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MDI Planning

(What should we do if Project Approval & Funding occur?)

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U.S. DEPARTMENT OF ENERGY Office of Science

SLAC NATIONAL ACCELERATOR LABORATORY

Preparing for the Preparatory Phase of ILC

List the fundamental shared design choices made in the long process of bringing the ILC to a reality

- What was chosen and why (briefly)
- Which choices, if any, should be re-evaluated
  - This partly so that the next generation who will see the project to completion "own" those choices
- Which choices have been so "baked-into" the design that they should not be questioned
- Documentation for choices made tends to be scattered over time & space

List MDI Engineering Issues and R&D required before construction begins

- Estimate resource & time requirements

Time Scale for Design Changes

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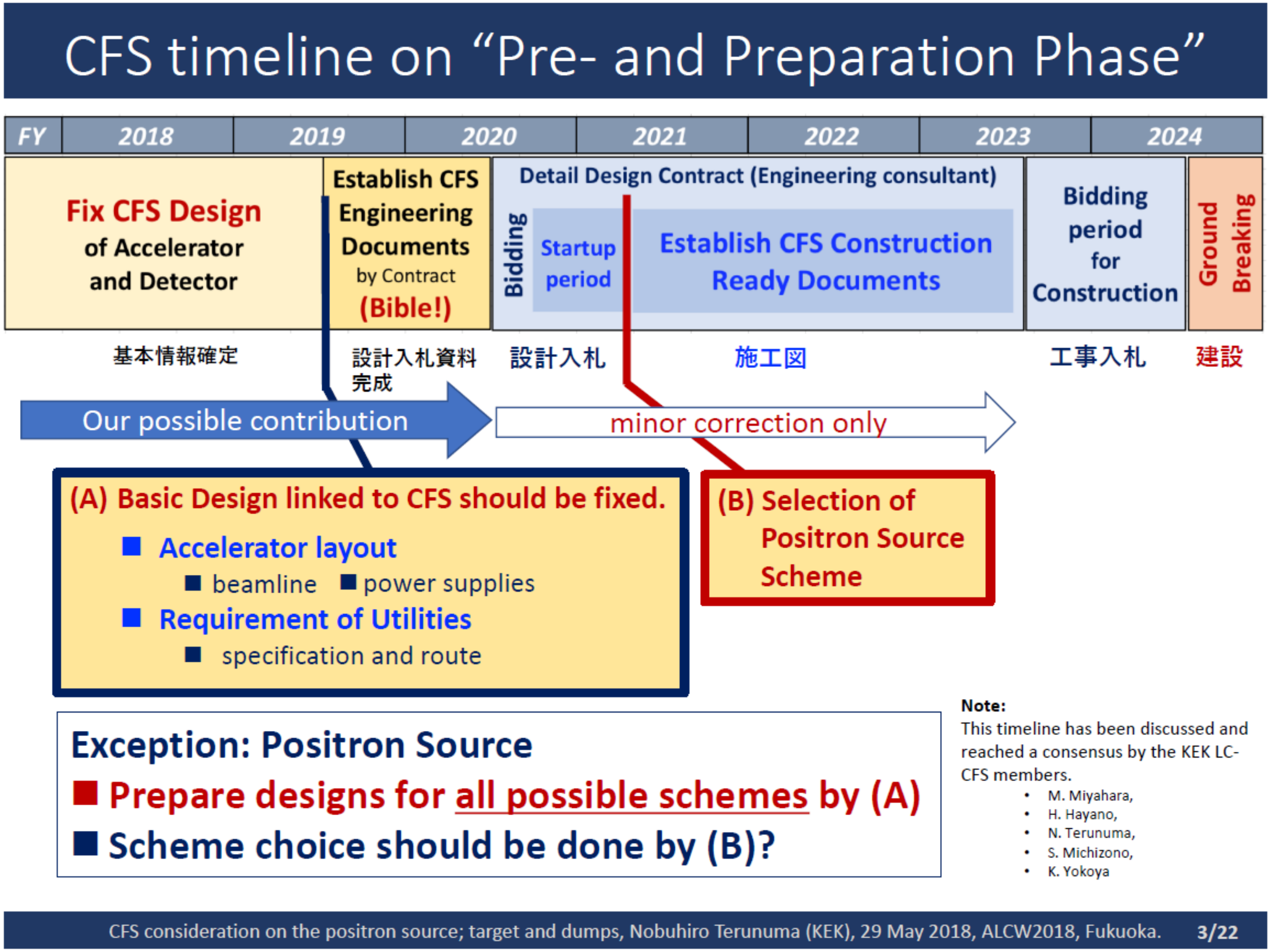

List of Design Choices

Crossing Angle

Extraction line chicane

Incoming line polarimeter

L*

Common L*

QD0 Technology

Muon Walls and Backgrounds

Self-Shielding

Magnetic Fringe Field Requirements

Anti-Detector-Integrated-Dipole

One or Two Detectors

Platform or not

Underground versus Above Ground Assembly

R&D List

Crab Cavity

QD0

He Distribution

Vibration & Vibration Suppression

SC Cable Design

Feedback (FONT)

Spot Size (ATF2)

Diagnostics

Polarimeters

Energy Spectrometers

Collimators

Crossing Angle

History

- 0 degrees TESLA
- 2 degrees
- 30 degrees Gamma-Gamma compatible
- 20 degrees CLIC compatible
- 14 degrees Current ILC

14 degrees chosen for ILC as it is thought to be the smallest crossing angle compatible with a minimum radius (30cm) compact SC Final Focus Cryostat housing both incoming and extraction QD and QF quads

- Couples to L* choice
- Assumed to minimize risk associated with crab cavity
- Assumed that package would be mounted in endcap and of minimal diameter to maximize detector acceptance

Extraction Line Chicane for Polarimeter & Energy Spectrometer

Pros

- Advocated by SLC experience
- Measures beam after beam-beam interaction has occurred

Cons

- Large aperture dipoles with large power requirements
- Radiation shielding required to handle off energy disrupted beam
- Increased size of dump window
- Superfluous according to advocates of Energy/Polarization in incoming beamline

Incoming Polarimeter & Energy Spectrometer

Pros

- Cleaner measurements made on non-disrupted beam
- Advocated by proponents coming from 0 crossing angle TESLA design

Cons

- Beam line length
- Superfluous if you believe advocates of extraction line solution

L*

Current compromise value of 4.1m

- Naïve assumption that smaller L* maximizes luminosity
  - Not necessarily born out by detailed studies where control of higher order optical effects dominate spot size
- 3.5m was consistent with smallest 14mrad crossing angle and compact SC technology developed by Parker at BNL
- 4.5m advocated for ILD with TPC

CLIC shows no loss of luminosity at larger L*

Mounting QD0 outside detector simplifies detector swap

- Management decision (Walker, ~2014) to have common L*

QD0 Technology

Direct wind compact SC magnets developed by Brett Parker at BNL

Introduced to LC Community at Snowmass 2005

Used at HERA , KEK and ??

ILC prototype begun but not completed due to funding issues

Concerns about vibration due to fluid

Other technologies researched by CLIC

Muon Walls and Backgrounds

- Historic SLC experience
- Gaseous tracking chambers more sensitive
- Design & leave space but do not implement at t=0
- Expensive

Self-Shielded Detectors

- Probably required in any model where a “garaged” detector is being worked on while 2nd detector is taking data
- Baked into design in 2-Detector push/pull model
  - Too long to demount
- Strong push from SLD people as SLC design had shallow tunnel
- May be somewhat similar situation to the “2-tunnel” original ILC design or the Kamaboko tunnel with thick shielding wall
  - “No access during beam operation” is current model

Magnetic Fringe Field Requirements

- Almost surely necessary to allow work on garaged detector" while IP-located detector is taking data

Anti-Detector-Integrated-Dipole

- Probably a detector risk/benefit choice

One or Two Detectors

Much less expensive, simplified IR design if powers that be descope to one detector

Platform
Underground versus Above Ground Assembly

- Motivated by CMS experience and CMS-like nature of ILD design
- Above vs. Below ground motivated by “timing” arguments that may need to be re-evaluated once funding profiles for ILC construction are known

Scope of R&D

Crab Cavity

- EM design
- Warm & Cold prototypes
- LLRF system with adequate phase jitter

QD0

- Complete QD0 prototype
- Prototype with incoming & extraction line quads & all windings
- Field measurements
- Vibration measurements

Vibration & Vibration Suppression

- Design & prototype Mover system with Feedback

SC Cable Design

- SiD and ILD based on 25 year old CMS cable design

He Distribution

- The He II system from the 4k cold box to the FFS is not trivial and should be identical for the two detectors.
- A joint R&D opportunity, which very likely is tied to the one for QD0.

Scope of R&D

Feedback (FONT)

Spot Size (ATF2)

Diagnostics

Polarimeters

Energy Spectrometers

Collimators & Dumps: Probably beyond scope of MDI