

# Stefan W. Ballmer

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## Curriculum Vitae

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### RECENT AND CURRENT POSITIONS

- Jul 2022 - **Director, Center for Gravitational-Wave Astronomy and Astrophysics**  
present Syracuse University, Syracuse, NY
- Jun 2021 - **Professor of Physics**  
present Syracuse University, Syracuse, NY
- Jun 2016 - **Associate Professor of Physics**  
May 2021 Syracuse University, Syracuse, NY
- May2019 - **Visiting Associate Professor of Physics**  
Jun 2019 Institute for Cosmic Ray Research, University of Tokyo, Japan
- May2018 - **Visiting Associate Professor of Physics**  
Jun 2018 Institute for Cosmic Ray Research, University of Tokyo, Japan
- May2017 - **Visiting Associate Professor of Physics**  
Jun 2017 University of Tokyo, Japan
- Jun 2013 - **Research leave at the LIGO Hanford Observatory**  
Aug2014 Commissioning the Advanced LIGO interferometer
- Aug2010 - **Assistant Professor of Physics**  
May2016 Syracuse University, Syracuse, NY
- Dec2009 - **NAOJ Visiting Researcher**  
Aug2010 National Astronomical Observatory of Japan.
- Sep2009 - **JSPS Postdoctoral Fellow** (Gaikokujin Tokubetsu Kenkyuin)  
Nov2009 National Astronomical Observatory of Japan.
- Jul 2006 - **Robert A. Millikan Postdoctoral Fellow**  
Aug 2009 California Institute of Technology, Pasadena, CA

### EDUCATION

- Jun 2006 **Ph.D. Physics, Massachusetts Institute of Technology (MIT),  
Cambridge, MA**  
Experimental Astrophysics, Laser Interferometer Gravitational Wave

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Observatory (LIGO).  
Apr 2000 **Diploma** (equivalent to Master of Science), **Physics, Swiss Federal Institute of Technology (ETH) Zurich, Switzerland**  
With honor, in Theoretical Physics (Cosmology).

## RESEARCH INTERESTS

Experimental Gravitational-Wave Physics, Next-Generation Gravitational-Wave Detectors, Gravitational-Wave Detector Technology, Strong Field Gravity, Observational Cosmology, Macroscopic Quantum Mechanics

## AWARDS

2021 **American Physical Society Fellow 2021**. Citation: For a critical role in the design and commissioning of the Advanced LIGO detectors and the scientific interpretation of their observations, for leadership in the development of third-generation gravitational-wave detectors, and mentoring of the next generation of gravitational-wave experimenters.

2017 **Bruno Rossi Prize** (to the LIGO Scientific Collaboration)

2017 **Royal Astronomical Society Group Achievement Award** (to the LIGO Scientific Collaboration)

2017 **Princess of Asturias Award** for Technical and Scientific Research (to the LIGO Scientific Collaboration)

2016 **Special Breakthrough Prize in Fundamental Physics** (to the LIGO Scientific Collaboration)

2016 **Gruber Cosmology Prize** (to the LIGO Scientific Collaboration)

2016 **TACNY Technology Project of the Year** (to the Syracuse University Gravitational Wave Group)

2016 **National Space Club Huntsville Distinguished Science Award** (to the LIGO Scientific Collaboration)

2012 **Teaching award**, Physics Department, Syracuse University  
for teaching PHY425 Electromagnetism II in Spring 2012

2009 **JSPS Postdoctoral Fellowship for Foreign Researcher** (Gaikokujin Tokubetsu Kenkyuin), Japan Society for the Promotion of Science

2006 **Robert A. Millikan Postdoctoral Prize Fellowship** for Experimental Astrophysics, California Institute of Technology

2006 **Honorable Mention, GWIC** (Gravitational Wave International Committee)  
**Thesis Prize**

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- 2003      **Alan H. Barrett Prize** for Excellence in Astrophysics (awarded to the best student in Astrophysics), Massachusetts Institute of Technology
- 2001      **Bruno Rossi Graduate Fellowship**,  
Massachusetts Institute of Technology
- 2000      **Polya-Fonds Award** for outstanding graduates,  
Swiss Federal Institute of Technology, Switzerland

## MEMBERSHIP IN PROFESSIONAL SOCIETIES

- 2002 -      American Physical Society (APS)  
present
- 2001 -      LIGO Scientific Collaboration (LSC)  
present

## PATENTS

- 2017      Patent for "Mode converter and quadrant photodiode for sensing optical cavity mode mismatch" (US patent US10453971B2).
- 2015      Patent for "Optical coating permitting cavity self-locking" (US patent US20160356983A1).

## GRANTS AND SUBCONTRACTS

- 2023      **NSF, MRI: Development of Large Optic Crystalline Coating Characterization Instrument (LOCCCI) for Gravitational Wave Detectors**,  
\$1'077k, 3 years, PHY-2320711, PI: Steven Penn (HWS), Co-PI: Stefan Ballmer, Andri Gretarsson
- 2023      **NSF, Center for Coatings Research**, Research towards reducing the dominant noise source in terrestrial gravitational-wave observatories: thermal noise in the interferometer mirrors.  
\$351k, 2 years, PHY- 2309296, PI: Stefan Ballmer
- 2023      **NSF, Launching the Cosmic Explorer Conceptual Design**,  
\$3'301k, 3 years, PHY-2309064, PI: Matthew Evans (MIT), Co-PI: Stefan Ballmer, Bangalore Sathyaprakash, Hannah Hansen, Joey Key
- 2023      **NSF, Identifying and Evaluating Sites for Cosmic Explorer**,  
\$362k, 3 years, PHY-2308989, PI: Joshua Russel (Syracuse University), Co-PI: Stefan Ballmer, Christopher Scholz
- 2023      **NSF, Cosmic Explorer Optical Design**,  
\$284, 3 years, PHY-2309266, PI: Georgia Mansell (Syracuse University), Co-PI: Stefan Ballmer, Craig Cahillane
- 2023      **NSF, Enabling Megawatt Optical Power in Cosmic Explorer**,  
\$202, 3 years, PHY-2309007, PI: Stefan Ballmer

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- 2022 **NSF, Detector Technology for Gravitational-Wave Astrophysics**, \$555k, 3 years, PHY-2207640, PI: Stefan Ballmer
- 2022 **NSF, The CSUF-led partnership for inclusion of underrepresented groups in gravitational-wave astronomy**, \$1180k, 5 years, AST-2219109, PI: Geoffrey Lovelace, Co-PI: Joshua Smith, Stefan Ballmer, Jocelyn Read, Georgia Mansell
- 2020 **NSF, LSC Center for Coatings Research**, Research towards reducing the dominant noise source in terrestrial gravitational-wave observatories: thermal noise in the interferometer mirrors. \$542k, 3 years, PHY- 2011723, PI: Stefan Ballmer
- 2019 **NSF, MRI: Multi-Frequency, Multi-Temperature Cryogenic Elastic Loss Measurement Apparatus to Enhance Gravitational-Wave Observatories**, Construction of a cryogenic nodal suspension experiment for measuring mechanical losses in new coating materials. \$167k, 3 years, PHY-1920023, PI: Stefan Ballmer
- 2019 **NSF, Detector Technology for Gravitational-Wave Astrophysics**, Research towards active wave front control in Advanced LIGO and operation at design arm power. \$480k, 3 years, PHY-1912536, PI: Stefan Ballmer
- 2019 **ICRR: Instrumentation for Gravitational Wave Research**, travel support for commissioning the KAGRA interferometer JPY400k, PI: Stefan Ballmer
- 2018 **NSF, The Next Generation of Gravitational Wave Detectors**, Funding for a design and costing study for the next generation of gravitational-wave detectors. \$240k, 3 years, PHY-1836702, PI: Stefan Ballmer
- 2017 **NSF, Collaborative Research: LSC Center for Coatings Research**, Research towards reducing the dominant noise source in terrestrial gravitational-wave observatories: thermal noise in the interferometer mirrors. \$350k, 3 years, PHY-1707876, PI: Stefan Ballmer
- 2017 **NSF, Collaborative Research: Multi-Mode Apparatus to Resolve the Discrepancy Concerning Big G**, Developing the metrology system for a torsion pendulum experiment aimed at resolving the uncertainty in Newton's gravitational constant  $G$ , \$120k, 3 years, PHY-1707993, PI: Stefan Ballmer
- 2017 **NSF Workshop: Dawn III: What's next for Gravitational Wave Astronomy?** For organizing the DAWN III international workshop on future terrestrial gravitational-wave detectors, \$10k, 1 year, PHY-1743270, PI: Stefan Ballmer

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- 2016 **NSF, The CSUF-Syracuse partnership for inclusion of underrepresented groups in gravitational-wave astronomy**, \$937k, 5 years, AST-1559694, PI: J. Read, (Co-I S. Ballmer, D. Brown, J. Smith, G. Lovelace)
- 2014 **NSF CAREER: Detector Technology and Science Education in the Era of Gravitational Wave Astrophysics**, Development of adaptive mode-matching for Advanced LIGO's output mode cleaner, \$800k, 5 years, PHY-1352511, PI: Stefan Ballmer
- 2014 **NSF AGEP GRS - Graduate Research Supplement**, \$60k, 1 year, PHY-1352511, PI: Stefan Ballmer
- 2013 **Advanced LIGO sub-contract: Advanced LIGO Commissioning**
- 2011 **NSF, Searching for a Stochastic Background, aLIGO Rare Transient Monitoring and Optical Mirror Trapping**, \$450k, 3 years, PHY-1068809, PI: Stefan Ballmer

## PENDING GRANTS APPLICATIONS

- 2022 **NSF, NRT: Cosmic Explorers: Nurturing the Next Generation of Gravitational-Wave Pioneers**, \$3'000k, 5 years, PI: Stefan Ballmer

## SELECTED PUBLICATIONS

Only collaboration papers with significant personal contribution are listed

- **“Study on electro-optic noise in crystalline coatings toward future gravitational wave detectors”**, Satoshi Tanioka, Daniel Vander-Hyde, Garrett D. Cole, Steven D. Penn, Stefan W. Ballmer, Phys. Rev. D 107, 022003 (2023)
- **“Piezo-deformable mirrors for active mode matching in advanced LIGO”**, Varun Srivastava, Georgia Mansell, Camille Makarem, Minkyun Noh, Richard Abbott, Stefan Ballmer, GariLynn Billingsley, Aidan Brooks, Huy Tuong Cao, Peter Fritschel, Don Griffith, Wenxuan Jia, Marie Kasprzack, Myron MacInnis, Sebastian Ng, Luis Sanchez, Calum Torrie, Peter Veitch, and Fabrice Matichard, Optics Express Vol. 30, Issue 7, pp. 10491-10501 (2022)
- **“Science-driven Tunable Design of Cosmic Explorer Detectors”**, Varun Srivastava, Derek Davis, Kevin Kuns, Philippe Landry, Stefan Ballmer, Matthew Evans, Evan D. Hall, Jocelyn Read, and B. S. Sathyaprakash, ApJ 931 22 (2022)
- **“Snowmass 2021 Cosmic Frontier White Paper: Future Gravitational-Wave Detector Facilities”**, Stefan W. Ballmer, Rana Adhikari, Leonardo Badurina, Duncan A. Brown, Swapan Chattopadhyay, Matthew Evans, Peter Fritschel, Evan Hall, Jason M. Hogan, Karan Jani, Tim Kovachy, Kevin Kuns, Ariel Schwartzman, Daniel Sigg, Bram Slagmolen, Salvatore Vitale, Christopher Wipf, arXiv:2203.08228 (2022)
- **“Performance of the KAGRA detector during the first joint observation with GEO 600 (O3GK)”**, H. Abe, S. W. Ballmer, ..... Z.-H. Zhu (The KAGRA collaboration), Prog. Theor. Exp. Phys. ptac093 (2022)

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- **“High frame-rate phase camera for high-resolution wavefront sensing in gravitational-wave detectors”**, Erik Muñiz, Varun Srivastava, Subham Vidyant, and Stefan W. Ballmer, *Phys. Rev. D* 104, 042002 (2021)
- **“A Horizon Study for Cosmic Explorer: Science, Observatories, and Community”**, Matthew Evans, Rana X Adhikari, Chaitanya Afle, Stefan W. Ballmer, Sylvia Biscoveanu, Ssohrab Borhanian, Duncan A. Brown, Yanbei Chen, Robert Eisenstein, Alexandra Gruson, Anuradha Gupta, Evan D. Hall, Rachael Huxford, Brittany Kamai, Rahul Kashyap, Jeff S. Kissel, Kevin Kuns, Philippe Landry, Amber Lenon, Geoffrey Lovelace, Lee McCuller, Ken K. Y. Ng, Alexander H. Nitz, Jocelyn Read, B. S. Sathyaprakash, David H. Shoemaker, Bram J. J. Slagmolen, Joshua R. Smith, Varun Srivastava, Ling Sun, Salvatore Vitale, Rainer Weiss; Report to the NSF, CE-P2100003, arXiv:2109.09882
- **“Gravitational-wave physics with Cosmic Explorer: limits to low-frequency sensitivity”**, Evan D. Hall, Kevin Kuns, Joshua R. Smith, Yuntao Bai, Christopher Wipf, Sebastien Biscans, Rana X Adhikari, Koji Arai, Stefan Ballmer, Lisa Barsotti, Yanbei Chen, Matthew Evans, Peter Fritschel, Jan Harms, Brittany Kamai, Jameson Graef Rollins, David Shoemaker, Bram Slagmolen, Rainer Weiss, Hiro Yamamoto, *Phys. Rev. D* 103, 122004 (2021)
- **“A two-carrier detector: evading 3dB quantum penalty in heterodyne readout”**, Teng Zhang, Philip Jones, Haixing Miao, Denis Martynov, Andreas Freise, Stefan Ballmer, *Phys. Rev. Lett.* 126, 221301 (2021)
- **“Point absorbers in Advanced LIGO”**, Aidan F. Brooks, Stefan Ballmer, ... (LIGO instrument author list), *Applied Optics* Vol. 60, Issue 13, pp. 4047-4063 (2021)
- **“Sensitivity and Performance of the Advanced LIGO Detectors in the Third Observing Run”**, A. Buikema, C. Cahillane, G. L. Mansell C. D. Blair, ...S. Ballmer, ... (LIGO detector author list), *Phys Rev. D* 102, 062003 (2020)
- **“Quantum correlations between light and the kilogram-mass mirrors of LIGO”**, Haocun Yu, L. McCuller, M. Tse, N. Kijbunchoo, L. Barsotti, N. Mavalvala & members of the LIGO Scientific Collaboration, *Nature* volume 583, pages43-47 (2020)
- **“Can we use next-generation gravitational wave detectors for terrestrial precision measurements of Shapiro delay?”**, Andrew G. Sullivan, Döğa Veske, Zsuzsa Márka, Imre Bartos, Stefan Ballmer, Peter Shawhan, Szabolcs Márka, *Class. Quantum Grav.* 37 205005 (2020)
- **“Sensing Optical Cavity Mismatch with a Mode-Converter and Quadrant Photodiode”**, Fabian Magaña-Sandoval, Thomas Vo, Daniel Vander-Hyde, J. R. Sanders, Stefan W. Ballmer, *Phys. Rev., D* 100, 102001, (2019)
- **“Cosmic Explorer: The U.S. Contribution to Gravitational-Wave Astronomy beyond LIGO”**, David Reitze, Rana X Adhikari, Stefan Ballmer, Barry Barish, Lisa Barsotti, GariLynn Billingsley, Duncan A. Brown, Yanbei Chen, Dennis Coyne, Robert Eisenstein, Matthew Evans, Peter Fritschel, Evan D. Hall, Albert Lazzarini, Geoffrey Lovelace, Jocelyn Read, B. S. Sathyaprakash, David Shoemaker, Joshua Smith, Calum Torrie, Salvatore Vitale, Rainer Weiss, Christopher Wipf, Michael Zucker, *Astro 2020 decadal survey white paper*, 2019 BAAS 51(7) 035

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- **“Detection prospects of core-collapse supernovae with supernova-optimized third-generation gravitational-wave detectors”**, Varun Srivastava, Stefan Ballmer, Duncan A. Brown, Chaitanya Afle, Adam Burrows, David Radice, David Vartanyan. *Phys. Rev., D100, 043026, (2019)*
- **“Direct approach for the fluctuation-dissipation theorem under nonequilibrium steady-state conditions”**, Kentaro Komori, Yutaro Enomoto, Hiroki Takeda, Yuta Michimura, Kentaro Somiya, Masaki Ando, and Stefan W. Ballmer. *Phys. Rev., D97, 102001, (2018)*
- **“On choosing the start time of binary black hole ringdowns”**, Swetha Bhagwat, Maria Okounkova, Stefan W. Ballmer, Duncan A. Brown, Matthew Giesler, Mark A. Scheel, and Saul A. Teukolsky., *Phys. Rev., D16 D97(10):104065, 2018*
- **“GW170817: Observation of Gravitational Waves from a Binary Neutron Star Inspiral”**, B. P. Abbott, ...S. W. Ballmer, ... and J. Zweizig, (The LIGO and Virgo Scientific Collaboration), *Phys. Rev. Lett. 119, 161101 (2017)*
- **“GW170814: A Three-Detector Observation of Gravitational Waves from a Binary Black Hole Coalescence”**, B. P. Abbott, ...S. W. Ballmer, ... and J. Zweizig, (The LIGO and Virgo Scientific Collaboration), *Phys. Rev. Lett. 119, 141101 (2017)*
- **“GW170104: Observation of a 50-Solar-Mass Binary Black Hole Coalescence at Redshift 0.2”**, B. P. Abbott, ...S. W. Ballmer, ... and J. Zweizig, (The LIGO and Virgo Scientific Collaboration), *Phys. Rev. Lett. 118, 221102 (2017)*
- **“Folding Gravitational-Wave Interferometers”**, J. R. Sanders, S.W. Ballmer, *Class. Quantum Grav. 34 (2017) 025003*
- **“Spectroscopic analysis of stellar mass black-hole mergers in our local universe with ground-based gravitational wave detectors”**, S. Bhagwat, D. A. Brown, S. W. Ballmer, *Phys. Rev. D 94, 084024, (2016)*
- **“Observation of Gravitational Waves from a Binary Black Hole Merger”**, B. P. Abbott, ...S. W. Ballmer, ... and J. Zweizig, (The LIGO and Virgo Scientific Collaboration), *Phys. Rev. Lett. 116, 061102 (2016)*
- **“GW150914: The Advanced LIGO Detectors in the Era of First Discoveries”**, B. P. Abbott, ...S. W. Ballmer, ... and J. Zweizig, (The LIGO and Virgo Scientific Collaboration), *Phys. Rev. Lett. 116, 131103 (2016)*
- **“New Technologies in Gravitational-Wave Detection”**, Stefan Ballmer, Vuk Mandic, *Annual Review of Nuclear and Particle Science, Vol. 65:555-577 (Oct 2015)*
- **“Observation of photothermal feedback in a stable dual-carrier optical spring”**, David Kelley, James Lough, Fabian Mangaña-Sandoval, Antonio Perreca and Stefan W. Ballmer, *Phys. Rev. D 92, 062003 (2015)*
- **“Gravitational wave detector with cosmological reach”**, S. Dwyer, D. Sigg, S. Ballmer, L. Barsotti, N. Mavalvala, and M. Evans. *Phys. Rev. D 91, 082001 (2015)*
- **“Observation of Parametric Instability in Advanced LIGO”**, M. Evans, ... S. Ballmer, ... C. Zhao, *Phys. Rev. Lett. 114, 161102 (2015)*
- **“Photo-thermal transfer function for dielectric mirrors”**, S. W. Ballmer. *Phys. Rev. D 91, 023010 (2015)*

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- **“Achieving resonance in the advanced LIGO gravitational-wave interferometer”**, A. Staley, ... S. Ballmer, ... and Christopher Wipf. *Class. Quantum Grav.* 31 245010 - 26 Sept 2014 (IOPselect)
- **“Radiative thermal noise for transmissive optics in gravitational-wave detectors”**, S. Dwyer, S. Ballmer. *Phys. Rev. D* 90, 043013 (2014).
- **“Multi-dimensional optical trapping of a mirror”**, A. Perreca, J. Lough, D. Kelley, S. Ballmer, *Phys. Rev. D* 89, 122002 (2014).
- **“Searching for stochastic gravitational waves using data from the two colocated LIGO Hanford detectors”**, J. Aasi, ...S. W. Ballmer, ... and J. Zweizig, (The LIGO and Virgo Scientific Collaboration), *Phys. Rev. D* 91,022003 (2015)
- **“Improved Upper Limits on the Stochastic Gravitational-Wave Background from 2009-2010 LIGO and Virgo Data”**, J. Aasi, ...S. W. Ballmer, ... and J. Zweizig, (The LIGO and Virgo Scientific Collaboration), *Phys. Rev. Lett.* 113, 231101(2014)
- **“Precise measurement of laser power using an optomechanical system”**, K, Agatsuma, D. Friedrich, S. Ballmer, G. DeSalvo, S. Sakata, E. Nishida, and S. Kawamura, *Optics Express*, 22(2): 2013-2030 (2014).
- **“New class of optical beams for large baseline interferometric gravitational wave detectors”**, S. Ballmer, D. Ottaway. *Phys. Rev. D* 88, 062004 (2013).
- **“Upper limits on a stochastic gravitational-wave background using LIGO and Virgo interferometers at 600-1000 Hz”**, J. Abadie, .S. Ballmer, ... and J. Zweizig, (The LIGO Scientific Collaboration), *Phys. Rev. D* 85, 122001 (2012).
- **“Optimal alignment sensing of a readout mode cleaner cavity”**, N. Smith-Lefebvre, S. Ballmer, M. Evans, S. Waldman, K. Kawabe, V. Frolov, N. Mavalvala, *Opt. Lett.* 36(22): 4365-4367 (2011).
- **“Directional Limits on Persistent Gravitational Waves Using LIGO S5 Science Data”**, J. Abadie, .S. Ballmer, ... and J. Zweizig, (The LIGO Scientific Collaboration), *Phys. Rev. Lett.* 107, 271102 (2011).
- **“Feasibility of measuring the Shapiro time delay over meter-scale distances”**, S. Ballmer, S. Marka, P. Shawhan, *Class. Quantum Grav.* 27 185018 (2010)
- **“Probing the anisotropies of a stochastic gravitational-wave background using a network of ground-based laser interferometers”**, E. Thrane, S. Ballmer, J. D. Romano, S. Mitra, D. Talukder, S. Bose, V. Mandic, *Phys. Rev. D* 80, 122002 (2009).
- **“Optimal strategies for gravitational wave stochastic background searches in pulsar timing data”**, M. Anholm, S. Ballmer, J. D. E. Creighton, L. R. Price, X. Siemens, *Phys. Rev. D* 79, 084030 (2009).
- **“Thermo-optic noise in coated mirrors for high-precision optical measurements”**, M. Evans, S. Ballmer, M. Fejer, P. Fritschel, G. Harry, G. Ogin, *Phys. Rev. D* 78, 102003 (2008).
- **“Gravitational wave radiometry: Mapping a stochastic gravitational wave background”**. S. Mitra, S. Dhurandhar, T. Souradeep, A. Lazzarini, V. Mandic, S. Bose, S. Ballmer, *Phys. Rev. D* 77, 042002 (2008).
- **“A Radiometer for Stochastic Gravitational Waves”**, Stefan W. Ballmer. *Class. Quantum Grav.* 23:S179-S185 (2006).
- **“For how long will gravitational waves remain hidden?”** E. Katsavounidis, S. Ballmer. *Phys. Lett. A*, 347(1-3): 33-37 (2005).



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- **"In-situ measurement of absorption in high power interferometers using beam diameter measurements"**, D. Ottaway, J. Betzwieser, S. Ballmer. *Opt. Lett.* 31(4):450-452 (2006).
- **"An upper limit on the stochastic gravitational-wave background of cosmological origin"**, B. Abbott, ...S. Ballmer, ... and J. Zweizig, (The LIGO Scientific Collaboration), *Nature* 460 (2009) 990.
- **"Observation of a kilogram-scale oscillator near its quantum ground state"**, B. Abbott, ...S. Ballmer, ... and J. Zweizig, (The LIGO Scientific Collaboration), *New J. Phys.* 11 (2009) 073032.
- **"LIGO: The Laser Interferometer Gravitational-Wave Observatory"**, B. Abbott, ...S. Ballmer, ... and J. Zweizig, (The LIGO Scientific Collaboration), *Rep. Prog. Phys.* 72 (2009) 076901.
- **"Upper limit map of a background of gravitational waves"**, B. Abbott, ...S. Ballmer, ... and J. Zweizig, (The LIGO Scientific Collaboration), *Phys. Rev. D* 76, 082003 (2007).
- **"Searching for a Stochastic Background of Gravitational Waves with the Laser Interferometer Gravitational-Wave Observatory"**, B. Abbott, ...S. Ballmer, ... and J. Zweizig, (The LIGO Scientific Collaboration), *Astrophys. J.* 659 (2007) 918.
- **"First cross-correlation analysis of interferometric and resonant-bar gravitational-wave data for stochastic backgrounds"**, B. Abbott, ...S. Ballmer, ... and J. Zweizig, (The LIGO Scientific Collaboration, ALLEGRO) *Phys. Rev. D* 76, 022001 (2007).
- **"Upper Limits on a Stochastic Background of Gravitational Waves"**, B. Abbott, ...S. Ballmer, ... and J. Zweizig, (The LIGO Scientific Collaboration), *Phys. Rev. Lett* 95, 221101 (2005).
- **"Detector description and performance for the first coincidence observations between LIGO and GEO"**, B. Abbott, ...S. Ballmer, ... and J. Zweizig, (The LIGO Scientific Collaboration) *Nucl. Instrum. Meth.* A517:154-179, (2004).
- **"Analysis of first LIGO science data for stochastic gravitational wave"**, B. Abbott, ...S. Ballmer, ... and J. Zweizig, (The LIGO Scientific Collaboration), *Physical Review D* 69, 122004, (2004).

## Book Chapter Publication:

- Book chapter **"Controlling non-fundamental noise sources in gravitational-wave interferometers"**, Stefan Ballmer, Bas Swinkels, in *Advanced Interferometric Gravitational-wave Detectors*, edited by David Reitze, Peter Saulson and Hartmut Grote; ISBN: 978-981-3146-07-5, <https://doi.org/10.1142/10181>
- S. Ballmer, K. Somiya, **"Methods of Improving Thermal Noise"**, Chapter 6 of *Optical Coatings and Thermal Noise in Precision Measurement*, Edited by Harry, Bodiya, DeSalvo, ISBN:9781107003385 (2012) (LIGO DCC P1000175)

## PUBLICATION IN PROGRESS

- **"Cryogenic Measurement of AlGaAs Coatings Mechanical Loss"**, Nicholas Didio, Elenna Capote, Satoshi Tanioka, Steve Penn, Stefan Ballmer, to be submitted to *Phys. Rev. D*

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- **“Measurement of Zr:Ta Coating Mechanical Loss”**, Elenna Capote, Nicholas Didio, Satoshi Tanioka, Steve Penn, Stefan Ballmer, to be submitted to *Phys. Rev. D*

## COLLABORATION POSITIONS AND SERVICE

- 2021 - LIGO Scientific Collaboration Program Committee Chair, charged with formulating the Science Program of the collaboration.
- 2020 - LIGO Scientific Collaboration Program Committee Co-chair.  
2021
- 2020 - Technical Advisor to the LIGO Laboratory Oversight Committee, charged  
2021 with advising the LIGO Laboratory stakeholders Caltech and MIT.
- 2018 & Commissioning of the KAGRA interferometer at the Kamioka Observatory  
2019 in Hida, Japan
- 2017 Member of the 2016 GWIC and Braccini Thesis Prizes referee team
- 2015 - Technical Adviser to the LIGO Laboratory Oversight Committee, charged  
2016 with advising the LIGO Laboratory stakeholders Caltech and MIT.
- 2013 - Commissioning of Advanced LIGO at the LIGO Hanford Observatory  
2014
- 2014 Member of the Advanced LIGO System acceptance review team
- 2014 Member of LIGO Academic Advisory Committee (LAAC)
- 2011 - Chair of LIGO Advanced Interferometer Configurations "green" team  
2014
- 2012 Member of KAGRA (Large Cryogenic Gravitational-Wave Telescope,  
Japan) External Review Committee (2nd review)
- 2007 - Co-chair of the LIGO stochastic gravitational wave background search  
2012 group
- 2011 Member of LIGO-India evaluation team
- 2011 Member of KAGRA (Large Cryogenic Gravitational-Wave Telescope,  
Japan) External Review Committee (1st review)

## PRESENTATIONS

### Invited Talks

- Snowmass “Panel Discussion: Cosmic Opportunities for Fundamental Physics”, 6/21 2022, A. Sonnenschein, C. Prescod-Weinstein, J. Newman, J. Carlstrom, K. Fang, M.E. Monzani, M. Loverde, S. Ballmer

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- Panel: David Reitze, Stefan Ballmer, Sheila Dwyer, Evan Hall, David Shoemaker, "Next Generation Gravitational-Wave Detectors", IGC@25, Penn State, State College, PA, June 25, 2019
- Stefan Ballmer, "Future Ground-Based GW Detectors", LISA Consortium meeting #4, Gainesville, FL, April 30, 2019
- Stefan Ballmer, "Supernovae & the next generation of GW observatories", Supernovae Workshop, Pasadena, CA, March 18, 2017
- Panel: Rainer Weiss, Peter Saulson, Duncan Brown, Stefan Ballmer, "Gravitational Waves: Celebrating a Landmark Discovery", Explorer's Club in New York City, Feb 2, 2017
- Stefan Ballmer, "Gravitational-Wave Astronomy - The next steps", NCTS Annual Theory Meeting, Hsinchu, Taiwan, Dec 6 2016
- Stefan Ballmer, "Beyond Advanced Detectors", Physics and Astrophysics at the Extreme (PAX) workshop, Penn State, State College, Dec 2 2016
- Stefan Ballmer, "Measuring the Neutron Star Equation of State - Experimental Considerations", Physics and Astrophysics at the Extreme (PAX) workshop, Penn State, State College, Dec 1 2016
- Stefan Ballmer, "Gravitational Wave Astronomy with Terrestrial Interferometer", OTA2016, Beijing, China, May 11 2016
- Stefan Ballmer, "Global Gravitational Wave Detector Array in the 21st century", APS April Meeting, Salt Lake City, April 16 2016
- Stefan Ballmer, "Improving the mid-frequency range", What comes next for LIGO? Planning for the post-detection era in gravitational-wave detectors and astrophysics, Silver Spring, Maryland, May 7 2015
- Stefan Ballmer, "Detectors for the Dawn of Gravitational-Wave Astronomy", Gravitational Physics PI Mini-Symposium at NSF headquarters, Oct 2014
- Stefan Ballmer, "Colliders and Beyond "The Promise of Future Gravitational-Wave Interferometers", The Abdus Salam International Centre for Theoretical Physics, Trieste Italy, June 2014
- Stefan Ballmer, "Experimental Challenges in Gravitational-Wave Astronomy", Colloquium, Fermilab, May 2013
- Stefan Ballmer, "Advanced LIGO, Advanced VIRGO and KAGRA: Precision Measurement for Astronomy", Miami 2012 conference, Fort Lauderdale, December 2012
- Stefan Ballmer, "Progress in Gravitational Wave Detection at LIGO", Frontiers in Optics / Laser Science XXVIII, Rochester NY, Oct 2012
- Stefan Ballmer, "Beyond Advanced LIGO: Astronomy and Astrophysics with Third-generation Gravitational-wave Detectors", Rattle and Shine, July 2012, KITP Santa Barbara
- Stefan Ballmer, "Prospects and challenges for Gravitational-wave astronomy", APS April meeting, March 2012 (Abstract ID: BAPS.2012.APR.B8.1)
- Stefan Ballmer, "2nd and 3rd generation gravitational-wave detectors", Physics Colloquium, University of Massachusetts Amherst, November 2011

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- Stefan Ballmer, "2nd and 3rd generation gravitational-wave detectors", Physics Colloquium, Rochester Institute of Technology, November 2011
- Stefan Ballmer, "Advanced LIGO", Rencontres de Moriond, March 2011, *Cancelled due to natural disaster in Japan*
- Stefan Ballmer, "Searching for Big Bang relicts with LIGO"; Gravitational Waves 2010 workshop at University of Minnesota, Oct 14-16 2010
- Stefan Ballmer, "An upper limit on the stochastic gravitational-wave background of cosmological origin", HEAP 2009 Workshop, KEK, Tsukuba Japan, November 2009
- Stefan Ballmer, "Precision length measurements in LIGO: Finding gravitational waves and more", Physics Colloquium, University of Washington, Seattle, April 2008
- Stefan Ballmer (for the LIGO Scientific Collaboration). "The LIGO Gravitational Wave Antennae, Nuts and Bolts and Current Sensitivity", Frontiers in Contemporary Physics III, Vanderbilt University, Nashville, TN, May 2005.

## Conference Presentations and Colloquia

- Stefan Ballmer, "Cosmic Explorer, the Next-Generation of US Gravitational-Wave Observatories", Colloquium at Cornell University, Dec 2, 2022
- Stefan Ballmer, "Cosmic Explorer, the Next-Generation of US Gravitational-Wave Observatories", Los Alamos, Oct 6, 2022
- Stefan Ballmer, "The Next Leap in Gravitational-Wave Astronomy", University of Nagoya, June 14, 2022
- Stefan Ballmer, "The Next Leap in Gravitational-Wave Astronomy", University of Tokyo, RESCEU, June 2, 2022
- Stefan Ballmer, "Building the Next Terrestrial Gravitational Wave Detectors", Colloquium at the University of Florida Nov 12, 2020 (virtual)
- Stefan Ballmer, "Building the Next Terrestrial Gravitational Wave Detectors", Colloquium at the Leibniz University of Hannover Nov 10, 2020 (virtual)
- Stefan Ballmer, "Designing the Next Terrestrial Gravitational Wave Detectors", Colloquium at the AEI Hannover, Germany, June 25, 2020
- Stefan Ballmer, "Exploring the Most Extreme Corners of the Universe", TACNY Jr. Café Scientifique, Museum of Science and Technology, Syracuse, Feb 16, 2019
- Stefan Ballmer, "Expected Detector Performance for O3", Aspen meeting on GW, Feb 10, 2019
- Stefan Ballmer, "Listening to the stars", talk at the K International School, Tokyo, Japan, Nov 24, 2017
- Stefan Ballmer, "The Next-Generation Gravitational-Wave Detectors", NYSS APS, Schenectady, Union College, Nov 10, 2017
- Stefan Ballmer, "Gravitational-Wave Astronomy: Now and in the Future", Indiana University-Purdue University Indianapolis, Oct 13, 2017
- Stefan Ballmer, "SU Physics Slam: Listening to the Dark side of the Universe", Syracuse University, Sept 21, 2017
- Stefan Ballmer, "QPD WFS mode-match/alignment sensor Experiment at SU / Fluctuation-Dissipation Theorem in Non-Equilibrium Conditions", LIGO-Virgo Collaboration Meeting, CERN, Geneva, Switzerland, Aug 29, 2017

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- Stefan Ballmer, "Gravitational-Wave Astronomy: Now and in the Future", Monash University, Melbourne, Australia, June 19, 2017
- Stefan Ballmer, "The latest news from Advanced LIGO's 2nd science run", Colloquium University of Tokyo, Japan June 5, 2017
- Stefan Ballmer, "Tests of General Relativity", GWADW Hamilton Island, Australia, May 8 2017
- Stefan Ballmer, "Engineering the photo-thermal response of dielectric mirror coatings to stabilize optical springs", Seminar University of Tokyo, Japan, April 7 2017
- Stefan Ballmer, "Instrumental Challenges with Advanced LIGO", Aspen Winter Conference, Aspen, CO, Feb 5 2017
- Stefan Ballmer, "Gravitational-Wave Astronomy in the Next Decades", HEP Seminar, Columbia University, New York City, Feb 1 2017
- Stefan Ballmer, "What comes next for Gravitational-Wave Astronomy", RESCEU, University of Tokyo, Japan, Dec 15 2016
- Stefan Ballmer, "The first steps in Gravitational-Wave Astronomy", ICRR, Kashiwa, Japan, Nov 24 2016
- Stefan Ballmer, "Lenses and Wedges for long arm cavities? - Terrain Following Interferometry", GWADW, Elba, Italy, May 26 2016
- Stefan Ballmer, "What if we are stuck with coatings? - Hanford 10km Extension Map & Terrain Profile & Cryogenic Folding", GWADW, Elba, Italy, May 25 2016
- Stefan Ballmer, "Gravitational Wave Astronomy with Terrestrial Interferometer", Tsinghua University, Beijing, China, May 12 2016
- Stefan Ballmer, "Listening to Black Holes", MIT Club of Northern NJ, Mar 29, 2016
- Stefan Ballmer, "Sept 14 2015", Syracuse University, Feb 18 2016
- Stefan Ballmer, "Catching Gravitational Waves", Syracuse University, Sept 10 2015
- Stefan Ballmer, "Large Optics for the future", at the Gravitational-Wave Advanced Detector Workshop (GWADW), Girdwood, AK (May 22, 2015).
- Stefan Ballmer, "LIGO Voyager and beyond - the big issues", LIGO-Virgo Collaboration Meeting, Pasadena California, March 2015
- Stefan Ballmer, "Explorer R&D" LSC-Virgo Collaboration Meeting, Pasadena California, March 2015
- Stefan Ballmer, "Detectors for the Dawn of Gravitational-Wave Astronomy", Seminar at the Rochester Institute of Technology, Dec 2014
- Stefan Ballmer, "The Dawn of Gravitational-Wave Astronomy", Colloquium at Tokyo University, Tokyo, Japan, Oct 2014
- Stefan Ballmer, "Commissioning Advanced LIGO to the 1st lock", seminar at the National Astronomical Observatory of Japan (NAOJ), June 2014.
- Stefan Ballmer, "Reducing coating thermal noise with folded cavities", Gravitational-Wave Advanced Detector (GWADW 2014) workshop, May 2014, Takayama, Japan
- Stefan Ballmer, "Lavender design ideas", Advantages of longer arm length gravitational-wave detectors", May 2013, GWADW La Biodola, Isola d'Elba, Italy
- Stefan Ballmer, "Optical Techniques for Reducing Thermal Noise", Gravitational Wave Advanced Detector Workshop, May 2013, GWADW La Biodola, Isola d'Elba, Italy

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- Stefan Ballmer, "Green team design ideas" for upgrading Advanced LIGO, Gravitational Wave Advanced Detector Workshop, May 2012, Waikoloa, Hawaii
- Stefan Ballmer, "Stress-Optic noise?", Gravitational Wave Advanced Detector Workshop, May 2011, La Biodola, Isola d'Elba, Italy
- Stefan Ballmer "Thoughts on optimizing coating thermal noise", GWADW May 2010, Kyoto, Japan
- Stefan Ballmer. "Laser Interferometry and Pulsar Timing: Looking for a Stochastic Gravitational Wave Background", International Pulsar Timing Array Meeting, Aug. 2008 Arecibo, PR
- Stefan Ballmer (for the LIGO / VIRGO Scientific Collaboration). "Building an International Gravitational Wave Network", AAS 211th Meeting, Austin, TX Jan. 2008
- Stefan Ballmer (for the LIGO Scientific Collaboration). "Estimating the Spatial Structure of a Stochastic Gravitational Wave Background", GWDAW 12, Cambridge, MA, Dec. 2007
- Stefan Ballmer. "Noise Couplings in the Laser Interferometer Gravitational Wave Observatory (LIGO)", Laser Science XIII, San Jose, CA, Sep. 2007
- Stefan Ballmer. "Upper Limit Map of a Stochastic Background of Gravitational Waves", AAS 209th Meeting, Thesis presentation, Seattle, WA, Jan. 2007
- Stefan Ballmer. "Upper Limit Map of a Stochastic Gravitational Wave Background", Poster presentation, 23rd Texas Symposium on Relativistic Astrophysics, Melbourne, Australia, Dec 2006
- Stefan Ballmer (for the LIGO Scientific Collaboration). "Status of LIGO and what the future holds, Toward joint EM/GW observations", Transient Universe 2006, Kavli Institute for Theoretical Physics, Santa Barbara, CA, Mar. 2006
- Stefan Ballmer (for the LIGO Scientific Collaboration). "Upper Limits on Stochastic Background of Gravitational Waves", 6th Edoardo Amaldi Conference on Gravitational Waves, Okinawa Japan, June 2005.
- Stefan Ballmer. "Pictures from LIGO - The Radiometer", LIGO Science Collaboration (LSC) meeting Cambridge, MA, Nov 2005.
- Stefan Ballmer. "Status of the Gravitational Wave Radiometer search", LIGO Science Collaboration (LSC) meeting Hanford, WA, Aug 2005.
- Stefan Ballmer. "Commissioning Progress and Plans, Hanford Observatory", LIGO Science Collaboration (LSC) meeting, Livingston, LA, March 2005.
- Stefan Ballmer. "Directional Stochastic Search: a Gravitational Wave Radiometer", LIGO Science Collaboration (LSC) meeting Hanford, WA, Aug 2004.

## SELECTED LIGO TECHNICAL DOCUMENTS

- "Preliminary Design for Static Adaptive Mode-Matching", J. Sanders, F. Magana-Sandoval, Thomas Vo, A. Perreca, S. Ballmer (2016 T1600496)
- "Active Wavefront Control Roadmap" A. Brooks, S. Ballmer et al. (2015 T1500188)
- "Adaptive Optic Element Specifications" F. Magana-Sandoval, S. Ballmer et al. (2015 E1500297)
- "OMC wave front control meeting" S. Ballmer (2015 G1500963)

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- "Adaptive High Order Mode Corrector: Example and constraints" A. Perreca, S. Ballmer, H. Yamamoto. (2015 T1500372)
- "High Sensitivity Telescope Presentation" S. Ballmer et al. (2015 G1500958)
- "The Advanced LIGO Angular Control System (ASC) (Hanford edition)" S. Ballmer (2015 G1500923)
- "aLIGO L1 and H1 Subsystem Meta-reviews" J. Giaime, S. Ballmer et al. (2015 L1500033)
- "LSC ODC documentation" T. Massinger, S. Ballmer et al. (2015 T1500264)
- "Dawn Workshop Instrument session" L. Barsotti, S. Ballmer et al. (2015 G1500599)
- "aLIGO System Acceptance Document Review " J. Giaime, S. Ballmer et al. (2015 L1500032)
- "Adaptive mode matching in the OMC " F. Magana-Sandoval, S. Ballmer et al. (2015 G1500282)
- "Online State Vector System", S. Ballmer, D. Brown, R. Fisher (2013, T1300542)
- "Online Detector Characterization System Overview", S. Ballmer, D. Brown, P. Couvares, R. Fisher, J. Lough, J. Smith (2012, T1200323)
- "Advanced LIGO Length Sensing and Control Final Design", R. Abbott, R. Adhikari, S. Ballmer, L. Barsotti, M. Evans, P. Fritschel, V. Frolov, G. Mueller, (2010, T1000298)
- "AdvLIGO Interferometer Sensing and Control Conceptual Design", R. Abbott, R. Adhikari, S. Ballmer, L. Barsotti, M. Evans, P. Fritschel, V. Frolov, G. Mueller; B. Slagmolen, S. Waldman (2007, T070247-01-I)
- "Interferometer Sensing and Control (ISC) Design Requirements", R. Adhikari; S. Ballmer; P. Fritschel (2007, T070236-00-D)
- "Arm Cavity Finesse for Advanced LIGO", P. Fritschel, R. Adhikari, S. Ballmer, M. Evans (2007, T070303-01-D)
- "Optical Absorption in Initial LIGO IFOs", David Ottaway, Stefan Ballmer, Joe Betzweiser, K. Kawabe, Bill Kells, Malik Rakhmanov, Rick Savage and Sam Waldman (2005, T050074-00-R)
- "Thermal Compensation System Description", Stefan Ballmer, Valera Frolov, Ryan Lawrence, Bill Kells, Gerardo Moreno, Ken Mason, David Ottaway, Michael Smith, Cheryl Vorvick, Phil Willems and Mike Zucker (2005, T050064-00-R)
- "Description of the Angular Sensing and Control (ASC) system in H1 during the third LIGO Science run (S3)", Luca Matone, Stefan Ballmer, Matt Evans, Peter Fritschel Nergis Mavalvala, Virginio Sannibale, Rick Savage, Paul Schwinberg, Daniel Sigg (2003, T030290-00-D)

## COURSES TAUGHT

Since **Modern Instrumentation (PHY351/651)**

2010 (Spring 2020, Fall 2018, Fall 2017, Fall 2016)  
Introductory Course on Analog and Digital Electronics.

**Syracuse University**

Graduate level.

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**Detecting Gravitational Waves** (Summer 2017)  
Theory and experimental techniques for detecting gravitational waves  
**University of Tokyo**  
Graduate level.

**Theory of Relativity I (PHY785)**  
(Spring 2013, Spring 2015, Spring 2017)  
**Syracuse University**  
Graduate level.

**Experimental Physics I (PHY344)**  
(Spring 2022, Spring 2021, Spring 2020, Spring 2019, Spring 2018)  
**Syracuse University**  
Undergraduate level.

**General Physics Laboratory II (PHY222)** (Fall 2022, Spring 2023, Fall 2023)  
**Syracuse University**  
Undergraduate level.

**Relativity and Cosmology (PHY312)** (Spring 2015, Spring 2016)  
**Syracuse University**  
Undergraduate level.

**Electromagnetism II (PHY425)** (Spring 2011 & Spring 2012)  
**Syracuse University**  
Undergraduate level.

**Major Concepts in Physics I (PHY101)**  
(Fall 2011, Fall 2012, Fall 2014)  
**Syracuse University**  
Undergraduate level for non-physicists.

Sep 2009 - **Course on Stochastic Gravitational-Wave Background**  
Dec 2009 **National Astronomical Observatory of Japan**  
Graduate level.

## DEPARTMENT SERVICE

2010 - Member of the Graduate Admissions Committee, Physics Department,  
present Syracuse University

Served on multiple department faculty search committees and faculty  
review committees

Member of the Physics Department Graduate Curriculum Committee,  
Syracuse University



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## RESEARCH STUDENTS SUPERVISED

Satoshi Tanioka (current post-doc),  
Jax Sanders (former post-doc, now faculty at Marquette University),  
Antonio Perreca (former post-doc, now faculty at University of Trento),  
Nicholas Didio (graduated 2023),  
Varun Srivastava (graduated 2022, now at Meta)  
Erik Muniz (graduated 2021, Senior Physics Engineer, Raytheon Technologies),  
Thomas Vo (graduated 2019, now optical metrology scientist at Facebook),  
Fabian Magaña-Sandoval (graduated 2019, now post-doc, University of Florida),  
Swetha Bhagwat (graduated 2018, now post-doc at Sapienza University, Rome),  
David Kelley (graduated 2015, now Lidar scientist at 3DEO, Inc),  
James Lough (graduated 2014, now junior scientist at AEI Hannover),  
Daniel Vander-Hyde (graduate),  
Elenna Capote (graduate),  
Subham Vidyant (graduate),  
Matt Todd (graduate)  
Ari Pedersen (graduate),  
Rebecca White (undergraduate),  
Almir Alemic (undergraduate),  
Philippe Lewalle (undergraduate)

## REFEREE SERVICE

National Science Foundation, *Physical Review Letters*, *Physical Review D*,  
*Classical and Quantum Gravity*

## ADDITIONAL SKILLS AND ACTIVITIES

Flight Instructor Airplane Single Engine, Instrument Airplane (CFII); Commercial Pilot Airplane  
Single and Multi- Engine Land, Instrument Airplane; Private Pilot Privileges:  
Single Engine Sea; Swiss and Japanese Private Pilot license; Member of  
Syracuse Flying Club and Caltech / JPL Flying Club (AACIT).

Languages English and French (fluent); German (native); Japanese (basic)

## REFERENCES

Available upon request

Stefan W. Ballmer