Update on X-Band LC

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Why X-band?

The technology is demonstrated TRC R1s and R2s for RF have been met (or due soon) Bulk of Talk

It is a complete project - all systems are prototyped test facilities verify the designs for subsystems ATF, ASSET, E-158, FFTB, GLCTA, NLCTA + more SLC verified the integrated system

There is a strong US-Japan collaboration large pool with expertise in X-band ready to build an LC

It is the path to higher energies

1.3 TeV in phase II and a stepping stone to multi-TeV CLIC only viable option - chance to learn necessary techniques upstream systems ~ identical to CLIC, could be reused



NLC Collaboration





GLC Collaboration







Design emittances demonstrated at ATF Damping Ring

SLAC and KEK physicists survey ring





Interlaboratory Collaboration for R&D Towards TeV-scale Electron-Positron Linear Colliders



International Linear Collider Technical Review Committee ILC-TRC 2003 GLC/NLC RF R&D Requirements R1 & R2

- R1 Demonstration of SLED-II pulse compression system at design power level
- R1 Test of complete accelerator structure at design gradient with detuning and damping
- R2 Test of PPM Klystron at full repetition rate

R2 Full system test of an RF sub-unit

- R1: R&D needed for feasibility demonstration of the machine
- R2: R&D needed to finalize design choices and ensure reliability
- R3: R&D needed before starting production of systems and components
- R4: R&D desirable for technical or cost optimization



NLC/GLC Linac RF Unit

(One of ~ 2000 at 500 GeV cms, One of ~ 4000 at 1 TeV cms)





SLED-II Demonstration (TRC R1)





SLED-II Demonstration (TRC R1 - Done)

Power to loads 580 MW at 400 ns (design is 475 MW)

Operated 500 hours at ~500 MW





Sami Tantawi (1/27/2004)



Structure Fabrication

IHI – KEK





Assembly and QC at KEK, SLAC, and shown here are Fermilab facilities:



Vacuum Braze Furnace

QC "Bead-Pull"



X-Band test Structures

ATTACAL DATA AND A DATA

32 Structures>20,000 hoursLower input power60cm lengthProduction recipe



Eight 60cm GLC/NLC Structures installed in NLCTA





Structure Demonstration (TRC R1 - Done)





PPM Klystron Demonstration (TRC R2 - Done)

75 MW Performance

Full Specification Performance by Two Tubes Only Two Full-spec Modulators for Testing – at SLAC Newness of PPM Focussing is Center -point of R&D Efforts

Klystron	Peak Power	Pulse-Width	Repetition Rate
SLAC XP3 S/N 3	75 MW	1.6 mu s	120 Hz
KEK PPM S/N 2	75 MW	1.7 mu s	60 Hz
	68 MW	1.7 mu s	120 Hz
KEK PPM S/N 3	65 MW	1.5 mu s	50 Hz
KEK PPM S/N 4	75 MW	1.6 mu s	25 Hz
SLAC 75 MW	75 MW	1.5 mu s	1 Hz
Prototype	79 MW	2.8 mu s	1 I Iz
KEK PPM S/N 1	68 MW	1.5 mu s	5 Hz
SLAC 50 MW	50 MW	1.5 mu s	120 Hz
	55 MW	2.4 mu s	60 Hz
	75 MW	1.5 mu s	120 Hz









GLC/NLC RF Sub-unit Tests (TRC R2 - In progress)

Goal is to demonstrate a full rf power unit in 2004

2-pack modulator, 2 PPM klystrons, SLED-II, 8 60-cm structures Rf power unit is replicated ~1000 times in each linac Two phases: Phase 2a NOW , Phase 2b in the Fall 2004 From SLED Staged approach maximizes testing of PPM

klystrons and other structures in parallel March '04 6 dB later '04 4.8 dB Overmoded 3 dB 3 dB 3 dB 3 dB 9 phase 2b phase 2a

Solid State Induction Modulator "Eight-Pack"

Sum many ~2kV sources inductively using "IGBTs" and "MetGlas" cores 76 Cores Three-Turn Secondary

Trace 2:

> 500 Hours of Operation

1) Trace 1: 4.6 VOL 500 nSEC

50 kVOL 500 nSEC







3rd Generation "Two-Pack" Modulator



Bechtel-LLNL-SLAC 500 kV at 1.6 μs.

Features

- 6.5 kV IGBTsCast casings.Improved cooling and connections.
- → Better reliability serviceability.

"DFM" 2-Pack Design





http://www-project.slac.stanford.edu/lc/local/ Projects/NLCTA/nlctasumm.html



Beam Delivery Layout Two IRs with Future Expansion Capability









Collimator System Design & R&D







IR Magnet Support, Stability & Feedback R&D







TRC Score Sheet

R1-1 R1-2	Gradient SLED-II	Done Done	Completed 6 of the 13 TRC R1 and R2 items identified for the X-band design with expectations of completing 4 to 5 more in 2004		
R2-1	Klystron	Done			
R2-2	RF Unit	Completion expected in 2004			
R2-3	E-cloud	Active program with demonstration planned in 2006			
R2-4	Ions	Active program with benchmarks planned in 2004			
R2-5	DR kicker	Done			
R2-6	DR ε	Done - ATF &	ALS results better than simulation!		
R2-7	LET tuning Active program with results expected in 2004				
R2-8	Instrumentation Active program with many elements done				
R2-9	Linac Vibration Active program with demonstration in 2005				
R2-10	Availability Done - 1 st pass with important conclusions				
R2-11	LET tuning	Active pr	ogram with results expected in 2004		



Energy for the Energy Frontier A Partner for the LHC

Luminosity (10^{34})

1350 Summary 1300 **25 Bunches** CMS Energy (GeV) Technology is demonstrated 1250 **Design is complete** 1200 All systems prototyped Strong experienced team 1150 **Reduced** "beam-Logical connection to loading" allows 1100 two-beam technology higher energy at 1050 expense of L **192 Bunches** 1000 1.5 2.5 05 1 0

Dick Taylor 1993 LCWS Waikaloa, Hawaii: "Why are you still talking about it, just build it already!"