

TERRENCE R. MEYER

Professor, Purdue University

School of Mechanical Engineering and School of Aeronautics and Astronautics (by courtesy)

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Career Experience

- 2015-present Professor, Mechanical Engineering, Aeronautics and Astronautics (by courtesy), Purdue University, West Lafayette, IN
- Research in aerothermal flows, hypersonics, combustion, and energetics
 - Development of burst-mode kHz-MHz 2D/3D imaging and spectroscopy
- 2010-2020 Guest Professor, Graduate School in Advanced Optical Technologies, Alexander-Friedrich University, Erlangen-Nuremberg, Germany
- High-speed imaging of combustion species using custom tunable laser sources
- 2006-2015 Associate Professor (2012-2015), William and Virginia Binger Assistant Professor (2011-2012), and Assistant Professor (2006-2011), Department of Mechanical Engineering, Iowa State University, Ames, IA
- Diagnostics for multiphase combustion phenomena and high-speed flows
- 2000-2006 Sr. Research Engineer, Innovative Scientific Solutions, Inc., Dayton, OH
- Research in combustion diagnostics for air breathing propulsion engines
 - High-speed laser-based fluorescence, absorption, and coherent Raman
- 2001-2004 Visiting Assistant Professor, EM2C, École Centrale Paris, France
- Particle velocimetry and CH fluorescence in multiphase counterflow flames
- 1994-2000 Graduate Research Assistant, Mechanical Engineering, University of Illinois, Urbana-Champaign, IL (MS earned in 1997, PhD earned in 2001)
- Tracer fluorescence of molecular-scale mixing in turbulent shear layers

Research

Prof. Meyer specializes in advanced multiphase and reacting flow diagnostics for propulsion, high-speed flows, and energetic systems. This includes coherent Raman, fluorescence, phosphorescence, x-ray radiography, scattering techniques, and molecular tagging velocimetry, among others. Applications include measurements in flows related to gas-turbine combustors, rotating detonation engines, rocket injectors, spray-combustion phenomena, novel energetic materials, and hypersonic flows.

Awards

- Editor's Pick, Optics Letters (2020, 2019) and Applied Optics (2019)
- Chair and Vice Chair, Gordon Research Conference on Laser Diagnostics in Energy and Combustion Science (2017-2023)
- Co-Chair, International Constant Volume and Detonation Combustion Workshop, Purdue University (2019)
- Awards Chair (2021-present) and Technical Chair (2018-2019), Aerodynamic Measurement Technology (AMT) Committee, AIAA Science and Technology Forum and Exposition
- Purdue University list of Outstanding Engineering Teachers (2016, 2018, 2019, 2020)
- Fellow, American Society of Mechanical Engineers (2017)

- Awardee, NSF CAREER Award, Combustion, Fire, and Plasma Systems (2011-2017)
- Best Student Presentation, 25th Annual Institute for Liquid Atomization and Spray Systems (ILASS)-Americas Conference (2013)
- Best Paper, Conference on Lasers and Electro-Optics, Active Optical Sensing (2011)
- General Co-Chair (2010-2012), Program Co-Chair (2008-2010), Optical Society of America Topical Meeting on Laser Applications to Chemical, Security, and Environmental Analysis
- Young Researcher Award and Guest Professorship, Erlangen Graduate School in Advanced Optical Technologies (SAOT) (2010)
- Chair (2009-2010) and Vice-Chair (2008-2009), Optical Society of America Conference on Lasers and Electro-Optics, Subcommittee on Active Optical Sensing
- Cover feature, Applied Optics (2003), Applied Spectroscopy (2007), Applied Optics (2009)
- Associate Fellow, American Institute of Aeronautics and Astronautics (2006)
- AIAA Dayton-Cincinnati Section Outstanding Technical Contribution Award (2003)
- AIAA Foundation Graduate Award in Fluid Dynamics (based on PhD dissertation) (2001)
- Regents of the University of Minnesota Service Award (1992)
- Tau Beta Pi (1990)

Other Relevant Accomplishments

- 110+ journal articles and 2 book chapters, h-index 41, i10-index 95, and 4500+ citations
- 35+ invited lectures, 325+ conference papers and presentations
- Reviewer for 20+ journals and numerous technical symposia
- Advised or advising 33 PhD, 22 MS, 65+ UG, and 4 post-doctoral researchers
- Research grants of over \$30M, with \$14M as PI and \$14M as Meyer's share

Journal Publications

1. J.M. Fisher, M.N. Slipchenko, and T.R. Meyer, "Grid-based femtosecond laser electronic excitation tagging for single-ended velocity field measurements," Applied Optics, Accepted for publication, 2021.
2. D.K. Lauriola, P.S. Hsu, N. Jiang, M.N. Slipchenko, T.R. Meyer, and S. Roy, "Burst-mode 100 kHz N₂ ps-CARS flame thermometry with concurrent nonresonant background referencing," Opt. Lett., Accepted for publication, 2021.
3. E.R. Westphal, A.D. Brown, E.C. Quintana, A.L. Kastengren, S.F. Son, T.R. Meyer, and K.N.G. Hoffmeister, "Temperature-dependent X-ray fluorescent response from thermographic phosphors under X-ray excitation," Appl. Phys. Lett. 119(3), 2021; doi.org/10.1063/5.0053469.
4. V. Athmanathan, K.A. Rahman, D. Lauriola, J. Braun, G. Paniagua, M.N. Slipchenko, S. Roy, and T.R. Meyer, "Femtosecond/picosecond rotational coherent anti-Stokes Raman scattering thermometry in the exhaust of a rotating detonation combustor," Combust. Flame 231, 111504, 2021; doi.org/10.1016/j.combustflame.2021.111504.
5. E. Westphal, A. Brown, E. Quintana, A. Kastengren, S. Son, T.R. Meyer, and K. Hoffmeister, "Visible emission spectra of thermographic phosphors under x-ray excitation," Meas. Sci. Technol. 32, 094008, 2021; doi.org/10.1088/1361-6501/abf222.
6. N. Rahman, B. R. Halls, K. E. Matusik, T. R. Meyer, and A. L. Kastengren, "Evaluation of liquid-phase thermometry in impinging jet sprays using synchrotron x-ray scattering," Appl. Opt. 60(11), 2967-2973, 2021; doi.org/10.1364/AO.417796.

7. J. Saavedra, G. Paniagua, F. Lozano, J. Fisher, A. Webb, and T. Meyer, "Flow conditioning system for tri-sonic high pressure aerothermal testing," *Flow Measurement and Instrumentation* 79, 101910, 2021; doi.org/10.1016/j.flowmeasinst.2021.101910.
8. J. Saavedra, V. Athmanathan, G. Paniagua, T. Meyer, D. Straub, J. Black, and S. Ramesh, "Scalable Heat Transfer Characterization on Film Cooled Geometries Based on Discrete Green's Functions," *J. Turbomach.* 143(2), 021005, 2021; doi.org/10.1115/1.4049613.
9. D.K. Lauriola, K.A. Rahman, H.U. Stauffer, M.N. Slipchenko, T.R. Meyer, and S. Roy, "Concentration and pressure scaling of CH₂O electronic-resonance-enhanced coherent anti-Stokes Raman scattering signals," *Appl. Opt.* 60(4), 1051-1058, 2021; doi.org/10.1364/AO.415496.
10. B.R. Halls, N. Rahman, K.E. Matusik, T.R. Meyer, and A.L. Kastengren, "Feasibility of X-ray scattering for tracer-free liquid-phase thermometry for multiphase flows," *Fuel* 290, 120040, 2021; doi.org/10.1016/j.fuel.2020.120040.
11. J.M. Fisher, B.C. Chynoweth, M.E. Smyser, A.M. Webb, M.N. Slipchenko, J.S. Jewell, T.R. Meyer, and S.J. Beresh, "Femtosecond laser electronic excitation tagging velocimetry in a Mach six quiet tunnel," *AIAA J.* 59(2), 768-772, 2021; doi.org/10.2514/1.J059879.
12. D.N. Collard, M.S. McClain, N.A. Rahman, N.H. Dorcy, T.R. Meyer, and S.F. Son , "Dynamic x-ray imaging of additively manufactured reactive components in solid propellants," *J. Propul. Power* 37(3), 2021; doi.org/10.2514/1.B38128.
13. R. Yokoo, K. Goto, J. Kasahara, V. Athmanathan, J. Braun, G. Paniagua, T. Meyer, A. Kawasaki, K. Matsuoka, A. Matsuo, and I. Funaki, "Experimental study of internal flow structures in cylindrical rotating detonation engines," *Proc. Combust. Inst.* 38(3), 3759-3768, 2021; doi.org/10.1016/j.proci.2020.08.001.
14. M.N. Slipchenko, T.R. Meyer, and S. Roy, "Advances in burst-mode laser diagnostics for reacting and nonreacting flows," *Proc. Combust. Inst.* 38(1), 1533-1560, 2021; doi.org/10.1016/j.proci.2020.07.024.
15. J.D. Miller, J.W. Tröger, S.R. Engel, T. Seeger, A. Leipertz, and T.R. Meyer, "CH and NO planar laser-induced fluorescence and Rayleigh-scattering in turbulent flames using multimode optical parametric oscillation," *Appl. Opt.* 60(1), 98-108, 2021; doi.org/10.1364/AO.406237.
16. M.E. Smyser, E.L. Braun, V. Athmanathan, M.N. Slipchenko, S. Roy, and T.R. Meyer, "Dual output fs/ps burst-mode laser for MHz-rate rotational coherent anti-Stokes Raman scattering," *Opt. Lett.* 45(21), 5933-5936, 2020; doi.org/10.1364/OL.404984.
17. J.M. Fisher, A.D. Brown, D.K. Lauriola, M.N. Slipchenko, and T.R. Meyer, "Femtosecond laser activation and sensing of hydroxyl for velocimetry in reacting flows," *Appl. Opt.* 59(34), 10853-10861, 2020; doi.org/10.1364/AO.404788.
18. P.S. Hsu, M.N. Slipchenko, N. Jiang, C.A. Fugger, A.M. Webb, V. Athmanathan, T.R. Meyer, and S. Roy, "Megahertz-rate OH planar laser-induced fluorescence imaging in a rotating detonation combustor," *Opt. Lett.* 45(20), 5776-5779, 2020; doi.org/10.1364/OL.403199.
19. J. Felver, M.N. Slipchenko, E.L. Braun, T.R. Meyer, and Sukesh Roy, "High-energy laser pulses for extended duration MHz-rate flow diagnostics," *Opt. Lett.* 45(16), 4583-4586, 2020; doi.org/10.1364/OL.400831.
20. J.M. Fisher, J. Braun, T. R. Meyer, and G. Paniagua, "Application of femtosecond laser electronic excitation tagging (FLEET) velocimetry in a bladeless turbine," *Meas. Sci. Technol.* 31(6), 064005, 2020; doi.org/10.1088/1361-6501/ab7062.

21. K.A. Rahman, E.L. Braun, M.N. Slipchenko, S. Roy, and T.R. Meyer “Flexible chirp-free probe pulse amplification for kHz fs/ps rotational CARS,” *Opt. Lett.* 45(2), 503-506, 2020; doi.org/10.1364/OL.382033 (Editor’s Pick).
22. J. M. Fisher, M.E. Smyser, M.N. Slipchenko, S. Roy, and T.R. Meyer, “Burst-mode femtosecond laser electronic excitation tagging (FLEET) for kHz–MHz seedless velocimetry,” *Opt. Lett.* 45(2), 335-338, 2020; doi.org/10.1364/OL.380109.
23. M.E. Smyser, M.N. Slipchenko, T.R. Meyer, A.W. Caswell, and S. Roy, “Burst-mode laser architecture for generation of high-peak-power MHz-rate femtosecond pulses,” *OSA Continuum* 2(12), 3490-3498, 2019; doi.org/10.1364/OSAC.2.003490.
24. B.R. Halls, N. Rahman, M.N. Slipchenko, J.W. James, A. McMaster, M.D.A. Lightfoot, J.R. Gord, and T.R. Meyer, “4D spatiotemporal evolution of liquid spray using kilohertz-rate x-ray computed tomography,” *Opt. Lett.* 44(20), 5013-5016, 2019; doi.org/10.1364/OL.44.005013.
25. J.A. Tiarks, C.E. Dedic, T.R. Meyer, R.C. Brown, J.B. Michael, “Visualization of physicochemical phenomena during biomass pyrolysis in an optically accessible reactor,” *Journal of Analytical and Applied Pyrolysis* 143, 104667, 2019; doi.org/10.1016/j.jaap.2019.104667.
26. K.A. Rahman, V. Athmanathan, M.N. Slipchenko, T.R. Meyer, and S. Roy, “Pressure-scaling characteristics of femtosecond, two-photon laser-induced fluorescence of carbon monoxide,” *Appl. Opt.* 58(27), 7458-7465, 2019; doi.org/10.1364/AO.58.007458.
27. A.D. Casey, Z.A. Roberts, A. Satija, R.P. Lucht, T.R. Meyer, and S.F. Son, “Dynamic imaging of the temperature field within an energetic composite using phosphor thermography,” *Appl. Opt.* 58(16), 4320-4325, 2019; doi.org/10.1364/AO.58.004320 (Editor’s Pick).
- A. Douglawi, A. McMaster, M.E. Paciaroni, J.B. Michael, B.R. Halls, J.R. Gord, and T.R. Meyer, “Tracer-free liquid-vapor imaging using lifetime-filtered planar laser-induced fluorescence,” *Opt. Lett.* 44(8), 2101-2104, 2019; doi.org/10.1364/OL.44.002101.
28. Douglawi, V. Athmanathan, M.N. Slipchenko, J.R. Gord, and T.R. Meyer, “Lifetime-filtered laser-induced exciplex fluorescence for crosstalk-free liquid-vapor imaging,” *Opt. Lett.* 44(6), 1399-1402, 2019; doi.org/10.1364/OL.44.001399 (Editor’s Pick).
29. K. Arafat Rahman, V. Athmanathan, M.N. Slipchenko, S. Roy, J.R. Gord, Z. Zhang, and T.R. Meyer, “Quantitative femtosecond, two-photon laser-induced fluorescence of atomic oxygen in high-pressure flames,” *Appl. Opt.* 58(8), 1984-1990, 2019; doi.org/10.1364/AO.58.001984.
30. G. Paniagua, D. Cuadrado, J. Saavedra, V. Andreoli, T. Meyer, J.P. Solano, R. Herrero, S. Meyer, and D. Lawrence, “Design of the Purdue experimental turbine aerothermal laboratory for optical and surface aero-thermal measurements,” *J. Eng. Gas Turbines Power* 141(1), 012601, 2018; doi.org/10.1115/1.4040683.
31. B.R. Halls, J.R. Gord, L.E. Schultz, W.C. Slowman, M.D.A. Lightfoot, S. Roy, and T.R. Meyer, “Quantitative 10-50 kHz X-ray Radiography of Liquid Spray Distributions Using a Rotating-Anode Tube Source,” *Int. J. Multiphas. Flow* 109, 123-130, 2018; doi.org/10.1016/j.ijmultiphaseflow.2018.07.014.
32. H.U. Stauffer, K.A. Rahman, M.N. Slipchenko, S. Roy, J.R. Gord, and T.R. Meyer, “Interference-free hybrid fs/ps vibrational CARS thermometry in high-pressure flames,” *Opt. Lett.* 43(20), 4911-4914, 2018; doi.org/10.1364/OL.43.004911.

33. K.A. Rahman, K.S. Patel, M.N. Slipchenko, T.R. Meyer, Z. Zhang, Y. Wu, J.R. Gord, S. Roy “Femtosecond, two-photon, laser-induced fluorescence (TP-LIF) measurement of CO in high-pressure flames,” *Appl. Opt.* 57(20), 5666-5671, 2018; doi.org/10.1364/AO.57.005666.
34. U. Retzer, R. Pan, T. Werblinski, F.T.J. Huber, M.N. Slipchenko, T.R. Meyer, L. Zigan, S. Will, “Burst-mode OH/CH₂O planar laser-induced fluorescence imaging of the heat release zone in an unsteady flame,” *Opt. Express* 26(14), 18105-18114, 2018; doi.org/10.1364/OE.26.018105.
35. R. Halls, P. S. Hsu, S. Roy, T. R. Meyer, and J. R. Gord, “Two-color volumetric laser-induced fluorescence of OH and temperature in turbulent reacting flows,” *Opt. Lett.* 43(12), 2961-2964, 2018; doi.org/10.1364/OL.43.002961.
36. R. Pan, U. Retzer, T. Werblinski, M. Slipchenko, T.R. Meyer, L. Zigan, and S. Will, “Generation of high-energy, kHz-rate narrowband tunable ultraviolet pulses using a burst-mode dye laser system,” *Opt. Lett.* 43(5), 1191-1194, 2018; doi.org/10.1364/OL.43.001191.
37. M.E. Smyser, K.A. Rahman, M.N. Slipchenko, S. Roy, and T.R. Meyer, “Compact burst-mode Nd:YAG laser for kHz–MHz bandwidth velocity and species measurements,” *Opt. Lett.* 43(4), 735-738, 2018; doi.org/10.1364/OL.43.000735.
38. C.D. Radke, P. McManamen, A.L. Kastengren, A.B. Swantek, and T.R. Meyer, “Synchrotron x-ray interrogation of turbulent gas-liquid mixing in cryogenic rocket sprays,” *AIAA J.* 55(12), 4306-4313, 2017; doi.org/10.2514/1.J055938.
39. B.R. Halls, P. Hsu, N. Jiang, E.S. Legge, J.J. Felver, M.N. Slipchenko, S. Roy, T.R. Meyer, and J.R. Gord, “kHz-rate four-dimensional fluorescence tomography using an ultraviolet-tunable narrowband burst-mode optical parametric oscillator,” *Optica* 4(8), 897-902, 2017; doi.org/10.1364/OPTICA.4.000897.
40. B.R. Halls, N. Jiang, T.R. Meyer, S. Roy, M.N. Slipchenko, J.R. Gord, “4D spatio-temporal evolution of combustion intermediates in turbulent flames using burst-mode volumetric laser-induced fluorescence,” *Opt. Lett.* 42(14), 2830-2833, 2017; doi.org/10.1364/OL.42.002830.
41. C.E. Dedic, T.R. Meyer, and J.B. Michael, “Single-shot ultrafast coherent anti-Stokes Raman scattering of vibrational/rotational nonequilibrium,” *Optica* 4(5), 563-570, 2017; doi.org/10.1364/OPTICA.4.000563.
42. B.R. Halls, J.R. Gord, T.R. Meyer, D.J. Thul, M.N. Slipchenko, and S. Roy, “20-kHz-rate three-dimensional tomographic imaging of the concentration field in a turbulent jet,” *Proceedings of the Combustion Institute* 36(3), 4611-4618, 2017; doi.org/10.1016/j.proci.2016.07.007.
43. B.R. Halls, C.D. Radke, B.J. Reuter, A.L. Kastengren, J.R. Gord, and T.R. Meyer, “High-speed, two-dimensional synchrotron white-beam x-ray radiography of spray breakup and atomization,” *Opt. Express* 25(2), 1605-1617, 2017; doi.org/10.1364/OE.25.001605.
44. T.R. Meyer, B.R. Halls, N. Jiang, M.N. Slipchenko, S. Roy, and J.R. Gord, “High-speed, three-dimensional tomographic laser-induced incandescence imaging of soot volume fraction in turbulent flames,” *Opt. Express* 24(26), 29547-29555, 2016; doi.org/10.1364/OE.24.029547.
45. J.D. Miller, N. Jiang, M.N. Slipchenko, J.G. Mance, T.R. Meyer, S. Roy, and J.R. Gord, “Spatiotemporal analysis of turbulent jets enabled by 100-kHz, 100-ms burst-mode particle image velocimetry,” *Exp. Fluids* 57, 192(1-17), 2016; doi.org/10.1007/s00348-016-2279-5.
46. B.R. Halls, S. Roy, J.R. Gord, A.L. Kastengren, and T.R. Meyer, “Quantitative imaging of single-shot liquid distributions in sprays using broadband flash x-ray radiography,” *Int. J. Multiphas. Flow* 87, 241-249, 2016; doi.org/10.1016/j.ijmultiphaseflow.2016.09.007.

47. B.R. Halls, D.J. Thul, D. Michaelis, S. Roy, T.R. Meyer, J.R. Gord, "Single-shot, volumetrically illuminated, three-dimensional, tomographic laser-induced-fluorescence imaging in a gaseous free jet," *Opt. Express* 24(9), 10040-10049, 2016; doi.org/10.1364/OE.24.010040.
48. Münsterjohann, F.J.T. Huber, T.C. Klima, S. Holfelder, S.R. Engel, J.D. Miller, T.R. Meyer, and S. Will, "Potential of two-line atomic fluorescence for temperature imaging in turbulent indium-oxide-producing flames," *J. Nanopart. Res.* 17, 459(1-10), 2015; doi.org/10.1007/s11051-015-3263-3.
49. J.D. Miller, C.E. Dedic, and T.R. Meyer, "Vibrational femtosecond/picosecond coherent anti-Stokes Raman scattering with enhanced temperature sensitivity for flame thermometry from 300–2400 K," *J. Raman Spectrosc.* 46(8), 702-707, 2015; doi.org/10.1002/jrs.4725.
50. C.D. Radke, J.P. McManamen, A.L. Kastengren, B.R. Halls, and T.R. Meyer, "Quantitative time-averaged gas and liquid distributions using x-ray fluorescence and radiography in atomizing sprays," *Opt. Lett.* 40(9), 2029-2032, 2015; doi.org/10.1364/OL.40.002029 (featured in *Advanced Photon Source Science Highlights* 12.10.2015).
51. J.B. Michael, P. Venkateswaran, C.R. Shaddix, and T.R. Meyer, "Effects of repetitive pulsing on multi-kHz planar laser-induced incandescence imaging in laminar and turbulent flames," *Appl. Opt.* 54(11), 3331-3344, 2015; doi.org/10.1364/AO.54.003331.
52. B.R. Halls, T.R. Meyer, and A.L. Kastengren, "Quantitative measurement of binary liquid distributions using multiple-tracer x-ray fluorescence and radiography," *Opt. Express* 23(2), 1730-1739, 2015; doi.org/10.1364/OE.23.001730.
53. C.E. Dedic, J.D. Miller, and T.R. Meyer, "Dual-pump vibrational/rotational femtosecond/picosecond coherent anti-Stokes Raman scattering temperature and species measurements," *Opt. Lett.* 39(23), 6608-6611, 2014; doi.org/10.1364/OL.39.006608.
54. S. Roy, J.D. Miller, M.N. Slipchenko, P.S. Hsu, J.G. Mance, T.R. Meyer, and J.R. Gord, "100-ps-Pulse-Duration, 100-Joule Burst-Mode Laser for kHz–MHz Flow Diagnostics," *Opt. Lett.* 39(22), 6462-6465, 2014; doi.org/10.1364/OL.39.006462.
55. M.N. Slipchenko, J.D. Miller, S. Roy, T.R. Meyer, J.G. Mance, and J.R. Gord, "100 kHz, 100 ms, 400 J burst-mode laser with dual-wavelength diode-pumped amplifiers," *Opt. Lett.* 39(16), 4735–4738, 2014; doi.org/10.1364/OL.39.004735.
56. J.B. Michael, P. Venkateswaran, J.D. Miller, M.N. Slipchenko, J.R. Gord, S. Roy, and T.R. Meyer, "100-kHz, thousand-frame burst-mode planar imaging in turbulent flames," *Opt. Lett.* 39(4), 739-742, 2014; doi.org/10.1364/OL.39.000739.
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59. J.D. Miller, J.B. Michael, M.N. Slipchenko, S. Roy, T.R. Meyer, and J.R. Gord, "Simultaneous high-speed planar imaging of mixture fraction and velocity using a burst-mode laser," *Appl. Phys. B*, 113, 93-97, 2013; doi.org/10.1007/s00340-013-5665-1.
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- measurements in binary gas mixtures,” *J. Raman Spectrosc.* 44(10), 1336-1343, 2013; doi.org/10.1002/jrs.4261.
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 63. M.N. Slipchenko, J.D. Miller, S. Roy, J.R. Gord, and T.R. Meyer, “All-diode-pumped Quasi-continuous Burst-mode Laser for Extended High-speed Planar Imaging,” *Opt. Express* 21(1), 681-689, 2013; doi.org/10.1364/OE.21.000681.
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