

Until January 2021, Prof. McMillan led the [SPACEWATCH](#)® Project which recovers and makes astrometric observations of Near-Earth Objects (NEOs). He stepped down from that leadership role, but continues as a co-investigator with that Project. He has also been a Co-Investigator on the Science Team of the NEO Wide-field Infrared Survey Explorer (NEOWISE) spacecraft mission that surveyed the sky in the near-infrared. The Spacewatch Project's role for that mission continues to be follow-up observations of asteroids and comets detected by that spacecraft.

McMillan's career has included studies of variable stars, statistics of stellar populations, interstellar dust, interstellar magnetic fields, planetary atmospheres, Doppler shift spectroscopy of stars, astronomical instrumentation, and surveys of asteroids. He has worked in the last four disciplines from 1979 to the present while at the Lunar and Planetary Laboratory at the University of Arizona. Some of McMillan's peer-reviewed first-author papers from the 1970s were still being cited and used as many as 40 years later.

McMillan's 1981-2001 radial velocity (RV) group at LPL was the first to publish stellar Doppler shift measurements better than ± 20 meters per second (m/s) in a refereed journal. They also made the first reliable detection of p-mode oscillations in a star other than the Sun (Arcturus), discovered the spectroscopic binary of then-longest known period, and established a new upper limit on the RV stability of the Sun observed as a point source. That limit was published in 1993, has been widely cited, and was confirmed independently as recently as 2016 by other unaffiliated investigators. McMillan also further investigated techniques to measure the RVs of stars in ways that minimize confusion of Doppler shift measurements by effects intrinsic to stellar atmospheres. He returned to the field in 2007 as a collaborator with a group from the U. S. Naval Observatory who used a dispersed Fourier Transform Spectrometer to measure the RVs of binary stars with the 2.3-meter Bok Telescope of the Steward Observatory.

As Co-Investigator, Deputy Principal Investigator, Project Scientist, and Project Manager of Prof. Tom Gehrels' Spacewatch Project from 1980-1997, McMillan guided the physical realization of CCD surveying as a productive method of exploring the solar system for asteroids and comets. McMillan became the Principal Investigator of Spacewatch in mid-1997. In 2000 McMillan discovered large Trans-Neptunian Object 2000 WR106, now known as Minor Planet (20000) Varuna. On 2005 Dec 28 he discovered minor planet 2005 YU55, a 300-meter diameter Earth-crossing asteroid that made a close approach to Earth on 2011 Nov 8. McMillan also discovered comets 208P and P/2010 J3.

The Spacewatch 1.8-m telescope was completed in 2002 and the 0.9-m telescope of Steward Observatory was completely rebuilt with all new optics and detectors under McMillan's leadership. The 0.9-m telescope was fully automated in 2006. The 1.8-m telescope received a new imaging camera in 2011 October, which increased the rate of observations by 50% and improved astrometric accuracy by a factor of 2. In 2015 October, the Spacewatch Project further boosted its rate of observations with a new CCD camera at the cassegrain focus of the Bok 2.3-meter telescope of the Steward Observatory and converting the operation of the Spacewatch 0.9-meter telescope from surveying to targeted followup observations.

Education:

B.S. in Astronomy with High Honors, Case Institute of Technology, Cleveland, OH, June 1972.

Senior Thesis Title: *Absolute Magnitudes Determined from the Catalogue of Bright Stars.*

M.A. in Astronomy 1974, University of Texas at Austin.

M. A. Thesis Title: *Intracluster Dust and the Wavelength Dependence of Interstellar Polarization.*

Ph.D. in Astronomy December 1977, University of Texas at Austin.

Ph.D. Dissertation Title: *New Constraints on the Composition of Interstellar Grains from Observations of Extinction and Polarization.*

Position Presently Held:

Adjunct Research Professor (retired), Lunar & Planetary Laboratory and Steward Observatory, 2020 to the present.

Past Positions:

Associate Research Scientist & earlier titles, Lunar and Planetary Laboratory, 1979-2020.

Associate Research Scientist (joint appointment), Steward Observatory, 1998-2020.

NAS- NRC Research Associate, NASA/Marshall Space Flight Center, 1977-79;

Teaching Assistant, Dept. of Astronomy, Univ. of Texas at Austin, 1973-77;

Research Assistant, McDonald Observatory, 1972-73;

Research Assistant, Warner & Swasey Observatory, Case Institute of Technology, Summer 1972;

Planetarium Lecturer, Ralph Mueller Planetarium, Cleveland Museum of Natural History, Summer 1972;

Research Assistant, National Radio Astronomy Observatory, Summer 1971;

Research Assistant, Kitt Peak National Observatory, Summer 1970;

Tutor, Math Dept., Case Western Reserve University, 1969-70;

Volunteer Assistant, Ralph Mueller Planetarium, Cleveland Museum of Natural History, 1968-69.

Doctoral Dissertation Student: William J. Merline, whose dissertation title is: *Observations of Small-Amplitude Oscillations in the Radial Velocity of Arcturus.* © 1995, The University of Arizona.

Memberships: AAS since 1971, AAS/DPS; IAU since 1988 (Formerly Commissions 20 & 30, presently Divisions A and F); SPIE since 1984.

Honors & Awards: Shared NASA Group Achievement Awards for the Wide-field Infrared Survey Explorer mission and the Near-Earth Object Observation Team.

Professional Service on:

NASA Task Force for the Scientific Use of the Space Station (1984-1986).

NASA Proposal for an orbiting Astrometric Imaging Telescope for detection of extrasolar planets (1984-1992).
NASA Working Group: Towards Other Planetary Systems (1992).
NASA proposal review panels (1992-2001).
NASA/JPL Team to develop Road Map to Detect Terrestrial Extrasolar Planets, 1995.
NASA Study to Determine the Feasibility of Extending the Search for Near-Earth Objects to Smaller Limiting Diameters (2002-2003).
Team for Phase B of the U. S. Naval Observatory's proposed mission entitled "Origins Billions-Star Survey: Galactic Explorer", 2004-2006.

Mail-in reviews of proposals to NASA and NSF for funding, 1984-present.
Refereed papers submitted to *Astrophysical Journal*, *Astrophysical Journal Letters*, *Astronomical Journal*, *Icarus*, *Journal of the Optical Society of America*, and *Monthly Notices of the Royal Astronomical Society*.
Served on Lunar & Planetary Laboratory committees for Library, Computing, Strategic Planning, and Recruitment.
Served on Steward Observatory committee for Strategic Planning for Small Ground-based Telescopes (2019).
Served on Telescope Allocation Committees of Steward and Keck Observatories.
Served on NASA panel reviewing the Minor Planet Center of the International Astronomical Union (2015).

Publications:

First-author, Peer-Reviewed:

- McMillan *et al.* (2026) 2026JAnSc..73...34M McMillan, R. S., Brucker, M. J., Lejoly, C., Larsen, J. A. 2026. SPACEWATCH Astrometry of Near-Earth Asteroids for Planetary Defense. *Journal of the Astronautical Sciences* 73. doi:10.1007/s40295-026-00575-1
- McMillan *et al.* (2010) 2010MPEC....J..103M McMillan, R. S. and 17 colleagues 2010. Comet C/2010 J3 (McMillan). *Minor Planet Electronic Circulars* 2010-J103.
- McMillan *et al.* (2008) 2008MPEC....U...29M McMillan, R. S. and 13 colleagues 2008. Comet P/2008 U1 (McMillan). *Minor Planet Electronic Circulars* 2008-U29.
- McMillan *et al.* (2005) 2005MPBu...32...53M McMillan, R. S., Block, M., Descour, A. S. 2005. The Spacewatch volunteer search for fast moving objects. *Minor Planet Bulletin* 32, 53.
- McMillan *et al.* (1994) 1994Ap&SS.212..271M McMillan, R. S., Moore, T. L., Perry, M. L., Smith, P. H. 1994. Long, Accurate Time Series Measurements of Radial Velocities of Solar-Type Stars. *Astrophysics and Space Science* 212, 271–280. doi:10.1007/BF00984531
- McMillan *et al.* (1993) 1993ApJ...403..801M McMillan, R. S., Moore, T. L., Perry, M. L., Smith, P. H. 1993. Radial Velocity Observations of the Sun at Night. *The Astrophysical Journal* 403, 801. doi:10.1086/172251

- McMillan *et al.* (1992) 1992PASP..104.1173M McMillan, R. S., Smith, P. H., Moore, T. L., Perry, M. L. 1992. Variation of the Radial Velocity of Epsilon Cygni A. Publications of the Astronomical Society of the Pacific 104, 1173. doi:10.1086/133105
- McMillan and Smith(1987) 1987PASP...99..849M McMillan, R. S., Smith, P. H. 1987. Nonvariability of the radial velocity of eta Cassiopeiae A.. Publications of the Astronomical Society of the Pacific 99, 849–851. doi:10.1086/132047
- McMillan *et al.* (1987) 1987LNP...274..264M McMillan, R. S., Smith, P. H., Merline, W. J. 1987. A Periodic Variation in the Radial Velocity of Arcturus. Stellar Pulsation 264. doi:10.1007/3-540-17668-3_218
- McMillan and Tapia(1978) 1978ApJ...226L..87M McMillan, R. S., Tapia, S. 1978. Discovery of polarized light scattered by dust around Alpha Orionis.. The Astrophysical Journal 226, L87–L89. doi:10.1086/182837
- McMillan(1978) 1978ApJ...225..880M McMillan, R. S. 1978. Predicted color excess ratios versus interstellar grain size.. The Astrophysical Journal 225, 880–886. doi:10.1086/156552
- McMillan(1978) 1978ApJ...225..417M McMillan, R. S. 1978. Are long wavelengths of maximum interstellar polarization due to water ice mantles on grains?. The Astrophysical Journal 225, 417–421. doi:10.1086/156503
- McMillan(1977) 1977ApJ...216L..41M McMillan, R. S. 1977. Walker No. 67 in NGC 2264: a candidate for strong interstellar circular polarization.. The Astrophysical Journal 216, L41. doi:10.1086/182505
- McMillan and Tapia(1977) 1977ApJ...212..714M McMillan, R. S., Tapia, S. 1977. The wavelength dependence of polarization in the Cygnus OB2 association: a new determination of interstellar birefringence. The Astrophysical Journal 212, 714–722. doi:10.1086/155096
- McMillan(1977) 1977PhDT.....19M McMillan, R. S. 1977. New Constraints on the Composition of Interstellar Grains from Observations of Extinction and Polarization.. Ph.D. Thesis.
- McMillan(1976) 1976AJ.....81..970M McMillan, R. S. 1976. Interstellar polarization in front of the young cluster NGC 7380. The Astronomical Journal 81, 970. doi:10.1086/111977
- McMillan *et al.* (1976) 1976PASP...88..495M McMillan, R. S., Breger, M., Ferland, G. J., Loumos, G. L. 1976. A survey for small-amplitude variability among population II stars.. Publications of the Astronomical Society of the Pacific 88, 495–509. doi:10.1086/129975

Co-Author, Peer-Reviewed:

Brucker, M. J., Larsen, J. A., Mastaler, R. A., Bressi, T. H., Read, M. T., McMillan, R. S. 2022. Spacewatch 0.9m Mosaic Camera Survey. Planetary Data System Small Bodies Node data archive. DOI: 10.26033/vg18-0670. <https://sbn.psi.edu/pds/resource/sw.html>

Larsen *et al.* (2014) 2014MPBu...41...68L Larsen, J. A., McMillan, R. S., Bressi, T. H., Scotti, J. V. 2014. The Lightcurve of 3753 Cruithne. *Minor Planet Bulletin* 41, 68–69.

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Behr *et al.* (2011) 2011AJ....142....6B Behr, B. B. and 6 colleagues 2011. Stellar Astrophysics with a Dispersed Fourier Transform Spectrograph. II. Orbits of Double-lined Spectroscopic Binaries. *The Astronomical Journal* 142. doi:10.1088/0004-6256/142/1/6

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Hajian *et al.* (2007) 2007ApJ...661..616H Hajian, A. R. and 17 colleagues 2007. Initial Results from the USNO Dispersed Fourier Transform Spectrograph. *The Astrophysical Journal* 661, 616–633. doi:10.1086/513181

Larsen *et al.* (2007) 2007AJ....133.1247L Larsen, J. A. and 15 colleagues 2007. The Search for Distant Objects in the Solar System Using Spacewatch. *The Astronomical Journal* 133, 1247–1270. doi:10.1086/511155

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Wisniewski *et al.* (1997) 1997Icar..126..395W Wisniewski, W. Z., Michalowski, T. M., Harris, A. W., McMillan, R. S. 1997. Photometric Observations of 125 Asteroids. *Icarus* 126, 395–449. doi:10.1006/icar.1996.5665

Lawrence *et al.* (1991) 1991OptEn..30..598L Lawrence, G. N., Huang, C., Levy, E. H., McMillan, R. S. 1991. High accuracy image centroiding with a moving Ronchi ruling. *Optical Engineering* 30, 598–608. doi:10.1117/12.55840

Black *et al.* (1991) 1991Ap&SS.177..307B Black, D. and 9 colleagues 1991. The Astrometric Telescope Facility. *Astrophysics and Space Science* 177, 307–313. doi:10.1007/BF00643696

Smith *et al.* (1987) 1987ApJ...317L..79S Smith, P. H., McMillan, R. S., Merline, W. J. 1987. Evidence for Periodic Radial Velocity Variations in Arcturus. *The Astrophysical Journal* 317, L79. doi:10.1086/184916

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Gehrels *et al.* (1986) 1986AJ.....91.1242G Gehrels, T., Marsden, B. G., McMillan, R. S., Scotti, J. V. 1986. Astrometry with a scanning CCD. *The Astronomical Journal* 91, 1242. doi:10.1086/114098

Moneti *et al.* (1984) 1984ApJ...282..508M Moneti, A., Pipher, J. L., Helfer, H. L., McMillan, R. S., Perry, M. L. 1984. Magnetic field structure in the Taurus dark cloud. *The Astrophysical Journal* 282, 508–515. doi:10.1086/162228

Tomasko *et al.* (1980) 1980JGR....85.5891T Tomasko, M. G., McMillan, R., Doose, L. R., Castillo, N. D., Dille, J. P. 1980. Photometry of Saturn at Large Phase Angles. *Journal of Geophysical Research* 85, 5891–5903. doi:10.1029/JA085iA11p05891

Gehrels *et al.* (1980) 1980Sci...207..434G Gehrels, T. and 22 colleagues 1980. Imaging Photopolarimeter on Pioneer Saturn. *Science* 207, 434–439. doi:10.1126/science.207.4429.434

Duthie and McMillan(1979) 1979ApJ...232..255D Duthie, J. G., McMillan, R. S. 1979. An upper limit on ultraviolet shot noise from Cygnus X-1. *The Astrophysical Journal* 232, 255–258. doi:10.1086/157284

Oskanyan *et al.* (1977) 1977ApJ...214..430O Oskanyan, V. S., Evans, D. S., Lacy, C., McMillan, R. S. 1977. An analysis of the slow light variability of BY Draconis. *The Astrophysical Journal* 214, 430–436. doi:10.1086/155268

Bopp *et al.* (1973) 1973ApJ...186L.123B Bopp, B. W., Grupsmith, G., McMillan, R. S., Vanden Bout, P. A., Wootten, H. A. 1973. Spectroscopic Observations of HZ Herculis. II.

The Astrophysical Journal 186, L123. doi:10.1086/181372

McCuskey and McMillan(1973) 1973AJ.....78...73M McCuskey, S. W., McMillan, R. S. 1973. Mean absolute magnitudes and dispersions for selected spectral groups. The Astronomical Journal 78, 73. doi:10.1086/111375

First-Author full articles, not peer-reviewed:

McMillan and Spacewatch Team(2007) 2007IAUS..236..329M McMillan, R. S., Spacewatch Team 2007. Spacewatch preparations for the era of deep all-sky surveys. *Near Earth Objects, our Celestial Neighbors: Opportunity and Risk* 236, 329–340. doi:10.1017/S1743921307003407

McMillan(2005) 2005M&PS...40..509M McMillan, R. S. 2005. Review of *Mitigation of hazardous comets and asteroids*, edited by M. J. S. Belton, T. H. Morgan, N. Samarasinha, and D. K. Yeomans. *Meteoritics and Planetary Science* 40, 509. doi:10.1111/j.1945-5100.2005.tb00397.x

McMillan *et al.* (2001) 2001ccno.conf....7M McMillan, R. S. and 10 colleagues 2001. A Progress Report on Spacewatch. *International Workshop on Collaboration and Coordination among NEO Observers and Orbital Computers* held at Kurshiki City Art Museum, 7–10.

McMillan(1999) 1999LPICo.988...15M McMillan, R. S. 1999. Spacewatch Discovery and Study of Accessible Asteroids. *Space Resources Utilization Roundtable 988*, 15.

McMillan *et al.* (1999) 1999ASPC..185..278M McMillan, R. S., Bressi, T. H., Montani, J. L., Moore, T. L., Perry, M. L., Tubbiolo, A. F. 1999. The Value of Fabry-Perot Interferometry in Studying Long-Term Convective Line Shifts. *IAU Colloquium 170: Precise Stellar Radial Velocities* 185, 278.

McMillan *et al.* (1990) 1990SPIE.1235..601M McMillan, R. S., Smith, P. H., Perry, M. L., Moore, T. L., Merline, W. J. 1990. Long-term stability of a Fabry-Perot interferometer used for measurement of stellar Doppler shift. *Instrumentation in Astronomy VII* 1235, 601–609. doi:10.1117/12.19123

McMillan and Smith(1988) 1988ASSL..144...91M McMillan, R. S., Smith, P. H. 1988. A Radial Velocity Search for Extrasolar Planets. *IAU Colloquium 99: Bioastronomy - The Next Steps* 144, 91. doi:10.1007/978-94-009-2959-3_13

McMillan *et al.* (1988) 1988ASPC....3..237M McMillan, R. S., Perry, M. L., Smith, P. H., Merline, W. J. 1988. The optical fiber feed of the LPL radial velocity spectrometer. *Fiber Optics in Astronomy* 3, 237–246.

McMillan *et al.* (1986) 1986SPIE..627..141M McMillan, R. S., Scotti, J. V., Frecker, J. E., Gehrels, T., Perry, M. L. 1986. Use of a scanning CCD to discriminate asteroid images moving in a field of stars. *Instrumentation in astronomy VI* 627, 141–154.

doi:10.1117/12.968084

McMillan *et al.* (1986) 1986SPIE..627....2M McMillan, R. S., Smith, P. H., Frecker, J. E., Merline, W. J., Perry, M. L. 1986. A Fabry-Perot interferometer for accurate measurement of temporal changes in stellar Doppler shift. *Instrumentation in astronomy VI* 627, 2–19. doi:10.1117/12.968068

McMillan *et al.* (1986) 1986IAUS..118..459M McMillan, R. S., Smith, P. H., Frecker, J. E., Merline, W. J., Perry, M. L. 1986. A Long-term Radial Velocity Program of High Accuracy with a Small Telescope. *Instrumentation and Research Programmes for Small Telescopes* 118, 459.

McMillan *et al.* (1985) 1985srv..conf..63M McMillan, R. S., Smith, P. H., Frecker, J. E., Merline, W. J., Perry, M. L. 1985. The LPL Radial Accelerometer. *Stellar Radial Velocities*, 63–86.

McMillan and Stoll(1982) 1982SPIE..331..104M McMillan, R. S., Stoll, C. P. 1982. Software simulations of the detection of rapidly moving asteroids by a charge-coupled device. *Instrumentation in Astronomy IV* 331, 104–112. doi:10.1117/12.933445

McMillan and Kirszenberg(1972) 1972S&T....44..300M McMillan, R. S., Kirszenberg, J. D. 1972. A Modern Version of the Ole Roemer Experiment. *Sky and Telescope* 44, 300.

Co-author of full articles, not refereed:

Lejoly *et al.* (2025) 2025epsc.conf..481L Lejoly, C. and 8 colleagues 2025. SPACEWATCH®: Following up Near-Earth Objects (NEOs) to help Determine their Orbits. EPSC-DPS Joint Meeting 2025 2025. doi:10.5194/epsc-dps2025-481

Pravec *et al.* (2021) 2021plde.confE..24P Pravec, P. and 13 colleagues 2021. Photometric Observations of the Unrelaxed Binary Near-Earth Asteroid (35107) 1991 VH in Support of the NASA Janus Space Mission - Detection of a Spin-Orbit Interaction. 7th IAA Planetary Defense Conference.

Scheirich *et al.* (2019) 2019arXiv191206456S Scheirich, P. and 36 colleagues 2019. A satellite orbit drift in binary near-Earth asteroids (66391) 1999 KW4 and (88710) 2001 SL9 -- Indication of the BYORP effect. arXiv e-prints. doi:10.48550/arXiv.1912.06456

Brucker *et al.* (2019) 2019LPICo2189.2005B Brucker, M. J. and 7 colleagues 2019. SPACEWATCH(R) Observations of High Priority Near-Earth Asteroids. Asteroid Science in the Age of Hayabusa2 and OSIRIS-REx 2189.

Mainzer *et al.* (2015) 2015hchp.book..583M Mainzer, A. and 10 colleagues 2015. Space-Based Infrared Discovery and Characterization of Minor Planets with NEOWISE. *Handbook of Cosmic Hazards and Planetary Defense* 583–611. doi:10.1007/978-3-319-03952-7 _41

Mainzer *et al.* (2012) 2012LPICo1667.6087M Mainzer, A. and 7 colleagues 2012. Small Body Science with WISE/NEOWISE: An Update. *Asteroids, Comets, Meteors 2012* 1667.

Mainzer *et al.* (2011) 2011epsc.conf.1530M Mainzer, A. and 7 colleagues 2011. The NEOWISE Project: Recent Results. *EPSC-DPS Joint Meeting 2011* 2011, 1530.

Masiero *et al.* (2011) 2011epsc.conf..182M Masiero, J. and 12 colleagues 2011. Investigating Main Belt asteroids with WISE/NEOWISE. *EPSC-DPS Joint Meeting 2011* 2011, 182.

Mainzer *et al.* (2011) 2011arXiv1105.0975M Mainzer, A. and 9 colleagues 2011. Thermal Model Calibration for Minor Planets Observed with WISE/NEOWISE. *arXiv e-prints*. doi:10.48550/arXiv.1105.0975

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Haskell *et al.* (2008) 2008LPICo1405.8250H Haskell, H. T., Larsen, J. A., McMillan, R. S., Spacewatch Team 2008. The Size Distribution of Small Earth Approaching Asteroids. *Asteroids, Comets, Meteors 2008* 1405.

Perry *et al.* (1998) 1998SPIE.3351..450P Perry, M. L., Bressi, T., McMillan, R. S., Tubbiolo, A., Barr, L. D. 1998. 1.8-m Spacewatch telescope motion control system. *Telescope Control Systems III* 3351, 450–465. doi:10.1117/12.308809

Gatewood *et al.* (1997) 1997ASPC..119...41G Gatewood, G. and 7 colleagues 1997. The Multi-Channel Astrometric Photometer with Spectrograph: A New Instrument for the Characterization of Extra-Solar Planetary Systems. *Planets Beyond the Solar System and the Next Generation of Space Missions* 119, 41.

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Huang *et al.* (1989) 1989cdoe.conf..148H Huang, C.-S., Lawrence, G., Levy, E., McMillan, R. 1989. Design analysis of the astrometrical telescope facility. *Conference on Current Developments in Optical Engineering III as Part of the Conference on Optical Engineering in Conjunction with SPIE's 32. Annual International Technical Symposium on Optical and Optoelectronic Applied Science and Engineering*, 148–161.

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Gatewood *et al.* (1988) 1988IAUS..133..421G Gatewood, G. and 6 colleagues 1988. A prototype detector for the astrometric telescope facility. *Mapping the Sky: Past Heritage and Future Directions* 133, 421–424.

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Huang *et al.* (1987) 1987SPIE..818..408H Huang, C., Lawrence, G. N., Levy, E. H., McMillan, R. S. 1987. Performance analysis of the multichannel astrometric photometer.. Current developments in optical engineering II 818, 408–418. doi:10.1117/12.978914

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