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Division algebras and supersymmetry. II. (English) Zbl 1260.81222

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Deep connections between supersymmetry and the four normed division algebras (real numbers, complex numbers, quaternions and octonions) have been studied in [*J. C. Baez and J. Huerta*, Proceedings of Symposia in Pure Mathematics 81, 65–80 (2010; [Zbl 1210.81117](#))], where it was shown how an n -dimensional normed division algebra gives rise to vectors and spinors in $(n + 2)$ -dimensional spacetime, thereby yielding the 3- ψ 's rule. In this paper the authors construct vectors and spinors in $(n + 3)$ -dimensional spacetime, thereby yielding the 4- Ψ 's rule. They show also that the 3- ψ 's rule and 4- Ψ 's rule can be interpreted as cocycle conditions. In every dimension, a symmetric bilinear intertwining operator eating two spinors and then splitting out a vector gives rise to a super-Minkowski spacetime. The infinitesimal translation symmetries of this entity constitute a Lie superalgebra called *supertranslation algebra* in [Quantum fields and strings: a course for mathematicians. Vol. 1, 2. Material from the Special Year on Quantum Field Theory held at the Institute for Advanced Study, Princeton, NJ, 1996–1997. Providence, RI: AMS, American Mathematical Society (1999; [Zbl 0984.00503](#))], whose third and fourth cohomologies are respectively nontrivial in dimensions 3, 4, 6 and 10 in deep deference to the 3- ψ 's rule, and in dimensions 4, 5, 7 and 11 in deep deference to the 4- Ψ 's rule. It is shown that an $(n + 1)$ -cocycle on a Lie superalgebra naturally gives rise to a Lie n -superalgebra as an extension, thereby obtaining Lie 2-superalgebras and Lie 3-superalgebras as extensions of supertranslation algebras. The final section is devoted to constructing superstring Lie 2-algebras and the 2-brane Lie 3-algebras.

Reviewer: [Hirokazu Nishimura \(Tsukuba\)](#)

MSC:

[81T60](#) Supersymmetric field theories
[83E50](#) Supergravity
[11R52](#) Quaternion and other division algebras: arithmetic, zeta functions
[17A35](#) Division algebras
[17A70](#) Superalgebras

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