

References

- [1] S. Albeverio, B. K. Driver, M. Gordina, and A. M. Vershik, [Equivalence of the Brownian and energy representations](#). *J. Math. Sci.* **219** (2016), no. 5, 612–630
- [2] S. Albeverio and R. Høegh-Krohn, The energy representation of Sobolev–Lie groups. *Compositio Math.* **36** (1978), no. 1, 37–51
- [3] S. Albeverio, R. J. Høegh-Krohn, J. A. Marion, D. H. Testard, and B. S. Torrèsani, *Noncommutative distributions. Unitary representation of gauge groups and algebras*. Monogr. Textbooks Pure Appl. Math. 175, Marcel Dekker, New York, 1993
- [4] S. Albeverio and B. Torrèsani, [Some remarks on representations of jet groups and gauge groups](#). *J. Math. Phys.* **35** (1994), no. 9, 4897–4908
- [5] H. Ando, [On the local structure of the representation of a local gauge group](#). *Infin. Dimens. Anal. Quantum Probab. Relat. Top.* **13** (2010), no. 2, 223–242
- [6] H. Araki, [Factorizable representation of current algebra. Non commutative extension of the Lévy–Kinchin formula and cohomology of a solvable group with values in a Hilbert space](#). *Publ. Res. Inst. Math. Sci.* **5** (1969/70), 361–422
- [7] H. Baumgärtel, *Operator algebraic methods in quantum field theory. A series of lectures*. Akademie, Berlin, 1995
- [8] D. Beltiță, H. Grundling, and K.-H. Neeb, [Covariant representations for possibly singular actions on \$C^*\$ -algebras](#). *Dissertationes Math.* **549** (2020), 94 pp.
- [9] F. A. Berezin, Representations of the continuous direct product of universal coverings of the group of motions of the complex ball. *Trans. Mosc. Math. Soc.* **36** (1979), 281–289
- [10] S. Bloch, [The dilogarithm and extensions of Lie algebras](#). In *Algebraic K-theory, Evanston 1980 (Proc. Conf., Northwestern Univ., Evanston, Ill., 1980)*, pp. 1–23, Lecture Notes in Math. 854, Springer, Berlin, 1981
- [11] H.-J. Borchers, [Translation group and particle representations in quantum field theory](#). Lecture Notes in Phys. New Ser. m Monogr. 40, Springer, Berlin, 1996
- [12] N. Bourbaki, *Lie groups and Lie algebras. Chapters 1–3*. Elem. Math. (Berlin), Springer, Berlin, 1989
- [13] O. Bratteli and D. W. Robinson, *Operator algebras and quantum statistical mechanics. I*. 2nd edn., Texts Monogr. Phys., Springer, New York, 1987
- [14] T. Bröcker and T. tom Dieck, *Representations of compact Lie groups*. Grad. Texts in Math. 98, Springer, New York, 1985
- [15] V. Chari and A. Pressley, [New unitary representations of loop groups](#). *Math. Ann.* **275** (1986), no. 1, 87–104
- [16] V. Chari and A. Pressley, [Unitary representations of the maps \$S^1 \rightarrow \mathfrak{su}\(N, 1\)\$](#) . *Math. Proc. Cambridge Philos. Soc.* **102** (1987), no. 2, 259–272
- [17] S. Del Vecchio, S. Iovieno, and Y. Tanimoto, [Solitons and nonsmooth diffeomorphisms in conformal nets](#). *Comm. Math. Phys.* **375** (2020), no. 1, 391–427

- [18] D. B. A. Epstein, The simplicity of certain groups of homeomorphisms. *Compositio Math.* **22** (1970), 165–173
- [19] C. J. Fewster and S. Hollands, Quantum energy inequalities in two-dimensional conformal field theory. *Rev. Math. Phys.* **17** (2005), no. 5, 577–612
- [20] D. S. Freed, M. J. Hopkins, and C. Teleman, Loop groups and twisted K -theory III. *Ann. of Math. (2)* **174** (2011), no. 2, 947–1007
- [21] E. Galina and A. Kaplan, On unitary representations of nilpotent gauge groups. *Comm. Math. Phys.* **236** (2003), no. 2, 187–198
- [22] I. M. Gelfand and M. I. Graev, Representations of quaternion groups over locally compact fields and function fields. *Funkcional. Anal. i Priložen.* **2** (1968), no. 1, 20–35
- [23] I. M. Gelfand, M. I. Graev, and A. M. Veršik, Representations of the group of functions taking values in a compact Lie group. *Compositio Math.* **42** (1980), no. 2, 217–243
- [24] R. Geroch, E. H. Kronheimer, and R. Penrose, Ideal points in space-time. *Proc. Roy. Soc. London Ser. A* **327** (1972), 545–567
- [25] J. Glimm and A. Jaffe, *Quantum physics. A functional integral point of view*. 2nd edn., Springer, New York, 1987
- [26] H. Glöckner, Lie groups of measurable mappings. *Canad. J. Math.* **55** (2003), no. 5, 969–999
- [27] H. Glöckner, Direct limits of infinite-dimensional Lie groups compared to direct limits in related categories. *J. Funct. Anal.* **245** (2007), no. 1, 19–61
- [28] H. Glöckner, Homotopy groups of ascending unions of infinite-dimensional manifolds. 2008, arXiv:0812.4713v2
- [29] H. Glöckner, Measurable regularity properties of infinite-dimensional lie groups. 2015, arXiv:1601.02568
- [30] H. Glöckner and K.-H. Neeb, Infinite-dimensional Lie groups. Book in preparation
- [31] G. A. Goldin, Lectures on diffeomorphism groups in quantum physics. In *Contemporary problems in mathematical physics*, pp. 3–93, World Scientific Publishing, Teaneck, NJ, 2004
- [32] R. Goodman and N. R. Wallach, Structure and unitary cocycle representations of loop groups and the group of diffeomorphisms of the circle. *J. Reine Angew. Math.* **347** (1984), 69–133
- [33] R. Goodman and N. R. Wallach, Projective unitary positive-energy representations of $\text{Diff}(S^1)$. *J. Funct. Anal.* **63** (1985), no. 3, 299–321
- [34] H. Grundling and K.-H. Neeb, Full regularity for a C^* -algebra of the canonical commutation relations. *Rev. Math. Phys.* **21** (2009), no. 5, 587–613
- [35] A. Guichardet, *Symmetric Hilbert spaces and related topics. Infinitely divisible positive definite functions. Continuous products and tensor products. Gaussian and Poissonian stochastic processes*. Lecture Notes in Math. 261, Springer, New York, 1972
- [36] A. Haddi, Homologie des algèbres de Lie étendues à une algèbre commutative. *Comm. Algebra* **20** (1992), no. 4, 1145–1166

- [37] S. W. Hawking and G. F. R. Ellis, *The large scale structure of space-time*. Cambridge Monogr. Math. Phys. 1, Cambridge University Press, Cambridge, 1973
- [38] S. Helgason, *Differential geometry, Lie groups, and symmetric spaces*. Pure Appl. Math. 80, Academic Press, New York, 1978
- [39] J. Hilgert and K.-H. Neeb, *Structure and geometry of Lie groups*. Springer Monogr. Math., Springer, New York, 2012
- [40] K. H. Hofmann, *Lie algebras with subalgebras of co-dimension one*. *Illinois J. Math.* **9** (1965), 636–643
- [41] K. H. Hofmann, *Hyperplane subalgebras of real Lie algebras*. *Geom. Dedicata* **36** (1990), no. 2-3, 207–224
- [42] K. H. Hofmann and S. A. Morris, *The structure of compact groups. A primer for the student—a handbook for the expert*. De Gruyter Stud. Math. 25, De Gruyter, Berlin, 1998
- [43] R. E. Howe and C. C. Moore, *Asymptotic properties of unitary representations*. *J. Functional Analysis* **32** (1979), no. 1, 72–96
- [44] W. Hurewicz and H. Wallman, *Dimension theory*. Princeton Math. Ser. 4, Princeton University Press, Princeton, NJ, 1941
- [45] R. S. Ismagilov, *On unitary representations of the group $C_0^\infty(X, G)$, $G = \text{SU}_2$* . *Math. USSR-Sb.* **29** (1976), 105–117
- [46] R. S. Ismagilov, *Representations of infinite-dimensional groups*. Transl. Math. Monogr. 152, American Mathematical Society, Providence, RI, 1996
- [47] H. P. Jakobsen and V. Kac, *A new class of unitarizable highest weight representations of infinite-dimensional Lie algebras. II*. *J. Funct. Anal.* **82** (1989), no. 1, 69–90
- [48] H. P. Jakobsen and V. G. Kac, *A new class of unitarizable highest weight representations of infinite-dimensional Lie algebras*. In *Nonlinear equations in classical and quantum field theory (Meudon/Paris, 1983/1984)*, pp. 1–20, Lecture Notes in Phys. 226, Springer, Berlin, 1985
- [49] B. Janssens and K.-H. Neeb, *Positive energy representations of gauge groups II: Conformal completion of space-time*. In preparation
- [50] B. Janssens and K.-H. Neeb, *Norm continuous unitary representations of Lie algebras of smooth sections*. *Int. Math. Res. Not. IMRN* **2015** (2015), no. 18, 9081–9137
- [51] B. Janssens and K.-H. Neeb, *Covariant central extensions of gauge Lie algebras*. In *Stochastic geometric mechanics*, pp. 101–114, Springer Proc. Math. Stat. 202, Springer, Cham, 2017
- [52] B. Janssens and K.-H. Neeb, *Projective unitary representations of infinite-dimensional Lie groups*. *Kyoto J. Math.* **59** (2019), no. 2, 293–341
- [53] B. Janssens and C. Wockel, *Universal central extensions of gauge algebras and groups*. *J. Reine Angew. Math.* **682** (2013), 129–139
- [54] V. G. Kac, *Infinite-dimensional Lie algebras*. 2nd edn., Cambridge University Press, Cambridge, 1985

- [55] V. G. Kac and A. K. Raina, *Bombay lectures on highest weight representations of infinite-dimensional Lie algebras*. Adv. Ser. Math. Phys. 2, World Scientific, Singapore, 1987
- [56] C. Kassel and J.-L. Loday, *Extensions centrales d'algèbres de Lie*. *Ann. Inst. Fourier (Grenoble)* **32** (1983), no. 4, 119–142
- [57] J.-L. Loday and D. Quillen, Homologie cyclique et homologie de l'algèbre de Lie des matrices. *C. R. Acad. Sci. Paris Sér. I Math.* **296** (1983), no. 6, 295–297
- [58] J.-L. Loday and D. Quillen, *Cyclic homology and the Lie algebra homology of matrices*. *Comment. Math. Helv.* **59** (1984), no. 4, 569–591
- [59] R. Longo, Real Hilbert subspaces, modular theory, $SL(2, \mathbb{R})$ and CFT. In *Von Neumann algebras in Sibiu*, pp. 33–91, Theta Ser. Adv. Math. 10, Theta, Bucharest, 2008
- [60] G. W. Mackey, *Imprimitivity for representations of locally compact groups. I*. *Proc. Nat. Acad. Sci. U.S.A.* **35** (1949), 537–545
- [61] P. Maier, *Central extensions of topological current algebras*. In *Geometry and analysis on finite- and infinite-dimensional Lie groups (Będlewo, 2000)*, pp. 61–76, Banach Center Publ. 55, Institute of Mathematics of the Polish Academy of Sciences, Warsaw, 2002
- [62] P. Maier and K.-H. Neeb, *Central extensions of current groups*. *Math. Ann.* **326** (2003), no. 2, 367–415
- [63] F. I. Mautner, *Geodesic flows on symmetric Riemann spaces*. *Ann. of Math. (2)* **65** (1957), 416–431
- [64] M. Mimura, *Homotopy theory of Lie groups*. In *Handbook of algebraic topology*, pp. 951–991, North-Holland, Amsterdam, 1995
- [65] S. Mohr dieck and R. Wendt, *Integral conjugacy classes of compact Lie groups*. *Manuscripta Math.* **113** (2004), no. 4, 531–547
- [66] C. C. Moore, *Ergodicity of flows on homogeneous spaces*. *Amer. J. Math.* **88** (1966), 154–178
- [67] C. C. Moore, *Restrictions of unitary representations to subgroups and ergodic theory: Group extensions and group cohomology*. In *Group Representations in Math. and Phys. (Battelle Seattle 1969 Rencontres)*, pp. 1–35, Lecture Notes in Phys. 6, Springer, Berlin, 1970
- [68] K.-H. Neeb, *Borel–Weil theory for loop groups*. In *Infinite dimensional Kähler manifolds (Oberwolfach, 1995)*, pp. 179–229, DMV Sem. 31, Birkhäuser, Basel, 2001
- [69] K.-H. Neeb, *Central extensions of infinite-dimensional Lie groups*. *Ann. Inst. Fourier (Grenoble)* **52** (2002), no. 5, 1365–1442
- [70] K.-H. Neeb, *Current groups for non-compact manifolds and their central extensions*. In *Infinite dimensional groups and manifolds*, pp. 109–183, IRMA Lect. Math. Theor. Phys. 5, De Gruyter, Berlin, 2004
- [71] K.-H. Neeb, *Towards a Lie theory of locally convex groups*. *Jpn. J. Math.* **1** (2006), no. 2, 291–468
- [72] K.-H. Neeb, *Non-abelian extensions of infinite-dimensional Lie groups*. *Ann. Inst. Fourier (Grenoble)* **57** (2007), no. 1, 209–271

- [73] K.-H. Neeb, [Semi-bounded unitary representations of infinite-dimensional Lie groups](#). In *Infinite dimensional harmonic analysis IV*, pp. 209–222, World Scientific, Hackensack, NJ, 2009
- [74] K.-H. Neeb, [On differentiable vectors for representations of infinite dimensional Lie groups](#). *J. Funct. Anal.* **259** (2010), no. 11, 2814–2855
- [75] K.-H. Neeb, [Semibounded representations and invariant cones in infinite dimensional Lie algebras](#). *Confluentes Math.* **2** (2010), no. 1, 37–134
- [76] K.-H. Neeb, [On analytic vectors for unitary representations of infinite dimensional Lie groups](#). *Ann. Inst. Fourier (Grenoble)* **61** (2012), no. 5, 1839–1874
- [77] K.-H. Neeb, [Holomorphic realization of unitary representations of Banach–Lie groups](#). In *Lie groups: structure, actions, and representations*, pp. 185–223, Progr. Math. 306, Birkhäuser/Springer, New York, 2013
- [78] K.-H. Neeb, [Positive energy representations and continuity of projective representations for general topological groups](#). *Glasg. Math. J.* **56** (2014), no. 2, 295–316
- [79] K. H. Neeb, [Semibounded unitary representations of double extensions of Hilbert-loop groups](#). *Ann. Inst. Fourier (Grenoble)* **64** (2014), no. 5, 1823–1892
- [80] K.-H. Neeb and H. Salmasian, [Differentiable vectors and unitary representations of Fréchet–Lie supergroups](#). *Math. Z.* **275** (2013), no. 1-2, 419–451
- [81] K.-H. Neeb, H. Salmasian, and C. Zellner, [Smoothing operators and \$C^*\$ -algebras for infinite dimensional Lie groups](#). *Internat. J. Math.* **28** (2017), no. 5, article no. 1750042, 32 pp.
- [82] K.-H. Neeb and F. Wagemann, [The second cohomology of current algebras of general Lie algebras](#). *Canad. J. Math.* **60** (2008), no. 4, 892–922
- [83] K.-H. Neeb, F. Wagemann, and C. Wockel, [Making lifting obstructions explicit](#). *Proc. Lond. Math. Soc. (3)* **106** (2013), no. 3, 589–620
- [84] K.-H. Neeb and C. Wockel, [Central extensions of groups of sections](#). *Ann. Global Anal. Geom.* **36** (2009), no. 4, 381–418
- [85] K.-H. Neeb and C. Zellner, [Oscillator algebras with semi-equicontinuous coadjoint orbits](#). *Differential Geom. Appl.* **31** (2013), no. 2, 268–283
- [86] E. Nelson, [Analytic vectors](#). *Ann. of Math. (2)* **70** (1959), 572–615
- [87] E. Nelson, [Time-ordered operator products of sharp-time quadratic forms](#). *J. Functional Analysis* **11** (1972), 211–219
- [88] G. I. Olshanskiĭ, [Spherical functions and characters on the group \$U\(\infty\)^X\$](#) . *Russian Math. Surveys* **37** (1982), 233–234
- [89] K. R. Parthasarathy and K. Schmidt, [Factorisable representations of current groups and the Araki–Woods imbedding theorem](#). *Acta Math.* **128** (1972), no. 1-2, 53–71
- [90] K. R. Parthasarathy and K. Schmidt, [A new method for constructing factorisable representations for current groups and current algebras](#). *Comm. Math. Phys.* **50** (1976), no. 2, 167–175
- [91] R. Penrose, [Zero rest-mass fields including gravitation: Asymptotic behaviour](#). *Proc. Roy. Soc. London Ser. A* **284** (1965), 159–203

- [92] R. Penrose and W. Rindler, *Spinors and space-time Vol. 2. Spinor and twistor methods in space-time geometry*. Cambridge Monogr. Math. Phys., Cambridge University Press, Cambridge, 1986
- [93] R. T. Powers, [Representations of uniformly hyperfinite algebras and their associated von Neumann rings](#). *Ann. Math. (2)* **86** (1967), 138–171
- [94] A. Pressley and G. Segal, *Loop groups*. Oxford Math. Monogr., Oxford University Press, Oxford, 1986
- [95] M. Reed and B. Simon, *Methods of modern mathematical physics. I. Functional analysis*. Academic Press, New York-London, 1972
- [96] W. Rudin, *Real and complex analysis*. 3rd edn., McGraw-Hill, New York, 1987
- [97] G. Segal, [Unitary representations of some infinite-dimensional groups](#). *Comm. Math. Phys.* **80** (1981), no. 3, 301–342
- [98] S. H. Shah, *Bicoloured torus loop groups*. Ph.D. thesis, Universiteit Utrecht, Nederland, 2017
- [99] Y. Shimada, [On irreducibility of the energy representation of the gauge group and the white noise distribution theory](#). *Infin. Dimens. Anal. Quantum Probab. Relat. Top.* **8** (2005), no. 2, 153–177
- [100] S. Solecki, [Unitary representations of the groups of measurable and continuous functions with values in the circle](#). *J. Funct. Anal.* **267** (2014), no. 9, 3105–3124
- [101] R. F. Streater, [A continuum analogue of the lattice gas](#). *Comm. Math. Phys.* **12** (1969), 226–232
- [102] Y. Tanimoto, [Ground state representations of loop algebras](#). *Ann. Henri Poincaré* **12** (2011), no. 4, 805–827
- [103] V. Toledano Laredo, *Fusion of positive energy representations of $LSpin(2n)$* . Ph.D. thesis, University of Cambridge, Cambridge, 1997, arXiv:math/0409044
- [104] V. Toledano Laredo, [Positive energy representations of the loop groups of non-simply connected Lie groups](#). *Comm. Math. Phys.* **207** (1999), no. 2, 307–339
- [105] B. Torr sani, [Unitary positive energy representations of the gauge group](#). *Lett. Math. Phys.* **13** (1987), no. 1, 7–15
- [106] B. L. Tsygan, [The homology of matrix Lie algebras over rings and the Hochschild homology](#). *Russian Math. Surv.* **38** (1983), no. 2, 198–199
- [107] A. M. Ver sik, I. M. Gelfand, and M. I. Graev, [Representations of the group \$SL\(2, \mathbf{R}\)\$, where \$\mathbf{R}\$ is a ring of functions](#). *Uspehi Mat. Nauk* **28** (1973), no. 5(173), 83–128
- [108] A. M. Ver sik, I. M. Gelfand, and M. I. Graev, [Irreducible representations of the group \$G^X\$ and cohomologies](#). *Funct. Anal. Appl.* **8** (1974), no. 2, 151–153
- [109] N. R. Wallach, [On the irreducibility and inequivalence of unitary representations of gauge groups](#). *Compositio Math.* **64** (1987), no. 1, 3–29
- [110] B. Walter, [Weighted diffeomorphism groups of Banach spaces and weighted mapping groups](#). *Dissertationes Math.* **484** (2012), 128

- [111] A. Wassermann, [Operator algebras and conformal field theory. III. Fusion of positive energy representations of \$LSU\(N\)\$ using bounded operators.](#) *Invent. Math.* **133** (1998), no. 3, 467–538
- [112] M. Weiner, [Conformal covariance and positivity of energy in charged sectors.](#) *Comm. Math. Phys.* **265** (2006), no. 2, 493–506
- [113] E. Wigner, [On unitary representations of the inhomogeneous Lorentz group.](#) *Ann. of Math. (2)* **40** (1939), no. 1, 149–204
- [114] C. Zellner, [On the existence of regular vectors.](#) In *Representation theory—current trends and perspectives*, pp. 747–763, EMS Ser. Congr. Rep., EMS Press, Zürich, 2017
- [115] P. Zusmanovich, The second homology group of current Lie algebras. *Astérisque* (1994), no. 226, 435–452. Errata on [arXiv:0812.2625](#)