



[http://kicp-workshops.uchicago.edu/SNClassification\\_2016/](http://kicp-workshops.uchicago.edu/SNClassification_2016/)

## WORKSHOP PRESENTATIONS

The Kavli Institute for Cosmological Physics (KICP) at the University of Chicago is hosting a workshop on the Photometric Classification of SNIA on April April 28-29, 2016. This workshop will focus on Photometric classification methods and validation techniques for large SNIA data samples. The emphasis will be on defining samples that can be used to measure cosmological parameters, rate vs redshift, and SN-host correlations.

## Organizing Committee

### Renee Hlozek

University of Toronto

### Richard Kessler

University of Chicago

### Daniel Scolnic

Kavli Institute for Cosmological Physics

**1. Peter J Brown, Texas A&M***Talk:* UV Photometric Classification of SNe

April 28, 2016 (1:30 PM - 2:00 PM)

Deep optical surveys will continue to find more distant supernovae for which the observed light was emitted in the ultraviolet. I will discuss rest-frame/observer-frame ultraviolet observations of nearby supernovae with Swift's Ultra-Violet Optical Telescope. These observations show a rich diversity in colors which should be useful for photometric differentiation of supernova types. I hope to get feedback as to the best ways to incorporate this information into photometric classifiers.

**2. Narayan Gautham, NOAO/UA***Talk:* Finding & Characterizing Interesting Transients Rapidly with LSST

April 29, 2016 (10:00 AM - 10:30 AM)

*Co-authors: The ANTARES Collaboration*

I'll discuss our work on the Arizona-NOAO Temporal Analysis and response to Events System. ANTARES is a joint project of the U.S. National Optical Astronomy Observatory, and the Department of Computer Science at the University of Arizona, and we are using our experience with the previous generation of supernova surveys and big data to tackle the general problem of characterizing the entire transient and variable sky that will be imaged by the Large Synoptic Survey Telescope (LSST). Our prototype is focused on identifying the "rarest of the rare" events in real-time to coordinate detailed follow-up studies, but we must accurately characterize known objects with sparse data to separate the wheat from the chaff. I'll detail some of the new algorithms being developed for the project, the more complex architecture we need to accomplish this more ambitious goal, and present some of our preliminary results using existing data sets.

**3. David O Jones, Johns Hopkins University***Talk:* PS1 Cosmology with Contaminated Samples

April 28, 2016 (10:00 AM - 10:30 AM)

*Co-authors: Daniel Scolnic, Adam Riess, Richard Kessler*

Pan-STARRS observed over 5,000 supernovae (SNe) over four years, over 1,000 of which are cosmologically useful Type Ia SNe with host galaxy redshifts. However, only a subset of these have been confirmed by a SN spectrum. If biases resulting from Core-Collapse SN contamination in this sample can be understood, these data will be able to provide the best current constraints on the dark energy equation of state,  $w$ . We present a Bayesian method for marginalizing over the contaminating distribution of SNe, using SN type probabilities from light curve classifiers as input. We use simulations and Pan-STARRS data to show that our methodology does not bias  $w$  and only modestly increases measurement uncertainty relative to a pure Ia sample.

**4. Natalia Karpenka, Southampton University***Talk:* Spectrophotometric Templates of Stripped-Envelope SNe

April 28, 2016 (3:00 PM - 3:30 PM)

*Co-authors: M Sullivan, M Smith***5. Richard Kessler, University of Chicago***Talk:* Building a Photometric SNIa Hubble Diagram from DES-SN Data

April 28, 2016 (10:30 AM - 11:00 AM)

6. **Steve Kuhlmann**, Argonne National Laboratory  
*Talk:* Studies of Template-Based Machine Learning Classification

April 28, 2016 (3:30 PM - 4:00 PM)

*Co-authors:* L. Asimacopoulos, S. Londo, J. Macaluso, J. Cunningham, Loyola University; R. Gupta, and E. Kovacs Argonne

We present photometric classification studies of SDSS data and DES simulations, using template-based and machine learning algorithms.

7. **Michelle Lochner**, University College London  
*Talk:* Photometric SN Classification with Machine Learning

April 29, 2016 (2:00 PM - 2:30 PM)

*Co-authors:* Jason McEwen, Hiranya Peiris, Ofer Lahav, Max Winter

The automated classification of photometric supernovae has become an active field in recent years in light of current and upcoming imaging surveys, including the Dark Energy Survey (DES) and the Large Synoptic Telescope (LSST). Spectroscopic confirmation of type will be impossible for all supernovae discovered with these surveys, making photometric classification an important step for both cosmology and core-collapse studies. With this in mind, we develop a multi-faceted classification pipeline, investigating the use of machine learning algorithms combined with existing and novel methods of extracting features from light curves. In this talk, I will provide an overview of the methods used and discuss the results from applying the pipeline to simulated supernova data. I will also discuss the effect of representativeness of training set and show that accurate classification is possible without redshift information.

8. **George Miller**, Harvard-Smithsonian Center for Astrophysics  
*Talk:* PS1 Classification of SN Using Ensemble Decision Tree Methods

April 29, 2016 (9:30 AM - 10:00 AM)

*Co-authors:* Edo Berger

In the modern age of large time-domain photometric surveys, classification and analysis of transient events prior to, or lacking, spectroscopic observation is becoming increasingly imperative. To this end, I will discuss our design of a simple model-based learning strategy intended to differentiate between multiple types of supernovae. We tune our model using over 500 spectroscopically classified supernovae in the Pan-STARRS1 Medium-Deep Survey, which uses a similar cadence strategy to future wide-field surveys like LSST. Our broad, inclusive model is fit using a Bayesian MCMC approach and then fed into a boosted decision tree learning method. Further corrections are used to account for imbalanced classes and ill-defined features. Future implementations to the model include better K-correction handling and external features such as galaxy information.

9. **Anais Moeller**, Australian National University and CAASTRO  
*Talk:* SN Photometric Classification of SNLS Data with Supervised Learning

April 28, 2016 (1:00 PM - 1:30 PM)

We present a new photometric classification of type Ia supernovae using SN-redshifts in the SNLS deferred photometric analysis. We develop an analysis that consists in three main stages: photometric redshifts are obtained directly from supernova light curves, features are extracted using a general light-curve fitter and classification is done using machine learning algorithms. We study the performance of different algorithms including: Random Forest and Boosted Decision Trees. We evaluate the performance using SNe simulations and real data from SNLS 3-year processing which contains large spectroscopically and photometrically selected type Ia samples. The best method is shown to obtain an AUC score of 0.98. We show that it is possible to obtain a large type Ia SNe sample with an estimated contamination of less than 5%. This work demonstrates the feasibility of applying a machine learning classification to real high-z SN data and highlights the differences of classifying simulated SNe and SNLS data.

10. **Masao Sako**, University of Pennsylvania  
*Talk:* SN Classification with Nearest Neighbors

April 29, 2016 (3:30 PM - 4:00 PM)