

研究室名
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最近の研究課題とその取り組みの概要
2016 年の LIGO による重力波の初検出によって、天体现象及びその周辺のエネルギー情報を持つ電磁波、素過程の情報を持つニュートリノなどの素粒子の観測に加えて、天体现象の起こる起点の情報を持つ時空間の変 動を直接観測することが可能になった。まさに重力波天文学が始まったばかりであり、これから KAGRA など世界の重力波望遠鏡がネットワークを構築して観測を行い、重力波天文学の確立が進んでいく。 当研究室は観測を基礎に置いて、宇宙の生い立ちや時空間の幾何学、宇宙で起きる様々な現象を実証的に解明していくことを目指していく。そのために、宇宙で支配的な力である重力の情報を直接運ぶ重力波の観測を中心に、電磁波、ニュートリノといった観測手段を連携するマルチメッセンジャー観測を進めていく。それとともに、重力波望遠鏡の診断システムの構築、将来に向けた重力波望遠鏡の高感度化についての研究を進めていく。 また、LIGO－Virgo－KAGRA 国際重力波観測コミュニティの中では、バースト性重力波観測グループにおいて、KAGRA からのチェアとしてプロジェクトのマネージメントを行っている。 魚群やムクドリなどの集団飛行にみられる高度に組織化された群行動に現れる知能―群知能―について、そのアルゴリズムや最適性を生態観測から研究し、その成果を重力波天文学や社会科学に応用していく研究も進めている。 キーワード：重力波、重力理論、重力波望遠鏡、干渉計診断、KAGRA、マルチバース、機械学習、群知能、宇宙幾何学
研究室の構成員
端山 和大（教授）・博士（理学） 大槻 かおり（助教）・博士（理学）
2023 年度の大学院生および卒論生の人数と研究テーマ
M1：1 名 M2：1 名 4 年次生：4 名 研究テーマ 大学院生 ・「多峰型重力波の天球位置再構成問題の提起とその解析手法」 ・「重力波望遠鏡に現れる突発性雑音の機械学習による評価」 卒論生 ・「ドレイク方程式を用いた地球外知的生命体文明数の導出」 ・「重力望遠鏡周辺の雑音振動源の即時特定」 ・「重力波観測における突発性雑音の特徴付けに向けて」 ・「超新星重力波の普遍的特徴と重力波観測」
教員の担当科目
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理科学研究Ⅱ、卒業論文 (大学院) 物理情報計測実験、物理情報計測講究、量子物理学特論、解析力学(工学研究科) 大槻 かおり：(学部) 物理科学実験Ⅰ、物理科学実験Ⅱ、物理学基礎ゼミナール、国際化と日本
教員の所属学会
端山 和大：日本物理学会、日本天文学会、International Astronomical Union(IAU)、宇宙線研究者会議(CRC) 大槻 かおり：日本天文学会、日本物理学会、International Astronomical Union(IAU)
最近5年間の学術論文
- Hayama, K., in the KAGRA, LIGO, Virgo collaboration, "Prospects for observing and localizing gravitational-wave transients with Advanced LIGO, Advanced Virgo and KAGRA", Living Reviews in Relativity, Volume 21, Issue 1, article id. 3, 57 pp.(2019). - Hayama, K. , 32nd author in Akutsu, T. , et al., "KAGRA: 2.5 generation interferometric gravitational wave detector" , Nature Astronomy volume3, pages35–40 (2019). - Hayama, K. 33rd author in Akiyama, Y., et al. "Vibration isolation system with a compact damping system for power recycling mirrors of KAGRA", Classical and Quantum Gravity, Volume 36, Issue 9, article id. 095015, May, (2019). - Hayama, K., 19th author in Michimura, Y., et al. "Prospects for improving the sensitivity of KAGRA gravitational wave detector" Proceedings for the Fifteenth Marcel Grossmann Meeting, Rome, July 1-7, (2019). - Hayama, K. , 32nd author in Akutsu, T., et al. "First cryogenic test operation of underground km-scale gravitational-wave observatory KAGRA" Classical and Quantum Gravity, Volume 36, Issue 16, article id. 165008 (2019). - Hayama, K., 7th author in Takeda, H., et al. "Prospects for gravitational-wave polarization tests from compact binary mergers with future ground-based detectors", Physical Review D, Volume 100, Issue 4, id.042001, Aug. (2019). - Eguchi, S., Shibagaki, S., Hayama, K., Kotake, K., "Prototype Implementation of a Web-Based Gravitational Wave Signal Analyzer: SNEGRAF" Astronomical Data Analysis Software and Systems XXVIII. ASP Conference Series, Vol. 523, proceedings of a conference held (11-15 October 2018) at The Hotel at the University of Maryland, College Park, Maryland, USA. Edited by Peter J. Teuben, Marc W. Pound, Brian A. Thomas, and Elizabeth M. Warner. San Francisco: Astronomical Society of the Pacific, p.493 (2019). - Hayama, K. , 32nd author in Akutsu, T., et al. "The status of KAGRA underground cryogenic gravitational wave telescope" Journal of Physics: Conference Series, Volume 1342, Issue 1, article id. 012014 Jan. (2020). - Hayama, K. , 32nd author in Akutsu, T., et al. "An arm length stabilization system for KAGRA and future gravitational-wave detectors" Classical and Quantum Gravity, Volume 37, Issue 3, id.035004

Feb. (2020).

10. Sakuno, Y., Hayama, K., "The dynamical properties of the rotation of GW170817 by circular polarization" Fukuoka University science reports 50(1), 8-12, Mar. (2020).
11. Hayama, K. , 32nd author in Akutsu, T., et al. "Application of independent component analysis to the iKAGRA data", Progress of Theoretical and Experimental Physics, Volume 2020, Issue 5, id.053F01, May, (2020).
12. Hayama, K., 19th author in Michimura, Y., et al. "Prospects for improving the sensitivity of the cryogenic gravitational wave detector KAGRA", Physical Review D, Volume 102, Issue 2, article id.022008 (2020).
13. Hayama, K., in the KAGRA, LIGO, Virgo collaboration, "Prospects for observing and localizing gravitational-wave transients with Advanced LIGO, Advanced Virgo and KAGRA", Living Reviews in Relativity, Volume 23, Issue 1, article id.3 (2020)
14. Nagano, H., Hayama, K., "Measuring the curvature of the universe using the gravitational wave observation", Fukuoka University science reports 50(2), 65-68, Sep. (2020).
15. Hayama, K. , 32nd author in Akutsu, T., et al, "Vibration isolation systems for the beam splitter and signal recycling mirrors of the KAGRA gravitational wave detector", Classical and Quantum Gravity, Volume 38, Issue 6, id.065011, 33 pp. March (2021)
16. Hayama, K. , 33rd author in Akutsu, T., et al, "Overview of KAGRA: Detector design and construction history", Progress of Theoretical and Experimental Physics, Volume 2021, Issue 5, id.05A101, 24 pp. May 2021
17. Hayama, K. , 41st author in Akutsu, T., et al, "Overview of KAGRA: Calibration, detector characterization, physical environmental monitors, and the geophysics interferometer", Progress of Theoretical and Experimental Physics, Volume 2021, Issue 5, id.05A102, 30 pp., May 2021
18. Hayama, K., 23rd author in Kawamura, S., et al, "Current status of space gravitational wave antenna DECIGO and B-DECIGO", Progress of Theoretical and Experimental Physics, Volume 2021, Issue 5, id.05A105, 11 pp., May 2021
19. Chan, M. L., Hayama, K., "Estimate of the detectability of the circular polarization signature of supernova gravitational waves using the Stokes parameters", Physical Review D, Volume 103, Issue 10, article id.103024, May 2021
20. Hayama, K., in the KAGRA, LIGO, Virgo collaboration, " Diving below the Spin-down Limit: Constraints on Gravitational Waves from the Energetic Young Pulsar PSR J0537-6910", The Astrophysical Journal Letters, Volume 913, Issue 2, id.L27, 15 pp., June 2021
21. Hayama, K., in the KAGRA, LIGO, Virgo collaboration, " Constraints on Cosmic Strings Using Data from the Third Advanced LIGO-Virgo Observing Run", Physical Review Letters, Volume 126, Issue 24, article id.241102, June 2021
22. Hayama, K., in the KAGRA, LIGO, Virgo collaboration, " Observation of Gravitational Waves from Two Neutron Star-Black Hole Coalescences", The Astrophysical Journal Letters, Volume 915, Issue 1, id.L5, 24 pp., July 2021

23. Hayama, K., in the KAGRA, LIGO, Virgo collaboration, " Upper limits on the isotropic gravitational-wave background from Advanced LIGO and Advanced Virgo's third observing run", Physical Review D, Volume 104, Issue 2, article id.022004, July 2021
24. Hayama, K., in the KAGRA, LIGO, Virgo collaboration, " Search for anisotropic gravitational-wave backgrounds using data from Advanced LIGO and Advanced Virgo's first three observing runs", Physical Review D, Volume 104, Issue 2, article id.022005, July 2021
25. Gushima, Y., Hayama, K., "Model-independent test of Scalar-Tensor gravity theory by reconstructing scalar mode of GW170817", Fukuoka University science reports, 51, 47 - 52 (2021)
26. Kukiwara, M., Hayama, K., " Probing multiverse using gravitational wave observations", Fukuoka University science reports, 51, 53 - 57 (2021)
27. Hayama, K., in the KAGRA, LIGO, Virgo collaboration, " All-sky search for continuous gravitational waves from isolated neutron stars in the early O3 LIGO data", Physical Review D, Volume 104, Issue 8, article id.082004, October 2021
28. Hayama, K., in the KAGRA, LIGO, Virgo collaboration, " Searches for Continuous Gravitational Waves from Young Supernova Remnants in the Early Third Observing Run of Advanced LIGO and Virgo", The Astrophysical Journal, Volume 921, Issue 1, id.80, 29 pp., November 2021
29. Hayama, K., in the KAGRA, LIGO, Virgo collaboration, " Constraints from LIGO O3 Data on Gravitational-wave Emission Due to R-modes in the Glitching Pulsar PSR J0537-6910", The Astrophysical Journal, Volume 922, Issue 1, id.71, 22 pp., November 2021
30. Hayama, K., in the KAGRA, LIGO, Virgo collaboration, " All-sky search for long-duration gravitational-wave bursts in the third Advanced LIGO and Advanced Virgo run", Physical Review D, Volume 104, Issue 10, article id.102001, November 2021
31. Hayama, K., in the KAGRA, LIGO, Virgo collaboration, " All-sky search for short gravitational-wave bursts in the third Advanced LIGO and Advanced Virgo run", Physical Review D, Volume 104, Issue 12, article id.122004, December 2021
32. Hayama, K., in the KAGRA, LIGO, Virgo collaboration, " Search for intermediate-mass black hole binaries in the third observing run of Advanced LIGO and Advanced Virgo", Astronomy & Astrophysics, Volume 659, id.A84, 25 pp., March 2022
33. Hayama, K., in the KAGRA, LIGO, Virgo collaboration, " Constraints on dark photon dark matter using data from LIGO's and Virgo's third observing run", Physical Review D, Volume 105, Issue 6, article id.063030, March 2022
34. The KAGRA, LIGO, Virgo collaboration, 著者 1638 人, K. Hayama " Search for Gravitational Waves Associated with Gamma-Ray Bursts Detected by Fermi and Swift during the LIGO-Virgo Run O3b", The Astrophysical Journal, Volume 928, Issue 2, article id.186, pp.1-20, April 2022
35. H. Abe et al., 著者 143 人, K. Hayama " The Current Status and Future Prospects of KAGRA, the Large-Scale Cryogenic Gravitational Wave Telescope Built in the Kamioka Underground", Galaxies, vol. 10, issue 3, pp.63_1-26, April 2022
36. The KAGRA, LIGO, Virgo collaboration, 著者 1662 人, K. Hayama " Narrowband Searches for

- Continuous and Long-duration Transient Gravitational Waves from Known Pulsars in the LIGO-Virgo Third Observing Run”, The Astrophysical Journal, Volume 932, Issue 2, article id.133, pp.1-27, June 2022
37. The KAGRA, LIGO, Virgo collaboration,著者 1670 人, K. Hayama " First joint observation by the underground gravitational-wave detector KAGRA with GEO 600”, Progress of Theoretical and Experimental Physics, Volume 2022, Issue 6, article id.063F01, pp.1-37, June 2022
 38. The KAGRA, LIGO, Virgo collaboration,著者 1630 人, K. Hayama, " All-sky, all-frequency directional search for persistent gravitational waves from Advanced LIGO's and Advanced Virgo's first three observing runs”, Physical Review D, Volume 105, Issue 12, article id.122001, pp.1-22, June 2022
 39. Yuya Gushima, Kazuhiro Hayama, “On the Reconstruction of the Scalar Mode of GW170817 in Scalar-Tensor Gravity Theory,” ANNALEN DER PHYSIK 2200139 2022
 40. Yuya Gushima and Kazuhiro Hayama, “Model-independent test of scalar-tensor gravity theory by reconstructing scalar mode of GW170817,” The Sixteenth Marcel Grossmann Meeting, pp. 921-931 2023
 41. Moe Kukihiro and Kazuhiro Hayama, “Probing multiverse using gravitational wave observations,” The Sixteenth Marcel Grossmann Meeting, pp. 531-537 2023
 42. The KAGRA, LIGO, Virgo collaboration,著者 1630 人, K. Hayama, " Constraints on the Cosmic Expansion History from GWTC–3”, The Astrophysical Journal, Volume 949, Issue 2, id.76, 37 pp. June 2023
 43. The KAGRA, LIGO, Virgo collaboration,著者 1630 人, K. Hayama, " The Astrophysical Journal Supplement Series, Volume 267, Issue 2, id.29, 28 pp. August 2023
 44. The KAGRA, LIGO, Virgo collaboration,著者 1630 人, K. Hayama, " Search for Gravitational Waves Associated with Fast Radio Bursts Detected by CHIME/FRB during the LIGO–Virgo Observing Run O3a” The Astrophysical Journal, Volume 955, Issue 2, id.155, 26 pp., October 2023
 45. The KAGRA, LIGO, Virgo collaboration,著者 1630 人, K. Hayama, " Search for subsolar-mass black hole binaries in the second part of Advanced LIGO's and Advanced Virgo's third observing run”, Monthly Notices of the Royal Astronomical Society, Volume 524, Issue 4, pp.5984-5992, October 2023
 46. The KAGRA, LIGO, Virgo collaboration,著者 1630 人, K. Hayama, " Performance of the KAGRA detector during the first joint observation with GEO 600 (O3GK)”, Progress of Theoretical and Experimental Physics, Volume 2023, Issue 10, id.10A101, 35 pp., October 2023
 47. The KAGRA, LIGO, Virgo collaboration,著者 1630 人, K. Hayama, " Gravitational wave physics and astronomy in the nascent era”, Progress of Theoretical and Experimental Physics, Volume 2023, Issue 10, id.10A103, 83 pp., October 2023
 48. The KAGRA, LIGO, Virgo collaboration,著者 1630 人, K. Hayama, " GWTC-3: Compact Binary Coalescences Observed by LIGO and Virgo during the Second Part of the Third Observing Run”,

Physical Review X, Volume 13, Issue 4, article id.041039, October 2023
最近 5 年間の学術著書
該当なし
最近 5 年間の学術国際会議での発表
Gushima, Y., Hayama, K. Leakage analysis in the reconstructed polarizations of burst gravitational waves for the polarization test of gravity Gravitational Wave Physics and Astronomy workshop 2022(GWPAW 2022) Melbourne Australia, 5-9 December 2022 Kukihara, M., Hayama, K. Prompt localization of sources of vibrations around a gravitational wave telescope Gravitational Wave Physics and Astronomy workshop 2022(GWPAW 2022) Melbourne Australia, 5-9 December 2022 重力波の再構成時に発生する偏極モード間におけるエネルギーの漏れ分析 具島侑也 日本天文学会 2022 年秋季年会 新潟大学 9 月 Gushima, Y., Hayama, K. Model-Independent test of Scalar-Tensor gravity theory by reconstructing scalar mode of GW170817 Sixteenth Marcel Grossmann Meeting (2021) Kukihara, M., Hayama, K. Probing multiverse using gravitational wave observations Sixteenth Marcel Grossmann Meeting (2021) Gushima, Y., Hayama, K. Model-Independent test of Scalar-Tensor gravity theory by reconstructing scalar mode of GW170817 Gravitational Wave Physics and Astronomy workshop 2021(GWPAW 2021) Hannover, Germany,(2021) Kukihara, M., Hayama, K. Probing multiverse using gravitational wave observations Gravitational Wave Physics and Astronomy workshop 2021(GWPAW 2021) Hannover, Germany, (2021)
最近 5 年間の代表者としての学外資金導入実績
2019～2021年度 科研費基盤C ” 即時重力波アラートに向けた環境雑音除去システムの構築”

最近 5 年間の代表者としての学内資金導入実績
2019年度高度化推進タイプI
最近 5 年間の学会等学術団体における役職など
端山 和大:LIGO-Virgo-KAGRA国際重力波観測コミュニティでのバースト性重力波観測グループ プチェア
最近 5 年間の一般向け論文と著書、行政報告書など
最近 5 年間の一般（非学術）集会での発表論文
最近 5 年間の学術団体以外の団体での啓蒙活動や社会貢献活動とその役職など
佐賀県立小城高校 模擬講義 2023年8月22日