

Abstract Submitted  
for the 4CS21 Meeting of  
The American Physical Society

**A new class of monopole solutions in five-dimensional general relativity and the role of negative scalar field energy in vacuum solutions<sup>1</sup>**  
YAROSLAV BALYTSKYI, University of Colorado Colorado Springs, DETLEF HOYER, Institut für Theoretische Elektrotechnik Technische Universität Hamburg (TUHH), Germany, ANATOLIY PINCHUK, University of Colorado Colorado Springs, LANCE WILLIAMS, Konfluence Research Institute Manitou Springs, Colorado, USA — Using numerical algebra tools, new classes of monopole solutions are obtained to the static, spherically-symmetric vacuum field equations of five-dimensional general relativity. First proposed by Kaluza, 5D general relativity unites gravity and classical electromagnetism with a scalar field. These monopoles correspond to bodies carrying mass, electric charge, and scalar charge. The Reissner-Nordström limit allows us to constrain the signature of the fifth component to be space-like, but valid solutions are obtained for either sign of the scalar field. We find that Kaluza vacuum solutions imply the scalar field energy density is the negative of the electric field energy density, so the total electric and scalar field energy of the monopole is zero. Yet the new solutions provide reasonable Reissner-Nordström and Coulomb limits in mathematical form, with varying possibilities for the scalar field. The vanishing of the total electric and scalar field energy density for vacuum solutions seems to imply the scalar field can be understood as a negative-energy foundation on which the electric field is built.

<sup>1</sup>This work was supported by DARPA DSO under award number D19AC00020.

Yaroslav Balytskyi  
University of Colorado Colorado Springs

Date submitted: 09 Sep 2021

Electronic form version 1.4