Outline:

Source layout and components

Major technical issues for the sources

R&D needed to meet those issues for the CDR

Specific subsystems detailed talks:

- Photocathode R&D
- Multibunch buncher design
- Laser design
- Positron target issues
- Polarized positron plans

Summary, schedule and technical risks

Source components:

- Polarized gun and Thermionic gun
- Laser to drive Polarized gun photocathode
- Space-charge limited aperture (jitter reduction)
- Electron bunching system
- Positron target
- Positron capture system
- Spin rotators around electron Damping Ring
- Polarimeters, low and high energy

Longer range R&D, exploration of future technology:

- Polarized positrons, viability & consequences for NLC site
Figure 1-11. Schematic layout of NLC systems (not to scale)
Polarized electrons

- Bunch charge at DR: 1.6E+10
- Bunch charge at 80 MeV: 2.0E+10
- Bunch charge at gun: 2.3E+10
- Bunch length at gun: 0.7 ns
- Charge at photocathode + 20% overhead: 2.8E+10
- Peak current with 20% overhead: 6.3 A
- Bunches per macro-pulse: 95
- Bunch separation: 2.8 ns or 1.4 ns
- Repetition rate: 120

- $dE/E$ @ gun: <1%
- $dE/E$ @ 80 MeV: <1%
- $dN/N$ bunch-to-bunch: <1%
- $dN/N$ train-to-train: <1%

- Normalized emittance, $x$ @ 80 MeV: 4.5E-5 m-rad
- Normalized emittance, $y$ @ 80 MeV: 4.5E-5 m-rad
- Polarization: >80%

Positrons

- Bunch charge at DR: 1.6E+10
- Bunch charge at 250 MeV: 4.0E+10
- Bunches per macro-pulse: 95
- Repetition rate: 120

- $dE/E$ @ 250 MeV collimation: ±5%
- $dN/N$ bunch-to-bunch: 2%
- $dN/N$ train-to-train: 2%

- Normalized emittance, $x$ (edge): 0.06 m-rad
- Normalized emittance, $y$ (edge): 0.06 m-rad

Drive electrons

- Electron beam energy: 6.2 GeV
- Conversion yield: 2.0
- Bunch charge at 6.2 GeV: 2.0E+10
- Bunch charge at gun: 2.9E+10
- Bunches per macro-pulse: 95
- Bunch separation: 2.8 ns or 1.4 ns
- Repetition rate: 120

- Energy density @ 1.6 mm sigma r: 1.5E+12 GeV/mm^2

- $dE/E$ @ gun: <1%
- $dE/E$ @ 80 MeV: <1%
- $dN/N$ bunch-to-bunch: <1%
- $dN/N$ train-to-train: <1%

- Normalized emittance, $x$ @ 80 MeV: 1 E-4 m-rad
- Normalized emittance, $y$ @ 80 MeV: 1E-4 m-rad
Major Technical Issues:

Photocathode

Overcoming the charge limit to obtain the NLC pulse train
Achieving >80% polarization at this current

Greg Mulhollan’s talk, for the PPRC

Laser

Producing high power micro-pulses with the required stability

Joe Frisch’s talk

T-Gun Pulser

Producing micro-pulses with the required stability

Jitter reduction by Space Charge Limited Aperture
Demonstration of effectiveness

Bunching

Beam loading compensation and bunching efficiency

Theo Kotseroglou’s talk

Positron target

Target damage threshold and target lifetime
Target cooling requires rotating vacuum and water seals

Artem Kulikov’s talk

Positron capture

Beam loading compensation and capture efficiency

Polarized Positron generation

Determine viability and any demands on accelerator layout

Theo Kotseroglou’s talk
Initial Band Bending BB after electron falls into surface state

Depletion region

$Q = Q_0 - \Delta Q$

$J_c$ charging current

$E_B = \frac{Q^2}{2 \varepsilon N_{dop}}$
NLC Polarized Source Laser Pulse Train

5 μJ, ±1%

0.7 ns

2.8 ns

95 pulses
Pre-CDR R&D Program to address Technical Issues:

R&D Goal for the CDR:

Technical backup for the claim that we can meet performance requirements.

Projects:

Polarized Electron Source:

Demonstrate an NLC multi-bunch charge structure off of a polarized photocathode (& off of a non-polarized photocathode for e+ production).

Develop the NLC multi-bunch laser.

Develop a high-charge polarized photocathode
(initially slighting the 80% polarization spec., P>60%)

Positron Target:

Study target damage threshold (beam tests?) and evaluate target lifetime. Simulate dynamics of positron target (shock, radiation effects). Demonstrate ZDR rotating positron target vacuum seal.

Bunching :

Study bunching and positron capture to optimize design and establish tolerances. Bunching simulations backed-up by experiments at ATF & KEK-B Improved positron capture reduces the level of target damage.
Other issues to be addressed post CDR:

Polarized gun system design
  Improve serviceability, up-time
  Design also depends on results of Laser-Photocathode tests,
  Could require R&D on high gradient electrode materials
  (on-going effort at KEK)

T-Gun Pulser
  On-going effort at ATF.
  Back-up: photocathode gun on e⁺ side.

Jitter reduction by Space Charge Limited Aperture
  Necessary reduction determined by Laser-Photocathode tests.
Overview of layout and technical issues    David Schultz    20 mins.


Achieving >80% polarization at high current.

Multibunch buncher design    Theo Kotseroglou    15 mins.

Validated simulation and design of high charge buncher.

Break    10 mins.

Laser design and challenges    Joe Frisch    20 mins.

A new (non-ZDR) design for the NLC polarized e⁻ source laser.

Positron target issues    Artem Kulikov    20 mins.

Review of SLC e⁺ target damage and NLC expectations.

Polarized positron plans    Theo Kotseroglou    15 mins.

Potential polarized e⁺ sources and feasibility.

Summary    David Schultz    10 mins.

Schedule and technical risk.