CHARA Technical Report

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Beam Heights and Optical Table Alignment

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1. INTRODUCTION

The CHARA Array will employ five 1-m size, alt-azimuth style telescopes at a site on Mount Wilson in southern California. The telescopes will be housed separately and operated remotely from a central laboratory. Light from each telescope will be directed by subsequent flat mirrors through vacuum pipes to additional optics and instrumentation at the central laboratory.

In order to design mounts and to be able to setup the alignment optics it is necessary to define optical beam heights, and while this was done some time ago, now that we have some hardware in place it's time to check these against reality. With the beam heights established, hopefully once and for all, the tables can be aligned and put at the correct heights. One would have thought that this would have been done by the company that installed them, but we have found that none of the tables delivered to date have been placed exactly as we requested. Some of them where not even stable and none of them level.

2. BEAM HEIGHTS

Selecting a beam height is a compromise between mount flexibility and mount stability. In order to reduce vibration it is best to keep the mounts as low as possible. On the other hand, if the mount is too low some optics may not fit. since the beam reducing telescopes are to have a 14″ primary mirror the height of the beam above the beam sampling tables at the western end of the delay line area must be greater than 7″ and has been set to $7\frac{1}{2}''$. In the beam combining laboratory there is no need to have the beam this high and the height of the beam above the table will be 6″. It may be necessary to add extra blocks of material below the legs of these tables to do this. The alignment beams will be above the science beams in many places and will be 9″ above the table at these locations, otherwise the alignment beam will be at the same height as the science light.

Of course, these heights are with respect to the table surfaces, and not the floor, nor the delay line optics. The real beam positions are determined by the delay line carts themselves, as

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there is no way we can move them. The light, both metrology and science, must be parallel to and correctly positioned with respect to the optics in these carts. Figures 1 and 2 show cross sections of the delay line rail and the cart face plate along with the nominal design dimensions. The beam heights are defined by the delay line cart face plates. The height of the science beam was measured to be correct to within $\frac{1}{4}''$ in all locations measured, and as the floor itself varies by this amount this is within tolerance. This is fortunate as there wouldn't be very much we could do about this if it weren't true! Note also that the separation of the carts themselves is defined to be $23''$, which is also true to within $\frac{1}{8}''$ on all existing carts. When the final alignment of the delay line rails is done we need to be more careful about this horizontal dimension.

All the beam heights are summarized in table 1.

TABLE 1. Beam heights.

Beam	Floor	Beam Sampling Tables	Beam Combining Tables
Science	$46\frac{5}{8}''$	$7\frac{1}{2}''$	$6''$
Alignment	$56\frac{5}{8}''$	$7\frac{1}{2}''$	$9''$
Metrology In	$44\frac{1}{8}''$	$5''$	NA
Metrology Out	$49\frac{1}{8}''$	$10''$	NA

3. OPTICAL TABLE ALIGNMENT

Obviously the tables can not be aligned with respect to a floor that itself can vary by $\frac{1}{4}''$ or more, they must be aligned with respect to the beam height defined by the delay line cart face plate. Since the southern most beam sampling table will not be used until we build the seventh and eighth telescopes, we will use this table as a reference fiducial for all other tables. The theodolite was placed on this table and leveled, after having ensured that all six legs were weight bearing and that the table did not wobble.

We do not have the flexibility to adjust the height of the theodolite and so it was necessary to find out how high is was compared to the science beam center as defined by the delay line cart. Using caliper the position of the top and bottom of the circular PZT cover of the S1 cart was measured and found to be $1\frac{1}{2}''$ and $\frac{1}{4}''$ above the line defined by the theodolite, making the theodolite some $\frac{7}{8}''$ above the science beam height. A target was then adjusted to be $8\frac{7}{8}''$ above the table so that, if the table is at the correct height, the target will be centered in the theodolite when the science beam is $7\frac{1}{2}''$ above the table.

The theodolite and target could then be used to align the tables themselves. All but three of the tables legs where moved so that the table was entirely supported at three corners only. Several of the delay line sleepers where placed on the table on one corner to ensure that the table would remain stable on these three legs. The target was then moved to one of the supported corners and the leg below adjusted until the target was centered in the theodolite. This was repeated for each corner, and iterated until the target was centered in all three corners. The target was then placed above each of the other three legs and the

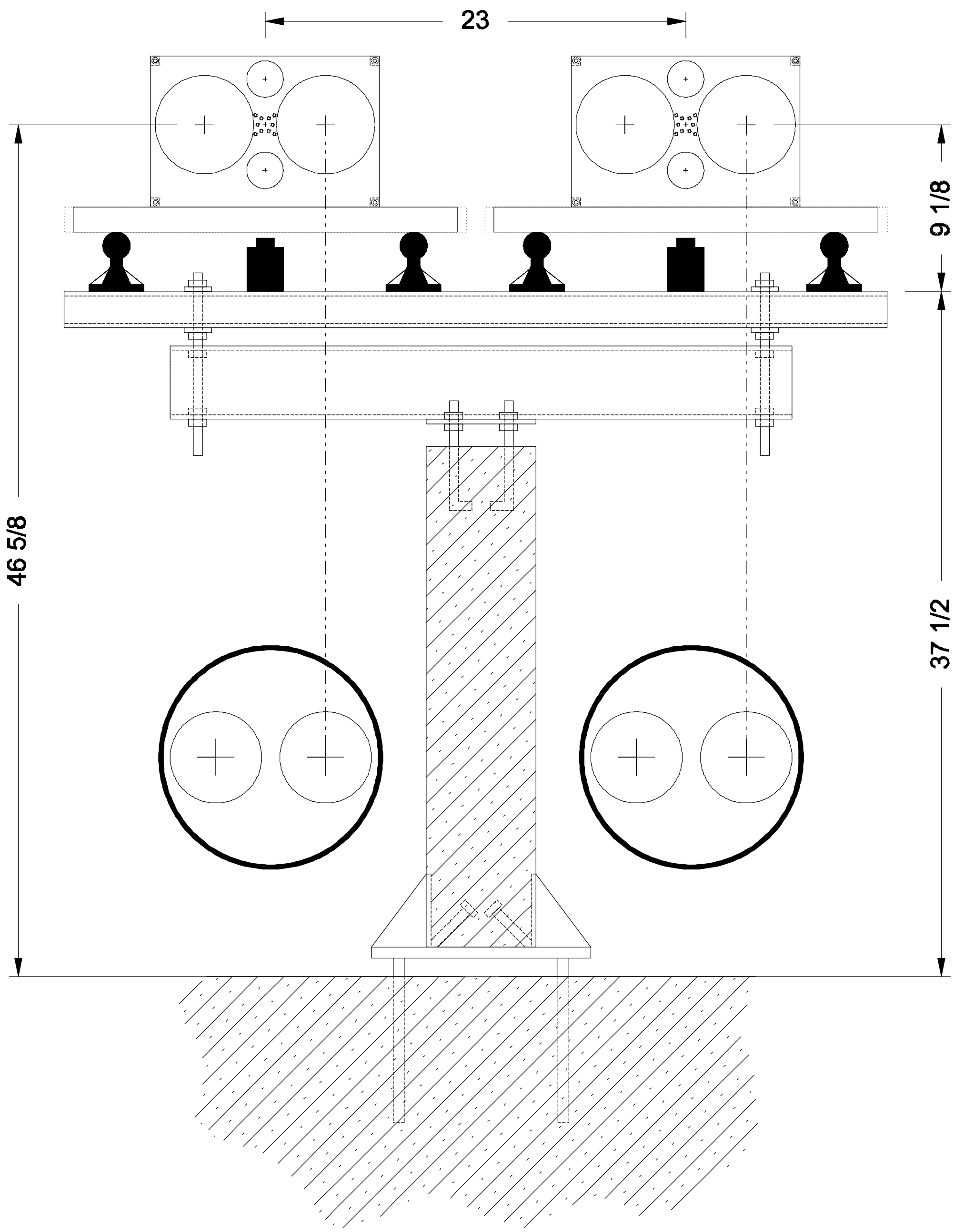

FIGURE 1. Nominal dimensions for the OPLE T support system as viewed from the west. The dotted lines mark the place where the light moves from the POPs in to the OPLE.

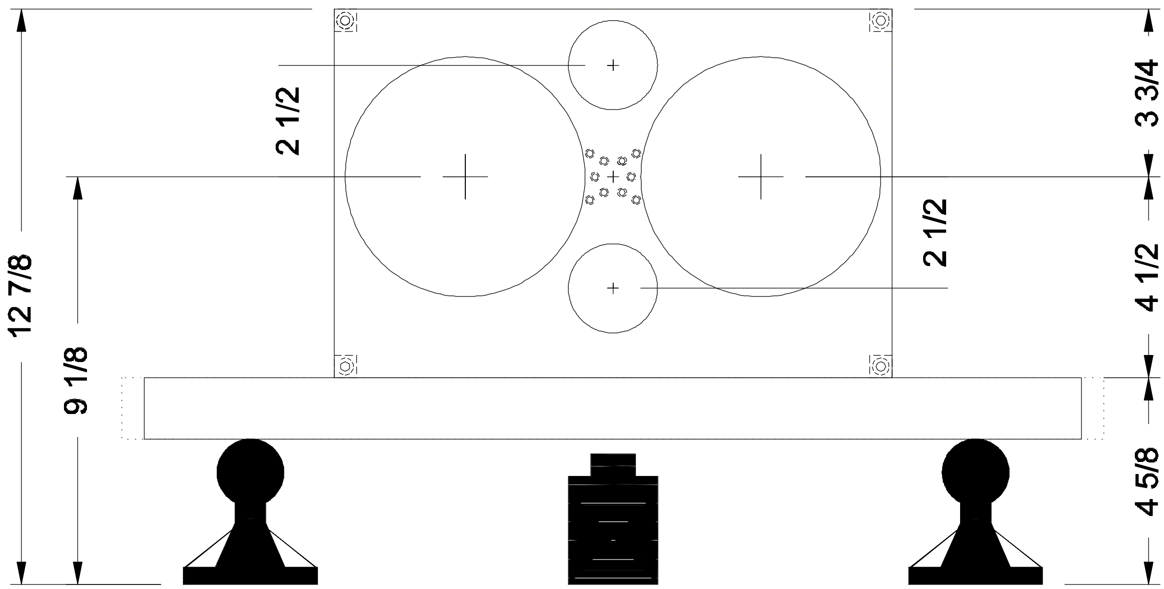

FIGURE 2. Nominal dimensions for the OPLE cart face plate.

legs adjusted until they were weight bearing and had the target correctly centered.

This process was repeated for the other two remaining beam sampling tables. These three tables should now define a plane and it was satisfying to find that this was indeed the case. As of the writing of this report the tables in the beam combining lab have not been aligned, but it is planed that this will be done using the same technique early in 1999. The remaining beam sampling table will then also be aligned.