

# Takanobu Amano

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Department of Earth and Planetary Science,  
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### PERSONAL DETAILS

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### RESEARCH INTERESTS

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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

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

## EDUCATION

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

## AWARDS

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- 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

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

### Refereed Articles

- [1] Jikei, T. and **T. Amano** (2021). A non-local fluid closure for modeling cyclotron resonance in collisionless magnetized plasmas. *Phys. Plasmas* 28(4), 042105. <https://doi.org/10.1063/5.0045335>
- [2] Ligorini, A., J. Niemiec, O. Kobzar, M. Iwamoto, A. Bohdan, M. Pohl, Y. Matsumoto, **T. Amano**, S. Matsukiyo, and M. Hoshino (2021). Mildly relativistic magnetized shocks in electron – ion plasmas - II. Particle acceleration and heating. *Mon. Not. R. Astron. Soc.* 502(4), 5065–5074. <https://doi.org/10.1093/mnras/stab220>
- [3] Ligorini, A., J. Niemiec, O. Kobzar, M. Iwamoto, A. Bohdan, M. Pohl, Y. Matsumoto, **T. Amano**, S. Matsukiyo, Y. Esaki, and M. Hoshino (2021). Mildly relativistic magnetized shocks in electron-ion plasmas - I. Electromagnetic shock structure. *Monthly Notices of the Royal Astronomical Society* 501(4), 4837–4849. <https://doi.org/10.1093/mnras/staa3901>
- [4] Bohdan, A., M. Pohl, J. Niemiec, P. J. Morris, Y. Matsumoto, **T. Amano**, M. Hoshino, and A. Sulaiman (2021). Magnetic Field Amplification by the Weibel Instability at Planetary and Astrophysical Shocks with High Mach Number. *Phys. Rev. Lett.* 126(9), 095101. <https://doi.org/10.1103/PhysRevLett.126.095101>
- [5] Bohdan, A., M. Pohl, J. Niemiec, P. J. Morris, Y. Matsumoto, **T. Amano**, and M. Hoshino (2020). Kinetic simulation of nonrelativistic perpendicular shocks of young supernova remnants. IV. Electron heating. *The Astrophysical Journal* 904(1), 12. <https://doi.org/10.3847/1538-4357/abbc19>
- [6] Yamakawa, T., K. Seki, **T. Amano**, N. Takahashi, and Y. Miyoshi (2020). Excitation of internally driven ULF waves by the drift-bounce resonance with ring current ions based on the drift-kinetic simulation. *Journal of Geophysical Research: Space Physics* 125(11), e2020JA028231. <https://doi.org/10.1029/2020ja028231>
- [7] Kitamura, N., Y. Omura, S. Nakamura, **T. Amano**, S. A. Boardsen, N. Ahmadi, O. Le Contel, P. A. Lindqvist, R. E. Ergun, Y. Saito, S. Yokota, D. J. Gershman, W. R. Paterson, C. J. Pollock, B. L. Giles, C. T. Russell, R. J. Strangeway, and J. L. Burch (2020). Observations of the source region of whistler mode waves in magnetosheath mirror structures. *Journal of Geophysical Research: Space Physics* 125(5). <https://doi.org/10.1029/2019JA027488>
- [8] Bohdan, A., M. Pohl, J. Niemiec, S. Vafin, Y. Matsumoto, **T. Amano**, and M. Hoshino (2020). Kinetic simulations of nonrelativistic perpendicular shocks of young supernova remnants. III. Magnetic reconnection. *The Astrophysical Journal* 893(1), 6. <https://doi.org/10.3847/1538-4357/ab7cd6>
- [9] **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>

- [10] 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>
- [11] 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>
- [12] 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>
- [13] 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>
- [14] 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>
- [15] 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>
- [16] **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
- [17] 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>
- [18] 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>
- [19] **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>
- [20] 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>

- [21] 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>
- [22] 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>
- [23] 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>
- [24] 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. Avakov, 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>
- [25] 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>
- [26] 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>
- [27] **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>
- [28] 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>
- [29] **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>
- [30] 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>
- [31] 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>

- [32] 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>
- [33] **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>
- [34] 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>
- [35] 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>
- [36] **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>
- [37] 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>
- [38] 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>
- [39] 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>
- [40] 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>
- [41] 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>
- [42] **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
- [43] **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>
- [44] 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>



- [45] 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>
- [46] 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>
- [47] 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>
- [48] 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
- [49] 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>
- [50] 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>
- [51] 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)

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- [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, *Non-linear 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)

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- [1] 衝撃波電子加速におけるホイッスラー波の役割, 第37回プラズマ・核融合学会年会シンポジウム, オンライン, 2020年12月1日.
- [2] 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.
- [3] 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.
- [4] 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.
- [5] 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.
- [6] 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.
- [7] 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.
- [8] 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.
- [9] 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.
- [10] 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.