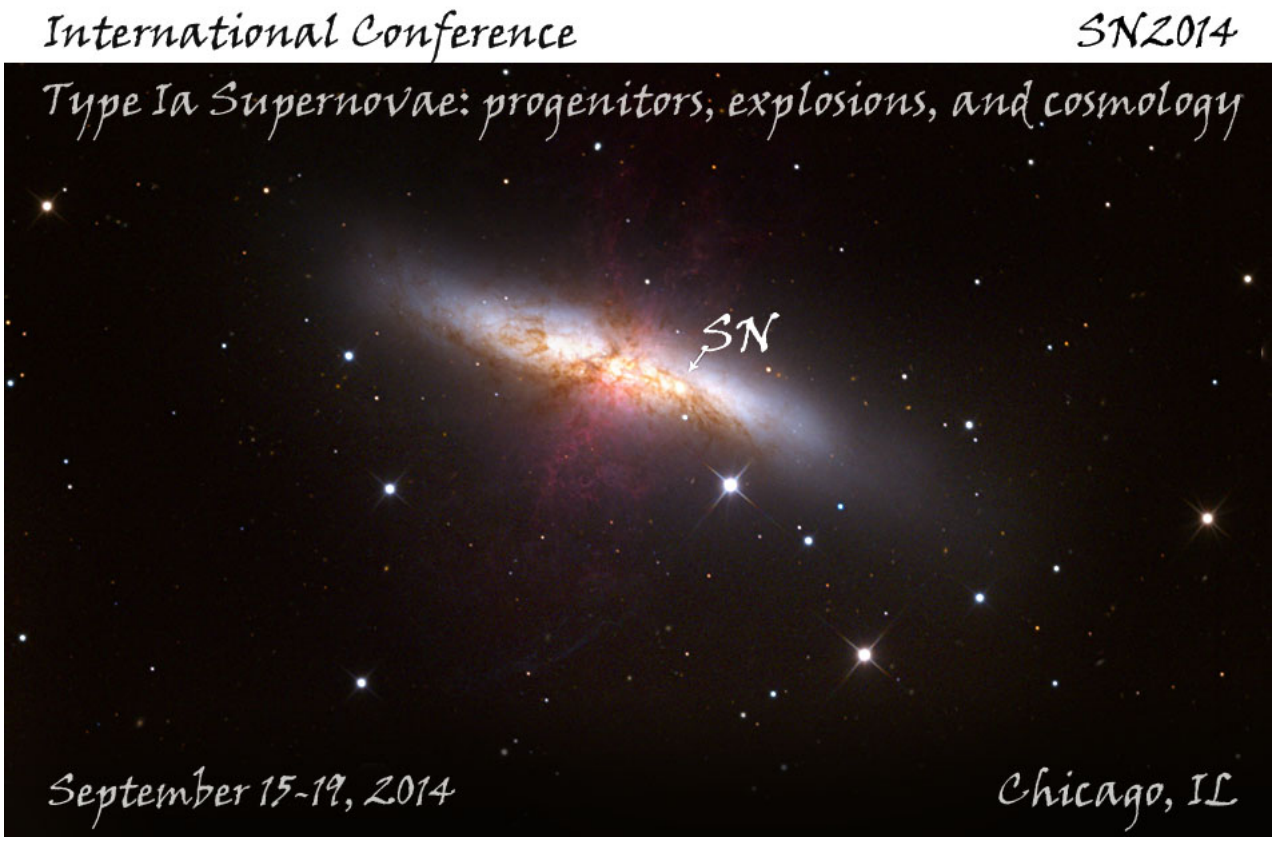

http://kicp-workshops.uchicago.edu/sn2014/

CONFERENCE PRESENTATIONS

The Joint Institute for Nuclear Astrophysics (JINA), the Kavli Institute for Cosmological Physics (KICP), and the Flash Center for Computational Science at the University of Chicago will host an International conference on the observations and simulations of thermonuclear "Type Ia Supernovae: progenitors, explosions, and cosmology" on on September 15-19, 2014. The conference will be held at the University of Chicago's Kersten Physics Teaching Center (KPTC).

Invited Speakers

Pierre Astier
LPNHE/ Univ. Paris

Laura Chomiuk
Michigan State University

Joshua Frieman
University of Chicago

Saurabh Jha
Rutgers University

Daniel Kasen
UC Berkeley

Robert Kirshner
Harvard University

Chiaki Kobayashi
University of Hertfordshire

Mario Livio
Space Telescope Science Institute

Keiichi Maeda
Kyoto University

Raffaella Margutti
Harvard University

Peter Nugent
Lawrence Berkeley National Laboratory

Saul Perlmutter
Lawrence Berkeley National Laboratory

Armin Rest
STScI

Adam Riess
John Hopkins Univeristy

Steven Rodney
Johns Hopkins University

Daniel Scolnic
KICP at UChicago

Ken Shen
UC Berkeley

Jeffrey Silverman
University of Texas at Austin

Stuart Sim
Queen's University Belfast

Mark Sullivan
University of Southampton

J. Craig Wheeler
University of Texas at Austin

Stan Woosley
UCSC

Michael Zingale
Stony Brook University

Scientific Organizing Committee

Laura Chomiuk
Michigan State University

Ryan Foley
University of Illinois

Joshua Frieman
University of Chicago

Wolfgang Hillebrandt
Max-Planck-Institut for Astrophysics

Robert Kirshner
Harvard University

Don Lamb
University of Chicago

Dan Maoz
Tel-Aviv University

Ken'ichi Nomoto
Kavli IPMU, University of Tokyo

Reynald Pain
LPNHE, Université Pierre et Marie Curie

Mark Phillips
Las Campanas Observatory - Carnegie Institution for Science

Fritz Röpke
Max Planck Institut für Astrophysik

Paul Ricker
University of Illinois

Ashley Ruiter
Australian National University

Frank Timmes
Arizona State University

Dean Townsley
University of Alabama

J. Craig Wheeler
University of Texas at Austin

Local Organizing Committee

Edward Brown
Michigan State University

Ryan Foley
University of Illinois

Peter Garnavich
University of Notre Dame

Ellen Harder
University of Chicago

Richard Kessler
University of Chicago

Don Lamb
University of Chicago

James Truran
University of Chicago

Daniel van Rossum
University of Chicago

1. **Greg Aldering**, Berkeley Lab
   Talk: Improved Cosmological Parameter Measurements using Local Galaxy Environments

   September 18, 2014 (1:50 PM - 2:10 PM)

   Co-authors: on behalf of the Nearby Supernova Factory
   It is now well-established that contemporary lightcurve-based two-parameter methods of standardizing Type Ia supernovae for cosmology leave Hubble residuals that depend on properties of their host galaxies. While initially found using global galaxy properties such as mass, star-formation rate and metallicity, such residuals have now been shown to be just as strong when segregating SNe Ia by the amount of star formation occurring local to the SN position. I will present evidence for this bias in Type Ia standardization using nearby SNe Ia along with different star-formation metrics and lightcurve fitters, and demonstrate how it is likely to have biased current measurements of the cosmological parameters based on Type Ia SNe.

2. **Pierre Astier**, LPNHE/ Univ. Paris
   Invited Talk: Cosmological use of supernovae

   September 19, 2014 (11:30 AM - 12:10 PM)

3. **Arturo Avelino**, Harvard University
   Poster: Constraints on the dimensionless age of the Universe

   September 15 - 19, 2014

   Co-authors: Robert Kirshner
   I will describe an interesting result from an analysis of the world sample of Type Ia supernovae including the new Pan-STARRS data. The dimensionless age of the Universe (H_o t_o) is very nearly 1.0. In a dark matter dark energy universe, a wide range of values is possible, and they should vary with cosmic epoch, but the accelerating Universe we live in happens to have the same relation between age and expansion rate as a coasting universe at the present time.

4. **Edward F Brown**, Michigan State University
   Talk: Theory and modeling summary

   September 19, 2014 (3:40 PM - 4:20 PM)

5. **Mattia Bulla**, Queen's University Belfast
   Talk: Theoretical Modelling of Type Ia polarisation spectra

   September 18, 2014 (9:00 AM - 9:20 AM)

   Co-authors: Dr. Stuart Sim
   Despite their importance in cosmology, Type Ia Supernovae (SNIa) present a puzzle, in that the nature of their progenitor/s is still unclear. Spectropolarimetry is a valuable tool in studying supernovae since it is able to provide information on geometry and so help address the question of what is actually exploding. Polarisation observation of SNIa have found a low continuum polarisation level but significant polarisation in the troughs of some absorption lines, suggesting that departures from spherical symmetry occur. Modern 3D explosion models predict asymmetries in the ejecta of varying degrees. Therefore including polarisation in modern multi dimensional radiative transfer codes helps both to assess the validity of these models and to make comparisons between their predictions and polarisation observations. In this talk, I will present a method that allows us to compute polarisation spectra with low Monte Carlo noise and show the first results we have obtained by including this new technique in the three-dimensional, time-dependent radiative transfer code ARTIS (Applied Radiative Transfer In Supernovae). This will include validating the approach on simple geometries and applications to real explosion models.

6. **Michael Childress**, Australian National University
   Talk: The Relationship Between SN Ia Ages and Host Galaxies Throughout Cosmic Time

   September 15, 2014 (11:30 AM - 12:10 PM)

   Co-authors: Chris Wolf, H. Jabran Zahid
   The age distribution of SNe Ia produced by a given galaxy is a product of the SN Ia delay time distribution (DTD) and the galaxy's star formation history (SFH). Using observationally-motivated empirical models, we can derive the SFH of galaxies as a function of their total stellar mass at all redshifts. Low mass galaxies are still actively star forming, and their SN Ia age distributions are consistently dominated by the peak age of the SN Ia DTD (insensitive to its exact form). High mass galaxies ceased star formation in the distant past and produce SNe Ia whose ages reflect that past epoch of star formation. Consequently, SN Ia ages transition rapidly from young to old along the galaxy mass sequence from low to high stellar mass, with a structure similar to that observed in SN Ia Hubble residuals. We predict how this age transition evolves in redshift, and show that it can introduce critical bias to SN Ia cosmology analyses if not properly accounted for.

7. **Laura Chomiuk**, Michigan State University
   Invited Talk: TBA

   September 15, 2014 (2:10 PM - 2:50 PM)

8. **Pavel Denisenkov**, University of Victoria
   Poster: Hybrid C-O-Ne White Dwarfs as Progenitors of Diverse SNe Ia

   September 15 - 19, 2014

   Co-authors: Falk Herwig (UVic, JINA), Sam Jones (UVic, JINA), and James Truran (UChicago, JINA)
   In most cases, carbon in super AGB stars is ignited off the center. Whether the C burning will be able to reach the center afterwards depends on the efficiency of extra mixing beneath the carbon convective shell. We show that, whereas thermohaline mixing turns out to be too slow to interfere with the C flame inward propagation, convective boundary mixing can prevent the C burning from reaching the center. As a result, a C-O-Ne white dwarf (WD) is formed, after the star has lost its envelope. Such a "hybrid" WD has a small CO core surrounded by a thick ONe zone. In our 1D stellar evolution computations, we let the hybrid WD accrete C-rich material with a sufficiently high rate at which H accreted by a WD in a close binary system would be processed into He under stationary conditions, assuming that He could then be transformed into C. When the mass of the accreting WD approaches the Chandrasekhar limit, we find a series of convective URCA flashes associated with high abundances of ^{23}Na and ^{25}Mg. They are followed by off-center C ignition leading to convection that occupies almost the entire star. Because of their hybrid structure, our pre-SNIa WD models have much lower C abundances at the moment of the final C ignition. This may explain the observed diversity of the SN Ia brightness.

9. **Dina Drozdov**, Clemson University
   Poster: The Detection of a Light Echo from SN 2007af

   September 15 - 19, 2014

   Co-authors: M. D. Leising, P. Milne, J. Pearcy, A. Riess, G. Bryngelson
   We present the discovery of a light echo from SN 2007af, a normal Type Ia supernova (SN Ia), in NGC 5584. HST images taken three years post explosion as part of a Cepheid campaign reveal two distinct echoes; an outer echo and extended central region, which we propose as an unresolved inner echo. Multiple images were obtained in the F160W, F350LP, F555W, and F814W filters using WFC3 in a four month timespan. The outer echo is produced by an interstellar dust sheet located ~800 pc in front of the SN. The inner echo could be from a dust sheet ~0.45 pc behind the SN due to backscattering of peak light or ~90 pc in front for forward scattering. The outer echo color (V - I) is consistent with typical interstellar dust laws, while the extreme blueness of the inner echo is not replicated by normal interstellar dust. Both dust sheets, if in the foreground, are optically thin for scattering, with the outer echo sheet thickness consistent with the inferred extinction from peak brightness. Whether the inner echo is from interstellar or circumstellar dust is ambiguous. Overall, the echo characteristics are quite similar to previously observed SN Ia echoes.

10. **Robert Fisher**, University of Massachusetts Dartmouth
Talk: The Post-Merger Magnetized Evolution of White Dwarf Binaries

September 16, 2014 (4:20 PM - 4:40 PM)

Co-authors: García-Berro, Enrique; Kashyap, Rahul; Aznar-Siguán, Gabriela; Ji, Suoqing; Tzeferacos, Pet os; Jordan, George; Lee, Dongwook; Lorén-Aguilar, Pablo; Cremer, Pascal; Behrends, Jan
Type Ia supernovae (SNe Ia) play a crucial role as standardizable cosmological candles, though the nature of their progenitors is a subject of active investigation. Recent observational and theoretical work has pointed to the double-degenerate channel, as the possible progenitor systems for some SNe Ia. Additionally, recent theoretical work suggests that mergers which fail to detonate may produce magnetized, rapidly rotating white dwarfs. In this talk, I will present the first multidimensional simulations of the post-merger evolution of white dwarf binaries to include a treatment of the magnetic field in full multidimensional magnetohydrodynamics. In these systems, the two white dwarfs complete a final merger on a dynamical timescale, and are tidally disrupted, producing a rapidly-rotating white dwarf merger surrounded by a hot scorona and a thick, differentially rotating disk. The disk is strongly susceptible to the magnetorotational instability (MRI), and we demonstrate that this leads to the rapid growth of an initially dynamically weak magnetic field in the disk, the spin-down of the white dwarf merger, and to the subsequent central ignition of the white dwarf merger. Additionally, these magnetized models exhibit new features not present in prior hydrodynamic studies of white dwarf mergers, including the development of MRI turbulence in the hot disk, magnetized outflows carrying a significant fraction of the disk mass, and the magnetization of the white dwarf merger to field strengths ~2 × 108 G. I will discuss the impact of our findings on the origins, circumstellar media, and potential observable properties of SNe Ia and their progenitors, as well as a possible "failure" mode leading to magnetized white dwarfs.

11. **Ryan Foley**, University of Illinois
Talk: Thermonculear Weirdos

September 17, 2014 (9:00 AM - 9:40 AM)

In addition to the "common" Type Ia supernovae, there are several kinds of other transients from thermonuclear explosions. These "thermonuclear weirdos" account for roughly 5-10% of discovered thermonuclear events, but could account for roughly half of all thermonuclear e xplosions in a given volume. I will describe several classes of thermonuclear weirdos, inc luding .Ia, Ca-rich SNe, 02es-like SNe, 06bt-like SNe, and SNe Iax. Although intrinsically interesting, detailed observations and modeling of these events may elucidate the physics of SNe Ia. Additionally, understanding this diverse landscape and what explosions/progenit or systems do not create SNe Ia will constrain the parameter space of possible SN Ia progen itors.

12. **Joshua Frieman**, University of Chicago
Invited Talk: Dark Energy and Type Ia Supernovae

September 19, 2014 (9:00 AM - 9:40 AM)

Supernovae provided the first direct evidence for cosmic acceleration and continue to provi de the strongest constraints on the nature of dark energy. I review the cosmological contex t and motivation for SN Ia surveys, describing the now-standard cosmological model, the rol e of dark energy and theoretical ideas about its nature, what we hope to learn from superno vae and other probes, and how SN Ia distance measurements constrain the properties of dark energy through the expansion history. I will review recent SN Ia cosmological constraints a nd describe the on-going Dark Energy Survey program to discover and measure high-quality li ght-curves for several thousand SNe Ia out to redshifts z~1. The current and next generatio n of increasingly large SN Ia surveys present unique opportunities and challenges for makin g progress, and I hope to stimulate discussion of these issues.

13. **Brian Friesen**, University of Oklahoma
Poster: NIR spectra of type Ia supernovae during the transitional phase

September 15 - 19, 2014

Co-authors: E. Baron, John P. Wisniewski, Jerod T. Parrent, R. C. Thomas, Timothy R. Miller, G. H. Marion
We present near-infrared synthetic spectra of a delayed-detonation hydrodynamical model and compare them to observed spectra of four normal type Ia supernovae ranging from day +56.5 to day +85. Our models indicate that [Ni II] fits the emission feature near 1.98 ?m, suggesting that a substantial mass of 58Ni exists near the center of the ejecta in these objects, arising from nuclear burning at high density. Most of the remaining features can be accounted for by permitted lines of Fe II and Co II, with contributions from several intermediate-mass elements. We discuss the implications of the [Ni II] emission line as a potential probe of explosion asymmetry.

14. **Yang Gao**, Tsinghua University
Poster: Pulsation in Spherical Premixed Flames with Large Lewis Numbers

September 15 - 19, 2014

Co-authors: Chung K. Law, Princeton University
The thermal-diffusional pulsating instability of a premixed spherical expanding flame with large Lewis number is considered. The positive flame curvature/stretch affects the criterion for the existence of the instability, causing the pulsating behavior of a flame front easier to occur. For pulsatingly unstable flames, we show that the amplitude of the flame speed pulsation is enhanced in an expanding spherical flame. It is then noted that although the average propagation speed is smaller than the steady state flame speed, in the hot-flame phase of a pulsation cycle, the flame front propagates faster than the steady state flame. This flame speed up arising from pulsation may lead to the formation of supersonic combustion waves. Relevant investigations may help us in understanding the evolution of spherical expanding or other highly curved flames in type Ia supernova explosions.

15. **Peter Garnavich**, University of Notre Dame
Talk: Continuous, Fast-Cadence Light Curves from Kepler

September 17, 2014 (4:00 PM - 4:20 PM)

Co-authors: Rob Olling, Armin Rest, Brad Tucker, Dan Kasen
While Kepler searched stars for transits of planets it also monitored several hundred galaxies. A handful of these galaxies produced supernovae followed with Kepler's unprecedented cadence and continuous coverage. We have identified three type Ia supernovae candidates in the data. We measure the early rise time parameters and search for evidence of initial shocks that would suggest a sizable companion to the exploding white dwarf.

16. **Ami Shimo Glasner**, The Hebrew University, Jerusalem
Talk: Sub Chandrasekhar Models for Supernovae

September 16, 2014 (4:00 PM - 4:20 PM)

Co-authors: E. Livne(HU) and J.W.Truran (UC)
We re-examine the possibility that burning initiated in the thick helium shell of an accreting carbon-oxygen white dwarf will lead to a supernova-like runaway. In the early 1980s, it was realized that, for a range of accretion rates around 10-8 Mo/yr, a thick helium layer would accumulate and ignite. In some cases, the helium runaway ignited as a single detonation, producing a faint supernova and leaving behind an intact white dwarf. In others, the helium detonation led to a secondary explosion of the CO core as well, and the star was completely disrupted. For the relevant timescales, the ignition takes place locally and therefore the exact ignition mechanism should be studied using multidimensional models. 1D models show that the helium envelope, prior to the runaway, is unstable to convection on timescales of days. In this research, we re-examine the problem of ignition in a convective region using 2D hydrodynamic models. The main issues we explore are: a) What is the exact mechanism for the ignition of detonation in convectively unstable flow. b) What are the effects of pre-mixing of the accreted helium envelope with carbon and oxygen from the underlying white dwarf on the post-runaway abundances.

17. **Danny Goldstein**, University of California, Berkeley
Poster: Supernova Emulators: Connecting Massively Parallel SN Ia Radiative Transfer Simulations to Data with Gaussian Processes

September 15 - 19, 2014

Co-authors: R. Thomas, D. Kasen
We introduce type Ia supernova (SN Ia) emulators, computationally lightweight predictive models that learn the mapping between the inputs and SED-derivable outputs of massively parallel SN Ia radiative transfer simulations from a training set of simulation input-output pairs. Trained emulators can instantaneously predict the synthetic observables a simulation code will generate on out-of-sample inputs, with estimates of prediction error. In combination with fitting or sampling algorithms, they can be used to quickly infer the regions of simulation input parameter space that are likely to have generated an observed light curve or spectrum. In our emulation framework, we model reduced representations of SN Ia synthetic observables as an ensemble of Gaussian Processes. As a proof of concept, we train a bolometric light curve emulator on a grid of 500 simulation inputs and outputs produced with the publicly available, gray, time-dependent Monte Carlo expanding atmospheres code, SMOKE. We fit bolometric light curves from the Nearby Supernova Factory with our emulator and obtain reconstructed masses (nickel mass, total ejecta mass) in agreement with published semi-analytic models. We discuss applications of emulation to cosmological systematics control.

18. **Ariel Goobar**, Stockholm University
Talk: Lessons from SN2014J - the closest SNIa in several decades

September 17, 2014 (1:50 PM - 2:10 PM)

The close distance to SN2014J in M82 allows for a unique series of observations over an impressive range in both wavelength and time. I will report on ongoing measurements from near-UV to mid-IR, some of which started only hours after the explosion. The large reddening of SN2014J allows for arguably the best study of extinction properties of a SNIa to date. Intriguingly, a good fit is found for the reddening model arising from multiple scattering on dust particles proposed in Goobar (2008). Furthermore, important constraints on the progenitor system can be placed through a combination of a multi-year pre-explosion data and <1 hour cadence observations after the onset of the SN.

19. **Melissa L Graham**, UC Berkeley
Poster: Twins for life? A comparative analysis of the Type Ia supernovae 2011fe and 2011by

September 15 - 19, 2014

Co-authors: M. L. Graham, S. Valenti, B. J. Fulton, L. Weiss, W. Zheng, P. Kelly, A. Filippenko, G. Marcy
The nearby Type Ia supernovae (SNe Ia) 2011fe and 2011by had nearly identical photospheric phase optical spectra, light-curve widths, and photometric colours, but at peak brightness SN 2011by reached a fainter absolute magnitude in all optical bands and exhibited lower flux in the near-ultraviolet (NUV). Based on those data, Foley & Kirshner (2013) argue that the progenitors of SNe 2011by and 2011fe were supersolar and subsolar, respectively, and that SN 2011fe generated 1.7 times the amount of 56Ni as SN 2011by. With this work, we extend the comparison of these SNe Ia to 10 days before and 300 days after maximum brightness with new spectra and photometry. We show that the nebular phase spectra of SNe 2011fe and 2011by are almost identical, and do not support a factor of 1.7 difference in 56Ni mass. Instead, we find it plausible that the Tully-Fisher distance for SN 2011by is an underestimate, in which case these SNe Ia may have reached similar peak luminosity, formed similar amounts of 56Ni, and had lower metallicity progenitors than previously estimated. Regardless of the true distance to SN 2011by, we find that the relative progenitor metallicity difference remains well supported by their disparity in NUV flux, which we show to be even stronger at pre-maximum epochs --- although contributions from differences in total ejecta mass, viewing angle, or progenitor density cannot be ruled out. We also demonstrate that, independent of distance modulus, SN 2011by exhibits a late-time luminosity excess that cannot be explained by a light echo, but is more likely to be the result of greater energy trapping by the nucleosynthetic products of SN 2011by.

20. **Or Graur**, NYU
Talk: Constraining the progenitor of SN2011fe with pre-explosion Hubble Space Telescope He II narrow-band observations

September 15, 2014 (12:10 PM - 12:30 PM)

Co-authors: Dan Maoz, Michael M. Shara
We present Hubble Space Telescope (HST) imaging observations of the site of the Type-Ia supernova SN2011fe in the nearby galaxy M101, obtained about 1 yr prior to the event, in a narrow band centered on the He II ?4686 Å emission line. In a "single-degenerate" progenitor scenario, the hard photon flux from an accreting white dwarf (WD), burning hydrogen on its surface over ˜1 Myr should, in principle, create a He III Strömgren sphere or shell surrounding the WD. Depending on the WD luminosity, the interstellar density, and the velocity of an outflow from the WD, the He III region could appear unresolved, extended, or as a ring, with a range of possible surface brightnesses. We find no trace of He II ?4686 Å line emission in the HST data. Using simulations, we set 2? upper limits on the He II ?4686 Å luminosity of L_He II < 3.4 × 10^34 erg s^-1 for a point source, corresponding to an emission region of radius r < 1.8 pc. The upper limit for an extended source is L_He II < 1.7 × 10^35 erg s^-1, corresponding to an extended region with r ˜ 11 pc. The largest detectable shell, given an interstellar-medium density of 1 cm^-3, has a radius of ˜6 pc. Our results argue against the presence, within the ˜10^5 yr prior to the explosion, of a supersoft X-ray source of luminosity L_bol ? 3 × 10^37 erg s^-1, or of a super-Eddington accreting WD that produces an outflowing wind capable of producing cavities with radii of 2-6 pc.

21. **Ravi Gupta**, Argonne National Laboratory
Poster: Luminosity Functions of Type Ia Supernovae and Their Host Galaxies From the 3-Year SDSS-II Supernova Sample

September 15 - 19, 2014

Co-authors: Mathew Smith, Masao Sako, Steve Kuhlmann, Mariangela Bernardi, Rick Kessler
Knowing the luminosity functions (LFs) for both SNe Ia and their host galaxies can provide insight into the environment of these SNe and help to constrain the progenitor systems in an age where SN Ia cosmology is limited by systematic uncertainties, including environmental dependencies on SN luminosities. To this end, we construct the LFs for a large sample of SNe Ia and their host galaxies drawn from the full three-year SDSS-II Supernova Survey. We also explore the role of evolution and its implications on SN Ia cosmology.

22. **Chelsea E Harris**, UC Berkeley
Talk: Prospects of Detecting CSM from SNe Ia Progenitor Systems

September 16, 2014 (10:50 AM - 11:10 AM)

Co-authors: Peter Nugent, Daniel Kasen
Circumstellar material (CSM) is one way to distinguish between possible SN Ia progenitors: many proposed progenitor systems have some associated CSM, .e.g., from a red giant wind, novae in unstable accretion, or tidal disruption in a merger. The fact that only a few percent of SNe Ia show interaction with CSM means that the dominant SN Ia progenitor channel is a very clean one -- or the CSM remains hidden. We create a large suite of simple models in which a "typical" SN Ia has CSM of semi-arbitrary configuration, then calculate the effect of each interaction on the supernova signal. Our goals are to quantify (1) required properties that the CSM needs to have in order to be detectable, and (2) the possibility of distinguishing between different CSM configurations in the case of detectable CSM.

23. **Wolfgang Hillebrandt**, Max-Planck-Institut for Astrophysics
Talk: Cosmological parameters from SN Ia luminosity distances: a model-independent approach

September 19, 2014 (2:30 PM - 3:10 PM)

A model-independent reconstruction of the cosmic expansion rate based on Type Ia supernova luminosity distances is performed. Using the most recent data sets, it is shown that the Hubble parameter as a function of redshift, allowed by the data without making any hypothesis about cosmological model or underlying gravity theory is consistent with a flat Î233 cold dark matter universe having H0 = 70.43 Â± 0.33 and Î©m = 0.297 Â± 0.020, weakly dependent on the choice of initial scatter matrix, in close agreement with the recently released Planck results (H0 = 67.3 Â± 1.2, Î©m = 0.314 Â± 0.020). In addition, we test various non-standard cosmologies such as braneworlds, f(R) and kinematical models to demonstrate the power of the method. Some extreme cosmologies clearly disagree with the reconstructed expansion history.

24. **Cole J Holcomb**, Princeton University
Poster: Head-On Collisions of White Dwarfs with Helium Envelopes

September 15 - 19, 2014

Co-authors: Doron Kushnir, Boaz Katz
We explore the outcomes of including helium (He) envelopes in head-on white dwarf (WD) collisions. We perform a set of 2D axisymmetric calculations using the FLASH hydrodynamics code. Detonation ignition in the He shell is found to significantly alter the nuclear yields and ejecta distributions. We determine critical He masses for detonation ignition.

25. **Andy Howell**, LCOGT/UCSB
Talk: Observational summary

September 19, 2014 (4:20 PM - 5:00 PM)

26. **Saurabh W Jha**, Rutgers University
Invited Talk: Type Iax Supernovae: Before and After

September 17, 2014 (9:40 AM - 10:20 AM)

Co-authors: Curtis McCully (Rutgers), Ryan J. Foley (Illinois)
I will summarize current observations and models for type Iax supernovae, formerly called SN 2002cx-like supernovae. These low velocity and low luminosity SNe show similar spectral features to normal SN Ia at maximum light, but diverge from all other known SN at late times. A promising model for SN Iax proposes these are the incomplete explosions of Chandrasekhar-mass carbon/oxygen white dwarfs. I will present our recent discovery of the progenitor system of the type Iax SN 2012Z and a possible "remnant" of SN 2008ha. Our observations are consistent with the incomplete explosion of a white dwarf that was accreting from a helium star companion, and I will discuss pros and cons of this and alternate scenarios.

27. **Young-Dae Jung**, Hanyang University
Poster: Bremsstrahlung process in astrophysical turbulent plasmas

September 15 - 19, 2014

The electron-ion bremsstrahlung process is investigated in astrophysical turbulent plasmas. The results show that the bremsstrahlung cross section including the influence of plasma turbulence and shielding decreases with an increase of the thermal energy for small impact parameters and, however, increases with increasing diffusion coefficient. In addition, the plasma shielding effect enhances the bremsstrahlung cross section for small thermal energies. It is also found that the shielding effect on the bremsstrahlung cross section increases with an increase of the diffusion coefficient and, however, decreases with increasing thermal energy in astrophysical turbulent plasmas.

28. **Yijung Kang**, Yonsei University
Poster: YOnsei Nearby Supernovae Evolution Investigation: YONSEI

September 15 - 19, 2014

Co-authors: Young-Lo Kim,Dongwook Lim,Chul Chung,Eon-Chang Sung,and Young-Wook Lee
Type Ia Supernova (SN Ia) cosmology is providing the only direct evidence for the presence of dark energy. This result is based on the assumption that the look-back time evolution of SNe Ia luminosity, after light-curve shape correction, would be negligible. However, the most recent compilation of SNe Ia data shows systematic difference in the Hubble residual (HR) between the E and Sd/Irr galaxies, indicating that the light-curve fitters used by the SNe Ia community cannot quite correct for a large portion of the population age effect. In order to investigate this possibility more directly, we have obtained low-resolution spectra for 50 nearby early-type host galaxies taken from the YONSEI supernova catalogue. These host spectra are used to estimate the luminosity weighted mean ages and metallicities of host galaxies by employing the population synthesis models, together with the dynamical masses. We found a well-known correlation between HR and host mass in these galaxies. More observations and analyses are being performed to investigate the possible correlation between population age of early-type hosts and HR of SNe Ia.

29. **Natallia Karpenka**, Stockholm University
Talk: Photometric supernova classification using neural networks.

September 18, 2014 (9:40 AM - 10:00 AM)

Co-authors: F. Feroz and M. P. Hobson
A method is presented for automated photometric classification of supernovae (SNe) as Type Ia or non-Ia. A two-step approach is adopted in which (i) the SN light curve flux measurements in each observing filter are fitted separately to an analytical parametrized function that is sufficiently flexible to accommodate virtually all types of SNe and (ii) the fitted function parameters and their associated uncertainties, along with the number of flux measurements, the maximum-likelihood value of the fit and Bayesian evidence for the model, are used as the input feature vector to a classification neural network that outputs the probability that the SN under consideration is of Type Ia.The method is trained and tested using simulated data from SNANA.We find that the quality of the classification does not vary significantly with SN redshift. Moreover, our probabilistic classification method allows one to calculate the expected completeness, purity and figure of merit (or other measures of classification quality) as a function of the threshold probability pth, without knowing the true classes of the SNe in the testing sample, as is the case in the classification of real SNe data. The method may thus be improved further by optimizing pth and can easily be extended to divide non-Ia SNe into their different classes.

30. **Daniel Kasen**, UC Berkeley
Invited Talk: Light Curves and Spectra of Type Ia Supernovae

September 17, 2014 (2:10 PM - 2:50 PM)

31. **Robert P. Kirshner**, Harvard University
Invited Talk: The challenge of using something you don't fully understand

September 15, 2014 (9:40 AM - 10:20 AM)

Co-authors: The RAISIN bunch
Type Ia supernovae are our sharpest tool for measuring extragalactic distances to individual galaxies and our best way to measure cosmic expansion in the range from z = 0.2- 0.6. Nobody doubts Type Ia supernovae are exploding white dwarfs, but the astronomical setting of their origin is still uncertain. Similarly, though the use of supernova light curve shapes and colors is widespread, the intrinsic colors and the proper way to treat extinction remain obscure. Thermonuclear supernovae are more nearly standard candles in the near infrared, and extinction is less of a problem at those wavelengths, so the precise history of cosmic expansion, and the dark energy that implies, are best studied in the rest frame near-infrared. I will report on progress in using the RAISIN sample detected with Pan-STARRS and followed up with HST to make valid inferences about dark energy, even if we don't have the full story of the origin for SN Ia.

32. **Chiaki Kobayashi**, University of Hertfordshire
Invited Talk: Progenitors of Type Ia Supernovae and Chemical Evolution of Galaxies

September 18, 2014 (11:30 AM - 12:10 PM)

TBA

33. **Doron Kushnir**, Institute for Advanced Study, Princeton, NJ
Talk: An unambiguous test for direct collisions as the primary channel for type Ia SNe is possible in the near fututre

September 16, 2014 (4:40 PM - 5:00 PM)

Co-authors: Boaz Katz (IAS), Subo Dong (KIAA-PKU)
It was recently shown that the majority of type Ia SNe may be the result of direct collisions of typical field CO WDs in triple systems. The supporting evidences are: 1. the rate of such collisions may be comparable to the SNe Ia rate, 2. in this case the nuclear detonation is due to a well understood shock ignition, devoid of commonly introduced free parameters such as the deflagration velocity or transition to detonation criteria, 3. the observed range of Ni56 among different explosions, including the tendency for faint SNe in elliptical galaxies and bright SNe in spirals, is explained as the result of the CO WDs mass range, 4. a unique feature of this model (doubly-peaked line profiles in nebular-phase spectra) has been found to be common among type Ia SNe. I will describe how to realize an unambiguous test for any progenitor model as the primary channel for type Ia SNe, based on: 1. a large sample of nebular-phase spectra. 2. a large set of accurate model computations. This test does not depend on radiation transfer calculations and can be realized in the near future. I will present preliminary comparison of the direct collision model to the available data.

34. **Don Q. Lamb**, University of Chicago
Talk: New Results on the Gravitationally Confined Detonation Model of Type Ia Supernovae

September 16, 2014 (11:30 AM - 12:10 PM)

Co-authors: Lamb et al.
TBD

35. **Denis Leahy**, University of Calgary
Poster: QN Ia: Light curves and Hubble diagram

September 15 - 19, 2014

Co-authors: R. Ouyed, N. Koning, J. Staff
QN Ia are SN Ia imposters: they have similar light curves and spectra but have a different origin. They are sub Chandrasekhar mass white dwarfs which are triggered to ignition and explosion by the shock wave from a companion neutron star when the neutron star converts into a quark star. We calculate light curves for QN Ia and consider what effect the have on the SN Ia Hubble diagram.

36. **Eun Hee Lee**, Yonsei University Observatory, Korea
Poster: Review of Korean historical observation of Type Ia supernovae SN 1572 and SN 1604, and its consequences

September 15 - 19, 2014

Co-authors: Eung Bum Lee (Department of Physics, University of Chicago, USA); Suk Jin YOON (epartment of Astronomy and Space Science, Yonsei University, Korea); Dae-Young LEE (Department of A tronomy and Space Science, Chungbuk National University, Korea)
Four centuries ago, two very bright "Guest Stars" were observed by Korean royal astronomers as well as Tycho and Kepler in A.D. 1572 and 1604. While Tycho's and Kepler's observational records provide us with valuable information on the supernova explosion, they do not have sufficient observations during the time the explosions reached their maximum brightness. On the other hand, the Korean record of A.D. 1572 supernova, first observed on 6 November, contains a brief but crucial observation revealing that its brightness has already reached at maximum before the Tycho's observation. Moreover, the Korean reports of A.D. 1604 supernova give us a very precise and detailed information about the brightness change not only around the maximum brightness but also after its peak for a long duration; in particular its observation on the time it took to reach the peak luminosity (from Oct. 9, 1604 to Oct. 28, 1064) coincides with the typical mean time of Type la supernovae (19 days) established in the modern time. In this study, therefore, we reconstruct the visual light curves, and recalculate the maximum luminosities of both supernovae by using the combined data of Korean, Chinese and European records. Furthermore, we discuss the brightness change around the peak magnitude and the decline rates, and compare the light curves of SN1572 and that of SN1604.

37. **Pierre-Francois Leget**, Laboratoire de Physique Corpusculaire de Clermont-Ferrand
Poster: Describing type Ia supernovae spectra with spectral indicators at maximum light.

September 15 - 19, 2014

Spectral indicators are known to trace intrinsic type Ia supernova (SNIa) properties such as stretch and to provide clues to supernova standardization. It remains to be clarified how many different intrinsic parameters affect the SNIa diversity. With the advent of spectrophotometric time series covering the extended visible range from the Nearby Supernova Factory, it is possible to investigate the parameter space of a broad range of spectral indicators at maximum light. In order to determine the number of components needed to describe the spectra variability and to remove the noise contribution, an Expectation-Maximization Principal Component Analysis (EM-PCA) on spectral indicators is used. Three main intrinsic components dominate the spectral variability at maximum light, and provide also a fair description of other phases. As a by-product we derive an extinction law and find it compatible with a Cardelli law as in Chotard et al 2011.

38. **Shing Chi Leung**, The Chinese University of Hong Kong
Poster: Effects of admixed dark matter on Type-Ia supernovae

September 15 - 19, 2014

Co-authors: Ming-Chung Chu, Lap-Ming Lin
Type-Ia supernovae (SNIa) is an important class of astrophysical objects. The similarity in their light curves and their presumably universal explosion conditions make SNIa a standard candle, which leads to the discovery of dark energy. However, in view of the dominance of dark matter (DM) in the universe, a white dwarf could be admixed with a significant amount of DM prior to the explosion as an SNIa, which may alter the explosion dynamics. Therefore, understanding the effects of DM admixture provides a more complete picture on the homogeneity and diversity of SNIa. Also, it provides another mean to probe DM properties indirectly from SNIa observations. To understand quantitatively the effects of DM on the explosion energetic, nucleosynthesis and other observational consequences, we developed a two-dimensional two-fluid Eulerian hydrodynamics code for the explosion stage. We consider both pure turbulent deflagration model and delayed detonation model as explosion mechanisms, and we assume the DM as an ideal degenerate Fermi gas. We find that dark matter admixture can lead to observable changes in the explosion energy, nickel production and ejecta velocity. To compare the hydrodynamics results with observations, we also developed a one-dimensional radiative transfer code to compute the corresponding light curves. By tuning the amount of admixed dark matter, we are able to fit the bolometric light curve with some observed subluminous supernovae. These results suggest that dark matter admixture may be invoked to account for a class of subluminous SNIa, and it may be possible to extractDM signals from SNIa observations.

39. **Ernst R. Lexen**, Hamburger Sternwarte
Poster: Testing the sensitivity of SN Ia models to parameter changes

September 15 - 19, 2014

In this work, parameters of Type Ia supernova spectra and light curve simulations are systematically varied to test the model sensitivity due to parameter changes. As starting model, the parametrized deflagration model W 7 is used. The atmospheric structure and the synthetic spectra are calculated with PHOENIX. Variations are done one at a time, first, the content of the radioactive energy is changed. For this purpose, the initial 56Ni mass of the W 7 model is changed in steps of 10 % from 50 % up to 150 % 56Ni. While the optical depth is not changed significantly, temperature differences occur up to 11000 K. Next the value of the parametrized line scattering parameter (epsilon line) is varied so that between 0 and 90 % of the photons are scattered. Strong scattering has great impact on the model spectra, especially in the IR, where the effects are very clear. The position of the photosphere is wavelength dependent: In LTE the UV photosphere is deeper and the IR photosphere is further out. But with high line scattering the pseudo UV photosphere essentially moves out to the surface and we get high luminosity there. In the IR, the exact opposite happens. The pseudo IR photosphere moves in so we get low luminosity there.

40. **Mario Livio**, Space Telescope Science Institute
Invited Talk: Closing in on the Progenitors of SNe Ia

September 15, 2014 (9:00 AM - 9:40 AM)

I will review the current status concerning the identification of the progenitor systems of Type Ia supernovae, in light of recent observations and theoretical developments. I will also show how current and future observations can be used to tame evolutionary effects, on the road to better constraints on the nature of dark energy.

41. **Keiichi Maeda**, Kyoto University
Invited Talk: Insight and Constraints on SN Ia Progenitor and Explosion

September 16, 2014 (9:00 AM - 9:40 AM)

I will provide a (self-biased) summary of constraints on SN Ia progenitors and explosion mechanisms obtained through comparing theory and observations at various wavelengths. The talk will include recently reported detection of gamma-rays from SN 2014J, early-to-late phase optical and NIR observationally-driven constraints on progenitors and explosions for nearby SNe. The theoretical expectations from several models (e.g., single degenerate and double-degenerate) will be compared with massively increasing amount of data.

42. **Kate Maguire**, European Southern Observatory
Talk: Circumstellar material around SNe Ia: observations and implications for the progenitors

September 15, 2014 (4:00 PM - 4:40 PM)

I will present a summary of the current constraints on the presence of circumstellar material (CSM) in the progenitor systems of SNe Ia using high-resolution optical spectroscopy. CSM can be investigated by studying the presence and variability of the narrow Na I D absorption lines observed in some SN Ia spectra. Until recently, the presence of time-varying Na I D lines was interpreted as a key signature of the single-degenerate progenitor scenario. However, modelling of double-degenerate systems has now also demonstrated mechanisms for producing these features. I will discuss the links between the latest observations and the different progenitor channels, as well as highlight new, complementary measurements that can help constrain the properties of SN Ia progenitor systems.

43. **Chris M Malone**, LANL
Talk: Linking Simmering to Deflagration in SNe Ia

September 16, 2014 (1:50 PM - 2:10 PM)

Most simulations in the literature of single-degenerate SNe Ia models assume a static white dwarf near the Chandrasekhar mass. A feature of the single-degenerate model, however, is a century of simmering convection, which establishes a turbulent flow field within the star, before a thermonuclear deflagration is ignited. The large-scale features of the convective flow have velocities comparable to the laminar flame speed (~100 km/s), and it is unclear whether this helps or hinders flame evolution. We discuss mapping our low Mach number results of the simmering phase obtained with the Maestro code to the fully compressible code Castro to follow the evolution of the deflagration in the presence of the turbulent field. We show - given our simplified flame model - that single-point ignition at a typical location (~ 40 km off-center) is not affected by the turbulent field. We also find, however, that a more central ignition scenario will lead to a highly distorted flame; even igniting a perfect sphere at the center of the white dwarf will lead to an asymmetric explosion model.

44. **Kaisey S Mandel**, Harvard-Smithsonian CfA
Talk: Type Ia Supernova Colors and Ejecta Velocities: Hierarchical Bayesian Regression with Non-Gaussian Distributions

September 18, 2014 (10:50 AM - 11:10 AM)

Co-authors: Ryan Foley, Robert Kirshner
Determining supernova distances with high precision and small systematic error is essential to modern constraints on the cosmic expansion history and the properties of dark energy. We investigate an interesting correlation between the expansion velocity of the SN Ia explosion and its intrinsic color, and its potential to improve inferences of host galaxy dust, and thus, distance estimates. We construct a new hierarchical Bayesian regression model and Gibbs sampler to estimate the statistical dependence of the peak optical intrinsic colors of a SN Ia on its ejecta velocity, measured from the Si II 6355A spectral feature at maximum light. The statistical model accounts for the random effects of intrinsic scatter, measurement error, and reddening by host galaxy dust. The method is applied to the apparent color data from BVRI light curves and Si II velocity data for 79 nearby SN Ia. Comparison of the apparent color distributions of high velocity (HV) and normal velocity (NV) supernovae reveals significant discrepancies in B-V and B-R, but not other colors. Hence, they are likely due to intrinsic color differences originating in the B-band, rather than dust reddening. The mean intrinsic B-V and B R color differences between HV and NV groups are 0.06 ± 0.02 and 0.09 ± 0.02 mag, respectively. Under a linear model for intrinsic B-V and B-R colors versus velocity, we find significant slopes of ?0.021 ± 0.006 and ?0.030 ± 0.009 mag/(1000 km/s), respectively. Since the ejecta velocity distribution is skewed towards high velocities, these effects imply non-Gaussian intrinsic color population distributions with skewness up to +0.3. Accounting for the intrinsic color-velocity correlation results in corrections in A_V dust extinction estimates as large as ?0.12 mag for HV SN Ia and +0.06 mag for NV events. Velocity measurements from SN Ia spectra have potential to diminish systematic errors from the confounding of intrinsic colors and dust reddening affecting supernova distances.

45. **Raffaella Margutti**, Harvard University
Invited Talk: X-ray observations of SNe Ia

September 17, 2014 (1:10 PM - 1:50 PM)

I will review the status of X-ray observations of Type Ia SNe, and in particular concentrate on the results from very deep X-ray observations of SNe 2011fe and 2014J

46. **Broxton J Miles**, University of Alabama
Poster: Dependence of Si-group Yields on Progenitor Composition in 2D Simulations of Type Ia Supernovae

September 15 - 19, 2014

Co-authors: Dean M. Townsley, Daniel R. van Rossum, Francis X. Timmes, Soma De, Brendan K. Krueger, Aaron P. Jackson, Alan C. Calder, Edward F. Brown, David A Chamulak
Based on the quasi-equilibirum that occurs during incomplete silicon burning, it is expected that the neutron excess in the composition of the exploding white dwarf (WD) in a Type Ia Supernova (SN Ia) will determine the relative abundances of intermediate mass elements (IME), including Si, S, and Ca, in a robustly predictable way. This may provide a way to infer, or at least constrain, the composition of the progenitor WD from abundances in the explosion itself determined from spectra near maximum light . In order to explore possible dependences on the model and intrinsic yield of the SNIa explosion, we have post-processed two cases with differing yields of radioactive nickel (0.8 and 0.7 Msun respectively) from the set presented in Krueger et al. 2012 at a wide variety of metallicities. These are 2D simulations of a SN Ia in the deflagration-detonation transition (DDT) scenario. We have distinguished between the neutron-enriched progenitor composition components arising from the initial stellar metallicity and from the pre-explosion central carbon burning. We find that while the total yields of IMEs differ in our two cases, the trends of yield ratios (Ca/Si and S/Si) show very little dependence on the overall yield. Also, using the radiation transfer code, PHOENIX-REB, artificial spectra and light curves were created for all cases in the hopes that an observable feature created by the variation in metallicity would present itself. We find in early spectra the best candidates are Si and Ca features at about 6000 and 8000 Angstroms respectively.

47. **Max Moe**, Harvard University
Talk: What can eclipsing binaries tell us about the progenitors of SNe Ia?

September 15, 2014 (4:40 PM - 5:00 PM)

Co-authors: Rosanne Di Stefano
The rates and properties of SNe Ia depend on the intrinsic frequency of their main-sequence (MS) progenitors. In the single-degenerate (SD) scenario and certain classes of the double-degenerate (DD) scenario, SNe Ia that explode in elliptical galaxies after long delay times evolve from MS binaries with specific combinations of physical parameters. Namely, both the symbiotic SD channel and the double-detonation sub-Chandrasekhar DD channel derive from mid-B type MS primaries (M_1 = 5 - 7 M_sun) with low-mass companions (M_2 = 1.0 - 1.8 M_sun) at initially moderate orbital periods (P > 20 days). Unfortunately, spectroscopic observations cannot adequately survey such extreme mass-ratio companions to early-type MS primaries. We have therefore utilized large catalogs of eclipsing binaries to measure the intrinsic frequency of close companions to B-type MS primaries across a broader parameter space, including low metallicities (-0.7 < log Z/Z_sun < 0.0), extreme mass ratios (q = M_2/M_1 = 0.06 - 0.30), and intermediate orbital periods (P > 20 days). I will discuss our results in the context of binary evolution toward SNe Ia in different environments and the implications for predicting SNe Ia rates via population synthesis.

48. **Bob Nichol**, ICG Portsmouth
Poster: Lensing of Supernovae

September 15 - 19, 2014

Co-authors: David Bacon (Portsmouth), Mat Smith (UWC), Dario Scovacricchi (Portsmouth), Tom Collett
We expect the brightness of supernovae to be gravitational lensed by the intervening matter along the light of sight. Recent studies by the SDSS and SNLS show evidence of such supernova lensing at the level expected for such samples (e.g. 2 sigma). However, recent new analysis looking at the skewness of the SN luminosity distribution as a function of redshift promise to deliver higher confidence measurements of this effect and initial results show such analyses can provide independent constraints on the growth of structure in the Universe (e.g. sigma8). With samples from DES and LSST, such measurements will become compelling and opens a new window on the physics of the small-scale power spectrum. In this talk I will review recent measurements as well as looking forward towards bigger samples.

49. **Ken'ichi Nomoto**, Kavli IPMU, University of Tokyo
Talk: Final Evolution of Spinning White Dwarfs and their Companions in Single Degenerate Models for Type Ia Supernovae

September 16, 2014 (3:40 PM - 4:00 PM)

Co-authors: Omar Benvenuto(2), Jorge Panei(2), and Izumi Hachisu(3)
(2)U. Nacional de La Plata,
(3)Dept. Earth Science and Astronomy, U. Tokyo
We will present the evolution of uniformly rotating, mass-accreting white dwarfs (WDs) and their companion stars in the single degenerate model for Type Ia supernovae. For certain ranges of binary parameters (the companion's mass and the binary separation), the WD increases its mass through the "effective" Chandrasekhar mass of the uniformly rotating WD, M(Ch, rot), and undergoes "prompt" carbon ignition. For nearby ranges of binary parameters, the WD mass exceeds the Chandrasekhar mass of the non-rotating WD but does not reach M(Ch, rot). Such a WD undergoes spin-down evolution and "delayed" carbon ignition. During the spin-down phase, the companion would evolve to become a He WD or a low mass star. We will discuss if the missing companion problem of some Type Ia supernovae can be reconciled.

50. **Peter Nugent**, Lawrence Berkeley National Laboratory
Invited Talk: Spectroscopic Correlations Among SNe Ia

September 17, 2014 (11:30 AM - 12:10 PM)

In the 20 years since the first correlations were found between the lightcurves and spectra of Type Ia supernovae (SNe Ia) and their absolute brightness much has changed in our understanding of these events - both theoretically and observationally. The combination of automated surveys which target individual galaxies and, more recently, those which survey large swaths of the sky coupled with high-quality detailed follow-up across the electromagnetic spectrum has created more questions than answers in this field. Here I will look at current state of the spectroscopic correlations among SNe Ia in light of the large number of "unusual" events found in the last several years as well as several new ideas about the nature of their progenitors and explosions.

51. **Marina Orio**, University of Wisconsin (USA) and INAF-Padova (ITaly)
Poster: Exploring an Alternative Channel of Evolution Towards SN Ia Explosions

September 15 - 19, 2014

Co-authors: E. Chiosi, C. Chiosi, P. Trevisan, L. Piovan
The single degenerate versus double degenerate model debate on the progenitor of type Ia supernovae may have been going on for too long. It is not clear at all whether double degenerate white dwarfs may explode as supernovae, and the rate produced by single degenerate binaries seems to be too low to account for the observations. It is time to explore an alternative channel. We show how new calculations of nuclear reactions rates indicate the path towards a previously unforseen model of sub-Chandrasekhar mass progenitors. Our initial exploration is semi-analytical; full evolutionary calculations should follow to assess the importance of this interesting, new class of progenitors.

52. **Ashley Pagnotta**, American Museum of Natural History
Poster: Treasure Hunting for SN Ia Ex-Companion Stars in the LMC

September 15 - 19, 2014

Co-authors: Emma S. Walker, Bradley E. Schaefer, Zachary I. Edwards
Observations of the central region of Ia supernova remnants can be used to place constraints on, and in some cases identify, the progenitor systems of nearby supernovae. This procedure has been employed in both the Milky Way (e.g. Ruiz-Lapuente et al. 2004; Kerzendorf et al. 2014) and the Large Magellanic Cloud (Schaefer & Pagnotta 2012; Edwards et al. 2012), with varying levels of success. I will present our recent results on the stars in the central regions of LMC SNR 0505-67.9 (DEM L71) and LMC SNR 0509-68.7 (N103B), as well as our spectrum of the nebulous region at the center of LMC SNR 0509-67.5 showing it to be a background galaxy unrelated to the supernova remnant.

53. **Yen-Chen Pan**, University of Illinois, Urbana-Champaign
Talk: Type Ia Supernovae and Their Host Galaxies

September 18, 2014 (2:30 PM - 2:50 PM)

Co-authors: Mark Sullivan and the PTF SN Ia Collaboration
Previous studies of type Ia supernovae (SNe Ia) have shown that the host galaxy environment is an important variable in influencing SN luminosities. We investigate the relation between SNe Ia and their host galaxies using high quality photometric and spectroscopic data using SNe Ia discovered by the Palomar Transient Factory. We compare the SN photometric and spectroscopic properties with the host galaxy stellar mass, star formation rate, metallicity and stellar age, as well as the position of the SN in the host galaxy. We find a variety of new trends in the data, and interpret these in the context of the SN Ia progenitor systems.

54. **Thomas Papatheodore**, University of Tennessee / ORNL
Poster: On Numerical Considerations for Modeling Reactive Astrophysical Shocks

September 15 - 19, 2014

Co-authors: O. E. Bronson Messer
Simulating detonations in astrophysical environments is often complicated by numerical approximations to shock structure. A common prescription to ensure correct detonation speeds and associated quantities is to prohibit burning inside the numerically broadened shock. We have performed a series of simulations to verify the efficacy of this approximation and to understand how resolution and dimensionality might affect its use. Our results show that in one dimension, prohibiting burning in the shock is important wherever the carbon burning length is not resolved, in keeping with the results of Fryxell et al. In two dimensions, we find that the prohibition of shock burning effectively inhibits the development of cellular structure for all but the most highly resolved cases. We discuss the possible impacts this outcome may have on sub-grid models and detonation propagation in models of Type Ia supernovae, including potential impacts on observables.

55. **Saul Perlmutter**, Lawrence Berkeley National Laboratory
Invited Talk: TBA

September 19, 2014 (10:20 AM - 11:00 AM)

56. **Amber L Porter**, Clemson University
Poster: Type Ia Supernovae and Spectropolarimetry

September 15 - 19, 2014

Co-authors: Mark D. Leising

57. **Chris Pritchet**, U Victoria
Talk: The DTD at late times: evidence against SD progenitors?

September 16, 2014 (11:10 AM - 11:30 AM)

The color distribution of SN Ia hosts has been measured in 2 supernova surveys (SDSS and MENeaCS). SN Ia hosts show a strong concentration to the red sequence, with essentially zero colour shift relative to the RS. We interpret this result in terms of simple stellar population models, and conclude that the DTD of SNe Ia is consistent with a continuous power law; DTD models with a strong cutoff starting at ~1-2 Gyr (as might be expected from the simplest single degenerate models) are excluded. The age distribution of SN Ia progenitors matches the age distribution of the underlying stellar population. We can rule out the hypothesis that SNe Ia originate only from a frosting of younger stars.

58. **Armin Rest**, STScI
Invited Talk: Cosmological Constraints with Type Ia Supernovae Discovered during the first 1.5 Years of the Pan-STARRS1 Survey

September 19, 2014 (12:10 PM - 12:50 PM)

Co-authors: Dan Scolnic & PS1 transients collaboration
We present griz light curves of 147 spectroscopically confirmed Type Ia Supernovae ($0.03 < z < 0.65$) discovered during the first 1.5 years of the PS1 Medium Deep Survey. The PS1 natural photometric system is determined by a combination of on-site measurements of the instrument response function and spectrophotometric standard star observations. We find that the systematic uncertainties in the absolute calibration are currently 1.2% without accounting for the uncertainty in the HST Calspec definition of the AB system. We discuss our efforts to minimize the systematic uncertainties in the photometry. A Hubble diagram is constructed with a subset of 117 SNe Ia (out of the 147) that pass our light curve quality cuts. We constrain the equation of state parameter w using the PS1 SN Ia, a low-z set of SNe Ia, and external constraints derived from BAO, CMB, and H0.

59. **Paul M Ricker**, University of Illinois
Poster: Search for Surviving Companions in Type Ia Supernova Remnants

September 15 - 19, 2014

The nature of the progenitor systems of type Ia supernovae (SNe Ia) is still unclear. One way to distinguish between the single-degenerate scenario and double-degenerate scenario for their progenitors is to search for the surviving companions (SCs). Using a technique that couples the results from multi-dimensional hydrodynamics simulations with calculations of the structure and evolution of main-sequence- (MS-) and helium-rich SCs, the color and magnitude of MS- and helium-rich SCs are predicted as functions of time. The SC candidates in Galactic type Ia supernova remnants (Ia SNR) and nearby extragalactic Ia SNRs are discussed. We find that the maximum detectable distance of MS SCs (helium-rich SCs) is 0.6-4 Mpc (0.4-16 Mpc), if the apparent magnitude limit is 27 in the absence of extinction, suggesting that the Large and Small Magellanic Clouds and the Andromeda Galaxy are excellent environments in which to search for SCs. However, only five Ia SNRs have been searched for SCs, showing little support for the standard channels in the singe-degenerate scenario. To better understand the progenitors of SNe Ia, we encourage the search for SCs in other nearby Ia SNRs.

60. **Adam Riess**, John Hopkins Univeristy
Invited Talk: Refining the Hubble Constant with Parallax, Cepheids and Type Ia Supernovae

September 19, 2014 (9:40 AM - 10:20 AM)

The Hubble constant remains one of the most important parameters in the cosmological model, setting the size and age scales of the Universe. Present uncertainties in the cosmological model including the nature of dark energy, the properties of neutrinos and the scale of departures from flat geometry can be constrained by measurements of the Hubble constant made to higher precision than was possible with the first generations of Hubble Telescope instruments. Streamlined distances ladders constructed from infrared observations of Cepheids and type Ia supernovae with ruthless attention paid to systematics now provide 3.5% precision and offer the means to do much better. While WFC3 has helped open this new route, its full exploitation can come from a new technique, Parallel Astrometric Spatial Scanning (PASS), to measure parallax distances beyond a kiloparsec. Transient, optical surveys like Pan-STARRS can help by identifying Cepheids in the Milky Way or nearby galaxies. This work also promises to deliver the most precise absolute calibration of the peak luminosity of type Ia supernovae, an invaluable input to e xplosion models. I will review recent and expected progress.

61. **Steven Rodney**, Johns Hopkins University
Invited Talk: Progenitor Constraints from Type Ia Supernova Rates

September 15, 2014 (1:30 PM - 2:10 PM)

I will review the use of Type Ia supernova rate measurements for testing progenitor models via the delay time distribution. This will focus on volumetric rate measurements from the last decade, highlighting improved precision at low redshift and recent extensions to z~2.5. I will discuss tensions among the observations, and between observation and theory, and evaluate prospects for improving these progenitor constraints in the near future.

62. **Michele Sasdelli**, Max Planck Institute for Astrophysics
Talk: A metric space for SNIa spectra

September 18, 2014 (9:20 AM - 9:40 AM)

Co-authors: Wolfgang Hillebrandt, Emille Ishida, Paolo Mazzali
Type Ia Supernovae (SNe Ia) are used as standardizable candles in cosmology. They are known to be thermonuclear explosions of white dwarfs, but the exact nature of the progenitor and the dynamics of the explosion have been a matter of debate for more than 50 years. In the last couple of decades large observational campaigns collected thousands of spectra of hundreds of extensively observed SNe. We develop a new framework to spectroscopically characterize SNe using Expectation Maximisation Principal Component Analysis (EMPCA). We apply the technique on SN Ia spectra. We study the derivative of the spectra instead of the flux to achieve significant improvements over previous works that used PCA on SN Ia spectra. The analysis is independent of reddening and does not need to know the distance to the SNe. We correlate the color and the absolute magnitude of the SNe with the spectral characteristics encoded in the PCA space using the Partial Least Square analysis (PLS). The analysis shows promise for studying the intrinsic color and reddening, and the absolute magnitude and extinction. The PC space gives a meaningful distance for comparison between SNIa spectral series. With a focus on model comparison. The same PLS-based approach can help to discover relations between the spectral properties and any other observable of the SNe or of the environment. We think that our metric space for SNe Ia will be useful for the study of progenitors and explosion mechanisms via comparison with explosion models.

63. **Clare M Saunders**, Lawrence Berkeley National Laboratory/UC Berkeley
Poster: Building a Type Ia Supernova Model with SNfactory Spectrophotometric Time Series

September 15 - 19, 2014

Co-authors: The Nearby Supernova Factory
The spectrophotometric time series of over one hundred Type Ia supernovae from the Nearby Supernova Factory provide unique opportunities for improving the standardization of Type Ia supernova magnitudes. We present a method for using the SNfactory data to build a spectral time series model. Using Gaussian processes, spectrophotometric observations are interpolated onto a spectral time series surface. Principal Component Analysis is then used to fit spectral time series templates. The model is verified using K-fold cross-validation. We discuss the potential for improvements over current lightcurve fitters using the model generated by this method.

64. **Richard A Scalzo**, Australian National University
Talk: Ejected Masses of Type Ia Supernovae

September 18, 2014 (10:00 AM - 10:20 AM)

The total mass ejected in a type Ia supernova explosion is a powerful discriminant between different evolutionary and explosion scenarios. The bolometric light curve of a type Ia supernova is sensitive to the ejected mass, and moreover can be reliably modeled using simple semi-analytic techniques. I will present ongoing work to measure type Ia supernova ejected masses by modeling the bolometric light curves, validating the technique by analyzing synthetic observables from contemporary explosion models alongside real data. Results suggest that type Ia supernovae eject a range of masses; that this range includes a significant relative rate of sub-Chandrasekhar-mass explosions; and that the ejected mass is correlated strongly with the light curve shape parameter from cosmology fitters. These results enable the distribution of ejected masses to be measured easily for large samples of type Ia supernovae, acting as a direct probe of binary population synthesis models and of the evolution of progenitor populations with redshift.

65. **Daniel Scolnic**, KICP at UChicago
Invited Talk: Color Dispersion and Milky Way Reddening among Type Ia Supernovae

September 19, 2014 (1:50 PM - 2:30 PM)

Co-authors: Daniel M. Scolnic, Adam Riess, Ryan Foley, Armin Rest, Steven Rodney, Dillon Brout, David Jones
Analyses of Type Ia supernovae have found an irreducible scatter of 5-10% in distance. While this scatter is mostly attributed to an intrinsic dispersion in luminosity, another, equally valid, source of this scatter is intrinsic dispersion in color. Misidentification of the true source of this scatter can bias both the retrieved color luminosity relation and cosmological parameter measurements. The size of this bias depends on the magnitude of the intrinsic color dispersion relative to the distribution of colors that correlate with distance. We re-analyze current published data sets with the assumptions that the distance scatter is predominantly the result of color variation. In this case, we find that the data are consistent with a Milky Way reddening law R_V=3.1, and that a Milky Way dust model better predicts the asymmetric color-luminosity trends than the conventional luminosity scatter hypothesis.

66. **Ken Shen**, UC Berkeley
Invited Talk: Double detonations in double white dwarf systems

September 16, 2014 (2:30 PM - 3:10 PM)

The double detonation scenario involves the ignition of a detonation in a helium-rich layer on the surface of a white dwarf that ignites a second detonation in the white dwarf's core. While disfavored in its original incarnation with a non-degenerate helium donor, recent variations have invoked low-mass white dwarf donors. I will present our work on the ignition and propagation of detonations in these extremely promising progenitor systems and discuss their impact on the circumstellar environment.

67. **Jeffrey Silverman**, University of Texas at Austin
Invited Talk: High-Velocity Features in the Spectra of Type-Ia Supernovae

September 17, 2014 (10:50 AM - 11:30 AM)

Co-authors: by J. M. Silverman, G. H. Marion, J. Vinko, J. C. Wheeler, and A. V. Filippenko
Optical spectra of Type-Ia supernovae (SNe Ia) obtained before maximum brightness sometimes show high velocity features (HVFs). They are most often seen in Si II and Ca II and in the most obvious cases appear as a second, separate absorption feature at ~6000-13,000 km/s higher expansion velocity than the more normal photospheric velocity features (PVFs). We explore how to determine the presence or absence of HVFs and how to accurately measure these two components. We investigate how often HVFs occur, at what epochs, and how they evolve with time using a large sample of low-resolution, optical spectra of nearby SNe Ia. Our ongoing study indicates that HVFs are quite common in SNe Ia during the weeks leading up to maximum brightness. Correlations between photometric observables and the strengths and expansion velocities of both HVFs and PVFs have been sought. Various explanations for the existence and behavior of the HVFs are being considered, with possibilities including a density enhancement or difference in ionization states in the outer portion of the SN ejecta or low levels of interaction with circumstellar material.

68. **Stuart A Sim**, Queen's University Belfast
Invited Talk: Light curves and spectra for multi-dimensional explosion models

September 17, 2014 (2:50 PM - 3:30 PM)

Co-authors: Markus Kromer
In recent years, multi-dimensional hydrodynamical explosion simulations have been carried out for a variety of models for thermonuclear supernovae. Radiative transfer calculations based on such simulations provide the synthetic observables needed to make the connection to observations - by critical comparison to data, we aim to use such calculations to better understand which progenitor/explosion scenarios may be applicable for which classes of transients. I will discuss ongoing efforts to develop and improve multi-dimensional modelling and the results obtained from recent studies of a variety of explosion scenarios. I will also highlight some of the key challenges in the modelling of supernova observations and prospects for future progress.

69. **Mathew Smith**, University of Southampton
Poster: The Effect of Weak Lensing on Distance Estimates from SNe Ia

September 15 - 19, 2014

Co-authors: David J. Bacon, Robert C. Nichol, Heather Campbell, Chris Clarkson, Roy Maartens, Chris B. D'Andrea, Bruce A. Bassett, David Cinabro, David A. Finley, Joshua A. Frieman, Lluis Galbany, Peter M. Garnavich, Matthew D. Olmstead, Donald P. Schneider, Charles Shapiro & Jesper Sollerman
In the next decade, the field of SNe Ia cosmology will move from being limited statistically to systematics dominated. One expected cause for an increase in the dispersion of SN Ia magnitudes is the weak gravitational lensing of SNe Ia by intervening matter along the line of sight. Using a sample of 608 Type Ia supernovae from the SDSS-II and BOSS surveys, combined with a sample of foreground galaxies from SDSS-II, we estimate the weak lensing convergence for each supernova line-of-sight, finding a correlation with Hubble residuals consistent with the prediction from lensing. We show for the first time that distance estimates from supernovae can be improved when lensing is incorporated by including a new parameter in the SALT2 methodology for determining distance moduli. The lensing of supernovae, while only seen at marginal significance in this low redshift sample, will be of vital importance for the next generation of surveys, such as DES and LSST, which will be systematics dominated.

70. **Assaf Sternberg**, Excellence Cluster Universe, TU München
Talk: High-resolution spectroscopy and Type Ia supernova progenitors

September 15, 2014 (2:50 PM - 3:10 PM)

Type Ia supernovae are very bright and relatively homogeneous events used as cosmic-scale standard candles. They are widely accepted to be the thermonuclear total disruption of carbon-oxygen white-dwarf stars in close binary systems. The nature of the companion, the mass donor, remains a mystery. A number of models have been suggested to explain the nature of their progenitor system. These models predict different environments in which the white-dwarfs are supposed to explode. High-resolution-spectroscopy is a very strong tool with which the environment along the line-of-sight to these explosions can be probed. Multi-epoch observations can be used to search for time-variable features that are indicative of circumstellar material being ionized by the explosion and recombining later. This was the tool used to find the first widely accepted claim of circumstellar material in a Type Ia supernova - SN 2006X, and the additional later cases - SN 2007le and PTF 11kx. The prediction of the theoretical models can be tested by comparing them to such observations. To date, multi epoch high-spectral-resolution observations have been published for only 6 Type Ia events. I will present the multi-epoch high-spectral-resolution observations of 14 additional Type Ia supernovae and discuss what these observations reveal about their progenitor systems.

71. **Mark Sullivan**, University of Southampton
Invited Talk: SNe Ia: Host galaxies and progenitors

September 18, 2014 (1:10 PM - 1:50 PM)

72. **Tamas Szalai**, Department of Optics and Quantum Electronics, University of Szeged, Hungary
Poster: The issue of measuring expansion velocities in Type Iax SNe

September 15 - 19, 2014

Co-authors: Vinko, Jozsef

73. **Dean M Townsley**, University of Alabama
Talk: Detonation Products and the Dependence of SNIa Spectra on Progenitor Composition

September 16, 2014 (2:10 PM - 2:30 PM)

Currently the composition of the progenitor of a SN Ia must be inferred from the stellar population from which it arises, typically that of the host galaxy. We have performed simulations in the DDT scenario of how the neutron excess created from the initial metallicity in the progenitor star can affect the abundances of ejected material and the resulting spectral properties of the supernova. This may provide a way to infer, or at least constrain, the composition of the progenitor WD from abundances in the explosion itself determined from spectra near maximum light. We find in early spectra the best candidates are Si and Ca features at about 6000 and 8000 Angstroms respectively, and some features created by stable Fe. The overlap of absorption and emission features from many contributions makes isolating an indicator challenging. I will discuss the stellar and detonation physics that lead to the ejecta abundances, including a consideration of the effect of detonation front curvature on stellar scales on detonation products. I will also discuss detonations in carbon-poor progenitors.

74. **Daniel R van Rossum**, University of Chicago
Talk: Supernova Light Curves and Spectra from Two Different Codes: Supernu and Phoenix

September 17, 2014 (4:20 PM - 4:40 PM)

Co-authors: Ryan Wollaeger
The observed similarities between light curve shapes from Type Ia supernovae, and in particular the correlation of light curve shape and brightness, have been actively studied for more than two decades. In recent years, hydronamic simulations of white dwarf explosions have advanced greatly, and multiple mechanisms that could potentially produce Type Ia supernovae have been explored in detail. The question which of the proposed mechanisms is (or are) possibly realized in nature remains challenging to answer, but detailed synthetic light curves and spectra from explosion simulations are very helpful and important guidelines towards answering this question. We present results from a newly developed radiation transport code, Supernu. Supernu solves the supernova radiation transfer problem uses a novel technique based on a hybrid between Implicit Monte Carlo and Discrete Diffusion Monte Carlo. This technique enhances the efficiency with respect to traditional implicit monte carlo codes and thus lends itself perfectly for multi-dimensional simulations. We show direct comparisons of light curves and spectra from Type Ia simulations with Supernu versus the legacy Phoenix code.

75. **Jozsef Vinko**, Department of Optics and Quantum Electronics, University of Szeged, Hungary
Poster: Distance measurements for recent bright SNe Ia

September 15 - 19, 2014

Photometric distances to SNe 2012cg, 2002ht, 2013dy and 2014J, determined by MLCS2k2 and SALT2 methods, are presented and discussed.

76. **J. Craig Wheeler**, University of Texas at Austin
Invited Talk: Multiple Rotational States of White Dwarfs

September 16, 2014 (9:40 AM - 10:20 AM)

Co-authors: Pranab Ghosh - Tata Institute
While there are many open issues with the nature of the prognitors of Type Ia supernovae, all viable models require the thermonuclear explosion of a carbon/oxygen white dwarf that has evolved in a binary system. In this context, rotation, specifically differential rotation, would seem to be an important aspect of any model, sub Chandrasekhar, Chandrasekhar, super-Chandrasekhar, single or double degenerate. Differential rotation is specifically invoked in the attempt to account for the apparent excess mass in the super-Chandrasekhar events, but even sub-Chandrasekhar progenitors are likely to rotate. The nature of the rotational state of the progenitor is uncertain both observationally and theoretically. On the observational side, typical SN Ia show little continuum polarization, suggesting that they do not display extremes of rotational distortion. In contrast, subluminous SN 1991B-like events seem to display continuum polarization with a well-defined orientation suggesting a rotation axis. On the theoretical side, some works suggest that only solid body rotation is consistent with the expected viscosity in white dwarfs, but others have found pronounced, steady-state differential rotation. We have clarified this situation by showing that the strong non-linearity of the viscosity in differentially-rotating white dwarfs subject to Kelvin-Helmholtz and baroclinic instabilities allows both solid body and differentially-rotating solutions. We capitalize on this insight by modeling the dependence of the bar mode instability limit, and hence the maximum mass of the white dwarf, on the profile of the distribution of the specific angular momentum distribution. The results are consistent with those deduced for super Chandrasekhar events. We also note that while stable solutions require the monotonically-positive gradient of the specific angular momentum, solutions involving smaller, secular instabilities and associated viscosity in the outer layers can give rise to portions of the structure that have a negatve gradient of the angular velocity. These regions are prone to amplification of any seed field by the magnetorotational instability.

77. **Donald E Willcox**, Stony Brook University
Poster: A Study of Steady-State Detonation Structures for Hybrid C, O, Ne White Dwarf Models

September 15 - 19, 2014

Co-authors: Dean Townsley, Alan Calder
We present a study of one-dimensional planar detonations in white dwarf material at varying compositions of C, O, and Ne, motivated by recent stellar evolution models which predict hybrid white dwarf stars with a C, O core inside an O, Ne shell. At a given density and composition, we integrate the Zel'dovich, von Neumann, During (ZND) equations while varying the strength of support for overdriven detonations to determine the detonation velocity corresponding to the sonic point. The pressure, density, and composition structure in the region behind the shock front for a barely overdriven detonation then characterizes steady-state burning and provides time scales that can be used to calibrate a combustion model for use in simulations of thermonuclear supernovae. This calibration will enable a future study of hybrid C, O, Ne white dwarf stars as possible progenitors for some Type Ia supernovae.

78. **Bill Wolf**, University of California Santa Barbara
Talk: Post-nova supersoft sources, recurrent novae, and the fastest recurrent nova yet discovered

September 15, 2014 (4:20 PM - 4:40 PM)

Co-authors: Sumin Tang, Jared Brooks, Lars Bildsten, Bill Paxton, and the iPTF Collaboration
Despite the many difficulties associated with it, the single degenerate channel remains a possibility for type Ia supernova progenitors. Thus, understanding the systems that are thought to comprise this channel can help us gain insight into massive white dwarf formation. Typically, we think of accreting white dwarfs in the context of novae, where material is accreted for a time and then a thermonuclear runaway drives a rapid increase in luminosity and radius, resulting in a peak in the optical radiation as well as mass loss. After this optical peak, a remnant envelope burns quasi-stably at nearly the Eddington luminosity while at a small radius, appearing for a time as a bright supersoft source in the sky. Models and recent observations of novae in M31 imply that this is the case for all novae, and observing the supersoft phase can tell us something about the underlying white dwarf. Recent observations in M31 by iPTF indicate a recurrent nova there has a recurrence time of one year, the shortest yet measured. From this short recurrence time and observations of the supersoft phase, we have constrained the mass of the white dwarf to between 1.32 Msun and 1.36 Msun. With such rapid accretion, this system is one of the most promising candidates for the single degenerate channel if it is indeed a C-O white dwarf. Before either detonating as a type Ia supernova or collapsing to a neutron star, the helium ash from successive flashes will necessarily undergo its own runaway, appearing as a helium nova. This predicted transient is interesting in its own right, but it also is important to understanding how quickly such a white dwarf would approach the Chandrasekhar mass.

79. **Rachel C Wolf**, University of Pennsylvania
Talk: Host Galaxy Environment as a Parameter for SN Ia Standardization

September 18, 2014 (2:10 PM - 2:30 PM)

Co-authors: Chris B. D'Andrea, Ravi Gupta, Masao Sako, John A. Fischer and others
We study the relationship between supernova properties, primarily their residuals on the Hubble Diagram, and those of their host galaxies. The results presented here constitute the largest homogeneous sample of Type Ia Supernovae (SNe Ia) host galaxy spectroscopic properties to date. We focus this work on a sample of 233 photometrically-classified and spectroscopically confirmed SNe Ia discovered as part of the SDSS-II Supernova Survey ($z < 0.55$). This analysis utilizes an ancillary program on the SDSS-III Baryon Oscillation Spectroscopic Survey (BOSS), that obtained spectroscopy for nearly all host galaxies of SDSS-II SN candidates. We examine correlations between supernova Hubble Residuals and host galaxy properties and investigate the "mass step" as discussed in current literature. Finally, we investigate the source of Hubble Residual scatter by applying corrections using host galaxy properties.

80. **Ryan Wollaeger**, University of Chicago
Poster: SuperNu: a State-of-the-Art IMC-DDMC Radiation Transport Code for Supernovae

September 15 - 19, 2014

Radiation transport calculations are required in order to compare the light curves and spec tra predicted by Type Ia supernova (SN Ia) models with observations. In calculating these light curves and spectra, the radiation passes through regions of the ejecta that are very optically thick and regions that are relatively optically thin. Traditional Monte Carlo transport methods have trouble dealing with optically thick regions . SuperNu is a new, state-of-the-art radiation transport code based on a hybrid method that c ombines Discrete Diffusion Monte Carlo (DDMC), to treat optically thick regions, with Impli cit Monte Carlo (IMC), to treat optically thin regions with transport theory. DDMC is very efficient in optically thick regions and, consequently, significantly accelera tes the transport calculations. SuperNu's seemless coupling between IMC and DDMC is robust in high-velocity outflows. We compare light curves and spectra from SuperNu to the deterministic radiation transport c ode PHOENIX for the W7 model of the SN Ia problem. Despite the considerable differences in the code methods, the light curves and spectra of S uperNu show good agreement to those of PHOENIX.

81. **Tyrone E Woods**, Max Planck Institute for Astrophysics
Poster: Emission-line diagnostics of the origin of SNe Ia in galaxies near and far

September 15 - 19, 2014

Co-authors: Marat Gilfanov
In the canonical single degenerate (SD) scenario, a white dwarf (WD) grows through nuclear burning of hydrogen accreted from a companion prior to explosion. This suggests that SD progenitors should be extremely luminous sources in the EUV and soft X-ray bands. Recently, we demonstrated that if the SD model is correct, then accreting, nuclear-burning white dwarfs should provide the dominant source of ionizing radiation in passively-evolving galaxies, ~40% of which are known to host extended emission-line nebulae. Therefore, one can search for the presence of any high-temperature SD progenitor population in these galaxies by looking for emission lines characteristic of ionization by very high-temperature (10^5 K - 10^6 K) sources. In this contribution, I will briefly outline our past work, presenting our first such constraints on the contribution of the SD channel to the SN Ia rate in nearby early-type galaxies (<~10%). A similar approach can be taken for individual SNe Ia, by searching for fossil nebulae in the vicinity of nearby events, which we demonstrate using a pre-explosion narrow-band H alpha + [N II] image of the vicinity of SN2014J (see also Graur+ 2014). Finally, I will discuss how optical spectroscopy and soft X-ray observations of nearby galaxies reveal fundamental problems in our present understanding of the population synthesis of SSSs and other accreting WD binaries.

82. **Stan E Woosley**, UCSC
Invited Talk: Models for Type Ia Supernovae

September 15, 2014 (10:20 AM - 11:00 AM)

Co-authors: Chris Malone, Dan Kasen, Rainer Moll, Cody Raskin, Mike Zingale, John Bell, Ann Almgren, Andy Nonaka
There are a lot of models for SN Ia. I will try to present a balanced overview including many recent results for the Chandrasekhar, sub-Chandrasekhar, and double degenerate classes. Quite probably SN Ia are more than one thing since there is no one model that explains everything. A general problem is the prediction of more diverse results than we seem to see in nature.

83. **Paula Zelaya**, Pontificia Universidad Catolica de Chile
Talk: Sodium and Polarizing Dust Around Ia SNe

September 18, 2014 (11:10 AM - 11:30 AM)

Co-authors: A.Clocchiatti, J.C.Wheeler, P.Hoflich, J.Maund, E.Reilly, L.Wang, F.Patat, D.Baade, F.Forster, S.Gonzalez-Gaitan
We present a spectropolarimetric study of 11 Ia SNe, selected because they exhibit narrow NaD lines at the velocity of their hosts. The sample displays a variety of polarimetric percentages but all of them follow an approximately linear trend with wavelength in the blue+visual wavelength range. SNe with redder colors are more polarized and show larger EW of NaI D, suggesting that we are observing polarization by aligned foreground dust. The polarimetric spectrum of the highly polarized events clearly deviate from that of the typical MW interstellar polarization, a behavior that we interpret as the result of a low value of Rv in the polarizing dust. Are these observations related to a particular SN Ia progenitor scenario? We collect and discuss evidence in favor of the two most popular evolutionary channels leading to a Type Ia SN explosion, the single and double degenerate scenarios, then suggest a relation between gas and dust around Ia's, revealed through the upper limit of the observed polarization.

84. **Bonnie Zhang**, Australian National University
Poster: SkyMapper Supernova Search

September 15 - 19, 2014

SkyMapper is a 1.3m wide-field robotic optical telescope located at Siding Spring Observatory in Australia, dedicated to carrying out a 6-filter digital survey of the southern sky. Alongside the main survey, the telescope will carry out a supernova search that aims to obtain high-quality ty pe Ia supernova light curves for cosmology, constraining both cosmic expansion and peculiar veloc ities. Over the next five years, SkyMapper will provide a low-redshift ($z < 0.1$) sample of approx imately 500 type Ia supernovae to complement the Dark Energy Survey sample at $0.2 < z < 1.2$. We a im to utilise the overlap of DES and SkyMapper fields to obtain millimag-level calibration, which combined with the unprecedentedly large sample size will result in much tighter cosmological con straints.

85. **Chenchong Zhu**, University of Toronto
Poster: Moving Mesh Simulations of a White Dwarf Merger

September 15 - 19, 2014

Co-authors: Ruediger Pakmor, Philip Chang and Marten H. van Kerkwijk
The merger of two carbon-oxygen white dwarfs, long-theorized to be a possible progenitor to type Ia supernovae, has traditionally been simulated using smoothed-particle hydrodynamics without the inclusion of magnetic fields. We simulate the merger of a 0.625 - 0.65 solar mass CO WD binary in the moving mesh code Arepo with either pure hydrodynamics or MHD. We find significant differences in the density and temperature structures of the merger remnant core between the pure hydro Arepo simulation an equivalent SPH Gasoline simulation. Our MHD run features the exponential growth of a global magnetic field during the final coalescence of the binary, saturating near 10^11 G in the remnant. We discuss how these features can affect further evolution of the merger remnant.

86. **Michael Zingale**, Stony Brook University
Invited Talk: Modeling the Early Phases of SNe Ia

September 16, 2014 (1:10 PM - 1:50 PM)

Co-authors: co-authors: Ann Almgren, John Bell, Adam Jacobs, Chris Malone, Andy Nonaka, Stan Woosley
Several of the progenitor models proposed for Type Ia supernovae begin with a slow convective period that sets the stage for the subsequent explosion. Capturing the dynamics of these flows is challenging for traditional hydrodynamics codes, but a complete end-to-end simulation of SNe Ia requires an understanding of this initial state. We describe the application of the low Mach number hydrodynamics code, Maestro, to the convective evolution of the Chandrasekhar and sub-Chandra models of SNe Ia. We discuss the distribution of the hotspots that seed the explosion, the state of the turbulent convective field, and the implications for the explosion models.