CITA ICAT Jamboree 2015

Canadian Institute for Theoretical Astrophysics
L'institut Canadien d'astrophysique théorique

1:00 PM — Introduction

Norman Murray murray@cita.utoronto.ca	**CITA** Introduction to CITA

1:05 PM — Theoretical Astrophysics

Norman Murray murray@cita.utoronto.ca	**Formation and evolution of stars and planets**
Ue-Li Pen pen@cita.utoronto.ca	**Pulsar Lensing** Pulsar radiation propagates through the ISM to arrive at earth along multiple paths which interfere and lead to scintillation. VLBI enables precision mapping of the lensing geometry, which in turn allows picoarcsecond localization of pulsar emission, enabling distance, mass and other measurements.
Peter G. Martin pgmartin@cita.utoronto.ca	**Why bother with the ISM (and why the ISM is a bother)** I will explain why this cool picture is hanging on my door, speculating on dust, gas, and magnetic fields.
Chris Thompson thompson@cita.utoronto.ca	**Topics in Theoretical Astrophysics** My recent and ongoing research activity explores the dynamics of very dusty gas, protoplanetary disks and planet formation, stellar rotation, magnetars,electromagnetic emission from relativistic outflows, and gamma-ray bursts.
Terrence Tricco ttricco@cita.utoronto.ca	**Simulating star formation with smoothed particle magnetohydrodynamics** I've been developing numerical methods to simulate magnetohydrodynamics with smoothed particle hydrodynamics. I will very generally discuss these along with some simulation results studying the effect of magnetic fields in the formation of low-mass stars and turbulence in molecular clouds.

Andrey Vayner avayner@cita.utoronto.ca	**Capturing Quenching Mechanisms in Distant Quasar Host Galaxies** I will present near-diffraction limited laser guide star observations of $1.4 < z < 2.5$ QSO host galaxies taken with the OSIRIS integral field spectrograph at the W.M. Keck observatory. Our observations are designed to remove the bright QSO to study the faint underlying host galaxy to search for evidence of direct radio jet feedback on star forming regions.
Dan Tamayo d.tamayo@utoronto.ca	**How the Protoplanetary Disk Shapes the Architectures of Planetary Systems** The protoplanetary disk will affect the dynamics of forming planets in important ways. I am working on incorporating these effects into N-body simulations, and on using theory and such simulations to understand the planetary architectures we observe around other stars.
Matt Russo mrusso@cita.utoronto.ca	**The Inner Life of Protoplanetary Disks** My work attempts to constrain the structure and evolution of PPDs through interactions with a protostellar wind and the population of suspended grains.
Cristobal Petrovich cpetrovi@cita.utoronto.ca	**New applications of the three-body problem to exoplanet systems** I will show some new applications of the three-body problem that attempt to explain the orbital architecture of two different populations of exoplanet systems: (1) planets around orbital resonances discovered by the Kepler spacecraft, and (2) gas giant planets in extreme orbital configurations mostly discovered by radial velocity and ground-based transit surveys.
Hanbo Wu hanbo@cita.utoronto.ca	**Influence of Atmospherical Thermal Tides on Planet's Rotation** Stromatolite data have shown that the Earth's present rate of spin deceleration is anomalously high. The day length throughout much of the Precambrian era is relatively constant near 21 hour until 600 Ma, when it quickly increased to the present 24 hours. The atmospheric torque could have been comparable in magnitude but opposite in direction to the lunar torque, halting the Earth's spin deceleration. We are running a series of simulations to search for resonant atmosphere response around 21 hours period.
Ian Parrish iparrish@cita.utoronto.ca	**Galaxy Clusters & Plasma Astrophysics** I am interested in a variety of astrophysical plasmas from the intracluster medium to accretion flows to the solar wind. I also study the lifecycle of gas in systems from thermal instability to star formation.

Robert Main ramain@cita.utoronto.ca	**Probing fundamental physics of pulsars using scintillometry** Pulsar radiation is scattered in the interstellar medium, resulting in multiple interfering images. My research is focused on using these scattered images as an interstellar interferometer to study pulsars with incredible precision.
Yevgeni Kissin kissin@cita.utoronto.ca	**Rotation in red giants and magnetism in white dwarfs** I will discuss a new proposed rotation profile for red giants, supported by Kepler observations, which facilitates the growth of strong magnetic fields seen in white dwarfs

1:50 PM — Cosmology

Dick Bond bond@cita.utoronto.ca	**Entangled in the Complex Webs of the Universe** A sampling of current projects will be given, drawn from explorations: of the cosmic superweb, e.g., intermittent non-Gaussianity, as might be revealed in anomalies in the CMB and LSS; of the cosmic web, e.g., improved cosmic displacements and flows from hierarchical potential pits, beyond peak-patches; of the interstellar web as revealed by Planckian dust intensity and polarization maps.
Marcelo Alvarez malvarez@cita.utoronto.ca	**Taking Structure Formation out of the Black Box** Theoretical studies of large scale structure very often involve performing large N-body simulations that evolve small random fluctuations forward in time under the influence of gravity. At the end of the simulation, structures such as halos are found, and their properties are analyzed in an effort to understand structure formation better and to compare to observations. I describe an approach we're taking at CITA to simulate halo formation by explicitly following the peaks from which the halos collapse, called peak patches. This approach not only allows for much larger and faster simulations, but also provides a deeper understanding of the process of structure formation itself.
George Stein gstein@cita.utoronto.ca	**Full-Sky Mock Simulations With the Peak Patch Approach** A new massively parallel implementation of the Peak Patch picture nears completion. As this method has the ability to quickly generate hundreds of mock universes much more efficiently than any Nbody the applications are plenty.
Philippe Berger pberger@cita.utoronto.ca	**The 21 cm line: from emission to observation** The 21 cm wavelength emission of cosmic neutral hydrogen, which traces the matter distribution, is redshifted by the expansion of the universe before being measured by the CHIME telescope, thus providing a three dimensional map thereof.

Liam Connor liam.dean.connor@gmail.com	**Observing the time and spatially fluctuating radio sky with CHIME** CHIME will make the biggest ever large-scale structure survey by mapping out diffuse HI emission. It will also see large swaths of pulsars each day and observe hundreds if not thousands of fast radio bursts (FRBs). I will talk about my work on these projects.
JD Emberson emberson@astro.utoronto.ca	**Simulating the universe on small and large scales at early and late times** I will discuss the research projects I have been working on at CITA over the past five years of my PhD work. These include hydrodynamic reionization simulations, substructure evolution within a galactic host, and neutrino plus cold dark matter N-body simulations.
Xin Wang xwang@cita.utoronto.ca	**Understanding the large-scale structure of the Universe** The large-scale structure of the Universe encodes valuable information about various physical processes. I'll explain (1) how to use sophisticated perturbation theory to describe the nonlinear clustering of bias tracer; (2) how to obtain statistically averaged evolution of individual fluid element in Newtonian cosmology; and eventually (3) how different observational techniques would help us to understand our questions.
Sandrine Codis codis@cita.utoronto.ca	**From cosmology to galaxy formation : what can we learn from the large-scale structure of the Universe?** The study of the large-scale structure of the Universe plays a paramount role in our quest to answer the fundamental questions at the heart of Cosmology: (i) What are the constituents of our Universe and what laws dictate its behaviour? (ii) What is the role of the environment in shaping galaxies? I will describe recent theoretical advances along those two lines.
I-Sheng Yang isheng.yang@gmail.com	**Everything about Gravity** Visualizing geometry in cosmology, astrophysics and AdS/CFT.
Joel Meyers jmeyers@cita.utoronto.ca	**The Cosmic Neutrino Background** Cosmic neutrinos carry a wealth of information about both cosmology and particle physics, but they are notoriously difficult to observe. I will discuss the current status and future prospects for indirect observation of cosmic neutrinos.
Derek Inman inmand@cita.utoronto.ca	**Neutrino Simulations** I run large N-body simulations containing cold dark matter and neutrino particles. These simulations allow us to better understand neutrino evolution and quantify potentially observable effects such as neutrino wakes behind collapsed structures.

Dana Simard simard@cita.utoronto.ca	**Massive Neutrinos in ΛCDM** The behavior of the cosmic neutrino background in the presence of non-linear structure formation has yet to be fully explored due to the computational expense of N-body simulations including neutrinos. I will discuss a method of modeling the cosmic neutrino background that includes the full non-linear description of dark matter without requiring simulations of neutrinos.
Zhiqi Huang zqhuang@cita.utoronto.ca	**Is ΛCDM Still Our Best Bet** I search for signals beyond ΛCDM in the CMB data and study modified gravity models.
Alex Van Engelen engelen@cita.utoronto.ca	**The CMB as a backlight** The time at which the Universe became transparent to CMB photons is inaccurately known as the epoch of last scattering. CMB photons have in fact undergone many processes more recently, including interactions with hot electrons in Galaxy clusters (the Sunyaev-Zel'dovich effect); gravitaional deflections from dark matter (gravitational lensing); scattering during and after reionization; and red- and blueshifting after the onset of dark energy (the integrated Sachs-Wolfe effect). Each of these effects is observable and offers a unique way to track the growth of structure in the Universe.
Daan Meerburg meerburg@cita.utoronto.ca	**The Cosmic Lab** Through the careful analysis of cosmological data, we can establish a better understanding of the physics in the early Universe. My work focusses theoretical model building and developing new (observation) methods to extract information from cosmological tracers.

2:40 PM — General Relativity

Kipp Cannon kcannon@cita.utoronto.ca	**Gravitational Wave Transient Astronomy** Advanced LIGO is now in observing mode and we are transmitting low-latency alerts to transient telescope partners. What are we up to and what might we find?
Prayush Kumar prkumar@cita.utoronto.ca	**Finding gravitational waves from binary black holes** Gravitational-wave (GW) astronomy is about to enter into a new era with the second-generation LIGO/Virgo detectors beginning operation soon. My work revolves around improving searches for GW signals from two-body systems of black holes, using results from analytic & numerical relativity. I will show some recent applications of numerical relativity in GW searches.

Aaron Zimmerman azimmer@cita.utoronto.ca	**Perturbation theory and black holes** I work on an array of topics dealing with perturbations of compact objects. I also study simulations of merging black holes, using new tools to compare with analytic approximations.