

Joel Primack

Distinguished Professor of Physics Emeritus, University of California, Santa Cruz

Cell: (831) 345-8960; Office Phone: (831) 459-2580, Fax: -3043; Home (831) 425-1194; Email: joel@ucsc.edu

Education: Princeton University A.B. 1966 Physics (Summa cum Laude, Valedictorian); Stanford University PhD 1970 Physics

Academic Positions: Junior Fellow, Society of Fellows, Harvard University 1970-73. Assistant Professor of Physics, UCSC 1973-1977; Associate Professor of Physics, UCSC, 1977-1983; Professor of Physics, UCSC 1983-present; Distinguished Professor 2007-; Emeritus 2014-. Chair, UCSC Committee on Educational Policy, 1992-94; Chair, UCSC Committee on Computing and Telecommunications, 2008- 2011; Chair, University Committee on Computing and Communications, 2010-12; Director, University of California systemwide High-Performance Astro-Computing Center (UC-HiPACC), 2010-2015, including organizing annual AstroComputing Summer Schools. Hosting the annual **Santa Cruz Galaxy Workshop**, a major international meeting.

Honors (partial list): A. P. Sloan Foundation Research Fellowship, 1974-1978
American Physical Society Forum on Physics and Society Award, 1977; APS Fellow, 1988
American Association for the Advancement of Science (AAAS), Fellow, 1995
Senior Award of the Alexander von Humboldt Foundation, 1999
California Academy of Sciences, Fellow, 2009
Spirit of Rustom Roy Award, Chopra Foundation, 2012
Leo Szilard Lectureship Award of the American Physical Society, 2016
President, Sigma Xi (Scientific Research Honor Society), 2018-19
American Physical Society Julius Edgar Lilienfeld Prize, 2020
AAAS Philip Hauge Abelson Prize, 2024

Advice (partial list): SAGENAP advisory panel to DOE/NSF 2000-2001; NSF Astronomy Theory Review Panel 2000; DOE Lehman Review of SNAP Proposal 2001; Chair, NASA Cosmology panel on LTSA and ADP 2001; Cosmology Panel, Hubble Space Telescope Time Allocation Committee 2003, 2017; National Academy Beyond Einstein panel, 2006-07; National Academy Review of NASA Technology Roadmap, 2010-11.

American Physical Society activities (partial list): Executive Committee, APS Division of Astrophysics, 2000-2002; APS Panel on Public Affairs (POPA) 2002-2004; Chair, POPA Task Force on Moon-Mars Program and Funding for Astrophysics 2004; Chair, APS Forum on Physics and Society 2005 and 2019; Chair, APS Sakharov Prize committee 2009

Outreach (partial list): Smithsonian National Air and Space Museum, Advisory Committee on *Cosmic Voyage* IMAX film, 1994-1996. Co-organizer, "Cosmic Questions" Conference, Smithsonian Museum of Natural History, Washington, DC, April 14-16, 1999. Over 100 public lectures on galaxies and cosmology, including Lansdowne Lecture, University of Victoria (September 2004); Halliday Lecture, UCSC (March 2006, with Nancy Abrams); Frontiers of Science Lecture, University of Utah (April 2006, with Nancy Abrams); Sackler Lecture, UC Berkeley (May 2006, with Nancy Abrams); NASA Ames Directors Colloquium (October 2006, with Nancy Abrams); J. Robert Oppenheimer Memorial Lecture, Los Alamos (July 2007); Banquet Lecture, APS Division of Plasma Physics, Orlando, FL (November 2007); APS Annual Meeting Public Lecture, St. Louis Science Center (April 2008, with Nancy Abrams); Buhl Lecture, Carnegie-Mellon University (April 2008); Banquet Lecture, U. S. Army Science Conference, Orlando, FL (December 2007, with Nancy Abrams); Dwight H. Terry Lectureship, Yale University (four lectures over two weeks in October 2009, with Nancy Abrams); Supercomputing the Universe (Keynote talk, Vail Computer Elements Conference, June 2013); Distinguished Lecture, Scientific Computing and Imaging (SCI) Institute, University of Utah (April 2016); Talks at Google: New Insights on Galaxy Formation (May 2017); UCSC Emeriti Research Lecture (November 2020); Golden Webinar in Astrophysics (April 2021). TV documentaries including [Inside the Milky Way](#). Help with Adler, Hayden, and Morrison Planetarium Shows.

Books

- Joel R. Primack and Frank von Hippel, *Advice and Dissent: Scientists in the Political Arena* (New York: Basic Books, 1974; New American Library, 1976) http://physics.ucsc.edu/~joel/Advice_and_Dissent.pdf
- Joel R. Primack and Nancy Ellen Abrams, *The View from the Center of the Universe: Discovering Our Extraordinary Place in the Cosmos* (New York: Riverhead/Penguin, 2006; London: HarperCollins, 2006; Paris: Laffont, 2008; and other foreign editions) <http://viewfromthecenter.com/>
- Nancy Ellen Abrams and Joel R. Primack, *The New Universe and the Human Future: How a Shared Cosmology Could Transform the World* (Yale University Press, 2011; Barcelona: Antoni Bosch, 2013) <http://new-universe.org/>; <http://www.el-nuevo-universo.com/>

Papers Over 500 scientific papers, >56,000 citations, h-index = 104 (Google Scholar); plus many popular articles in *American Scientist*, *IEEE Spectrum*, *Scientific American*, *Science*, *Sky & Telescope*, etc.

Primack's undergraduate senior thesis first applied modern nuclear physics theory to nuclear fission (Primack 1966). His graduate and post-graduate research was on particle physics, including papers with Brodsky on composite particles, and papers on what is now known as the standard model of particle physics. Lee, Primack, and Treiman 1972 calculated the mass of the charm quark, in agreement with the discovery of the J/ψ in 1974.

Primack is best known for helping to create the modern cosmological standard model, Λ CDM. He was the first to propose that the lightest supersymmetric partner particle is a natural candidate for the dark matter particle (Pagels & Primack 1982), which led to warm dark matter (Blumenthal, Pagels, Primack 1982) and then **cold dark matter** (Primack & Blumenthal 1983; Blumenthal, Faber, Primack, Rees 1984; Primack 1984). Subsequent work:

- **baryonic contraction of dark matter galactic halos** (Blumenthal, Faber, Flores, & Primack 1986)
- **how to discover dark matter** (Primack, Seckel, & Sadoulet, Annual Rev. Nuclear & Particle Science 1988)
- calculations of **linear power spectra for many CDM variants** (John Holtzman's 1989 dissertation based on Blumenthal & Primack 1983 code, and comparison with observations Holtzman & Primack 1993)
- **dynamical effects of a cosmological constant**, including on the growth rate of structure (Lahav, Lilje, Primack, & Rees 1991)
- **cosmological structure formation simulations** on CDM variants Cold + Hot Dark Matter (Klypin et al. 1993, Primack et al. 1995) and LCDM (Klypin, Primack, & Holtzman 1996) **compared with observations**
- **conflicts between steep central dark matter halo profiles in dark matter simulations vs. observations** of dwarf galaxies and galaxy clusters (Flores & Primack 1994, based on Flores dissertation research with Primack)
- improvements in **semi-analytic modeling of the galaxy population** (Rachel Somerville's thesis paper Somerville & Primack 1999; also Somerville, Primack & Faber 2001 and many subsequent papers including Somerville et al. 2012, Gilmore et al. 2012, Porter et al. 2014ab, Brennan et al. 2015, Pandya et al. 2017)
- **semi-analytic modeling of damped Ly α systems** (Ari Maller's dissertation papers with Prochaska, Somerville, and Primack 2000-2002)
- **dark matter halo concentration evolution and angular momentum distribution** (Primack's grad student James Bullock's dissertation papers with Avishai Dekel, Anatoly Klypin, and Primack 2001)
- **dark matter halo assembly history and angular momentum evolution** (Primack's grad student Risa Wechsler's dissertation papers with Avishai Dekel, Anatoly Klypin, and Primack 2002)
- **halo occupation distribution and predicted evolution of the galaxy two-point correlation function** (Kravtsov et al. 2004), subsequently shown to have correctly predicted observed galaxy correlations
- **Gini-M20 non-parametric classification of galaxy images** (Lotz, Primack, & Madau 2004 and many subsequent papers, including observability timescales for indications of galaxy mergers (Lotz, Jonsson, Cox, and Primack 2008, 2011ab) used for measurement of **galaxy merger rates** compared with theory (Lotz et al. 2011)
- **shapes of dark matter halos** (Brandon Allgood's dissertation paper with Primack, 2006)
- the **Sunrise code for producing images from galaxy simulations** including the effects of stellar evolution and dust scattering, absorption, and re-emission of light (Patrik Jonsson's dissertation and postdoc research with Primack, 2002-2010; papers and MAST mock images with Greg Snyder and Raymond Simons, 2015-2024)

- comparing **extragalactic background light** from calculations with observations (Rudy Gilmore and Alberto Dominguez dissertation papers with Primack 2010, and many subsequent papers including Dominguez+2024)
- high-resolution **Bolshoi cosmological simulations compared with observations** (Klypin, Trujillo-Gomez, & Primack 2011, Trujillo-Gomez, Klypin, Primack, Romanowsky 2011, Prada et al. 2012, with analyses by Peter Behroozi, Mike Busha, Risa Wechsler et al. 2012, and the Klypin-Primack *Bolshoi-Planck* simulations 2016, Halo Demographics Rodriguez-Puebla et al. 2016, Galaxy-Halo Connection Rodriguez-Puebla et al. 2017)
- **high-resolution hydrodynamic cosmological galaxy simulations**, including roles of cold streams and violent disk instabilities, compared with HST CANDELS survey (papers with Daniel Ceverino, Avishai Dekel, Sandra Faber, Anatoly Klypin, Nir Mandelker, Sandro Tacchella, Matteo Tomassetti, Adi Zolotov, et al. 2010-)
- co-leadership of **AGORA** comparison of high-resolution cosmological galaxy simulations by leading codes
- discovery of and explanation for **prolate** (pickle-shaped) early-stage galaxies (Ceverino, Primack, Dekel 2015)
- effect of varying abundance of thorium and uranium **radiogenic heating of rocky planets** on volcanic activity, magnetic field generation, and plate tectonics -- and therefore of planetary habitability (Nimmo, Primack+2020)
- **deep learning for galaxies**, papers published & in preparation in collaboration with Marc Huertas-Company, Dekel, and others comparing many features of simulated and observed galaxies, including **galaxy morphological evolution, compaction, and giant clumps** in star-forming galaxies

Leadership in creating new institutions Primack co-organized Stanford Workshops on Political and Social Issues (SWOPSI) in 1969, courses for credit that aim to change the world, a program that continued at Stanford for twenty years. Primack played the main role in starting the Congressional Science and Technology Fellowship Program of the American Physical Society (APS) and the American Association for the Advancement of Science (AAAS) in 1973, through which over 2000 scientists have now served on Congressional staffs. This has evolved into the AAAS Science and Technology Fellowship Program, which now places about 300 scientists each year in government internships. Primack co-organized the APS Forum on Physics and Society in 1972, and served as chairman of the FPS in 2005 and again in 2019. In 1972, Primack proposed that APS conduct studies on public policy issues, including writing with Freeman Dyson the proposal for the first study, on nuclear reactor safety, and raising the funding for it. Primack initiated the AAAS Science and Human Rights program in 1976, including the Coalition on Science and Human Rights. Primack and Frank von Hippel worked with Senator Ted Kennedy to draft the legislation and organize the Congressional hearings for the NSF Science for Citizens Program, which was signed into law in 1977. In 1987-89 Primack initiated and led the Federation of American Scientists Space Nuclear Power Arms Control project, which helped to end the USSR's nuclear reactor powered ROSAT satellite program. Primack proposed the University of California High-Performance Astrocomputing Center (UC-HiPACC) and directed it 2010-2015, including organizing annual conferences and summer schools. In 2017 Primack was thanked by Space Telescope Science Institute (STScI) for proposing anonymous review of Hubble Space Telescope (HST) proposals, which led to anonymized proposals for STScI programs including HST and James Webb Space Telescope. This resulted in a higher fraction of successful proposals by women and young scientists, and proposals are now anonymous for many other NASA programs.

Innovations at UCSC For more than a decade Primack co-taught with Nancy Ellen Abrams the UCSC course Cosmology and Culture, which developed a new visual language for modern cosmology that provided the basis for our co-authored books and many public lectures. In teaching elementary physics, Primack pioneered at UCSC Harvard physicist Eric Mazur's *Peer Instruction*, also known as active learning and the flipped classroom. As chair of the UCSC and then the UC systemwide computer committee, Primack helped UC negotiate free access to non-advertising Gmail and Google documents for current students and faculty.