2014 CfA Summer Colloquium Series

The Summer Colloquium series provides a broad introduction to the research going on at the CfA. Summer interns and other junior staff are particularly encouraged to attend but all are welcome. Talks are in Phillips Auditorium at 4 pm preceded by refreshments at 3:30 pm.

June 12: Large Scale Structure with Galaxy Redshift Surveys

Dr. Cameron McBride  
Harvard-Smithsonian Center for Astrophysics

Exciting fundamental questions about our Universe continue to arise in the domains of Cosmology and Galaxy Formation. This is especially true now, as there are a number of galaxy redshift surveys that did, continue to, and will soon provide incredible datasets to test and constrain our theoretical models. The statistical strength of these data push us to refine our theories, develop new methods of analysis, and define better ways to numerically simulate the data. I will briefly review some of the current research in the context of modern galaxy surveys, as well as the questions we want to address (both now and with future data). I will highlight some specific aspects of our ongoing research within BOSS (Baryon Oscillation Spectroscopic Survey), a part of the Sloan Digital Sky Survey III project.

June 26: Hot on the Trail of Warm Planets Orbiting Cool Stars

Prof. John Johnson  
Harvard University

Just three years ago the prospect of finding temperate, rocky worlds around other stars was still the subject of science fiction: none had been found and reasonable estimates put us years or decades away from such a momentous discovery. All of that has changed very recently on the heels of the extraordinarily successful NASA Kepler mission. By searching for the tiny diminutions of starlight indicative of an eclipsing planet, Kepler has produced thousands of new planet candidates orbiting distant stars. Careful statistical analyses have shown that the majority of these candidates are bona fide planets, and the number of planets increases sharply toward Earth-sized bodies. Even more remarkably, many of these planets are orbiting right next door, around tiny red dwarf stars. I will describe our multi-telescope campaign to validate and characterize these tiny planetary systems, and present some early, exciting results that point the way to the first detection of the first Earth-sized planets in the habitable zones of nearby stars.
July 3: Stellar Winds Across the H-R Diagram

Dr. Steven Cranmer  
*Harvard-Smithsonian Center for Astrophysics*

All stars are believed to possess expanding outer atmospheres known as stellar winds. Essentially, all stars are continually "evaporating" gas from their surfaces, but the big questions are "how much" and "how fast?" The gas emitted by stellar winds has a significant impact on how stars evolve and on whether their surrounding planets are habitable. In this talk I will attempt to review our knowledge about how winds are driven from stars across the H-R Diagram. Young stars exhibit simultaneous disk accretion, polar jet-like outflows, and magnetic activity. We are only beginning to figure out "what drives what" in these complex environments. Main sequence stellar winds are divided into two types: (1) Hot, massive stars (O, B, Wolf-Rayet) have dense winds driven by radiation pressure. (2) Cool, solar-type stars have chromospheres and coronae that are heated to millions of degrees by magnetic effects and which also drive low-density winds. When both types of stars evolve into red supergiants, their mass loss rates increase due to some combination of strong radial pulsations and radiation pressure on dust grains.

July 10: B-Mode Polarization in the Cosmic Microwave Background with Bicep2 and the Keck Array

Chin Lin Wong  
*Harvard-Smithsonian Center for Astrophysics*

Inflation, which theorizes an exponential expansion in the early universe is expected to generate a background of gravitational waves. This primodial gravitational waves will imprint a B-mode polarization pattern in the Cosmic Microwave Background. Bicep2 and the Keck Array, a series of targeted experiments located at the South Pole, are optimized to target the degree angular scales at which this signal is expected to peak. Bicep2 has recently published a detection of B-mode polarization at degree angular scales. Bicep2 and the Keck Array use a small-aperture, cold, on-axis optical design that allow us to fully characterize the far-field performance of the instrument. I will briefly discuss the science, describe the Bicep2 and Keck Array instrument and the efforts to characterize the beam shapes at the South Pole.

July 17: Solar System Evolution from Compositional Mapping of the Asteroid Belt

Dr. Francesca DeMeo  
*Harvard-Smithsonian Center for Astrophysics*

Asteroids and other small bodies are markers, like tiny beacons, relaying information about the initial temperature and composition conditions of our Solar System revealed by their surface compositions, as well as the Solar Systems evolution fossilized in the scattering record of these bodies. Today we are armed with major advancements from the past decade that have revolutionized the field of asteroids in areas such as discovery, physical characterization, meteorite links, and dynamical models. Based on tens of thousands of measurements from the Sloan Digital Sky Survey, in this talk I present a new compositional map of the asteroid belt that reveals a greater diversity of asteroids as a function of size and distance. This new map differs greatly from the maps created three decades ago that showed a smooth gradient with distance from the sun suggesting a "calm" Solar System history. I will review the state of current models in the context of this new distribution map that support a much more dynamic evolutional history of the Solar System.
July 24: Extreme Supernovae: Transient Science in the Era of Wide-Field Untargeted Surveys

Maria Drout
Harvard-Smithsonian Center for Astrophysics

In the past three decades, the field of time-domain astronomy has been revolutionized by advances in both detector technology and survey strategy. Consider this: SN1987A – the closest supernova to Earth to explode in modern times – was the first supernova discovered in year 1987 when it was seen on Feb 23rd. Now, fast forward 27 years ... during an equivalent 54-day period this past winter, more than 200 supernovae and other astronomical transients were reported. This was made possible, in part, by the advent of wide-field untargeted transient searches such as the Panoramic Survey Telescope & Rapid Response System (Pan-STARRS1) and the Palomar Transient Factory (PTF). In this talk I will give a brief overview of the history of transient discovery and how modern transient searches are carried out, and then discuss two significant scientific advances that have come out of these surveys: (1) the construction of large, statistical, samples of known types of transients and (2) the discovery of rare classes of previously unknown transients such as superluminous supernovae, rapidly evolving supernovae, and tidal disruption events.

August 7: Chandra’s 15 Year Mission

Dr. Belinda Wilkes, Director, Chandra X-ray Center
Harvard-Smithsonian Center for Astrophysics

NASA’s Chandra X-ray Observatory was launched and deployed by the Space Shuttle Columbia on July 23, 1999, so this year we are celebrating our 15 year anniversary. A recent detailed engineering study shows no show-stoppers to a 25+ year mission, so we are planning on many more anniversaries.

Chandra represents a major step forward in our ability to study the X-ray Universe. In particular its exquisite (0.5") spatial resolution is unique in any currently operating or planned X-ray observatory.

X-rays originate in the hottest and most violent places in the Universe, from exploding stars to super-massive black holes. As with all major new facilities, Chandra has made many, exciting and ground-breaking discoveries, such as ~ 100s kpc-scale X-ray jets in active galaxies, including the first targeted source (a quasar), complex morphologies in clusters of galaxies, the largest gravitationally bound structures in the Universe, finding (or not finding!), for the first time, dense neutron stars in the centers of supernova remnants, and providing direct evidence for dark matter.

I will describe Chandra and its launch and tour selected scientific highlights and discoveries.