

Takanobu Amano

天野 孝伸 (あまの たかのぶ)

Associate Professor
Department of Earth and Planetary Science,
Graduate School of Science, The University of Tokyo

PERSONAL DETAILS

Affiliation	Department of Earth and Planetary Science, Graduate School of Science, The University of Tokyo
Address	Room 803, Faculty of Science Bldg. 1, 7-3-1 Hongo, Bunkyo-ku, Tokyo, 113-0033, JAPAN.
E-mail	amano@eps.s.u-tokyo.ac.jp
Phone	+81-3-5841-1921
Fax	+81-3-5841-8321
Website	https://amanotk.github.io/

RESEARCH INTERESTS

I am interested in theoretical aspects of space and astrophysical plasma phenomena. My major research interests include physics of collisionless shocks (both non-relativistic and relativistic regimes), high-energy particle acceleration and transport, linear and nonlinear theory for kinetic plasma instabilities, and numerical techniques for advanced kinetic/fluid plasma simulations.

APPOINTMENTS

Aug. 1, 2016 - present	Associate Professor Department of Earth and Planetary Science, School of Science, The University of Tokyo
Mar. 16, 2012 - Jul. 31, 2016	Assistant Professor Department of Earth and Planetary Science, School of Science, The University of Tokyo
Apr. 1, 2009 - Mar. 15, 2012	Designated Assistant Professor Division of Particle and Astrophysical Science, Nagoya University
Apr. 1, 2008 - Mar. 31, 2009	Postdoctoral Researcher Solar-Terrestrial Environment Laboratory, Nagoya University

EDUCATION

Apr. 1, 2005 - Mar. 31, 2008	Ph.D degree Department of Earth and Planetary Science, Graduate School of Science, The University of Tokyo
Apr. 1, 2003 - Mar. 31, 2005	MS degree Department of Earth and Planetary Science, Graduate School of Science, The University of Tokyo
Apr. 1, 1999 - Mar. 31, 2003	BS degree Department of Earth and Planetary Physics, School of Science, The University of Tokyo

AWARDS

- 2018 Young Researcher Award (under 40 yrs. old) from Association of Asia Pacific Physical Societies, Division of Plasma Physics (AAPPS-DPP)
- 2015 Obayashi Early Career Scientist Award from Society of Geomagnetism and Earth, Planetary and Space Sciences (SGEPSS)
- 2005 JSPS (Japan Society for the Promotion of Science) Research Fellowship for Young Scientists (DC1)

PUBLICATIONS

See also, [Google Scholar](#), [Mendeley](#), or [Publons](#) profile pages for the up-to-date list of publications and citation statistics.

Refereed Articles

- [1] **Amano, T.**, T. Katou, N. Kitamura, M. Oka, Y. Matsumoto, M. Hoshino, Y. Saito, S. Yokota, B. L. Giles, W. R. Paterson, C. T. Russell, O. Le Contel, R. E. Ergun, P.-A. Lindqvist, D. L. Turner, J. F. Fennell, and J. B. Blake (2020). Observational evidence for stochastic shock drift acceleration of electrons at the Earth's bow shock. *Physical Review Letters* 124(6), 065101. <https://doi.org/10.1103/PhysRevLett.124.065101>
- [2] Oka, M., F. Otsuka, S. Matsukiyo, L. B. Wilson, M. R. Argall, **T. Amano**, T. D. Phan, M. Hoshino, O. Le Contel, D. J. Gershman, J. L. Burch, R. B. Torbert, J. C. Dorelli, B. L. Giles, R. E. Ergun, C. T. Russell, and P. A. Lindqvist (2019). Electron scattering by low-frequency whistler waves at Earth's bow shock. *The Astrophysical Journal* 886(1), 53. <https://doi.org/10.3847/1538-4357/ab4a81>
- [3] Bohdan, A., J. Niemiec, M. Pohl, Y. Matsumoto, **T. Amano**, and M. Hoshino (2019). Kinetic Simulations of Nonrelativistic Perpendicular Shocks of Young Supernova Remnants. II. Influence of Shock-surfing Acceleration on Downstream Electron Spectra. *The Astrophysical Journal* 885(1), 10. <https://doi.org/10.3847/1538-4357/ab43cf>
- [4] Iwamoto, M., **T. Amano**, M. Hoshino, Y. Matsumoto, J. Niemiec, A. Ligorini, O. Kobzar, and M. Pohl (2019). Precursor wave amplification by ion–electron coupling through wakefield in relativistic shocks. *The Astrophysical Journal* 883(2), L35. <https://doi.org/10.3847/2041-8213/ab4265>
- [5] Bohdan, A., J. Niemiec, M. Pohl, Y. Matsumoto, **T. Amano**, and M. Hoshino (2019). Kinetic simulations of nonrelativistic perpendicular shocks of young supernova remnants. I. Electron shock-surfing acceleration. *The Astrophysical Journal* 878(1), 5. <https://doi.org/10.3847/1538-4357/ab1b6d>
- [6] Katou, T. and **T. Amano** (2019). Theory of stochastic shock drift acceleration for electrons in the shock transition region. *The Astrophysical Journal* 874(2), 119. <https://doi.org/10.3847/1538-4357/ab0d8a>
- [7] Yamakawa, T., K. Seki, **T. Amano**, N. Takahashi, and Y. Miyoshi (2019). Excitation of storm time Pc5 ULF waves by ring current ions based on the drift-kinetic simulation. *Geophysical Research Letters* 46(4), 1911–1918. <https://doi.org/10.1029/2018GL081573>
- [8] **Amano, T.**, M. Iwamoto, Y. Matsumoto, and M. Hoshino (2019). The efficiency of coherent radiation from relativistic shocks. In *Progress in Photon Science*, Volume 119, pp. 371–383. Springer, Cham
- [9] Seki, K., Y. Miyoshi, Y. Ebihara, Y. Katoh, **T. Amano**, S. Saito, M. Shoji, A. Nakamizo, K. Keika, T. Hori, S. Nakano, S. Watanabe, K. Kamiya, N. Takahashi, Y. Omura, M. Nose,

- M.-C. Fok, T. Tanaka, A. Ieda, and A. Yoshikawa (2018). Theory, modeling, and integrated studies in the Arase (ERG) project. *Earth, Planets and Space* 70(1), 17. <https://doi.org/10.1186/s40623-018-0785-9>
- [10] Keika, K., S. Kasahara, S. Yokota, M. Hoshino, K. Seki, M. Nosé, **T. Amano**, Y. Miyoshi, and I. Shinohara (2018). Ion energies dominating energy density in the inner magnetosphere: spatial distributions and composition, observed by Arase/MEP-i. *Geophysical Research Letters* 45(22), 12,153–12,162. <https://doi.org/10.1029/2018GL080047>
- [11] **Amano, T.** (2018). A generalized quasi-neutral fluid-particle hybrid plasma model and its application to energetic-particle-magnetohydrodynamics hybrid simulation. *Journal of Computational Physics* 366, 366–385. <https://doi.org/10.1016/j.jcp.2018.04.020>
- [12] Walia, N. K., K. Seki, M. Hoshino, **T. Amano**, N. Kitamura, Y. Saito, S. Yokota, C. J. Pollock, B. L. Giles, T. E. Moore, R. B. Torbert, C. T. Russell, and J. L. Burch (2018). A statistical study of slow-mode shocks observed by MMS in the dayside magnetopause. *Geophysical Research Letters* 45(10), 4675–4684. <https://doi.org/10.1029/2018GL077580>
- [13] Iwamoto, M., **T. Amano**, M. Hoshino, and Y. Matsumoto (2018). Precursor wave emission enhanced by Weibel instability in relativistic shocks. *The Astrophysical Journal* 858(2), 93. <https://doi.org/10.3847/1538-4357/aaba7a>
- [14] Kamiya, K., K. Seki, S. Saito, **T. Amano**, and Y. Miyoshi (2018). Formation of butterfly pitch angle distributions of relativistic electrons in the outer radiation belt with a monochromatic Pc5 wave. *Journal of Geophysical Research* 123(6), 4679–4691. <https://doi.org/10.1002/2017JA024764>
- [15] Matsumoto, Y., **T. Amano**, T. N. Kato, and M. Hoshino (2017). Electron Surfing and Drift Accelerations in a Weibel-Dominated High-Mach-Number Shock. *Physical Review Letters* 119(10), 105101. <https://doi.org/10.1103/PhysRevLett.119.105101>
- [16] Oka, M., L. B. W. III, T. D. Phan, A. J. Hull, **T. Amano**, M. Hoshino, M. R. Argall, O. Le Contel, O. Agapitov, D. J. Gershman, Y. V. Khotyaintsev, J. L. Burch, R. B. Torbert, C. Pollock, J. C. Dorelli, B. L. Giles, T. E. Moore, Y. Saito, L. A. Avanov, W. Paterson, R. E. Ergun, R. J. Strangeway, C. T. Russell, and P. A. Lindqvist (2017). Electron scattering by high-frequency whistler waves at Earth's bow shock. *The Astrophysical Journal* 842(2), L11. <https://doi.org/10.3847/2041-8213/aa7759>
- [17] Iwamoto, M., **T. Amano**, M. Hoshino, and Y. Matsumoto (2017). Persistence of precursor waves in two-dimensional relativistic shocks. *The Astrophysical Journal* 840(1), 52. <https://doi.org/10.3847/1538-4357/aa6d6f>
- [18] Hirabayashi, K., M. Hoshino, and **T. Amano** (2016). A new framework for magnetohydrodynamic simulations with anisotropic pressure. *Journal of Computational Physics* 327, 851–872. <https://doi.org/10.1016/j.jcp.2016.09.064>
- [19] **Amano, T.** (2016). A second-order divergence-constrained multidimensional numerical scheme for relativistic two-fluid electrodynamics. *The Astrophysical Journal* 831(1), 100. <https://doi.org/10.3847/0004-637X/831/1/100>

- [20] Balsara, D. S., **T. Amano**, S. Garain, and J. Kim (2016). A high-order relativistic two-fluid electrodynamic scheme with consistent reconstruction of electromagnetic fields and a multidimensional Riemann solver for electromagnetism. *Journal of Computational Physics* 318, 169–200. <https://doi.org/10.1016/j.jcp.2016.05.006>
- [21] **Amano, T.** (2015). Divergence-free approximate Riemann solver for the quasi-neutral two-fluid plasma model. *Journal of Computational Physics* 299, 863–886. <https://doi.org/10.1016/j.jcp.2015.07.035>
- [22] Matsumoto, Y., **T. Amano**, T. N. Kato, and M. Hoshino (2015). Stochastic electron acceleration during spontaneous turbulent reconnection in a strong shock wave. *Science (New York, N.Y.)* 347(6225), 974–978. <https://doi.org/10.1126/science.1260168>
- [23] Minoshima, T., Y. Matsumoto, and **T. Amano** (2015). A finite volume formulation of the multi-moment advection scheme for Vlasov simulations of magnetized plasma. *Computer Physics Communications* 187, 137–151. <https://doi.org/10.1016/j.cpc.2014.10.023>
- [24] Itou, H., **T. Amano**, and M. Hoshino (2014). First-principles simulations of electrostatic interactions between dust grains. *Physics of Plasmas* 21(12), 123707. <https://doi.org/10.1063/1.4904373>
- [25] **Amano, T.**, K. Higashimori, and K. Shirakawa (2014). A robust method for handling low density regions in hybrid simulations for collisionless plasmas. *Journal of Computational Physics* 275, 197–212. <https://doi.org/10.1016/j.jcp.2014.06.048>
- [26] Matsumoto, Y., **T. Amano**, and M. Hoshino (2013). Electron acceleration in a nonrelativistic shock with very high Alfvén Mach number. *Physical Review Letters* 111(21), 215003. <https://doi.org/10.1103/PhysRevLett.111.215003>
- [27] Saito, T., M. Hoshino, and **T. Amano** (2013). Stability of cosmic-ray modified shocks: two-fluid approach. *The Astrophysical Journal* 775(2), 130. <https://doi.org/10.1088/0004-637X/775/2/130>
- [28] **Amano, T.** and J. G. Kirk (2013). The role of superluminal electromagnetic waves in pulsar wind termination shocks. *The Astrophysical Journal* 770(1), 18. <https://doi.org/10.1088/0004-637X/770/1/18>
- [29] Minoshima, T., Y. Matsumoto, and **T. Amano** (2013). Multi-moment advection scheme in three dimension for Vlasov simulations of magnetized plasma. *Journal of Computational Physics* 236, 81–95. <https://doi.org/10.1016/j.jcp.2012.11.024>
- [30] Matsumoto, Y., **T. Amano**, and M. Hoshino (2012). Electron accelerations at high Mach number shocks: two-dimensional particle-in-cell simulations in various parameter regimes. *The Astrophysical Journal* 755(2), 109. <https://doi.org/10.1088/0004-637X/755/2/109>
- [31] Umeda, T., S. Matsukiyo, **T. Amano**, and Y. Miyoshi (2012). A numerical electromagnetic linear dispersion relation for Maxwellian ring-beam velocity distributions. *Physics of Plasmas* 19(7), 072107. <https://doi.org/10.1063/1.4736848>

- [32] Hayakawa, T., K. Torii, R. Enokiya, **T. Amano**, and Y. Fukui (2012). Molecular and Atomic Gas toward HESS J1745 – 303 in the Galactic Center: Further Support for the Hadronic Scenario. *Publications of the Astronomical Society of Japan* 64(1), 8. <https://doi.org/10.1093/pasj/64.1.8>
- [33] Minoshima, T., Y. Matsumoto, and **T. Amano** (2012). Multi-moment advection scheme for Vlasov simulations. *ASP Conference Series* 459(17), 277–282. <https://doi.org/10.1016/j.jcp.2011.05.010>
- [34] **Amano, T.** and M. Hoshino (2012). Recent progress in the theory of electron injection in collisionless shocks. In *Astrophysics Space Science Proceedings*, Volume 33 of *Astrophysics and Space Science Proceedings*, Berlin, Heidelberg, pp. 143–152. Springer Berlin Heidelberg
- [35] **Amano, T.**, K. Torii, T. Hayakawa, and Y. Fukui (2011). Stochastic acceleration of cosmic rays in the central molecular zone of the Galaxy. *Publications of the Astronomical Society of Japan* 63(6), L63–L66. <https://doi.org/10.1093/pasj/63.6.L63>
- [36] Minoshima, T., Y. Matsumoto, and **T. Amano** (2011). Multi-moment advection scheme for Vlasov simulations. *Journal of Computational Physics* 230(17), 6800–6823. <https://doi.org/10.1016/j.jcp.2011.05.010>
- [37] **Amano, T.**, K. Seki, Y. Miyoshi, T. Umeda, Y. Matsumoto, Y. Ebihara, and S. Saito (2011). Self-consistent kinetic numerical simulation model for ring current particles in the Earth’s inner magnetosphere. *Journal of Geophysical Research* 116, A02216. <https://doi.org/10.1029/2010JA015682>
- [38] **Amano, T.** and M. Hoshino (2010). A critical mach number for electron injection in collisionless shocks. *Physical Review Letters* 104(18), 181102. <https://doi.org/10.1103/PhysRevLett.104.181102>
- [39] Shimada, N., M. Hoshino, and **T. Amano** (2010). Structure of a strong supernova shock wave and rapid electron acceleration confined in its transition region. *Physics of Plasmas* 17(3), 032902. <https://doi.org/10.1063/1.3322828>
- [40] **Amano, T.** and M. Hoshino (2009). Effect of Shock Angle on Fast and Direct Acceleration of Electrons in High Mach Number Quasi-Perpendicular Shocks. In *AIP Conference Proceedings*, Volume 1144, pp. 36–39. AIP
- [41] **Amano, T.** and M. Hoshino (2009). Nonlinear evolution of Buneman instability and its implication for electron acceleration in high Mach number collisionless perpendicular shocks. *Physics of Plasmas* 16(10), 102901. <https://doi.org/10.1063/1.3240336>
- [42] **Amano, T.** and M. Hoshino (2009). Electron shock surfing acceleration in multidimensions: two-dimensional particle-in-cell simulation of collisionless perpendicular shock. *The Astrophysical Journal* 690(1), 244–251. <https://doi.org/10.1088/0004-637X/690/1/244>
- [43] **Amano, T.** and M. Hoshino (2007). Electron injection at high Mach number quasi-perpendicular shocks: surfing and drift acceleration. *The Astrophysical Journal* 661(1), 190–202. <https://doi.org/10.1086/513599>

Non-Refereed Articles

- [1] Amano, T. (2016). Inside a plasma shock. *Physics* 9, 117. <https://doi.org/10.1103/Physics.9.117>

Non-refereed Articles in Japanese

- [1] 星野真弘, 天野孝伸 (2009), 宇宙における衝撃波粒子加速機構の新展開, 日本物理学会誌, 64(6), 421
- [2] 天野孝伸 (2009), 超新星残骸衝撃波における電子注入, 天文月報, 102(1), 9

INVITED TALKS (INTERNATIONAL CONFERENCES)

- [1] Non-thermal Particle Acceleration at Collisionless Shocks, *Max Planck Princeton Center Workshop*, Göttingen, Germany, Jan. 22, 2020.
- [2] Three-dimensional Particle-In-Cell Simulations for High Mach Number Collisionless Shocks, *The 2nd Asia-Pacific Conference on Plasma Physics*, Kanazawa, Japan, Nov. 15, 2018.
- [3] Nonthermal Electron Acceleration at Earth's Bow Shock: Theory, Simulation and Observation, *The 13th International School/Symposium for Space Simulations (ISSS-13)*, Los Angeles, USA, Sep. 13, 2018.
- [4] Stochastic Shock Drift Acceleration for Electrons, *8th East-Asia Workshop on Laboratory, Space, Astrophysical Plasmas*, Daejeon, Korea, Aug. 1, 2018.
- [5] Cosmic-Ray Acceleration via Astrophysical Coherent Radiation, *20th International Symposium on Very High Energy Cosmic Ray Interactions (ISVHECRI)*, Nagoya, Japan, May 24, 2018.
- [6] Particle Acceleration in Relativistic Plasmas, *Dawn of a New Era for Black Hole Jets in Active Galaxies*, Sendai, Japan, Jan. 26, 2018.
- [7] Nonthermal Electrons at Quasi-perpendicular Collisionless Shocks, *7th East-Asia Workshop on Laboratory, Space, Astrophysical Plasmas*, Weihai, China, Jul. 25, 2017.
- [8] Coherent and Stochastic Acceleration in Quasi-perpendicular Collisionless Shocks, *Workshop on Plasma Astrophysics from the Laboratory to the Non-thermal Universe*, Oxford, UK, Jul. 4, 2017.
- [9] Kinetic Simulations of Particle Acceleration and Transport around Collisionless Shocks, *AOGS 13th Annual Meeting*, Beijing, China, Aug. 1, 2016.
- [10] Particle Acceleration and Transport at Collisionless Shocks, *6th East-Asia Workshop on Laboratory, Space, Astrophysical Plasmas*, Tsukuba, Japan, Jul. 11, 2016.
- [11] Key Issues in Particle Acceleration Theory at Collisionless Shocks, *18th International Congress on Plasma Physics*, Kaohsiung, Taiwan, Jun. 29, 2016.
- [12] Energetic Particle Hybrid Code and Its Application, *11th International Conference on Numerical Modeling of Space Plasma Flows (ASTRONUM2016)*, Monterey, USA, Jun. 9, 2016.
- [13] Superluminal Electromagnetic Waves in Highly Magnetized Relativistic Shocks, *5th East-Asia School and Workshop on Laboratory, Space, Astrophysical Plasmas*, Pohang, Korea, Aug. 21, 2015.
- [14] Quasi-neutral Two-fluid Plasma Simulation Model, *10th International Conference on Numerical Modeling of Space Plasma Flows (ASTRONUM 2015)*, Avignon, France, Jun. 10, 2015.
- [15] Physics of Very High Mach Number Collisionless Shocks, *The Many Facets of Supernova Remnants*, Rikkyo University, Japan, Nov. 10, 2014.

- [16] Relativistic Electromagnetic Two-fluid Simulations of Pulsar Wind Termination Shocks, *The 6th East-Asian Numerical Astrophysics Meeting (EANAM6)*, Suwon, Korea, Sep. 18, 2014.
- [17] Robust Handling of Low Density Regions in Hybrid Simulations, *9th International Conference on Numerical Modeling of Space Plasma Flows (ASTRONUM 2014)*, Long Beach, USA, Jun. 25, 2014.
- [18] Relativistic Pulsar Wind Termination Shocks Modified by Superluminal Electromagnetic Waves, *8th International Conference on Numerical Modeling of Space Plasma Flows (ASTRONUM 2013)*, Biarritz, France, Jul. 1, 2013.
- [19] Structure of Relativistic Shock Modified by Nonlinear Superluminal Waves, *Nonlinear Waves and Chaos Workshop 9*, La Jolla, USA, Mar. 7, 2013.
- [20] Self-consistent Drift-kinetic Numerical Ring-current Modeling : Five-dimensional Vlasov-Maxwell Approach, *Inner Magnetosphere Coupling II (IMC II)*, Los Angeles, USA, Mar. 20, 2012.
- [21] Nonthermal Electron Acceleration and Injection in Collisionless Shocks, *International Astrophysics Forum Alpbach (IAFA) 2011*, Alpbach, Austria, Jun. 24, 2011.
- [22] Kinetic and Self-consistent Numerical Modeling of the Terrestrial Inner Magnetosphere, *6th International Conference on Numerical Modeling of Space Plasma Flows (ASTRONUM 2011)*, Valencia, Spain, Jun. 17, 2011.
- [23] Electron Acceleration and Injection by Whistler Waves in Collisionless Shocks, *2010 International Space Plasma Symposium*, Tinan, Taiwan, Jun. 28, 2010.
- [24] Surfing and Drift Acceleration of Electrons at High Mach Number Quasi-perpendicular Shocks, *Kinetic Modeling of Astrophysical Plasmas*, Crakow, Poland, Oct. 6, 2008.
- [25] Nonthermal Electron Acceleration in High Mach Number Collisionless Shocks, *The 9th International Workshop on the Interrelationship between Plasma Experiments in Laboratory and Space (IPELS)*, Palm Cove, Australia, Aug. 10, 2007.

INVITED TALKS (DOMESTIC CONFERENCES)

- [1] 内部磁気圏における ULF 波動励起機構, 実験室・宇宙プラズマ研究集会, 東京大学本郷キャンパス, 2019 年 9 月 17 日.
- [2] 宇宙空間衝撃波の遷移層, 日本物理学会 春季年会, 東京理科大学野田キャンパス, 2018 年 3 月 24 日.
- [3] 内部磁気圏 RC モデリングの新しい試み, 太陽地球圏環境予測のためのモデル研究の展望, 名古屋大学東山キャンパス, 2017 年 1 月 27 日.
- [4] MMS 衛星で見る無衝突衝撃波と電子加速, 高エネルギー宇宙物理学研究会, 青山学院大学相模原キャンパス, 2016 年 12 月 2 日.
- [5] 宇宙プラズマのハイブリッドシミュレーション, 日本物理学会 2016 秋季年会, 金沢大学角間キャンパス, 2016 年 9 月 14 日.
- [6] Theory and Simulations of Particle Acceleration in Collisionless Shocks, 高エネルギーガンマ線でみる極限宇宙 2015, 2016 年 1 月 14 日.
- [7] パルサー風衝撃波と電磁波の相互作用, 高エネルギー宇宙物理学研究会, 九州大学西新プラザ, 2014 年 11 月 25 日.
- [8] 相対論的電磁変性衝撃波の構造と電磁エネルギー散逸, 日本物理学会 2013 春季年会, 広島大学, 2013 年 3 月 27 日.
- [9] 無衝突衝撃波の数値シミュレーションと粒子加速, 宇宙流体力学のフロンティア, 京都大学, 2009 年 11 月 16 日.