Below are the abstracts of proposals selected for funding for the SWIFT Cycle 10 program. Principal Investigator (PI) name, institution, and proposal title are also included. 175 proposals were received in response to this opportunity. On February 12, 2014, 35 proposals were selected for funding.

Marco Ajello/CLEMSON UNIVERSITY
BL LAC OBJECTS AT THE HIGHEST REDSHIFTS

For a long time high-redshift BL Lac objects were deemed not to exist. Fermi showed us that there is relevant population of BL Lacs with redshift beyond 1.0. Some of them belong to the high-synchrotron peaked (HSP) class and are among the hardest gamma-ray sources detected by Fermi showing emission up and beyond 100 GeV. This makes them the most luminous BL Lacs ever detected and rates them among the most powerful accelerators in the Universe. We plan to observe 6 extreme BL Lacs simultaneously with GROND and Swift. This will provide unprecedented coverage of the synchrotron peak from IR to X-ray allowing us: to understand the nature and the energetic of these objects, to answer long-standing questions on the blazar sequence and to use them as probe of the extragalactic background light.

Andrei Beloborodov/TRUSTEES OF COLUMBIA UNIVERSITY IN THE CITY OF NEW YORK
Early Afterglow Emission of Gamma-Ray Bursts

We propose to develop a new model for optical flashes and afterglow of GRBs, which is expected from the external blast wave of the explosion. We will use a new proxy for the external medium density—the GeV flash, which was detected in 36 GRBs. We recently proposed a model explaining the observed GeV light curve, which provides evidence that GRBs explode in winds from their progenitors. The GeV data analysis allows us to determine the wind density without involving uncertain parameters of the shock. Using the measured density, we will investigate possible synchrotron emission from the blast wave, compare it with data, and derive constraints on the magnetic field and the electron acceleration in the forward shock. We will also investigate the possible contribution of the reverse shock.
Edo Berger/HARVARD COLLEGE, PRESIDENT & FELLOWS OF RAPID OPTICAL AND NEAR-INFRARED SPECTROSCOPY OF SWIFT GRBS: COSMIC REIONIZATION, METAL ENRICHMENT, AND HIGH-Z HOSTS

The use of GRB afterglows as probes of the high redshift universe has flourished thanks to rapid and accurate positions from Swift. Our group uses some of the world's largest telescopes to rapidly obtain spectroscopic observations of Swift bursts. These observations provide redshifts, a crucial quantity for any subsequent analysis (e.g. energetics, broadband modeling). Equally important, they probe the chemical composition of high redshift galaxies, providing information that is inaccessible with either quasars or traditional galaxy surveys. Similarly, we continue to aggressively pursue searches and studies of GRBs at z>6 to trace the process of re-ionization and to pinpoint high redshift galaxies. Finally, we continue to pursue absorption redshifts for short GRBs.

Arash Bodaghee/GEORGIA COLLEGE & STATE UNIVERSITY
Swift ToO observations of hard X-ray transients from the Inner Galaxy

Swift Target of Opportunity (ToO) observations are proposed for up to 10 new hard X-ray transients discovered during the course of our approved INTEGRAL programs to regularly monitor the Inner Galaxy (i.e., spiral arms, center, and bulge). These regions are teeming with transient X-ray sources such as high-mass and low-mass X-ray binaries (including microquasars and bursters), and magnetars. INTEGRAL will devote 4.2 Ms of observing time to the these fields in the next year, enabling the discovery of new X-ray sources, which will then trigger these Swift observations that are a crucial first step in determining their nature. Thanks to its high imaging and spectral sensitivity, Swift will allow us to obtain a precise X-ray position which is necessary for identifying counterparts at other wavelengths, and a quality spectrum in a broad energy band (0.5-100 keV). The rapid reaction time of Swift is a key ingredient in successfully establishing the fundamental properties of a new X-ray source before it returns to quiescence.

Dennis Bodewits/UNIVERSITY OF MARYLAND
The Activity and Evolution of Oort Cloud Comets

We propose to use Swift UVOT to characterize the activity of two dynamically new Oort Cloud comets, C/2013 A1 (Siding Spring) and C/2012 K1 (Panstarrs). We will use the filters and UV grism on UVOT to quantitatively measure the gas and dust content in the coma at incremental heliocentric distances. Grism spectroscopy will allow us to simultaneously measure the production rates of water and several minor species. Broadband UVW1 and V-filter observations will allow for independent measures of the OH and dust content in the coma. Our systematic sampling of the comet's activity at different heliocentric distances will allow us to search for asymmetries around perihelion,
which reflect the comet’s evolution from a highly active new comet into more typical comet behavior. Swift’s unique capabilities will allow us determine how the physical and chemical evolution of the activity of new comets compares to that of other classes of comets.

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**Slavko Bogdanov/TRUSTEES OF COLUMBIA UNIVERSITY IN THE CITY OF NEW YORK**  
**OBSERVING THE NEXT X-RAY BINARY - RADIO-MILLISECOND PULSAR TRANSITION**

The recent detection of the X-ray transient IGR J18245 2452 switching back and forth between an accreting and a rotation-powered pulsar state has finally unambiguously established the long-suspected evolutionary connection between low-mass X-ray binaries and recycled radio millisecond pulsars. The fact that this source was a previously known radio millisecond pulsar implies that similar binary radio millisecond pulsars are also nascent recycled pulsars that still sporadically revert to an accreting phase. We propose a Swift XRT/UVOT target of opportunity observation of the next binary radio millisecond pulsar to switch back to an accreting state. This effort would greatly aid in obtaining a better understanding of the transition process of pulsars from accretion to rotation power, and vice versa.

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**Steven Boggs/REGENTS OF THE UNIVERSITY OF CALIFORNIA, THE**  
**ToO Observation of GRBs Detected with the NCT Balloon Payload**

The Nuclear Compton Telescope (NCT) is a wide-field, balloon-borne gamma-ray telescope (0.1-5 MeV) that will launch from Antarctica around December 1, 2014. The primary goal of this NCT 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 NCT 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.
**Joel Bregman/REGENTS OF THE UNIVERSITY OF MICHIGAN**  
**Mapping Ultraviolet Halos in a Mini-Survey of Nearby Starburst Galaxies**

This proposal takes advantage of the spectrum produced by dust grains in the halos of galaxies to determine the metal content of the gas in which these grains are located. Our aim is to determine whether the metal content of the halo gas differs as a function of position around several nearby starburst galaxies. An emerging model of starbursts involves fueling by gas inflow along the major axis, while the rapid star-formation that ensues drives gas out of the galaxy along the minor axis in a galactic wind. The metal content in the wind is expected to be higher than the inflowing gas, as stellar processes enrich the interstellar medium. We will combine new data from Swift with existing GALEX data to produce a map of the spectrum around the galaxy. The next step is to create a model that links the dust spectrum to the metal content of the gas. This is the bulk of the project. We will build on existing models, but physically motivated models in the literature provide different explanations for the same spectral shapes. Specifically, we will need to use a variety of dust grain types, stellar populations, and mock-up galaxy spectra to determine the role of metallicity and the uniqueness of the solutions. This project addresses two issues of fundamental importance to galaxy evolution, which falls under NASA's Cosmic Origins program. The stellar content of galaxies is determined by the rate at which gas (the fuel for star formation) flows in and out, and it is not clear how and when the inflow happens over cosmic time; it is also not known whether most of the gas around galaxies was previously expelled or prevented from falling in. Likewise, the role of starbursts in forming and regulating star formation remains unclear.

**Frederick Bruhweiler/CATHOLIC UNIVERSITY OF AMERICA (THE)**  
**Investigating the Anomalous Behavior of Extreme Blazars**

We propose to add Swift XRT and UVOT observations to our ongoing multi-wavelength monitoring campaign of the extreme blazar PKS1424-418. This source has been extraordinarily active in the Fermi gamma-ray band for the last year, reaching a peak flux ~2 orders of magnitude times its quiescent level. Our campaign includes optical/NIR and 4-frequency-band radio support. Goals are to establish the empirical characteristics of individual light curve structures, but beyond that to apply methodologies that tie empirical flare characteristics to physical parameters. The XRT band is critical to these analyses and is often the missing observational component. We request 25 individual 5-ksec observations at a ~1-week cadence with a shift to higher cadence in the event of extreme activity.
Deepto Chakrabarty/MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Studying the Onset of Propeller Accretion in SAX J1808.4-3658 with NuSTAR and Swift

We propose a joint program with NuSTAR and Swift to monitor the accreting millisecond pulsar SAX J1808.4-3658 during its return to quiescence at the end of an outburst. The goal of this campaign is to measure the hard X-ray spectrum and to detect pulsations from the source in the tail of the outburst. This will probe the role of the magnetosphere in the "propeller" accretion regime and will explore whether magnetically channeled accretion still occurs there. The flexible monitoring capability of Swift will be used to trigger high-sensitivity NuSTAR hard X-ray observations at the appropriate flux level during the decay of a transient outburst. Based on the previous outburst history of SAX J1808.4-3658, we estimate a high likelihood that the source will outburst again during Swift Cycle 10.

Michael Corcoran/UNIVERSITIES SPACE RESEARCH ASSOCIATION
X-RAY MONITORING of Eta Car DURING ITS 2014 PERIASTRON PASSAGE: TESTING VARIABLE MASS-LOSS MODELS

Eta Car is the nearest supermassive star, a notoriously eruptive variable and arguably the progenitor of the next Galactic SN. Its periodic 2024-day X-ray emission identifies the star as a massive, long-period, extremely eccentric ($e\sim0.9$) colliding wind binary in which variable $2-10$ keV X-ray emission is produced by the strong collision of the wind from the companion star (ec-B) with that of the Luminous Blue Variable primary (ec-A). Detailed monitoring of the variation in the $2-10$ keV band has played a key role defining the star as a massive, eccentric colliding wind binary and is the best diagnostic of the strong, variable stellar mass loss which determines the ultimate evolution of the star. Along with strictly cyclical variability, X-ray observations over the last 17 years (3 orbital cycles) have shown surprising variations -- most notably a dramatic shortening of the X-ray "eclipse" in 2009 -- which suggest a sudden, large scale change in the mass loss rate or other property of the stellar wind. We request monitoring observations with the \swift-XRT to provide critical measurements of the current state of the system up to, through, and after the next X-ray minimum/periastron passage, which occurs in the summer of 2014.

Alessandra Corsi/THE GEORGE WASHINGTON UNIVERSITY
Unraveling the missing link between 1998bw-like SNe and GRBs

ABSTRACT: The progress in our understanding of Gamma-Ray Bursts (GRBs) has been quite spectacular. We now know that these events are the most relativistic explosions, likely arising from a collapsing compact object (long GRBs). However, it is still a mystery what makes some small fraction of core-collapse supernovae (SNe) produce the
relativistic ejecta that powers a GRB. Our proposal aims at clarifying the GRB-SN connection, via follow-up observations of broad-line (BL) Ic SNe detected by the intermediate Palomar Transient Factory (iPTF), using Swift and the Karl G. Jansky Very Large Array (VLA). This proposal is linked to our approved 2012/2013 VLA program (that we will continue renewing - PI: A. Corsi), and is aimed at complementing our study with data of fundamental importance from Swift. NASA STRATEGIC OBJECTIVES: This proposal addresses NASAs Strategic Goal 3D, being aimed at understanding the contents of the Universe and the physical processes that govern their behavior, with particular regard to GRBs and their link with SNe.

Nathalie Degenaar/REGENTS OF THE UNIVERSITY OF MICHIGAN
Continuing a Swift Legacy: The Monitoring Campaign of the Galactic Center

The center of our Galaxy has been monitored at intervals of 1-4 days with the Swift/XRT since 2006. This has proven to be an excellent setup to capture X-ray flares from Sgr A* and to study the long-term behavior of 15 nearby X-ray binaries. In addition, the exciting discovery of a 3 Earth-mass gaseous object that is expected to interact with Sgr A* within the next year, provides the rare opportunity to closely follow a disruption event and the feeding process of the supermassive black hole. We have assembled a strong observational and theoretical research team, and secured complementary observing programs at different wavelengths. Here, we propose to continue our existing Swift/XRT monitoring program of the Galactic center in cycle 10 and request daily 1-ks observations that amount to 248 ks.

Abe Falcone/ PENNSYLVANIA STATE UNIVERSITY, THE
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.
UV SPECTROSCOPY/PHOTOMETRY 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.

Hunting High-z GRBs with the FIRST Near-IR IFU Spectrograph on a 2M Robotic Telescope

We propose to develop a Near-IR (NIR, 0.8-1.8 microns) fiber bundle Integral Field Unit (IFU) spectroscopy mode in the FIRST near IR (NIR) high resolution spectrograph and associated data pipeline for capturing medium-resolution Gamma Ray Burst (GRB) NIR spectra within 5 minutes of the trigger release by Swift using the Tennessee State University 2m robotic telescope, AST, at Fairborn Observatory in Arizona. The broad NIR wavelength coverage (from I band to H band) will allow the prompt identification of GRBs in the z=5.5-13.5 redshift range and the acquisition of high signal-to-noise afterglow spectra. Using such high quality data we will be able to investigate the chemical content (e.g. neutral hydrogen, metal enrichment) of the first generation of galaxies during the re-ionization epoch, a task that will be very challenging (and time consuming) even with dedicated Lyman-break galaxy surveys using the new generation of 30m telescope. The fast response of the robotic telescope (in ~1-2 min) and the sufficiently large (~20 arcsec) FOV will always allow to cover the average Swift-XRT or the future SVOM-SXT error circles (~5 and ~10 arcsecs respectively) and to capture a high-z GRB spectrum during its brightest phase. The IFU 3-D imaging spectroscopy nature allows us to reconstruct both broad band and narrow band images of the GRB field, which can provide accurate coordinates with subarcsec accuracy to facilitate follow-up observations at other observatories. FIRST has been built at UF and tested with sky and calibration sources in the lab and is ready for commissioning in Oct. 2013.
We propose to monitor for 6 months the prototypical bare active galactic nucleus (AGN) Ark 120 with the UVOT and XRT. A simultaneous study of optical, UV, and X-ray variability in AGNs is one of the most effective tools to shed light on their central engine. The selected target is ideal to investigate correlated flux variation in different energy bands because: 1) it is a bright clean system without warm absorbers or jets, 2) it is highly variable on all timescales over the entire spectrum, 3) its large black hole mass coupled with low accretion rate offers the ideal conditions to produce a tight X-ray/optical correlation. The proposed study will provide crucial information on the origin of variability and the interplay between disk and corona in AGNs and black hole systems in general.

In order to achieve the scientific goals reported above, we will systematically compare the multi-wavelength temporal evolution of Ark 120 with similar long-term studies of radio-quiet Seyfert galaxies with different black hole masses and accretion rate, and with analogous works carried out on Galactic black holes (GBHs) in different spectral states to investigate whether the disk-corona interaction occurs in the same way on vastly different scales. For the data analysis, we will use several model independent tools, such as the cross-correlation analysis, Hardness Ratio Count Rate and Fractional variability Energy plots, which have proved to be powerful diagnostics for AGNs, allowing also for a direct comparison with Galactic black holes, where these methods are frequently used. The research proposed here will contribute to NASA's Strategic Goal "Develop a balanced overall program of science, exploration, and aeronautics consistent with the redirection of the human spaceflight program to focus on exploration" and, specifically, to Sub-goal "Discover the origin, structure, evolution, and destiny of the universe, and search for Earth-like planets". In particular, our study, making use of space observatories, will explore the origin and the destiny of the universe, studying events around black holes, in perfect agreement with one of the NASA's science outcome.
Observatory. This Cycle 10 program will allow us to complete our study of spectral indices and SEDs in quiescent states as well as add to the analysis how the spectral indices change as the flux state varies.

Svetlana Jorstad/TRUSTEES OF BOSTON UNIVERSITY
Multi-Wavelength Observations of Blazar Flares

We propose to observe 3 blazars with the XRT at 0.3-10 keV and UVOT (all 6 filters) over a 2 week period during a flaring state. The targets are from the list of gamma-ray blazars that we monitor with the VLBA at 43 GHz and at optical wavelengths. For each blazar in the sample, the triggering criteria are based on its history of gamma-ray and optical behavior. We will determine (1) the lag between the synchrotron and Compton light curves at various frequencies, (2) the dependence of spectral index on wavelength, (3) relative amplitudes and timescales of variability at different wavebands, and (4) the timing of changes in VLBI images at mm wavelengths relative to outbursts at shorter wavelengths. This information is needed for theoretical modelling of the mechanism(s) of high energy photon production in blazar jets.

Amy Lien/UNIVERSITY OF MARYLAND BALTIMORE COUNTY
CHASING SHORT GAMMA-RAY BURSTS WITH SWIFT AND FERMI

Our knowledge about the nature of short Gamma-ray bursts (GRBs) remains limited and difficult to advance, mainly due to the low rate of well-localized events. Previous studies found that Swift detects fewer short bursts than other instruments, either because of instrumental bias, or there might exist some confusion in the burst classifications. We propose to utilize a code we recently developed that simulates the complex trigger algorithm of Swift/BAT, along with the rich Fermi/GBM data of short bursts, to investigate possible instrumental effects and perform the first systematic study of causes for the missing bursts in Swift s detections. Moreover, we will search for possible automated methods to increase Swift s detection rate of short bursts and apply it to the data stream of Swift/BAT and Fermi/GBM.

Tim McMahon/LANGSTON UNIVERSITY
Multifold S/N amplitude improvement and energy resolution of GRB and non-GRB point sources in Swift's BAT Survey

We have demonstrated an algorithm for improving the image reconstruction of point sources in the BAT Survey archive for signal amplitude and energy distributions. These improvements have the potential to increase the scientific return on a variety of GRB and non-GRB related investigations of low flux detections of undetected distant or nearby GRB, transient or tidal disruption events.
John Mulchaey/CARNEGIE INSTITUTION OF WASHINGTON
UNDERSTANDING YOUNG SUPERNOVAE AND EXOTIC TRANSIENTS
WITH SWIFT AND IPTF

The Palomar Transient Factory (PTF) is a synoptic survey dedicated to the eponymous
goal of a systematic exploration of the transient sky since 2009. The new phase of
intermediate Palomar Transient Factory (iPTF) operations began in February 2013 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 supernovae. Commissioning is
underway for our robotic spectrograph (SED machine) on the Palomar 60-inch with
successful first light this summer. Here, we propose to continue our very productive
Swift-iPTF program focused on young supernovae and fast evolving transients
particularly in the local universe. X-ray observations have played a key role in both
identifying and understanding non-thermal sources whereas UV observations have
proved to be of unique value for the youngest supernovae. The proposed Swift-iPTF
program will be complemented with an aggressive multi-wavelength (Palomar, Magellan,
Keck, APO and EVLA) program.

Thomas Nelson/REGENTS OF THE UNIVERSITY OF MINNESOTA
Swift Observations of the Earliest X-ray Emission in Novae

We propose to continue our Swift survey of the earliest X-ray emission observed in nova
outbursts. This monitoring program aims to explore the origin of the X-ray emitting
shocks in one or two novae, and the role they play in the evolution of the radio emission
from the ejecta observed by the VLA. We will do this by (1) determining the ubiquity of
early hard X-ray emission in a large sample of novae, (2) assessing the timescales over
which the faster ejecta responsible for X-ray emission emerge, and (3) looking for
evidence of circumbinary medium in the resulting X-ray, optical and radio datasets.
Understanding mass loss from novae, both in outburst and during the accreting phase, is
crucial for determining the long term evolution of the white dwarfs in these systems.

Jeremy Perkins/NASA/GODDARD SPACE FLIGHT CENTER
FERMI-LAT INITIATED TOO'S FOR BRIGHT FLARING GAMMA-RAY
BLAZARS

In the Fermi/Swift era, the high gamma-ray flux alerts provided by the all-sky monitoring
of the LAT give unique opportunities to study the optical to gamma-ray emission from
blazars during such states. We propose to continue to obtain prompt Swift XRT/UVOT
ToO observations of bright gamma-ray ($\geq 1.0\times 10^{-6} \text{ ph cm}^{-2} \text{ s}^{-1}; >100 \text{ MeV}$) flaring blazars detected by Fermi-LAT. At such high gamma-ray states, the LAT observes more than 20 such events per year, thus we request up to 20 Swift triggers of 2 by 5 ks each. The Swift and LAT observations will allow a broad-band characterization of each flaring blazar, providing constraints on models for the optical to gamma-ray emission.

**Jason Prochaska/UNIVERSITY OF CALIFORNIA, SANTA CRUZ**  
**GRB AFTERGLOWS AS PROBES**

We propose to continue our on-going effort to carry out target-of-opportunity (ToO) observations of GRBs discovered with Swift. The primary objective of the proposed program is to apply the GRB afterglows as a background source for studying physical properties of intervening gas both in the local GRB progenitor environment and in the foreground galaxies along the line of sight. To reach the goal, we have been conducting rapid ($< 6$ hours) spectroscopic follow-up of well-localized afterglows through various ToO programs on different ground-based facilities, including the Keck telescopes, Gemini, Lick Observatory, Magellan Telescopes, and the Apache Point telescope. These data provide fresh insight into the mechanisms that produce these enigmatic explosions and also into the processes of star formation in the first generations of galaxies in the distant universe.

**Christopher Reynolds/UNIVERSITY OF MARYLAND**  
**Optical/UV/X-ray Variability of the Bare AGN Fairall 9**

Fairall 9 (F9) is a luminous active galactic nucleus that has never shown signs of X-ray absorption or optical/UV extinction - we appear to have a clean view of the inner accretion disk around the supermassive black hole. Building upon a pilot program, we propose SWIFT-optical/UV/X-ray monitoring of F9 with 100 visits (each 1ks) spaced 2 days apart. We will (i) examine the relationship between the optical/UV/X-rays, including frequency-dependent timelags, to probe the accretion physics, (ii) search for UV/soft-X correlations and relate these to the physics of the soft X-ray excess, (iii) examine the nature of the curious X-ray dips discovered in RXTE monitoring, distinguishing absorption models from a disk-disruption scenario, (iv) inform a proposed joint XMM/NuSTAR observation of F9.

**Peter Roming/SOUTHWEST RESEARCH INSTITUTE**  
**USING THE UV LEVER ARM TO PROBE TYPE IIN SUPERNOVAE SHELLS**

Type IIn supernovae (SNe) are intrinsically bright, with a substantial fraction of the bolometric luminosity (usually at early times) contained in the UV. As such, they are
promising candidates as probes of star formation out to high redshifts; however, their UV properties are currently poorly understood. Only recently has the sample size of well observed UV Type IIn SNe become available. Using this new sample, and the fact that the UV brightness particularly provides an excellent lever arm for quantifying differences in absorption columns and metallicity, we are positioned to place limits on the key parameters of the ejected shell. We propose to create a grid of Type IIn SNe shell models by varying four shell parameters: mass, thickness, metallicity, and mass loss. These models will then be compared with the recent sample of Type IIn SNe, obtained with the Swift Ultra-Violet/Optical Telescope (UVOT), in order to constrain the appropriate shell parameters.

Nicholas Suntzeff/Texas A & M University
Swift Ultraviolet Spectroscopy of Superluminous and 2002cx-Like Type Ia Supernovae

We propose to observe one superluminous Type Ia supernova (SN Ia) and one 2002cx-like SN with the Swift Ultra-Violet/Optical Telescope (UVOT) to gather early-epoch UV spectra and absolute magnitude light curves. At early epochs UVOT photometry has shown that both target SNe subclasses are UV bright and blue, making them good targets for study with this instrument. These observations, when combined with archival UVOT and Carnegie Supernova Project data, will complement a comprehensive set of UVOIR observations that document the spectral evolution from early to post-maximum light epochs of the major subclasses of SNe. We will compute integrated bolometric lightcurves from the UVOIR spectra and perform the first internally consistent comparison of differing SNe Ia subclasses. This analysis will reveal differences between the total energy outputs as well as continuum and metal features among the subclasses and will help in determining the physical origins of observable differences, the progenitor systems and the underlying explosion mechanisms. This program capitalizes on Swift's unique strengths of rapid response, short term scheduling and UV capabilities to improve our understanding of the standard candles essential to studies of the expanding universe.

John Tomsick/Regents of the University of California, The Understanding the Hard X-ray Component from Neutron Star Transients

At low luminosities, the X-ray spectra of neutron star (NS) LMXB transients often contain two components: one is due to thermal emission from the NS surface and is reasonably well-understood, while the other is a hard power-law of unknown origin. By observing Cen X-4 in quiescence, NuSTAR has given us our first look at the hard component above 10 keV, and we see a sharp cutoff that is consistent with a bremsstrahlung emission mechanism. After Cen X-4, the next brightest system that would provide a comparison to Cen X-4 is Aql X-1, but the source is often too faint for
NuSTAR. Thus, we propose to monitor Aql X-1 during the decay of its next outburst in order to trigger deep observations with NuSTAR and XMM-Newton near quiescence.

John Tomsick/REGENTS OF THE UNIVERSITY OF CALIFORNIA, THE
Black Hole Transients in the Hard State: Constraining the System Geometry with NuSTAR and Swift

The Nuclear Spectroscopic Telescope Array (NuSTAR) satellite enables high-quality hard X-ray measurements of accreting black hole (BH) systems at low luminosity. This is the first time that measurements of the entire Compton reflection component from the accretion disk will be possible at low mass accretion rates in the hard state. As this is the only state where steady jets are detected, NuSTAR and Swift can open a new window on the disk/jet connection by measuring the system geometry (and its evolution) while measuring the strength of the jet with radio observations. Swift/XRT monitoring is required to trigger NuSTAR and longer XRT observations (that are also part of this proposal) at these low flux levels.

John Tomsick/REGENTS OF THE UNIVERSITY OF CALIFORNIA, THE
Black Hole Transients During Outburst Decay

An important step in improving our understanding of black hole (BH) jets is to determine the physics of BH systems in their hard state, which is the only BH state in which a steady and powerful jet is seen. We propose to use Swift to monitor a BH transient in the hard state during outburst decay. Swift will be used to follow the evolution of the flux and energy spectrum in order to: 1. Study correlations between X-rays and radio measurements made at ATCA; 2. Trigger an INTEGRAL observation to study possible non-thermal hard X-ray emission; and 3. Trigger a Suzaku observation to constrain the system geometry.

Tilan Ukwatta/MICHIGAN STATE UNIVERSITY
Swift Localization and Follow-up of HAWC Transients

We propose a Swift Target-of-Opportunity (ToO) campaign to follow-up GeV/TeV transients detected by the HAWC (High Altitude Water Cherenkov) observatory. HAWC is a ground based very-high energy detector with a large field-of-view (FoV) and near continuous operation. HAWC is sensitive to gamma-rays in the energy range from \(-30 \text{ GeV} \) to \(100 \text{ TeV} \) and complements the pointed TeV Imaging Atmospheric Cherenkov Telescopes (VERITAS, H.E.S.S. and Magic) with its capability to survey the entire overhead sky every day. HAWC will be used to conduct real-time searches for flaring GeV/TeV emission from known sources and for random transients in its FoV. Multi-
wavelength observations are key not only to understanding the mechanisms of particle acceleration in these transient sources but also to localize emission regions. Sources such as Gamma-ray Bursts (GRBs) or Active Galactic Nuclei (AGN), can emit across the entire electromagnetic spectrum from radio to high-energy gamma-rays. The modeling of these sources frequently involves energetic electrons radiating via synchrotron emission at X-ray energies and producing high-energy gamma rays via inverse Compton emission. Simultaneous observations of X-ray and high-energy photons are particularly useful because they can break degeneracy in these models and may even point to hadron acceleration in these objects. Thus the characterization of HAWC transients depends critically on their localization and ensuing multi-wavelength follow-up efforts. The uncertainty of a transient location (< 1 degree) reported by HAWC is too large for most observatories to perform follow up observations in lower energy bands. Swift is the only X-ray observatory that can respond quickly enough to HAWC transients and cover the HAWC error circle to observe any contemporaneous low-energy counterparts before they fade away. Hence, we propose to follow-up significant HAWC transients with Swift and in the case of uncataloged transients localize them using XRT tiling observations. Already 30% deployed, HAWC will be completed and will operate at full sensitivity at the beginning of Swift Cycle 10. With HAWC and Swift working together we will have, for the first time, an opportunity to understand the X-ray/TeV connection in an unbiased way. The potential for discovery is high.

Frederick Walter/THE RESEARCH FOUNDATION OF STATE UNIVERSITY OF NEW YORK

SSS Turn-on and Turn-off Times of Classical Novae

Classical novae are responsible for enriching the Galaxy with low z elements, form one of the pathways to the type Ia supernovae, and have recently been shown to be a transient source of high energy gamma-rays. Swift time-series observations of classical novae at soft X-ray energies have revealed both new phenomena and new insights into the basic paradigms of how white dwarfs explode. With expanded multi-wavelength monitoring supporting the XRT observations of the hot nuclear-burning surface of the white dwarf, we are subjecting the detailed physics of the nova phenomenon to unprecedented scrutiny. We request 157 ksec for followup observations to extend the time sampling of a diverse sample of 21 recent novae, most of which have been previously observed with Swift.

Charles Woodward/REGENTS OF THE UNIVERSITY OF MINNESOTA

Synoptic SWIFT TOO X-Ray/UV Observations Of A Bright Nova In Outburst

We propose a 60 ks Target-of-Opportunity (ToO) campaign for one (1) bright classical or recurrent nova in outburst using the rapid response and multi-wavelength capabilities of Swift to obtain simultaneous ³-ray, X-ray and ultraviolet (UV) observations. Swift
provides unique insight into the novae phenomena during all the evolutionary phases, revealing many new and currently poorly understood events including phases of persistent hard X-rays as well as episodes of rapid and variable X-ray/UV emission. Our goal is to characterize the three major X-ray phases in novae: 1) the early ³-ray and hard X-ray phase; 2) a rapid and highly variable transition phase; and 3) the later and brighter SSS phase. Swift ToO, supplemented with data from Fermi/LAT monitoring and our extant space- and ground-based OIR programs will grow the temporal and panchromatic archive of these events, requisite to glean the underlying physics of these new phenomena and novae evolution.

Jason Young/PENNSYLVANIA STATE UNIVERSITY, THE
Anchoring the blue end of Low Surface Brightness Disk Galaxy SEDs

Understanding Low Surface Brightness (LSB) galaxies is necessary to achieve a complete view of star formation across cosmic time. LSB galaxies are paradoxical in that they have blue optical colors (suggesting the presence of young stars), but extremely low star-formation rates. Radio observations deepen the paradox by revealing that they are massive gas-rich disks which would seem to be the ideal locations for star formation. Deep surveys suggest that LSB galaxies are particularly common, possibly accounting for half of the galaxy-bound baryons in the universe, yet they do not seem to represent a distinct class of galaxy, but are simply on the faint end of the distribution of spiral galaxy surface brightnesses. A comprehensive view of star formation in spiral galaxies must including LSB galaxies; essentially, to understand why galaxies like our Milky Way form stars, we must examine spiral galaxies with very little star formation despite ample gas supplies.

To this end, we propose to determine the mode and chronology of star formation in LSBs galaxies. Because of their unusual colors, LSB galaxies have confounded all such attempts to date. Our approach is to fit candidate star-formation histories to spectral energy distributions (SEDs) of distinct regions within a sample of targeted LSB galaxies. These SEDs are centered on optical integral field unit (IFU) spectra and anchored at the red end with archival Spitzer IRAC observations and the blue end with Swift UV observations. The UV observations will constrain current star-formation rates, the IRAC 3.6micron observations will constrain integrated star-formation histories, and the optical IFU spectra will break the degeneracies between candidate star-formation histories via sensitivity to intermediate age indicators. This past November we made the first of our IFU observations at the Harlan J. Smith Telescope at the McDonald Observatory; a first look at the results of these observations was presented in a poster at the recent AAS meeting. We intend to apply for additional IFU time at the McDonald Observatory as well as the WIYN telescope at Kitt Peak.

The optical IFU spectra give our project the leverage needed to test different theories about star formation in LSB galaxies. Our team has experience with the SED fitting code FAST. FAST finds a parametric best fit to a stellar SED for a given model star-formation history. Our aim is to determine which type of history fits our observed SEDs best.
Because our observations are designed to break degeneracies between age and star-formation history, we will be uniquely able to test a variety of theories about star formation in LSB galaxies, such as the patchy star formation suggested by some works and the sporadic burst/quench cycles theorized by others.

UV observations from the Swift UVOT instrument are an essential component of this project as UV emission is directly tied to current star formation. We previously submitted a successful Phase 1 proposal for UVOT observations of nine LSB galaxies. Our observing plan is well suited to the fill in program at Swift as our targets are located in different parts of the sky and we do not require a specific UV filter.