

# Curriculum Vitae of Prof. Dr. Hans Peter Beck

## Personal data

Name	Beck
Given names	Hans Peter
Born	19 January 1965
Nationality	Swiss
Civil Status	Married, three daughters
Field of interest	Particle Physics
Inspire ID	<a href="https://inspirehep.net/literature/158888">INSPIRE-00065459</a>
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## Degrees

<b>Prof. tit.</b>	University of Fribourg, Switzerland, July 2019
<b>Habilitation</b>	Venia Docendi für Experimentalphysik, University of Bern, Switzerland, November 2004 <i>Trigger and Data–Acquisition in the ATLAS Proton–Proton Experiment at the Large Hadron Collider</i>
<b>PhD</b>	University of Zürich, Switzerland, April 1996 <i>Measurement of the Total Photoproduction Cross Section at the Electron Proton Collider HERA at <math>W_{\gamma p}</math> of 200 GeV</i>
<b>MSc</b>	University of Zürich, Switzerland, February 1991 <i>Design, construction, commissioning &amp; operation of a computer controlled gas–mixing device for the operation of gaseous particle detectors</i>

## Professional record

Dozent I (Reader) at the Laboratorium für Hochenergiephysik, University of Bern, Switzerland, 2006→ (tenure)  
Visiting lecturer at University of Fribourg, Switzerland, 2014→  
Senior researcher at the Laboratory for High Energy Physics, University of Bern, Switzerland, 1999→2006  
CERN scientific associate for the ATLAS and NA52 experiments, CERN, Geneva, Switzerland, 1997→  
Research associate at the Laboratory for High Energy Physics, University of Bern, Switzerland, 1997→1999  
Consultant information engineering with Electrowatt, Engineering Ltd, Zürich, Switzerland, 1996→1997  
Research associate at the Physics Institute of the University of Zürich, Switzerland, 1996  
DESY scientific associate for the H1 experiment, Hamburg, Germany, 1992→1996

## Publications in international peer-reviewed scientific journals

From 1992, author and co-author of 931 peer reviewed papers (incl. papers under current peer review) in international journals, of which 19 are renowned papers with over 500 citations, 55 are famous papers with over 250 citations; 190 are very well-known papers with over 100 citations; and 268 are well known papers with over 50 citations. A full list is available from Inspire: <http://inspirehep.net/author/profile/H.P.Beck.1>

Here, I only list those ATLAS papers in the recent years, where I made major contributions and where I had direct responsibilities in them. I also mention the Higgs discovery paper, where I was deeply involved with, although this is was longer than five years ago.

1. *Measurements of gluon-gluon fusion and vector-boson fusion Higgs boson production cross-sections in the  $H \rightarrow WW^* \rightarrow e\nu\mu\nu$  decay channel in  $pp$  collisions at  $\sqrt{s} = 13$  TeV with the ATLAS detector*  
ATLAS Collaboration, arXiv:[1808.09054], *Phys. Lett. B* 789 (2019) 508
2. *Search for Dark Matter Produced in Association with a Higgs Boson Decaying to  $bb^-$  using  $36\text{ fb}^{-1}$  of  $pp$  collisions at  $\sqrt{s} = 13$  TeV with the ATLAS Detector*  
ATLAS Collaboration, arXiv:1707.01302 [hep-ex], *Phys. Rev. Lett.* 119 (2017) 181804
3. *Measurement of the ZZ production cross section in  $pp$  collisions at 8 TeV using ZZ to  $2l2\nu$  and ZZ to  $4l$  decay channels with the ATLAS detector*  
ATLAS Collaboration, arXiv:1610.07585 [hep-ex], *JHEP* 01 (2017) 099
4. *Measurement of total and differential  $W^+W^-$  production cross sections in proton-proton collisions  $\sqrt{s} = 8$  TeV with the ATLAS detector and limits on anomalous triple-gauge-boson couplings*  
ATLAS Collaboration, arXiv:1603.01702 [hep-ex], *JHEP* 09 (2016) 029

5. *Search for high-mass diboson resonances with boson-tagged jets in proton-proton collisions at  $\sqrt{s} = 8 \text{ TeV}$  with the ATLAS detector*  
ATLAS Collaboration, arXiv:1506.00962 [hep-ex], JHEP 1512 (2015) 055
6. *Evidence for the spin-0 nature of the Higgs boson using ATLAS data*  
ATLAS Collaboration, arXiv:1307.1432 [hep-ex], Phys.Lett. B726 (2013) 120-144
7. *Observation of a new particle in the search for the Standard Model Higgs boson with the ATLAS detector at the LHC*  
ATLAS Collaboration, arXiv:1207.7214 [hep-ex], Phys.Lett. B716 (2012) 1-29

## Oral contributions to international conferences and events

Invited talk and evening lecture, *Particle Physics Outreach as a Strategic Pillar for Society*, XL Brazilian National Meeting on Particle Physics and Fields XLII Brazilian National Workshop on Nuclear Physics, Workshop of the National Network for High Energy Physics (RENAFAE), Campos do Jordão, Brazil, September 2019  
 Invited talk on *CERN physics*, CERN Cognitive Festival, Georgian Technical University, Tbilisi, Georgia, October 2018  
 Invited talk on *IPPOG - Introduction and Activities*, ATLAS collaboration week, Waseda University, Tokyo, June 2018  
 Invited talk on *Science Culture - A particle physicists view* at Swiss Academy of Natural Sciences, Bern, May 2017  
 Invited scientist at the *Inside CERN Event*, Swiss embassy, Tel Aviv, Israel, April, 2017  
 Invited talk on *IPPOG – Enabling Outreach Globally*, ATLAS collaboration week, New York University, July 2016  
 Invited talk on *Worldwide Outreach*, LHCP 2016, Lund, Sweden, June 2016  
 Invited seminar on *Higgs Boson - Year four after its discovery*, University of Göttingen, Germany, February 2016  
 Invited colloquium on *Higgs Boson - Year four after its discovery*, TU Darmstadt, Germany, February 2016  
 Invited plenary talk on *Outreach in the LHC era – Higgs – what’s next?*, ICNFP 2015, Crete, Greece, August 2015  
 Invited plenary talk on *Highlights from precision studies in ATLAS*, Kruger14, 1-6 December, South Africa  
 Invited colloquium *Die Physik des Higgs Bosons*, at University of Jena, Germany, January 2015  
 Invited plenary talk on *Education, communication and outreach*, at ICHEP 2014, Valencia, July 2014  
 Invited colloquium on *Higgs discovery*, University of Fribourg, February 2014  
 Invited podium Switzerland: *Small Country – Big Science*, Swiss embassy, London UK, January 2014  
 Invited plenary talk at Noble symposium on *Higgs discovery*, University of Oslo, Norway, December 2013  
 Invited talk on *Higgs discovery*, Deutsche Physikalische Gesellschaft, Bad Honnef, German, July 2013  
 Invited talk on *Higgs discovery*, University of Jena, Germany, July 2013

## Institutional responsibilities

I am reader (Dozent I) at the physics department at University of Bern, co-responsible for the physics education of the medical students at University of Bern. I am the delegate for physics and astronomy for the *Qualitätssicherung und -entwicklung* (QSE) of the Faculty of Natural Sciences at University of Bern. I am also co-responsible for the *Physik am Freitag* lecture series and the *Physics Masterclasses*, both targeted for high-school students in the wider surroundings of Bern.

## Approved research projects

Since 2006 continuous, co-applicant of several SNF approved project funding (Div. II), FORCE, FLARE, ProDoc. My contributions to all these requests and research activities were all related to particle physics research with the ATLAS detector at the Large Hadron Collider. See <http://p3.snf.ch/person-44954-Beck-Hans-Peter> for details. I was granted the SNF/AGORA project *Interactions - Swiss particle physicists initiate a dialogue with society* (2013-2015)

## Teaching activities

Since 2006 I am lecturing regular courses for graduate and undergraduate students at University of Bern; since 2014, I am also lecturing at University of Fribourg. A summary of my courses follows:  
 Physics II / Modern Physics for 2<sup>nd</sup> semester undergraduate physics major and physics minor students (yearly 2006-2014);  
 General physics for 1<sup>st</sup> and 3<sup>rd</sup> semester undergraduate students of medicine (yearly since 2008→);  
 The Standard Model of Particle Physics, specialist course for 6<sup>th</sup> and 8<sup>th</sup> semester physics master students (yearly 2008→);  
 Introduction to Particle- and Nuclearphysics for 4<sup>th</sup> semester physics students in Fribourg (yearly since 2017→)  
 Particle physics for 5<sup>th</sup> and 7<sup>th</sup> semester physics students (combined, one class) in Fribourg (even years since 2014→);  
 Further, individual lectures and lecture series in Advanced Methods in Modern Particle Physics; Physics of the Standard Model and Beyond; Accelerator Physics; etc. (at irregular intervals since 2006)

## Memberships in panels, boards, etc., and individual scientific reviewing activities

Elected member of the ATLAS Speakers Committee, 2015→2018

Elected member of the ATLAS Publication Committee, 2012→2014  
 Member and chair of editorial boards for ATLAS analyses in Higgs, Standard-Model, and exotics physics (2011→)  
 Chair of the Higgs to four leptons editorial board, leading to the Higgs boson discovery in 2012, January 2012→2014  
 Elected Chair of the International Particle Physics Outreach Group (IPPOG), which I turned into a formal scientific Collaboration with its own funding structure in 2016. IPPOG reports to CERN Council, to the CERN Science Policy Committee (SPSC) and to ECFA, 2013→  
 Swiss delegate to the International Particle Physics Outreach Group (IPPOG), 2009→2017  
 Member of the CHIPP Board (Swiss Institute for Particle Physics) Outreach Coordinator, 2009→  
 Elected chair of the ATLAS Trigger and Data-acquisition (TDAQ) Institutional Board, in charge of resources and project planning involving 73 institutions and ca. 500 authors of TDAQ, 2009→2011  
 Elected member and chair of the ATLAS Speakers Committee Advisory Board, 2007→2010, chair 2008→2010  
 Elected member and chair of the TDAQ Speaker Committee, 2003–2006, chair: 2005–2006  
 Elected member of the TDAQ Steering Group, in charge of DataFlow, EventBuilding, Trigger selection, and data storage of ATLAS data, 2000→2011  
 Scientific contact person for the NA52 experiment, 1998→2002  
 Group leader of the NA52 experiment in matters of safety (GLIMOS), 1998→2002  
 Swiss delegate to the European Committee for Future Accelerators (Plenary ECFA), 1997→2003  
 External referee in the scientific evaluation of proposals submitted to the ERC Starting Grant  
 Refereeing IEEE TNS, refereeing JINST, refereeing NIMA, refereeing Journal of Physics conference series, refereeing Physica Scripta

Reporting to CERN Council and to Restricted ECFA (RECFA) on IPPOG activities

### **Active memberships in scientific societies, fellowships in renowned academies**

IUPAP: Swiss delegate and voting member, 2019→  
 EPS: Member of the European Physical Society Council, Swiss delegate, 2016→  
 SPS: President of the Swiss Physical Society, 2017→  
 Vice-president of the Swiss Physical Society, 2016→2017  
 Chair of the particle, astroparticle, and nuclear physics division of the Swiss Physical Society, 2014→2016  
 Chair of the physics education and promotion division of the Swiss Physical Society, 2013→2017

### **Organisation of conferences**

Member and chair of several local and scientific organizing committees and/or session convener at a number of international conferences, workshops, symposia, international meetings and events, inviting speakers, chairing sessions, etc.: HCP, SPS, IPPOG, ATLAS, SCNAT, etc.

During my term in the ATLAS speakers committee, in continuous contact with conference organizers, for organizing ATLAS contributions, talks, abstracts, and names of speakers.

### **Major scientific achievements**

#### **Summary**

My scientific interests are in the precise understanding of the Standard Model and in new physics beyond the Standard Model at the high-energy frontier, which is accessible with the LHC. I had major contributions and leadership responsibilities since the early days of the ATLAS experiment at CERN's Large Hadron Collider, where I was designing key elements of the trigger and data acquisition system (TDAQ), its development, construction, commissioning and operations. I was deputy group leader of the Bern ATLAS group till 2011, and chair of the ATLAS TDAQ collaboration board, where I was responsible of resources and project planning involving 73 institutions and ca. 500 authors of TDAQ. Throughout the year 2012, I was responsible for the Higgs to four leptons,  $H \rightarrow 4\ell$ , analysis in ATLAS, where I was chair of the editorial board, finalizing and optimizing the analysis, scrutinizing the methods proposed, and leading the writing of the Higgs discovery conference contribution for the ICHEP 2012 conference in Melbourne, where the Higgs discovery was first announced via broadcast from the CERN auditorium on 4 July 2012. Ever since, I am continuously pushing Higgs properties analysis studies not only in the four leptons channel, but also in the  $H \rightarrow WW$  channel and including various production modes, gluon-gluon fusion (ggF), vector boson fusion (VBF), Higgsstrahlung (WH). I was strongly involved in the first assessments of the spin, charge conjugation and parity estimation of the newly found Higgs particle. I commit myself also to complementary efforts in Standard Model precision measurements, mainly in processes involving electroweak interactions, which nicely complement the Higgs studies. Especially differential distributions of kinematical properties of electro-weak produced particles at LHC energies allow for further insight in the mechanics of the Standard Model and allow for theorists and phenomenologists to further improve the methods of higher loop calculations, handling of soft resummation terms, determining the parton density functions of partons inside the proton, the handling of the underlying event structure and the hadronization and showering scheme. All will finally lead to an improved understanding of the physics processes involved and leading to continuously improving Monte-Carlo based event generators.

## **ATLAS experiment at CERN's Large Hadron Collider, 1997 – today**

I joined the ATLAS collaboration in 1997, where I have been involved in the design, development and assessment of the online event–selection scheme and the data–acquisition system for the ATLAS detector. During this time, I was able to define large parts of the online data–acquisition and event–selection architecture. It was due to my strong pushing that the ATLAS event builder follows a pull paradigm, rather than the former standardly used push paradigm. This allowed controlling the flow data packets in such a way that traffic jams could largely be avoided; with the price of somewhat larger buffering capacities needed upstream the data path. A common framework was needed to analyse event fragments at the 2<sup>nd</sup> level trigger and full events at the final trigger stage, which I designed while leading the DataCollection group of TDAQ in 2000–2011 and that finally enabled the integration of these two trigger levels into the ATLAS High Level Trigger. For over ten years, I served in the TDAQ steering group from 2000 to 2011. I was chief editor of the ATLAS High–Level Triggers, DAQ and DCS: Technical Proposal, chair of the ATLAS TDAQ Speakers Committee, and chair of the TDAQ Institutional Board from 2009–2011.

I served in the ATLAS Speakers Committee Advisory Board, which I chaired in 2009. In there, the rules and fair share of ATLAS physicists were established and further refined. With 3000 physicists in ATLAS, and only a modest number of international conferences on high energy physics taking place annually world-wide, ATLAS physicists have to wait in average three years for giving a single talk at an international conference where they are allowed to speak on behalf of the ATLAS collaboration. Only with a clear metric defined, taking into account contributions to the detector operation, and their contributions to the understanding of the detector, and involvement in physics analysis efforts, fair treatment can be established. Even personal invitations from conference organizers to individual members of the ATLAS collaboration cannot be accepted as such, and must be agreed by the ATLAS Speakers Committee first in order to establish a fair share of talks per individual physicist. From 2012 to 2014 I served in the ATLAS Publication Board, where I was responsible for many of the ATLAS analyses to get formalized and ready for publishing, predominantly for Higgs searches at low and high Higgs mass, for exotic searches, and in particular for Standard Model precision measurements in the electro weak sector with single and di-boson production of W and Z bosons. During the time of the Higgs discovery, I assumed direct responsibilities for the Higgs to four leptons channel and was the chair of the editorial board that supervised and guided the analysis and its defence within the ATLAS Collaboration. The ATLAS Collaboration publishes ca. 100 physics papers in peer reviewed journals annually, involving senior physicists organized in editorial board teams to scrutinize, improve, guide, and edit the analyses, their tools and methods, their internal documentation. Per analysis many hundreds of pages are usually written in ATLAS internal documents, containing cross checks from several working groups active on various aspects such as establishing proper object selection, reducible and irreducible background estimates in all the different final state channels, the signal extraction, fitting procedures, etc., before the writing of the paper can even start. Once a paper written, the ATLAS internal review process takes over allowing the full ATLAS collaboration to comment and the editorial board and the analysers to response. After this step, final sign-off for publishing is given to the Spokesperson for papers, and to physics coordination for conference contributions. I am regularly signing-off ATLAS publication drafts on behalf of the ATLAS physics coordination.

I was elected member of the ATLAS Speakers Committee in 2015–2018, responsible for selecting deserving members of the ATLAS Collaboration to present its latest results at international conferences, assuring their high-quality presentation.

I have been invited speaker on various occasions at national and international conferences, workshops and events. I was one of the three invited guest speakers at the Higgs Symposium on 8 December 2013 in Oslo, organized by University of Oslo on the very day of the Nobel Prize celebration in Stockholm, where Peter Higgs and François Englert were awarded with the 2013 Nobel Prize in physics.

I intend to further contribute to ATLAS globally, through my long-time experience in ATLAS through all layers of the organization, and in close contact with ATLAS physics coordination and upper level management. With the new collision data being collected, many interesting analyses can be pursued with higher and higher precision. As no spectacular beyond standard model signature could be found or could be established so far, and as no substantial increase in collision energy will be possible, I will invest myself in the years to come for precise determination of the properties of the Higgs (especially the couplings to fermions and bosons) and of the Standard Model itself (precise differential cross-section measurements of many kinematical distributions of decay products of the Higgs particle itself, and of the weak bosons, W and Z. This will allow further establishing the Standard Model as such, and therefore increase its precision power at high energies, or, possibly, it will allow to find cracks in the Standard Model, where new physics could lurk, e.g. through measured couplings outside their predicted Standard Model values.

## **H1 experiment at DESY's HERA electron-proton collider, Hamburg, Germany, 1990 – 1996**

Although this experiment is long past history, I list it here as it shaped my interest in high-energy physics, shows my complementarity to ATLAS, which is a true lifetime investment, and explains where my interest and expertise in trigger and event selection are stemming from. Indeed, the best detector, and the best physics intention are worth nothing if the not the right data is selected to be read out and stored. Selecting the right data, however, requires a deep understanding of the underlying physics processes in order to tune and steer the trigger strategy.

## Outreach activities

I do have an outstanding interest in science communication, education and outreach. As such, I am responsible for the Swiss institute for particle physics (CHIPP) outreach activities, where I have initiated and lead the “Verflixtes Higgs” project in 2012 after the Higgs particle discovered. This project was initially funded by the Swiss state secretary for education and research (SERI), which allowed to start a bigger follow-up project “Interactions - Swiss particle physicists initiate a dialogue with society”, funded by SNF/Agora (2013-2015). This effort then enabled and initiated the Swiss particle physics portal <http://www.teilchenphysik.ch>, which is now residing in the web portal of the Swiss Academy of Sciences (SCNAT) <http://www.naturalsciences.ch>, where I also receive some funding for further maintaining it.

With ‘Interactions’, I’ve organized podium discussions involving the broad public, I was screening the movie Particle Fever at open air cinema, organized high-school teachers education at CERN, gave interviews in the Swiss printed press, appeared in Swiss TV shows (Rosanna checkt’s, Müslüm TV), etc. A more complete list is available from the SNF P3 database <http://p3.snf.ch/Project-145626>, and from the particle physics topical portal of the SCNAT: <http://www.naturalsciences.ch/topics/particlephysics>

I am founder and one of the two elected chairpersons of the IPPOG collaboration. IPPOG, the international particle physics outreach group, is a scientific collaboration comprising 27 signing member-organizations (countries, laboratories, experiments) whose goal is to maximize the impact of education and outreach efforts related to particle physics. Current signing members are: Australia, Austria, Belgium, Brazil, Czech Republic, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Sweden, Switzerland, USA; CERN; and the experimental collaborations ALICE, ATLAS, CMS, LHCb, at the Large Hadron Collider (LHC), and the Belle 2 collaboration at KEK, Japan. IPPOG formerly was a relatively small group of people interested in particle physics outreach activities. Since I took over its lead, I evolved this group into a scientific collaboration, funded through membership fees, based on a memorandum of understanding (MoU) defining the purpose, governance and obligations of IPPOG and its members. It’s organization and structure follow closely the way large-scale experimental collaborations are organized in particle physics, and allows to solidify and professionalize the impact IPPOG can generate. IPPOG is explicitly mentioned in the European strategy report for particle physics in 2013. IPPOG is raising standards and is visible internationally through its contributions to international conferences on particle physics as well as international conferences on physics education. The flagship activity of IPPOG is the annual organization of the physics masterclasses, where in 2018 alone over 14’000 high-school students in 48 countries world-wide were trained in particle physics and were analysing real collision data from the LHC.

A few articles related to IPPOG:

1. *Future Challenges in Particle Physics Education and Outreach*  
H.P. Beck and Steven Goldfarb  
Contribution to the European particle physics strategy update 2020  
<https://naturalsciences.ch/service/publications/109093-ippog-for-the-european-strategy-update>
2. *Viewpoint: Reaching out in the era of big science*  
H.P. Beck  
<http://cerncourier.com/cws/article/cern/67712>  
CERN Courier – Feb 15 (2017)
3. *Some ethical questions in particle physics*  
H.P. Beck, I. Melo, T. Naumann  
<http://www.uniza.sk/komunikacie/menu/komunik.asp?id=4&v=a&rok=2017>  
Communications - Scientific Letters of the University of Žilina, Volume 19, January 2017
4. *International Masterclasses in the LHC era*  
H.P. Beck, et al  
<http://cerncourier.com/cws/article/cern/57305>  
CERN Courier – May 22 (2014)

## General contributions to science

### Swiss Physical Society

At the general assembly meeting of the Swiss Physical Society (SPS) in August 2017 at CERN, I was elected president of SPS. The SPS is a learned society uniting persons interested in physics from universities, schools, research, development and industry, and promotes the scientific exchange of ideas in Switzerland and with its international environment. Before becoming president, I was elect vice-president (2016), chair of the SPS division on particles,

astroparticles, and nuclei (2014), and chairing the education and promotion of physics division (2013). Both these tasks did complement nicely my outreach activities and useful contacts could be established in- and outside Switzerland. As vice-chair of this society, I am able to further push the image physics has in society to the recognition it deserves, promoting women where possible and reasonable to further reduce the gender bias in physics, and to work towards a better understanding of Big Science projects: why these are necessary, what these imply for science and for the recognition of the individual scientists working in mega projects.

A few selected articles that I wrote in the context of the Swiss Physical Society:

5. *Global Warming and the Role of Science*  
H.P. Beck  
<http://www.sps.ch/fileadmin/doc/Mitteilungen/Mitteilungen.56.pdf>  
Swiss Physical Society – Mitteilungen Nr. 56 (2018)
6. *Big Science – Assessing Collaborative and Individual Merits*  
H.P. Beck  
<http://www.sps.ch/fileadmin/doc/Mitteilungen/Mitteilungen.49.pdf>  
Swiss Physical Society – Mitteilungen Nr. 49 (2016)
7. *The Nobel Prize in Physics*  
H.P. Beck  
<http://www.sps.ch/fileadmin/doc/Mitteilungen/Mitteilungen.41.pdf>  
Swiss Physical Society – Mitteilungen Nr. 41 (2013)

and a further article (in German), targeted to high school teachers that explains the Standard Model and Higgs mechanism:

8. *Das verflixte Higgs – Die Sache mit der Masse- wieso braucht es ein Higgs-Boson, um das Universum zu verstehen?*  
H.P. Beck  
Astronomie und Raumfahrt im Unterricht Jg. 51, Heft 6, 27-33 (2014)