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	authors	<ul style="list-style-type: none">Bernard L. Julia	authors	<ul style="list-style-type: none">Julia, Bernard L.	DUPLICATES	964
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	id	id4782122667803499523	id	id-6429894279139787162		
	abstract	It seems to me at this time that two recent developments may permit fast progress on our way to understand the symmetry structure of toroidally (compactified and) reduced M-theory. The first indication of a (possibly) thin spot in the wall that prevents us from deriving a priori the U-duality symmetries of these models is to be found in the analysis of the hyperbolic billiards that control the chaotic time evolution of (quasi)homogeneous anisotropic String, Supergravity or Einstein cosmologies near a spacelike singularity. What happens is that U-duality symmetry controls chaos via negative constant curvature. On the other hand it was noticed in 1982 that (symmetrizable) "hyperbolic" Kac-Moody algebras have maximal rank ten, exactly like superstring models and that two of these four rank ten algebras matched physical theories. My second reason for optimism actually predates also the previous breakthrough, it was the discovery in 1998 of surprising superalgebras extending U-dualities to all (p+1)-forms (associated to p-branes). They have a super-nonlinear sigma model structure similar to the symmetric space structure associated to 0-forms and they obey a universal self-duality field equation. As the set of forms is doubled to implement electric-magnetic duality, they obey a set of first order equations. More remains to be discovered but the beauty and subtlety of the structure cannot be a random emergence from chaos. In fact we shall explain how a third maximal rank hyperbolic algebra BE_10 controls heterotic cosmological chaos and how as predicted Einstein's General Relativity fits into the general picture.	abstract	It seems to me at this time that two recent developments may permit fast progress on our way to understand the symmetry structure of toroidally (compactified and) reduced M-theory. The first indication of a (possibly) thin spot in the wall that prevents us from deriving a priori the U-duality symmetries of these models is to be found in the analysis of the hyperbolic billiards that control the chaotic time evolution of (quasi)homogeneous anisotropic String, Supergravity or Einstein cosmologies near a spacelike singularity. What happens is that U-duality symmetry controls chaos via negative constant curvature. On the other hand it was noticed in 1982 that (symmetrizable) "hyperbolic" Kac-Moody algebras have maximal rank ten, exactly like superstring models and that two of these four rank ten algebras matched physical theories. My second reason for optimism actually predates also the previous breakthrough, it was the discovery in 1998 of surprising superalgebras extending U-dualities to all (p+1)-forms (associated to p-branes). They have a super-nonlinear sigma model structure similar to the symmetric space structure associated to 0-forms and they obey a universal self-duality field equation. As the set of forms is doubled to implement electric-magnetic duality, they obey a set of first order equations. More remains to be discovered but the beauty and subtlety of the structure cannot be a random emergence from chaos. In fact we shall explain how a third maximal rank hyperbolic algebra \$BE_{10}\$ controls heterotic cosmological chaos and how as predicted Einstein's General Relativity fits into the general picture.Comment: Lecture at les Houches 200		
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