

CONTACT INFORMATION	Kavli Institute for Theoretical Physics University of California, Santa Barbara	<i>e-mail:</i> <a href="mailto:remmen@kitp.ucsb.edu">remmen@kitp.ucsb.edu</a> <i>web:</i> <a href="http://grantremmen.com">grantremmen.com</a>
POSITIONS	<b>University of California, Santa Barbara</b> , Fundamental Physics Fellow <b>Kavli Institute for Theoretical Physics</b> , Postdoctoral Scholar  <b>University of California, Berkeley</b> , Miller Research Fellow  <b>Harvard University Society of Fellows</b> , Junior Fellow (declined)	2020–present  2017–2020  2017
EDUCATION	<b>California Institute of Technology</b> Ph.D., Physics M.S., Physics Hertz Fellow and NSF Graduate Research Fellow  <b>University of Minnesota, College of Science &amp; Engineering</b> B.S., Physics, <i>summa cum laude</i> , High Distinction, 4.0 GPA B.S., Astrophysics, <i>summa cum laude</i> , High Distinction, 4.0 GPA B.S., Mathematics, <i>summa cum laude</i> , High Distinction, 4.0 GPA	2012–2017 June 2017 June 2015  2008–2012 May 2012 May 2012 May 2012
HONORS & AWARDS	<b>Appointed as Hertz Fellowship Interviewer</b> <b>Sakurai Dissertation Award in Theoretical Particle Physics</b> American Physical Society award citation: “For his contributions to understanding the structure and self-consistency of gravity and effective field theories using ideas from quantum field theory and holography.” <b>Stemple Memorial Prize in Physics</b> , Caltech <b>Delegate to the 66<sup>th</sup> Lindau Nobel Laureate Meeting</b> <b>Hertz Fellow</b> <b>NSF Graduate Research Fellow</b> , National Science Foundation <b>Goldwater Scholar</b> <b>Chambliss Astronomy Achievement Student Award</b> , American Astronomical Society <b>Dean’s Summer International Student Scholarship</b> , University College London <b>United States Presidential Scholar</b> , White House Commission on Presidential Scholars & U.S. Dept. of Education <b>National Merit Scholar</b> <b>Byrd Honors Scholar</b> <b>Hagstrum Award in Physics</b> , Univ. of MN <b>Outstanding Graduate in Mathematics</b> , Univ. of MN <b>Franklin Scholarship in Physics</b> , Univ. of MN <b>Lando Scholarship in Mathematics</b> , Univ. of MN <b>Richards Scholarship in Mathematics</b> , Univ. of MN <b>Nier Scholarship in Physics</b> , Univ. of MN <b>Thorp Scholarship in Mathematics</b> , Univ. of MN <b>Undergraduate Research Scholarship</b> , Univ. of MN <b>Basford Award in Physics</b> , Univ. of MN <b>Institute of Technology Alumni Award</b> , Univ. of MN <b>Institute of Technology Honors Undergraduate Research Scholarship</b> , Univ. of MN <b>Maroon &amp; Gold Leadership Award</b> , Univ. of MN <b>3M/Alumni Award</b> , Univ. of MN <b>Bentson Scholar</b> , Univ. of MN <b>Dean’s List</b> , Univ. of MN College of Science & Engineering/Institute of Technology <b>McGraw Hill Student Achievement Recognition</b> , Univ. of MN, for Meritorious Work in General Chemistry	2018–present 2018  2016 2016 2012–2017 2012–2017 2010–2012 2011 2011 2008  2008–2012 2008–2011 2012 2012 2011–2012 2011–2012 2011–2012 2010–2011 2010–2011 2010 2009–2010 2009–2010 2009 2008–2012 2008–2012 2008–2012 2008–2012 2008–2012 2008

- PUBLICATIONS Achilleas P. Porfyriadis, **Grant N. Remmen** under review, JHEP  
*Large Diffeomorphisms and Accidental Symmetry of the Extremal Horizon* arXiv:2112.13853
- Grant N. Remmen** Gen. Rel. Grav. **53** (2021) 101  
*Exploration of a Singular Fluid Spacetime* arXiv:2111.08713
- Nima Arkani-Hamed, Yu-tin Huang, Jin-Yu Liu, **Grant N. Remmen** under review, JHEP  
*Causality, Unitarity, and the Weak Gravity Conjecture* arXiv:2109.13937
- Grant N. Remmen** Phys. Rev. Lett. **127** (2021) 241602, Editors' Suggestion  
*Amplitudes and the Riemann Zeta Function* arXiv:2108.07820
- Achilleas P. Porfyriadis, **Grant N. Remmen** JHEP **10** (2021) 142  
*Horizon Acoustics of the GHS Black Hole and the Spectrum of  $AdS_2$*  arXiv:2106.10282
- Ning Bao, Aidan Chatwin-Davies, **Grant N. Remmen** JHEP **7** (2021) 113  
*Entanglement Wedge Cross Section Inequalities from Replicated Geometries* arXiv:2106.02640
- Ning Bao, Jonathan Harper, **Grant N. Remmen** Phys. Rev. D **105** (2022) 026010  
*Holevo Information of Black Hole Mesostates* arXiv:2103.06888
- Grant N. Remmen**, Nicholas L. Rodd under review, Phys. Rev. D  
*Signs, Spin, SMEFT: Sum Rules at Dimension Six* arXiv:2010.04723
- Rafael Aoude et al. (including **Grant N. Remmen**) Snowmass 2021 Letter of Interest  
*On-Shell Methods for the SMEFT*
- Ning Bao, Aidan Chatwin-Davies, **Grant N. Remmen** JHEP **9** (2020) 102  
*Warping Wormholes with Dust: a Metric Construction of the Python's Lunch* arXiv:2006.10762
- Grant N. Remmen**, Nicholas L. Rodd Phys. Rev. Lett. **125** (2020) 081601  
*Flavor Constraints from Unitarity and Analyticity* arXiv:2004.02885
- Clifford Cheung, **Grant N. Remmen** JHEP **5** (2020) 100  
*Entanglement and the Double Copy* arXiv:2002.10470
- Ning Bao, Aidan Chatwin-Davies, Jason Pollack, **Grant N. Remmen** JHEP **8** (2020) 65  
*Cosmological Decoherence from Thermal Gravitons* arXiv:1911.10207
- Grant N. Remmen**, Nicholas L. Rodd JHEP **12** (2019) 32  
*Consistency of the Standard Model Effective Field Theory* arXiv:1908.09845
- Ning Bao, Aidan Chatwin-Davies, Jason Pollack, **Grant N. Remmen** JHEP **7** (2019) 152  
*Towards a Bit Threads Derivation of Holographic Entanglement of Purification* arXiv:1905.04317
- Clifford Cheung, Junyu Liu, **Grant N. Remmen** Phys. Rev. D **100** (2019) 046003  
*Entropy Bounds on Effective Field Theory from Rotating Dyonic Black Holes* arXiv:1903.09156
- Raphael Bousso, Yasunori Nomura, **Grant N. Remmen** Phys. Rev. D **99** (2019) 046002  
*Outer Entropy and Quasilocal Energy* arXiv:1812.06987
- Ning Bao, Aidan Chatwin-Davies, **Grant N. Remmen** JHEP **2** (2019) 110  
*Entanglement of Purification and Multiboundary Wormhole Geometries* arXiv:1811.01983
- Grant N. Remmen** Phys. Rev. D **98** (2018) 124008  
*New Spacetimes for Rotating Dust in  $(2+1)$ -Dimensional General Relativity* arXiv:1810.12305
- Ning Bao, Aidan Chatwin-Davies, Jason Pollack, **Grant N. Remmen** JHEP **11** (2018) 71  
*Traversable Wormholes as Quantum Channels:  
Exploring CFT Entanglement Structure and Channel Capacity in Holography* arXiv:1808.05963
- Yasunori Nomura, **Grant N. Remmen** JHEP **8** (2018) 63  
*Area Law Unification and the Holographic Event Horizon* arXiv:1805.09339

- PUBLICATIONS, Venkatesa Chandrasekaran, **Grant N. Remmen**, JHEP **11** (2018) 15  
 CONTINUED Arvin Shahbazi-Moghaddam arXiv:1804.03153  
*Higher-Point Positivity*
- Clifford Cheung, Junyu Liu, **Grant N. Remmen** JHEP **10** (2018) 4  
*Proof of the Weak Gravity Conjecture from Black Hole Entropy* arXiv:1801.08546
- Ning Bao, Sean M. Carroll, Aidan Chatwin-Davies, Phys. Rev. D **97** (2018) 126014  
 Jason Pollack, **Grant N. Remmen** arXiv:1712.04955  
*Branches of the Black Hole Wave Function Need Not Contain Firewalls*
- Chris Akers, Raphael Bousso, Illan F. Halpern, Phys. Rev. D **97** (2018) 024018  
**Grant N. Remmen** arXiv:1711.06689  
*Boundary of the Future of a Surface*
- Clifford Cheung, **Grant N. Remmen**, Chia-Hsien Shen, Congkao Wen JHEP **4** (2018) 129  
*Pions as Gluons in Higher Dimensions* arXiv:1709.04932
- Clifford Cheung, **Grant N. Remmen** JHEP **9** (2017) 2  
*Hidden Simplicity of the Gravity Action* arXiv:1705.00626
- Sean M. Carroll, **Grant N. Remmen** Phys. Rev. D **95** (2017) 123504  
*A Nonlocal Approach to the Cosmological Constant Problem* arXiv:1703.09715
- Ning Bao, **Grant N. Remmen** EPL (Europhysics Lett.) **121** (2018) 60007, Editor's Choice  
*Bulk Connectedness and Boundary Entanglement* arXiv:1703.00018
- Clifford Cheung, **Grant N. Remmen** JHEP **1** (2017) 104  
*Twofold Symmetries of the Pure Gravity Action* arXiv:1612.03927
- Clifford Cheung, **Grant N. Remmen** Phys. Rev. Lett. **118** (2017) 051601  
*Positivity of Curvature-Squared Corrections in Gravity* arXiv:1608.02942
- Grant N. Remmen**, Ning Bao, Jason Pollack JHEP **7** (2016) 48  
*Entanglement Conservation,  $ER=EPR$ , and a New Classical Area Theorem for Wormholes* arXiv:1604.08217
- Sean M. Carroll, **Grant N. Remmen** Phys. Rev. D **93** (2016) 124052  
*What is the Entropy in Entropic Gravity?* arXiv:1601.07558
- Clifford Cheung, **Grant N. Remmen** JHEP **4** (2016) 2  
*Positive Signs in Massive Gravity* arXiv:1601.04068
- Ning Bao, Jason Pollack, **Grant N. Remmen** JHEP **11** (2015) 126  
*Wormhole and Entanglement (Non-)Detection in the  $ER=EPR$  Correspondence* arXiv:1509.05426
- Brando Bellazzini, Clifford Cheung, **Grant N. Remmen** Phys. Rev. D **93** (2016) 064076  
*Quantum Gravity Constraints from Unitarity and Analyticity* arXiv:1509.00851
- Ning Bao, Jason Pollack, **Grant N. Remmen** Fortschr. Phys. **63** (2015) 705  
*Splitting Spacetime and Cloning Qubits: Linking No-Go Theorems across the  $ER=EPR$  Duality* arXiv:1506.08203
- Ning Bao, ChunJun Cao, Sean M. Carroll, Aidan Chatwin-Davies, Phys. Rev. D **91** (2015) 125036  
 Nicholas Hunter-Jones, Jason Pollack, **Grant N. Remmen** arXiv:1504.06632  
*Consistency Conditions for an AdS Multiscale Entanglement Renormalization Ansatz Correspondence*
- Clifford Cheung, **Grant N. Remmen** JHEP **12** (2014) 87  
*Infrared Consistency and the Weak Gravity Conjecture* arXiv:1407.7865

PUBLICATIONS, CONTINUED	<b>Grant N. Remmen</b> , Sean M. Carroll <i>How Many e-Folds Should We Expect from High-Scale Inflation?</i>	Phys. Rev. D <b>90</b> (2014) 063517 arXiv:1405.5538
	Clifford Cheung, <b>Grant N. Remmen</b> <i>Naturalness and the Weak Gravity Conjecture</i>	Phys. Rev. Lett. <b>113</b> (2014) 051601 arXiv:1402.2287
	<b>Grant N. Remmen</b> , Sean M. Carroll <i>Attractor Solutions in Scalar-Field Cosmology</i>	Phys. Rev. D <b>88</b> (2013) 083518 arXiv:1309.2611
	<b>Grant N. Remmen</b> , Kris Davidson, Andrea Mehner <i>Unexpected Ionization Structure in Eta Carinae's "Weigelt Knots"</i>	Astrophys. J. <b>773</b> (2013) 27 arXiv:1302.2659
	<b>Grant N. Remmen</b> , Kinwah Wu <i>Complex Orbital Dynamics of a Double Neutron Star System Revolving around a Massive Black Hole</i>	Mon. Not. R. Astron. Soc. <b>430</b> (2013) 1940 arXiv:1301.2836
	<b>Grant Remmen</b> , Elwood McCreary <i>Measurement of the Speed and Energy Distribution of Cosmic Ray Muons</i>	JURP <b>25</b> (2012)
	<b>Grant Remmen</b> <i>A New Assessment of Dark Matter in the Milky Way Galaxy</i>	JURP <b>23</b> (2010)
	<b>Ph.D., Physics</b>   California Institute of Technology Grant Newton Remmen <i>Defining Gravity: Effective Field Theory, Entanglement, and Cosmology</i> Thesis advisors: Clifford Cheung and Sean M. Carroll, California Institute of Technology	Defended May 2017
	<b>B.S., Mathematics</b> , <i>summa cum laude</i>   University of Minnesota Grant N. Remmen <i>Dynamics of a Rigid Spinning Ring in the Schwarzschild Metric: A Solution to a Gravitational Problem in Mathematical Physics</i> Thesis advisor: Willard Miller, School of Mathematics, University of Minnesota Research supervised by Kinwah Wu, Head of Theory, Mullard Space Science Laboratory, University College London.	Defended May 2012
	<b>B.S., Astrophysics</b> , <i>summa cum laude</i>   University of Minnesota Grant N. Remmen Hubble Space Telescope <i>Subpixel Modeling of Anomalous High-Excitation Emission Lines in the Ejecta of Eta Carinae</i> Thesis advisor: Kris Davidson, MN Institute for Astrophysics, University of Minnesota	Defended December 2011
TALKS	<b>B.S., Physics</b> , <i>summa cum laude</i>   University of Minnesota Grant Remmen <i>Distortion of Black Holes caused by Motion relative to the Cosmic Microwave Background</i> Thesis advisor: Robert Gehr, Director, MN Institute for Astrophysics, University of Minnesota	Defended April 2010
	QCD Meets Gravity Workshop   UCLA (virtual)	December 2021
	Kavli Institute for Theoretical Physics   Locals' Event	November 2021
	UC Santa Barbara   High Energy and Gravity Seminar (virtual)	November 2021
	International Centre for Theoretical Physics   High Energy, Cosmology, and Astroparticle Physics Seminar (virtual)	November 2021
	Brandeis University   Quantum/Gravity Seminar (virtual)	November 2021
	ETH Zürich   QFT, Strings and Beyond Seminar (virtual)	October 2021
	Perimeter Institute   Quantum Fields and Strings Seminar (virtual)	October 2021

TALKS,	Hertz Foundation Innovation Hour (virtual)	June 2021
CONTINUED	California Amplitudes Meeting   UCLA (virtual)	March 2021
	New York University   Physics Department Colloquium (virtual)	March 2021
	New York University   Physics Research Seminar (virtual)	February 2021
	University of Florida   High Energy Physics Seminar (virtual)	January 2021
	University of Chicago   Particle Theory Seminar (virtual)	January 2021
	Korea Institute for Advanced Study   High Energy Physics Seminar (virtual)	December 2020
	UC Santa Barbara   High Energy and Gravity Seminar (virtual)	November 2020
	Yale University   Particle Theory Seminar (virtual)	October 2020
	Brookhaven National Laboratory   High Energy Theory Seminar (virtual)	April 2020
	Kavli IPMU, Univ. Tokyo   Astronomy-Cosmology-Particle Physics Seminar (virtual)	April 2020
	UC Davis, QMAP   Fields, Strings, Gravity Seminar (virtual)	April 2020
	The String Swampland and Quantum Gravity Constraints on Effective Theories Program   Kavli Institute for Theoretical Physics	March 2020
	Brandeis University   High-Energy and Gravitational Theory Chalk Talk	January 2020
	Brandeis University   Physics Department Colloquium	January 2020
	University of Michigan, LCTP   High Energy Theory Seminar	November 2019
	From Scattering to Expansion Workshop   Northwestern University	October 2019
	UC Santa Barbara   Particle Physics Phenomenology Seminar	October 2019
	UC Santa Barbara   High Energy and Gravity Seminar	October 2019
	Navigating the Swampland Conference   Instituto de Física Teórica, UAM-CSIC, Madrid, Spain	September 2019
	University of Washington   AdS/CFT Group Meeting	May 2019
	University of Washington   Particle Theory Seminar	May 2019
	University of Minnesota, FTPI   High Energy Theory Seminar	April 2019
	Stanford University   Stanford Institute for Theoretical Physics Colloquium	April 2019
	UC Berkeley   4D Seminar	April 2019
	California Institute of Technology   High Energy Theory Seminar	February 2019
	UC Davis   Joint Theory Seminar	January 2019
	Harvard University   Black Hole Initiative Colloquium	November 2018
	Cornell University   Particle Theory Seminar	October 2018
	Institute for Advanced Study   High Energy Theory Seminar	October 2018
	Vistas over the Swampland Conference   Instituto de Física Teórica, UAM-CSIC, Madrid, Spain	September 2018
	King's College London   Special Seminar, Theoretical Particle Physics & Cosmology	June 2018
	Gravity, Cosmology & Physics Beyond the Standard Model Conference   LPNHE, UPMC, Paris, France	June 2018
	Sakurai Thesis Prize Talk   American Physical Society April Meeting, Columbus, OH	April 2018
	<i>Quantum Gravity Constraints for Effective Field Theories</i>	

TALKS, CONTINUED	University of Illinois, Urbana-Champaign   Mathematical and Theoretical Physics Seminar	April 2018
	McGill University   High Energy Theory Group Seminar (virtual)	March 2018
	California Institute of Technology   High Energy Theory Seminar	February 2018
	California Institute of Technology   Quantum Spacetime Meeting	February 2018
	UC Berkeley   String Seminar	February 2018
	Stanford University   Stanford Institute for Theoretical Physics Seminar	January 2018
	SLAC National Accelerator Laboratory   Elementary Particle Physics Theory Seminar	October 2017
	Institute for Advanced Study   High Energy Theory Seminar	October 2017
	Massachusetts Institute of Technology   String/Gravity Theory Seminar	May 2017
	California Institute of Technology   Theoretical Physics Research Group Meeting	April 2017
	California Institute of Technology   Theoretical Physics Journal Club	April 2017
	UC Berkeley   String Seminar	February 2017
	QCD Meets Gravity Workshop   UCLA	December 2016
	California Institute of Technology   Theoretical Physics Research Group Meeting	November 2016
	California Institute of Technology   Theoretical Physics Research Group Meeting	October 2016
	Johns Hopkins University   High Energy Theory/Cosmology Seminar	October 2016
	California Institute of Technology   Theoretical Physics Research Group Meeting	May 2016
	New York University   High Energy Seminar	April 2016
	Harvard University   Particle Theory Seminar	April 2016
	California Institute of Technology   Theoretical Physics Research Group Meeting	February 2016
	California Institute of Technology   Theoretical Physics Research Group Meeting	November 2015
	California Institute of Technology   Theoretical Physics Journal Club	October 2015
	California Institute of Technology   Theoretical Physics Research Group Meeting	April 2015
	California Institute of Technology   Theoretical Physics Research Group Meeting	February 2015
	California Institute of Technology   Theoretical Physics Research Group Meeting	October 2014
	California Institute of Technology   Theoretical Physics Journal Club two-part talk	October 2014
	20 <sup>th</sup> International Symposium on Particles, Strings and Cosmology (PASCOS 2014)   Warsaw, Poland	June 2014
	California Institute of Technology   Theoretical Physics Research Group Meeting	May 2014
	California Institute of Technology   Theoretical Physics Journal Club	February 2014
	California Institute of Technology   Theoretical Physics Research Group Meeting	February 2014
	California Institute of Technology   Theoretical Physics Journal Club	September 2013
	Hertz Foundation 50 <sup>th</sup> Anniversary Symposium   Poster Presentation	August 2013
	American Physical Society April Meeting, Denver, CO	April 2013
	Mullard Space Science Laboratory, United Kingdom   Theory Group Meeting	August 2011
	Dean's Summer International Student Day of Talks   University College London, United Kingdom	August 2011

TALKS, CONTINUED	217 <sup>th</sup> Meeting of the American Astronomical Society, Seattle, WA   Poster Presentation	January 2011
CONFERENCE ORGANIZATION	Conference Co-Chair   Kavli Institute for Theoretical Physics (virtual) <i>UV Meets the IR: Effective Field Theory Bounds from QFT to String Theory</i>	October 2020
SEMINAR ORGANIZATION	Organizer   UC Santa Barbara High Energy and Gravity Seminar Series Organizer   UC Berkeley HEP-QIS Seminar Series Organizer   UC Berkeley String Seminar Series	2020–2021 2018–2019 2017–2019
TEACHING EXPERIENCE	<b>UC Santa Barbara, Department of Physics</b> Instructor and organizer of graduate short course <i>Impossible Physics: Constraining the Laws of Nature, from Scattering Amplitudes to Black Holes</i>  <b>UC Berkeley, Department of Physics</b> Guest lecturer in Prof. Petr Hořava's Quantum Field Theory course  <b>University of Minnesota, Institute of Technology, Department of Astronomy</b> Teaching assistant to Prof. Robert Gehr, Department Chair	Fall 2020       April 2018   Fall 2009
JOURNAL REFEREE	Physical Review Letters Physical Review D Journal of High Energy Physics Nuclear Physics B Scientific Reports - Nature	
SCIENCE OUTREACH	Outreach talk for KITP administrative staff Guest lecturer for Caltech's <i>Storytelling for Scientists</i> course Presented talks on dark matter to physics classes in rural Minnesota	May 2021 April 2021 2011
LEADERSHIP, SERVICE, & CULTURAL ACTIVITIES	California Institute of Technology Graduate Student Council Board of Directors Member, Academics Committee and Director at Large Member, Academics Committee and Physics Representative California Institute of Technology Faculty Library Committee, Student Representative Co-author/-composer of a two-act musical, <i>From the Earth to the Moon</i> , based on the Verne novel Co-author/-composer of a two-act musical, <i>Boldly Go!</i> , a musical parody based upon <i>Star Trek</i> Music director of Caltech production of <i>Boldly Go!</i>   Mainstage production Public reading University Study Abroad May Seminar: <i>Great Minds of the Renaissance</i> , Italy   Examined history of Renaissance scientists (Galileo, daVinci, et al.) and their relationship to society University of Minnesota Gospel Choir Detroit Lakes Community Summer Band Program University of Minnesota Honors Student Association University of Minnesota volunteer caller for Admissions Office U.S. Department of Education volunteer   Assembled hygiene kits for Washington, D.C. homeless	2013–2017 2016–2017 2013–2016 2013–2017      2016 2015  2011   2008–2010 2008–2010 2008–2012 2008–2009  2008

PRESS	Featured in APS <i>Physics Magazine</i> <i>A Physical Match for the Riemann Zeta Function</i>	December 2021
	Featured in <i>Quanta Magazine</i> <i>Black Hole Paradoxes Reveal a Fundamental Link Between Energy and Order</i>	May 2020
TEST SCORES	GRE Physics—Perfect Score: 990/990	2011
	GRE General—Quantitative: 800/800, Verbal: 720/800, Analytical Writing: 5.5/6.0	2011
	SAT—Perfect Score: 2400/2400	2008
	SAT II—Perfect Scores: Math Level II 800/800 and Biology–Molecular 800/800	2008
SCIENTIFIC & HONORARY	American Physical Society American Astronomical Society	
AFFILIATIONS	International Society on General Relativity and Gravitation Golden Key International Honour Society Sigma Pi Sigma, National Physics Honor Society	