

MULTI-VALUED POTENTIALS AND PHYSICAL REALITY

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ABSTRACT

Riemann's paper [1] on multi-valued potentials in multiply-connected domains marks arguably the origin of topology. It prompted Lord Kelvin [2] to propose a correction to Green's first identity in potential theory, but his result remained almost unnoticed. Following Kelvin's own work we re-derive this result from first principles, and show how ideas and techniques introduced have important implications in modern physics and in current applications of multi-valued gauge theory in condensed matter physics [3].

- [1] Riemann, B. 1857 Lehrsätze aus der analysis situs für die Theorie der Integrale von zweigliedrigen vollständigen Differentialen. *J. Mathematik* **54**, 105-110.
- [2] Thomson, W. (Lord Kelvin) 1869 On vortex motion. *Trans. Roy. Soc. Edin.* **25**, 217-260.
- [3] Ricca R.L., Foresti M. 2022 Multi-valued potentials in topological field theory. In *Knotted Fields* (edited by R.L. Ricca & X. Liu), to appear, Springer.