Curriculum Vitae

Dr Henrik Gustafsson
Born March 11, 1988, Sweden. Citizenship: Swedish
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Department of Mathematics and
Mathematical Statistics
Umeå University
SWEDEN

Current appointment

Feb, 2022 –	**Assistant Professor, tenure track** (Swedish: biträdande universitetslektor)
Umeå	**Umeå University**
Sweden	Department of Mathematics and Mathematical Statistics

Previous postdoctoral appointments

Sep, 2019 –	**Researcher and Postdoctoral Researcher**
Jan, 2022	**University of Gothenburg**
Gothenburg	Department of Mathematical Sciences (joint with Chalmers University of
Sweden	Technology). Coordinating organization of my postdoctoral grant from the Swedish Research Council.
	Until Sep 2021 my title was "Postdoctoral Researcher" and then "Researcher".

Sep, 2019 –	**Visiting Researcher**
Sep, 2021	**Rutgers, The State University of New Jersey**
New Brunswick,	Department of Mathematics
NJ USA	Faculty mentor: Siddhartha Sahi

Sep, 2019 –	**Member, School of Mathematics**
July, 2021	**Institute for Advanced Study**
Princeton, NJ	Faculty contact: Akshay Venkatesh
USA	

Oct, 2017 –	**Wallenberg Postdoctoral Scholar**
Sep, 2019	**Stanford University**
Stanford, CA	Department of Mathematics
USA	Faculty mentor: Daniel Bump

Education

Aug 25, 2017	**Doctoral degree**
2013 – 2017	**Chalmers University of Technology**
Gothenburg	Degree of Doctor of Philosophy in Fundamental Physics with specialization in
Sweden	Mathematical Physics
	Thesis title: Automorphic forms and string theory: Small automorphic representations and non-perturbative effects
	Thesis advisor: Daniel Persson (Department of Mathematics, Chalmers)
Dec 14, 2015	**Licentiate degree**
Gothenburg	**Chalmers University of Technology**
Sweden	Degree of Licentiate of Engineering in Fundamental Physics with specialization in Mathematical Physics
	Thesis title: Automorphic string amplitudes
	Thesis advisor: Daniel Persson (Department of Fundamental Physics, Chalmers)
Oct 19, 2012	**Degree of Master of Science in Physics**
2011 – 2012	**Perimeter Institute** and **University of Waterloo** (degree-granting)
Waterloo, ON	Perimeter Scholars International
Canada	Thesis title: Minimal Surfaces for Scattering Amplitudes and the Harmonic Oscillator
	Thesis advisor: Pedro Vieira (Perimeter Institute)
Jun 4, 2013	**Degree of Master of Science in Fundamental Physics**
2010 – 2011,	**Chalmers University of Technology**
2012 – 2013	Thesis title: Eisenstein Series and Instantons in String Theory
Gothenburg	Thesis advisor: Daniel Persson (Fundamental Physics, Chalmers)
Sweden	
Jun 1, 2010	**Degree of Bachelor of Science in Engineering Physics**
2007 – 2010	**Chalmers University of Technology**
Gothenburg	Thesis title: Geometry, Topology and Physics
Sweden	Thesis advisor: Per Salomonson (Fundamental Physics, Chalmers)

Grants, scholarships and awards

2019 – 2022
Awarded 2018

Swedish Research Council International Postdoc Grant

Three-year grant from the Swedish Research Council (Vetenskapsrådet) for postdoctoral research. The coordinating organization for the grant is the University of Gothenburg. Hosts: Institute for Advanced Study and Rutgers the State University of New Jersey.

Title: Fourier coefficients of automorphic forms
Principal and sole applicant: Henrik Gustafsson
Project ID: 2018-06774. Project details:
https://www.vr.se/english/swecris.html#/project/2018-06774_VR

Abstract:
My research is in representation theory and number theory studying automorphic forms and their Fourier coefficients. I am currently focusing on two projects regarding:
1. Whittaker functions on metaplectic covers of p-adic groups.
2. Fourier coefficients of automorphic forms in small automorphic representations of adelic groups.

The aim of Project 1 is to explore new connections that we have recently discovered relating multiple Dirichlet series, metaplectic Whittaker functions, quantum groups and solvable lattice models with vertex operators and LLT polynomials. The main tool of this work is the quantum deformed Fock space defined by Kashiwara, Miwa and Stern.

The aim of Project 2 is to evaluate Fourier coefficients of automorphic forms with respect to different unipotent subgroups with applications to string theory and black hole quantum state counting. This will be achieved using deformations of Whittaker pairs as introduced by Gomez, Gourevitch and Sahi.
The projects are parts of the long-term efforts of two different collaborations as detailed in the research plan, with Project 2 including my suggested mentor Siddhartha Sahi at the host institute Rutgers University. There I also give detailed objectives for the two projects ranging from one-year-endeavors to some undertakings that may even stretch beyond the grant period.

At Rutgers I will be able to further develop my collaboration with Siddhartha Sahi and take advantage of the local expertise in vertex operators.

2017 – 2019
Awarded 2017

The Wallenberg Foundation Postdoctoral Scholarship at Stanford University

Awarded a two-year postdoctoral scholarship at the Department of Mathematics, Stanford University. The scholarship is awarded to outstanding young Swedish scientists in all disciplines of science.

Title: Non-perturbative effects and discrete symmetries in string theory
Principal and sole applicant: Henrik Gustafsson
https://kaw.wallenberg.org/en/calls/wallenberg-foundation-postdoctoral-scholarship-program-stanford-university

Abstract:
My research lies at the interface between theoretical physics and mathematics, more specifically between string theory, number theory and representation theory. The aim is to find a detailed, quantum description of non-perturbative effects in string theory such as instantons and black holes. These are examples where the effects from both gravity and quantum mechanics are particularly strong and are crucial to understanding the fundamental laws of any theory of quantum gravity unifying the two pillars of theoretical physics: quantum field theory and Einstein's theory of gravity.

Using the discrete symmetries called U-dualities in string theory the non-perturbative effects can be described by automorphic forms in different automorphic representations. To extract physical information from these automorphic forms, which are functions on higher rank Lie groups, we need to compute their Fourier coefficients with respect to different subgroups. Such coefficients have previously only been computed in a few simple cases, but I, together with my collaborators Axel Kleinschmidt and Daniel Persson, are developing a method for computing all Fourier coefficients of interest in string theory using nilpotent orbits and the adelic framework building on important results from number theory and representation theory. The method would allow us to exactly determine the non-perturbative effects from gravity in string theory.

The mathematical results from this work are explicit expansions of automorphic forms in small automorphic representations with respect to parabolic subgroups in terms of so called degenerate Whittaker vectors extending recent results by Dmitry Gourevitch, Raoul Gomez, Siddhartha Sahi and Stephen D. Miller.

2014 **John Ericsson medal**
Each year Chalmers University of Technology awards six newly graduated students with the John Ericsson medal based on performance. The six recipients were chosen from 750 Master of Science students that graduated from Chalmers in 2013.

2013 – 2017 **Travel/conference grants**
I have also been awarded various travel and conference grants from the following Swedish foundations:
- Stiftelsen Wilhelm och Martina Lundgrens vetenskapsfond
- Stiftelsen Karl och Annie Leons minnesfond för vetenskaplig forskning
- Stiftelsen Lars Hiertas minne
- Stiftelsen Längmanska kulturfonden

Publications

Please see separate List of Publications further down in this PDF file and
My website: https://hgustafsson.se/publications/
Google Scholar: https://scholar.google.com/citations?user=2wIJfBQAAAAJ
ORCID: https://orcid.org/0000-0002-3364-1547

Teaching (recent)

2022 **Calculus in One Variable 2** (7.5 credits)
Course coordinator (Swedish: kursansvarig). Responsible for examination, course administration, preparing and giving lectures as well as tutorials.

Invited talks

Please see https://hgustafsson.se/talks for video recordings, slides and more information.

2023-03-01	Umeå University	*Seminar in Mathematical Modelling and Analysis*
2023-02-07	Aarhus University and Paderborn University	*Geometric and Harmonic Analysis Seminar*
2022-08-23	Isaac Newton Institute, Cambridge	*New connections in number theory and physics*
2022-05-05	Umeå University	*Discrete Seminar*
2021-09-28	Chalmers, Gothenburg	*Algebraic Geometry and Number Theory Seminar*
2021-06-04	Rutgers University	*Lie Group/Quantum Mathematics Seminar*
2021-02-17	Stanford University	*Solvable Lattice Models Seminar*
2020-09-29	Institute for Advanced Study	*Postdoc member short talk*
2020-08-21	University of Ottawa	*Quantum Groups, Representation Theory, Superalgebras, and Tensor Categories : an on-line conference*
2020-07-21	Institute for Advanced Study	*Basic Notions Seminar in Number Theory*
2020-04-30	Institute for Advanced Study and Princeton University	*Joint Number Theory Seminar*
2019-11-13	Yale, New Haven	*Colloquium, Department of Mathematics*
2019-10-04 – 2019-11-01	Rutgers, New Brunswick	*Five-part seminar series in working group: Symmetric functions and applications*
2019-09-25	Institute for Advanced Study	*Postdoc member short talk*
2019-03-06	Simons Center, Stony Brook	*Two-parts overview lecture in workshop: Automorphic Structures in String Theory*
2018-12-18	Chalmers, Gothenburg	*Algebraic Geometry and Number Theory Seminar*
2018-12-07	Rutgers, New Brunswick	*Lie Group/Quantum Mathematics Seminar*
2018-11-28	Stanford	*Quantum Groups Learning Seminar*
2017-12-20	Chalmers, Gothenburg	*Algebraic Geometry and Number Theory Seminar*
2017-07-18	KIAS, Seoul	*Four lectures during the program Arithmetic Geometry and Quantum Field Theory*
2017-01-30	Oxford	*String theory seminar*
2016-12-06	AEI, Potsdam	*Seminar*
2016-11-15	ULB, Brussels	*HEP seminar*
2016-11-03	DAMTP, Cambridge	*String theory seminar*
2016-10-11	IPhT Saclay, Paris	*Séminaire de matrices, cordes et géométries aléatoires*
2016-10-05	Stanford (SITP)	*SITP seminar*
2016-10-04	Stanford (math dep.)	*Representation theory seminar*
2016-09-30	Rutgers, New Brunswick	*Lie Group/Quantum Mathematics Seminar*
2016-09-14	Simons Center, Stony Brook	*Program: Automorphic forms, mock modular forms and string theory*
2016-01-26	Rutgers, New Brunswick	*Number Theory Seminar*
2015-06-22	Strings 2015, Bangalore	*Poster session*

2015-06-11	Advanced Strings School, Bangalore	*Gong-show*
2015-03-17	AEI, Potsdam	*Seminar*
2015-03-10	Chalmers, Gothenburg	*Fundamental physics group seminar*

Workshops, conferences, doctoral schools and extended visits

Events in 2020 and 2021 were online due to the pandemic.

2023-06-05 – 2023-06-16 **New connections between physics and number theory (Workshop)**
Pollica Physics Center, Pollica, Italy

2023-05-01 – 2023-05-03 **Workshop on the representation theory of p-adic groups and connections to quantum groups, geometry and combinatorics**
University of Amsterdam, Netherlands

2022-08-14 – 2022-08-28 **New connections in number theory and physics**
Isaac Newton Institute, Cambridge, UK

2021-10-18 – 2021-10-22 **Elliptics '21**
Uppsala University, Sweden

2021-05-24 – 2021-05-28 **New connections in number theory and physics (Workshop)**
Isaac Newton Institute for Mathematical Sciences, Cambridge, UK

2020-09-29 – 2020-10-02 **New Connections in Integrable Systems**
University of Queensland, Brisbane, Australia

2020-08-20 – 2020-08-23 **Quantum Groups, Representation Theory, Superalgebras, and Tensor Categories : an on-line conference**
University of Ottawa, Canada

2020-05-11 – 2019-05-14 **Conference on Representation Theory and Algebraic Analysis in honor of Joseph Bernstein on the occasion of his 75th birthday**
Weizmann Institute of Science, Rehovot, Israel

2019-03 – 2019-04 **Automorphic structures in string theory**
Simons Center for Geometry and Physics, Stony Brook

2018-06 **Automorphic forms on reductive groups and their covers: A conference in honour of Solomon Friedberg**
ETH, Zürich

2017-10 **Automorphic forms, mock modular forms and string theory**
BIRS, Banff

2017-07 **Arithmetic Geometry and Quantum Field Theory**
KIAS, Seoul

2016-08 – 2016-10 **Automorphic forms, mock modular forms and string theory**
Simons Center for Geometry and Physics, Stony Brook

2016-06 **String-Math 2016**
Collège de France, Paris

2016-05 **Number theory and physics workshop**
Institut Henri Poincaré, Paris

2016-05 – 2016-06 **Program on the mathematics of string theory**
Institut Henri Poincaré, Paris

2016-01 – 2016-02 **Extended visit for collaborations**
Rutgers University, New Brunswick

2015-06 **Strings 2015**
International Centre for Theoretical Physics, Bangalore

2015-06 **Advanced Strings School 2015**
Indian Institute of Science, Bangalore

2014-09 **Journées de Physique Mathématique Lyon**
BPS States, Hitchin Systems, and Quivers
University of Lyon

2014-06 **Strings 2014**
Princeton University and the Institute for Advanced Study, Princeton

2014-06 **Prospects of Theoretical Physics**
Institute for Advanced Study, Princeton

2013-09 – 2013-12 **Amsterdam-Brussels-Paris Doctoral School**
Solvay Institutes (Brussels), École Normale Supérieure (Paris),
University of Amsterdam

2013-06 **Strings 2013**
Sogang University, Seoul

2013-06 **String-Math Conference**
Simons Center, Stony Brook

2013-03 **Spring School on Superstring Theory and Related Topics**
ICTP, Trieste

2013-02 **CERN Winter School on Supergravity, Strings and Gauge Theory**
CERN, Geneva