

# Four of a kind: $I$ -Love- $Q$ - $\delta M$

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## ABSTRACT

*In a recent work [1] we applied a rigorous perturbed matching framework [2] to show the amendment of the mass of rotating stars in Hartle's model [3]. Here, we apply this framework to the tidal problem in binary systems [4]. Our approach fully accounts for the correction to the Love numbers needed to obtain the universal  $I$ -Love- $Q$  relations [5]. This correction arises from the jump in the first derivative of one of the functions in the perturbations at the surface of the star, proportional to the energy density there. Hence it is relevant for linear equations of state, used to model quark stars. The combination of this correction for tidal numbers and the correction for the mass of rotating stars allows us to find a universal relation involving the second-order contribution to the mass  $\delta M$ . We thus complete the set of universal relations for the tidal problem in binary systems, involving four perturbation parameters, namely  $I$ , Love,  $Q$ , and  $\delta M$ . These relations can be used to obtain the perturbation parameters directly from observational data.*

## References

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