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Neutron Stars in Scalar-Tensor Theories: Analytic Scalar Charges and Universal Relations MICHAEL STEPNICZKA, KENT YAGI, University of Virginia — Neutron stars are ideal astrophysical sources to probe general relativity due to their large compactnesses and strong gravitational fields. For example, binary pulsar and gravitational wave observations have placed stringent bounds on certain scalar-tensor theories in which a massless scalar field is coupled to the metric through matter. A remarkable phenomenon of neutron stars in such scalar-tensor theories is spontaneous scalarization, where a normalized scalar charge remains order unity even if the matter-scalar coupling vanishes asymptotically far from the neutron star. On the other hand, certain quasi-universal relations have been found for global quantities of neutron stars (such as the moment of inertia and quadrupole moment) that are insensitive to the underlying equations of state. While most works on scalarization of neutron stars focus on numerical analysis, we derive accurate scalar charges *analytically*, providing ready-to-use expressions for scalar charges in massless scalar-tensor theories. We also find a new quasi-universal relation in these theories between the scalar charge and stellar binding energy (related to stellar compactness) and give mathematical support for this relation.

Michael Stepniczka
University of Virginia

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