

Associate Status for Dr. A. A. Miller

Nominator: S. R. Kulkarni

ZTF Associate status is reserved for those who have, and are expected to, make deep, across the board contributions to the fundamental development of ZTF. In return, the Associate has freedom to pursue several projects within the partnership framework. Through this memo I request Associate status for Dr. Adam A. Miller.

The memo is organized as follows: in §1 I summarize Dr. Miller’s past and on-going contribution to ZTF and in §2 his (modest) science aspirations. This nomination has been endorsed by Dr. Matthew Graham, Project Scientist.

1 Miller’s Contributions to ZTF:

Prior to the start of regular ZTF operations, Dr. Miller was a primary contributor in the development of the ZTF Galactic science case and the design of the public Galactic plane survey for the NSF MSIP proposal. From 2014–2016, Dr. Miller served as the ZTF Education and Public Outreach Lead, and within this role he was the head teaching instructor for the PTF summer schools during those years. Dr. Miller played an essential role in the success of those schools, which, along with the public PTF data releases, were one of the major requirements for the NSF MSIP program prior to 2018. Furthermore, during the late stages of iPTF, Dr. Miller was the PI of the “Color Me Intrigued” proposal, the first effort in PTF/iPTF to survey the sky simultaneously in the g and R filters, a strategy that is now the baseline for the public ZTF MSIP survey. During iPTF, Dr. Miller led the development of the PTF star-galaxy catalog and the IPAC/PTFIDE scanning page. Recognizing that the PTF star-galaxy catalog would be insufficient for ZTF, he recently turned his attention to PanSTARRS1 (PS1) data to develop a superior catalog.

The initial (and ongoing) contribution from Dr. Miller has been the construction of a probabilistic star-galaxy catalog using data from PS1.¹ To date, Dr. Miller has constructed a machine learning model that has provided $> 10^9$ classifications of PS1 sources. This catalog has a direct impact on several facets of ZTF science. At the most basic level, the proper identification of stars is required to photometrically calibrate ZTF images. Further down the pipeline, in the search for extragalactic transients the catalog is essential for the real-time output from IPAC, as all new alerts can be properly associated with a point-source or extended-source counterpart. Any ZTF alerts associated with a point-source can be rejected as non-extragalactic transients. This catalog will prove especially helpful when searching for counterparts to LIGO events, because it will enable the rejection of flare stars, the most common false-positive in the search for rapidly fading transients. Furthermore, the catalog will prove useful in studies examining long-term variability (e.g., variable stars, AGN, etc) as it will prevent the need to run expensive computation (e.g., Lomb-Scargle periodograms) on the $\gtrsim 10^9$ billion galaxies that will be observed by ZTF.

¹ It is worth noting that Miller mentored Yutaro Tachibana, a graduate student from Tokyo Institute of Technology, in this project.

Going forward Miller plans (working with Dr. Alberto Krone-Martins, currently on sabbatical at Caltech) to take advantage of *Gaia* data release 2 (DR2). This catalog will provide parallax and proper motion measurements for $> 10^8$ sources and enable the construction of a high-purity training set for the PS1 star-galaxy model. This training-set expansion and future development will, in turn, dramatically improve the real-time pipeline (e.g., by better rejecting stars from the extragalactic transient alert stream). Finally, Dr. Miller participates in the development of the point source real-bogus model for ZTF.

2 Science Interests

Dr. Miller would like to participate in two partnership projects: (i) the search for and study of young SNe Ia (partnership high-cadence survey) and (ii) relativistic explosions (partnership high-cadence survey). Separately, Dr. Miller is a member of the Caltech Redshift completeness (RCF) project (which is a partnership between the collaboration and Caltech).

Briefly, using SNe discovered in the high-cadence ZTF collaboration survey, Dr. Miller will provide and organize comprehensive follow-up of young Type Ia SNe (i.e., those discovered at $M < -15.5$ mag). The primary scientific objective of these observations, and the corresponding follow-up, is to constrain the progenitor systems and explosion physics of Type Ia SNe.

The group will search the high-cadence (ZTF collaboration) observations for rapidly-fading, relativistic transients. This effort will be in support of Anna Ho's thesis, with a primary objective of characterizing these events while also measuring their rates.

The RCF survey will obtain an SEDm spectrum (using Caltech SEDm access) of every SN brighter than $m = 18$ mag. Each of these SNe will be matched to redshift catalogs in the nearby universe to determine if the host-galaxy redshift was known *prior* to the SN discovery, thereby measuring the completeness of galaxy catalogs in the local universe.

Data Contributions

In addition to significant software contributions, Dr. Miller will provide telescope access in support of the scientific objectives outlined above. Dr. Miller is the co-PI of an *HST* proposal to obtain rapid UV spectroscopy of a Type Ia SN that displays signatures of ejecta-companion interaction. Dr. Miller further has access to the Las Cumbres Observatory 1 m imaging telescopes (via NOAO) to obtain colors of young SNe Ia and relativistic transients. Dr. Miller will additionally have access (expected allocation is 1–2 nights per semester) to the 6.5 m MMT telescope (via Northwestern starting in 2018B)² to obtain rapid spectroscopic observations of young SNe and relativistic transients. Finally, Dr. Miller will support efforts to obtain observations with the Gemini and *Swift* telescopes and should those efforts prove successful, he will organize and curate those observations.

While searching for young SNe Ia and relativistic explosions, Dr. Miller will naturally follow-up a handful of false-positive triggers. Data obtained from these observations (e.g., a rapid-response spectrum of a core-collapse SN) will be shared and distributed to the relevant science working groups within the ZTF collaboration.

² Northwestern has entered into telescope partnership arrangements: Keck and MMT starting in 2018B.

Dr. Miller is an “LSST Data Science Fellow” at Northwestern with some duties for LSST. He has no students or postdocs working with him (at Northwestern) and this is likely to be the case until he applies for a faculty or research job (the likely earliest start date is September 2019). In that case it is envisaged a student working in one area of interest to the PI (namely, early Ia studies) The proposed arrangement would go into effect immediately upon approval and last through CY2018. As with other such arrangements it is expected to be reviewed in CY2019 and CY2020.