

# A magic pyramid of supergravities

A. Anastasiou, L. Borsten, M. J. Duff, L. J. Hughes and S. Nagy

*Theoretical Physics, Blackett Laboratory, Imperial College London,  
London SW7 2AZ, United Kingdom*

alexandros.anastasiou07@imperial.ac.uk  
leron.borsten@imperial.ac.uk  
m.duff@imperial.ac.uk  
leo.hughes07@imperial.ac.uk  
s.nagy11@imperial.ac.uk

## ABSTRACT

By formulating  $\mathcal{N} = 1, 2, 4, 8$ ,  $D = 3$ , Yang-Mills with a single Lagrangian and single set of transformation rules, but with fields valued respectively in  $\mathbb{R}, \mathbb{C}, \mathbb{H}, \mathbb{O}$ , it was recently shown that tensoring left and right multiplets yields a Freudenthal-Rosenfeld-Tyts magic square of  $D = 3$  supergravities. This was subsequently tied in with the more familiar  $\mathbb{R}, \mathbb{C}, \mathbb{H}, \mathbb{O}$  description of spacetime to give a unified division-algebraic description of extended super Yang-Mills in  $D = 3, 4, 6, 10$ . Here, these constructions are brought together resulting in a *magic pyramid* of supergravities. The base of the pyramid in  $D = 3$  is the known  $4 \times 4$  magic square, while the higher levels are comprised of a  $3 \times 3$  square in  $D = 4$ , a  $2 \times 2$  square in  $D = 6$  and Type II supergravity at the apex in  $D = 10$ . The corresponding U-duality groups are given by a new algebraic structure, the magic pyramid formula, which may be regarded as being defined over three division algebras, one for spacetime and each of the left/right Yang-Mills multiplets. We also construct a *conformal magic pyramid* by tensoring conformal supermultiplets in  $D = 3, 4, 6$ . The missing entry in  $D = 10$  is suggestive of an exotic theory with  $G/H$  duality structure  $F_{4(42)}/\text{Sp}(3) \times \text{Sp}(1)$ .

# A Magic Pyramid Of Supergravities Researchgate

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