

## **Curriculum Vitae**

Name:	Bruno Leibundgut
Address (office):	European Southern Observatory Karl-Schwarzschild-Strasse 2 D-85478 Garching Germany
Email:	bleibundgut@eso.org
Web site:	<a href="http://www.eso.org/~bleibund">http://www.eso.org/~bleibund</a>
Languages:	English, German, Spanish, French
Current positions:	ESO Emeritus Astronomer Honorary Professor Technical University Munich ORIGINS Cluster Emeritus

### **Degrees**

March 1979	Eidgenössische Matura Typus B (including Latin)
October 1981	Vordiplom in physics, astronomy and mathematics
November 1983	Diplom in theoretical physics, experimental physics, astronomy and mathematics
January 1989	Doctorate in astronomy (PhD)

### **Employment history**

February 1989 – September 1989	Post-doctoral research fellow at the Astronomical Institute of Basel
October 1989 – September 1992	Post-doctoral Research Associate at the Harvard-Smithsonian Center for Astrophysics
October 1992 – November 1993	Post-doctoral Research Associate at the University of California, Berkeley
December 1993 – April 2025	Staff Astronomer at the European Southern Observatory (ESO)
December 1993 – July 1995	Member of the Science Division
August 1995 – August 1998	Working with the VLT Programme Scientist in the Office of the Director General
September 1998 – July 2001	Head of the VLT Data Flow Group within the Data Management Division
August 2001 – January 2008	Head of the Office for Science
February 2008 – January 2014	Director for Science
August 2014 – March 2023	VLT Programme Scientist
April 2023 – March 2025	Director for Science
April 2025	Senior Science Advisor to the Director General
Since May 2025	ESO Emeritus Astronomer

### **Professional affiliations**

Swiss Society of Astronomy and Astrophysics (SGAA/SSAA)  
Astronomische Gesellschaft (Germany)  
European Astronomical Society (EAS)  
American Astronomical Society (AAS)  
International Astronomical Union (IAU)

### **Major scientific collaborations**

1993 –	Supernova INTensive Studies (SINS) and Supernova 1987A INTensive Study (SAINTS) – HST project (Cycles 1-33)
1999 –	Optical and IR studies of the evolution of SN 1987A – VLT project
1994 – 2000	High-z Supernova Search Team
2000 – 2016	ESSENCE - Equation of state through distant supernovae
2000 – 2005	European Union Research Training Network 'The Physics of Type Ia Supernovae' and the European Supernova Consortium
2006 – 2018	Transregional Collaborative Research Centre 'The Dark Universe' (financed through the Deutsche Forschungsgesellschaft (DFG))
2007 – 2018	Excellence Cluster 'The Origin and Structure of the Universe' (financed by DFG)
2019 –	Excellence Cluster 'ORIGINS' (financed by DFG)
2016 –	adH0cc (accurate determination of H0 with core collapse supernovae) – VLT project
2019 –	FLAWS (Aarhus-Barcelona peculiar velocity project)

### **Awards**

1998	Science Magazine Breakthrough of the Year (as a member of the High-z Supernova Search Team)
2007	Gruber Cosmology Prize (High-z Supernova Search Team)
2015	Breakthrough Prize in Fundamental Physics (High-z Supernova Search Team)
2019	Johannes-Geiss Fellow at the International Space Science Institute, Bern

### **Teaching**

September 2003	Lectures at the NATO Advanced Study Institute "Frontiers in Cosmology" in Cargese, France
July 2005	Lecture at the Summer School Alpbach "Dark Energy and Dark Matter in the Universe", Austria
December 2007	Lectures on "Supernovae" within the 3 <sup>eme</sup> Cycle de la Physique en Suisse Romande (14 hours), University of Geneva
Since 2014	Masters courses at the Technical University Munich "Observational Cosmology" "Extragalactic Astrophysics" "Observational Astrophysics" Seminar "Nuclei in the Cosmos" (with several teachers)

### **Books**

Series Editor of the ESO Astrophysics Symposia Series (2001 – 2007)  
Series Editor of the Astronomy and Astrophysics Library (2008 – 2017)

*From Twilight to Highlight: The Physics of Supernovae*  
eds. Wolfgang Hillebrandt, Bruno Leibundgut, Springer Verlag, 2003

*Scientific Requirements for Extremely Large Telescopes* (IAU Symposium 232)  
eds. Patricia A. Whitelock, Michel Dennefeld, Bruno Leibundgut  
Cambridge University Press, 2006

*Relativistic Astrophysics and Cosmology - Einsteins Legacy*  
eds. Bernd Aschenbach, Vadim Burwitz, Günther Hasinger, Bruno Leibundgut  
Springer Verlag, 2007

### **Committee service (selection)**

1995 – 1998	Organising Committee of the Joint Munich Astrophysics Colloquia
1999 – 2014	ESO Scientific Personnel Committee (chair from 2001 to 2014)
2000 – 2005	Opticon ELT Science working group (co-chair of cosmology subpanel)
2002	ESO-Portugal Committee
2002 – 2003	La Silla 2006+ Committee
2002 – 2003	Astrophysical Virtual Observatory Working Group
2002 – 2007	Series Editor of the ESO Astrophysics Symposia
2002 – 2014	ESO-Government of Chile Joint Committee
2002 – 2014	ESO Press Release Committee (chair)
2003 – 2007	ST-ECF Review Board
2003 – 2013	ESO Council Science Strategy Working Group
2004 – 2005	Calar Alto Time Allocation Committee
2004 – 2009	Executive Committee of Commission 28 of the International Astronomical Union
2004 – 2014	Astronomy & Astrophysics Board of Directors
2005	Visiting Committee of the Isaac Newton Group (La Palma)
2005 – 2006	ESA-ESO Working Group on Fundamental Cosmology
2005 – 2007	Astronet Science Vision Panel A (Cosmology)
2005 – 2014	ESO-ESA coordination group
2006 – 2009	E-ELT Science Working Group (co-chair in 2006)
2006 – 2011	Astronomy Advisory Board of the Lorentz Center (Leiden)
2007	Evaluation Committee for the Astrophysikalische Institut Potsdam (AIP)
2008	ESA European Dark Energy Mission - Concept Advisory Team
2008 – 2009	ESA Euclid Science Study Team
2008 – 2017	Editorial Board of the Astronomy and Astrophysics Library (Springer Series)
2009 – 2014	ASTRONET Board
2010 – 2014	Finnish Center for Astronomy (FINCA) Science Advisory Committee
2012 – 2018	Science Board of the Excellence Cluster Universe Munich (Speaker of Research Area G - Nucleosynthesis)
2012	Review Committee of the School of Physics of the University of New South Wales, Sydney, Australia
2013 –	Beirat <i>Sterne und Weltraum</i>
2014 – 2018	Programme Committee of the Munich Institute for Astro- and Particle Physics
2017 – 2025	Member of the ESO International Relations Team
2018	Chair of the review committee of the Joint Institute for VLBI in Europe (JIVE)
2019 – 2025	Member of the Selection Committee of the Seed Fund Projects of the Origins Cluster
2020	Panel Member of Physical Sciences panel review by the Czech Academy of Sciences
2021	Member of the Fachbeirat of the Zentrum für Astrophysik, Heidelberg
2022	Member of the GTC Instrumentation Working Group
2025	Chair of the Evaluation Panel for the Astronomical Institute of the Czech Academy of Sciences

## **Professional Experience**

My scientific career has exposed me to many different observatories and observing techniques, various research cultures and numerous scientists. I could participate in some of the most exciting developments in observational cosmology. The discovery of cosmic acceleration through supernovae has been recognised by several prizes to the team leaders and the High- $z$  Supernova Search Team (e.g. Science Magazine Breakthrough of the Year 1998, the 2007 Gruber Prize in Cosmology, the 2011 Nobel Prize in Physics and the Breakthrough Prize in Fundamental Physics 2015).

Several of my students have worked on detailed studies of Type Ia supernova explosions and we have established new ways to measure the nickel mass as the power source in the explosions, the ejecta mass and applications to determine the cosmic expansion rate, i.e. the Hubble constant  $H_0$ .

Another focus of my work is the detailed study of the old SN 1987A which now turns into a supernova remnant. As part of this work, we could for the first time ever resolve the inner ejecta of a supernova and demonstrate the non-symmetric distribution of the newly synthesised elements in the explosion, yielding the first direct observational evidence for an asymmetric explosion in core collapse supernovae. We have also found dust and molecules in the supernova ejecta and could identify a new energy source exciting some of the ejecta material at late phases. We now observe the destruction of the circumstellar ring around the supernova.

In the past years, I turned my attention to new determinations of the Hubble constant. We employ Type II supernovae to measure individual distances to objects in the Hubble flow bypassing the distance ladder (parallaxes, Cepheids, TRGB) completely. The adH0cc (accurate determination of  $H_0$  with core-collapse supernovae) has collected all necessary data (with FORS2) and we will present an independent determination of  $H_0$  in the coming year.

Throughout my career I have worked with students. First as a mentor while at Harvard and Berkeley and as informal and formal PhD supervisor since I joined ESO. I have also actively mentored ESO young staff (as Head for the Office for Science and then as Director for Science) and helped several young astronomers develop their careers. Since 2014 I regularly teach astrophysics courses and as of 2019 I am an Honorary Professor at the Technical University Munich.

Community services include refereeing of publications and grant proposals, providing evaluations for tenure decisions and award nominations as well as editing scientific books. I have served on several visiting, review and strategy committees (e.g. the ESA-ESO working group on cosmology, the cosmology panel of the ASTRONET Science Vision, updates of the Science Vision and Roadmap documents, WHT, JIVE, GTC). I was a member of the ESA European Dark Energy Concept Advisory Team and the Science Study Team for this mission, which is now called *Euclid*. In addition, I have co-organised numerous workshops and conferences as member of Scientific Organising Committees.

In the 40 years of my career I have authored and co-authored 149 refereed publications, which have collected over 40000 citations so far and result in an H-index of 65. I have written several review articles (e.g. Annual Reviews of Astronomy and Astrophysics, Annual Reviews of Nuclear and Particle Physics, Handbooks).

I have been given many opportunities to present my work at conferences, workshops, colloquia, graduate schools and in public talks (in English and German; for an incomplete list of presentations since 2002 see <http://www.eso.org/~bleibund/talks.html>). I have written articles for newspapers and magazines and given radio and television interviews on my research.

At ESO, I first worked on operational concepts for the VLT and have been instrumental in developing the concepts and the original implementation of VLT science operations. I formed and led the Data Flow Operations Group which was tasked with the post-observation processing of the VLT data including the operations of the ESO science archive. From 2001 to 2008 I led the Office for Science which encompasses the Fellowship- and Studentship Programmes and the organisation of all research activities at ESO in Garching and in Chile. Between February 2008 and January 2014 I was ESO Director for Science setting the scientific agenda of the organisation. From August 2014 until March 2023 I provide the scientific guidance to the VLT as Programme Scientist to return as Director for Science in April 2025. Since May 2025, I am retired and an ESO Emeritus Astronomer.

## 10 most relevant publications by Bruno Leibundgut

- Leibundgut, B., Kirshner, R.P., Pinto, P.A., Rupen, M.P., Smith, R.C., Gunn, J.E., Schneider, D.P.: Spectra of two very old Supernovae: SN 1986J and SN 1980K, *ApJ*, 372, 531 (1991)  
*This paper established a new field for supernovae – decade-old emission from supernova shock interaction with circumstellar material.*
- Leibundgut, B., et al.: SN 1991bg: A Type Ia Supernova with a Difference, *AJ*, 105, 301 (1993)  
*SN 1991bg turned out to be the first example of sub-luminous Type Ia supernovae. This paper together with Phillips et al. (AJ, 103, 1632, 1992), which described the superluminous Type Ia SN 1991T, indicated that the pure standard candle picture was no longer tenable.*
- Leibundgut, B., et al.: Time Dilation in the Light Curve of the Distant Type Ia Supernova SN 1995K, *ApJ*, 466, L21 (1996)  
*The first direct observations of cosmic time dilation in a redshifted object. This was the first paper from the High-z SN Search Team.*
- Riess, A.G., Filippenko, A.V., Challis, P., Clocchiatti, A., Diercks, A., Garnavich, P.M., Gilliland, R.L., Hogan, C.J., Jha, S., Kirshner, R.P., Leibundgut, B., Phillips, M.M., Reiss, D., Schmidt, B.P., Schommer, R.A., Smith, R.C., Spyromilio, J., Stubbs, C., Suntzeff, N.B., Tonry, J.: Observational Evidence for an Accelerating Universe and a Cosmological Constant, *AJ*, 116, 1009 (1998)  
*This paper reported the discovery of accelerated expansion in the universe. My contributions to this project were the ESO observations (3.6m telescope) of photometry and spectroscopy of distant supernovae, the interpretation of SN classifications and light curves, and the evaluation of the local SN sample.*
- Leibundgut, B.: Type Ia Supernovae, *The A&A Review*, 10, 179 (2000)  
*At the time one of the very few review articles on Type Ia supernovae combining the available observations.*
- Leibundgut, B.: Cosmological Implications from Type Ia Supernovae, *Annual Review Astronomy & Astrophysics*, 39, 67 (2001)  
*Review of the state of SN cosmology after the discovery of the accelerated expansion. A follow-on article presenting the situation in 2011 was published by Goobar & Leibundgut in the Annual Reviews of Nuclear and Particle Physics (61, 251, 2011).*
- Stritzinger, M., Leibundgut, B., Walch, S., Contardo, G.: Constraints on the Progenitor Systems of Type Ia Supernovae, *A&A*, 450, 241 (2006)  
*My student Max Stritzinger demonstrated that observationally not all Type Ia supernovae could come from Chandrasekhar-mass white dwarf progenitors. At the time this result was mostly ignored but has stood the test of time and the favourite progenitor channel now is through sub-Chandrasekhar mass white dwarfs.*
- Kjaer, K., Leibundgut, B., Fransson, C., Jerkstrand, A., Spyromilio, J.: The 3-D structure of SN 1987A's inner ejecta, *A&A*, 517, A51 (2010)  
*Through integral-field spectroscopy, my student Karina Kjaer showed that the ejecta of SN 1987A are asymmetric and oriented within the plane of the equatorial ring. The former supported a theoretical prejudice, while the latter was unexpected and has been confirmed in subsequent observations.*
- Dhawan, S., Leibundgut, B., Spyromilio, J., Blondin, S.: Reddening-free method to estimate the  $^{56}\text{Ni}$  mass of Type Ia supernovae, *A&A*, 588, A84 (2016)  
*Using near-infrared light curves my student Suhail Dhawan developed a very simple method to determine nickel masses in Type Ia supernovae. It also provides interesting insights into the supernova physics.*
- Dhawan, S., Jha, S.W., Leibundgut, B.: Measuring the Hubble Constant with Type Ia Supernovae as near-infrared standard candles, *A&A*, 609, A72 (2018)  
*Another part of Suhail's PhD thesis concerned the use of near-infrared light curves to measure the Hubble constant. The exclusive use of infrared data reduces the dependence on dust corrections. A new publication with an expanded set of supernovae has been submitted (Galbany et al., arXiv:2209.02546).*