A Search for Failed Supernovae
(The Ohio State University)

Variable Stars:

- We are searching for vanishing supergiants by examining both sources that are bright stars and sources that are found to be variable. We define 'bright' as a band luminosity of $10^4 L_\odot$, and is used to identify variable sources, note the absence of crowding. While this source is displayed, this particular source had an initial luminosity of $10^4 L_\odot$.

Differential Photometry:

- We reliably identified Cepheids with periods down to 3 days, and with periods up to 4 years. This allows us to build a sample over a large range of galactic radii, a proxy for metallicity. This approach, together with building a sample of Cepheids within a well-defined box in the color-magnitude plane, is key to this survey.

Supernova Progenitors:

- We can use these Cepheids in multiple ways, including as proper motions, building a sample of Cepheids to use as a standard candle, and in the search for failed supernovas. Star fade in luminosity by 50% between the first and last epochs.

Failed Supernova Rate:

- We find that the failed supernova rate is some fraction, $f_{fs}$, of the normal SN rate, $R_{sn}$. To be a candidate vanishing supergiant, we then require:
  1. The star must be at least 80% as bright in the second epoch as it is in the first epoch.
  2. The star must be at least 80% as bright in the second epoch as it is in the first epoch.
  3. The star fade in luminosity by 50% between the first and last epochs.

Statistics:

- We are searching for vanishing supergiants by examining both sources that are bright stars and sources that are found to be variable. We define 'bright' as a band luminosity of $10^4 L_\odot$, and is used to identify variable sources, note the absence of crowding. While this source is displayed, this particular source had an initial luminosity of $10^4 L_\odot$.

Orientation: roughly face-on to minimize crowding.

Depth: must be able to study all evolved stars with $M > 8M_\odot$, including all evolved $>8M_\odot$ sources.

Resolution: within 10 Mpc, building a sample over a large range of galactic radii, a proxy for metallicity.

By monitoring 10 nearby galaxies with the LBT to enable a statistical study of the deaths of massive stars, we will have a large amount of other science that can be done with this dataset.