Thoughts on NLC Test Beams and Primary Beam Extraction

1. Possible production target locations
2. Secondary beam layout
3. Secondary particle yields
4. Primary beam extraction and transport
Target location - design conditions

1. Assume parasitic operation - no dedicated running.

2. Allow access to the experiment building and detectors during NLC running.

3. Must have **useful** secondary yields up to 80% of the primary beam energy. This requirement sets the production angle. (Because the NLC pulse train is \( \approx 300 \) nsec, cannot use the SLC trick of \( n \) simultaneous low energy particles to approximate a single high energy particle).

4. Supply the same experiment building with secondary particles as well as the **full** intensity primary beam for fixed target experiments.

5. Muon background must be kept to a minimum.
1. Able to transport the full primary beam energy.

2. Keep $\delta p/p$ small, $\approx 1\%$. This requires a relatively small source size to get good energy resolution at the energy slit. The small source size has implications for the length and power capability of the beryllium target. Also want zero energy dispersion in the experiment building.

3. Set magnet apertures for $x_0' = y_0' = \pm 1 \text{ mrad} (\equiv 4 \mu \text{sr})$.

4. Should have zero net bend so that the longitudinal polarization is preserved no matter what beam energy is being used in NLC.

5. A four-stage beam line $-600 \text{ m long}$ will satisfy the above requirements. It will bring a full energy primary/secondary beam 3-5 meters below grade at a cut and cover site, where the IP is 12 meters below grade.

6. For a 500 GeV beam the simplest design uses 10 quadrupoles with a 10 cm bore, eight with a strength of about 120 T and two with a strength of about 40 T. There are four dipole strings, two with $B \cdot L = 13 \text{ T} \cdot \text{m}$ and two with $B \cdot L = 18 \text{ T} \cdot \text{m}$.

7. For primary beam extraction, replace the secondary production target with an 0.25 deg. bend (73 $\text{KG} \cdot \text{m} @ 500 \text{GeV}$). This dipole needs a 10-12 cm gap to allow passage of the beamstrahlung photons.

8. Need a high power energy slit in the first high dispersion region and a protection collimator in front of the first quadrupole to absorb the low energy tail.

9. If the extraction angle is vertical at a cut and cover site, many radiation safety questions must be addressed.
Possible Test Beam Production Target Locations in NLC
Target/Dump Setup

4 cm beam pipe through water

Beamstrahlung

End View

NLC Dump

1.5 m φ

Possible locations of 4 cm φ secondary beam channel

H₂O flow

20 cm φ entrance window
Yields in NLC Parasitic Test Beam

250 GeV e− beam on an 0.3 r1 Be target

10E12 e−/pulse train
del_p/p = +/−2%
del_omega = 4 usr
0.25 degree production

FLUKA calc. (S. Rokni)
Yields in NLC Parasitic Test Beam

250 GeV e− beam on an 0.3 r1 Be target

10E12 e−/pulse train
del_p/p = +/−2%
del_omega = 4 usr
0.25 degree production

Particles/pulse train

Energy (GeV)

FLUKA calc.
(S. Rokni)
Fixed Target Experiment Upstream from NLC Dump

- If parasitic operation, no access to Expt. Bldg., muons from beamstrahlung dump a problem.
- Limited transverse space on side next to opposite going beam.
Conclusions

1. In parasitic operation it is feasible to construct a beam line which can transport secondary hadrons and electrons up to the full NLC energy for either detector testing or fixed target physics with the high current NLC beam.

2. There can be independent access to the detectors or experiment and the longitudinal polarization is preserved for fixed target experiments.