

# Aaron S. Chou

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## Professional Experience:

- 2016- Analysis Chair, ADMX-G2 Collaboration
- 2013-2015 Director's Science Advisory Council, Fermilab
- 2010-2016 Co-spokesperson and project manager, Holometer experiment, FNAL E-990
- 2007-2009 Co-spokesperson, GammeV experiment, FNAL T-1007

## Positions:

- 2012- Scientist, Fermilab
- 2008-2011 Wilson Fellow / Associate Scientist, Fermilab

## Professional Preparation:

- 2013 Advanced Strategy Program  
University of Chicago Booth School of Business
- 2012 Strategic Laboratory Leadership Program  
University of Chicago Booth School of Business
- 2007-2008 Senior Research Scientist w/Glennys Farrar  
Center for Cosmology and Particle Physics, New York University
- 2002-2007 Research Associate w/Paul Mantsch  
Fermi National Accelerator Laboratory
- 2001-2002 Research Associate w/John Jaros  
Stanford Linear Accelerator Center
- 2002 PhD, Applied Physics, Advisors: Martin Breidenbach, John Jaros  
Stanford University
- 1993 B.A. Magna cum laude, Physics  
Cornell University

## Awards:

- 2017- Fermilab Laboratory Directed R&D grant \$2.3M (qubit sensors)
- 2015- Heising-Simons Foundation grant (axion detectors)
- 2011-2016 DOE Early Career award \$2.5M (Holometer construction)
- 2009-2011 DOE Outstanding Junior Investigator in High Energy Physics (Laser axion searches)
- 2009, 2010 Fermilab-U.Chicago Strategic Collaborative Initiative grant

## Current Research Activities:

### · Search for Axion Dark Matter, 2014-present

I lead the Fermilab axion dark matter group (including Daniel Bowring, Swapan Chattopadhyay, Akash Dixit, Estia Eichten, Chris Hill, Al Moretti, Erik Ramberg, Andrew Sonnenschein, Alvin Tollestrup, and William Wester) which develops new techniques to enable present and future axion searches. I led a successful proposal in 2015 to join the ADMX-G2 experiment, one of the DOE Generation 2 dark matter projects, and Fermilab has now become the DOE lead lab for the operations phase of this experiment. My formal ADMX management roles include the following:

- Analysis Chair, responsible for coordinating all science data analysis efforts within the collaboration;
- Detection Committee member, responsible for verifying and validating any claimed signal excess;
- Level 2 manager for electronic cavity tuning.

My current axion R&D activities include the following:

- Transferring the superconducting qubit technology from the quantum computing field for use as quantum non-demolition, single microwave photon detectors. With orders of magnitude lower noise than conventional microwave power detectors, these detectors will enable next generation axion experiments. This activity received seed funding from the Heising-Simons Foundation, and just received a Fermilab LDRD grant for procurement of a milli-Kelvin test stand incorporating a high field magnet.
- Designing multiplexed cavity systems for higher frequency axion searches.
- Designing superconducting frequency-multiplexed readout systems based on Cosmic Microwave Background experimental technologies for lower frequency axion searches.

· **Interferometric Probes of the Planck Scale, 2009-present**

I co-designed, proposed, and built the Holometer experiment ([holometer.fnal.gov](http://holometer.fnal.gov)) – the world’s most sensitive microphone for detecting tiny spatial position jitter predicted by a model of holographic quantum gravity. Using a cross-correlation technique to average the measurements of beam splitter motion in two neighboring high power laser interferometers over  $10^{28}$  repeated measurements, we were able to extract more significant digits of information than has ever been achieved in human history.

From 2011-2016, I managed the construction and operation of the Holometer, which was funded by my 2011 DOE Early Career grant. The first science results disproving a certain model of holographic shear noise were published in Physical Review Letters in 2016. The current efforts are in reconfiguring the interferometers from a Michelson configuration into a partial Sagnac configuration with bent arms in order to gain sensitivity to a new model of holographic rotational noise. Science data taking in this new configuration will commence in 2017.

**Previous Research Activities:**

· **Laser searches for ultra-weakly-interacting particles, 2006-2010**

I designed and proposed the GammeV experiment ([gammev.fnal.gov](http://gammev.fnal.gov)) at Fermilab, a search for conversions of photons into axion-like milli-eV mass particles. The initial search for axion-like particles produced in the single best laboratory limit (at the time) on the photon-axion coupling. A reconfiguration of the apparatus allowed us to perform a pioneering search for chameleons – exotic Higgs-like or axion-like particles whose mass is predicted to depend on their local environment. The GammeV program and the follow-up CHASE experiment resulted in three Physical Review Letters publications.

Funded by a DOE Outstanding Junior Investigator grant, I developed an laser cavity-based axion search experiment which would be sensitive to couplings at the  $10^{11}$  GeV scale. While this experiment has been postponed in the U.S. for various reasons, a similar experiment (ALPS-II) has now been approved in Germany.

· **Ultra-high-energy cosmic rays, 2002-2008**

During much of my postdoc period, I worked on the Pierre Auger Observatory, an ultra-high-energy cosmic ray (UHECR) telescope located in Malargue, Argentina. By making simultaneous measurements of the longitudinal development of cosmic ray air showers with fluorescence telescopes, and the transverse development with a ground array of water Cherenkov detectors, we were able to measure the energy spectrum of cosmic rays in the energy range  $10^{18}$  eV- $10^{20}$  eV and confirm the existence of a suppression in the flux at the highest energies, consistent with the predicted Greisen-Zatsepin-Kuzmin energy loss

due to scattering on cosmic microwave background photons. In addition to the energy spectrum measurement, I worked closely with Katsushi Arisaka to identify cosmic ray composition-sensitive observables, allowing discrimination between protons, heavy nuclei, and high energy gamma rays. This collaboration resulted in Auger's first published limits on the possible photon flux component in the ultra-high-energy spectrum, using water Cherenkov surface detectors. I also evaluated and quantified the systematic errors in the analysis observing the mysterious anisotropy in the cosmic ray arrival directions.

Working with Glennys Farrar, I co-wrote the proposal for a water Cherenkov array telescope for detecting very-high-energy cosmic neutrinos. This array would utilize existing fire-extinguishing water tanks on rooftops in New York City. The idea eventually became the NSF-funded NYSCPT program for installing cosmic ray detectors in NYC high schools.

· **Optimizing the vertex detector for the International Linear Collider, 2001-2002**

Utilizing my expertise with bottom and charm hadron tagging via reconstruction of displaced vertices, I performed Monte Carlo studies of the silicon vertex detector design to optimize the charm quark tagging capabilities of the detector, and thus enable a precise measurement of the Higgs to charm Yukawa coupling. These results were presented at the LC2002 workshop.

· **Electroweak Symmetry Breaking and  $B$  decays with the SLD, 1994-2001**

While I was a graduate student at Stanford, I worked primarily on the SLC Large Detector experiment. The SLD's state-of-the-art CCD vertex detector offered unprecedented precision in tracking and vertexing. Combined with the small, stable beam spot of the collider, a highly efficient and pure B tag was developed which yielded a rich program of electroweak and b decay physics. My work with the SLD included:

- Writing an efficient and robust vertex detector/drift chamber pattern recognition algorithm used in SLD reconstruction for measuring charged particle trajectories.
- Designing and maintaining beam position measurements for use in b and c hadron identification. Maintaining the heavy flavor analysis veto for run periods with poor beam position measurement accuracy.
- Computing and analyzing data on track-to-CCD-hit distance residuals which were used to diagnose and fix vertex detector electronics problems (charge transfer inefficiencies, hardware clock skipping and offsets) and to perform the vertex detector alignment.
- Upgrading the topological vertexing software by modelling the spatial evolution of the track error ellipses in the global vertex search algorithm in order to maximize the vertex finding efficiency.

- Rewriting and tuning the SLD B decay Monte Carlo in order to match the SLD physics simulation to the latest CLEO data.
- Tuning the Monte Carlo vertex detector simulation in order to match the true resolution of the detector as measured in track impact parameter data and tau decay vertexing data.

Once the detector was understood and the Monte Carlo simulations were tuned, we were able to produce a rich set of heavy flavor physics results including measurements of the production of heavy quarks from  $Z^0$  decays, and measurements of the subsequent decay properties of these heavy quarks.

· **Theoretical physics** (w/Prof. Renata Kallosh), 1995-1996

While studying theoretical physics, I initiated a working group on N=2 supersymmetry. We were able to apply our work to the recent "discovery" of an eleventh dimension in string theory to prove the existence of a unique global minimum of the superpotential for M theory compactified on any Calabi-Yau manifold. The goal of this work was to determine a mechanism by which a preferred vacuum could be selected from the vast landscape of possible string vacua, and hence to endow the theory with some predictive power.

· **Quantum Optics** (w/Prof. Yoshihisa Yamamoto), 1993

I designed and built digital temperature control circuits for heating birefringent crystals used for optical down conversion and the generation of correlated, squeezed photon states.

· **Biophysics** (w/Prof. Watt W. Webb), 1992-1993

As an undergraduate research assistant, I wrote a pixel clustering algorithm to identify and track the motion of CCD images of fluorescent molecular tags in-vivo. This technology was used to measure calcium wave responses in cells. Later I worked on synthesizing liposomes for further in-vivo tagging applications.

· **Low Temperature Physics** (w/Prof. Albert Sievers), 1991

As the recipient of a Pell research grant, I synthesized novel crystal windows for a millimeter wave interferometer.

### Selected Conference Talks:

- *Quantum Detectors for Dark Matter Axion Detection*  
8th INFIERI Workshop, Fermilab, October 17, 2016.
- *Axion Dark Matter: From Fermi to Rabi*  
Simplicity II, Fermilab, September 8, 2016.
- *Single microwave photon detectors for ADMX*  
ICHEP2016, Chicago, August 4, 2016.
- *Single microwave photon detection enables high frequency axion searches*  
12th Patras Workshop on Axions, WIMPs and WISPs, Jeju, South Korea, June 20, 2016.
- *Experimental Probes of Quantum Geometry*  
AAAS Meeting, Chicago, February 15, 2014.
- *Comments on Axion Searches*  
Snowmass on the Mississippi, University of Minnesota, August 2, 2013.
- *Probing the quantum vacuum with lasers (Unruh radiation)*  
Intensity Frontier Workshop, Argonne National Laboratory, April 25, 2013.
- *Search for Planck-Suppressed Position Noise in Interferometers*  
Cosmic Frontier Workshop, SLAC, March 6, 2013.
- *The Hunt for Axions*  
IDM 2012, Chicago, July 23, 2012.
- *Purely Laboratory Experiments (Laser + EM fields)*  
Vistas in Axion Physics, University of Washington, April 24, 2012
- *Probes of fundamental physics using intense photon beams*  
TIPP 2011, Chicago, IL, June 9, 2011.
- *Experimental probes of axions*  
ASK11 Workshop, Seoul National University, April 11, 2011.
- *Probes of the  $10^{-11} \text{ GeV}^{-1}$  photon-axion coupling scale*  
Axions 2010, Gainesville, Florida, January 15-17, 2010.
- *Experimental Probes of Axions (Review talk)*  
Physics in Collision, Kobe, Japan, August 30-September 2, 2009.
- *Search for chameleon particles using a photon regeneration technique*  
4th Patras Workshop on Axions, WIMPs and WISPs, DESY, June 20, 2008.

## Selected Seminars and Colloquia:

- *ADMX-G2: an Axion Dark Matter Radio*  
HEP seminar, Northwestern University, October 3, 2016.
- *ADMX-G2: Searching for axion radio broadcasts from the galaxy.*  
Joint KEK Theory Fermilab Theory Meeting, September 28, 2016.
- *Searching for Planck-suppressed phenomena with the Fermilab Holometer.*  
HEP seminar, Argonne National Laboratory, February 24, 2016.
- *Searching for Axion Radio Broadcasts from the Galaxy: ADMX Generation 2 and Beyond.*  
Physics Department seminar, Argonne National Laboratory, November 23, 2015.
- *Searching for Planck-suppressed phenomena with the Fermilab Holometer.*  
Physics colloquium, University of Florida, April 9, 2015.
- *Probing ultra-weakly coupled phenomena with coherent bosonic beams.*  
DUSC seminar, University of Washington, February 25, 2015.
- *Searching for Axion Radio Broadcasts from the Galaxy.*  
Astronomy lunch seminar, University of Chicago, October 18, 2014.
- *Search for Planck-Suppressed Position Noise in Interferometers.*  
Kavli Institute for Cosmological Physics seminar, University of Chicago, April 12, 2013.
- *Probing the Planck scale using intense photon beams*  
University of Minnesota HEP Seminar, March 29, 2011.
- *Experimental probes of axions*  
University of Minnesota Cosmology Seminar, March 28, 2011.
- *Development of optical experiments to test fundamental physics*  
LIGO Hanford seminar, December 3, 2009.
- *Experimental probes of axions*  
Physics Colloquium, University of Kentucky, Nov. 20, 2009.
- *Search for oscillations from photons to milli-eV mass particles*  
Nuclear seminar, University of Kentucky, Nov. 19, 2009.
- *Searching for axions and other low-mass particles by shining light through walls*  
Astroparticle Physics Seminar, Princeton University, May 7, 2009.
- *Detecting the invisible axion with an adiabatic following technique*  
Brown Bag Seminar, New York University, March 10, 2008.
- *Search for oscillations from photons to milli-eV particles*  
HEP Seminar, Columbia University, February 6, 2008.

### **Selected Management/Administration/Service:**

- Served on various hiring committees:
  - 2016-present: Wilson Fellows hiring committee (tenure-track scientist position).
  - 2013: Fermilab Intensity Frontier postdoc hiring committee.
  - 2012: Chair, Schramm Experimental Fellowship committee.
  - 2008-2013: Fermilab Particle Astrophysics Center postdoc hiring committee.
- Served on Fermilab Director's Science Advisory Council for 2013-2015 term. We met weekly with director Pier Oddone and subsequently director Nigel Lockyer and the Fermilab senior management team to advise on scientific strategy.
- Represented Fermilab at various DOE budget/program reviews, justifying more than \$100M in cumulative budgets for scientific, technical and equipment support.
  - 2016 Generic Detector R&D review:  
Prepared supporting superconducting sensors white paper.
  - 2014 Cosmic Frontier Operations review.
  - 2013 Cosmic Frontier Experimental Program review.
  - 2012 Cosmic Frontier Operations review.
  - 2012 Generic Detector R&D review:  
Co-editor of review report for the entire FNAL program.
  - 2011 Science and Technology (S&T) review of Fermilab.
  - 2010 Non-Accelerator-Based Projects review.
  - 2009 Generic Detector R&D review.
- Frequent reviewer for DOE, NSF, other funding agencies, and various journals

### **Synergistic activities:**

- PhD advisor for U.Chicago student Akash Dixit (axion searches).
- PhD advisor for U.Chicago student Robert Lanza (Holometer), now postdoc at MIT.
- PhD committee member for U.Chicago graduate student Lee McCuller (Holometer), now postdoc at MIT.
- Outreach, including academic lectures, Fermilab Saturday Morning Physics program for high school students, and interviews with journalists from Scientific American, Wired, Nature, Discover, Science, Physics World, etc.
- Mentoring and supervision of undergraduate and graduate students for various Fermilab summer research projects.

## Selected Recent Publications:

· *The Holometer: An Instrument to Probe Planckian Quantum Geometry*  
Holometer Collaboration, arXiv:1611.08265 [physics.ins-det]. Submitted to  
Class.Quant.Grav.

**As project manager, I oversaw all aspects of the Holometer instrumentation and was specifically responsible for the custom optics and shot-noise-limited RF photoreceivers described in this instrumentation paper.**

· *First Measurements of High Frequency Cross-Spectra from a Pair of Large Michelson Interferometers*

A.S. Chou, et.al, Phys.Rev.Lett. 117 (2016) no.11, 11102, arXiv:1512.01216.

**This paper reports the first science data from the Holometer experiment, which I conceived, built, and operated. These data rule out the Hogan model of transverse holographic noise.**

· *Laboratory constraints on chameleon dark energy and power-law fields.*

J.H. Steffen et.al., arXiv:1010.0988 [astro.ph.CO]. Phys.Rev.Lett. 105 (2010) 261803.

**This paper reports the results of the CHASE experiment, a followup to GammeV which performed a nearly definitive laser chameleon search. I worked closely with postdocs Jason Steffen and Amol Upadhye on the phenomenology, technical design, and data analysis.**

· *Search for chameleon particles using a photon regeneration technique*

A.S. Chou, et.al. arXiv:0806.2438 [hep-ex]. Phys.Rev.Lett. 102:030402, 2009.

**This paper reports the results of pioneering chameleon search via a trapped chameleon technique which I invented and implemented in the GammeV apparatus.**

· *Observation of the suppression of the flux of cosmic rays above  $4 \times 10^{19}$  eV*

Pierre Auger Collaboration. arXiv:0806.4302 [astro-ph]. Phys.Rev.Lett. 101:061101, 2008.

**I worked on the aperture and energy scale systematics for this paper which ruled out the excess of super-GZK cosmic rays reported by AGASA.**

· *Search for axion-like particles using a variable baseline photon regeneration technique*

A.S. Chou, et.al, arXiv:0710.3783 [hep-ex], Phys.Rev.Lett. 100, 080402 (2008).

**This paper reported results from the GammeV experiment which I designed, proposed, and operated. The data ruled out the anomalous axion signal seen by PVLAS, and for a time provided the world's most sensitive laser constraints on the axion-photon coupling.**

**Other publications for which I am a/the primary author:**

- *On the anomalous afterglow seen in a chameleon afterglow search*  
J.H. Steffen, et.al. arXiv:1205.6495 [physics-ins-det]. Phys.Rev. D86 (2012) 012003.
- *Designing dark energy afterglow experiments.*  
A. Upadhye, J.H. Steffen, and A.S. Chou. arXiv:1204.5476 [hep-ph]. Phys.Rev. D86 (2012) 035006.
- *A Faraway Quasar in the Direction of the Highest Energy Auger Event*  
I.F.M. Albuquerque and A.S. Chou. arXiv:1001.0972 [astro-ph.HE]. JCAP 1008:016, 2010.
- *A model-independent method for determining energy scale and muon number in cosmic ray surface detectors*  
F. Schmidt, M. Ave, L. Cazon, and A.S. Chou. arXiv:0712.3750 [astro-ph]. Astropart.Phys. 29:355-365 (2008).
- *Correlation of the highest energy cosmic rays with the positions of nearby active galactic nuclei*  
Pierre Auger Collaboration. arXiv:0712.2843 [astro-ph]. Astropart.Phys.29:188-204 (2008).
- *Correlation of the highest energy cosmic rays with nearby extragalactic objects*  
Pierre Auger Collaboration. Science (front cover), 318:938-943, 2007.
- *The accuracy of signal measurement with the water-Cherenkov detectors of the Pierre Auger Observatory*  
M. Ave, P. Bauleo, A. Castellina, A. Chou, J.L. Harton, R. Knapik, G. Navarra, Nucl.Instrum.Meth.A 578 (2007) 180-145.
- *Anisotropy Studies Around the Galactic Center at EeV Energies with the Auger Observatory*  
Pierre Auger Collaboration, Astropart.Phys. **27**, 244 (2007) [astro-ph/0607382].
- *Deep Shower Interpretation of the cosmic ray events observed in excess of the Greisen-Zatsepin-Kuzmin energy*  
A. Chou, Phys. Rev. **D74**, 103001 (2006) [astro-ph/0606742].
- *Properties and Performance of the Prototype Instrument For the Pierre Auger Observatory*  
(Pierre Auger Collaboration), Nucl.Instrum.Meth **A523**:50-95 (2004).
- *Design and Performance of the SLD Vertex Detector, a 307 MPixel Tracking System.*  
K. Abe, et.al, Nucl.Instrum.Meth. **A400**:287-353 (1997)
- *Critical Points and Phase Transitions in 5-D Compactifications of M Theory.*  
A. Chou, et.al, Nucl.Phys. **B508**:147-180 (1997) [hep-th/9704142].

**Other publications to which I made significant contributions:**

- *Working Group Report: New Light Weakly Coupled Particles*  
R. Essig et.al. arXiv:1311.0029. 2013 Snowmass report.
- *Upper limit on the cosmic-ray photon flux above  $10^{19}$  eV using the surface detector of the Pierre Auger Observatory*  
Pierre Auger Collaboration. arXiv:0712.1147 [astro-ph]. Astropart.Phys.29:243-256 (2008).
- *An upper limit to the photon fraction in cosmic rays above  $10^{19}$  eV from the Pierre Auger Observatory*  
J. Abraham et.al, (Pierre Auger Collaboration), Astropart.Phys. **27**, 155 (2007) [astro-ph/0606619].
- *Measurement of the Branching Ratio of the  $Z^0$  into Heavy Quarks*  
(SLD Collaboration), Phys. Rev. **D71**, 112004 (2005) [hep-ex/0503005].
- *Direct Measurements of  $A(B)$  and  $A(C)$  Using Vertex/Kaon Charge Tags at SLD*  
(SLD Collaboration), Phys. Rev. Lett. **94**, 091801 (2005) [hep-ex/0410042].
- *Production of  $Pi^+$ ,  $Pi^-$ ,  $K^+$ ,  $K^-$ ,  $P$  and Anti- $P$  in Light( $uds$ ),  $C$ , and  $B$  Jets From  $Z^0$  Decays.*  
(SLD Collaboration), Phys. Rev. **D69**, 072003 (2004) [hep-ex/0310017].
- *First Measurement of the Double Inclusive  $B$ /Anti- $B$  Hadron Energy Distribution in  $e^+e^-$  Annihilations, and of Angle Dependent Moments of the  $B$  and Anti- $B$  Energies*  
(SLD Collaboration), Phys. Lett **B578**, 45-53 (2004) [hep-ex/0309058].
- *Search for Time Dependent  $B^0(S)$  - Anti- $B^0(S)$  Oscillations Using a Vertex Charge Dipole Technique*  
(SLD Collaboration), Phys. Rev. **D67**, 012006 (2003) [hep-ex/0209002].
- *A Search for Time Dependent  $B^0(S)$ -Anti- $B^0(S)$  Oscillations Using Exclusively Reconstructed  $D^{+-}(S)$  Mesons*  
(SLD Collaboration), Phys. Rev. **D66**, 032009 (2002) [hep-ex/0207048].
- *An Improved Study of the Structure or  $e^+e^- \rightarrow B$  Anti- $B$   $G$  Events and Limits on the Anomalous Chromomagnetic Coupling of the  $B$  Quark*  
(SLD Collaboration), Phys. Rev. **D66**, 052001 (2002) [hep-ex/0205066].
- *Measurement of the  $B$  Quark Fragmentation Function in  $Z^0$  Decays*  
(SLD Collaboration), Phys. Rev. **D65**, 092006 (2002) [hep-ex/0202031].
- *Precise Measurement of the  $b$ -quark Fragmentation Function in  $Z^0$  Boson Decays.*,  
(SLD Collaboration), Phys. Rev. Lett. **84**, 4300-4304 (2000) [hep-ex/9912058].

## Other Publications:

- *MHz Gravitational Wave Constraints with Decameter Michelson Interferometers*  
Holometer Collaboration, arXiv:1611.05560 [physics.ins-det]. Submitted to Phys.Rev.D
- *Trigger and aperture of the surface detector array of the Pierre Auger Observatory.*  
Pierre Auger Collaboration. Nucl.Instrum.Meth.A613:29-39, 2010.
- *Measurement of the Depth of Maximum of Extensive Air Showers above  $10^{18}$  eV.*  
Pierre Auger Collaboration. arXiv:1002.0699 [astro-ph.HE]. Phys.Rev.Lett.104:091101, 2010.
- *A Study of the Effect of Molecular and Aerosol Conditions in the Atmosphere on Air Fluorescence Measurements at the Pierre Auger Observatory.*  
Pierre Auger Collaboration. arXiv:1002.0366 [astro-ph.IM]. Astropart.Phys.33:108-129, 2010.
- *The Fluorescence Detector of the Pierre Auger Observatory*  
Pierre Auger Collaboration. arXiv:0907.4282. Nucl.Instrum.Meth.A620:227-251, 2010.
- *Upper limit on the diffuse flux of UHE tau neutrinos from the Pierre Auger Observatory*  
Pierre Auger Collaboration. arXiv:0712.1909 [astro-ph]. Phys.Rev.Lett. 100:211101 (2008).
- *Improved Direct Measurement of the Parity Violation Parameter  $A(B)$  Using a Mass Tag and Momentum Weighted Track Charge*  
(SLD Collaboration), Phys. Rev. Lett. **90**, 141804 (2003) [hep-ex/0208044].
- *Improved Direct Measurement of  $A(B)$  and  $A(C)$  at the  $Z0$  Pole Using a Lepton Tag*  
(SLD Collaboration), Phys. Rev. Lett.**88**, 151801 (2002) [hep-ex/0111035].
- *Improved Measurement of the Probability for Gluon Splitting into  $B$  Anti- $B$  in  $Z0$  Decays*  
(SLD Collaboration), Phys. Lett. **B507** 61-69 (2001) [hep-ex/0102002].
- *Measurement of  $A(c)$  with Charmed Mesons at SLD*  
(SLD Collaboration), Phys. Rev. **D63**, 032005 (2001) [hep-ex/0009035].
- *First Symmetry Tests in Polarized  $Z0$  Decays to  $B$  Anti- $B$   $G.$* , (SLD Collaboration), Phys. Rev. Lett. **86**, 962-966 (2001) [hep-ex/0007051].
- *An Improved Direct Measurement of Leptonic Coupling Asymmetries with Polarized  $Z$  Bosons*, (SLD Collaboration), Phys. Rev. Lett. **86**, 1162-1166 (2001) [hep-ex/0010015].
- *Search for Charmless Hadronic Decays of  $B$  Mesons with the SLD Detector*  
(SLD Collaboration), Phys. Rev. **D62**, 071101 (2000) [hep-ex/9910050].

### Other Publications (continued):

- *First Direct Measurement of the Parity Violating Coupling of the  $Z^0$  to the  $S$  Quark*, (SLD Collaboration), Phys. Rev. Lett. **85**, 5059-5063 (2000) [hep-ex/0010015].
- *A High Precision Measurement of the Left-Right  $Z$  Boson Cross-section Asymmetry*, (SLD Collaboration), Phys. Rev. Lett. **85**, 5059-5063 (2000) [hep-ex/0010015].
- *Direct Measurement of  $A(B)$  in  $Z^0$  Decays using Charged Kaon Tagging*, (SLD Collaboration), Phys. Rev. Lett. **83**, 1902-1907 (1999)
- *Direct Measurement of  $A(B)$  in  $Z^0$  Decays using a Lepton Tag.*, (SLD Collaboration), Phys. Rev. Lett. **83**, 3384-3389 (1999)
- *An Improved Test of the Flavor Independence of Strong Interactions* (SLD Collaboration), Phys. Rev. **D59**, 012002 (1999) [hep-ex/9805023].
- *Production of  $\pi^+, K^+, K^0, K^{*0}, \phi, P$ , and  $\Lambda^0$  in Hadronic  $Z^0$  Decays* (SLD Collaboration), Phys. Rev. **D59**, 052001 (1999) [hep-ex/9805029].
- *A Direct Measurement of Parity Violation in the Coupling of  $Z^0$  Bosons to  $B$  Quarks Using a Mass Tag and Momentum Weighted Track Charge.*, (SLD Collaboration), Phys. Rev. Lett. **81**, 942-946 (1998)
- *Measurement of  $R(B)$  using a Vertex Mass Tag*, (SLD Collaboration), Phys. Rev. Lett. **80**, 660-665 (1998) [hep-ex/9708015]
- *First Study of the Structure of  $e^+e^- \rightarrow B$  Anti- $B$   $G$  Events and Limits on the Anomalous Chromomagnetic Coupling of the  $B$  Quark* (SLD Collaboration), Phys. Rev. **D60**, 092002 (1999) [hep-ex/9903004].
- *Measurement of the  $B^+$  and  $B^0$  Lifetimes using Topological Reconstruction of Inclusive and Semileptonic Decays*, (SLD Collaboration), Phys. Rev. Lett. **79**, 590-596 (1997)
- *Measurement of the  $B$  Hadron Energy Distribution in  $Z^0$  Decays* (SLD Collaboration), Phys. Rev. **D56**, 5310-5319 (1997) [hep-ex/9707011].
- *Direct Measurement of Leptonic Coupling Asymmetries with Polarized  $Z$ s*, (SLD Collaboration), Phys. Rev. Lett. **79**, 804-808 (1997) [hep-ex/9704012]
- *Measurement of Leading Particle Effects in Decays of  $Z^0$  Bosons into Light Flavors*, (SLD Collaboration), Phys. Rev. Lett. **78**, 3442-3446 (1997) [hep-ex/9702009]
- *Measurement of the Tau-Neutrino Helicity and the Michel Parameters in Polarized  $e^+e^-$  Collisions*, (SLD Collaboration), Phys. Rev. Lett. **78**, 4691-4696 (1997) [hep-ex/9701020]
- *An Improved Measurement of the Left-Right  $Z^0$  Cross-section Asymmetry*, (SLD Collaboration), Phys. Rev. Lett. **78**, 2075-2079 (1997) [hep-ex/9611011]

**Other Publications (continued):**

- *First Measurement of the Left-Right Charge Asymmetry in Hadronic Z Boson Decays and a New Determination of  $\sin^2 \theta(W)(\text{Eff})$* , (SLD Collaboration), Phys. Rev. Lett. **78**, 17-21 (1997) [hep-ex/9609019]
- *A Study of the Orientation and Energy Partition of Three Jet Events in Hadronic Z0 Decays*, (SLD Collaboration), Phys. Rev. **D55**, 2533-2545 (1997) [hep-ex/9608016]
- *Measurement of the Charged Multiplicities in B, C, and Light Quark Events from Z0 Decays*, (SLD Collaboration), Phys. Rev. **B386**, 475-485 (1996) [hep-ex/9608008]
- *First Study of Rapidity Gaps in e+e- Annihilation*, (SLD Collaboration), Phys. Rev. Lett. **76**, 4886-4890 (1996) [hep-ex/9607008]
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