Opportunistic Transient Targeting – Pat Hall, Charling Tao, Yue Shen, Sarah Gallagher

MSE can dominate the identification of faint transient or variable astrophysical sources of scientific interest (`transients'). If N fibers in every MSE observation were dedicated to transient followup, the survey efficiency decrease of (N/30)% would yield the equivalent of N 10-m telescopes doing nothing but transient spectroscopy. (This effort would be distinct from targets of opportunity which would interrupt ongoing observations.)

Large-scale sky surveys are beginning to catalog the sky for faint variable sources. Many of those sources will be run-of-the-mill AGN, typical SNe, or unremarkable examples of known types of stellar variables. But variable-source surveys are already producing exciting science on unusual supernovae (e.g., Chornock et al. arXiv:1302.0009), tidal disruptions of stars by supermassive BHs (e.g., Chornock et al. arXiv:1309.3009; Holoien et al. arxiv:1405.1417), extreme stellar flares (e.g., Schmidt et al. arXiv:1310.4515), etc. At the time MSE is operating, those surveys and/or their successors (e.g., CRTS, PTF, ZTF, Pan-STARRS, LSST) will provide a large number of transients each night for followup. Furthermore, EUCLID will identify hundreds of SNe (Astier et al. 2014) for which ancillary ground-based followup will provide checks on systematics in typing and redshift determination. Lastly, followup of photometrically identified optical/near-IR counterparts of radio, X-ray and gamma-ray transients will also be in demand. (The above list is not comprehensive, but gives an idea of the science possible with transients.)

Spectroscopy of transients involves a few dedicated instruments on small telescopes (Ngeow et al. arXiv:1209.4699) and targets-of-opportunity on larger telescopes. We advocate a program of transient identification in MSE Galactic and Extragalactic surveys, at the cost of as little as 1 fiber per pointing (with survey team agreement, up to 30 fibers could be utilized without significant survey impact). For each MSE survey, we assume that each night a list of pointings, each with prioritized targets, is accessible for observation at a given time. In an opportunistic survey, recently reported transients (as recently as a few minutes ago) in the appropriate magnitude range and with properties of interest for observation would be checked for spatial matches to all accessible survey targets. Pointings with one or more transients already among their targets (e.g. a flaring star, a galaxy with a new SNe near its center, or an AGN with unusual variability) would be prioritized in the queue. Each survey would decide on the weight to give such prioritization; other considerations such as the need to observe a pointing within survey airmass limits could dominate the weightings by design. Alternatively, if a sufficiently interesting transient exists in the field of a pointing at a location accessible to a scientific (as opposed to sky or calibration star) fiber, that pointing would be prioritized and the fiber would be reassigned to the transient (along with other fibers to other transients, if desired). Once the observation of the transient(s) was completed, transient spectra would be reduced and released to the collaboration and/or the public immediately. In deep survey pointings, where multiple observations will be made, some transients can be targeted in every observation and some can be replaced or alternated with new transients.

The transient classes targeted will evolve to keep the science cutting-edge. From the start, typical stellar and quasar variability will be ignored so that the stars and quasars being targeted in various surveys do not dominate the transients being followed up.

While the transient targeting flexibility will decrease as more survey pointings are observed, there will be enough transients to target. LSST alone will image ~1500 deg^2 per night accessible to MSE, in which area there will be ~300 new SNe and >75,000 variable stars (Ridgway et al. arXiv:1409.3265). And collaborations could be undertaken to monitor single-pointing deep spectroscopic fields during their MSE observing windows. MSE will dominate a new regime of faint transients (probing very early or very late stages, as well as large distances and low luminosities), including fast transients, as it will be able to dedicate more of its time to transient spectroscopy than any other 8-m class telescope.

Transient followup will require good integration with the alerts from large-scale sky surveys, and the better the automated decision making based on those alerts, the better the science will be. At this stage, we merely wish to draw attention to the opportunity for MSE to dominate faint transient spectroscopy at negligible cost to its survey capabilities.