

Torsion in Superstring Theory

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Steven Hawking: Torsion is necessary to make superstring theory consistent.

Edward Witten: Superstring theory is a piece of 21st century physics that somehow

fell into the 20th century.

Vladimir Arnold: The A-D-E graphs classify all simple mathematical objects.

An: o-o-o...-o	1-1-1...-1	Z(n + 1)
SU(n + 1)	1	

Dn: o-o-o...-o	1-2-2..2-1	Q(2n)
o	1 1	
SO(2n)		

E6: o-o-o-o-o	1-2-3-2-1	TD(24)
o	2	
	1	

E7: o-o-o-o-o-o	1-2-3-4-3-2-1	OD(48)
o	2	

E8: o-o-o-o-o-o-o	2-4-6-5-4-3-2-1	ID(120)
o	3	

Torsion is a superfield that lives on superspace.

Superspace is a non-Riemannian manifold with both bosonic and fermionic coordinates.

Bosonic coordinates commute:

$$[x, y] = xy - yx = 0$$

Fermionic coordinates anticommute:

$$\{a, b\} = ab + ba = 0$$

The simplest version of superspace is the 8-d coset space of the 14-d graded Poincaré group with respect to the Lorentz subgroup.

This is generalizable to higher dimensional superspaces, bigger graded Lie groups.

Example: 11-d supergravity theory with 7 “hidden” dimensions, with E7 gauge group.

