

## CURRICULUM VITAE

### Bruce Alan Macintosh

**Present Position:** Professor of Physics  
Kavli Institute for Particle Astrophysics and Cosmology  
Department of Physics  
Stanford University  
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Principal Investigator, Gemini Planet Imager

**Education:** Ph.D., Astronomy, 1994  
University of California, Los Angeles  
Advisors: Prof. Eric Becklin and Prof. Ian McLean

B.Sc., Physics, 1988  
Trinity College, University of Toronto, Ontario, Canada

**Awards and honors:** 2013 LLNL Physics Directorate Award for Outstanding Postdoc Mentoring  
2011 Elected Fellow of the SPIE  
2010 Newcomb Cleveland Prize from the American Association for  
Advancement of Science for best paper published in *Science* between  
July 2008-June 2009 for “Direct Imaging of Multiple Planets Orbiting  
the Star HR8799”  
2010 LLNL Science and Technology award for outstanding research  
2009 LLNL Science and Technology Directorate award for excellence in  
publication  
2004 “Spatially filtered wave-front sensor for high-order adaptive optics”  
selected as most significant paper in adaptive optics by OSA

#### Research Interests:

- Direct detection and spectroscopy of extrasolar planets
- Science-driven optimization of astronomical visible and IR instrumentation
- High contrast imaging systems for ground and space based telescopes
- Extrasolar planet population statistics
- Future large optical telescopes
- Astronomical adaptive optics: design, performance characterization, and observational techniques
- Application of signal processing approaches to astronomy
- Adaptive optics for next-generation x-ray light sources
- Wavefront control for microscopy and biomedical imaging

## Community and Committee Service:

Scientific Organizing Committee, Sagan Exoplanet Summer Workshop	2014
Wide-field IR Survey Telescope Science Definition Team	2013-present
Convener, Thirty Meter Telescope Exoplanet International Science Development Team	2013-present
Program Committee, “Adaptive Optics Systems and Applications”, 2012 SPIE Astronomical Instrumentation	2012
LSST Camera Systems Integration Conceptual Design Review	2011
Program Committee, “Techniques for detection of exoplanets” 2011 SPIE Optics and Photonics	2011
NASA Exoplanet Analysis Group Executive Committee	2010-2012
National Research Council ASTRO2010 Decadal Survey: Program Prioritization Panel on Ground Based Optical/IR	2009-2010
Thirty Meter Telescope IRIS Science Team	2008-present
Program Committee, “Adaptive Optics Systems and Applications” 2008 SPIE Astronomical Instrumentation	2008
Astronomy and Astrophysics Advisory Committee Exoplanet Task Force (ExoPTF)	2007-2008
NASA APRA Review Panel (X-ray)	2007-2008
ESO Very Large Telescope SPHERE planet finder PDR and CDR	2007, 2008
Scientific Organizing Committee, Spirit of Lyot conference	2007
Giant Segmented Mirror Telescope Science Working Group	2007-2008
Keck Next Generation AO System Science Team	2006-present
Gemini Adaptive Optics Working Group	2006-2009
TMT Narrow-field IR AO System Conceptual Design Review	2006
Laboratory Directed Research and Development selection committee, LLNL	2005-2007
Keck Observatory Next-Generation Wavefront Controller CDR (chair)	2005
Terrestrial Planet Finder instrument conceptual design selection	2005
NSF AO Development Plan Steering Committee	2004
JPL Terrestrial Planet Finder Technology Advisory Committee	2004-2006
Keck Observatory Adaptive Optics Working Group	2002-Present
University of California Observatories Infrared Working Group	1995-2002
NSF Major Research Instrumentation Astronomy Review Panel	2003
NASA Gossamer Spacecraft Program Review Panel	2001
LLNL IGPP Director Search Committee	2001
Referee for Ap.J., Ap.J. Letters, A&A, PASP, Optics Express, JOSA A, and Applied Optics	

## Memberships:

American Astronomical Society  
AAS Division of Planetary Sciences  
SPIE (Fellow)

### **Research grants held as principal investigator:**

Herschel OT1 funding, “Testing Planetary Dynamics Evolutionary History in the HR 8799 Planet/Disc System”, \$18K	2011
LLNL Laboratory Directed Research and Development, “Images and spectra of extrasolar planets with advanced adaptive optics”, \$1.62M	2010-2012
NASA Origins of Solar Systems, “Spectroscopic characterization of the HR8799 Planetary System”, \$420K	2010-2012
Gemini Planet Imager Design & Construction, \$24M	2006-2011
LLNL Laboratory Directed Research and Development, “Tracing The Shadows of Planetary Systems”, \$1.8M	2008-2010
HST funding, “Probing the compact disk of a nearby T Tauri star”, \$57K	2007-2009
Thirty Meter Telescope, “Feasibility study for planet formation Imager”, \$300K	2006
LLNL Laboratory Directed Research and Development, “Probing Other Solar Systems with Current&Future AO”, \$1.5M	2005-2007
Gemini/AURA, “Conceptual design of an Extreme Adaptive Optics Coronagraph”, \$200K (Gemini) plus institutional support	2004-2005
NSF Center for Adaptive Optics, “Extreme Adaptive Optics: Studying the formation and properties of extrasolar planets with the world’s most powerful AO system”, \$1.7M	2003-2010
LLNL Laboratory Directed Research and Development, “Direct Detection of Warm Extrasolar Planets”, \$600K	2002-2004
NSF Center for Adaptive Optics, “High Dynamic Range Imaging and Spectroscopy of Young Stellar Objects”, \$68K	2002
NSF Center for Adaptive Optics, “Evaluation and Improvement of Performance of AO Systems”, \$157K	2002
NSF Center for Adaptive Optics, “Primitive Planetary Systems”, \$160K	2000-2001
LLNL Laboratory Directed Research and Development, “Primitive Planetary Systems via the Keck Telescope”, \$630K	1999-2001

### **Students and postdoctoral scholars supervised**

Undergraduate research interns supervised:

Megan Eckart	1996-1999
Dane Kent	1998
Quinn Konopacky	2001-2003
Joshua Isaacs	2009

Graduate students:

Kathleen Morzinski, UC Santa Cruz	2005-2011
Lisa Poyneer, UC Davis / LLNL	2005-2007
Julia Evans, UC Davis / LLNL	2002-2006
Co-supervised thesis of Denise Kaisler Ph.D. student at UCLA	2000-2005
Involved in Ph.D. thesis research for Henry Roe and James Lloyd at UC Berkeley	1997-2002

Postdoctoral scholars:	
Seran Gibbard	1996-1999
Jennifer Patience	2000-2003
Marcos van Dam	2002-2004
Christian Marois	2005-2008
Michael Fitzgerald	2008-2010
Quinn Konopacky	2009-present
Mark Ammons	2010-present
Dmitry Savransky	2011-present

**Past positions:**

Physicist Applied Physics Section, Physics Division Lawrence Livermore National Laboratory	2001-2014
Associate Director for High-Contrast AO National Science Foundation Center for Adaptive Optics	1998-2001
Physicist Institute of Geophysics and Planetary Physics Lawrence Livermore National Laboratory	1997-2001
Postdoctoral Researcher Institute of Geophysics and Planetary Physics Lawrence Livermore National Laboratory	1994-1997
Research Assistant Department of Astronomy University of California, Los Angeles	1991-1994
Summer Researcher Rockwell International Science Center Thousand Oaks, California	1991
Teaching Assistant Department of Astronomy University of California, Los Angeles	1988-1991
Summer Research Assistant Canadian Institute for Theoretical Astrophysics University of Toronto, Ontario, Canada	1989
Summer Research Assistant Department of Mathematics Royal Military College, Kingston, Ontario, Canada	1988
Summer Research Assistant Department of Physics and Astronomy Queen's University, Kingston, Ontario	1985-1987



**PUBLICATION LIST**  
**Bruce Alan Macintosh**

1. Konopacky, Q., Barman, T., Macintosh, B., and Marois, C., “Detection of Carbon Monoxide and Water Absorption Lines in an Exoplanet Atmosphere”, 2013 *Science* in press (to appear March 14)
2. Savransky, D., Thomas, S., Poyneer, L., and Macintosh, B., “Computer vision applications for coronagraphic optical alignment and image processing”, 2013 *Applied Optics* submitted
3. Galicher, R., Marois, C., Zuckerman, B., and Macintosh, B., “Fomalhaut b: Independent analysis of the Hubble Space Telescope public archive data”, 2012 *Ap.J.* accepted
4. Vigan, A., Patience, J., Marois, C., Bonavita, M., De Rosa, R.J., Macintosh, B., Song, I., Doyon, R., Zuckerman, B., Lafreniere, D., Barman, T., “The International Deep Planet Survey. I. The frequency of wide-orbit massive planets around A stars”, 2012 *A&A* 544, A9
5. De Rosa, R.J., Patience, J., Vigan, A., Wilson, P.A., Schneider, A., McConnell, N.J., Wiktorowicz, S.J., Marois, C., Song, I., Macintosh, B., Graham, J.R., Bessell, M.S., Doyon, R., Lai, O., “The Volume-limited A-Star (VAST) survey - II. Orbital motion monitoring of A-type star multiples”, 2012 *MNRAS* 422, 2765
6. Konopacky, Q.M., Ghez, A.M., Fabrycky, D.C., Macintosh, B., White, R. J., Barman, T. S., Rice, E. L., Hallinan, G., Duchene, G., “Rotational velocities of individual components in very low mass binaries”, 2012 *Ap.J.* 750, 79
7. Rodriguez, D.R., Marois, C., Zuckerman, B., Macintosh, B., Melis, C., “A substellar companion to the dusty pleiades star HD23514”, 2012 *Ap.J.* 748, 30
8. Galicher, R., Marois, C., **Macintosh, B.**, Barman, T., and Konopacky, Q., “M-band imaging of the HR8799 planetary system using an Innovative LOCI-based background subtraction technique”, 2011 *Ap. J. Letters.*, 739, L41
9. Thomas, S., Soummer, R., Dillon, D., **Macintosh, B.**, Gavel, D., and Sivaramakrishnan, A., “Testing the apodized pupil Lyot coronagraph on the Laboratory for Adaptive Optics extreme adaptive optics testbed”, 2011 *A.J.*, 142, 119
10. Barman, T., **Macintosh, B.**, Konopacky, Q., and Marois, C., “The young planet-mass object 2M1207b: a cool, cloudy, and methane-poor atmosphere” 2011 *Ap. J. Letters*, 735, L39
11. McBride, J., Graham, J.R., **Macintosh, B.**, Beckwith, S.V.W., Marois, C., Poyneer, L., and Wiktorowicz, S., “Experimental design for the Gemini Planet Imager”, 2011 *P.A.S.P.*, 123, 692
12. Barman, T., **Macintosh, B.**, Konopacky, Q., Marois, C., “Clouds and chemistry in the atmosphere of extrasolar planet HR8799b”, 2011 *Ap.J.*, 733, 65
13. De Rosa, R.J., Bulgar, J., Patience, J., Leland, B., **Macintosh, B.**, Schneider, A., Song, I., Marois, C., Graham, J.R., Bessel, M., and Doyon, R., “The Volume-limited A star (VAST) survey – I, Companions and the unexpected X-ray detection of B6-A7 stars”, 2011 *M.N.R.A.S.*, 415, 854
14. Wright, D., Chené, A.-N., De Cat, P., Marois, C., Mathias, P., **Macintosh, B.**, Isaacs, J., Lehmann, H., and Hartmann, M., “Determination of the inclination of the multi-planet hosting star HR8799 using astroseismology”, 2011 *Ap. J. Letters* 728, L20
15. Soummer, R., Sivaramakrishnan, A., Pueyo, L., **Macintosh, B.**, and Oppenheimer, B., “Apodized Pupil Lyot Coronagraphs for Arbitrary Apertures. III. Quasi-Achromatic Solutions”, 2011 *Ap. J.* 729, 144
16. Marois, C., Zuckerman, B., Konopacky, Q., **Macintosh, B.**, Barman, T., “Images of a fourth planet orbiting HR8799”, 2010 *Nature* 7327, 1080
17. Bennett, D. P., Rhie, S. H., Nikolaev, S., Gaudi, B. S., Udalski, A., Gould, A., Christie, G. W., Maoz, D., Dong, S., McCormick, J., Szymański, M. K., Tristram, P. J., **Macintosh, B.**,

- Cook, K. H., Kubiak, M., Pietrzyński, G., Soszyński, I., Szewczyk, O., Ulaczyk, K., Wyrzykowski, Ł., DePoy, D. L., Han, C., Kaspi, S., Lee, C.-U., Mallia, F., Natusch, T., Park, B.-G., Pogge, R. W., Polishook, D., Abe, F., Bond, I. A., Botzler, C. S., Fukui, A., Hearnshaw, J. B., Itow, Y., Kamiya, K., Korpela, A. V., Kilmartin, P. M., Lin, W., Ling, J., Masuda, K., Matsubara, Y., Motomura, M., Muraki, Y., Nakamura, S., Okumura, T., Ohnishi, K., Perrott, Y. C., Rattenbury, N. J., Sako, T., Saito, To., Sato, S., Skuljan, L., Sullivan, D. J., Sumi, T., Sweatman, W. L., Yock, P. C. M., Albrow, M., Allan, A., Beaulieu, J.-P., Bramich, D. M., Burgdorf, M. J., Coutures, C., Dominik, M., Dieters, S., Fouqué, P., Greenhill, J., Horne, K., Snodgrass, C., Steele, I., Tsapras, Y., Chaboyer, B., Crocker, A., and Frank, S., “Masses and orbital constraints for the OGLE-2006-BLG-109LB,c Jupiter/Saturn Analog Planetary System”, 2010 *Ap. J.* 713, 837
18. Sumi, T., Bennett, D. P., Bond, I. A., Udalski, A., Batista, V., Dominik, M., Fouqué, P., Kubas, D., Gould, A., **Macintosh, B.**, Cook, K., Dong, S., Skuljan, L., Cassan, A., Abe, F., Botzler, C. S., Fukui, A., Furusawa, K., Hearnshaw, J. B., Itow, Y., Kamiya, K., Kilmartin, P. M., Korpela, A., Lin, W., Ling, C. H., Masuda, K., Matsubara, Y., Miyake, N., Muraki, Y., Nagaya, M., Nagayama, T., Ohnishi, K., Okumura, T., Perrott, Y. C., Rattenbury, N., Saito, To., Sako, T., Sullivan, D. J., Sweatman, W. L., Tristram, P. J., Yock, P. C. M., Beaulieu, J. P., Cole, A., Coutures, Ch., Duran, M. F., Greenhill, J., Jablonski, F., Marboeuf, U., Martioli, E., Pedretti, E., Pejcha, O., Rojo, P., Albrow, M. D., Brilliant, S., Bode, M., Bramich, D. M., Burgdorf, M. J., Caldwell, J. A. R., Calitz, H., Corrales, E., Dieters, S., Dominis Prester, D., Donatowicz, J., Hill, K., Hoffman, M., Horne, K., Jørgensen, U. G., Kains, N., Kane, S., Marquette, J. B., Martin, R., Meintjes, P., Menzies, J., Pollard, K. R., Sahu, K. C., Snodgrass, C., Steele, I., Street, R., Tsapras, Y., Wambsganss, J., Williams, A., Zub, M., Szymański, M. K., Kubiak, M., Pietrzyński, G., Soszyński, I., Szewczyk, O., Wyrzykowski, Ł., Ulaczyk, K., The OGLE Collaboration, Allen, W., Christie, G. W., DePoy, D. L., Gaudi, B. S., Han, C., Janczak, J., Lee, C.-U., McCormick, J., Mallia, F., Monard, B., Natusch, T., Park, B.-G., Pogge, R. W., and Santallo, R., “A Cold Neptune-Mass Planet OGLE-2007-BLG-368Lb: Cold Neptunes are Common”, 2010 *Ap. J.* 710, 1641
  19. Evans, J., **Macintosh, B.**, Norton, A., Dillon, D., and Gavel, D., “The effect of a small heat source on PSF stability for high-contrast imaging”, 2009 *Optics Express* 17, 11652
  20. Thomas, S., Evans, J., Gavel, D., Dillon, D., and **Macintosh, B.**, “Amplitude variations on a MEMS-based extreme adaptive optics coronagraph testbed”, 2009 *Applied Optics* 48, 4077
  21. Cady, E., **Macintosh, B.**, Kasdin, N.J., and Soummer, R., “Shaped pupil design for the Gemini Planet Imager”, 2009 *Ap. J.* 698, 938
  22. Morzinski, K., **Macintosh, B.**, Gavel, D., and Dillon, D., “Stroke Saturation on a MEMS deformable mirror for woofer-tweeter adaptive optics”, 2009 *Optics Express* 17, 5829
  23. Lunine, J., **Macintosh, B.**, and Peale, S., “The detection and characterization of extrasolar planets”, 2009 *Physics Today* 62, 46
  24. Marois, C., **Macintosh, B.**, Barman, T., Zuckerman, B., Song, I., Patience, J., Lafreniere, D., and Doyon, R., “Direct imaging of multiple planets orbiting the star HR8799”, 2008 *Science* 322, 1347
  25. Zuckerman, B., Melis, C., Song, I., Meier, D., Perrin, M., **Macintosh, B.**, Marois, C., Weinberger, A., Rhee, J., Graham, J., Kastner, J., Palmer, P., Forveille, T., Becklin, E., Wilner, D., Barman, T., Marcy, G., Bessel, B., “Gas and dust associated with the strange, isolated star BP Piscium”, 2008 *Ap. J.* 683, 1085
  26. Poyneer, L., Dillon, D., Thomas, S., and **Macintosh, B.**, “Laboratory demonstration of accurate and efficient nanometer-level wavefront control for extreme adaptive optics”, 2008 *Applied Optics* 47, 1317

27. Marois, C., Lafreniere, D., **Macintosh, B.**, and Doyon, R., “Confidence level and sensitivity limits in high-contrast imaging”, 2008 *Ap. J.* 673, 647
28. Gaudi, S., and 67 coauthors, “Discovery of a Jupiter/Saturn analog with gravitational microlensing”, 2008 *Science* 319, 927
29. Lafreniere, D., Doyon, R., Marois, C., Nadeau, D., Oppenheimer, B., Roche, P., Rigaut, F., Graham, J., Jayawardhana, R., Johnstone, D., Kalas, P., **Macintosh, B.**, and Racine, R., “The Gemini Deep Planet Survey”, 2007 *Ap. J.* 670, 1367
30. de Pater, I., Laver, C., Marchis, F., Roe, H., and **Macintosh, B.**, “Spatially resolved observations of the forbidden SO rovibronic transition on Io during an eclipse and a volcanic eruption at Ra Patera”, 2007 *Icarus* 191, 172
31. Poyneer, L., **Macintosh, B.**, and Véran, J.-P., “Fourier transform wavefront control with adaptive prediction of the atmosphere,” 2007 *J. Opt. Soc. Am. A* 24, 2645
32. Konopacky, Q., Ghez, A., Duchene, G., McCabe, C., and **Macintosh, B.**, “Measuring the mass of a pre-main-sequence binary star through the orbit of TWA 5A”, 2007 *AJ* 133, 2008
33. **Macintosh, B.**, Graham, J., Palmer, D., Doyon, R., Gavel, D., Larkin, J., Oppenheimer, B., Saddlemyer, L., Wallace, J., Bauman, B., Erikson, D., Poyneer, L., Sivaramakrishnan, A., Soummer, R., and Veran, J.-P., “Adaptive optics for direct detection of extrasolar planets: the Gemini Planet Imager”, 2007 *Comptes Rendus Physique* 8, 365
34. Lafreniere, D., Doyon, R., Marois, C., Nadeau, D., Oppenheimer, B., Roche, P., Rigaut, F., Graham, J., Jayawardhana, R., Johnstone, D., Kalas, P., **Macintosh, B.**, and Racine, R., “The Gemini Deep Planet Survey”, 2007 *Ap. J.* 670, 1367
35. de Pater, I., Lave, C., Machis, F., Roe, H., and **Macintosh, B.**, “Spatially resolved observations of the forbidden SO rovibronic transition on Io during an eclipse and a volcanic eruption at Ra Patera”, 2007 *Icarus* 191, 172
36. Close, L, Zuckerman, B., Song, I, Barman, T., Marois, C., Rice ,E., Siegler, N., **Macintosh, B.**, et al., “The Wide Brown Dwarf Binary Oph 1622-2405 and Discovery of a Wide, Low-Mass Binary in Ophiuchus (Oph 1623-2402): A New Class of Young Evaporating Wide Binaries?”, 2007 *Ap. J.* 660, 1492
37. Sigeler, N., Close, L., Burgasser, A., Cruz, K., Marois, C., **Macintosh, B.**, and Barman, T., “Discovery of a 66 mas ultracool binary with laser guide star adaptive optics”, 2007 *AJ* 133, 2320
38. Marois, C., **Macintosh, B.**, and Barman, T., “GQ Lup B Optical and Near-Infrared Photometry”, 2007 *Ap. J. Lett.* 654, 151
39. Marois, C., Lafrenier, D., Doyon, R., Racine, R., Nadeau, D., and **Macintosh, B.**, “Angular differential imaging: a powerful high-contrast imaging technique”, 2006 *Ap. J.* 641, 556
40. Konopacky, Q., Ghez, A, Duchene, G., McCabe, C., and **Macintosh, B.**, “Measuring the mass of a pre-main-sequence binary star through the orbit of TWA5A”, 2007 *AJ* 133, 2008
41. Poyneer, L., Bauman, B., **Macintosh, B.**, Dillon, D., and Severson, S. “Experimental demonstration of phase correction with a 32 x 32 microelectromechanical systems mirror and a spatially filtered wavefront sensor”, 2006 *Opt. Lett.* 31, 293
42. Wong, M., de Pater, I., Showalter, M, Roe, H., **Macintosh, B.**, Verbanac, G, “Ground-based near infrared spectroscopy of Jupiter’s ring and moons”, 2006 *Icarus* 185, 403
43. Song, I., Schneider, G., Zuckerman, B., Farihi, J., Becklin, E., Bessel, M., Lowrance, P., **Macintosh, B.**, “HST NICMOS imaging of the planetary-mass companion to the young brown dwarf 2MASS J1207334-393254”, 2006 *Ap. J.* 652, 724
44. Marois, C., Lafreniere, D., **Macintosh, B.**, and Doyon, R. “Accurate Astrometry and Photometry of Saturated and Coronagraphic Point Spread Functions”, 2006 *Ap. J.* 647, 612



45. Evans, J., **Macintosh, B.**, Poyneer, L., Morzinski, K., Severson, S., Dillion, D., Gavel, D., and Reza, L., "Demonstrating sub-mm closed-loop MEMS flattening", 2006 *Optics Express* 14, 5558
46. Evans, J., Sommargen, G., **Macintosh, B.**, Severson, S., and Dillon, D., "Effects of wavefront error on 10<sup>-7</sup> contrast measurements", 2006 *Optics Letters* 31, 565
47. Max, C., Canalizo, G., **Macintosh, B.**, et al. "The core of NGC 6240 from Keck adaptive optics and Hubble Space Telescope NICMOS observations", 2005 *Ap. J.* 621, 738-749.
48. Van Dam, M., le Mignant, D., and **Macintosh, B.**, "Performance of the Keck Observatory AO System", 2004 *Applied Optics* 43, 5458
49. de Pater, I., Gibbard, S., Chiang, E., Hammel, H., **Macintosh, B.**, Marchis, F., Martin, S., Roe, H., and Showalter, M., "The dynamic Neptunian ring arcs: evidence for a gradual disappearance of Liberté and a resonant jump of Courage", 2005 *Icarus* 174, 263
50. Van Dam, M., le Mignant, D., and **Macintosh, B.**, "Performance of the Keck Observatory Adaptive Optics System", 2004 *Applied Optics* 43, 5458
51. Poyneer, L., and **Macintosh, B.**, "Spatially-filtered wavefront sensor for high-order adaptive optics", 2004 *Journal of the Optical Society of America A*, 21, 810
52. Farihi, J., Becklin, E., and **Macintosh, B.**, "Mid-Infrared Observations of van Maanen 2: No Substellar Companion", 2004 *Ap. J.* 608, L109
53. Duchene, G., McCabe, C., Ghez, A., and **Macintosh, B.**, "A multi-wavelength scattered light analysis of the dust grain population in the GG Tau circumbinary ring", 2004 *Ap. J.* 606, 969
54. Gibbard, S., de Pater, I., **Macintosh, B.**, Roe, H., Max, C., Young, E., and McKay, C., "Titan's 2  $\mu$ m surface albedo and haze optical depth 1996-2004", 2004 *Geophysical Research Letters*, 31, L17S02
55. Roe, H., de Pater, I., Gibbard, S., **Macintosh, B.**, Max, C., Young, E., Brown, M., and Bouchez, A., "A new 1.6 micron map of Titan's surface", 2004 *Geophysical Research Letters*, 31, L17S03
56. de Pater, I., Marchis, F., **Macintosh, B.**, Roe, H., le Mignant, D., Graham, J. and Davies, A., "Keck AO observations of Io in and out of eclipse", 2004 *Icarus* 169, 250
57. Gibbard, S., **Macintosh, B.**, Gavel, D., Max, C., de Pater, I., Roe, H., Ghez, A., Young, E., and McKay, C., "Titan: 2 micron surface albedo and haze optical depth in 1996-1998", 2004 *Icarus*, 169, 429
58. Kaisler, D., Zuckerman, B., Song, I., **Macintosh, B.**, Weinberger, A., Becklin, E., Konopacky, Q., and Patience, J., 2003, "No evidence for dust around the Beta Pictoris moving group stars HD 199143 and HD 358623", 2004 *A&A* 414, 175
59. Gibbard, S., de Pater, I., Roe, H., Martin, S., **Macintosh, B.**, and Max, C., "The altitude of Neptune cloud features from high-spatial-resolution near-infrared spectra", 2003 *Icarus* 166, 359
60. **Macintosh, B.**, Gavel, D., Gibbard, S., Max, C., de Pater, I., Ghez, A., and Spencer, J., "Speckle imaging of volcanic hotspots on Io with the Keck telescope", 2003 *Icarus* 165, 137
61. **Macintosh, B.**, Becklin, E., Kaisler, D., Konopacky, Q., and Zuckerman, B., "Deep adaptive optics searches for planets in the dust of Epsilon Eridani and Vega", 2003 *Ap. J.* 594, 538
62. Poyneer, L., Troy, M., **Macintosh, B.**, and Gavel, D., "First experimental validation of Fourier transform wave-front reconstruction at Palomar", 2003 *Optics Letters*, 798
63. Max, C., **Macintosh, B.**, Gibbard, S., Gavel, D., Roe, H., de Pater, I., Ghez, A., Acton, D., Lai, O., Stomski, P., and Wizinowich, P., "Cloud structures of Neptune observed with Keck telescope adaptive optics", 2003 *AJ* 125, 364

64. Sivaramakrishnan, A., Lloyd, J., Hodge, P., and **Macintosh, B.**, “Speckle decorrelation and dynamic range in speckle noise-limited imaging”, 2002 *Ap. J.* 581, L59
65. Gavel, D., Max, C., Olivier, S., Bauman, B., Pennington, D., **Macintosh, B.**, Patience, J., Brown, C., Danforth, P., Hurd, R., Gates, E., Severson, S., and Lloyd, J., “Science with laser guide stars at Lick Observatory”, 2002, *Proc. SPIE* 4494, 336
66. Patience, J., White, R., Ghez, A., McLean, I., McCabe, C., Larkin, J., Prato, L., Kim, S., Lloyd, J., Liu, M., Graham, J., **Macintosh, B.**, Gavel, D., Max, C., Bauman, B., Olivier, S., Wizinowich, P. and Acton, D., “Stellar Companions to Stars with Planets”, 2002 *Ap. J.* 581, 654
67. Roe, H., de Pater, I., **Macintosh, B.**, and McKay, C., “Titan’s clouds from Gemini and Keck adaptive optics imaging”, 2002, *Ap. J.* 581, 1399
68. de Pater, I., Gibbard, S., **Macintosh, B.**, Roe, H., Gavel, D., and Max, C., 2002, “Keck adaptive optics images of Uranus and its rings”, 2002 *Icarus* 160, 359
69. Marchis, F., de Pater, I., Davies, A., Roe, H., Fusco, T, le Mignant, D., **Macintosh, B.**, and Prange, R., “High resolution Keck adaptive optics imaging of violent volcanic activity on Io”, 2002, *Icarus* 160, 124
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#### OTHER PUBLICATIONS

- Lunine, J., Macintosh, B., and Peale, S., “The Detection and Characterization of Exoplanets”, 2006, *Physics Today*, 62, 46
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- Ge, J., Ciarlo, D., Kuzmenko, P., **Macintosh, B.**, Alcock, C., and Cook, K., “Etched Silicon Gratings for NGST”, 1999, *Proc. NGST Science and Technology Exposition*
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#### INVITED TALKS

1. “Planet detection by direct imaging”, 16th International Conference on Gravitational Microlensing, 2012
  2. “MEMS adaptive optics in the Gemini Planet Imager”, SPIE 2012 Photonics West
  3. “Extreme is the new normal: lessons learned from GPI and SPHERE for ELT AO”, AO4ELT 2011 conference
  4. “High Contrast Adaptive Optics: History, Progress and Prospects”, 2010, SPIE Astronomical Instrumentation
  5. “Ground based direct detection”, 2009, Techniques and Instrumentation for Detection of Exoplanets, SPIE Optics and Photonics “Prospects for direct planet detection with high-contrast adaptive optics”, 2007, Navigator Program Forum, Ames Research Center
  6. “Extreme Adaptive Optics for Direct Detection of Extrasolar Planets”, 2007 Airforce Maui Optical Station AMOS conference
  7. “The Gemini Planet Imager”, 2007, Spirit of Lyot Conference, UC Berkeley
  8. “Capabilities of Extremely Large Telescopes”, NOAO Workshop on the Future of Interferometry, Tucson, AZ
  9. “Extreme AO: the future of high-contrast imaging with adaptive optics”, 2001, AAS meeting 198, 83.04 (invited talk in Special Session on high-contrast imaging)
  10. “An adaptive optics search for young extrasolar planets”, 2000, AAS meeting 197, 64.01 (invited talk in Special Session on adaptive optics science)
  11. “Direct Detection of Planets and Brown Dwarfs from Antarctica”, 1998, AAS meeting 192, 62.24 (invited talk in Topical Session on Antarctic astronomy)
- Colloquia at Boston University, Ohio State University, KIPAC, UC Irvine, Jet Propulsion Laboratory, NASA Exoplanet Science Institute, Stanford Linear Accelerator Center, Harvard/Smithsonian Center for Astrophysics, Massachusetts Institute of Technology, UC Santa Barbara, Space Telescope Science Institute, Goddard Spaceflight Center, UC Santa Cruz, SETI institute, Cornell, European Southern Observatory, UC Berkeley, University of British Columbia, University of Wisconsin, UC Santa Cruz, UCLA, Lunar and Planetary Institute, 2000-2012