Swift Cycle 12
Abstracts of selected proposals
(NNH15ZDA001N - Swift)

Below are the abstracts of proposals selected for funding for the Swift Cycle 12 program. Principal Investigator (PI) name, institution, and proposal title are also included. **185** proposals were received in response to this opportunity. On March 17, 2016, **29** proposals were selected for funding.

Marco Ajello/Clemson University
ON THE ORIGIN OF THE EXTRAGALACTIC GAMMA-RAY AND NEUTRINO BACKGROUNDS

Cosmic-ray interactions with ambient matter and radiation fields create high-energy neutrino and gamma-rays, thus establishing a link between the extragalactic gamma-ray background (EGB) measured by Fermi and the neutrino flux recently reported by IceCube. Star-forming galaxies are currently considered as candidates to explain the neutrino background and part of the EGB. Fermi s most recent survey above 50 GeV indicates that star-forming galaxies do not contribute substantially to either backgrounds. Thus, the gamma-ray and neutrino background might not have a common origin, unless there is, above 50 GeV, a non-neglibile population of sources other than blazars. Swift will test this hypothesis, by targeting half of the sample of unidentified >50 GeV sources that are visible from Chile.

Carlos Badenes/University of Pittsburgh
A Complementary Radio/X-ray Study of Shocks and Mass Ejection in Novae

We propose to continue our multiwavelength survey of nova outbursts, of which Swift XRT/UVOT are key components, augmented by radio, optical, infrared, and gamma-ray observations. Specifically, this program aims to explore how mass loss proceeds during nova outbursts using contemporaneous X-ray and VLA radio observations of up to two novae during the first year after discovery (160 ks request total). Together, the two regimes provide a complementary probe of the quantity, kinematics and structure of the ejected material. Understanding how mass is ejected in nova outbursts is crucial for determining the long term evolution of the white dwarfs in these systems and understanding the origin of GeV gamma-ray emission in novae.

Dennis Bodewits/University of Maryland
The Activity and Evolution of Oort Cloud Comets

We will investigate the effects of activity on cometary evolution, and to address which properties reflect comets origins and which are products of subsequent processing. To do this we propose to use Swift UVOT to characterize the activity of two Oort cloud comets: one dynamically new, and one more evolved. We will use grism spectroscopy and photometric imaging to measure production rates of OH, dust, and minor species over the course of the apparitions. Our systematic sampling of the comets activity at different heliocentric distances will allow us to search for asymmetries around perihelion. Swift s unique capabilities will allow us determine the physical and chemical evolution of the comets activity which can then be compared to that of other age classes of comets.

Slavko Bogdanov/Columbia University
SWIFT MONITORING OF NEARBY X-RAY BINARY-RADIO MILLISECOND PULSAR TRANSITION OBJECTS

The recent identification of three binary millisecond pulsars transforming between accreting and rotation-powered states has finally closed the evolutionary missing link between low-mass X-ray binaries and "recycled" pulsars. These discoveries imply that their parent population, redbacks, may also be nascent recycled pulsars that sporadically revert to/from a low-luminosity accreting phase. We propose a Swift X-ray and UV monitoring campaign of all such nearby binary radio millisecond pulsars in the field of the Galaxy aimed at "catching them in the act" of switching to/from an accreting state. This effort would greatly aid in constraining key aspects of the poorly understood transition process of pulsars between accretion and rotation power.

Steven Boggs/University of California
ToO Observation of GRBs Detected with the COSI Balloon Payload

The Compton Spectrometer and Imager (COSI) is a wide-field, balloon-borne gamma-ray telescope (0.1-5 MeV) that will launch from New Zealand around April 1, 2016. The primary goal of this COSI flight is to perform pioneering measurements of gamma-ray polarization in GRBs to help probe the prompt emission mechanism and field geometry. On a ~50-day flight, we anticipate detecting around 8-10 GRBs and definitively measuring the polarization of ~4 GRBs. We are requesting Swift ToO observations of GRBs triggered by COSI with fluence levels high enough to permit measurement of the polarization. Swift observations will be crucial for enabling follow-up host galaxy and redshift determinations, as well as placing the polarization measurements in context of the afterglow properties.

Stephen Cenko/Goddard Space Flight Center
HIGH-CADENCE XRT MONITORING OF ULTRALUMINOUS X-RAY SOURCES TO SEARCH FOR ORBITAL PERIODS

We propose high-cadence XRT monitoring observations (1 ks x 5 visits per day for 10 days) of two variable, high-inclination ultraluminous X-ray sources (ULXs: NGC 5408 X-1 and NGC 55 ULX). Our main goal is to search for orbital periods in the range of a few 10s of hours in these two sources. This particular period range -- typical of stellar-mass black hole binaries -- has not been probed before. Any detected periods will be an important step towards dynamical mass measurement of these black holes. Swift, with its excellent X-ray sensitivity and fast maneuvering capability, is currently the only observatory that can carry out these observations. This proposal builds on previous successful Swift/XRT detection of a 12.1 hr orbital period from the ULX Holmberg IX X-1.

Stephen Cenko/Goddard Space Flight Center
UNVEILING THE PROGENITORS OF SHORT GAMMA-RAY BURSTS

Despite tremendous progress in the last decade, an unambiguous link between short gamma-ray bursts (SGRBs) and their presumed progenitor systems, binary neutron star mergers, has remained elusive. Here we request funding to support our multi-wavelength campaign dedicated to the follow-up of Swift SGRBs, designed ultimately to directly identify their progenitor systems. Specifically, we focus on two questions: 1) What are the opening angles of Swift SGRBs (currently the dominant source of uncertainty in predicting detection rates for the Advanced LIGO and Virgo gravitational wave detectors)? 2) Can we detect the smoking gun "kilonova" signature to directly associate SGRBs with binary neutron star systems?

Alessandra Corsi/Texas Tech University
UNRAVELING THE PHYSICS OF BROAD-LINE TYPE IC SUPERNOVAE WITH ALMA+SWIFT

Supernovae (SNe) of type Ib/c are believed to mark the deaths of massive stars that are stripped of their hydrogen (type Ib), and possibly helium (type Ic), envelope before explosion. This proposal focuses on a particular sub-class of Ib/c SNe called broad-line (BL) Ic, estimated to constitute only ~5% of the Ib/c population. Particular interest in BL-Ic SNe has been generated by their relation to gamma-ray bursts (GRBs). Here we propose to complement our approved VLA+ALMA observing program of a nearby BL-Ic SN discovered by the intermediate Palomar Transient Factory (iPTF), with data of crucial importance from Swift. With ALMA+Swift, we can diagnose the fundamental physics of particle acceleration in SN shocks, and probe the cosmic-ray-dominated shock scenario.

Alessandra Corsi/Texas Tech University
JOINT iPTF-VLA-SWIFT FOLLOW-UP OF aLIGO EVENTS

Starting from 2015, a new window on the universe is going to open as the advanced ground-based Gravitational Wave (GW) detectors, aLIGO (now in its 1st observing run) and Virgo, will reach design sensitivity. Because GW-triggered events are expected to be only coarsely localized to large areas of the sky, the identification of electromagnetic counterparts could provide orders of magnitude better localization and enhance confidence in the GW detections. Here, we propose to complement our iPTF+VLA follow-up program of aLIGO triggers with data from Swift. A radio plus X-ray detection of the several optical candidates expected to be found in a typical GW trigger error-area would greatly enhance the confidence in the detection, and help identify the nature of the event.

Douglas Cowen/Pennsylvania State University
Seeking the Sources of the Highest-Energy Cosmic Neutrinos with Swift

We propose the first prompt searches for X-ray and UV/optical counterparts to IceCube high-energy (E >~ 30 TeV) likely-cosmic neutrinos with Swift. Using newly-installed high-energy event identification and reconstruction algorithms running at the South Pole, we will select up to three neutrinos with high probabilities of cosmic origin and good localizations. Each trigger will be observed with a mosaic of 19 Swift pointings, tiling the neutrino localization to >50% completeness and 1 ks exposure within roughly 16 hours, in sequence designed to recover >50% of Swift GRB X-ray afterglows. Discovery of even a single EM counterpart to a high-energy neutrino would revolutionize our understanding of the source population, and potentially, reveal the origins of the highest-energy cosmic rays.

Abe Falcone/Pennsylvania State University
THE LARGEST FLARES FROM KNOWN TEV GAMMA RAY BLAZARS: SIMULTANEOUS OBSERVATIONS WITH TOOS

We propose to study known TeV blazars, most of which have never previously benefited from multiwavelength campaigns, during their highest flaring states. These proposed simultaneous multiwavelength observations will place severe constraints on the emission models. Simultaneous observations of X-ray, UV/optical, and gamma-ray emission during high states from these sources will provide the means to study relative flux, time delays, and the SED, thus enabling studies of particle acceleration and emission processes in blazar jets. Since the 1st peak of these SEDs is typically in the X-ray band and the 2nd

peak is in the GeV/TeV band, Swift, VERITAS, and Fermi are ideal for these studies. The high flaring states required by the trigger criteria will ensure high science return.

Brian Fields/University of Illinois at Urbana-Cham paign
Swift Alert, Localization, and First Look at a Type Ia Supernova in the Milky Way

Future Milky Way supernovae offer unique scientific opportunities, but likely explode ~10 kpc away in the Galactic plane and thus are optically dim. A Galactic Type Ia supernova will also be dim in the radio, X-ray, and neutrinos. Fortunately, Swift can detect Galactic SNIa events via the 158 keV gamma-ray line emitted in the radioactive decay of 56Ni to 56Co. Perhaps on the first day, this signal will rise above background in BAT, with line presenting a unique spectral signature. For ~1 day after discovery, Swift will be the only space-based telescope on target while others slew. We propose to model the ability of Swift to (1) detect this signal, (2) confirm its Type Ia origin, (3) localize the event for followup, and (4) constrain its properties via observations with the XRT and UVOT.

Ryan Foley/University of Illinois
UV Spectroscopy of Type Ia Supernovae

Type Ia supernovae (SN Ia) are incredibly useful distance indicators. However, we still do not know exactly what progenitors create SN Ia or how they explode. We have an approved HST program to obtain ultraviolet (UV) spectral time series of multiple nearby SN Ia. The UV portion of a SN Ia spectral energy distribution is strongly affected by progenitor composition and the nuclear burning during the explosion. We propose to take advantage of Swift's fast turn-around capabilities to obtain UV spectra immediately after discovery (before HST can be scheduled). We also propose to obtain UVOT light curves of these well-observed SN. The combination of Swift, HST, and ground-based data will further our understanding of SN Ia progenitor systems and explosions and improve SN Ia distance estimates.

Suvi Gezari/University of Maryland
CLEARING THE FOG: SYSTEMATIC SWIFT UV/X-RAY FOLLOW-UP OF iPTF NUCLEAR TRANSIENTS

Nearly 50 years ago, theorists first proposed that an outburst of radiation from the tidal disruption of a star would be a unique signpost for a dormant supermassive black hole (SMBH) lurking in the center of a galaxy. Over the last decade, there has been major progress in the search for tidal disruption event (TDE) candidates in wide-field surveys across the electromagnetic spectrum. With the now archetypal TDE candidate PS1-10jh, we demonstrated that time domain observations of TDEs can act not just as signposts, but also as cosmic scales to weigh SMBHs in distant galaxies. The Zwicky Transient Facility and the Large Synoptic Survey Telescope are poised to build up a statistically significant sample of TDE light curves to probe the demographics of SMBHs at cosmic distances. However, in order to realize their potential as TDE discovery factories, one must be able to filter out interlopers in the transient Universe which are orders of magnitude more common. Hence, we propose a key project to utilize the unique UV and X-ray follow-up capabilities of Swift, and capitalize on the manageable discovery rate of iPTF nuclear transients, to perform a systematic, and unbiased follow-up of nuclear transients in order to clear the fog of nuclear SNe and flaring AGN, and develop and train a real-time classification engine to enable prompt classification and follow-up of bonafide TDEs among the deluge of transients to be discovered by the next generation of optical synoptic surveys.

Svetlana Jorstad/Boston University
OPTICAL, UV, AND X-RAY DIPS IN THE RADIO GALAXY 3C 120

The investigators propose to monitor the radio galaxy 3C~120 with Swift over 2 years at optical-UV and X-ray bands in order to test two scenarios for the accretion disk/jet connection established by previous studies. One scenario predicts that the optical-UV spectral slope should steepen dramatically at the start of X-ray dips as the inner accretion disk (AD) vanishes. Under the other hypothesis, in which the X-ray emission occurs at the base of the jet, no such effect is expected. The resulting Swift observations will also provide a legacy dataset important for understanding the complex AD/corona/jet relationship.

Oleg Kargaltsev/The George Washington University
REVEALING PULSARS HIDDEN IN THE 3RD FERMI CATALOGUE

Abstract: We propose a survey of unclassified Fermi sources from the 3FGL and 2FHL catalogs. Using several parameter cuts, we have identified a sub-sample that will be dominated by pulsars with inclusion of high mass X-ray binaries (HMXBs), PWNe, and SNRs. We aim to identify their X-ray counterparts, thus increasing the population of

galactic particle accelerators and, in particular, pulsars detected in both gamma-rays and X-rays. With this prudent shallow survey approach we will be able to identify new X-ray bright targets suitable for detailed follow-up studies with Chandra and XMM-Newton.

Mansi Kasliwal/California Institute of Technology
Understanding Young Supernovae & Exotic Transients with SWIFT and IPTF

The intermediate Palomar Transient Factory (iPTF)operations are now in full swing with a focus on faster cadence and even more rapid response follow-up of optical transients. Our new software pipeline, building on the PTF legacy, regularly issues automated alerts for intra-night spectroscopic follow-up of extremely young or fast events. Here, we propose to continue our very productive Swift-iPTF program focused on young supernovae and fast evolving transients. UV observations have proved to be of unique value for the youngest supernovae. X-ray observations have played a key role in both identifying and understanding non-thermal sources. Our approved ultra-rapid HST ToO for flash UV spectroscopy depends on prompt Swift/UVOT observations. Our ongoing large program at Gemini for rapid ToOs provides optical spectroscopy within hours. NSF just awarded us the PIRE GROWTH program to build a global network of follow-up telescopes. Thus, the proposed Swift-iPTF program will be complemened with an aggressive multi-wavelength (HST, Palomar, Magellan, Keck, Gemini and EVLA) program.

Jamie Kennea/Pennsylvania State University
SWIFT LOCALIZATION OF MAXI DISCOVERED GALACTIC X-RAY TRANSIENTS

We propose to continue the highly successful program to use Swift to perform localization of Galactic X-ray Transients newly discovered by MAXI. MAXI scans almost the entire X-ray sky every ~92 minutes, with a source detection sensitivity of ~60 mCrab in one orbit and ~15 mCrab in one day, discovering X-ray transients with 0.1-0.5 degree accuracies in the 0.7-20 keV energy band. Swift is able to provide rapid follow-up observations of MAXI triggers and localization up to 1.4 arc-second error radius, which is vital for identifying any optical/radio counterpart. XRT observations will also provide measurements of the low energy X-ray spectra. UVOT will be used to provide astrometric corrections, and to search for any optical counterparts. Swift is proven to be uniquely capable in this task.

Ragnhild Lunnan/California Institute of Technology
Unveiling Superluminous Supernovae with IPTF and SWIFT

Superluminous supernovae (SLSNe) are a rare class of transients with peak luminosities 10-100x those of ordinary SNe and unique spectra. Now, a decade after their first discoveries (and even with > 50 objects found), fundamental questions like their energy sources and progenitors are still unknown. One way to make progress is to focus on the low-redshift population, which can be studied in greater detail and to later times than their high-redshift counterparts.

We propose to combine the discovery potential and follow-up resources of the Palomar Transient Factory with the UV time-domain capabilities of Swift to study two low-z SLSNe, allowing for a detailed comparison with explosion models, and facilitating comparison with the growing number of high-z SLSNe discovered.

Raffaella Margutti/New York University
EXPLOSION MECHANISMS AND ENERGY SOURCES POWERING SUPER-LUMINOUS SUPERNOVAE

With bolometric peak luminosities L>7d43 erg/sec, the new class of Super Luminous Super Novae (SLSNe) outshine standard SN explosions of a factor ~10 and represent the death of the most massive stars in our Universe. Their exceptional luminosity requires exotic explosion mechanisms and/or sources of energy whose nature is unclear. Here we propose rapid Swift follow up of 2 SLSNe to map their UV and X-ray emission during the early stages of their evolution as part of our multi-wavelength effort through programs on the VLA, XMM, Chandra and optical/NIR facilities. The final aim is to: (i) Pin down the energy source of SLSNe; (ii) Map the diversity of their progenitor stars and pre-explosion evolution.

Raffaella Margutti/New York University
Probing the Mass-Loss History of Massive Stars with Swift

Contrary to expectations from current stellar evolutionary models, recent observations uncovered the ejection of shells of material by massive stars in the years before the supernova explosion, thus revealing our inadequate understanding of the last stages of evolution of massive stars. Here we propose a focused Swift project, with the aim to (i) constrain the mass-loss history of massive stars before explosion, employing multi-wavelength observations of the supernova shock breaking out through a dense medium; and (ii) constrain the efficiency of cosmic-ray acceleration by supernova shocks. This study will open up a new window of investigation on the SN shock circum stellar medium interaction.

Brian Metzger/Columbia University
Testing the Magnetar Model for Superluminous Supernovae with Swift

The discovery of ``super-luminous'' supernovae (SLSNe), with radiated energies 10-100 times higher than normal SNe, indicates that massive stars end their lives in ways previously unanticipated. A popular model posits that SLSNe are powered by the magnetic spin-down a newly-born, rapidly-rotating magnetar. However, the magnetar model lacks a smoking gun observational prediction that would distinguish it from alternative scenarios. We will model the time evolution of nascent millisecond magnetar nebulae, in order to determine whether and when UV/X-ray radiation can ionize through the ejecta and escape to the observer (ionization break-out). Our results will allow us to translate UV/X-ray observations of SLSNe with Swift into a quantitative test of the magnetar model.

Jon Miller/The University of Michigan
Swift and Astro-H Observations of Transient Black Hole X-ray Binaries

This proposal targets stellar-mass black holes in binary systems, that will be the focus of early-phase observations with the new Astro-H (Hitomi) X-ray observatory. Simultaneous observations with Swift are requested, with the goal of calibrating the early-phase observations, and exploring potential synergy between these two complementary missions.

Nicola Omodei/Stanford University
THE SWIFT DATA MINING PROJECT

We have developed a new, innovative framework based on machine-learning algorithms to analyze available catalog data and to provide a classification of the sources where is missing. The idea is simple: Classification Trees are trained on known objects, in order to predict the membership of a new object to a given class on the basis of its measured quantities. We propose to apply our methodology, already successfully applied to archival Fermi LAT data, to Swift surveys. We also plan to extend our analysis to the catalog of Swift GRBs applying data-mining algorithms to evaluate if intrinsic correlations between the variables exist. This could potentially provide a new method to estimate the cosmological redshift of the source and to intrinsically separate sub-classes of objects.

Rosalba Perna/SUNY Stony brook
SWIFT PRECURSORS TO LONG GRBS: HIDDEN SIGNS OF A NEWLY-BORN, HYPER-ACCRETING MAGNETAR?

Precursors to the prompt Gamma-ray Burst emission have arguably been one of the biggest surprises of the Swift satellite. They were not readily predicted by the collapsar model, and their interpretation still remains elusive.

Among the various suggested scenarios, an accreting magnetar appears promising in explaining some of the main precursor features, by virtue of the strong dynamical coupling between its B-field lines and the accreting plasma.

Here we propose to develop a quantitative model of this scenario, which computes the fallback mass accretion rate from numerical models of the collapsing envelope of the progenitor star, and generalizes the torque equations for magnetically-threaded disks to the hyper-accreting regime. By means of a statistical comparison between the numerical results and the Swift data, we aim at testing the magnetar model for precursors.

David Sand/Texas Tech University
EXPLOSION PHYSICS AND PROGENITORS FROM A ONE DAY CADENCE SUPERNOVA SEARCH

In the early hours to days after explosion, supernovae (SNe) provide clues to how they explode, and what their progenitor star systems were. Motivated by the need to discover, and study, SNe within the first day of explosion, we have begun an NSF-funded one-day cadence SN search of nearby galaxies (D<40 Mpc), directly tied to robotic optical spectrographs for prompt followup. Our new survey will find <2-3 SN Ia, <2-3 SN Ib/c and <5-6 SN II during the next Swift cycle, all within a day of explosion. The program will feed Swift young SN targets, and the resulting ultraviolet and X-ray data will put strong constraints on the progenitors of these nearby events.

Jay Strader/Michigan State University
The Comprehensive VLA Survey for Black Holes in Globular Clusters

Spurred by our surprising Very Large Array discovery of the first black holes in Milky Way globular clusters, we propose to continue our ambitious survey for both stellar-mass and intermediate-mass black holes in globular clusters. With well-defined selection criteria, our sample will allow the first statistical determination of the presence of black holes in clusters. This survey will make an immediate impact in a number of fields, including black hole demographics, accretion physics, gravitational wave predictions, and globular cluster evolution.

W. Thomas Vestrand/Los Alamos National Laboratory
Collecting Critical Optical Diagnostics of Gamma-Ray Bursts with the RAPTOR Telescopes

We will explore the prompt and early afterglow optical emission from Swift-localized gamma ray bursts (GRBs) employing our RAPTOR (RAPid Telescopes for Optical Response) robotic telescopes. RAPTOR is a network of fast slewing telescopes with unique capabilities for collecting critical diagnostic measurements the optical emission during the first few minutes of the GRB. Our seven 0.4-meter rapid response telescopes will collect polarization, simultaneous 4-color (g r i z) photometry, and high-cadence photometry starting <10 seconds after receipt of the Swift GRB localization. Those fast response measurements are complimented by observations from persistent monitors that cover the entire Swift field-of-view to search for bright emission before the response telescopes are on target.

David Williams/University of California
Target of Opportunity Multiwavelength Observations of New TeV Blazars

We propose target of opportunity observations of blazars showing strong evidence with VERITAS of being new very-high-energy gamma-ray sources. The known TeV blazars have spectral energy distributions with a synchrotron peak in the X-ray/UV/optical bands and a second peak at GeV energies, often thought to be inverse Compton emission. The VHE detection of a blazar often occurs when the blazar is in an active state, potentially lasting only a few days. Swift X-ray and UV observations during the discovery observations by VERITAS will probe the correlated flux and spectral variability patterns of the highest energy electrons. This will unveil information on the energetics and time scales of particle acceleration and cooling, critical to understanding the physics of jets in these new sources.