Samirnath Mallik & Sourav Sarkar, Hadrons at Finite Temperature (2nd Copy), Cambridge University Press, 2016; pp. 262; ISBN: 978-1107145313; Price: 119.55.

Supersymmetry, Supergravity, and Unification (Cambridge Monographs on Mathematical Physics), Pran Nath, Cambridge University Press, 2016; pp. 536; ISBN: 978-0521197021; Price: 94.99.

Supersymmetry, Supergravity, and Unification (Cambridge Monographs on Mathematical Physics) - 2nd Copy, Pran Nath, Cambridge University Press, 2016; pp. 536; ISBN: 978-0521197021; Price: 94.99.

The Structure and Dynamics of Cities: Urban Data Analysis and Theoretical Modeling, Marc Barthelemy, Cambridge University Press, 2017; pp. 278; ISBN: 978-1107109179; Price: 94.99.

Book Reviews / *Critiques de livres*

Book reviews for the following books have been received and posted to the Physics in Canada section of the CAP's website: http://www.cap.ca.

Des revues critiques ont été reçues pour les livres suivants et ont été affichées dans la section "La Physique au Canada" de la page web de l'ACP: http://www.cap.ca.

Electricity and Magnetism by Edward Purcell, Cambridge University Press, 2013, pp: 484, ISBN: 978-107-01360-5, price 70.00.

This second edition was first published in 1985, and is based on the first edition first published in 1963. This textbook in its variety of editions is widely used for Electricity and Magnetism courses at the undergraduate level. It was originally written as part of a series of four courses that formed the core of the Berkeley undergraduate physics degree. It should be noted that there is a third edition by Purcell and Morin, that has been updated with additional examples and the use SI units instead of the cgs units of this second edition. The book would be good for a second year undergraduate physics course, where the students are already getting some exposure to vector calculus in concurrent math courses. I would place its level as being slightly simpler than that of Griffiths, "Introduction to Electrodynamics," but above the typical first year textbook treatment.

The first chapter largely covers electric fields from point charges and continuous charge distributions, and introduces Gauss' law. There are sections on electrical energy, force on a layer of charge and energy associated with the electric field that feel a bit out of place, but otherwise the description is excellent. The addition of the examples in the third edition are very welcome.

The second and third chapters present the electric potential, and electric fields around conductors which includes capacitance of different arrangements of conductors. The treatments of both of these is very well done. The fourth chapter on electric currents builds up to DC circuits from a fundamental level.

Chapter five describes the electric field from a moving point charge, in a way I haven't seen in other introductory textbooks. It assumes that students already have some familiarity with special relativity and derives what the electric field from a moving charge looks like. The description is again very well done, and leads to a picture of what the electric field around an accelerating charge looks like.

Chapters six and seven introduce the magnetic field and electromagnetic induction respectively. Inductance and circuits with inductive components are introduced near the end of chapter seven.

The eighth chapter is on alternative current circuits, and is done using complex impedance and admittance as it should be at this level.

Chapter nine introduces the displacement current, and Maxwell's equations in differential form. Electromagnetic waves are then shown to result from these equations. Plane wave propagation and the power density in electromagnetic waves is described.

Chapters ten and eleven describe electric field in matter and magnetic fields in matter respectively. The exposition again proceeds from fundamental physics arguments, starting from the electric dipole for electric fields in matter, leading to a description of dielectrics in capacitors. Magnetization and ferromagnetic materials are also introduced.

In summary this textbook introduces electricity and magnetism in a nice logical order. Electricity and magnetism is of course the favourite first application of the vector calculus methods in a physics course, and the text does a good job of introducing the mathematics as it is being used, rather than in a separate introductory chapter with just the math. The figures are simple grey scale but are well done, and augment the description of the concepts which are presented in a practical and pedagogical way. I would recommend the third edition over this edition, due to the additional examples provided, and the use of SI units.

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Incoming Asteroid! What Could We Do about It by Duncan Lunan, Springer, 2013, pp: 390, ISBN 146148748X (ISBN 13: 9781461 487487), price 54.12.

Once in a while, we get smacked on the head by one of the millions of Near Earth Objects (NEOs) that cross our planet's orbital trajectory. One of those bolides created quite a commotion in Russia a few years ago; the Chelyabinsk meteor was an atmospheric phenomenon due to a small asteroid entering the atmosphere at a shallow angle, at speeds of 19-20 km/s over Russia in February 2013. Exploding catastrophically in mid-air, it generated a shower of smaller meteorites and a detonation shock wave, releasing about 2PJ of energy, or 500kT of TNT, nearly 30 times Hiroshima! The small object measured approximately 20 m in diameter and weighted some 12 kT. No fatalities were reported, but one thousand people were injured.

On the other end of the scale, the Chixhulub impact in Yucatan, which coincided with the geological Cretaceous–Paleogene boundary (K–Pg boundary) around 66 million years ago, was 500 times larger and released more than 400 ZJ (Zeta Joules) - or over a billion times the energy of the atomic bombings of Hiroshima and Nagasaki. Leading to one of the six major planetary extinction events in earth's history, accompanied with the passing away of 75% of all planetary biota.

At impact, most of the kinetic energy is transformed into a detonation. The pock marks and craters on the face of the earth and the moon tell us that statistically, a small meteorite under 5 m will reach us every 10 years. A larger one in the 100m range will occur every 11 ky and a 1km diameter impactor will reach us every half million years or so.

We have yet to record a death from a meteorite impact, although statistically there is a probability of one person for every 200,000, being hit in a

lifetime! The record of injuries in the 2013 Russian airburst is a potent indicator of meteoritic risk.

As a planetary scientist by trade and passion, and having participated in multiple NASA closed workshops on the subject of deflecting asteroids off earth's trajectory and other associated conferences in the 80s, I was very much interested in reviewing this book. My interest was further stimulated from witnessing a sub-meter airburst last fall, while driving to my cottage in the Laurentians, and from having a friend who co-founded Planetary Resources, a US West coast start-up bent on mining NEO bodies. The first event served as a reminder that the comfort of the recent time spell without incident is not representative of an abatement in overall risk, and while it is true that we have been living through a quiet large meteoritic period, the real probability of an impact has nonetheless not decreased with time. This is the very theme of Incoming Asteroid! What could we do about it? by Duncan Lunan.

The author's interest in the subject stems from a project within ASTRA (the Association in Scotland to Research into Astronautics) the Scottish equivalent of the British Astronautical Society, in the 80s. The intemporally relevant question he asks is 'what would we do if we knew there was going to be an asteroid impact in ten years' time or less?'. The main scenario being considered is an impactor of 1kilometer emanating from the asteroid belt. The key factor in the question is the 10 yr period, thus an impending as opposed to a putative impact. If lower than 10 years, the impact more or less becomes a *fait accompli*, and if much longer (for instance crossing many decades) then the urgency for immediate action would not exist. Lunan tells us first and foremost, that effecting changes in human behaviour necessitates a sense of urgency. As such, a NEO impact has an advantage over climate change, as the potential to instill panic in the population, is present and rapid.

The author proposes 3 *possible courses of action*: 1. We do nothing, 2. we attempt to deflect the incoming boulder using various push-out-of-way techniques, or 3. we try to blow the asteroid to kingdom come. The sci-fi aficionados, within the scientific community, will readily identify the two later options as being Hollywoodian in nature. As a matter of fact, I also saw movies treating of the first option as well. The book then discusses the political will to proceed to an action-oriented scenario.

This is where Lunan discusses the possible reactions of leaders. Would a post-factual president not believe in the impending disaster and decide to revert to option 1., and do nothing? Akin, metaphorically, to the slowly evolving meta climatic problems we are now facing. Possibly not, according to our optimistic writer, because of the economic benefit of spending trillions on removing the threat would enable us to develop more rapidly key value-added technologies and, *de facto*, become a planetary civilisation which could exploit the planetary resources bounty.

Although published by Springer in their mechanical engineering series, Lunan's book is really meant for the larger readership in hope of raising, within the public and policy maker, the spectre of an impactor's menace into actionability band - the media analogy of raising an electron to the valence band. It is, as such, recommendable and largely a good read. The oft flashbacks to the Sci-fi culture are not distractive and are quite enjoyable. The book is filled with historical references, those that one can forget in the fog-of-science, those brought back a lot of found memories to me.

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EXPERIMENTAL STUDIES OF NEUTRINO OSCILLATIONS by Kajita, Takaaki, World Scientific Publishing, 2016, pp: 98, ISBN 978-981-4759-26-7, price 46.80.

In 2015 Takaaki Kajita and Arthur B. McDonald were awarded the Nobel Prize in Physics for the discovery of neutrino oscillations. To celebrate his achievement, World Scientific Publishing released **Experimental Studies of Neutrino Oscillations** which is a collection of papers by Kajita. These papers were previously published in various conference proceedings between 2000 and 2009. Because Kajita heads the Super-Kamiodande (Super-K) collaboration, the book predominantly presents results from the Japanese neutrino observatories.

The book summarizes the current status of the neutrino oscillation measurements and discusses the next-generation experiments. Neutrino oscillations were discovered by the Kamiokande detector (1988) when the measured ratio of muon to electron neutrinos from the atmosphere fell well below predicted values. This deficit could be explained by neutrino flavour oscillations which implies that neutrinos have nonzero mass. Ten years later, the larger Super-K detector measured the zenith angle dependence of the neutrino flux. The deficit of downward-moving muon neutrinos that travel 15 km from the upper atmosphere to reach the detector was minimal, whereas a large deficit was found for upward-moving muon neutrinos that travelled 12800 km through the earth before being detected. The Super-K data showed that muon neutrinos were oscillating to either tau neutrinos or hypothetical sterile neutrinos (neutrinos that interact with matter only via the gravitational force).

The collaboration was able to place experimental bounds on the flavour mixing angle and the mass-squared difference. Kajita also explains how the Sudbury Neutrino Observatory (SNO) and the Japanese experiment kamLAND studied the deficit of solar electron neutrinos. These measurements gave evidence of electron neutrino oscillations and led to experimental bounds on a second mixing angle and mass difference.

In the most recent Super-K measurements, the collaboration has searched for evidence of either solar or atmospheric neutrinos oscillating to sterile neutrinos. So far, there is no experimental evidence in favour of the sterile neutrino. The Tokai to Kamioka (T2K) experiment uses an intense beam of accelerator-produced neutrinos that is directed to Super-K 295 km away. T2K is currently trying to measure the third mixing angle which is thought to be very small. The collaboration will also attempt to find evidence of CP violation by looking for differences between neutrino oscillations and anti-neutrino oscillations. This project may require an even larger detector, called Hyper-Kamiokande. In addition to searching for CP violation, the next generation neutrino experiments will also attempt to determine the ordering of the mass eigenstates.

Experimental Studies of Neutrino Oscillations by Kajita provides a nice summary of the current state of neutrino oscillation physics and the goals of the next generation experiments. The conference papers included in the collection do not provide a lot of experimental details, but rather focus on the results of the measurements and their implications. Because the seven papers occur over a relatively short time, there tends to be substantial repetition. Overall the book is an interesting read, but someone interested in the past, present, and future of experimental neutrino oscillation physics may get more value out of a good review article.

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