Curriculum Vitae
Iain W. Stewart

January 2024

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Academic Appointments

2013-present	**Professor** at the Massachusetts Institute of Technology
2019-present	**Director** of the Center for Theoretical Physics, MIT
2009-2013	**Associate Professor with Tenure** at the Massachusetts Institute of Technology
2007-2009	**Associate Professor** at the Massachusetts Institute of Technology, Cambridge
2003-2006	**Assistant Professor** at the Massachusetts Institute of Technology, Cambridge
2002-2003	**Research Assistant Professor** at the University of Washington, Seattle Advisor: David B. Kaplan
1999-2002	**Post-Doctoral Research Associate** at the University of California, San Diego Advisor: Aneesh Manohar

Education

1995-1999	**Ph.D., Theoretical Physics,** California Institute of Technology, Pasadena Thesis: Applications of Chiral Perturbation Theory in Reactions with Heavy Particles. Advisor: Mark B. Wise
1994-1995	**M.Sc., Theoretical Physics,** University of Manitoba, Winnipeg, Canada Thesis: Derivative Expansion Approximation of Vacuum Polarization Effects.
1990-1994	**B.Sc., Joint Honors Physics and Mathematics**, University of Manitoba, Canada

Teaching Experience (20xx, F for fall, S for spring)

12_F–23_F	**MIT**, 8.09 & 8.309. Lecturer for classical mechanics III.
14_S,15_F,17_S,20_S,22_S,24_S	**MIT**, 8.EFTx. Created a free online graduate course with worldwide enrollment.
03_S,06_S,09_F,13_S,17_S,20_S	**MIT**, 8.851. Created and Lectured a graduate course on effective field theories.
07_S–10_S, 12_S	**MIT**, 8.325. Lecturer for graduate quantum field theory part III.
11_F	**MIT**, 8.03. Section instructor for vibrations and waves.
04_F, 05_F, 07_F	**MIT**, 8.05. Lecturer for undergraduate quantum mechanics.
03_F, 04_S, 16_S, 21_S	**MIT**, 8.05 & 8.06. Section instructor for undergraduate quantum mechanics.

Honors and Selected Awards

2024	Committed to Caring award from MIT's Office of Graduate Education
2021	Appointed the Otto and Jane Morningstar Professor of Science
2016	Erwin Schrödinger Visiting Professor, University of Vienna, City of Vienna
2015	MIT Buechner Faculty Teaching Award
2014-present	Simons Investigator of the Simons Foundation
2013	Fellow of the American Physical Society
2012, 2014, 2015	MISTI international collaboration awards from MIT
2008-present	Friedrich Wilhelm Bessel Award from the Alexander von Humboldt Foundation
2004-2008	Alfred P. Sloan Research Fellowship
2003-2008	Outstanding Junior Investigator Award, US Department of Energy
1994	Governor General's Silver Medal (highest standing in the University graduating class)

Selected Service

Lead advisor for the annual series of SCET workshops 2003-present. Organizer for *World SCET 2021*, the 18'th annual International SCET workshop, online, April 19-23, 2021. Organizer for *World SCET 2020*, the 17'th annual International SCET workshop, online, June 2 & 8-13, 2020.

Organizer for Schrödinger Institute program *Quantum Field Theory at the Frontiers of the Strong Interaction*, Vienna, 5 weeks, August 2023.

Organizer for Schrödinger Institute program *Challenges and Concepts for Field Theory and Applications in the Era of LHC Run-2*, Vienna, 4 weeks, July-Aug 2016.

Organizer for Schrödinger Institute program *Jets and Quantum Fields for the LHC*, Vienna, 5 weeks, July 2013.

Organizer for TASI summer school, *Particle Physics: The Higgs Boson and Beyond*, CO, June 2013.

Organizer for *Workshop on Precision Measurements of* α_s, Munich, Germany, Feb. 9-11, 2011.

Organizer for the workshop *Implications of First LHC Data*, MIT, August 10-13, 2010.

Organizer for the 6th annual workshop on the Soft-Collinear Effective Theory (SCET 2009), MIT, March 25-28, 2009.

Program Organizer, *Effective Field Theory, QCD, and Heavy Hadrons*, Seattle (March–June, 2005).

Director of the Center for Theoretical Physics & Division head (2019-present), Nuclear Theory Group Leader (2009-present), Graduate Student Officer (2012-2019), Chair of Computer Users Group (2011-2018), Pappalardo executive committee (2010-2016,2019), Chair of CTP faculty search committee (2012,2018), Institute: MITx faculty advisory board member (2015-present).

Research Overview **(Link to INSPIRE Publication List)**

Euclidean Distributions for Lattice QCD: Derived a factorization theorem between euclidean and light-cone parton distributions with the operator product expansion. Devised a method to determine the non-perturbative Collins-Soper evolution Kernel. Derived formalism for relating euclidean and light-cone transvere momentum parton distribution functions. [Selected Publications: **PRD 97** (2018) 5, 054512; **PRD 98** (2018) 5, 056004; **PRD 99** (2019) 3, 034505; **JHEP 09** (2019) 037]

Collider Physics and Soft-Collinear Effective Theory: Simplified proofs of factorization in classic hard scattering processes. Derived a new factorization theorem for the invariant mass differential cross-section for energetic jets from an unstable massive quark, and defined a top-mass scheme for jet measurements with well defined perturbative and non-perturbative corrections relating it to the invariant mass peak. Computations of the perturbative and power corrections for the e^+e^- thrust and C-parameter event shapes, consistent at $\mathcal{O}(\alpha_s^3)$ and N^{3}LL, and determined $\alpha_s(m_Z)$ with 1% precision. Introduced beam functions to describe initial state radiation at the LHC. Devised the method of estimating perturbative uncertainties currently used in Higgs searches with a jet-veto, and computed the vetoed cross section at NNLL+NNLO. Invented N-jettiness, an event shape to define exclusive N-jet events at the LHC. Developed a procedure to calibrate the meaning of the top mass parameter in parton shower Monte Carlos. Demonstrated how to resum fiducial power corrections for the Drell-Yan q_T spectrum at N^{3}LL. [Selected Publications: **PRD 77** (2008) 074010; **PRD 81** (2010) 094035; **PRL 105** (2010) 092002; **PRD 85** (2012) 034011; **PRD 88** (2013) 054031; **JHEP 1506** (2015) 077; **PRL 117** (2016) 23, 232001; **arXiv:2006.11382** (2020)]

Soft-Collinear Effective Theory - Formalism: Developed an effective theory for processes with energetic hadrons or jets. This theory is applicable to both exclusive and inclusive hard processes in QCD and for B-decays to light hadrons. Developed a subtraction procedure for "differential effective field theories", such as the soft-collinear effective theory and Non-Relativistic QCD, and used it to provide a setup to resolve an old puzzle on endpoint singularities in exclusive processes by seperating modes in rapidity. Devised an operator formalism to describe hadron mass effects in event shapes. Developed an effective field theory for systematically treating forward scattering and factorization violation. Derived a one-loop subleading power soft theorem for amplitudes. Developed helicity based techniques for SCET operator bases. Developed formalism for summing soft and collinear logarithms at subleading power, and performed the first such all orders resummation. [Selected Publications: **PRD 63** (2001) 114020; **PLB 16** (2001) 134; **PRD 65** (2002) 054022; **PRD 76** (2007) 074002; **PRD 85** (2012) 045010; **PRD 87** (2013) 014025; **JHEP 08** (2016) 025; **PRD 95** (2016) 9, 094003; **JHEP 11** (2017) 142; **JHEP 08** (2018) 013; **JHEP 04** (2019) 123]

B Physics and Soft-Collinear Effective Theory: Selected applications: The first proof of factorization for the $B \to D\pi$ class of decays. Formulated rigorous definitions for soft and hard form factor contributions to heavy-to-light form factors. Discovered a factorization theorem for color suppressed decays. Derived a factorization theorem for the $B \to M_1 M_2$ class of decays which are used to study CP violation. Proposed a new method to measure the CP-violating standard model parameter γ. Classified and analyzed power corrections for nonleptonic decays to light mesons. Computed subleading endpoint decay rates for the inclusive processes $B \to X_s\gamma$ and $B \to X_u \ell\bar{\nu}$, and the leading rate for the measurable $B \to X_s \ell^+\ell^-$ spectra. Developed a method to systematically treat uncertainties in quark distribution functions. [Selected Pubs: **PRD 68** (2003) 114009; **PRD 70** (2004) 054015; **PRD 74** (2006) 011501; **PRD 78** (2008) 114014; **arXiv:2007.12304** (2020)]

Non-relativistic QCD/QED: Accounting for coupled energy and momentum scales, calculated $t\bar{t}$ production near threshold with an order of magnitude reduction in the uncertainty. Developed a renormalization group for Coulombic systems such as Hydrogen, positronium, and muonium. Computed logarithms of the fine structure constant in Lamb shifts, hyperfine splittings, and decay widths and proved that the $(\alpha \ln \alpha)^k$ series terminate. Resolved $\alpha^8 \ln^3 \alpha$ Hydrogen Lamb shift controversy. Constructed an effective theory for the annihilation of heavy dark matter. [Selected Publications: **PRL 85** (2000) 2248-2251; **PRL 86** (2001) 1951-1954; **PRD 65** (2002) 014014]

Heavy Quark Effective Theory, Chiral Perturbation Theory, and Operator Product Expansion: Study of perturbative and $\Lambda_{\rm QCD}/m_Q$ corrections in heavy quark systems. Examples: Predicted semileptonic B (Λ_b) decays to excited charmed mesons (baryons). Determined the $D^*D\pi$ coupling using chiral perturbation theory. Presented a method for a precision extraction of $|V_{ub}|$ from exclusive decays. Discovered, "R-evolution", a method for stabilizing heavy quark masses and operator product expansions. [Selected Publications: **NPB 529** (1998) 62-80; **PRD 57** (1998) 308-330; **PRL 92** (2004) 202001; **PRL 95** (2005) 071802; **PRL 101** (2008) 151602]

Few-Nucleon Effective Theory: Classified pion contributions in two-nucleon effective field theory. Calculated next-to-next-to-leading order NN phase shifts in the ${}^1S_0$, ${}^3S_1$, and ${}^3D_1$ channels including radiation pion contributions. Demonstrated the presence of non-relativistic conformal symmetry and Wigner symmetry in the limit of large scattering lengths and studied their implications. [Selected Publications: **PRL 83** (1999) 931-934; **NPA 665** (2000) 164-182; **NPA 677** (2000) 313-366; **PLB 474** (2000) 145-152]

Dark Matter Indirect Detection: Developed an effective field theory to accurately calculate the annihilation of heavy dark matter to two photons, including the simultaneous resummation of both Sommerfeld electroweak potential effects and Sudakov duble logarithms. Further expanded this EFT to treat finite photon resolution effects, which enable the detected photon to recoil against a jet of electroweak particles. [Selected Publications: **PRL 114** (2015) 21, 211302; **PRD 95** (2017) 5, 055001; **JHEP 03** (2018) 117; **JHEP 01** (2019) 036]

Graduate Student Supervisor

1) Sonny Mantry, Ph.D. 2005. Thesis: "Heavy Quark Symmetry in the Soft Collinear Effective Theory". Faculty at Georgia Tech University
2) Vivek Mohta, Ph.D. 2005 (from Harvard Math Department). Thesis: "Applications of Chiral Per-

turbation Theory"

3) Keith S.M. Lee, Ph.D. 2006. Thesis: "Effective Field Theories for Inclusive B Decays"
4) Chris Arnesen, Ph.D. 2007. Thesis: "Model-Independent Approaches to QCD and B Decays"
5) Ambar Jain, Ph.D. 2009. Thesis: "Heavy Quarks in Effective Field Theories". Faculty at IISER Bhopal, India
6) Claudio Marcantonini, Ph.D. 2010. Thesis: "Applying SCET to Parton Showers"
7) Wouter Waalewijn, Ph.D. 2010. Thesis: "Factorization at the LHC: From PDFs to Initial State Jets". Faculty at the University of Amsterdam.
8) Riccardo Abbate, Ph.D. 2012. Thesis: "Precision Determination of the Strong Coupling Constant"
9) Teppo Jouttenus, Ph.D. 2012. Thesis: "Jet Production at Hadron Colliders"
10) Daniel Kolodrubetz, Ph.D. 2016. Thesis: "Accuracy and Precision in Collider Event Shapes"
11) Ian Moult, Ph.D. 2016. Thesis: "Effective Field Theories for the LHC". Faculty at Yale University.
12) Aditya Pathak, Ph.D. 2017. Thesis: "Top Mass Determination using Effective Field Theory"
13) Gherardo Vita, Ph.D. 2020. Thesis: "QCD Beyond Leading Power"
14) Gregory Ridgway, Ph.D. 2022. Thesis: "Exotic Dark Matter in the Early Universe" (jointly advised with Tracy Slatyer)
15) Stella Schindler (6th year)
16) Anjie Gao (5th year)
17) Zhiquan Sun (4th year)
18) Anna Ferdinand (1st year)

Post-Docs and Research Fellows Supervised

1) Dan Pirjol, 2003-2006, currently with J.P. Morgan Chase
2) Bjorn Lange, 2004-2007, Research Fellow, University of Siegen, Germany
3) Alejandro Jenkins, 2006-2009, University of Costa Rica, Faculty
4) Ignazio Scimemi, 2007, University of Madrid, Faculty
5) Carola Berger, 2007-1010, started the company CFB Scientific Translations
6) Frank Tackmann, 2008-2011, DESY Hamburg, Senior Scientist
7) Christopher Lee, 2010-2012, Los Alamos National Lab, Scientist
8) Vicent Mateu, 2011-2013, Salamanca University, Faculty
9) Daekyoung Kang, 2011-2014, Fudan University, Faculty
10) Simone Marzani, 2014-2015, Genoa University, Faculty
11) Andrew Larkowski, 2012-2015, Reed College, Faculty
12) Duff Neill, 2012-2016, Los Alamos National Laboratory, tenure track Scientist
13) HuaXing Zhu, 2015-2017, Zhejiang University, China, Faculty
14) Yong Zhao, 2016-2019, Argonne National Lab, tenure track Scientist
15) Yang-Ting Chen, 2016-2019, Georgia State University, junior Faculty
16) Markus Ebert, 2017-2020, postdoc at MPI in Munich
17) Bernhard Mistlberger, 2018-2020, SLAC, tenure track Scientist
18) Varun Vaidya, 2019-2022, University of South Dakota, Faculty
19) Xiaojun Yao, 2019-2022, University of Washington, Seattle, research assistant professor
20) Johannes Michel, 2020-2023, MIT postdoc
21) Kyle Lee, 2022-present, MIT postdoc
22) Fanyi Zhao, 2023-2024, MIT postdoc

Undergraduate Research and Senior Thesis Supervisor

1) Shankar Mukherji, UROP Summer 2003, "On Ultraviolet Divergences in Quantum Mechanical Perturbation Theory"
2) Tongyan Lin, UROP Summer 2006. Senior Thesis fall 2006, spring 2007: "On Isospin and SU(3) Relations for Three-Body Nonleptonic B-Decays". Currently Junior Faculty at University of California, San Diego
3) Mobolaji Williams, Independent study on effective field theory and supported by OCW to produce a latex version of my SCET lecture notes from my special topics graduate course, Spring 2011
4) Emily Nardoni, UROP for credit Spring 2012. Sponsored UROP Summer 2012, Fall 2012, "On Gaining Precision in Higher Order Jet-Binning Uncertainties", current postdoc at UC Los Angeles
5) Jeffrey Prouty, .Senior Thesis "On Investigating the Strong Coupling via Analysis of Thrust Distributions" UROP Fall 2012, Summer 2013. Senior Thesis Spring 2014
6) Amyas Chew, on "Non-Relativistic Quantum Electrodynamics", sponsored UROP for Summer and Fall 2014, also attended workshop in Vienna in Summer 2015. Currently a graduate student at Caltech
7) Brad Bachu, on "Kinematic Extraction of Short Distance Top Mass", sponsored UROP for Spring and Fall 2016. Currently a graduate student at Princeton
8) Cyuan-Han Chang, on "Constructing Subleading Operator Basis for Glauber Exchange", sponsored UROP for Summer and Fall 2017. Currently a graduate student at Caltech
9) Arindam Bhattacharya, on "Helicity Methods for High Multiplicity Subleading Soft and Collinear Limits", UROP for Summer 2018, Fall 2018
10) Sanjay Raman, on "Soft-Glauber Duality Relations", UROP for Summer 2020, Spring 2021, Summer 2021, Fall 2021, Spring 2022, Fall 2022, Spring and Fall of 2023