



Dr. Markus Battarbee – Curriculum Vitae

Personal details

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CV updated	September 16, 2021		https:// github.com/markusbattarbee

In short

I am a space physicist by trade, investigating collisionless plasma physics, energetic ions, space weather, and solar eruptions. I am fascinated by plasma physics phenomena at the Sun, in interplanetary space, and in the vicinity of the Earth. My current focus is on terascale hybrid-Vlasov simulations of the Earth's magnetosphere, investigating particle acceleration and injection at the bow shock of the Earth and wherever plasma dynamics arise. My scientific career began with statistical studies of Solar Energetic Particle (SEP) observations. During my graduate studies, I programmed and performed numerical simulations of SEP acceleration at shocks driven by Coronal Mass Ejections (CMEs). During my postdoctoral studies, in 2013–2015, I was a member of the AMS-02 collaboration, working on observations of cosmic rays and SEPs at GV-TV scales. In the UK, at the University of Central Lancashire, I performed full-orbit simulations and investigations of SEP propagation throughout the inner heliosphere. My strengths include a solid knowledge of space plasma physics, and expertise in the numerical modeling of many interesting topics related to SEPs and space plasmas, including massively parallel computing, wave-particle interactions, acceleration and propagation modeling, and data analysis. I am at home when developing new simulation and analysis tools and am fluent with version control tools.

Education and degrees

12.12.2013 **Ph.D. in space physics** Dept. of Physics and Astronomy, University of Turku, Finland
08.05.2008 **M.Sc. in space physics** Dept. of Physics and Astronomy, University of Turku, Finland
2010–2011 **Research and Development of Higher Education, basic studies** (Personnel training, University of Turku, Finland) 10 ECTS credits

Current position

09/2020–present **University researcher**, Fixed-term (5y) full-time position, **Centre of Excellence** in Research of Sustainable Space, Department of Physics, University of Helsinki, Finland
Investigation of the Earth's magnetosphere and the bow shock via hybrid-Vlasov simulations

Previous work experience

10/2017–08/2020 **Postdoctoral researcher**, **Centre of Excellence** in Research of Sustainable Space, Department of Physics, University of Helsinki, Finland
Investigation of the Earth's magnetosphere and the bow shock via hybrid-Vlasov simulations
01/2016–08/2017 **Postdoctoral research associate**, Jeremiah Horrocks Institute, University of Central Lancashire (UCLan), UK. *Modelling solar energetic particle transport at and near the heliospheric current sheet*
01/2014–12/2015 **Postdoctoral researcher**, Dept. of Physics and Astronomy, University of Turku (UTU),

- Finland. *Applying the AMS-02 instrument to solar energetic particle observations*
- 2008–2013 **Doctoral student**, Dept. of Physics and Astronomy, UTU, Finland. *Numerical modelling of self-consistent solar energetic ion acceleration at coronal shocks*
- 2006–2011 **Teaching assistant**, part-time, Dept. of Physics and Astronomy, UTU, Finland
- 2006–2008 **Software programmer**, part-time, Aboa Space Research Oy, Turku, Finland. *BepiColombo mission, SIXS-P detector ground support software engineering*
- 06–12/2007 **Project scientist**, Aboa Space Research Oy, Finland. *Electronics, verification and testing. Product and quality assurance manuals and processes*

Research funding and grants

- 2021 **Co-investigator**, pilot usage for LUMI-C supercomputer, CSC - IT CENTER FOR SCIENCE LTD.
- 2021 **Took over grant management duties** for TEMPO: Towards electron-scale modelling of space plasmas: Observations and Modelling; Academy of Finland 4-year project (2017-2021, PI: Minna Palmroth), 399 495 EUR
- 2020 **Co-Investigator, Work Package leader**, ICT-Solutions to Understand Variability of Arctic Climate (ICT-SUNVAC), Academy of Finland decision #335554, 318 533 EUR
- 2019 **Co-investigator**, PRACE tier-0 computational grant, SIMPLE – Six- dimensional Ion Modelling of PLasma near Earth. 60M core hours on Hawk hosted by GCS at HLRS, Germany
- 2019 **Support funding** for the Faculty of Science, University of Helsinki, 12 750 EUR

Language skills (CEFR)

- Finnish **Mother tongue** (Proficient C2)
- English **Mother tongue** (Proficient C2)
- Swedish **Independent** (B1 oral, B2 written).

Leadership and supervision experience

- 02-08/2020 **Project manager**, Towards Electron-scale Modelling of space Plasmas: Observations and global simulations (TEMPO), Academy of Finland grant #309937. Took over managing duties for UH half of consortium mid-project.
- 2020– **Supervisor**, PhD students, 3 ongoing, University of Helsinki (UH), Finland
- 2018–2021 **Supervisor**, 2 Postdocs, UH, Finland
- 2018– **Supervisor**, BSc students, 2 completed, 3 ongoing, UH, Finland
- 2019– **Supervisor**, MSc students, 1 completed, UH, Finland
- 2019 **Supervisor**, Non-military service personnel, UH, Finland
- 2016–2017 **Lead developer**, SPEC solar particle propagation simulation, UCLan, UK
- 2016 **Assistant supervisor / Moderator**, BSc student, UCLan, UK
- 2015 **Assistant supervisor**, MSc student, UTU, Finland
- 2013–2015 **Deputy team leader**, UTU team within the AMS-02 collaboration
- 2008–2015 **Lead developer**, CSA Coronal Shock Acceleration simulation, UTU, Finland

2007 **PA/QA manager**, Aboa Space Research Oy, Finland

Teaching experience

- 2020–present **Staff tutor**, Personal tutoring for space physics MSc and BSc students, UH, Finland
2018–2020 **Visiting lecturer**, Introduction to physical sciences, Introduction to Plasma physics, electricity and magnetism, advanced plasma physics (9 lectures), UH, Finland
2017 **2x Module tutor, 1x Module moderator**, Distance Learning in Astronomy, UCLan, UK
2014, 2015 **Lecturer**, Introduction to Plasma Physics (graduate level, 2 courses), UTU, Finland
2006–2011 **Teaching assistant**, 3 different courses, total of 6 periods, UTU, Finland,

Experience of organising scientific meetings

- 2018 **Local Organizing Committee**, 2nd Vlasiator Science hackathon, UH, Finland
2017 **Session co-convenor**, 14th European Space Weather Week, Ostend, Belgium
2010 **Local Organizing Committee**, 22nd European Cosmic Ray Symposium, UTU, Finland

Scientific and academic honours and awards

- 2017 **Invited expert**, 1st international Vlasiator Science hackathon, UH, Finland
2015–2016 **Invited young scientist** member of ISSI team 342: The Connection Between Coronal Shock Wave Dynamics and Early SEP Production
2012 **Outstanding Student Paper Award**, Space Physics and Aeronomy, American Geophysical Union Fall Meeting

Other key scientific or academic merits

- 2021 **Lead guest editor**, Bringing together observations and numerical simulations of collisionless solar system plasmas, *Frontiers in Astronomy and Space Sciences*
2019–present **Member** of ISSI team 465: *Foreshocks Across The Heliosphere: System Specific Or Universal Physical Processes?*
2018,2019 **Judge**, Outstanding Student Poster and PICO (OSPP) Award, EGU General Assembly
2016 **Invited expert Q&A** responses, astronomy magazine *Tähdet & Avaruus* (2 letters)
2012–2014 Additional mobility: CERN (Switzerland / France, 7 weeks), University of Trento (Italy, 3 weeks), and Universität Würzburg (Germany, 3 months)
18.09.2010 Co-organizer of public lecture by Dr. James Grime, the Millennium Mathematics Project, University of Cambridge, *ENIGMA - An introduction to cryptography*, Turku, Finland

Memberships and positions of trust in scientific societies

- 2018–present Finnish **Centre of Excellence** in Research of Sustainable Space
2018–present European Geophysical Union
2017–present **PI team member**, Vlasiator hybrid-Vlasov simulation group
(<http://www.physics.helsinki.fi/vlasiator>)
2016–2017 **Co-investigator**, Vlasiator hybrid-Vlasov simulation group
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2016–2017 Fellow of the Royal Astronomical Society

2008–2017 American Geophysical Union

2013–2015 **AMS-02 collaboration** with 600+ physicists, 56 institutions, 16 countries

Scientific and societal impact of research

Publications **49 journal articles** (published or accepted) in scientific peer-reviewed journals.

Five publications in conference proceedings (light peer-review).

Citations **Total 2976 citations, highest citation count 504**, highest first-author paper citation count 19, **h-index 17**. (<https://ui.adsabs.harvard.edu>)

Full publications list at <https://blogs.helsinki.fi/markusbattarbee/publications/>

Conferences Author or co-author on 41 oral presentations (5 invited/solicited) and 35 posters (2 solicited) at international conferences.

Referee for journals such the *Astrophysical Journal* and *Annales Geophysicae*, multiple occasions

Tutoring On-line secondary school vocational training programme “TiedeTET” (2014)

Outreach Numerous outreach activities such as open days, primary school and high school visits, and a stargazing event.

Selected publications

- **Ion Acceleration Efficiency at the Earth’s Bow Shock: Observations and Simulation Results**, A. Johlander, M. Battarbee, A. Vaivads, L. Turc, Y. Pfau-Kempf, U. Ganse, M. Grandin, M. Dubart, Yu. V. Khotyaintsev, D. Caprioli, C. Haggerty, S. J. Schwartz, B. L. Giles, and M. Palmroth. *The Astrophysical Journal* Vol.914, 82 (2021) <https://doi.org/10.3847/1538-4357/abfafc>
- **Vlasov simulation of electrons in the context of hybrid global models: an eVlasiator approach**, M. Battarbee, T. Brito, M. Alho, et. al., *Ann. Geophys.* 39, 85-103 (2020) <https://doi.org/10.5194/angeo-39-85-2021>
- **Helium in the Earth’s foreshock: a global Vlasiator survey**, M. Battarbee, X. Blanco-Cano, L. Turc, et. al., *Ann. Geophys.*, 38, 1081–1099 (2020) <https://doi.org/10.5194/angeo-38-1081-2020>
- **Non-locality of the Earth’s quasi-parallel bow shock: injection of thermal protons in a hybrid-Vlasov simulation**, M. Battarbee, U. Ganse, Y. Pfau-Kempf, et. al., *Ann. Geophys.*, 38, 625–643 (2020) <https://doi.org/10.5194/angeo-38-625-2020>
- **Vlasov methods in space physics and astrophysics**, M. Palmroth, U. Ganse, Y. Pfau-Kempf, M. Battarbee, et. al., *Living Rev Comput Astrophys* (2018) 4:1 <https://doi.org/10.1007/s41115-018-0003-2>
- **Cavitons and spontaneous hot flow anomalies in a hybrid-Vlasov global magnetospheric simulation**, X. Blanco-Cano, M. Battarbee, L. Turc, et. al. , *Ann. Geophys.*, 36, 1081-1097 (2018) <https://doi.org/10.5194/angeo-36-1081-2018>
- **Modelling solar energetic particle transport near a wavy heliospheric current sheet**, M. Battarbee, S. Dalla, and M. S. Marsh, *The Astrophysical Journal*, Volume 854, 23 (2018) <https://doi.org/10.3847/1538-4357/aaa3fa>
- **Multi-spacecraft observations and transport simulations of solar energetic particles for the May 17th 2012 event**, M. Battarbee, J. Guo, S. Dalla, et. al., *Astronomy & Astrophysics* Vol. 612, A116 (2018) <https://doi.org/10.3847/1538-4357/aaa3fa>

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- **Modelling of proton acceleration in application to a ground level enhancement**, A. Afanasiev, R. Vainio, A. P. Rouillard, M. Battarbee, A. Aran, and P. Zucca, *Astronomy & Astrophysics* Vol. 614, A4 (2018) <https://doi.org/10.1051/0004-6361/201731343>
 - **Injection of thermal and suprathermal seed particles into coronal shocks of varying obliquity**, M. Battarbee, R. Vainio, T. Laitinen and H. Hietala, *Astronomy & Astrophysics* Vol. 558, A110 (2013) <https://dx.doi.org/10.1051/0004-6361/201321348>
 - **Heavy-ion acceleration and self-generated waves in coronal shocks**, M. Battarbee, T. Laitinen and R. Vainio, *Astronomy & Astrophysics* Vol. 535, A34 (2011) <https://dx.doi.org/10.1051/0004-6361/201117507>
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