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# William J. Capecchi

Physicist with +2 years postdoc experience in energetic particle research and industry experience with strong statistical, data modeling, data analysis, and problem-solving skills. Proven history of plasma diagnostic development, able to develop effective analytics on large datasets. Seeking to drive innovative research towards a successful fusion device.

## EXPERIENCE

Present — **Research Associate** LTX-β
- Implemented technical upgrades to 700kW NBI for fast-ion studies in low recycling plasmas, upgrade underway to extend NBI pulse length enabling improved plasma heating/fueling
- Designed Neutral Particle Analyzer (NPA) for study of energetic particle population in LTX-β
- Expanded full orbit code (POET) to include spherical tokamak equilibria for study of particle adiabatic invariance breaking and power deposition onto vessel wall due to orbit loss
- Optimized beam coupling using full orbit code model results validated against TRANSP
- Implemented rapid post-shot analysis of beam coupling utilizing ion orbit topology model

Sept 2019 — **Sr. Simulation Engineer** Donaldson Inc
- Technical lead on collaboration with University of MN project to develop liquid filtration model
- Completed work on dust loading diagnostic bench with laser distance transducer technology to provide experimental validation to dust loading algorithm improvement
- Developed first principles dust loading algorithm to improve accuracy of filter life model
- Improved physics of filtration efficiency modeling through simulation of particle trajectories in flow

Aug 2017 — **Freelance Data Scientist** Upwork
- Developed custom solutions for clients. Projects were varied, but included aspects such as machine-learning, time-series analysis, database management, spreadsheet automation, and used tools such as Jupyter, Scikit-learn, SQL, Python, d3.js, Mapbox, and Excel VBA

Jan 2017 — **PhD Candidate/Research Assistant** UW Madison, Madison Symmetric Torus (MST) Group
- Characterized stability threshold of observed NB driven Alfvén continuum mode
- Achieved first measurement of fast-ion pressure in an RFP through experimental concept development, prototyping, model validation, testing, and analysis of 72GB of experimental data
- Created custom 2D linear regression algorithm with chi-squared statistical analysis to improve agreement between Abel inverted data and modeled plasma pressure
- Coded Monte Carlo model to generate knowledge of neutron energy spectrum to assess product performance, validated against industry standard neutron model with confidence interval testing
- Developed fast-ion orbit model (POET) from first principles to give phase-space information to MST diagnostics, validated with existing experimental data, integrated into MST standard software

May 2012 — **Research/Teaching Assistant** UW Madison, ECE & Columbia University, Applied Physics
- Developed optical lens with reversed chromatic aberration through full EM wave phase/attenuation modeling, using least-squares regression optimization and reduced chi-squared statistic
- Developed a team of researchers at Columbia University to move research into lab testing

Sept 2009 — **Team Leader/Infantryman** MN Army National Guard
- Led infantry team on 30+ missions on deployment in support of Operation Iraqi Freedom
- Decorated Bronze Star for service for effectively reducing hostile action in high conflict area of Iraq
- Awarded Army Commendation Medal for aid rendered to foreign military on deployment to Kosovo

## EDUCATION

UNIVERSITY OF WISCONSIN- MADISON
Madison, Wisconsin
2017 Ph.D. Plasma Physics
Dissertation: *A Critical Fast Ion Beta in the Madison Symmetric Torus Reversed Field Pinch*

ST. JOHN'S UNIVERSITY
Collegeville, Minnesota
2009 B.A. Physics & Mathematics

## SKILLS

- Energetic Particle Physics
- Python/IDL/VBA
- Neutral Beams
- Neutron Detection
- Diagnostic development
- Team Management
- Data Visualization
- Modeling/Data Analysis

## HOBBIES

- Backpacking/Hiking
- Trail Running
- Road Cycling
- Ultramarathons
- Rock Climbing
- Canoe Building

## PRESENTATIONS

Present

*Optimized beam fueling in LTX-β*
62nd APS DPP Meeting. Virtual

2021

*A neutral particle analyzer for fast ion physics studies in LTX-β*
61st APS DPP Meeting. Ft Lauderdale, FL

2020

2019

2016

## PUBLICATIONS

W. Capecchi et al
"*Neutral beam prompt loss in LTX-β*"
Nucl. Fusion (accepted DOI: 10.1088/1741-4326/ac2bbf) (2021)

P. Hughes, W. Capecchi, D. B. Elliott, L. E. Zakharov, R. E. Bell, C. Hansen, D. P. Boyle, S. N. Gorelenkov, R. Majeski, R. Kaita, *"Toroidal plasma acceleration due to NBI fast ion losses in LTX-β"* Plasma Phys. Control. Fusion **63**, 085020 (2021)

W. Capecchi et al "*A measure of fast ion beta at marginal stability in the Reversed Field Pinch*", Nucl. Fusion 59 086026 (2019)

W. Capecchi et al "*A collimated neutron detector for RFP plasmas in MST*", Rev. Sci Instrum **87**, 11D826 (2016)

J.K. Anderson, J. Kim, P. J. Bonofiglo, W. Capecchi, S. Eilerman, M. D. Nornberg, J. S. Sarff, S. H. Sears "*Dynamics of a reconnection-driven runaway ion tail in a reversed field pinch plasma*"
Phys. Plasmas **23**, 055702 (2016)

P. J. Bonofiglo, J. K. Anderson, A. F. Almagri, J. Kim, J. Clark, W. Capecchi, S. H. Sears, J. Egedal, "*Development towards a fast ion loss detector for the reversed field pinch*", Rev. Sci. Instrum. **87**, 11D824 (2016)

J. Kim, J. K. Anderson, W. Capecchi, P. J. Bonofiglo, S. H. Sears, "*Analysis techniques for diagnosing runaway ion distributions in the reversed field pinch*", Rev. Sci. Instrum. **87**, 11D819 (2016)

**Invited Talk**: *Energetic Particle Physics in MST Reversed Field Pinch*
US Transport Task Force Workshop. Salem, MA

*Fast ion beta limit measurements by collimated neutron detection in MST plasmas*
57th APS DPP Meeting. Savannah, GA

2015

J. K. Anderson, W. Capecchi, S. Eilerman, J. J. Koliner, M. D. Nornberg, J. A. Reusch
"*Fast ion confinement in the three-dimensional helical reversed-field pinch*"
Plasma Phys. Control. Fusion **56** (9) 094006 Aug. 2014

*Fast ion beta limit measurements by collimated neutron detection in the MST*
Exploratory Plasma Research Workshop. Madison, WI

*Fast ion beta limit measurements by collimated neutron detection in the MST*
56th APS DPP Meeting. New Orleans, LA.

L. Lin, J. K. Anderson, D. L. Brower, W. Capecchi, W. X. Ding, S. Eilerman, *et al*.
*"Energetic-particle-driven instabilities and induced fast-ion transport in the RFP"*
Phys. Plasmas **22** (5) 056104 Apr. 2014

2014

K. C. Hammond, W. Capecchi, S. D. Massidda, F. A. Volpe
*"Metamaterial lens of specifiable frequency-dependent focus and adjustable aperture for electron cyclotron emission in the DIII-D tokamak"*
Journal of Infrared, Millimeter, and Terahertz Waves 34, 437 (2013)

*Investigation of the fast ion beta limit in MST*
55th APS DPP Meeting. Denver, CO

2013

*Multi-frequency reflectometer for edge density profile and fluctuation measurements on MST*
54th APS DPP Meeting. Providence, RI

W. Capecchi, N. Behdad, F. A. Volpe
*"Reverse chromatic aberration and its numerical optimization in a metamaterial lens"*
Optics Express **20** (8) pp. 8761-8769 (2012)

*Reverse chromatic aberration and its numerical optimization in a metamaterial lens*
19th Topical Conference on High-Temperature Plasma Diagnostics. Monterey, CA

W. Capecchi, T. Q. Sibley
*"When the trivial is nontrivial"*
Pi Mu Epsilon Journal **13** (6) pp. 333-336 (2012)