

A century of Charge Quantization.

quantized charge	expression	charged object	quantizing cohomology theory	see
magnetic flux	$[F_2(A)]$	gauge monopole	ordinary cohomology in degree 2	[Di31] [Fra97, §16.4e]
2nd Chern form	$[c_2(A)]$	gauge instanton	non-abelian cohomology $H^1(-; G_{\text{gauge}})$	[Ch50] [Ch51, §III]
1st Pontrjagin form	$[\frac{1}{2}p_1(\omega)]$	gravitational instanton	non-abelian cohomology $H^1(-; \text{Spin})$	
NS-flux	$[H_3]$	string	ordinary cohomology in degree 3	[Ga86] [FW99] [CJM02]
RR-flux	$[F_2\bullet]_{H_3}$	D-branes	twisted topological K-theory	[Wi98][Fr00] [GS19c]
shifted C-field flux	$[G_4 + \frac{1}{4}p_1(\omega)]$	M5-brane	twisted 4-Cohomotopy	[FSS19b, §3.4]
Hopf-WZ/ Page charge	$[H_3 \wedge (G_4 + \frac{1}{4}p_1(\omega)) + 2G_7]$	M2-brane	twisted 7-Cohomotopy	[FSS19c]
heterotic C-field flux	$[G_4 - \frac{1}{4}p_1(\omega)]$ $= [F_2 \wedge F_2]$	heterotic M5-brane	twistorial Cohomotopy	[FSS20b]
heterotic B-field flux	dH_3 $= \frac{1}{2}p_1(\omega_{\text{tot}}) - c_2(A)$	heterotic NS5-brane	$\mathbb{Z}_2^{\text{het}}$ -equivariant twistorial Cohomotopy	[SS20c]

References

- [CJM02] A. Carey, S. Johnson and M. Murray, *Holonomy on D-Branes*, Journal of Geometry and Physics Volume 52, Issue 2, October 2004, Pages 186-216 [arXiv:hep-th/0204199]
- [Ch50] S.-S. Chern, *Differential geometry of fiber bundles*, in: *Proceedings of the International Congress of Mathematicians*, 1950 [ncatlab.org/nlab/files/Chern-DifferentialGeometryOfFiberBundles.pdf]
- [Ch51] S.-S. Chern, *Topics in Differential Geometry*, Institute for Advanced Study, Princeton, 1951, [ncatlab.org/nlab/files/Chern-IASNotes1951.pdf]
- [Di31] P.A.M. Dirac, *Quantized Singularities in the Electromagnetic Field*, Proc. Royal Soc. **A133** (1931), 60-72, [doi:10.1098/rspa.1931.0130].
- [FSS19b] D. Fiorenza, H. Sati, and U. Schreiber, *Twisted Cohomotopy implies M-theory anomaly cancellation on 8-manifolds*, Commun. Math. Phys. **377** 3 (2020), 1961-2025, [arXiv:1904.10207].
- [FSS19c] D. Fiorenza, H. Sati and U. Schreiber, *Twisted Cohomotopy implies M5 WZ term level quantization*, Commun. Math. Phys. (to appear) [arXiv:1906.07417].
- [FSS20b] D. Fiorenza, H. Sati, and U. Schreiber, *Twistorial Cohomotopy implies Green-Schwarz anomaly cancellation*, [arXiv:2008.08544].
- [Fra97] T. Frankel, *The Geometry of Physics - An introduction*, Cambridge University Press, 2012, [doi:10.1017/CB09781139061377].
- [Fr00] D. Freed, *Dirac charge quantization and generalized differential cohomology*, Surveys in Differential Geometry, Int. Press, Somerville, MA, 2000, pp. 129-194, [arXiv:hep-th/0011220].
- [FW99] D. Freed and E. Witten, *Anomalies in String Theory with D-Branes*, Asian J. Math. 3:819, 1999 [arXiv:hep-th/9907189]
- [Ga86] K. Gawedzki, *Topological Actions in two-dimensional Quantum Field Theories*, in: *Nonperturbative quantum field theory* Springer 1986 [doi:10.1007/978-1-4613-0729-7_5]
- [GS19c] D. Grady and H. Sati, *Ramond-Ramond fields and twisted differential K-theory*, [arXiv:1903.08843].
- [SS20c] H. Sati and U. Schreiber, *Equivariant twistorial Cohomotopy implies Hořava-Witten localization to MO-planes in heterotic M-theory*, (in preparation)
- [Wi98] E. Witten, *D-Branes And K-Theory*, JHEP 9812:019, 1998 [arXiv:hep-th/9810188]