Winner of the DTP/WITP Ph.D. Thesis Competition 2018

27 March 2018

Dear DTP and WITP members:

It was encouraging to see the quality and range of work submitted to our DTP/WITP PhD Thesis Prize Competition this year. The selection committee composed of Svetlana Barkanova, Khodr Shamseddine and Masoud Ghezelbash reviewed six theses in total and arrived at the following top three (listed in alphabetical order):

1. **Philippe Landry**, University of Guelph, supervised by Eric Poisson.

   Thesis title: *Tidal Response of a Rotating Neutron Star in General Relativity*

2. **Evan McDonough**, McGill University, supervised by Robert Brandenberger and Keshav Dasgupta

   Thesis title: *High Energy Physics and the Early Universe*

3. **Alexander R. H. Smith**, University of Waterloo, supervised by Robert B. Mann, Marco Piani and Daniel R. Terno.

   Thesis title: *Detectors, Reference Frames, and Time*

Of the top three, the committee selected **Philippe Landry** as the winner. Philippe's abstract can be found at the end of this message. Congratulations Philippe!

Philippe Landry receives a prize of $500 and will give an invited talk at Theory Canada 13 where the prize will be awarded. Theory Canada 13 will be held at St. Francis Xavier University, Antigonish, NS , June 7-9, 2018 (a few days prior to the CAP Congress 2018). http://physics.stfx.ca/TC13/index.html

We thank all those who submitted this year and look forward to your submissions in 2019. Note that, except for the winner, those who submitted this year can submit again next year provided their thesis was completed after January 15, 2017.

Svetlana Barkanova, chair of the selection committee and DTP past chair

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Philippe's abstract:

Internal-structure-dependent tidal deformations in inspiralling neutron star binaries alter the phase of the gravitational waves generated by these systems' orbital motion. Measurement of the tidal phase shift could serve as a probe of the neutron star equation of state, which is poorly constrained above nuclear density. Motivated by this prospect, we extend the general relativistic theory of tidal deformations to the astrophysically relevant case of spinning bodies. Working in a perturbative framework of weak, slowly varying tides and slow rotation, we find that the familiar gravitational Love numbers K_2^{el} and K_2^{mag} which fully describe the external geometry of a deformed nonrotating body, must be supplemented by rotational-tidal Love numbers to account for couplings between the body's spin and the applied tidal field. By

integrating the Einstein field equations inside the body, we compute the rotational-tidal Love numbers explicitly for polytropes, and we find that they vanish identically for black holes. The field equations also reveal that the tidal field generically induces time-dependent fluid motions within the rotating body; these tidal currents are dynamical even if the tidal field is stationary. We calculate the amplitude of the currents for a typical neutron star in an equal-mass binary system, and find that it is on the order of kilometers per second.