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#### A. 研究概要

フュージョン圏におけるフル部分圏の Drinfel'd の意味での相対可換子圏の研究を続けた。特に相対チューブ環の部分環として相対トーラス環を定義し、その上で  $S$  行列の作用を考えた。これについて相対 Verlinde 公式を証明した。これは、フル部分圏が全体に一致する場合には、通常の Drinfel'd 中心の Verlinde 公式であり、またフル部分圏が自明な場合にはもとのフュージョン則をそのまま書いたものである。したがって一般の場合にはこの両極端の間を「補間」したものになっている。

We have continued study of the relative Drinfel'd commutant of a full subcategory of a fusion category. We have introduced a relative torus algebra as a subalgebra of a relative tube algebra and considered an action of the  $S$ -matrix on it, and proved the relative Verlinde formula. When the subcategory coincides with the entire category, this is the usual Verlinde formula for the Drinfel'd center, and if the subcategory is trivial, this gives the original fusion rules back. So in the general case, we have an “interpolation” between these two opposite extreme cases.

#### B. 発表論文

1. Y. Kawahigashi, Y. Ogata, E. Størmer: “Normal states of type III factors”, *Pac. J. Math.* **267** (2014), 131–139.
2. M. Bischoff, Y. Kawahigashi, R. Longo, K.-H. Rehren, “Phase boundaries in algebraic conformal QFT”, *Commun. Math. Phys.* **342** (2016), 1–45.
3. M. Bischoff, Y. Kawahigashi, R. Longo, K.-H. Rehren, “Tensor categories and endomorphisms of von Neumann algebras (with applications to Quantum Field Theory)”, *SpringerBriefs in Mathematical Physics* Vol. **3**, 2015.
4. M. Bischoff, Y. Kwahigashi, R. Longo, “Characterization of 2D rational local conformal nets and its boundary conditions:

the maximal case”, *Doc. Math.* **20** (2015), 1137–1184.

5. S. Carpi, Y. Kawahigashi, R. Longo, M. Weiner, “From vertex operator algebras to conformal nets and back”, *Mem. Amer. Math. Soc.* **254** (2018), no. 1213, vi+85 pp.
6. Y. Kawahigashi, “Conformal field theory, tensor categories and operator algebras”, *J. Phys. A* **48** (2015), 303001, 57 pages.
7. Y. Kawahigashi, “A remark on gapped domain walls between topological phases”, *Lett. Math. Phys.* **105** (2015), 893–899.
8. Y. Kawahigashi, “A relative tensor product of subfactors over a modular tensor category”, *Lett. Math. Phys.* **107** (2017), 1963–1970.
9. Y. Kawahigashi, The relative Drinfeld commutant of a fusion category and  $\alpha$ -induction, to appear in *Internat. Math. Res. Notices*.
10. Y. Kawahigashi, “Conformal field theory, vertex operator algebras and operator algebras”, to appear in the *Proceedings of ICM 2018*.

#### C. 口頭発表

1. Conformal field theory and operator algebras, *Noncommutative Geometry and Representation Theory*, Sichuan University (China), May 2018.
2. The relative Drinfeld commutant of a fusion category, orbifold subfactors and alpha-induction, *AQFT: Where Operator Algebra Meets Microlocal Analysis*, Cortona (Italy), June 2018.
3. Algebraic quantum field theory and subfactors, *The 14th Korean Operator Algebras Seminar*, Busan (Korea), June 2018.
4. Conformal field theory, operator algebras and vertex operator algebras, *XXXVII Workshop on Geometric Methods in Physics*, Bialowieza (Poland), July 2018.

5. The relative Drinfeld commutant of a fusion category, orbifold subfactors and alpha-induction, 18th Workshop: Non-commutative Probability, Operators Algebras, Random Matrices and Related Topics, with Applications, Bedlewo (Poland), July 2018.
  6. Conformal field theory, vertex operator algebras and operator algebras, International Congress of Mathematicians 2018, Rio de Janeiro (Brazil), August 2018.
  7. Topological phases of matter, modular tensor categories and operator algebras, Quantum Computing Materials Challenges, Institute for Pure and Applied Mathematics (U.S.A.), August 2018.
  8. The relative Drinfeld commutants and the relative Verlinde formula, Fusion Categories and Subfactors, Banff International Research Station (Canada). October 2018.
  9. Topological phases of matter and subfactors, AMS Special Session on Quantum Symmetries: Subfactors and Fusion Categories, Joint Mathematics Meeting 2019, Baltimore (U.S.A.), January 2019.
  10. Topological phases of matter, subfactors and the relative Verlinde formula, Subfactors in Sydney: Operator algebras, representation theory, quantum field theory, Sydney (Australia), February 2019.
- D. 講義 (学生さんは記入されなくてもよい。)
1. 解析学 VI・解析学特別演習 III : Fourier 解析と超関数. (理学部 3 年生講義)
- E. 修士・博士論文
1. (博士) 早瀬 友裕 (HAYASE Tomohiro) : Parameter Estimation of Random Matrix Models via Free Probability Theory
  2. (修士) 鈴木 大 (SUZUKI Dai) : The Structure of Graph and Groupoid  $C^*$ -algebras and Topological Full Groups
  3. (修士) 水田 黎 (MIZUTA Rei) : Pseudo-polynomial Time Algorithm for Computing Moments of Polynomials in Free Semi-circular Elements
  4. (修士) 山下 真由子 (YAMASHITA Mayuko) : A Topological Approach to Indices of Geometric Operators on Manifolds with Fibered Boundaries
- F. 対外研究サービス
1. *Communications in Mathematical Physics* の editor.
  2. *International Journal of Mathematics* の editor.
  3. *Japanese Journal of Mathematics* の managing editor.
  4. *Journal of Mathematical Physics* の associate editor.
  5. *Journal of Mathematical Sciences, the University of Tokyo* の editor-in-chief.
  6. *Reviews in Mathematical Physics* の associate editor.
  7. *Mathematical Physics Studies* (Springer) の editor.
  8. 日本数学会「第 21 回高木レクチャー」(京都大学, 2018 年 6 月 23 日) のオーガナイザー.
  9. サマースクール数理物理「位相的場の量子論」(東京大学大学院数理科学研究科, 2018 年 8 月 17-19 日) のオーガナイザー.
  10. 日本数学会「第 22 回高木レクチャー」(東京大学, 2018 年 11 月 17, 18 日) のオーガナイザー.
  11. 「物質のトポロジカル相の理論的探究」(京都大学, 2018 年 12 月 11~14 日) のオーガナイザー.
  12. East Asian Core Doctoral Forum on Mathematics (東北大学, January 9-11, 2019) のオーガナイザー.
  13. “Theoretical studies of topological phases of matter” (東京大学, February 12-15, 2019) のオーガナイザー.

14. Workshop “Quantum Math” (沖縄科学技術大学院大学, March 2-3, 2019) のオーガナイザー.