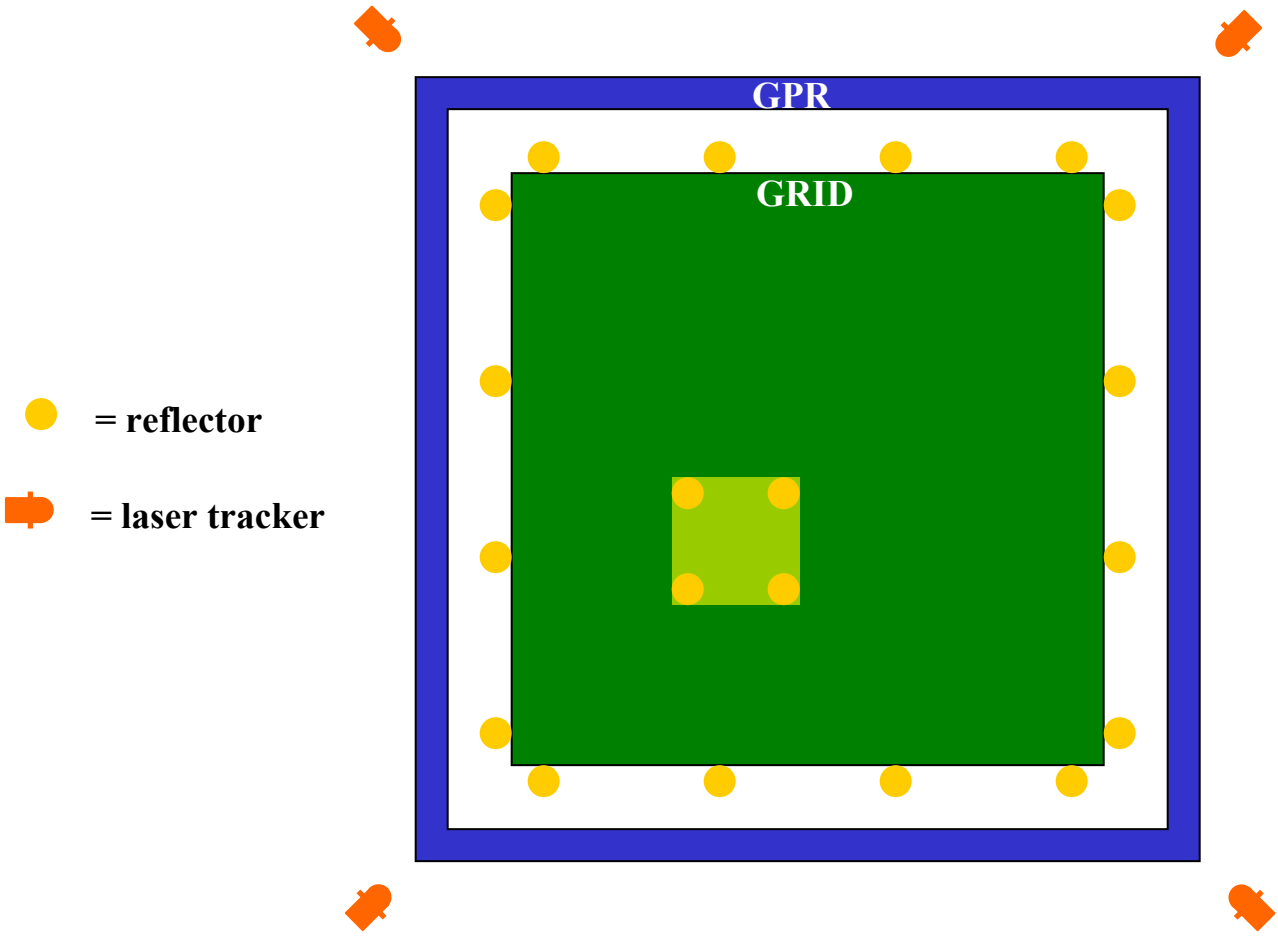
7.1.1. TKR Optical Survey Test Configuration

The setup for TKR optical survey in Room 104, Building 33, SLAC is shown in the following diagram. Note that the laser tracker will be mounted on a moveable stand which gives the laser tracker lines of sight to reflectors over GPR and to reference targets located throughout the room.

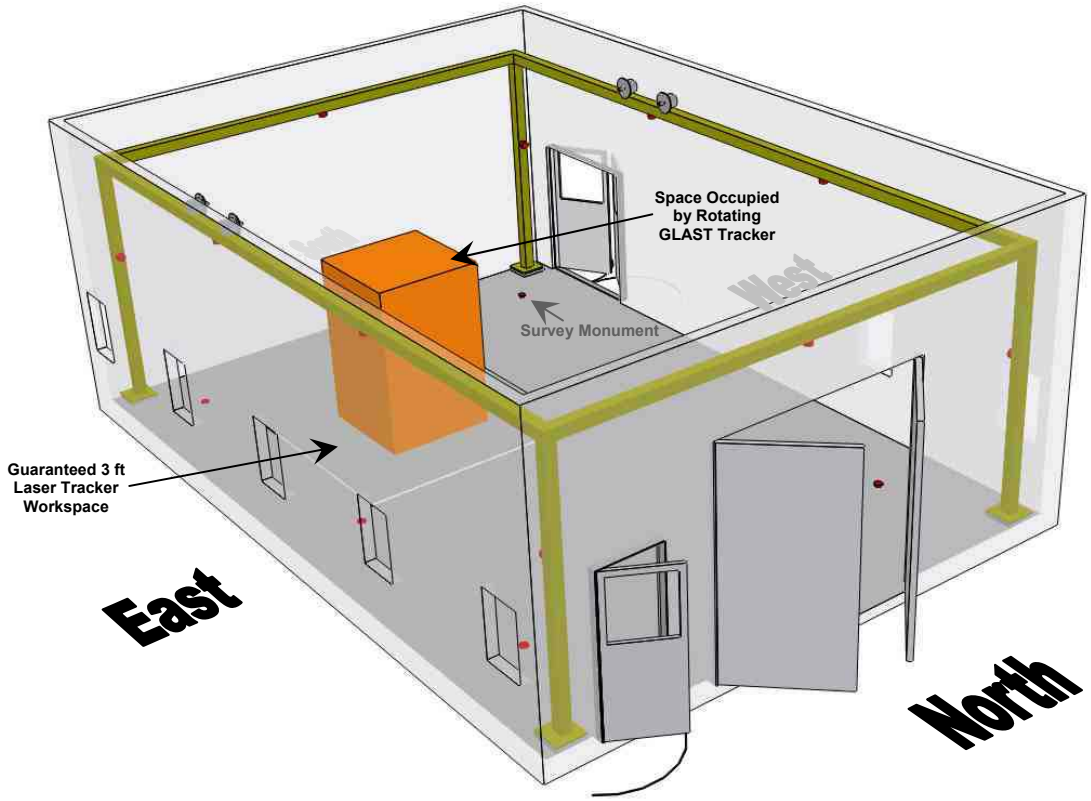
The stand used for the laser tracker has retractable wheels that allow only one instrument to be rolled around the TKR to each corner. It also can be adjusted for height changes. Although the four positions of the laser tracker will likely be as shown in the diagram, almost any extra free space in Room 104 can be used to improve accuracy.



An overview of Room 104 (the LAT integration facility) is shown in the following figure with ten crane-mounted reference reflector targets and six reference floor targets. These targets are actually the “nests” or “cups” into which a Spherically Mounted Retroreflector (SMR) is placed. They were installed by the Alignment Engineering Group soon after Room 104 was built. Also indicated in the figure is an orange rectangular spatial region in which the LAT assembly will reside. This does *not* represent the LAT but just the extremes of an area where the LAT will be assembled. This configuration is used to simulate the expected survey accuracies of any targets within that region by using an in-

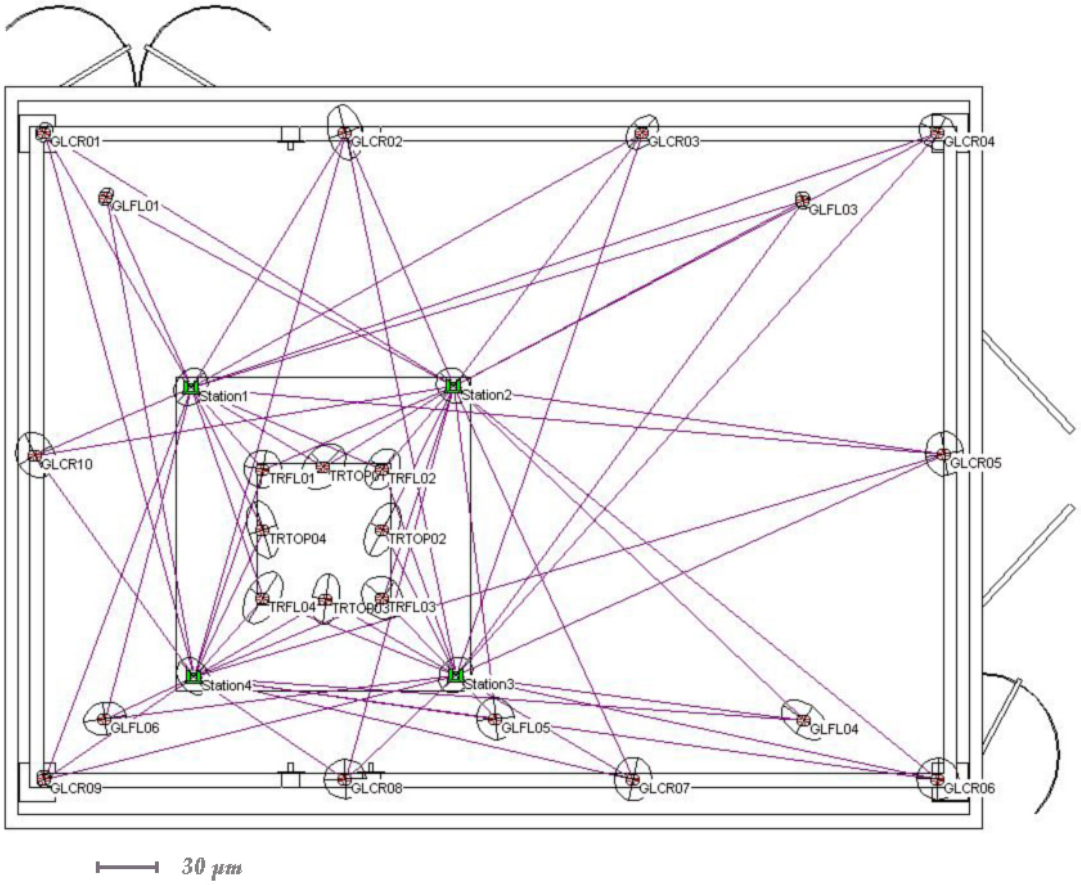
house package called SIMS. Details of this package and the survey network established in the room are covered in the following two sections.

Survey Configuration for GLAST Assembly Room

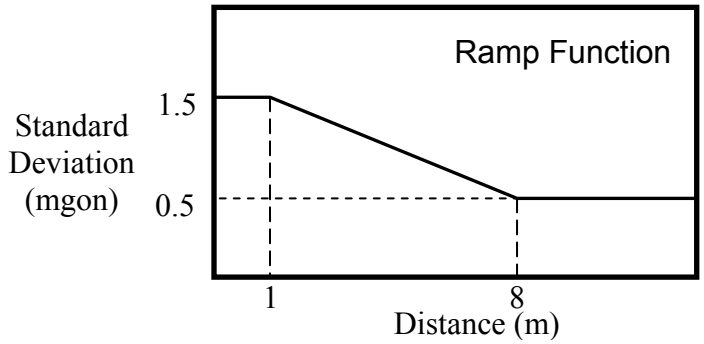


7.1.2. TKR Optical Survey Network Description

A laser tracker is positioned in Room 104 by observing all visible wall and floor targets using two angles and a distance (a triplet). In the computational approach chosen, no prior knowledge of the reference target positions is necessary. Laser tracker and reference target positions can be solved for simultaneously. Note that not all wall and floor targets need to be seen from any particular laser tracker setup. Once one setup has been completed, the laser tracker is moved to the next station and this process is repeated. At the end of the observation phase, all the measurements are mathematically combined into a fully integrated survey network. The following figure is a simulation of this network.



This output is a 2D graphical snapshot of the 3D computational results from SIMS. The error propagation software computes a simulation result based on the same computational software engine used by the actual survey adjustment package. This package will be implemented when using the real observations made in the LAT integration facility. The capabilities of the measuring instrument are an integral part of this simulation. A fixed standard deviation of 30µm is chosen for all observed distances. A ramp function relating the target distance to the instrument is used to assign the standard deviations of the observed angles. This function applies to both horizontal and vertical angle observations and is based on the known characteristics of the laser tracker. Other angular models are valid but have been shown to give similar adjustment results.



Given the choice of a free network approach solving directly for the datum unknowns, this simulation generates a full-rank symmetrical 99 x 99 normal matrix. The unknowns can be classified as follows:

Position unknowns	81
Orientation unknowns	12
Datum unknowns	6

Using the above standard deviations at one sigma, the following accuracy results are expected when measuring the LAT.

Target	a (μm)	b (μm)	φ (deg)	h (μm)
TRFL01	23	22	190	25
TRFL02	26	19	60	31
TRFL03	27	23	160	31
TRFL04	33	20	65	36
TRTOP01	32	22	45	35
TRTOP02	34	18	70	35
TRTOP03	30	17	90	32
TRTOP04	34	18	120	36

The error ellipses are defined through a semi-major axis “a” and semi-minor axis “b” with an orientation “φ”. The last column “h” refers to the standard deviation of the third coordinate. Essentially with this design, points on the LAT assembly, including the TKR, will be accurate to about 30μm at one sigma.