Today, Paul presented exciting results of linac octupole studies with MATLAB. Paul placed an octupole at each QF quadrupole, with octupole signs alternating from FODO cell to FODO cell. He gave an argument why the alternating octupole sign is advantageous, based on the cross talk between adjacent cells. He illustrated the superiority of this scheme by comparing $6\sigma$ trajectories for the same-sign and the odd-sign configurations.

Paul's final lattice has octupoles of length 20 cm, 5 kG pole tip field, and 5 mm bore radius, for a beam energy of 10 GeV. With this set up, only 2% of the particles in a $50\sigma$ flat tail are not lost. All the non-lost particles are at small horizontal and modest vertical amplitudes. A set of octupoles located near the QD quadrupoles would probably remove these few survivors. Paul also showed the fraction of surviving particles as a function of octupole strength and the number of cells, as well as the distribution of particles lost along the beam line. Almost all the losses occur at the entrance of the line, over the first few meters. This loss distribution can be spread out by tapering the octupole strength, for example by linearly increasing the strength $K_3l$ along the beam line.

Yuri presented new results of linac dynamic aperture studies using LEGO. He pointed out that a particle is considered lost in LEGO, when it reaches an amplitude of 1 m. For this reason, he tracks through a larger number of cells to be confident that most of the unstable particles are really identified as lost. Yuri confirmed Paul's discovery that placing octupoles with alternating sign is much more efficient, roughly by a factor 200 in octupole strength, than the equal sign configuration. Also the resonance lines in the phase-advance diagrams (dynamic aperture plotted vs. the two phase advances) are much more pronounced in this case. To collimate in both planes, Yuri changed the location of the odd-sign octupole pairs every 1.5 FODO cells from a QF to a QD quadrupole or vice versa. His final octupole strengths are remarkably weak, $K_3l = 4000$ m$^{-3}$ near the QF, and $K_3l = 10000$ m$^{-3}$ near QD. For a beam energy of 50 GeV, octupole length of 10 cm, and radius 5 mm, these gradients correspond to 1.4 kG and 3.5 kG pole tip fields, respectively. Near the $4\mu_{x,y}$ resonances, the amplitudes where particles loss occurs are about $5\sigma_x$ and $100\sigma_y$.

Frank was puzzled that there is such a large difference between the equal and odd sign constellations. He thought that first order perturbation theory suggests that the equal sign is more effective, in clear contradiction to all the tracking results and to Paul's argument. Perhaps 2nd order perturbation theory should be invoked to explain the apparent discrepancy.

Frank then showed some orbit oscillation through the entire NLC beam delivery system, starting in the linac and ending either at the incoming or outgoing final quadrupole. He found that in the NLC design collimation lattice, there is an enormous nonlinearity close to the desired collimation depth ($6\sigma_x$ and $6\sigma_y$), compared to which the effect of any octupole would be weak. The origin of this nonlinearity was traced back to the sextupoles in the collimation section. Without those sextupoles, the response of the final-doublet orbit to an initial orbit displacement in the linac is almost perfectly linear. An octupole placed about 100 m upstream of the final doublet, with a strength $K_3l$ of 1000 m$^{-3}$, folds in the tails in the vertical distribution at the doublet and increases the effective beam stay-
clear at least by a factor of 2. But the octupole strength required seems to be considerably larger than that expected from a simple estimate, presented previously. This is another puzzle. The amplitudes at the outgoing doublet are not worse than on the incoming side. The effect of the octupole on the horizontal plane is small. Unfortunately, it turned out that the octupole increases the rms IP spot size by almost a factor of 7. This increase could be dominated by a few large-amplitude fliers, but it is still worrisome. PT suggested to further optimize the betatron phase at the octupole, for example by placing the octupole in the beta matching section.