Swift Cycle 13
Abstracts of selected proposals
(NNH16ZDA001N –Swift16)

Below are the abstracts of proposals selected for funding for the Swift Cycle 13 program. Principal Investigator (PI) name, institution, and proposal title are also included. 156 proposals were received in response to this opportunity. On February 28, 2017, 23 proposals were selected for funding.

Jian Ge/The University of Florida
Hunting High-z GRBs with FIRST Near-IR IFU Spectrograph on a 2m Robotic Telescope

We propose to operate a NIR (0.9-1.7 microns) fiber bundle Integral Field Unit spectroscopy mode in the FIRST high resolution spectrograph in 2017-2018 for capturing medium-resolution GRB NIR spectra within 10 minutes of the trigger release by Swift using the AST 2m robotic telescope in Arizona. The broad simultaneous NIR wavelength coverage (0.9-1.7 micron) will allow the prompt identification of GRBs in the z=6.5-13 redshift range and the acquisition of high S/N afterglow spectra which can constrain the high-z GRB rate, shedding light on the fate of massive stars, their role on re-ionization, cosmic star formation rate at high redshifts, and investigate the chemical content (e.g. neutral hydrogen, metal enrichment) of the first generation of galaxies during the re-ionization epoch.

Marco Ajello/Clemson University
HUNTING HIGH REDSHIFT BLAZARS WITH SWIFT AND SARA

The class of AGNs called blazars, are prominent members of Fermi detected sources. The study of blazar evolution with redshift is important in its own right, but, perhaps more importantly they provide a powerful diagnostic tool to study the evolution of the Extragalactic Background Light (EBL). Using blazars as cosmological probes requires knowledge of their redshift. We propose to jointly use Swift-UVOT and SARA-CT, a 0.65 m telescope at Cerro Tololo, Chile to derive photometric redshifts for sources above $z \sim 1.3$. This method makes use of 10 UV-optical filters, which allows for reliable redshift measurements. This project will deliver measurements of the Spectral Energy Distributions for 14 new 3FGL blazars and establish photometric redshifts for those with $z > 1.3$.

Dennis Bodewits/University of Maryland
Rotation and chemical heterogeneity of comet 41P/Tuttle-Giacobini-Kresak

We propose to use Swift-UVOT to measure rotational variations of the gas and dust surrounding comet 41P/Tuttle-Giacobini-Kresak. We will derive prime rotational properties from continuum observations and will look for evidence of that variability in the production rate and mixing ratio measurements of OH, CN, and other volatiles. Observing from space, Swift is unhindered by day-night aliasing, permitting unrivaled temporal coverage of this comet. The close proximity of the comet combined with UVOT s large field of view and its UV imaging and spectroscopy capabilities will allow for a very sensitive rotational study of the inner coma. Our results will represent a unique contribution to the anticipated worldwide observing campaign and, coupled with observations from ground-based observatories, should yield one of the most complete pictures of cometary activity every assembled.

Andy Howell/Las Cumbres Observatory
Tidal Disruption Events - A Window to Quiescent Super-Massive Black Holes and Accretion Physics

We propose to study a new tool in the quest to understand the nature of supermassive black holes (SMBHs). SMBHs, with masses above one million times the mass of the sun, lie in the centers of most galaxies, but not much is known about their properties or how they are formed. Some SMBHs feed off of gas in their surroundings, heating the gas in the process, and causing it to emit light. These are known as "active" SMBHs. Until recently, we could study only the active SMBHs beyond the nearby (~100 Mpc) universe, because inactive SMBHs don't emit light, and because we can not discern the motions of their orbiting stars at large distances. This is giving us a skewed picture of the nature of SMBHs, one which is dominated by the properties of the active objects. This may be about to change.

Occasionally, a star will wander too close to an inactive SMBH and will be torn apart by strong gravitational tidal forces. Part of the material from the star will heat up and emit light for a brief (months / years) period of time. These are known as Tidal Disruption Events (TDEs). TDEs have been predicted theoretically since the 1970's, but no compelling observations of TDEs were obtained, until recently.

In 2011, NASA's Swift satellite detected a bright high-energy flare from a distant galaxy. This flare is now believed to be associated with a TDE. In 2012, an additional well-observed TDE candidate (detected in the optical from the ground-based Pan-STARRS survey, and in the UV from the GALEX satellite) was announced. In 2014 we identified additional TDE candidates in the ground-based Palomar Transient Factory survey and tied them together with the 2012 Pan-STARRS flare and additional candidates, to a single class of objects. The accumulated evidence of this expanded sample strongly supports a TDE origin for these events, and now allows us to identify them more readily in ongoing

transient surveys. But in order to better understand the physics behind the emission of TDEs, and to be able to connect the observed properties of the flare to the properties of the SMBH responsible for it, we must collect well-sampled multi-wavelength data on additional events.

Here we propose to use NASA's Swift satellite and NOAO's Jansky Very Large Array (JVLA) to observe three TDEs to be discovered during Swift Cycle 13. The Swift UV data will be crucial in constraining the color temperature of the emission (which was seen to peak in the UV for previous TDEs), the Swift X-ray data will probe any relativistic or otherwise non-thermal emission, and the JVLA radio data can trace the presence of off-axis jets, constrain the energetics and shock properties of the events and provide precise localization with respect to the host galaxy center (as further evidence for a TDE origin of the studied events). We will augment these observations with our own ground-based optical data obtained with the Las Cumbres Observatories Global Telescope (LCOGT) Network. We will thus obtain truly comprehensive wavelength coverage for TDEs in real time. This data will provide vital diagnostics of the basic physics of these systems, as well as their potential use as tools to study non-active SMBHs.

Jamie Holder/University of Delaware
Identifying TeV J2032+4130 and discovering a new TeV binary system with Swift and VERITAS

The gamma-ray and radio pulsar PSR J2032+4127 has recently been identified as the compact object in a Be-star binary system. The orbit is highly eccentric, with a period of 45-50 years. Periastron is expected to occur within Swift Cycle 13, around November 2017. PSR J2032+4127 is also coincident with TeV~J2032+4130, the first unidentified TeV gamma-ray source. We propose to replicate our work with the most similar system known, HESS~J0632+057, by regularly monitoring the source in both X-rays and TeV gamma-rays with Swift and VERITAS. A measurement of correlated flux changes over the periastron approach would firmly establish the connection between these sources, solving the longstanding mystery of the nature of TeV~2032+4130, and adding another example to the handful of known TeV binary systems.

Alan Marscher/Boston University
Relationship between X-ray Flares and Optical Polarization Spectra of Blazars

Recent observations have uncovered a possible relationship between the optical polarized flux spectrum and high-energy flares in blazars. The investigators propose to explore this connection through Swift monitoring of the optical-UV and X-ray flux of blazars simultaneous with measurements of 4-color optical total and polarized flux spectra. Resulting correlations or non-correlations of the optical polarized flux spectral index with X-ray flares will test mechanisms for acceleration of high-energy electrons involved in synchrotron X-ray and very high-energy gamma-ray flares.

Bradford Wargelin/Smithsonian Astrophysical Observatory
Proxima Centauri's Stellar Cycle

15 years of ASAS V-band monitoring have yielded strong evidence for a 7-year stellar cycle in Proxima Cen (dM5.5e), which is very exciting because standard models say that fully convective stars cannot support solar-like magnetic activity cycles. We have also shown that 4 years of Swift XRT and UVOT observations are consistent with the optical cycle, and opposite in phase. X-ray/UV rotational modulation likewise appears to have opposite phase from the 83-day optical period, but this is less secure. Our analysis will use data from ten 3.5-ks observations with ~8-day spacing to confirm the X-ray cyclical and rotational modulations. Prox Cen is the only late-type M star practical for such studies and Swift is the X-ray mission best suited to monitor this flare star, which also hosts the nearest exoplanet.

Alessandra Corsi/Texas Tech University
RADIO-TO-X-RAY FOLLOW-UP OF ADVANCED LIGO TRIGGERS

The direct detection of gravitational waves (GWs) from colliding black holes (BHs) by Advanced LIGO (aLIGO) has marked the start of a new era in astronomy. As ground-based GW detectors progress toward their design sensitivity, GWs from compact object binaries containing at least one neutron star, and their electromagnetic (EM) counterparts, should come into reach. Here, we propose to complement our iPTF/ZTF+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. Our follow-up program was approved for Swift Cycle 12. Here we ask to renew it for Cycle 13.

Mansi Kasliwal/California Institute of Technology
Withdrawn: 16-SWIFT16-0009: UNDERSTANDING YOUNG SUPERNOVAE & EXOTIC TRANSIENTS WITH SWIFT AND ZTF

The Zwicky Transient Facility (ZTF) is poised to open a new window into time-domain astronomy with its survey speed of 3750 deg2 hr 1 to 20.4 mag; we are on-schedule to begin commissioning April 2017 and full survey operations in October 2017. Building on our PTF and iPTF legacy, we are preparing to focus on even faster cadence and even more rapid response follow-up of optical transients. Here, we propose to continue our very productive Swift-PTF program into the ZTF era focusing on extremely 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. NSF has awarded us the PIRE GROWTH program to systematically build a global network of follow-up telescopes. Thus, the proposed Swift-ZTF program will be complemented with an aggressive multi-wavelength (Palomar, Keck, Gemini, HCT, NOT, DCT and EVLA) program.

Francis Marshall/GSFC
Keeping Close Track of the Most Luminous Gamma-ray Pulsar

The most luminous gamma-ray pulsar is extragalactic, intermittent, and has a tiny braking index. Using Swift observations of the 50 ms pulsar B0540-69 in the LMC, we discovered a large (36%) increase in its spin-down rate, which we interpret as a state change due to a re-configuration of the magnetic field. Further Swift observations revealed a large change in the braking index n from 2.13 ± 0.01 to 0.031 ± 0.013, the new value being smaller than those known for almost any other pulsar. We now see gamma-ray pulsations in the new spin-down state. Continued monitoring will allow us to find a possible change back to its old spin-down state; to look for a change in n; to search for an anticipated change in the gamma-ray flux or pulse profile; and to continue to characterize this extreme pulsar.

Nathaniel Butler/Arizona State University
GRB and Gravitational Wave Followup with RATIR and the DDOTI

The Reionization and Transients InfraRed (RATIR) camera, mounted on an autonomous 1.5m Telescope at SPM, is a highly-unique facility for Gamma-Ray Burst (GRB) research. It is 100% time-dedicated to the followup of Swift GRBs and is often the world's only facility capturing light curve data at both early times (t<1 day) and routinely at late times, with the addition of simultaneous optical and NIR coverage. Here we highlight key RATIR results since installation in 2012 as well as prospects for the near future. With modest support requested for nightly monitoring and equipment upgrades, we hope to continue our GRB program and to also support Swift gravitational wave followup. This year we offer to extend the RATIR software to support a new program at SPM -- the Deca-Degree Optical Transient Imager -- to chase gravitational waves in tandem with RATIR.

Mansi Kasliwal/California Institute of Technology
UNDERSTANDING YOUNG SUPERNOVAE & EXOTIC TRANSIENTS WITH SWIFT AND ZTF

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GROWTH program to systematically build a global network of follow-up telescopes. Thus, the proposed Swift-ZTF program will be complemented with an aggressive multi-wavelength (Palomar, Keck, Gemini, HCT, NOT, DCT and EVLA) program.

Edo Berger/Harvard University
Unique Insights Into Swift GRBs With The VLA and ALMA

The discovery of GRB afterglows was a watershed event. It demonstrated a cosmological origin; narrow jets with an energy of ~1e51 erg for long GRBs, and wider jets with an energy of ~1e49 erg for short GRBs; an association with star-forming galaxies for long GRBs, and a mix of ellipticals and spirals for short GRBs; a massive star origin for long GRBs and an old progenitor population (NSNS/NS-BH mergers) for short GRBs. Radio observations have played a central role in these studies, particularly in delineating the energy scale, explosion geometry, and circumburst environments. The radio band uniquely captures the peak of the afterglow spectrum at ~>1 day, as well as the synchrotron self-absorption frequency which probes the circumburst density. Radio observations are also critical for studying reverse shock emission, and hence the composition of the GRB ejecta. Still, prior to the advent of the Jansky VLA (JVLA), the limited sensitivity and bandwidth of the old VLA prevented several crucial studies, and resulted in a low detection fraction of less than 25%. Our group has been leading a wide range of investigations with the JVLA that address the most pressing open questions in the study of GRBs. We were recently also awarded ALMA time for the rapid-response millimeter observations of GRBs. With these time allocations we are in an excellent and unique position to address the following main goals: (i) Reverse Shocks: the Nature of the Ejecta; (ii) Short GRBs and the Radio Counterparts of LIGO Sources; (iii) High-Redshift Bursts.

Slavko Bogdanov/Columbia University
OBSERVING THE NEXT X-RAY BINARY-RADIO MILLISECOND PULSAR TRANSITION

Within the past two years, three neutron star binaries have been observed to switch between accreting and rotation-powered pulsar states, thereby unambiguously establishing the long-suspected link between low-mass X-ray binaries and "recycled" pulsars. In the accreting state, they exhibit X-ray and optical variability unlike anything observed in other X-ray binaries. We propose a continuation of our Swift XRT/UVOT target of opportunity program approved in Cycles 10 and 11 to observe the next nearby binary recycled pulsar transformation to an accreting state. This will result in an improved understanding of the peculiar phenomenology of these systems, which may shed light on the little-understood physics of the quiescent regime in neutron star X-ray binaries.

Zoltan Haiman/Columbia University
TESTING THE ORIGIN OF PERIODIC VARIABILITY FOR THE BINARY CANDIDATE QUASAR PG1302-102

The bright quasar PG1302-102 exhibits periodic variability in optical bands and was identified as a subparsec supermassive black hole binary (SMBHB) candidate. If PG1302-102 consists of an unequal mass SMBHB, the relativistic motion of the secondary black hole will inevitably lead to strong Doppler boosting of the luminosity of the source, even if the rest-frame luminosity is constant. This model can successfully explain the sinusoidal variability in optical and UV bands. However, the UV light curve is quite sparse and additional follow-up observations are necessary. We propose to monitor PG1302-102 with the UVOT and the XRT to further test the relativistic beaming hypothesis in UV and, for the first time, extend the test to the X-rays.

Thomas Maccarone/Texas Tech University
THE SWIFT GALACTIC BULGE MONITORING SURVEY

This is a proposal for funding to conduct a Swift investigation. The goal of the investigation is to identify ~10-20 new faint X-ray transients by using Swift monitoring composed of 15 epochs of a 16 square degree region.

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

We propose to continue, for the final year of MAXI operations, 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 2-20 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.

Nico Cappelluti/Yale University
UNBIASED CLUSTERING MEASURE OF LOCAL AGN WITH SWIFT-BAT

The goal of the project is to derive for the first time the Halo Occupation Distribution of Swift-BAT X-ray selected AGN from their two point 3D angular correlation function at z~0. The clustering signal will be highly significant and no other instruments provide such a valuable sample. We will characterize with unprecedented precision the environment where local AGN live and grow, constrain their duty cycle and triggering mechanisms and determine which BH parameter depends from the environment. Our clustering analysis will provide an important view on the physics of active galactic nuclei at z=0 and provide a fundamental probe for AGN growth and evolution models.

Jeroen Homan/Massachusetts Institute of Technology
SWIFT COVERAGE OF A FULL STATE- TRANSITION CYCLE IN 4U 1636-536

With its flexible monitoring capabilities and the broad spectral coverage provided by the UVOT, XRT, and BAT, Swift is in a unique position to provide new insights into the nature of spectral states in X-ray binaries and the transitions between them. Here we propose to cover a full state-transition cycle of the neutron-star LMXB 4U 1636-536. Our main focus lies on 1) the evolution of the boundary layer and accretion disk components across state transitions and 2) changes in the efficiency of X-ray reprocessing between different spectral states. We request 33 monitoring observations (3 ks each, total ~100 ks) over a period of ~100 days, which, for the first time, allows us to cover a complete state-transition cycle in an X-ray binary with Swift.

Amy Lien/NASA Goddard Space Flight Center
QUANTIFYING THE INSTRUMENTAL EFFECTS AND SYSTEMATIC UNCERTAINTIES IN THE DURATIONS OF SWIFT/BAT GAMMA-RAY BURST

The pulse durations of gamma-ray bursts (GRBs) hold the key to crucial information in understanding the underlying physics. In particular, the widely-adopted classification of long and short GRBs, with the separation of ~ 2 sec in the burst durations, has been commonly used to infer the different origins of GRBs. However, the observed burst duration can suffer from different degrees of instrumental and observational biases, and thus might not reflect the true intrinsic duration. We propose to study the biases of the burst durations in the GRB sample from the Swift Burst Alert Telescope (BAT), and quantify the instrumental effects and systematic uncertainties on those durations. The proposed study will utilize a code we developed that is capable of simulating Swift/BAT GRBs with accurate instrumental response and the BAT trigger algorithm.

Raffaella Margutti/
Detailed Mapping of Extreme Mass-Loss From Evolved 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.

Fiona Harrison/California Institute of Technology
SWIFT MONITORING OF NEUTRON STAR POWERED ULTRA-LUMINOUS X-RAY SOURCES

Following a series of remarkable recent discoveries, we now know that some of the most luminous members of the ultraluminous X-ray source (ULX) population are actually powered by highly super-Eddington neutron star accretors. Three such systems are now known: M82 X-2, NGC 7793 P13, and NGC 5907 ULX1. Here we propose <weekly Swift monitoring of the latter two of these systems, which are suf ciently isolated for Swift to provide robust uxes, across the full visibility window available for each source in the upcoming cycle. These observations will help to reveal the nature and physical properties of the most extreme accretors known.

James Neill/California Institute of Technology
ROBOTIC SPECTROSCOPIC FOLLOWUP OF SWIFT GRBS

We propose to undertake rapid and robotic multicolor imaging and spectroscopy of GRB afterglows on the Palomar 60-inch telescope. Robotic spectroscopy is made possible by the newly commissioned Spectral Energy Distribution Machine (a low resolution integral field spectrograph). Our annual yield is expected to be ten multi band photometric observations and five redshift determinations. We will disseminate these findings in near real time and thereby enable wider follow up of Swift bursts. The specific science goals to our group are are to: (i) provide an automated, early time spectroscopic capability to enable immediate redshift measurement and sensitive constraints on the color evolution of GRBs with the SED Machine; (ii) rapidly identify high-redshift and highly dust-obscured GRBs; (iii) conduct multi wavelength observations to identify reverse shocks and constrain the total energetics of GRBs; (iv) build up large, high-quality, unbiased samples of optical light curves and host galaxies to enable demographic studies.

Chryssa Kouveliotou/George Washington University
TOWARDS A POPULATION CENSUS OF YOUNG GALACTIC X-RAY SOURCES

We propose a 2-yr Survey of 40deg of the Galactic Plane for hard X-ray sources (0.1-10keV) with good depth coverage, and large areas to increase their numbers, as well as high angular resolution to enable source identification and follow up studies in multiple wavelengths. We require two sets of 183 XRT pointings at 5ks each for a total of 1.8Ms spread over two years. Our Survey will produce a very rich sample of new sources and transients focused on Magnetars, HMXBs and also covering a broad serendipitous discovery space. Using our multiwavelength pipeline we will analyze all new X-ray sources to complement and enhance the results of the ChaMPlane Survey. Our results will comprise the first deep, homogeneous, and contiguous GP Survey and will significantly contribute to the Swift legacy.