

Kevin Peter Hand, Ph.D.

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Deputy Chief Scientist for Solar System Exploration
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Kevin P. Hand is a planetary scientist/astrobiologist at JPL working on numerical modeling and laboratory investigations concerning the physics and chemistry of icy moons in the outer solar system.

Education

Ph.D., Geological & Environmental Sciences, Stanford University, Stanford, CA. (2007)
Dissertation: ‘On the physics and chemistry of the ice shell and sub-surface ocean of Europa’.
Advisor: C.F. Chyba

M.S., Mechanical Engineering, focus on robotics (2002), Stanford University, Stanford, CA.

B.A. Physics, with minor in Astronomy (1998), Dartmouth College, Hanover, New Hampshire.
Thesis: A Search for the Optical Counterpart to the Mysterious High-Latitude Transient X-ray Source, 4U0042+32.

Research Interests

- Icy moons and sub-surface oceans of the outer solar system
- Electromagnetic field interactions at icy worlds
- Radiolytic chemistry in planetary and astrophysical environments
- Spectroscopic biosignatures
- Understanding connection between terrestrial cryosphere processes and the climate change record

Currently Funded Proposals

- ASTID 2010, *Miniature Hyperspectral Laser Spectrometer Probe for Astrobiology*, PI: Nan Yu. Co-I: K.P. Hand.
- Exobiology 2010, *Laboratory Investigation of the Workman-Reynolds Effect*, PI: K.P. Hand
- JPL Internal Advanced Concepts: *Europa Surface Science Package for EJSM*, PI: K.P. Hand
- NAI-CAN5, *Astrobiology of Icy Worlds*. PI: I. Kanik, Deputy PI: K.P. Hand
- PIDDP, *CIRIS A combined infrared interferometric spectrometer for compositional and thermal studies of moons, comets, and asteroids*. PI: R.W. Carlson. Co-I: K.P. Hand

Professional Experience

- Scientist, Planetary Ices Group (3227), Jet Propulsion Laboratory, California Institute of Technology (Oct. 2007-Sept. 2011).
- Europa Flagship Mission Science Definition Team (2007 & 2008 studies).
- Visiting Research Fellow, Dept. of Astrophysical Sciences, Princeton University (2006-2007).
- Geobiology Summer School, University of Southern California/Agoroun Institute. Catalina Island, CA. (June-July 2003).
- Research Assistant to C.F. Chyba, SETI Institute, (2000).
- Michelson Interferometry Summer School, NASA Jet Propulsion Laboratory/California Institute of Technology, Pasadena, CA. (July-August 1999).

- Research Assistant, Center for Mars Exploration, NASA Ames Res. Ctr. (1998-1999).
- Intern, Theoretical Astrophysics Division (TA-6), Los Alamos National Laboratory. Worked with S. Colgate on the late-time light curve of Type Ia Supernovae and on modeling plume convection in stellar atmospheres. (Spring 1995. Winter 1996)
- Research Assistant, Michigan-Dartmouth-MIT Observatory, Kitt Peak, AZ. Operated the 1.3 m reflector for 8 nights (Fall 1996).

Awards

National Geographic Society Emerging Explorer Award, 2011

Teaching Experience

Lecturer for 2011 University of Hawaii NASA Astrobiology Winter School, PI: Karen Meech.
<http://www.ifa.hawaii.edu/UHNAI/2011winterschool/>

Lecturer for 2008 NASA Astrobiology Institute ‘Josep Comas I Sola’ International Summer School on ‘The Astrobiology of Icy Worlds’. <http://nai.arc.nasa.gov/uimp/IcyWorlds/>

Lecturer for Split University two-week “International Winter School on Astrobiology and Extrasolar Planets”. Split, Croatia. Feb-March 2007 and 2008.
[\(http://fizika.pmfst.hr/astro/english/astrobiologija.html\)](http://fizika.pmfst.hr/astro/english/astrobiologija.html)

Stanford: “GES 51: Undergraduate seminar on the Origin and Evolution of the Universe” (Spring 2004) Teaching assistant for Professor Mike McWilliams. Responsibilities included giving many lectures, advising on research topics, and grading term papers. Also coordinated a class field trip to several locales in Southern California, including a visit to JPL. Class size: ~15.

Stanford: “GES 2: Earth System History” (Winter 2003/2004) Teaching assistant for Professor Mike McWilliams. Responsibilities included giving several lectures, grading, and running lab sessions and field trips. Class size: ~60 students.

Stanford: “Geological & Environmental Sciences (GES) 1: Dynamic Earth: Fundamentals of Earth Science” (Spring 2003) Teaching assistant for Professor Page Chamberlain. Responsibilities included giving several lectures, grading, and running lab sessions and field trips. Class size: ~60 students.

Stanford: “GES 2: Earth System History” (Winter 2002/2003) Teaching assistant for Professor Page Chamberlain. Responsibilities included giving lectures, grading, and running lab sessions and field trips. Class size: ~60 students.

Stanford: “GES 7: An Introduction to Wilderness Skills” (2002-2003) Instructor for course taught through the GES department. Course covers everything from camping basics to avalanche danger and technical climbing skills. Originally designed to prepare students for field work. Responsibilities included classroom lectures and weekend trips to the Sierra. Class size: ~10 students.

Santa Clara University: “Introduction to the Solar System” (Spring 1999) Guest lectured for two weeks, covering the terrestrial planets. Class size: ~40 students.

Dartmouth: “Astrophysics 15, Introduction to Astrophysics” (1997) Teaching assistant for Professor John Thorstensen. Responsibilities included grading problem sets and running observation sessions at the on-campus observatory (9.1 inch refractor). Class size: ~15 students.

Dartmouth: “Astronomy 3, Introduction to Astronomy”, (TA’d on several occasions between 1995-1997). Teaching assistant for Professors R. Fesen, J. Thorstensen, and G. Wegner.

Responsibilities included grading homework and exams, and running observation sessions at the on-campus observatory (9.1 inch refractor). Class size: ~80 students.

Publications

In revision

Hand, K.P. & Carlson, R.W. Radiolytic modification of short-chain alkanes and alkenes in Solar System ices. *J. Geophys. Res.*

Wilson, J.P., Grotzinger, J.P., Fischer, W.W., **Hand, K.P.**, Jensen, S., Knoll, A.H., Abelson, J., Metz, J.M., McLoughlin, N., Cohen, P.A., Tice, M.M. Incised Valley Deposits at the Proterozoic-Cambrian Boundary in Southern Namibia Contain Abundant Treptichnus Pedum. *Palaios*.

In print

Hand, K.P. and Carlson, R.W. (2011) H₂O₂ production by high-energy electrons on icy satellites as a function of surface temperature and electron flux. *Icarus*. doi:10.1016/j.icarus.2011.06.031

Hand, K. P., K. K. Khurana, and C. F. Chyba (2011), Joule heating of the south polar terrain on Enceladus, *J. Geophys. Res.*, 116, E04010, doi:10.1029/2010JE003776.

Korablev, O., Gerasimov, M., Dalton, J.B., **Hand, K.**, Lebreton, J-P., and Webster, C. (2011) Methods and measurements to assess physical and geochemical conditions at the surface of Europa, *Adv. Space Res.* doi:10.1016/j.asr.2010.12.010..

Hand, K.P., McKay, C.P., & Pilcher, C. (2010). Spectroscopic and spectrometric differentiation between abiotic and biogenic material on icy worlds. Proceedings of the International Astronomical Union, 6, pp 165-176 doi:10.1017/S1743921310007374.

Raulin, F., **Hand, K. P.**, McKay, C., Fortes, D., Viso, M. (2010). Exobiology, Habitability, and Planetary Protection. In *Satellites of the Outer Solar System: Exchange Processes Involving the Interiors*, Space Sciences Series of ISSI. Eds. O. Grasset, M. Blanc, A. Coustenis, W. Durham, H. Hussmann, R. Pappalardo, D. Turrini. 536p.

Cassidy, T., Coll, P., Raulin, F., Carlson, R.W., Johnson, R.E., Loeffler, M.J., **Hand, K. P.**, Baragiola, R.A. Radiolysis and Photolysis. (2010). In *Satellites of the Outer Solar System: Exchange Processes Involving the Interiors*, Space Sciences Series of ISSI. Eds. O. Grasset, M. Blanc, A. Coustenis, W. Durham, H. Hussmann, R. Pappalardo, D. Turrini. 536p.

Sparks, W.B., McGrath, M., **Hand, K.P.**, Ford, H.C., Geissler, P., Hough, J.H., Turner, E.L., Chyba, C.F., Carlson, R., Turnbull, M. (2010) Hubble Space Telescope observations of Europa in and out of eclipse. *Int. J. of Astrobiology* 9(4):265-271.

Lorenz, R.D., Gleeson, D., Prieto-Ballesteros, Gomez, F., **Hand, K. P.**, Bulat, S. (2010) Analog Environments for a Europa Lander Mission. *Adv. in Space Research*, doi: 10.1016/j.asr.2010.05.006.

Clark, K., Boldt, J., Greeley, R., **Hand, K.P.**, Jun, I., Lock, R., Pappalardo, R.T., Van Houten, T., Yan, T. (2010) Return to Europa: Overview of the Jupiter Europa Orbiter Mission. *Adv. in Space Research*, doi:10.1016/j.asr.2010.04.011.

Hand, K.P. (2010) The ocean of Europa and implications for habitability and the origin of life. Astrobiology: from simple molecules to primitive life. Eds. V.A. Basiuk and R. Navarro-Gonzalez.

Hand, K.P., Chyba, C.F., J.C. Priscu, Carlson, R.W. & K.H. Nealson (2009) Astrobiology and the Potential for Life on Europa. In *Europa*. Eds. R. Pappalardo, W. McKinnon, & K. Khurana. Univ. of AZ Press.

Khurana, K.K., Kivelson, M.G., **Hand, K.P.**, and Russell, C.T. (2009) Electromagnetic induction from Europa's ocean and the deep interior. In *Europa*. Eds. R. Pappalardo, W. McKinnon, & K. Khurana. Univ. of AZ Press.

(Book review) **Hand, K.P.** (2009) Is there life on Europa? *Nature*, 457:384.

Cohen, P.A., Bradley, A., Knoll, A.H., Grotzinger, J.P., Jensen, S., Abelson, J., **Hand, K.**, Love, G., Metz, McLoughlin, N., Meister, P., Shepherd, R., Tice, M., Wilson, J.P. (2008) Tubular Compression Fossils from the Ediacaran Nama Group, Namibia. *Journal of Paleontology*.

Hand, K.P., Carlson, R. W., & Chyba, C. F. (2007) Energy, chemical disequilibrium, and geological constraints on Europa. *Astrobiology*. 7:6, 1-18.

Hand, K. P., & Chyba, C.F. (2007) Empirical constraints on the salinity of the europa ocean and implications for a thin ice shell. *Icarus*. 189:2, 424-438.

Hand, K. P., Carlson, R. W., Cooper, J., & Chyba, C. F. (2006) Clathrate hydrates of oxidants in the ice shell of Europa. *Astrobiology*. 6:3, 463-482.

Chyba, C. F. & **Hand, K. P.** Astrobiology: The Study of the Living Universe (2005) *Annual Reviews of Astronomy and Astrophysics*. 43:2.1-2.44.

Hand, K.P., Carlson, R.W., Sun, H., Anderson, M., Wadsworth, W., Levy, R. (2005) Utilizing active mid-infrared microspectrometry for in-situ analysis of cryptoendolithic microbial communities of Battleship Promontory, Dry Valleys, Antarctica. *Proceedings of SPIE Vol. #5906*. Optical Engineering and Instrumentation Instruments, Methods, and Missions for Astrobiology IX, 31 July- 2 August, 2005.

Anderson, M.S., Andringa, J.M., Carlson, R.W., Conrad, P., Hartford, W., Shafer, M., Soto, A., Tsapin, A.I., Dybwad, J.P., Wadsworth, W., **Hand, K.P.** (2005) Fourier transform infrared spectroscopy for Mars science. *Review of Scientific Instruments*. 76: 034101.

McKay, C. P., **Hand, K. P.**, Doran, P. T., Andersen, D. T. & Priscu, J. C. (2003) Clathrate formation and the fate of noble and biologically useful gases in Lake Vostok, Antarctica. *Geophys. Res. Lett.* Vol. 30, No. 13, 1702.

Zaitseva, L., and **Hand, K. P.** (2003) Nuclear Smuggling Chains: Suppliers, Intermediaries, and End-Users. *American Behavioral Scientist* 46:6, 822-844.

Chyba, C.F. and **Hand, K.P.** (2001) Life without Photosynthesis. *Science* 292, 2026-2027.

Hand, K.P. and Chyba, C.F. (2001) Prospects for Life on Europa. In "Frontiers of Life" (L.Celnikier, Ed.) *Proceedings of the Frontiers of Life Conference*, Blois, France, 25th June - 1st July 2000.

Colgate, S.A., Fryer, C.L., and **Hand, K.P.** (1997) Low Mass SN Ia and the Late Light Curve. In "Thermonuclear Supernovae" (P.Ruiz-Lapuente, R. Canal, J. Isern, Eds.) NATO Science Series C. Kluwer Academic Publishers, Boston, MA. p273-302.

Plus dozens of posters and talks at various DPS, AGU, NAI, etc. meetings

References

Christopher F. Chyba, Professor of Astrophysics and International Affairs
Director, Program on Science & Global Security, (cchyba@princeton.edu, phone: 609 258 3588)

Robert W. Carlson, Senior Research Scientist, JPL. (rwcarlso@jpl.nasa.gov)

Carl B. Pilcher, Director, NASA Astrobiology Institute (carl.b.pilcher@nasa.gov)

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