

Bonn Physikshow

Herbert Dreiner, Michael Kortmann, Ewald Paul, & Sascha Heinz
and over 180 Bonn University physics students

1 Awards

2006 Alumni Preis der Universität Bonn

2009 European Physical Society High Energy Physics Outreach Prize

2012 Within the framework of the SFB TR-110 we were awarded a large four year grant (k€60) by the DFG to travel with our Physikshow at least once per year in Europe and also once to China.

2 Highlights

- 2004 Video ‘*Ship Floating on air*’ receives over 5 million viewings on YouTube.
- 2006 – 2013 Performed three times with three shows each at the Deutsches Museum, München.
- 3.10.2011 performed at the main stage of the Deutschlandfest at the Bonn Münsterplatz in front of over 10,000 people (central festivities in honour of the German national holiday).
- Sept. 2010 performed the 2nd Particle Physics Show at CERN, Geneva, Switzerland in French.
- Mar. 2014 six performances of new particle physics show on the Higgs and the LHC at Oxford University and University College London, UK.
- Mar. 2015 four performances of new particle physics show on the Higgs and the LHC at Padua University and ICTP, Trieste, Italy.
- Have “sold out” over 70 performances in the Wolfgang-Paul Lecture Hall at Bonn University, with a capacity of 520 people, reaching over 35,000 people.
- Over 180 Bonn physics students trained in science outreach in the Physikshow.

3 Publications

1. *It’s Physikshow time in Germany*
Herbert K. Dreiner
CERN Courier 9 (2007) 30.
2. *A Physics Show Performed by Students for Kids: From Mechanics to Elementary Particle Physics*
Herbert K. Dreiner,
Physics Teacher 46 (2008) 358 (refereed journal); e-Print: physics/0701344.

3. *Fun physics in school: students perform for students*
Herbert K. Dreiner, and Tobias Strehlau
Science in School 9 (2008) 46.
4. *Physique? C'est tout le Français à moi*
Herbi Dreiner
Guardian Newspaper, Life and Physics, Sept. 22nd, 2010.
5. *SLAM POW BANG: On Tour in England with the Bonn Physics Show*
Herbi Dreiner
Guardian Newspaper, Life and Physics, March 13th, 2014.

4 Physikshow

The Bonn Physikshow was founded in Dec. 2001 by Prof. Herbert Dreiner, Ph.D. and Michael Kortmann. This is about 6 months before the Kinderuni started in Tübingen, Germany. Ewald Paul joined in 2004, specifically for the particle physics shows. Sascha Heinz joined in 2010. All are members of the Physikalisches Institut, Universität Bonn. The typical feature of the Bonn physics shows is that they are developed and performed by the university physics students. Also, most shows feature a storyline to hold the attention of the audience and put the experiments in a context. It is important to note that essentially all activities below included an extensive involvement by Michael Kortmann or Sascha Heinz or both. In particular in each trip at least one of them accompanied the show and was responsible for all technical safety issues. No entrance fee is charged for the shows.

4.1 Annual Shows

Every year since 2002 we have been performing a new show in autumn, typically in September. It is the core activity of the Bonn Physikshow. This consisted of three performances, with two on the weekend for a general audience and one in the morning on schooldays for school classes. The school classes mainly come from Bonn and the immediate vicinity, but we also regularly have classes from Köln and Aachen and even as far as Dortmund or Rostock (once). The show is repeated the following March. All shows have basically been sold out from the beginning, with over 500 people per performance. Since October 2003 the shows have had a story line, which presents a significant novelty in outreach physics. The shows always have two main protagonists, one woman, and one man. Typically 20 university physics students take part.

Performances: Since 2002, 6 performances per year in Bonn. (No new show 2010 and 2014.)

4.2 Particle Physics Shows

Most physics shows involve classical physics demonstration experiments, typically for children. In 2004 we in Bonn took on the challenge of developing the show concept to explain modern physics, in this case the physics of elementary particle physics. We believe we are the only people doing this. This concept was further developed in 2008 and 2014. Prof. Ewald Paul was involved from the beginning in 2004.

1st Particle Physics Show 2004: In 2004 CERN celebrated its 50th anniversary. For this occasion we developed for the first time a show on elementary particle physics. In the show we went through the topics: (i) Atomic & Nuclear Physics; (ii) Elementary particle Zoo; (iii) Forces and Symmetries, (iv) Astrophysics and Cosmology. The show involved many demonstration experiments and had as a running theme the new particles introduced. *Performances: four times in Bonn, 2004.*

2nd Particle Physics Show 2008: In 2008 we were invited by the BMBF (German national ministry for Education and Research) to perform a show on particle physics at the national exhibition ‘*Weltmaschine*’ (World Machine) on the occasion of the launch of the LHC. This was a considerably modified version of the first particle physics show, but still following the same four physics topics. We initially performed four times in the Berlin U-Bahn Station *Bundeskanzleramt*, in Nov. 2008.

Performances: Berlin (4x, Nov. 2008); DESY Hamburg (3x, Sept. 2009); Heidelberg University (3x, Dec. 2009); Deutsches Museum München; CERN, Geneva (3x, Sept. 2010); Bonn, Wolfgang-Paul Lecture Theater (1x, Nov. 2010) .

3rd Particle Physics Show 2014: In the summer of 2013 we received the invitation to perform our show in Oxford and London, UK, in March 2014. For this we developed a brand new 90min Particle Physics Show. This show focused on the topics of accelerators and the Higgs boson. It involved now a story line with two proponents travelling back in time to visit famous physicists in their own laboratories and understand their contributions. The locations were Rutherford in Manchester, UK, 1910; Lawrence in Berkeley, Calif., USA, in 1950; Sau Lan Wu at DESY Hamburg, 1980 and CERN, 2014. About 15 studentns involved in each performance.

Performances: four performances at Oxford University, in Oxford, UK, Mar. 2014; two performances at UCL, in London, UK, Mar. 2014; one performance at the Deutsches Museum, Bonn, Bad Godesberg, May 2014; three performances at Padua University, Padua, Italy, Mar. 2015, one performance at ICTP (International Centre for Theoretical Physics), Trieste, Italy, Mar. 2015.

4.3 Mond Show (Moon Show)

In 2009 several students developed a physics show to accompany an art exhibit at the Wallraf-Richartz Museum in Köln. The exhibition was co-organised by Ludmila Piters an art history student and former physics student and was entitled ‘*Der Mond*’ (The Moon). The show was called ‘*Odyssee im Weltraum*’ (Odyssee in outer space) and focused on topics in astronomy, astrophysics, and cosmology.

Performances: 4 performances in the Wallraf-Richartz Museum Köln, Aug. 2009; two performances in Solingen Feb. 2010, hosted by the Sternwarte Solingen; two performances in Bonn May, 2010.

5 List of Annual Shows performed in Bonn

This is our central activity, where we focus most of our energy.

Nov. 2002: Two 2-hr physics shows for 12-14 year old high school students; organised and performed together with 17 third year physics students. Attracted audience of 650 people per show.

Mar. 2003: Repeat of the Nov. 2002 show.

- Oct. 2003:** New 2-hr show entitled ‘*Odyssee durch die Physik*’ (Odyssee through physics).
- Mar. 2004:** Repeat of ‘*Odyssee durch die Physik*’ show.
- Sept. 2004:** 2-hr show entitled ‘*Wer nicht fragt bleibt dumm*’ (Sesame Street theme).
- Mar. 2005:** Repeat of previous show.
- Sept. 2005:** New 2-hr show ‘*Zeitreise durch die Physik*’ (Time travel through physics).
- Mar. 2006:** Repeat of ‘*Zeitreise durch die Physik*’ show.
- Sept. 2006:** New 2-hr show ‘*Episode V*’ (Show set up as a computer game with four levels.)
- Mar. 2007:** Repeat of ‘*Episode V*’ show.
- Sept. 2007:** New 2-hr show ‘*Physik im Alltag*’ (physics in everyday life).
- Mar. 2008:** Repeat of previous show.
- Sept. 2008:** New 2-hr show ‘*Per Anhalter durch die Physik*’ (Hitchhiker’s Guide to Physics).
- Mar. 2009:** No show due to construction on lecture hall.
- June 2009:** Repeat of ‘*Per Anhalter durch die Physik*’ show.
- Sept. 2011:** New 2-hr show ‘*Physiker, Wetten dass ...?*’ (Physics in a game show).
- Mar. 2012:** Repeat of previous show.
- Sept. 2012:** New 2-hr show ‘*20th Century Physics Proudly presents*’ (Film and TV studios: cooking show, James Bond, Dinner for One, Galileo Mystery).
- Mar. 2013:** Repeat of previous show.
- Sept. 2013:** New 2-hr show ‘*In 80 Minuten durch die Physik*’ (In 80 days through physics, à la Jules Verne).
- Mar. 2014:** Repeat of previous ‘*In 80 Minuten durch die Physik*’ show.
- Sept. 2015:** New 2-hr show ‘*Sherlock Holmes*’

6 Additional Shows and Performances in Bonn

- June 2004:** Physics Show at the local *Wissenschaftsnacht* (Bonn University Science Night).
- Oct. 2004:** Three performances of the 1st Particle Physics Show in the Wolfgang-Paul Lecture Theater.
- July 2006:** ‘*Wassershow*’ (Water show) at *Wissenschaftsnacht* (Bonn University Science Night) at Bonn University. Afterwards joint performance with the team from the TV show *Kopfball* on the central stage.
- June 2007:** Science table at a family fun fair in the Rheinaue park in Bonn, Germany.
- Nov. 2007:** Physics show at the celebration of the opening of the Bonn Cologne Graduate school of physics (BCGS).

- Apr. 2010:** 4hr hands-on physics table at the inner courtyard of the main building of Bonn University.
- Dec. 2007:** The students organised on their own a special Christmas Physics Show for the Bonn University community.
- June 2010:** Show on *Energy Physics* and a stand at the Bonn University Science Night.
- Nov. 2010:** Performance of the 2nd Particle Physics Show in the Wolfgang-Paul lecture theatre in Bonn.
- Sept. 2013:** Two performances of a 30min show *Party Physics* in the Botanical Gardens of Bonn University at the annual celebration of the Bonn University administrators.
- Nov. 2013:** One performance for the opening of the exhibition *Der Teilchenfänger* on Wolfgang Paul at the Deutsches Museum, Bonn, Bad Godesberg.
- June. 2015:** Four performances of a 30 min show *Physics & Cooking* in the Deutsches Museum, Bonn, Bad Godesberg.

7 International Shows & Trips

It requires a huge logistical and also financial effort to travel with the physics show. Typically we travel with two VW Transporters full of equipment and between 15 and 20 students. Travelling abroad has additional requirements with respect to transporting radioactive sources. These shows all involved overnight stays, which are very expensive.

- Sept. 2010:** We performed the 2nd Particle Physics Show three times in the Globe at CERN, Geneva, Switzerland in French! The topics included: (i) Atomic & Nuclear Physics; (ii) Elementary particle Zoo; (iii) Forces and Symmetries, (iv) Astrophysics and Cosmology.
- Mar. 2014:** We performed the 3rd Particle Physics Show four times at Oxford University and twice at University College London. The show focused on the Higgs and consisted of a time travel story, with visits to Rutherford in Manchester 1910, Lawrence in Berkeley in the 1950s, Sau Lan Wu at DESY Hamburg in 1980, and to CERN 2014.
- Mar. 2014:** Repeat of the 3rd Particle Physics Show at Padua University, Padua, Italy (3 performances), and at ICTP Trieste, Italy (one performance).

8 Performances of Shows throughout Germany

- Sept. 2005:** Deutsches Museum, Bonn, Bad Godesberg. We performed a 30min show on the theme of ‘*Physics at Parties*’ at 10th anniversary party of the museum.
- Dec. 2005:** Joint performance with Köln drama group c.t.201 on “Werner Heisenberg, Leben und Werk” (Werner Heisenberg, Life and Work) at the Crown Plaza Hotel in Köln.
- Mar. 2006:** Three performances of the show ‘*Wer nicht fragt bleibt dumm*’ (Sesame Street theme) at the Deutsches Museum, München.

- May 5th, 2008:** 40min Show on the theme ‘*Travelling the world*’ at Göttingen University within the weekly colloquium; combined with a 30 min talk about the physics show.
- Nov. 2008:** Four performances of the 2nd Particle Physics Show at the BMBF (German national ministry of Education and Research) funded exhibition ‘*Weltmaschine*’ (World machine) to mark the launch of the LHC at CERN. The exhibition was hosted in Berlin, in the U-Bahn station ‘*Bundeskanzleramt*’ between the Bundeskanzleramt and the Reichstag.
- Jan. 2009:** 45min physics show within the colloquium at the Bergische Universität Wuppertal, Germany.
- Mar. 2009:** Three performances of the 2nd Particle Physics Show at the Deutsches Museum, München.
- Aug. 2009:** Four performances of the Show ‘*Odyssee im Weltraum*’ at the Wallraf-Richartz Museum in Köln, accompanying the art exhibit ‘*Der Mond*’.
- Sept. 2009:** Three performances of the 2nd Particle Physics Show at DESY, Hamburg.
- Dec. 2009:** Three performances of the 2nd Particle Physics Show at Heidelberg University, Germany.
- Feb. 2010:** Two performances of the ‘*Odyssee im Weltraum*’ Show in Solingen, Germany, upon invitation of the Sternwarte Solingen.
- Oct. 3rd, 2011:** We performed a 30min show on the theme ‘*Physics at Parties*’ on the central stage at the Deutschlandfest in Bonn. There were approximately 10,000 spectators there. (Immediately after us Wolfgang Niedecken performed with the WDR Big Band.)
- 18th Mar. 2012:** We performed the ‘*Physiker Wetten, dass ...*’ show at the Baykomm communication center of Bayer Leverkusen.
- Feb. 2013:** 60 min show on the frequency range in electromagnetism at the Lions Club Düren. Ticket sales went as a donation to a local elementary school.
- Mar. 2013:** Three performances of the show ‘*20th Century Physics Proudly Presents*’ (TV and Movies theme) at the Deutsches Museum, München.
- Nov. 2013:** We performed a 15min physics show on the occasion of the opening of the exhibition *Wolfgang Paul: Der Teilchenfänger* (Wolfgang Paul: the particle catcher).
- May 2014:** We performed the 3rd particle physics show (100 min) at the Deutsches Museum, Bonn, Bad Godesberg as part of the exhibit *Wolfgang Paul: Der Teilchenfänger* (Wolfgang Paul: The Particle Catcher).
- June 2014:** Three performances of the show ‘*In 80 Minuten durch die Physik*’ at DESY, Hamburg.
- Jan. 2015:** We performed a 30 min show: *Physik Quizshow*, at the Industry Museum, LVR (Landschaftsverband Rheinland) Oberhausen, Zinkfabrik Altenberg.
- Feb. 2015:** We performed a 70 min show: *Eine Reise mit Heinrich Hertz durch das Elektromagnetische Frequenzspektrum* at the communications center BayKomm of Bayer Leverkusen, in Leverkusen, Germany.

9 Euro Physics Fun

Euro Physics Fun is a European organisation of physics shows. It was started in Leiden, NL in 2005. EPF has annual meetings where people active in physics shows meet and exchange ideas. We have attended and performed at the following meetings

- **Mar. 2007** Leiden, Nederland
- **Apr. 2010** Bad Honnef, Germany
- **Apr. 2011** Kharkiv, Ukraine
- **Apr. 2012** Bergen, Norway
- **Apr. 2013** Göttingen, Germany

10 Work in Schools

Autumn 2007: Under our supervision a group of high school students of the Amos-Comenius-Gymnasium, Bonn, Bad Godesberg, performed a physics show (2 shows) for their fellow high school students in their own school. We provided most of the experiments. The university students tutored the high school students on how to do a show. Article on this published in ‘Science in School’.

Spring 2008: A 10 part afternoon hands-on physics activity at the Münster Elementary school, Bonn. It was organised by 8 physics show students and involved fourth grade 15 children at the school.

June 2008: Project work with 3 classes of second graders on electrical currents in the Catholic Elementary School, Holzlar.

Autumn 2008: A 10 part afternoon hands-on physics activity at the Münster Elementary school, Bonn. It was organised by 8 physics show students and involved fourth grade 15 children at the school.

Winter 2010: A 10 part afternoon hands-on physics activity at the OGS Josefsschule in Bonn Beuel (local elementary school). It was organised by 8 physics show students and involved fourth grade 15 children at the school.

Spring 2012: Repeated the Amos-Comenius-Gymnasium effort at the Clara-Schumann Gymnasium, Bonn. Two performances by the older high school students for their fellow students. The show was organised as a talent show.

11 Kinderuni

June 2005: Kinderuni Bonn, 30min show for 8 year old kids on the topic ‘*Atome – gemeinsam sind wir stark*’ (Atoms, together we are strong).

Apr. 2009: Kinderuni Bonn, 30min show for 8 year old kids on the topic ‘*Wat es de LHC? Über die größte Maschine der Welt*’ (What on Earth is the LHC? On the largest machine in the world).

12 Television & Radio

- June 2004:** Provided several experimental ideas for the SAT1 show *Clever*. The experiments were used but not credited.
- June 2005:** Ten 3min films of experiments produced with professional WDR team. Broadcast over several weeks on the WDR Lokalzeit Bonn. Students moderated the films.
- Sept. 2005:** Interview in *Die Kleine Cordula Stratmann Show*.
- Oct. 2008:** Judith Wild (geb. Schindler), a member of the Physikshow team, appeared on the German science TV show *Kopfball* in a 15min segment to explain the physics of going down water slides.
- Nov. 2008:** 25min interview on WDR5 show *Redezeit* with Sabine Brandi discussing the Bonn Physikshow.
- Apr. 2011:** 20min segment on *Quarks & Caspers*, a WDR TV show, on ‘*Wie kocht man das perfekte Ei?*’ (How to boil the perfect egg).
- Apr. 2012:** Herbert Dreiner was a main guest on Horst Lichter’s (famous German TV cook) show ‘*Lichter’s Schnitzeljagd*’. 20min appearance with several Physikshow experiments.
- Sept. 2012:** Report of Deutsche Welle on the Bonn Physikshow.
- Sept. 2012:** Contribution in the *ARD Buffet* TV show on the topic ‘*Warum wird der Wasserkocher kurz vorm Kochen immer ganz leise?*’ (Why does the tea kettle turn silent just before boiling?).
- Jan. 2013:** WDR complete coverage (film and radio) of a science slam in the Jakobshof in Aachen. H. Dreiner performed a slam on *The Higgs Boson* using demonstration experiments performed by the Physikshow students.
- Sept. 2012:** WDR Lokalzeit Bonn had an extensive report from ‘*20th Century Physics Proudly Presents*’ show in the Wolfgang-Paul lecture theatre.
- Sept. 2013:** WDR Lokalzeit Bonn reports live from the rehearsals for the ‘*In 80 Minuten durch die Physik*’ show in the Wolfgang-Paul lecture theatre.