The LSST project clearly recognizes the importance of transients and variables. To this end, a specific Science Working Group has been formed. Through this paper we wish to inform the community of the vision and stated goals of this group (see panel on pg. 1). The working group is seeking members to join this effort. In addition to astronomers working at major institutions we are seeking astronomers with wide experience at observational depth in variable stars.

Perhaps the best evidence of the vibrancy of the transient and variable star field are provided by the findings in 2006: the Hallowen transient (likely a nearby microlensing event), the Perseus transient (the brightest supernova recorded to date), the Coma mystery object, the M81 transient (the brightest member of an emerging class of transients), a new class of GRBs and the GALEX transient (a star being swallowed by a nuclear black hole).

There are a number of transients noted in the past but whose nature still remains uncertain or controversial. Examples include V838 Mon and the pseudo supernova SN 1981v. In almost all cases, precise identification and follow up would mostly certainly have led to better understanding. This lesson has not been lost on our working group.

The study of variable stars is an essentially interesting area in itself. However, the proper identification of Galactic variables is absolutely essential prior to identification of extragalactites transients (Becker et al. 2004, see below). One of the recent dramatic flares is from 8 Pegasi (a well known active binary system located 42 pc away). The energy in non-thermal electrons exceeded 10^9 erg (Oden et al. 2006).

**Vision**

The Transients Working Group addresses the science returns arising from temporal variation of astronomical objects. As such we plan to focus on the astrophysics of sources which show regular, irregular and dramatic variations. Examples of dramatic events include explosive (supernovae, GRBs), cataclysmic (novae, eruptive variables, dwarf novae), active (luminous blue variables) and accreting sources (X-ray binaries, cataclysmic variables, RS CVn). Examples of regular variations include eclipsing binaries, pulsators and rotators. Next, the large end of LSST should result in discovery of kinematic transients (microlensing, mesolensing). Finally, the extensive sky coverage of LSST should help in identifying transients found at other wavelengths (X-ray, radio).

It is our hope that LSST will discover entirely new classes of transients apart from increasing our understanding of the currently known transients.

**Program**

We see a three phase program. The first phase is : [1] becoming familiar with known classes of transients and variables, [2] developing a plan for classifying transients (archival data) and real time detection of transients, [3] understanding the systematics of the detector and other artifacts especially in regard to very fast transients and [4] scoping out and developing the followup plans.

The next phase will be to develop annual sky rates of variables and transients. This may require analysis of on-going survey (e.g. supernova searches) or conducting experiments expressly designed for such purposes.

The Working Group expects to have a document which captures all of the above work in the form of a Collaboration Report (by December 2010).

The third phase will be to develop specific plans to optimize at least some part of time LSST for transient research.

**GRB 060614: A new type of GRB**

Until recently only two classes of GRBs were known: short (< 2s) and long GRB 060614 is of neither. This long (102s) Gehrels et al. 2006) had an afterglow, but no associated supernova (Gal-Yam et al. 2006; Fynbo et al. 2006; DeU Valle et al., 2006). It also resided in a galaxy that appears to be elliptical when compared to hosts of previously studied long GRBs. This GRB may well require a new process to explain it: either a massive star that is very different from those that make either long GRBs and (which does not end up as a white dwarf), or a compact binary merger that can produce long-lived radiation (contrary to theoretical models and all previous examples of short, SN-like bursts) or something totally new.

**Halloween 2006 Transient in Cassiopeia**

Japanese amateurs (Togo and Nakano, CBBT 711), observing with a 70-mm f/13.2 lens and a Canon EOS digital camera, reported the discovery a brightening star in Cassiopeia on Halloween – October 31, 2006. It appeared that a “perfectly respectable” A star (CSS 35651328) at a distance of 1 kpc from Earth brightened from 11 mag to 7 mag and decayed on a timescale of a week (CBBT 711, 718, ARA 591, 942, 943). The object was followed up by professional and amateur telescopes (including the Center for Backyard Astrophotography). Several authors argue that the event was a microlensing event. The probability of such a strongly amplified event is 10^-10.

**A CONICAM Transient**

An intriguing 7th magnitude flash seen by the CONICAM all-sky camera located in Cerro Pachon and La Palma (marked by circle; see below). Since a third CONICAM, located at Cerro Paranal, did not detect the flash, the authors suggest that the flash was perhaps a series of cosmic ray hits, meteors or satellite glints (Bumre & Niemirof 2006).

**Perseus 2006 Transient, SN 2006gy**

Quinty (CBBT 644) discovered a bright transient, designated SN 2006gy, towards NGC 1260 in the Perseus Cluster. It is now the brightest supernova known, having peaked at an absolute magnitude of -22 mag. Spectroscopic observations revealed that the event is a member of the emerging class of “type IIn” supernova (Dildor et al. 2006) or a type I supernova (Smith et al. 2006). It is possible that SN 2006gy could be the first of a pair instability supernova (postdated several decades ago and expected to be prevalent in the early Universe).

**Systematic studies of variables: Fundamental Astronomy**

LSST will enable the systematic studies of a large number of Galactic variables. Consider, as an example, astrophotometry of white dwarfs. While white dwarfs crystallize with age which affects the observed power spectrum, Mattila, Montgomery and Kasian (2004) infer 90% of BPM 07093 is crystallized. Such a study expanded to a large number of white dwarfs can sharpen the use of white dwarfs as Galactic chronometers.

**SN 1991Y**

SN 1991Y was either a giant eruption of a luminous blue variable (LBV) between the main sequence and Wolf-Rayet phases, or a peculiar type of supernova (Nebicki’s “Type-VI”) (SN). Its progenitor is an extremely massive (~ 100 M⊙) star (Goodrich et al. 1989) in NGC 1069. SN 1991Y has an atypical light curve - a peak absolute magnitude of -14mag. It is a low containing a small number of star-formation candidates for survivors of the explosion - an O5WN star (Goodrich et al. 1969). K-type supergiant (Filippenko et al. 1995) or a yellow supergiant (Cui et al. 2004), suggesting its an LBV.

**VE838 Mon.**

The Galactic transient VE838-Mon, discovered by Brown (2002), had a peak outburst amplitude of -10 mag, reaching V of 6.7 mag during its multi-peaked, two-month-long eruption. Soon after the eruption, spectacular expanding light echoes were detected, the evolution of which has been imaged with the Hubble Space Telescope (Figure, Bond et al. 2002) and also recently with Spitzer (Banerjee et al. 2006). Possible scenarios include a binary merger (Soker & Yelda 2005) or a star swallowing a planet (Rafflor & Maroni 2003).

**Red Luminous Nova in M86 (2006)**

**GALEX Transient**

Gazriel et al. (2006) report a luminous flare coincident with a 2-0.37 atilcalp light galaxy which does not have an active nucleus. They provide a compelling interpretation that the flare result from tidal disruption of a star in the vicinity of the (expected) central black hole of the host galaxy. This example demonstrates an entirely new and efficient way to study the statistics (and spin) of nuclear black holes.