Currently MULAN is developing and LED system based on the KAMLAND pulser system rather than a laser system. The short discussion below contains the preliminary ideas towards calibration. Most up-to-date materials can be found in the LED discussion pages on the web.

Calibration is an important step in the analysis of data from all detector systems. Most detectors are calibrated using a combination of procedures:

1. specialized tests done by putting components in test beam,
2. calibration with selected events during normal data taking,
   2.1. minimum ionizing particles, MIP's, for example,
3. special runs with unique conditions during data taking cycle,
4. cosmic tests (both in lab and during run cycles), and
5. calibration events generated by special subsystems.

The µLan detector must operate with the following special features:

- low background positron detection (2.5-50 Mev positrons),
- low thresholds,
- double pulse resolution, Δt, as small as possible (Δt < 10 nsec),
- reliable time determination,
- gain stability better than 1%, and
- threshold stability better than 1%.
  - 0.1% threshold stability over 20 μsec data period.

This section will discuss plans for a subsystem (item 5) to enable the detector to operate within the requirements specified above. There are several options for a calibration subsystem. Typically the calibration subsystem injects a known amount of light at a determined time somewhere into the particle detection stream. The analysis of the processed signals then yields an energy and time value that can be compared to the known values. Some types of calibration and monitoring subsystems are:

1. High level radioactive sources: Produce a dc current that is non-standard for the readout. Tests the complete chain (all components) for energy but not time.
2. Inject UV light into active material: Produce a similar detector response to real events. Test most of the components in chain, transmission, collection, electronics, material damage and aging etc.
3. Inject visible light pulse (LED's, compact source/scintillators): Test photon readout detectors but not active material.

Variations and combinations of these systems are typically included as part of modern detector design. Examples of recently used calibration systems for CMS detector at LHC, PHENIX detector at RHIC, CLAS detector at Jefferson Lab and the GRAAL detector describe some typical scenarios. A fairly comprehensive system (2) which
implores UV light pulses that are capable of exciting the flours in the scintillator, will be the starting point for the development of a calibration system for the $\mu$Lan detectors. The signal generation is almost equivalent to that of a charged particle. Only the first stage is missing. (Charged particles generate UV photons as they loose energy. These photons are absorbed in the doped scintillator material, flours, and re-emitted as blue light.) Such as system tests transmission, transparency, pmt response and electronic response. Special configurations could be implemented that would allow for more elaborate testing, for example, the double pulse resolution. The components required and an estimate of their price is given in the following table. See excel spreadsheet.


