

Graham Barnes
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Education

Yale University	Mathematics and Physics	B.S., 1992
Cornell University	Physics Major, Astronomy Minor	M.S., 1995
Cornell University	Physics Major, Astronomy Minor	Ph.D., 1999

Appointments

06/15-present	Senior Research Scientist, NorthWest Research Associates, Inc.
01/03-06/15	Research Scientist, NorthWest Research Associates, Inc.
12/02-04/05	Visiting Scientist, High Altitude Observatory, National Center for Atmospheric Research
08/01-12/02	Postdoctoral Research Fellow, NorthWest Research Associates, Inc.
12/00-07/01	Visiting Scientist, High Altitude Observatory, National Center for Atmospheric Research
10/98-10/00	Postdoctoral Research Fellow, Dept. of Mathematics, Monash University

Research Interests

Measurement and analysis of solar magnetic fields.
Magnetic topology, particularly with regard to solar energetic events.
Discriminant analysis and statistical prediction.
Local helioseismology.
Astrostatistics, particularly bringing modern statistical techniques to solar physics.

Professional Societies and Service

Member of International Astronomical Union.
Member of American Astronomical Society/Solar Physics Division.
Member of American Geophysical Union.
Member of Steering Committee for FLARECAST.
Member of International Space Sciences Institute (ISSI) team “Nonlinear Force-Free Modeling of the Solar Corona: Towards a New Generation of Methods”.
Member of ISSI team “Improving the Reliability of Solar Eruption Predictions to Facilitate the Determination of Targets-of-Opportunity for Instruments With a Limited Field-of-View”.
Developed Disambiguation module for *SDO*/HMI Vector Magnetic Field Pipeline.
Co-organizer of SHINE session on coronal magnetic energy.
Co-organizer of two workshops comparing the performance of flare-forecasting methods.

Graduate Students/Postdocs/Support Scientists Supervised

Crouch, A. D., NWRA/CoRA, 2006 – 2007.

Derouich, M., NWRA/CoRA, 2010.

Gilchrist, S., NWRA/CoRA, 2015 – 2019.

Lee, J.-Y., NWRA/CoRA, 2008 – 2009.

Petty, S., NWRA/CoRA, 2021.

Schumer, E. A., Air Force Institute of Technology, 2003 – 2005.

Wagner, E., NWRA/CoRA, 2009 – present.

Wan, K., NWRA/CoRA, 2011.

Random Other Accomplishments

- 2021 Summited Ixtaccihuatl (elev. 5300m), Mexico
- 2020 Colorado Triple Crown - Stove Prairie Stampede, Peak-to-Peak Double Century, Clear Creek Crusher
- 2018 Raid Pyrénéen - cycling 720 km through the Pyrenees in 100 hr
- 2016 Colorado Triple Crown - Cycle to Saturn Double Century, Cripple Creek Crippler, Tim Kalisch Memorial Grand Loop
- 2015 Colorado Triple Crown - Colorado High Country Double Century, Colorado Death Ride, Tim Kalisch Memorial Grand Loop
- 2012 Summited Pequeño Alpamayo (elev. 5300m), Huayna Potosi (elev. 6100m), Bolivia
- 2007 Summited Mt. Rainer (elev. 4400m) via the Kautz Route
- 2004 Summited Cotopaxi (elev. 5900m) and Chimborazo (elev. 6300m), Ecuador
- 2002 4th in age category, 24 hour solo world championships of mountain biking
- 2001 13th overall, 24 hour solo world championships of mountain biking
- 2000 Summited Mera Peak (elev. 6400m), Nepal

Publications

- [1] Higgins, R. E. L., D.F. Fouhey, S. K. Antiochos, G. Barnes, M. C. M. Cheung, J. T. Hoeksema, K. D. Leka, Y. Liu, P.W. Schuck, T. I. Gombosi: 2022 ‘SynthIA: A Synthetic Inversion Approximation for the Stokes Vector Fusing SDO and Hinode into a Virtual Observatory’ *Astrophys. J. Supp.*, **259**, 24.
- [2] Higgins, R. E. L., D.F. Fouhey, D. Zhang, S. K. Antiochos, G. Barnes, J. T. Hoeksema, K. D. Leka, Y. Liu, P.W. Schuck, T. I. Gombosi: 2021 ‘Fast and Accurate Emulation of the SDO/HMI Stokes Inversion with Uncertainty Quantification’ *Astrophys. J.*, **911**, 130.
- [3] Gilchrist, S. A., K. D. Leka, G. Barnes, M. S. Wheatland, and M. L. DeRosa: 2020 ‘On Measuring Divergence for Magnetic Field Modeling’. *Astrophys. J.*, **900**, 136.
- [4] Park, S.-H., K. D. Leka, K. Kusano, J. Andries, G. Barnes, S. Bingham, D. S. Bloomfield, A. E. McCloskey, V. Delouille, D. Falconer, P. T. Gallagher, M. K. Georgoulis, Y. Kubo, K. Lee, S. Lee, V. Lobzin, J. Mun, S. A. Murray, T. A. M. Hamad Nageem, R. Qahwaji, M. Sharpe, R. A. Steenburgh, G. Steward, and M. Terkildsen ‘A Comparison of Flare Forecasting Methods. IV. Evaluating Consecutive-day Forecasting Patterns’. *Astrophys. J.*, **881**, 101.

- [5] Leka, K. D., S.-H. Park, K. Kusano, J. Andries, G. Barnes, S. Bingham, D. S. Bloomfield, A. E. McCloskey, V. Delouille, D. Falconer, P. T. Gallagher, M. K. Georgoulis, Y. Kubo, K. Lee, S. Lee, V. Lobzin, J. Mun, S. A. Murray, T. A. M. Hamad Nageem, R. Qahwaji, M. Sharpe, R. A. Steenburgh, G. Steward, and M. Terkildsen: 2019 ‘A Comparison of Flare Forecasting Methods. III. Systematic Behaviors of Operational Solar Flare Forecasting Systems’ *Astrophys. J.*, **881**, 101.
- [6] Leka, K. D., S.-H. Park, K. Kusano, J. Andries, G. Barnes, S. Bingham, D. S. Bloomfield, A. E. McCloskey, V. Delouille, D. Falconer, P. T. Gallagher, M. K. Georgoulis, Y. Kubo, K. Lee, S. Lee, V. Lobzin, J. Mun, S. A. Murray, T. A. M. Hamad Nageem, R. Qahwaji, M. Sharpe, R. A. Steenburgh, G. Steward, and M. Terkildsen: 2019 ‘A Comparison of Flare Forecasting Methods. II. Benchmarks, Metrics, and Performance Results for Operational Solar Flare Forecasting Systems’ *Astrophys. J. Supp.*, **243**, 36.
- [7] DeRosa, M. L. and G. Barnes: 2018 ‘Does Nearby Open Flux Affect the Eruptivity of Solar Active Regions?’ *Astrophys. J.*, **861**, 131.
- [8] Leka, K. D., G. Barnes, and E. L. Wagner: 2018 ‘The NWRA Classification Infrastructure: description and extension to the Discriminant Analysis Flare Forecasting System (DAFFS)’. *J. Space Weather Space Clim.*, **8**, A25.
- [9] Barnes, G. and K. D. Leka: 2018 ‘Inferring Currents from the Zeeman Effect at the Solar Surface’. In: A. Keiling, O. Marghitsu, and M. Wheatland (eds.): *Electric Currents in Geospace and Beyond*, John Wiley & Sons, Inc, Hoboken, N.J., p. 81
- [10] Barnes, G., N. Schanche, K. D. Leka, A. Aggarwal, and K. Reeves: 2017 ‘A Comparison of Classifiers for Solar Energetic Events’. In: M. Brescia (ed.): *IAU Symposium 325*. pp. 201.
- [11] Leka, K. D., G. Barnes, and E. L. Wagner: 2017 ‘Evaluating (and Improving) Estimates of the Solar Radial Magnetic Field Component from Line-of-Sight Magnetograms’. *Solar Phys.*, **292**, 36.
- [12] Gilchrist, S. A., D. C. Braun, and G. Barnes: 2016 ‘A Fixed-point Scheme for the Numerical Construction of Magnetohydrostatic Atmospheres in Three Dimensions’. *Solar Phys.*, **291**, 3583.
- [13] Barnes, G., K. D. Leka, C. J. Schrijver, T. Colak, R. Qahwaji, O. W. Ahmed, Y. Yuan, J. Zhang, R. T. J. McAteer, D. S. Bloomfield, P. A. Higgins, P. T. Gallagher, D. A. Falconer, M. K. Georgoulis, M. S. Wheatland, C. Balch, T. Dunn, and E. L. Wagner: 2016 ‘A Comparison of Flare Forecasting Methods, I: Results from the “All-Clear” Workshop’. *Astrophys. J.*, **829**, 89.
- [14] Schuck, P. W., S. Antiochos, K.D. Leka, and G. Barnes: 2016 ‘Achieving Consistent Doppler Measurements from SDO/HMI Vector Field Inversions’. *Astrophys. J.*, **823**, 101.
- [15] DeRosa, M. L., M. S. Wheatland, K. D. Leka, G. Barnes, T. Amari, A. Canou, S. A. Gilchrist, J. K. Thalmann, G. Valori, T. Wiegelmann, C. J. Schrijver, A. Malanushenko, X. Sun, and S. Régnier: 2015 ‘The Influence of Spatial resolution on Nonlinear Force-free Modeling’. *Astrophys. J.*, **811**, 107.

- [16] Bobra, M. G., X. Sun, J. T. Hoeksema, M. Turmon, Y. Liu, K. Hayashi, G. Barnes, and K. D. Leka: 2013 ‘The Helioseismic and Magnetic Imager (HMI) Vector Magnetic Field Pipeline: SHARPs – Space-weather HMI Active Region Patches’. *Solar Phys.*, **289**, 3549.
- [17] Centeno, R., J. Schou, K. Hayashi, A. Norton, J. T. Hoeksema, Y. Liu, K. D. Leka, and G. Barnes: 2013 ‘The Helioseismic and Magnetic Imager (HMI) Vector Magnetic Field Pipeline: Optimization of the Spectral Line Inversion Code’. *Solar Phys.*, **289**, 3531.
- [18] Hoeksema, J. T., Y. Liu, K. Hayashi, X. Sun, J. Schou, S. Couvidat, A. Norton, M. Bobra, R. Centeno, K. D. Leka, G. Barnes, and M. Turmon: 2013 ‘The Helioseismic and Magnetic Imager (HMI) Vector Magnetic Field Pipeline: Overview and Performance’. *Solar Phys.*, **289**, 3483.
- [19] Barnes, G., K. D. Leka, A. C. Birch, and D. C. Braun: 2013 ‘Helioseismology of Pre-emerging Active Regions. III. Statistical Analysis’. *Astrophys. J.*, **786**, 19.
- [20] Birch, A. C., D. C. Braun, K. D. Leka, G. Barnes, and B. Javornik: 2013 ‘Helioseismology of Pre-emerging Active Regions. II. Average Emergence Properties’. *Astrophys. J.*, **762**, 131.
- [21] Leka, K. D., G. Barnes, A. C. Birch, I. Gonzalez-Hernandez, T. Dunn, B. Javornik, and D. C. Braun: 2013 ‘Helioseismology of Pre-emerging Active Regions. I. Overview, Data, and Target Selection Criteria’. *Astrophys. J.*, **762**, 130.
- [22] Leka, K. D. and G. Barnes: 2012 ‘Modeling and Interpreting the Effects of Spatial Resolution on Solar Magnetic Field Maps’. *Solar Phys.*, **277**, 89–118.
- [23] Leka, K. D., G. Barnes, G. A. Gary, A. D. Crouch, and Y. Liu: 2012 ‘Response to “Comment on ‘Resolving the 180° Ambiguity in Solar Vector Magnetic Field Data: Evaluating the Effects of Noise, Spatial Resolution, and Method Assumptions’ ”’ *Solar Phys.*, **276**, 441–450.
- [24] Ferguson, R., R. Komm, F. Hill, G. Barnes and K. D. Leka: 2011 ‘Subsurface Vorticity of Flaring versus Flare-Quiet Active Regions’. *Solar Phys.*, **268**, 389–406.
- [25] Lee, J.-Y., G. Barnes, K. D. Leka, K. K. Reeves, K. E. Korreck, L. Golub, and E. E. DeLuca: 2010 ‘The Role of Magnetic Topology in the Heating of Active Region Coronal Loops’. *Astrophys. J.*, **723**, 1493.
- [26] Crouch, A. D., G. Barnes and K. D. Leka: 2009 ‘Resolving the Azimuthal Ambiguity in Vector Magnetogram Data with the Divergence-Free Condition: Application to Discrete Data’. *Solar Phys.*, **260**, 271–287.
- [27] Leka, K. D., G. Barnes, A. D. Crouch, T. R. Metcalf, G. A. Gary, J. Jing, and Y. Liu: 2009 ‘Resolving the 180° Ambiguity in Solar Vector Magnetic Field Data: Evaluating the Effects of Noise, Spatial Resolution, and Method Assumptions’. *Solar Phys.*, **260**, 83–108.
- [28] DeRosa, M. L., C. J. Schrijver, G. Barnes, K. D. Leka, B. W. Lites, M. J. Aschwanden, T. Amari, A. Canou, J. M. McTiernan, S. Régnier, J. K. Thalmann, G. Valori, M. S. Wheatland, T. Wiegmann, M. C. M. Cheung, P. A. Conlon, M. Fuhrmann, B. Inhester and T. Tadesse: 2009 ‘A Critical Assessment of NonLinear Force-Free Field Modeling of the Solar Corona for a Recent Solar Active Region’. *Astrophys. J.*, **696**, 1780–1791.

- [29] Longcope, D. W., G. Barnes and C. Beveridge: 2009, ‘Effects of Partitioning and Extrapolation on the Connectivity of Potential Magnetic Fields’. *Astrophys. J.*, **693**, 97–111.
- [30] Barnes, G. and K. D. Leka: 2008, ‘Evaluating the Performance of Solar Flare Forecasting Methods’. *Astrophys. J. Letters*, **688**, L107–L110.
- [31] Schrijver, C. J., M. L. DeRosa, T. R. Metcalf, G. Barnes, B. Lites, T. Tarbell, J. McTiernan, G. Valori, T. Wiegmann, M. S. Wheatland, T. Amari, G. Aulanier, P. Démoulin, M. Fuhrmann, K. Kusano, S. Régnier and J. K. Thalmann: 2008 ‘Non-Linear Force-Free Modeling of a Solar Active Region Around the Time of a Major Flare and Coronal Mass Ejection’. *Astrophys. J.*, **675**, 1637–1644.
- [32] Metcalf, T. R., M. L. DeRosa, C. J. Schrijver, G. Barnes, A. A. van Ballegooijen, T. Wiegmann, M. S. Wheatland, G. Valori and J. M. McTiernan: 2008 ‘Non-Linear Force-Free Modeling of Coronal Magnetic Fields. II. Modeling a Filament Arcade from Simulated Chromospheric and Photospheric Vector Fields’. *Solar Phys.*, **247**, 269–299.
- [33] Crouch, A. D. and G. Barnes: 2008 ‘Resolving the Azimuthal Ambiguity in Vector Magnetogram Data with the Divergence-Free Condition: Theoretical Examination’. *Solar Phys.*, **247**, 25–37.
- [34] Barnes, G.: 2007, ‘On the Relationship Between Coronal Magnetic Null Points and Solar Eruptive Events’. *Astrophys. J. Letters*, **670**, L53–L56.
- [35] Longcope, D. W., C. Beveridge, J. Qiu, B. Ravindra, G. Barnes, and S. Dasso: 2007, ‘Modeling and Measuring the Flux Reconnected by the Two-ribbon Flare/CME Event on 7 November 2004’. *Solar Phys.*, **244**, 45–73.
- [36] Longcope, D. W., B. Ravindra and G. Barnes: 2007, ‘Determining the Source of Coronal Helicity through Measurements of Braiding and Spin Helicity Fluxes in Active Regions’. *Astrophys. J.*, **668**, 571–585.
- [37] Barnes, G., K. D. Leka, E. A. Schumer, and D. J. Della-Rose: 2007, ‘Probabilistic Forecasting of Solar Flares from Vector Magnetogram Data’. *Space Weather J.*, **5**, S09002.
- [38] Leka, K. D. and G. Barnes: 2007, ‘Photospheric Magnetic Field Properties of Flaring Versus Flare-Quiet Active Regions IV: A Statistically Significant Sample’. *Astrophys. J.*, **656**, 1173–1186.
- [39] Metcalf, T. R., K. D. Leka, G. Barnes, B. W. Lites, M. K. Georgoulis, A. A. Pevtsov, G. A. Gary, J. Jing, K. S. Balasubramaniam, J. Li, Y. Liu, H. N. Wang, V. Abramenko, V. Yurchyshyn, and Y.-J. Moon: 2006, ‘An Overview of Existing Algorithms for Resolving the 180° Ambiguity in Vector Magnetic Fields: Quantitative Tests with Synthetic Data’. *Solar Phys.*, **237**, 267–296.
- [40] Barnes, G. and K. D. Leka: 2006, ‘Photospheric Magnetic Field Properties of Flaring Versus Flare-Quiet Active Regions III: Magnetic Charge Topology Models’. *Astrophys. J.*, **646**, 1303–1318.

- [41] Barnes, G., K. D. Leka, and M. S. Wheatland: 2006, ‘Quantifying the Performance of Force-Free Extrapolation Methods Using Known Solutions’. *Astrophys. J.*, **641**, 1188–1196.
- [42] Barnes, G., D. W. Longcope, and K. D. Leka: 2005, ‘Implementing a Magnetic Charge Topology Model for Solar Active Regions’. *Astrophys. J.* **629**, 561–571.
- [43] Leka, K. D., Y. Fan, and G. Barnes: 2005, ‘On the Availability of Sufficient Twist in Solar Active Regions to Trigger the Kink Instability’. *Astrophys. J.* **626**, 1091–1095.
- [44] Leka, K. D. and G. Barnes: 2003b, ‘Photospheric Magnetic Field Properties of Flaring Versus Flare-Quiet Active Regions II: Discriminant Analysis’. *Astrophys. J.* **595**, 1296–1306.
- [45] Leka, K. D. and G. Barnes: 2003a, ‘Photospheric Magnetic Field Properties of Flaring Versus Flare-Quiet Active Regions I: Data, General Approach, and Sample Results’. *Astrophys. J.* **595**, 1277–1295.
- [46] Barnes, G. and K. B. MacGregor: 2003, ‘Angular Momentum Transport Between a T Tauri Star and an Accretion Disk’. In: A. Brown, G. M. Harper, and T. R. Ayres (eds.): *The Future of Cool-Star Astrophysics*. pp. 747–753.
- [47] Barnes, G. and P. S. Cally: 2001, ‘Frequency Dependent Ray Paths in Local Helioseismology’. *Proc. Astron. Soc. Aust.* **18**, 243–251.
- [48] Barnes, G. and P. S. Cally: 2000, ‘Mode Mixing by a Shallow Sunspot’. *Solar Phys.* **193**, 373–382.
- [49] Barnes, G. and K. B. MacGregor: 1999, ‘On the magnetohydrodynamics of a conducting fluid between two flat plates’. *Physics of Plasmas* **6**, 3030–3046.
- [50] Barnes, G., P. Charbonneau, and K. B. MacGregor: 1999, ‘Angular Momentum Transport in Magnetized Stellar Radiative Zones. III. The Solar Light-Element Abundances’. *Astrophys. J.* **511**, 466–480.
- [51] Barnes, G., P. Charbonneau, and K. B. MacGregor: 1998, ‘Angular Momentum Transport in Magnetized Stellar Radiative Zones: The Solar Light Element Abundances’. In: R. A. Donahue and J. A. Bookbinder (eds.): *ASP Conf. Ser. 154: Cool Stars, Stellar Systems, and the Sun*. p. 886.
- [52] Barnes, G., K. B. MacGregor, and P. Charbonneau: 1998, ‘Gravity Waves in a Magnetized Shear Layer’. *Astrophys. J. Letters* **498**, L169–L172.

Recent Presentations

- [1] Lecture: “Disambiguation Techniques”, HAO/NSO Spectropolarimetry School, 2022
- [2] Invited talk: “Recent Progress on Understanding Coronal Mass Ejection/Flare Onset by a NASA Living with a Star Focused Science Team”, ISWAT-COSPAR, 2022
- [3] Contributed talk: “Is the coronal magnetic topology of Potential Field Source Surface models robust to boundary conditions from different Surface Flux Transport models?”, TESS, 2022

- [4] Contributed talk: “Forecasting Solar Flares for the Ionosphere”, TESS, 2022
- [5] Poster: “Is the coronal magnetic topology of Potential Field Source Surface models robust to boundary conditions from different Surface Flux Transport models?”, SHINE Workshop, 2022
- [6] Invited talk: “Validation Methods and Tools: Some Lessons Learned from Flare Forecasting”, ISWAT-COSPAR, 2021
- [7] Invited talk: “Validation Methods and Tools”, SOLSTICE (NASA DRIVE Science Center) Science Seminar, 2021
- [8] Discussant: “Statistical and Machine Learning Efforts on Solar Flare Predictions”, Joint Statistical Meeting, 2021
- [9] Poster: “Are Potential Field Source Surface models from different magnetic maps sufficiently robust to track the evolution of the coronal magnetic topology?”, SPD Meeting, 2021
- [10] Poster: “Attempting to Estimate the Lorentz Force Vector at the Photosphere”, Solar Polarization Workshop 9
- [11] Poster: “Understanding the Where and the How Big of Solar Flares”, SHINE Workshop, 2019
- [12] Co-Organizer: “A Potential Field is Unique...Right?!?”, SHINE Workshop, 2019
- [13] Poster: “To what degree do regions of open flux located near active regions affect their eruptivity?”, IAU Symposium 354
- [14] Invited talk: “Global Boundary Magnetic Field Optimization for Coronal and Solar Wind Models”, Space Weather Week, 2019