Swift Cycle 14
Abstracts of selected proposals
(NNH11ZDA001N-SwiftC14)

Below are the abstracts of proposals selected for funding for the Swift Cycle 14 program. Principal Investigator (PI) name, institution, and proposal title are also included. 146 proposals were received in response to this opportunity. On March 22, 2018, 21 proposals were selected for funding.

Marco Ajello/Clemson University
Towards the Full Identification of the 3FHL Catalog

We propose to use Swift to search for X-ray and optical/UV counterparts of the 20 brightest unassociated objects in the 3FHL catalog. This catalog of sources detected by Fermi/LAT above 10 GeV is the deepest look at the very high-energy sky and will be used by CTA to plan most of the observations. Making it as complete as possible will result in stronger detections and characterizations of the EBL, better understanding of the origin of the IceCube neutrino flux and better planning for CTA. These observations will be coupled to our ongoing optical spectroscopic and photometric campaigns to measure the redshift of the proposed objects rendering this program highly efficient.

Thomas Barclay/NASA Goddard Space Flight Center
A Comprehensive, Multi-wavelength Survey of Cool Star Activity

M-dwarfs are abundant and frequently host small planets. In the coming decade, efforts to detect and characterize rocky planets will focus on M-dwarfs. However, these stars are known to be highly magnetically active, thus planets they host are subjected to significantly more radiation than we experience from the Sun; just how much this affects their habitability is unsettled. We propose an ambitious multi-year, multi-instrument campaign to monitor M-dwarfs with ages from 10 Myr to 10 Gyr. X-ray, UV, and radio observations will be combined with simultaneous high-precision optical data from the Transiting Exoplanet Survey Satellite (TESS). The combined data will provide a complete picture of M dwarf activity, enabling us to identify environments conducive to harboring habitable planets.

Edo Berger/Harvard University
Unique Insights into Swift GRBs with the VLA and ALMA

Radio observations of GRB afterglows with the VLA and ALMA can address several fundamental open questions in GRB science: (1) the composition of the relativistic ejecta through observations of the reverse shock radio emission, (2) the explosion properties of short GRBs, with implications for radio counterparts of Advanced LIGO sources, and (3)

whether high-redshift GRBs form a distinct population that may point to Pop III massive star progenitors. Here we propose to address these questions using on-going JVLA and new ALMA programs, which represent the most comprehensive radio/millimeter view of Swift GRBs. The proposal takes advantage of the unparalleled sensitivity of VLA and ALMA, and builds on our long-term success in radio studies of GRBs.

Dennis Bodewits/University of Maryland
Rotation and chemical heterogeneity of hyperactive comet 46P/Wirtanen

We propose to use Swift-UVOT to measure rotational variations of the gas and dust surrounding comet 46P/Wirtanen. We will derive the rotational period of the nucleus from continuum observations and will look for evidence of rotational chemical variability in the production rates of OH, CN, C2, and other volatiles. We will compare the rotation and chemical variability before and after the comet's approach to the Sun to measure changes in the rotation period caused by gas jets. This allows us to evaluate the chemical heterogeneity of the nucleus, and how comets evolve through their activity. The Swift observations will provide critical context to the anticipated world-wide observing campaign of this close-approach comet.

Peter Brown/Texas A&M, College Station
Supernova Key Project: Swift Response to Nearby Supernovae

Swift has proven itself to be an extraordinary supernova observatory. The clearest application of Swift's unique strengths is obtaining very early UV and X-ray data on young supernovae to constrain their progenitor systems.
As part of this key project, we propose a two-year follow-up program to rapidly observe all of the nearest extragalactic transients (mostly supernovae) without waiting for them to be spectroscopically classified. The quick-response, distance-limited program we propose will detect any UV-bright radiative cooling following the shock breakout from core-collapse supernovae and shocked companions from Type Ia supernovae. Just as importantly, we will constrain the fraction of events for which it is not seen. Continuing to obtain high-quality supernova data and share it with the community capitalizes on Swift's unique capabilities and will enhance the legacy of the Swift dataset. This work contributes to NASA's strategic goal to "expand human knowledge" and the strategic objective of "discovering the secrets of the universe."

Edward Cackett/Wayne State University
Accretion disk reverberation mapping of a super-Eddington AGN

At high mass accretion rates, accretion disks are expected to be significantly different from the standard optically thick, geometrically thin disk. However, observational tests of disk structure are rare. Emission line reverberation mapping has revealed that the broad line region in super-Eddington AGN are quite different, but what about the disk? The accretion disk reverberation mapping technique provides a way to observationally test the structure of the accretion disk at high accretion rates. Through flexible and high-cadence monitoring, Swift has revolutionized accretion disk reverberation over the last few years. Here, we propose to apply this technique to a super-Eddington AGN for the first time, to explore the structure of disks at extreme mass accretion rates.

Deepto Chakrabarty/Massachusetts Institute of Technology
XRT and UVOT Monitoring of the Tidal Disruption Flare ASASSN-14LI to Detect the Newly Formed Accretion Disk

We propose high-cadence XRT and UVOT monitoring observations (2ksx8 visits per day for 3 days) of Rosetta Stone tidal disruption flare (TDF) ASASSN-14li at late times. Our main goals are (1) search for a correlation between the X-ray and UV light curves, and (2) detect an X-ray-UV time lag/lead in the range of a few hours to tens of hours. Any detected lag will not only establish unambiguously the presence of an accretion disk in a TDF for the first time, but will also directly give us the minimum size of the putative disk. ASASSN-14li is currently the only TDF where such measurements can be made. Swift, with its excellent X-ray sensitivity and UV capability, combined with fast maneuvering ability, is currently the only observatory that can perform simultaneous X-ray and UV observations.

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

We propose further prompt searches for X-ray and UV/optical counterparts to IceCube high-energy (E>~30 TeV) likely-cosmic neutrinos with Swift. Using realtime high-energy event reconstruction algorithms running at the South Pole, we will set the selection criteria such that we will trigger four neutrinos per year. Three proposed triggers will prompt a 7-pointing mosaic by Swift, providing >50% coverage of the neutrino localization to 1 ks depth in <10 hours, while one single proposed trigger will prompt a 19-pointing mosaic providing ~50% coverage to 1 ks depth in <16 hours. Discovery of even a single electromagnetic 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.

Rick Edelson/University of Maryland, College Park
Intensive Swift/ground-based/HST accretion disk reverberation mapping of the "bare" active galactic nucleus Fairall 9

Led by Swift, Intensive Disk Reverberation Mapping (IDRM) is providing new insights into the physics of active galactic nuclei (AGN) and strongly challenging the standard thin accretion disk/reprocessing model of AGN central engines. Fairall 9 is a "bare" AGN with very low absorption, simplifying its physical interpretation. This plus the fact that it is observable by Swift throughout the year makes it an ideal IDRM target. We request 650 x 500 s daily visits, for which we will also obtain ground-based ugriz at a similar cadence to measure the interband lag-wavelength relation to perform echo mapping on the disk. We will also request HST monitoring in year 2 of the campaign to measure the lag spectrum and disentangle contributions to the lags from the disk and broad-line region.

Alexei Filippenko/University of California, Berkeley
Ground-Based Optical Studies of Swift Gamma-Ray Bursts, Cycle 14

The proposal presents a continuation of a fast, optical follow-up program for Swift GRBs, to be carried out through photometry (076m-Lick KAIT, Lick Nickel-1m, Lick-3m and Keck-10 m) and spectrocscopy (Lick-3m and Keck-10 m). The goals of the program are capturing the early optical afterglow of GRBs, to inform theoretical models of prompt/early afterglow emission, and obtaining high-quality spectra to find evidence of a supernova associated to a GRB. Spectropolarimetry of GRB optical afterglows and/or of the associated supernovae, possible only for brighter events, is an additional objective of the proposal.

Sylvain Guiriec/George Washington University
Testing a New Unified Model for GRB Prompt Emission from Optical to Gamma-Rays and Exploring GRBs as Standard Candles

The cosmological origin of Gamma Ray Bursts (GRBs) combined with their brightness in the gamma-ray regime lead to great expectations in using these sources as cosmological probes. In addition, the recent discovery of gravitational waves from black hole binary mergers marks the advent of a brand new field in astronomy in which GRBsýresulting from compact object mergersýwill definitely play a major role. However, before using GRBs as tools we must first understand the origin and nature of the radiations released during these powerful explosions and investigate if GRBs can be established as standard candles. The aim of our project is to (i) probe the nature of GRB prompt emission over

the broadband spectrum from the optical to the gamma-ray regime using a multi-component model that we have been successfully developing during the past years, (ii) explore the transition between prompt and
afterglow emissions, and (iii) test a new luminosity-hardness relation derived from our multi-component model, which shows promises in establishing GRBs as cosmological standard candles.

Zoltan Haiman/Columbia University
Testing the Origin of Periodic Variability for the Binary Candidate Quasar PG1302-102

The quasar PG1302-102 exhibits periodic optical variability and was identified as a sub-pc supermassive black hole binary (SMBHB) candidate. If PG1302 consists of an unequal-mass SMBHB, the relativistic motion of the secondary BH will produce strong Doppler modulations, even if the rest-frame luminosity is constant. This effect can explain the variability in optical, UV and X-rays (including our observations from Cycle 13). However, the UV/X-ray light curves are sparse and, given the 5yr period of PG1302, additional observations are needed. We propose to continue multi-wavelength monitoring of PG1302 with UVOT and XRT to robustly test the relativistic boost hypothesis. Swift is uniquely suited to perform this test, as it can cover the optical, UV and X-ray bands simultaneously.

Jamie Holder/University of Delaware
Complete periastron coverage of the 50-year binary PSR J2032+4127/ MT91 213.

In 2015, the gamma-ray and radio pulsar PSR J2032+4127 was identified as the compact object in a binary system, together with the Be star MT91 213. The source holds particular interest, as its location coincides with a steady, extended TeV gamma-ray source, TeV J2032+4130, which is believed to be powered by the wind nebula associated with the pulsar. While many Galactic TeV gamma-ray sources are associated with pulsar wind nebulae, TeV gamma-ray binary systems are much less common, with only five such systems detected in our Galaxy. The combination of both, if confirmed, would be unique.

The binary orbit is highly eccentric, with a period of 45-50 years. Periastron is predicted to occur within Swift Cycle 13, around November 2017. We have been monitoring the system with Swift throughout Cycle 13, over which time the source X-ray flux has increased dramatically. We have established a multi-instrument observing campaign to cover the periastron period, including Swift, Fermi, VERITAS and MAGIC. Here we propose continued regular X-ray monitoring with Swift, to cover the post-periastron period when we expect the emission to fall back towards the quiescent state. Observations over Swift Cycle 14, with post-periastron coverage of a similar duration and cadence as the pre-periastron monitoring, will allow stringent tests of models of the geometry and high-energy emission mechanisms in this system.

Jeroen Homan/Eureka Scientific, Inc.
A Rare Look at a Black Hole Transient Emerging from Quiescence

A large fraction of the black hole low-mass X-ray binaries (BH LMXBs) are transient systems. They occasionally go into outburst, during which their luminosities can increase by factors of more than a million. The occurrence of an outburst is difficult to predict. New outbursts are generally first noticed by all-sky monitors or wide-field cameras. However, given the limited sensitivity of such instruments a transient's flux is typically already a factor of 1e3-1e4 above its pre-outburst level when it is first detected, and follow-up observations with more sensitive instruments often do not start until the flux has risen by an additional factor of 5-10. As a result, the early rising phase of BH LMXB outbursts is relatively poorly studied.

In this proposal we ask for a short X-ray monitoring campaign with Swift to observe the early outburst rise in the BH transient H1743-322. This source showed a major outburst in 2003, followed by a few smaller ones. In late 2008 H1743-322 entered a very regular outburst pattern, currently consisting of 13 outbursts with similar durations and peak fluxes. H1743-322 is currently the only transient BH LMXB that shows outbursts with this kind of regularity. Its narrow range of recurrence times allows us to predict the start of the next outburst of the source with much higher confidence than for other BH

transients. This, in turn, enables us to set up short monitoring programs at various wavelengths that have a high chance of catching H1743-322 as it emerges from quiescence and moves through its early rising phase.

We request Swift X-ray observations and Very Large Array (VLA) radio observations that will complement coverage in the near-infrared (nIR). With our proposed multiwavelength campaign we aim to catch H1743-322 as it emerges from quiescence. Our two main scientific goals are to study:

* Disk-jet coupling during outburst rise: It has been shown for many accreting black holes that they exhibit strong coupling between the matter inflow through a disk and matter outflow through a jet. These inflows and outflows can be studied in X-rays and radio/nIR, respectively. The disk-jet coupling is not the same for all BH LMXBs, however; for the same X-ray luminosity, some systems show strong radio emission and others substantially weaker emission. H1743-322 is one of the 'weak radio' systems, but, like the other 'weak radio' systems it actually joins the 'strong radio' systems at low luminosities, during outburst decay. By studying disk-jet coupling during the rise of H1743-322 we hope to gain a better understanding of when and why some systems become 'radio weak' at high luminosities.

* The onset of outbursts in transient BH LMXBs: Although the disk-instability model is widely accepted as the most likely explanation for the onset of outbursts, some aspects, especially relating to the early outburst phase, have not been properly verified in BH LMXBs. With our dataset we will be able to test predictions of the disk-instability model that are difficult to test with existing data, in particular a sudden increase in the rate of brightening during the outburst rise.

We will start monitoring observations on March 1 2018. This allows us to follow (most of) the rise, even if it were to progress at a slow rate initially. We ask for observations once every two days while the source is not yet detected. We ask for another set of observations to cover the period between the first XRT detection and the time that the source reaches an unabsorbed 0.5-10 keV flux of 2e-8 erg/cm^2/s For this period we request up to 20 observations, with a maximum cadence of one observation per day.

We also ask for six VLA observations as the source traverses the 5e33-1e37 erg/s luminosity range, during which we expect the source to switch from the standard radio track to a radio faint one.

Our proposed research addresses item 1 in NASA's Strategic Objective for Astrophysics.

Erin Kara/University of Maryland
Testing the ULX Unified Model with Swift Monitoring of NGC 6946 X-1

In recent years, a unified picture of Ultraluminous X-ray sources has been derived from its spectral properties. In this model, the hardest, most luminous ULXs are observed face-on, revealing the hottest part of the super-Eddington accretion flow, while softer, less-luminous ULXs that show evidence for Ultrafast Outflows are observed at larger inclinations. If this unification model is correct, it should have observable implications on the long term variability of ULXs, as the edge-on systems should show more variability due to clumpy material along the line of sight. With this Swift monitoring campaign, we aim to test this model by observing the well-known ULX NGC 6946 X-1, which, according to the unified picture is viewed at higher inclinations. NGC 6946 X-1 is an ideal target because, while little is known about its long-term variability thus far, it is one of the most highly variable Ultraluminous X-ray Sources on short timescales. We request 1 ks monitoring every 5 days throughout Cycle 14 for a total of 73 ks. We will measure the X-ray and UV fluxes, searching for periodicities and/or extreme changes in luminosity.

Jamie Kennea/Pennsylvania State University
Key Project: The Detection and Monitoring of Electromagnetic Counterparts of Gravitational Wave Sources with Swift in O3

We seek to identify and follow-up EM counterparts of GW triggers detected by ALIGO and AVirgo. To identify EM counterparts, Swift will perform a large scale shallow tiling, covering the highest probability regions from which the GW trigger is likely to have originated. These are selected by convolving the GW error regions with galaxy catalogs. Based on lessons learned during O2, including the detection of the first NS-NS merger event with an EM counterpart, GW 170817, and through collaboration with Fermi/GBM, we seek to improve this follow-up, maximizing the science return. In addition we request deep follow-up observations at high priority in order to detect and characterize any EM counterpart detected either by Swift or other observatories, in X-ray or optical/UV.

Raffaella Margutti/Northwestern University, Evanston
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 ý circum stellar medium interaction.

James Neill/California Institute of Technology
Robotic Spectroscopic Followup of Swift GRBs

We propose rapid and robotic multicolor imaging and spectroscopy of GRB afterglows on the Palomar 60-inch telescope. Robotic spectroscopy is available on the fully proven Spectral Energy Distribution Machine (a low resolution integral field spectrograph). Our annual yield is expected to be ten multi-band photometric observations and five redshifts. We will disseminate these findings quickly and thereby enable wider follow up of SWIFT bursts. The goals of our group are are: (i) provide automated, rapid spectroscopy enabling immediate redshift measurement and sensitive constraints on the color evolution of GRBs; (ii) rapidly identify high-redshift and dust-obscured GRBs; (iii) identify reverse shocks and constrain energetics of GRBs; (iv) collect unbiased samples for demographic study.

Julia Roman-Duval/STScI
Modeling the Physical Parameters and Ultraviolet Extinction Curve in Five Nearby Dwarf Galaxies

We will use the Ultraviolet/Optical Telescope (UVOT) on the Neil Gehrels Swift Observatory to observe five recently-discovered dwarf galaxies in the Local Volume. These tiny galaxies are representative of the building blocks of larger galaxies; understanding them addresses the NASA Science Mission Directorate Big Question "How Did We Get Here?", which seeks to understand how the universe transitioned from the Big Bang to the planets, stars, and galaxies we see today. We will combine new observations in the UV filters with archival imaging to model the spectral energy distributions of each tiny galaxy, revealing information including their stellar masses, star formation history, and the shape of their dust attenuation curve. This information will contribute to our understanding of the formation and evolution of dwarf galaxies, which in turn will inform theories for the growth of structure at small scales.

David Williams/University of California
Probing a Scenario of Multiple Recollimation Shocks in the BL LAC MRK 421

The origin and location of the non-thermal particle acceleration zone in active galactic nuclei (AGN) jets is one of the major questions still pending for these objects. The current consensus scenario involves a first-order Fermi process of a highly relativistic

flow passing through a strong recollimation shock close to or in the radio core, revealed by very long baseline interferometry (VLBI). The common observations of multiple VLBI stationary knots in high-frequency-peaked BL Lacs (HBLs) can be interpreted as multiple recollimation shocks accelerating particles along jets. Hence, a unique pattern of the variability should appear after each strong flare, particularly well adapted for the X-ray bright BL Lac Mrk 421 and the capabilities of the Swift instruments.

Andreas Zezas/Smithsonian Astrophysical Observatory
Revealing the Transient X-Ray Binary Population of the LMC

We will analyze data from systematic monitoring observations of 25 fields in the Large Magellanic Cloud (LMC) with quasi-bi-weekly cadence. This will be the first dedicated X-ray monitoring campaign of a large area of the LMC. With these observations we will: (a) identify the elusive, transient High-Mass X-ray binary (HMXB) populations in the LMC; (b) obtain a more complete census of its HMXB populations that will allow us to better constrain their formation efficiency; (c) constrain their orbital periods; (d) identify new accreting pulsars. Through this campaign we will study the populations of HMXBs in a galaxy with a metallicity bridging the gap between the SMC and our Galaxy, allowing us to constrain models for their formation and evolution.