Western University
Department of Physics and Astronomy

PHYSICS & ASTRONOMY COLLOQUIUM

Date: **Thursday, 10 September 2020**
Time: **1:30 p.m.**
via Zoom:

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"Things we teach in elementary Physics and probably should not!"

ABSTRACT

In this slightly tongue-in-cheek presentation, I will speak about some unique dilemmas pertaining to teaching Physics at elementary levels (first and even second-year). While it would be nice to teach things 'from the ground up', making no assumptions and gradually and smoothly unfolding all of Physics, it is not possible, and often it is necessary to introduce topics 'before their time'. Examples include things like force-field inverse square laws, equipartition of energy, over-simplified 'proofs' containing inherent errors, application of inviscid equations to nominally viscous fluids, and even the particle nature of matter. We often need to appeal to some sort of unproven 'common-sense' rather than a robust proof. Equipartition of energy is a good example: it is presented in thermodynamics as obvious that the energy associated with rotation, vibration, translation in a molecule (once activated) are all equal per degree of freedom. An astute student who questions this assumption is basically asked *"Is it not obvious?"* Or *"Is it not, at least, reasonable?"* Yet students do not see a proof of this equality until much later, and the most general proof involves knowledge of the partition function—far beyond the capabilities of a first-year student. Furthermore, students then learn that this 'reasonable law' is not, in fact, obvious, and requires an energy which is a quadratic in displacement or velocity. Exceptions to the equipartition rule, in fact, abound (e.g. turbulence studies), and are still not fully comprehended even by some experienced scientists.

Many examples of 'approximate Physics' (for want of a better term) abound, and infiltrate the Internet. The number of *incorrect* explanations of aircraft flight on the web vastly outweigh the number of *correct* ones, and students only discover, much later, that use of Bernoulli's theorem to describe flight is in direct violation of Kelvin's circulation theorem for inviscid flow, for example. Many other examples exist, including even the wave-function collapse proposed in the Copenhagen interpretation.

The purpose of the talk is not to change things—that would be impossible. But some consideration needs to be given to just when *we do* give students a better approximation of the truth, recognizing that it needs to be done in a way that does not denigrate too severely the concepts taught in earlier years. Furthermore, students who do not continue in Physics after first year can be left with long-lasting impressions that are incorrect.

Open discussion will be encouraged—bring your thoughts.

Footnote: in my last session as Colloquium chair, I offered free vegemite sandwiches to all attendees at the first Colloquium. Based on this study, it seems culture is not universal. I therefore will NOT be offering free **VVS* this time around.

**VVS = Virtual Vegemite Sandwiches*

Host: **Prof. R.J. Sica**