2	C2	C1	C1	C1
French				
A2	B1	A1	A1	A1

Levels: A1 and A2: Basic user - B1 and B2: Independent user - C1 and C2: Proficient user
Common European Framework of Reference for Languages

Communication skills   I have been organizing outreach events for high school students and the general public and coordinated the IFIN-HH group. I have lectured on high energy physics and international research collaborations topics.

As a science communicator I have participated in radio and TV shows and I have written articles on outreach matters.

I am editing the websites for different scientific communication events.

Organisational / managerial skills   **Organizer of conferences, workshops, schools:**

- Modern Aspects of Quantum Field Theory and Applications, Bucharest PhD training school, 2015, event within CERN – SEENET-MTP program, website
- National conference of the Community for Science education – *Scientix 2015, 2017,* website

■ Măgurele Science and Technology Summer School 2018, <u>website</u>

Since 2013 I am involved in the activities of the outreach group of IFIN-HH and I have proposed, organized or coordinated outreach events on behalf of the institute.

The outreach events range from the ones addressed to secondary school students (Summer schools, Open days at IFIN-HH , LHCb International Masterclass), to teachers (workshops about research and education, webinars, schools, conferences), to university students (job info events) or to the general public (TEDxCERN@IFIN-HH). The projects had also impact through the media channels (facebook page, youtube channel, webpages).

Job-related skills   High Energy Physics, Data Analysis, Mathematical Physics, Machine Learning, Programming

Digital skills

SELF-ASSESSMENT				
Information processing	Communication	Content creation	Safety	Problem solving
Proficient user	Proficient user	Proficient user	Independent user	Independent user

<u>Digital skills - Self-assessment grid</u>

LaTeX, Python, SQL, C++, website development

Letter of recommendation for Dr. Bogdan Popovici

I have known Dr. Bogdan Popovici since 2012 as a colleague in the Department of Theoretical Physics of the Horia Hulubei Institute, Bucharest –- which is the national Physics research institute of Romania.

Bogdan belongs to a select group of highly talented young scientists, whose breadth of scientific interests is truly impressive. While his original research concerned mathematical physics and conformal field theories, he latter switched to applications of computing in experimental high energy physics, working with the LHC collaboration at CERN. During this period, he accumulated extensive knowledge in computer science, including (but not limited to) distributed and grid computing, data analysis and numerical modeling and contributed to a number of relevant software projects within the LHC collaboration. At the same time, he maintained his interest in mathematical aspects of theoretical physics, being an active participant in the Bucharest Seminar on "Geometry and Physics", which is organized jointly by the Horia Hulubei Institute and by the Mathematics Institute of the Romanian Academy (see https://events.theory.nipne.ro/gap/).

Motivated by his long-standing interests in computing, artificial intelligence, quantum and geometric information theory and related branches of mathematical physics, Bogdan has gradually developed a deep passion for various facets of category theory, a subject which he has been studying for many years and which is gradually becoming the main focus of his research. In particular, he is deeply interested in monoidal categories, bicategories and higher categories, while following their increasingly impressive applications to various branches of science.

Given his deep interest in the subject and his extensive expertise in various areas of computing and of theoretical and experimental high energy physics, it is my opinion that Bogdan is well placed to bring new insights to the subject and to develop new applications of category theory to areas in which they were not previously considered. Hence it is my opinion that he would greatly benefit from participation in the ACT 2019 school, to which he could contribute new perspectives. Therefore, I warmly recommend Bogdan for participation in the Adjoint School.

With kindest regards,

Calin Lazaroiu
Center for Geometry and Physics
Institute for Basic Science
Pohang, South Korea

A brief statement (~300 words) on why you are interested in the ACT2019 School. Some prompts:
- **how can this school contribute to your research goals?**
- **how can this school help in your career?**

As mentioned in the background section my interest comes from two directions. First from a theoretical physics point of view to understand the different formulations of quantum theories is a long term goal, and, second from my programming experience, I am able to gauge the importance of having a higher level of representation of computation processes in the overall design. Thus, having a tool like category theory for multiple domains is an opportunity for merging perspectives and new insights.

On a more concrete level in our local institute a new research group is forming in the field of quantum information and quantum technologies. ROQNET (https://roqnet.ro/qutech-ro/) network started last year and is proposing to develop both theoretical and computational methods for quantum fields as well as laboratories and platforms for hardware devices. Having the knowledge in the proposed topics of the school and category theory in general would bring me closer to contribute to this rapidly developing field and to enlarge the expertise in the local network. The diversity of the school's topics is also useful for better mastering the tools and understanding the connections between fields.