SiD R&D tasks for the LOI

- Subsystem R&D tasks

- Summary of SiD R&D

- Prioritization of R&D tasks

    -> Document for DoE/NSF   ~Feb 2009

(Mainly based on Marty's R&D document)

SiD has a *baseline design* appropriate to a detector concept at this stage of maturity and with an earliest construction start date more than 4 and probably more than 6 years out. The *baseline design requires substantial R&D (mostly D)* to progress towards a Technical Design Report.

Simulation, Reconstruction and Analysis Software

- Develop simulation software to optimize/validate detector design, demonstrate performance.

- PFA development beyond LOI

- Tracking performance

- Currently below critical mass for these tasks

   (the SiD PFA for the LOI was developed by a very small group of dedicated people over an extended period of time. Some of these people will/have moved on. PFA development will continue post LOI!)

- ? How to recruit/retain more people?

Beamline Systems

- Beampipe, Lumcal and Beamcal

- Major issue: selection of detector for Beamcal

- Chip for 100% occupancy being designed at SLAC

    => should be good for Beamcal, inner part of Lumcal

Vertex Detector (VXD)

- MAJOR ISSUE: Selection of sensor(s) for ILC spatial and time resolution requirements

Some candidates:

-> 3D structures (FNAL)

-> bunch tagging MAP device

-> Chronopix (Oregon, Yale, SLAC)

+ concept for short column CCD (SLAC)

- Make sensor selection late, study geometry, mechanical structure, and cooling options for now.

- Worldwide initiative on this topic LCWS08/CERN

Tracker

- Baseline design: Si strips/KPiX readout (bonded to sensor)

- Need several sensor demonstration

- Sensor demonstration in 5T field.

- Optimize sensors for endcaps

- Baseline alignment system is the Frequency Scanning Interferometer – needs demonstration.

Electromagnetic Calorimeter (EMCal)

- Si-W sampling calorimeter: high spatial resolution, small Moliere radius

- Pixels ~$15mm^2$, readout by KPiX bump bonded to sensors.

- Need several sensor demonstration, with attention to 1.25mm gap and long cables.

- 2nd generation sensor now available

- Alternative technology: MAP CMOS/very small pixels/threshold

- Need to test sensors in 5T field.

Hadronic Calorimeter (HCal)

- Baseline: 4.5λ steel absorber sampling calorimeter with RPC active layers with 1 cm^2 pixels and KPiX readout

- Alternative technologies: GEM, Micromegas and Scintillator/SiPM (who will work on this?)

- Highest priority: Meter scale tests of (scalable) technologies with integrated readout that fits within 8mm active gap – with reasonable efficiency and crosstalk.

- Tests of 1m^3 scale prototypes – check on aspects of GEANT4 shower models(?)

- Another, more radical, alternative technology – dual readout calorimetry, high density crystal or glass, using separate Cerenkov and Scintillator signals to achieve high jet energy resolution. Can this fit in ECal+HCal space?

- Need tests of all sensors in 5T field.

Particle Flow Algorithm

- Major effort! Now have a working version which satisfies the requirements of 3-4% jet energy resolution

- Now being used with track finding/reconstruction as the basis for event reconstruction for LOI physics studies.

- "SiD-ish" version of PANDORA/PFA used for SiD optimization.

- Frozen version of SiD PFA for LO studies – but development continues for post-PFA.

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Muon Tracker

- Baseline: Bakelite RPC's with strip "pixels" and KPiX readout

- Priority: prototype system with required efficiency and crosstalk

- Alternative technology: Scintillator with SiPM readout.

Electronics

- Priority: final development and demonstration of 1024 channel readout directly bonded to Si sensors.

- Power distribution, probably based on high voltage DC to low voltage DC conversion, integrated with data collection systems

- Data acquisition based on ATCA technology is being developed in parallel with efforts for LSST and other projects

Magnet

- Major effort: optimization of the steel to contain the leakage field and be made from transportable modules

– Solenoid baseline field is 5T and uses the CMS conductor

- R&D: develop a conductor that does not require e-beam welding of structural aluminum to the pure aluminum stabilizer, based either on metal matrix technology or co-extruded high strength wire ropes

– the magnet steel structure, the solenoid support, and the calorimeter support form the cryostat – stable support for inner detectors during push-pull

General Issues

-> LOI structure: R&D in individual sections/ R&D summary

-> R&D summary as basis for prioritized R&D list to agencies – how to achieve this?

-> What time period should this cover – through TDR/2012?

-> Recent discussions between agencies and labs on ILC detector R&D

-> Developing discussion with Universities on ILC detector R&D.

-> Long term "model" for SiD detector R&D.