ILC-Asia WG1 plans

Major design choices in 2005

Study items

Major design choices

Will be decided in 2005.

Major choice 1: Gradient

‘Summary’ of WG5 at ILCWS

- 25 MV/m is in hand
- 35 MV/m need essential work
- 45 MV/m is for upgrade (500 GeV → 1 TeV)

Cost (site independent) minimum is 35 – 40 MV/m

- But ‘Flat minimum’.
- Need to review the cost models.
- Site dependent factor will be important.

Example: Cost study by TESLA Group (ITRP Q&A)

500 GeV Variants

Break down of component cost

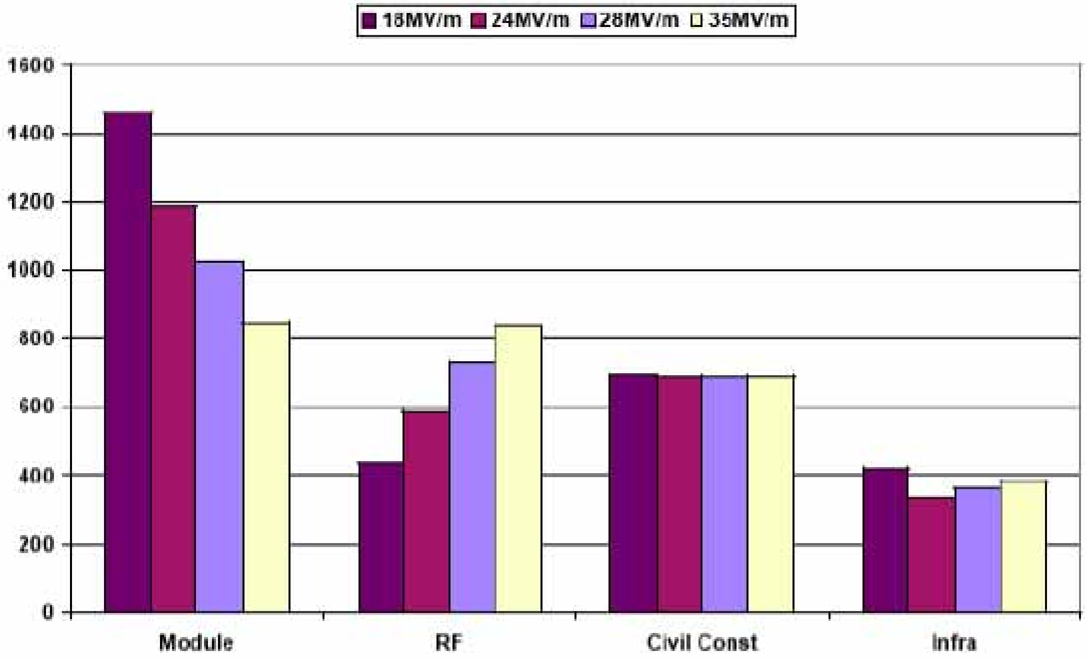
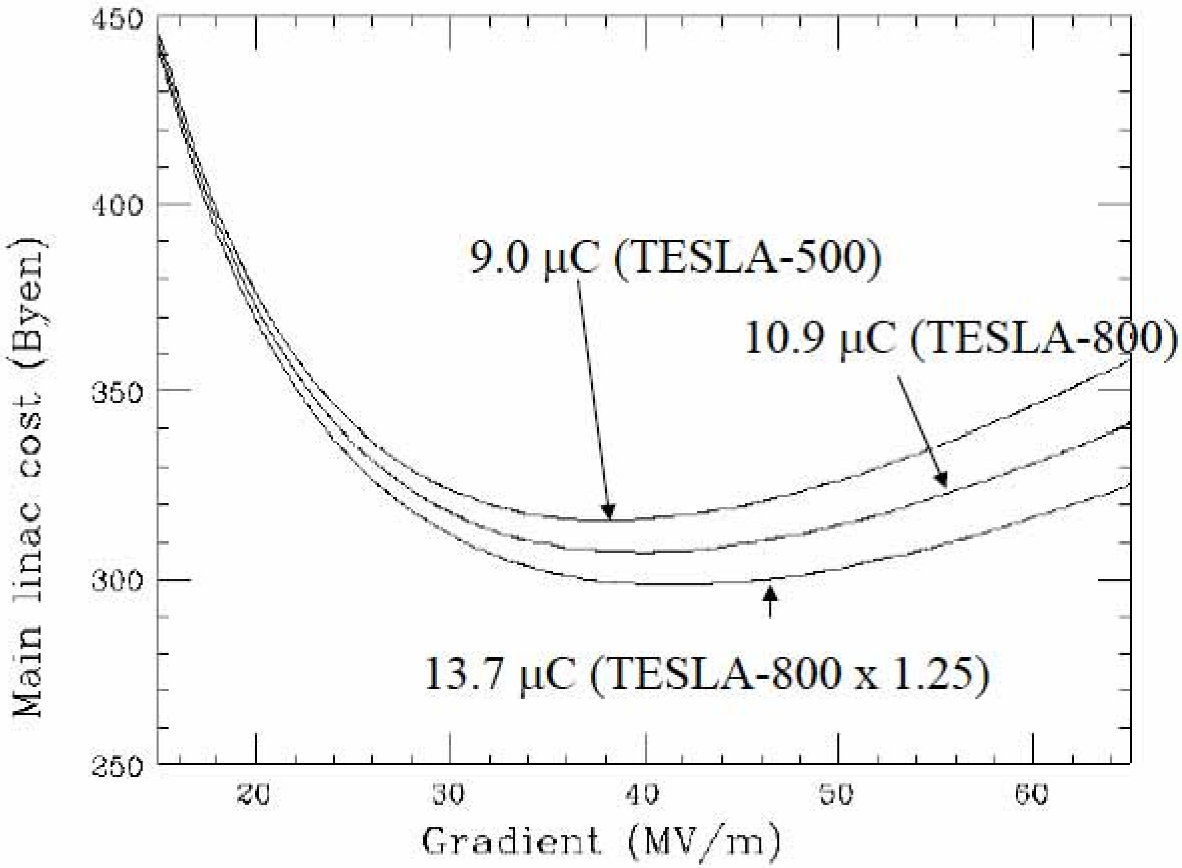


Figure 2. This figure shows the relative change in the breakdown of the costs as different gradient options are considered.

Example:

Cost vs. Gradient, for ECM 500GeV

Three different charge/pulse,
optimized (minimum total cost) pulse length.
For the same beam power as TESLA-500.



K.Kubo presented ILCWS, 2004

Cost vs. Gradient study

Review of the cost model

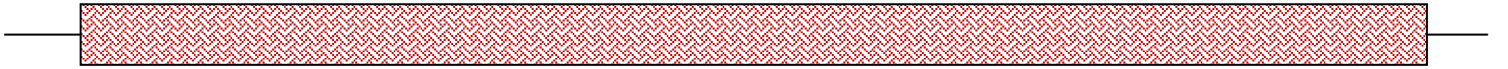
Consideration of site dependence

Related to RF system design
Beam parameters

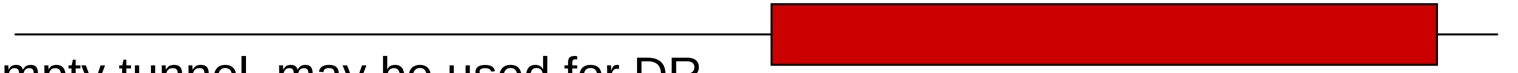
Energy Upgrade Scenario

Ecm 500 GeV → 1 TeV is required.

500GeV, Option A: Low Gradient, Full length, Low gradient



500 GeV, Option B: High Gradient, Half length, High gradient



empty tunnel, may be used for DR

1 TeV: Full length, High Gradient

Major choice 2: Positron source

- Conventional source

  Independent electron linac for e+ production.

- Undulator based source

  Use gamma rays for e+ production.

  Gamma rays produced by electron beam before collision.

- Laser-Compton source

  Use gamma rays for e+ production.

  Gamma rays produced by Compton sccatering, using independent electron linac and high intensity laser.

Advantages and disadvantages of the three options

Conventional source

- Construction and commissioning can be done independently from e-.
- Injector beam configuration can be independent from main linac beam.
- More target damage for the same e+ yield than gamma ray scheme.
- Polarization will not be possible.

Undulator based source

- Less target damage.
- Polarization will be possible with circular undulator.
- No demonstration and full commissioning before construction of electron main linac.
- Positron beam depend on electron main beam.

Laser-Compton source

- Need serious R&D for required intensity.
- Will be an option for upgrade to polarized beam.

We should decide conventional or undulator. What should be done before the decision?

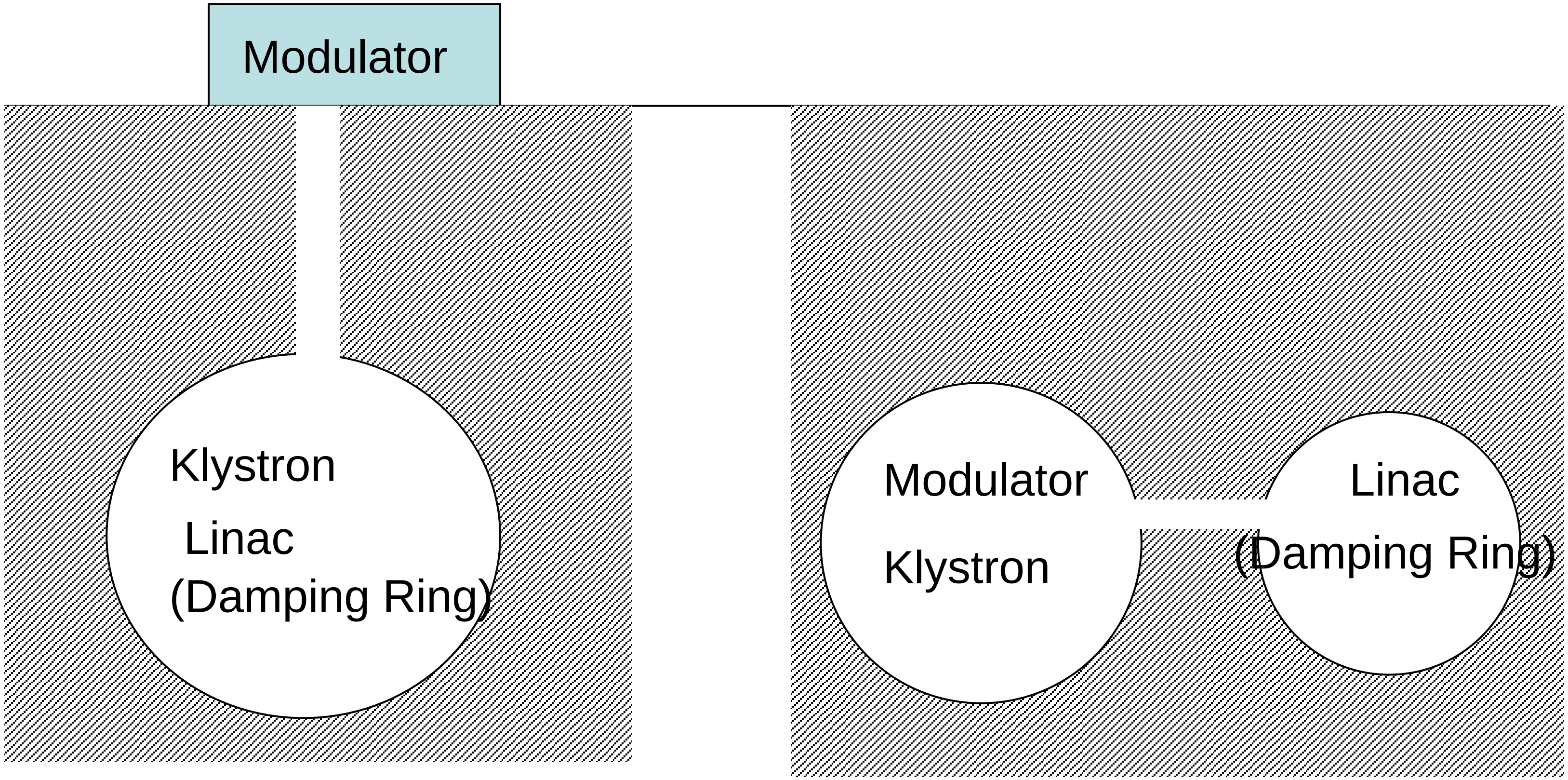
Check target damage, especially for conventional. (WG-3)

Make maintenance plans for various falures.

Make construction and commissioning schedule.

Cost estimation.

Major choice 3: 1- or 2-Tunnel



1- or 2-Tunnel

- Generally approved statement:
  - 1-tunnel will be cheaper.
  - 2- tunnel will have better availability.

  But how much, how seriously?
- Safety issues should be considered.
- Construction and commissioning schedule should be made. (Related to Damping Ring layout.)
- Maintenance plans for various failures should be made.

QUESTIONS:

- Is 1-tunnel still cheaper considering the availability, etc.?
- Then, should we choose 1-tunnel?

Major choice 4: Damping Ring Layout

- Share the tunnel with Main Linac (Dogbone)
  - Low cost for long damping rings
  - Interference with Main Linac
    - Stray field from the linac may affect DR
    - Commissioning and maintenance
- Independent tunnel
  - Earlier commissioning
  - Better availability
  - High cost
    - Circumference need to be reduced.

What we should know for deciding DR layout?

Kicker technology for beam extraction. (WG-3)

    Circumference ~ number of bunches x rise time

Beam dynamics in DR.

    Dynamic aperture, collective instabilities, etc.

Interference with the main linac.

    Effects of stray field (field from main linac)

    Construction and commissioning schedule.

    Maintenance procedure.

Cost estimation.

Study items of WG-1

Setting beam and RF parameters
Construction schedule, commissioning, availability study (e+ source, tunnel layout)
Beam dynamics issues, tolerances
Define required instrumentation

Study item 1(a): RF Parameter

No major changes from TESLA parameters (?)

- Frequency 1.3 GHz
- Max power ~ 10 MW / klystron
- Pulse length ~ 1.5 ms

Number of cavities/klystron will be changed.

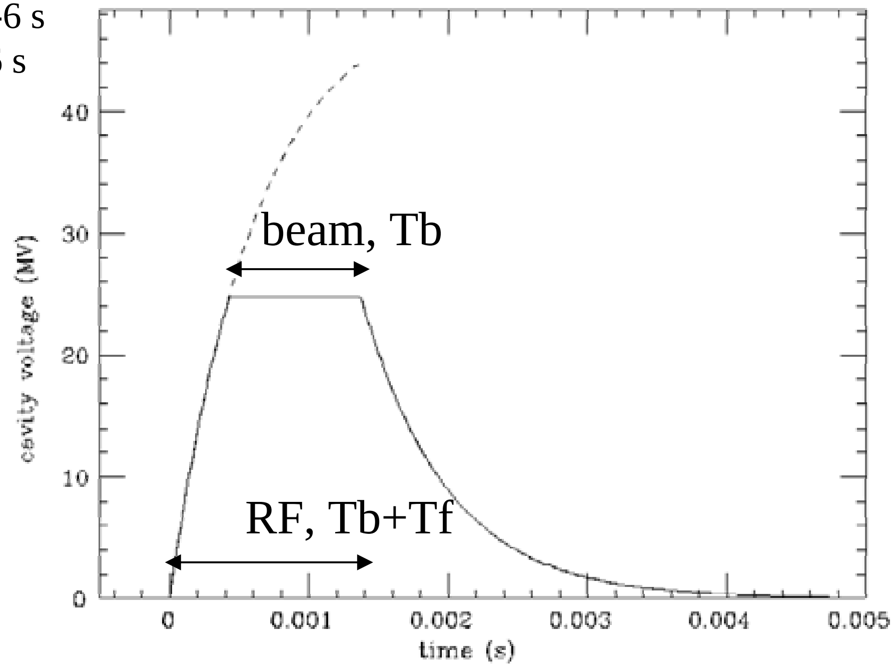
- Depend on gradient and beam current.

Work with WG-2.

RF related parameter of TESLA-500

Cavity voltage as a function of time for one pulse, calculated from TESLA-500 parameters.

Cavity voltage (VC):	24.7 MV (1.038m
RF frequency:	1.3 GHz
External Q ~ Loaded Q (Qext):	2.5E6
Cavity time constant (tf):	612 E-6 s
Number of particles/bunch (N):	2E10
Number of bunches/pulse (nb):	2820
Bunch spacing:	337E-9 s
Beam pulse length (Tb):	950E-6 s
RF pulse length (Tb+Tf):	1370E-6 s
Fill time (Tf):	420E-6 s



Study item 1(b): Beam Parameter

TELSA parameter should be critically reviewed.

Parameter at IP (single bunch parameter)

Flexibility is needed to try different sets of parameters covering potential operation scenarios.

- Nominal: less disruption, less beamstrahlung and larger vertical emittance. (?)

Study of beam-beam interaction is needed.

Work with WG-4(BDS) and WG-3(Bunch conpressor).

Study item 1(b): Beam Parameter (continued)

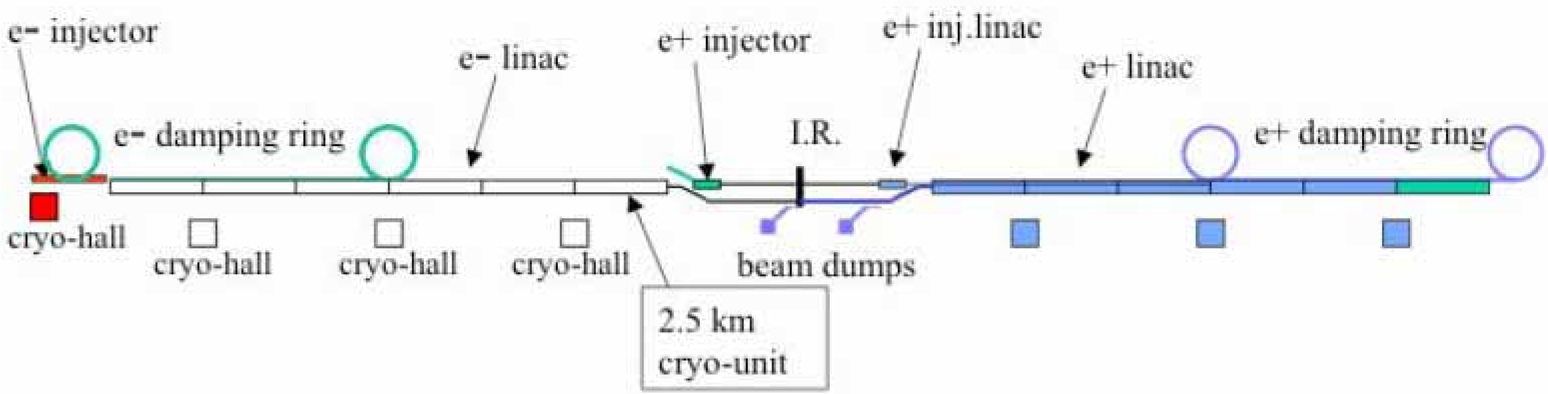
- Beam current (bunch intensity, number of bunches, bunch spacing)
  - For RF to beam power efficiency, higher current is desirable.
  - Higher current need more klystrons.
  - Positron production performance, beam dynamics, kicker performance, etc., should be considered. (WG-3)
- Optimum beam parameter should depend on gradient

Study item 2: Construction schedule, commissioning, availability

- For different options of e+ source, damping ring layout and number of tunnels.

Example from TESLA Study of Commissioning

TESLA ITRP Q&A



1: beam commissioning of e- injector (5 GeV), after 3 years.

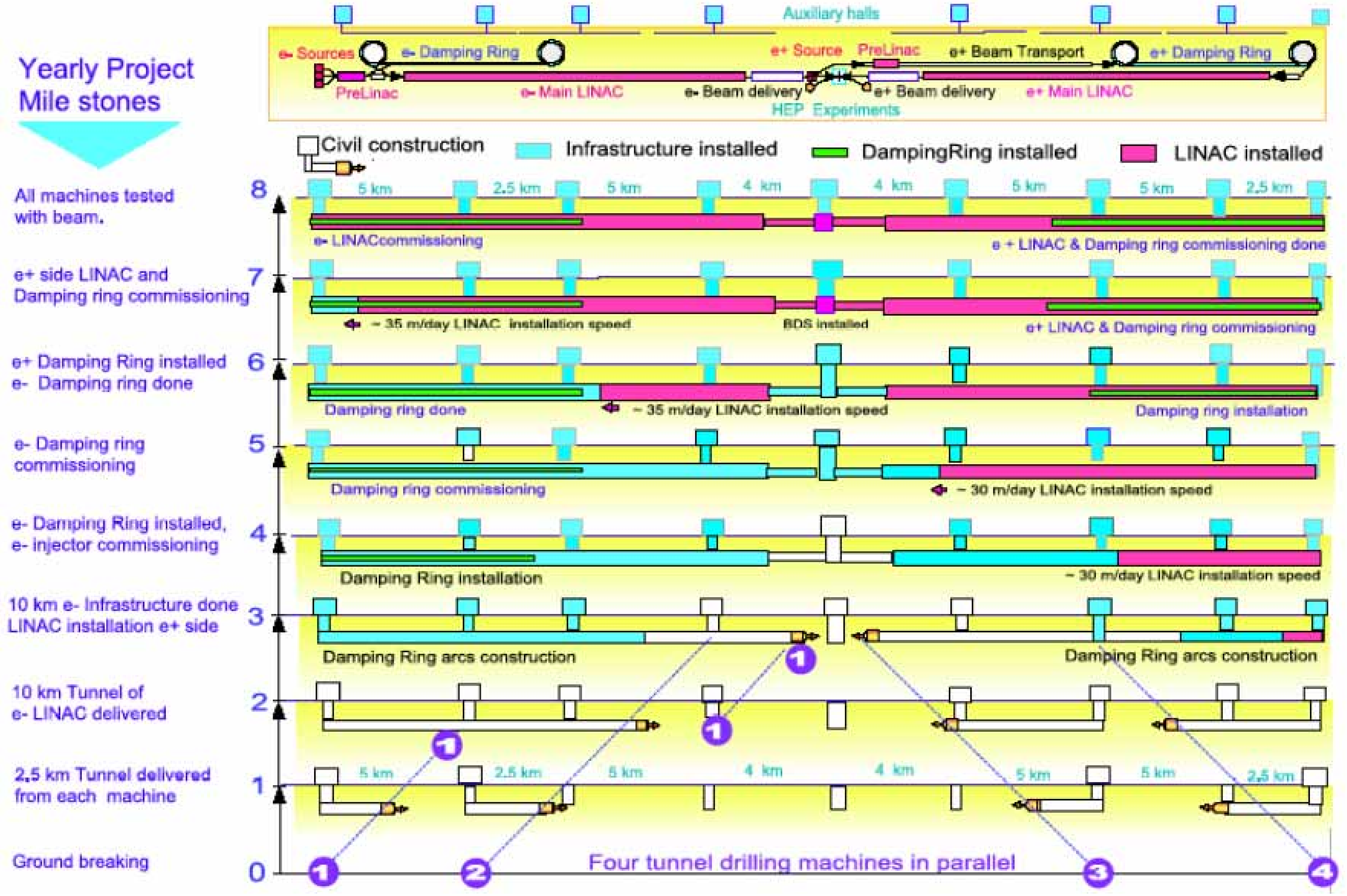
2: beam commissioning of e- damping ring, after 4 years.

3: technical commissioning of 2.5 km linac-cryo unit, after 4 years.

4: beam commissioning of e+ injector with beams from auxiliary e- source, after 6 years.

5: beam commissioning of e+ damping ring and linac with e- beams, after 6 years.

Example from TESLA study, 8 years from ground breaking to all machine ready.



Study item 3: Beam Dynamics study plans

(Beam dynamics after damping rings.)

Predictions of simulations should be
cross-checked by different codes, if possible.

Simulation tools from Japan:

SAD: General

CAIN: Collision (beam-beam interaction)

SLEPT: Main linac

SAD

Macro particles - point charges.

Any(?) higher order magnetic fields (multi-Poles) and wakefield.

- Bunch compressor
- Beam delivery System

CAIN

Macro particles - point charges.

beam-beam interaction

- IP

SLEPT

Several (10~20) slices with fixed z (relative longitudinal position is fixed).

Only linear components, Rough tracking.

e.g. quad=drift + thin quad + drift

- Main Linac

Study item 4: Define Required Instrumentation

Necessary beam monitors should be defined from beam dynamics simulations, considering errors and corrections.

Summary of WG-1 Plans

- **Major design choices (August ? 2005)**
  - Gradient, upgrade scenario
  - Positron source
  - 1 or 2 tunnel
  - Damping Ring layout
- **Study items**
  - Setting beam and RF parameters
  - Construction schedule, commissioning, availability study (e+ source, tunnel layout)
  - Beam dynamics issues, tolerances
  - Define required instrumentation