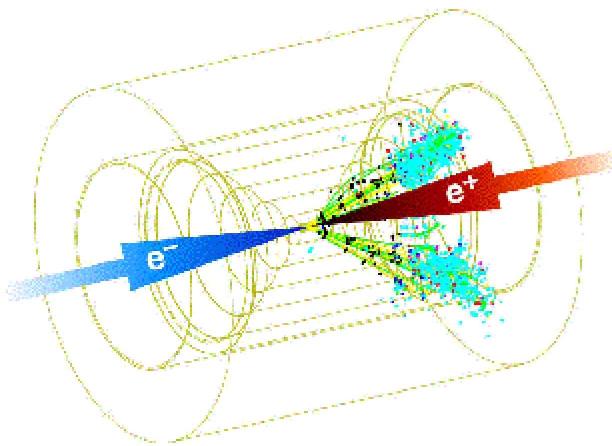
MDI Workshop @SLAC



WORKSHOP

Machine-Detector Interface

at the *International Linear Collider*

International Linear Collider
at Stanford Linear Accelerator Center

SLAC

January 6-8, 2005

http://www-conf.slac.stanford.edu/mdi/default.htm

ILC

K. Yokoya

Official Time Schedule

ILCSC wish

2005.2	Decide the director and location of **Central GDI**
2005.	Establish Regional GDIs
2005.8	Decide the **design outline in Snowmass Workshop** (acc.gradient, 1 or 2 tunnel, dogbone/small DR, e^+generation etc)
2005 end	Complete **CDR** with rough cost/schedule
2007 end	Complete **TDR**, role of regions, start site selection
2008	Decide the site, budget approval
2009	Ground breaking
2014	Commissioning starts

ATF2

Welcome & Accelerator facilities for ILC in TDR era	T.Raubenheimer	9:00-9:20
Recent activities of ILC-Asia working groups and schedule of ATF2 in terms of ILC CDR, TDR and construction	K.Yokoya	9:20-9:40
Overview of the ATF2 project at KEK	T. Tauchi	9:40-10:10
Experience from FFTB	P.Tenenbaum	10:10-10:40
COFFEE BREAK		10:40-11:00
FF optics design for ATF2	S. Kuroda	11:00-11:20
FF optics design for ILC & ATF2	A.Seryi	11:20-11:40
ATF2 optics, tolerances, tuning, scaling to 1 TeV	D.Angal-Kalinin	11:40-12:00
FF optics tracking cross-check	M.Pivi	12:00-12:20
LUNCH		12:30-13:30
ATF2 photon collider laser facility	J.Gronberg	13:30-13:50
Performance of the ATF extraction line	K. Kubo	13:50-14:10
Vertical dispersion and coupling correction in extraction line	M.Woodley	14:10-14:30
Kicker for ILC-like train	M.Ross	14:30-14:50
BINP kicker design proposal	B.Grishanov, F.Podgorny (presented by A.Seryi)	14:50-15:10
IP nano-BPM for ATF IP, laserwire, and IP beam size monitor	Y. Honda	15:10-15:30
Energy spectrometer cavity BPMs	S.Smith	15:30-15:50
COFFEE BREAK		15:50-16:10
High resolution cavity BPM design	Z. Li	16:10-16:30
Laser wire for ATF2 & ILC, and IP size monitor	G.Blair	16:30-16:50
IP beam size monitor	A.Brachmann	16:50-17:10
Intra-train feedback, possible active stabilization, alignment	P.Burrows	17:10-17:30
Ground motion at the ATF and ATF2	T.Tauchi	17:30-17:50
Discussion on quantification of ILC risk reduction due to ATF2 and further work	ALL	17:50-18:10
Summary of ATF2 Workshop		

Final Goal

T. Tauchi

Ensure collisions between nanometer beams;
i.e. luminosity for ILC experiment

Reduction of Risk at ILC

FACILITY construction, first result	ATF2/KEK 2005-07-07?	FFTB/SLAC 1991-93-94
Optics	Pantaleo's local choromaticity correction scheme; very short and longer L^* (β^*_y=100μm, L_{tot}=36.6m)	Oide's conventional (separate) scheme; non-local and dedicated CCS at upstream; high symmetry; i.e. orthogonal tuning (β^*_y=100μm,, L_{tot}=185m)
Design beam size	37nm / 3.4μm, aspect=92 ($\gamma\epsilon_y=3 \times 10^{-8}$ m)	60nm / 1.92μm, aspect=32 ($\gamma\epsilon_y=2 \times 10^{-6}$ m)
Achieved	?	70nm (beam jitter remains !)

ATF2

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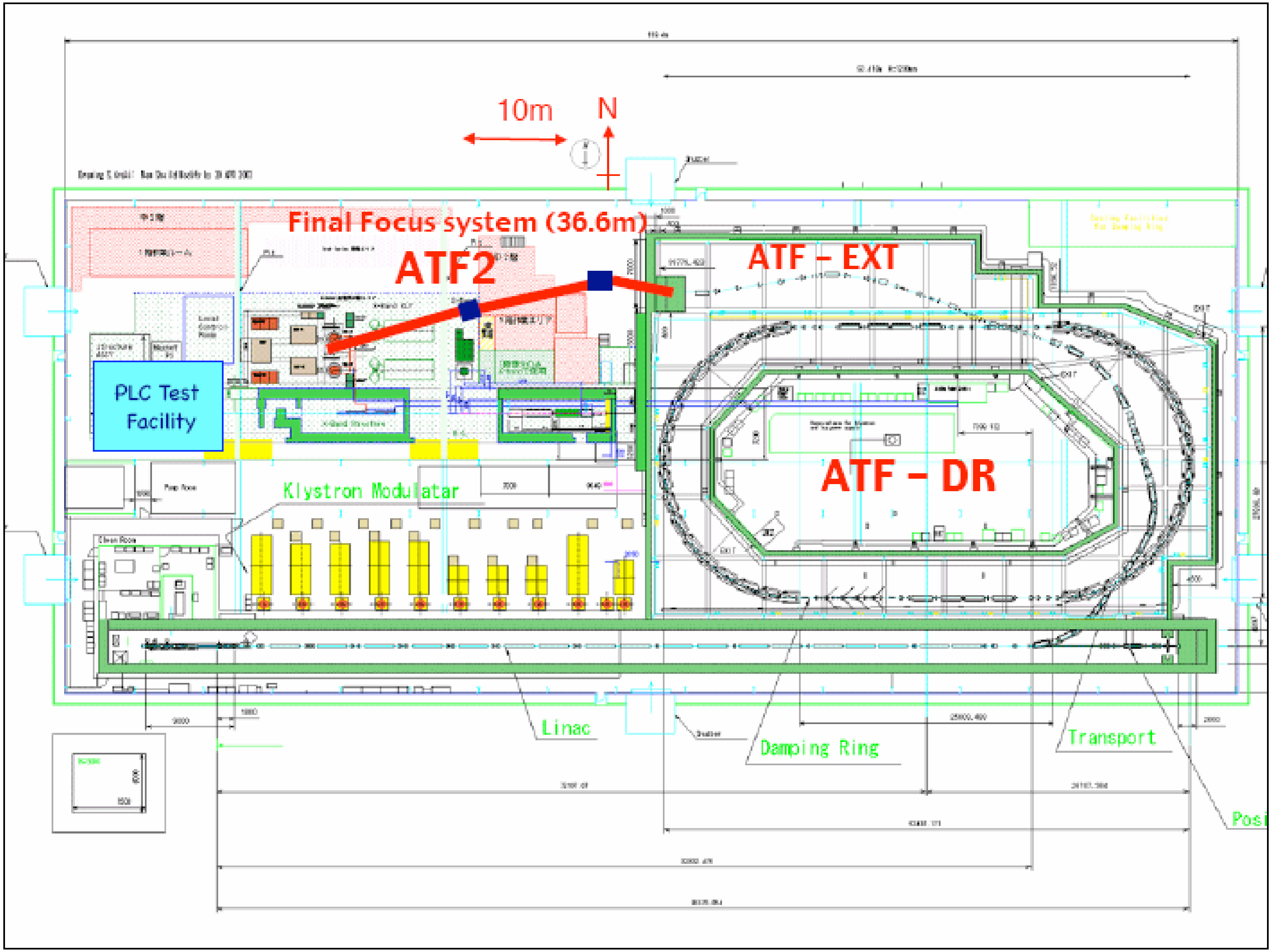


10m
N
Final Focus system (36.6m)
ATF2
ATF – EXT
PLC Test Facility
ATF – DR
Klystron Modulatar
Linac
Damping Ring
Transport

ATF2 Beam At Final Focus

σ_x	2-4 μm
$\sigma_{x'}$	250-500 μrad
σ_y	35 nm
$\sigma_{y'}$	300 μrad
Bunch length	8 mm
Bunch spacing	300 ns
Bunch charge (5E9 electron)	0.8 nC

- C

Mode-I

A. Achievement of 37nm beam size

A1) Demonstration of a new compact final focus system; proposed by P.Raimondi and A.Seryi in 2000,

A2) Maintenance of the small beam size (several hours at the FFTB/SLAC)

Mode-II

B. Control of the beam position

B1) Demonstration of beam orbit stabilization with nano-meter precision at IP. (The beam jitter at FFTB/SLAC was about 20nm.)

B2) Establishment of beam jitter controlling technique at nano-meter level with ILC-like beam (2008 -?)

Requirements

Mode	ATF-EXT	ATF2
I	Jitter < 30% of σ_y $\gamma\epsilon_y=(4.5 \rightarrow 3) \times 10^{-8}$m	BSM (laser in higher mode) BPMs with 100nm res. at Qs Power supplies of < 10^{-5} Active mover of Final Q
II	Jitter < 5% of σ_y (2nm jitter at FP)	BPM with < 2nm res. at FP Intra-bunch feedback for ILC style beam

Novel IP-BPM R&D

Position resolution of less than 2nm under the large beam divergence of 300μrad and the bunch length of 8mm.

V. Vogel proposed at the 2nd Mini-Workshop on Nano Project at ATF, 11-12, Dec. 2004

Triplet of Cavity-BPMs

1st Cavity: Y position at FP

2nd Cavity: X position at 5cm from FP

both with damped Q for common modes

3rd Cavity: very small gap of 0.5-1mm

for angle and tilt measurements

Schedule

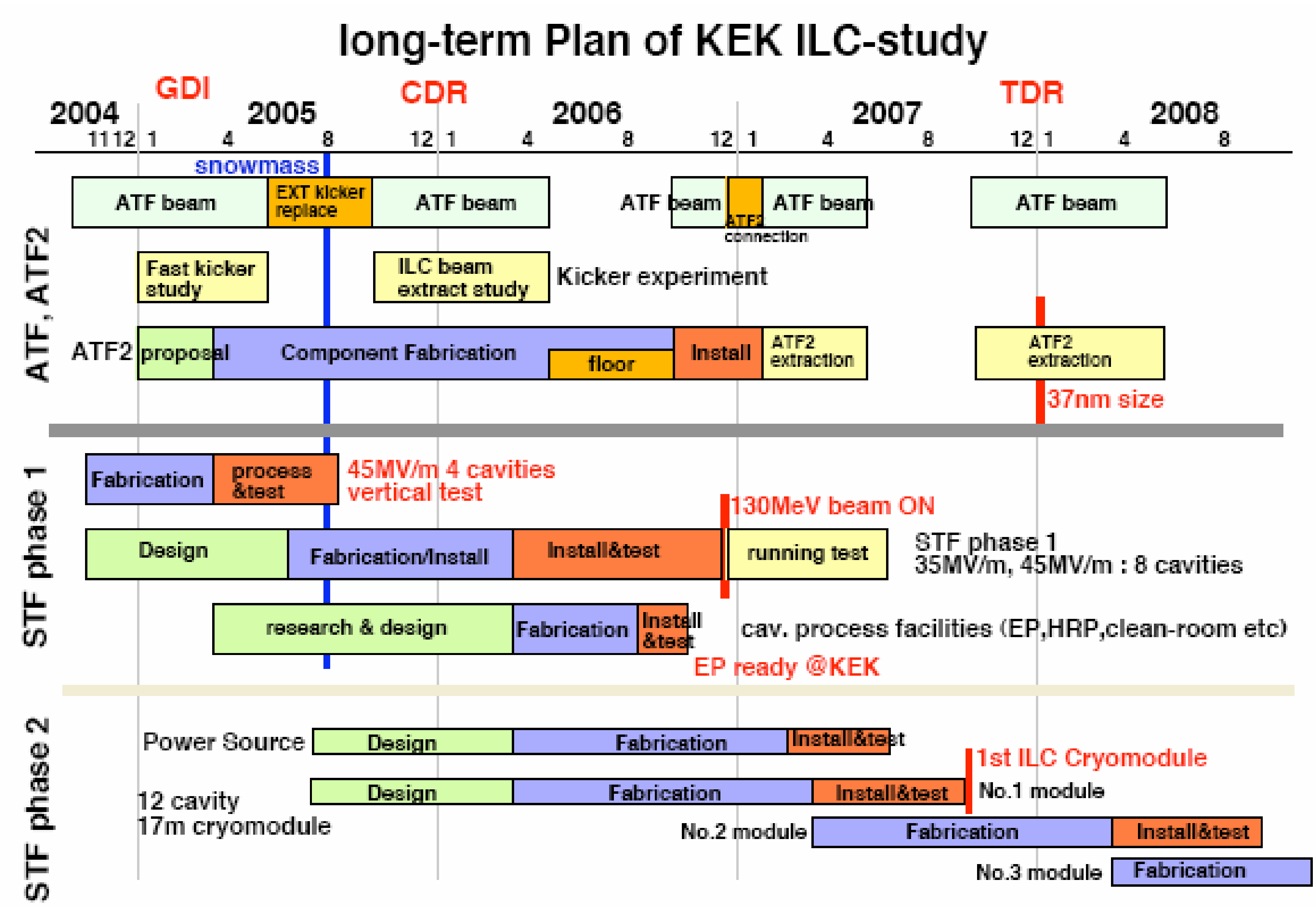
2002 optics design (Local correction, S.Kuroda)
2005.3 "international" proposal with ILC-WG4
2005.4 construction starts
2007.3 completion
2007.4-6 achievement of $\sigma_y^* = 37$nm
- 2008 nanometer stabilization of final quadrupole
2009-α PLC test facility
strong QED experiments

SLAC-FFTB schedule
1989 optics design (Oide)
1991.3 proposal (CDR)
1993 summer completed
1994 spring 70nm
1995 RF-BPM
1997 E144:collision with laser (non-linear QED)

International Collaboration on ATF2

- Design study going on by international collaboration
  - Mini-workshops: Dec.11 at KEK, Jan.5 at SLAC
  - Completion of optics design in ~ March 2005 ?
- Budget requirements
  - Total 2.8 Oku Yen (floor, beamline, diagnostics)
  - Floor + shielding ~ 0.6 Oku Yen
  - Desirable to share other expenses among Asia, North Ameri-oca, Europe
  - Japanese budget request for JFY2005 (Apr.2005-Mar.2006) almost ready

Expected contribution/region = 2.2 M$/3 = 0.73 M$


long-term Plan of KEK ILC-study
GDI
CDR
TDR
2004
2005
2006
2007
2008
11 12 1 4 8 12 1 4 8 12 1 4 8 12 1 4 8
snowmass
ATF, ATF2
ATF beam
EXT kicker replace
ATF beam
ATF beam
ATF2 connection
ATF beam
ATF beam
Fast kicker study
ILC beam extract study
Kicker experiment
ATF2
proposal
Component Fabrication
floor
Install
ATF2 extraction
ATF2 extraction
37nm size
STF phase 1
Fabrication
process &test
45MV/m 4 cavities vertical test
130MeV beam ON
Design
Fabrication/Install
Install&test
running test
STF phase 1
35MV/m, 45MV/m : 8 cavities
research & design
Fabrication
Install &test
cav. process facilities (EP,HRP,clean-room etc)
EP ready @KEK
STF phase 2
Power Source
Design
Fabrication
Install&test
1st ILC Cryomodule
No.1 module
12 cavity
17m cryomodule
Design
Fabrication
Install&test
No.2 module
Fabrication
Install&test
No.3 module
Fabrication

Note: SC cavity developements

K. Yokoya

Development of 45MV/m

- Single-cell test in Dec 2004
- Individual vertical test of four 9-cell cavities **by Sep.2005**
  - Just in time for CDR completion
  - In existing facilities (AR east)
  - If expected performance not obtained,
    $\Rightarrow$ change to slower plan for ILC 2nd stage
- Cryomodule test by end of 2006 $\Rightarrow$ STF Phase 1
- Industrial design by TDR

FFTB: Stuff We Did Wrong

P. Tenenbaum

- BSM Systematics
  - never convinced ourselves we'd found all effects
- Extraction line
  - Looks at FD and FP spot
  - poor BPMs
  - poor optics
  - Tight aperture for Compton photons, etc
- Coupling
  - Didn't have full control
  - Was there a rotation @ FP?
- Collimation
  - Extremely hard to get OK conditions for BSM
  - Took linac collimators + 2 sets of jaws in FFTB
  - Optics probably halo limited anyway!
- Intermediate small-spot diagnostics
  - Wire scanners don't work well at 100:1 aspect ratio

Use ATF2 as a testbed for the gamma collider

J. Gronberg

I. Strawman layouts } Ongoing

II. Low power tests

III. High power tests

IV. Turn-key operation

(II–IV) } Will be done at lead institution

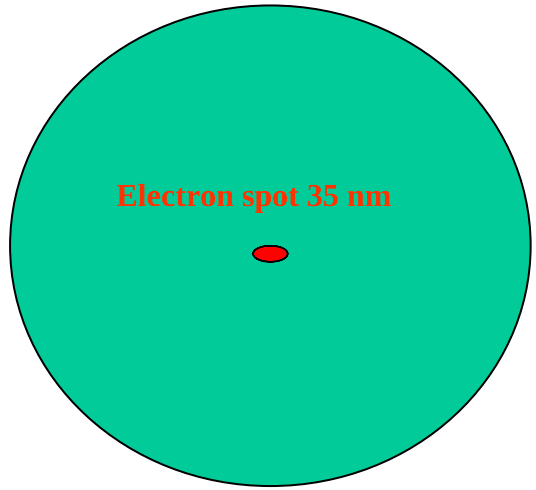
V. Laser / electron beam integration } Performed at ATF2

VI. Installation

VII. Operations

V. Laser / Electron beam integration

- Proper operation requires overlap of the laser and electron beam
  - Laser pulse and electron beam must arrive at the center of the laser focus with <1/2 ps jitter
  - Electron and laser beam spots must overlap transverse
- Alignment and stabilization schemes must be developed and demonstrated



Laser spot 10 micron

The ATF2 can provide a facility for demonstrating the laser / electron beam integration

Probably not needed for ~5 years

A working facility could provide an intense ~ 40 MeV photon beam for a positron source test bed

What can be done at ATF2?

As envisioned ATF2 will have a beam with a cold bunch structure although not the full train length

The proposed 35nm electron spot size is small enough to test a beam overlap feedback system

At 2 GeV electron energy the system will produce a photon beam of 40 MeV photons. This can be measured directly in a calorimeter or the average energy loss of the beam can be measured in a post interaction chicane.

Are 40 MeV photons useful?

- A photon beam of this type is similar to what is being proposed for positron production.

- With a facility of this type one could test:
  - Conversion targets
    - Average power issues
    - Radiation damage
  - Capture efficiency with polarization

- This would require a much larger facility with a larger footprint than what is currently proposed.

Summary of ATF2 workshop

- ATF2 is an important project for ILC
- Continue ATF2 project development
- Adopt ILC-like optics
  - Study BC; smaller betaY*; variable L*; collim.
- Improve extraction line, install sextupoles, continue study to decrease extracted beam emittance
- Study consistency of all systems with goals A and B (e.g. fast ion inst);
- Continue R&D on two fundamental monitors: IP BPM and IP BSM and other hardware & instrumentation
- Study possibility to reuse existing hardware
- Plan possible contributions from collaborating labs and institutes

CLIC team participation would be very welcome

Scope and Goals

- Evaluate "experiment impact" of the ILC design. The ILC Design impacts the ILC Detector and Physics, beyond just the delivered luminosity and energy reach. The Machine-Detector Interface (MDI) group needs to evaluate how the ILC design impacts the Experiment (Detector design and physics capabilities) and how the Experimental requirements impact the ILC design.
- Give input to both the ***ILC Beam Delivery Group*** and the ***World-wide Study for ILC Physics and Detectors*** regarding critical choices, beam tests, the CDR and the TDR.
- Address viability and issues for crossing angle choices: head-on, 300-mrad vertical, 2-mrad horizontal, 7-mrad horizontal, 12-25 mrad horizontal
- Form international sub-groups working on individual topics, and identify available and needed resources.
- This Workshop is an important milestone: preparing for the CDR and for subsequent meetings at ***LCWS*** (March 2005) and ***Snowmass*** (August 2005).

Latest Workshop News ...

Workshop Photos

MDI Workshop

Program

Thursday, January 6

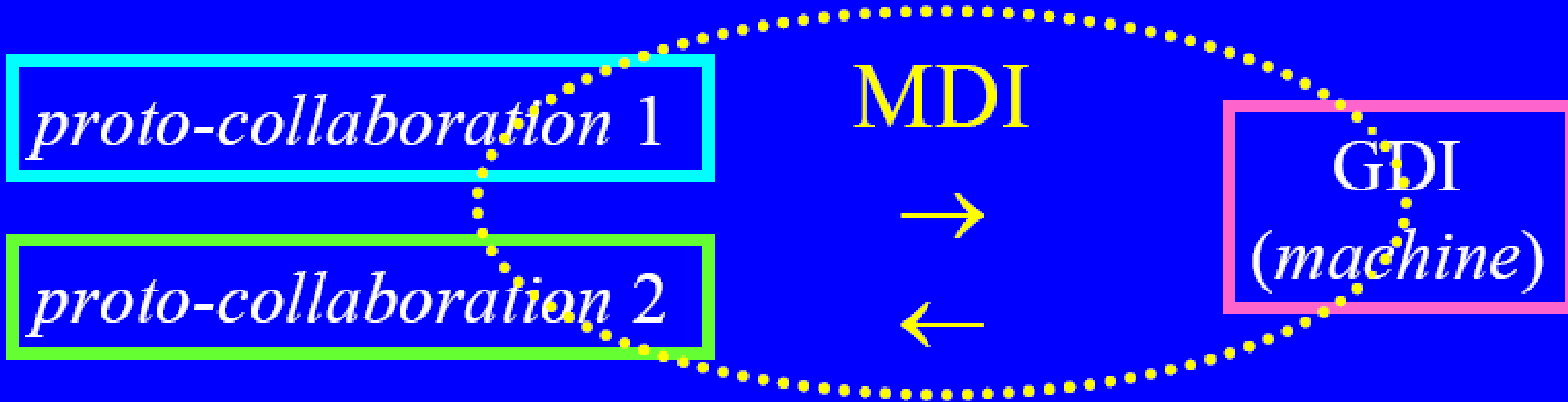
TIME	TOPIC
8:00 -9:00	Registration
9:00 - 9:30	**Welcome, ILC News and Workshop Organization** (photos from this session) Welcome (Ewan Patterson, SLAC) 5' ILC News (David Miller, UC London) 10' Comments from Local Organizing Committee (Mike Woods, SLAC) 5' Workshop Program and Goals (Philip Bambade, LAL-Orsay) 10'
9:30 - 10:30	**Polarimetry** (K. Moffeit, K. Monig Convenors)
10:30 - 11:00	COFFEE
11:00 - 12:00	**Polarimetry** (K. Moffeit, K. Monig Convenors)
12:00 - 12:45	**Physics Options Overview** (Albert de Roeck, CERN)
12:45 - 1:45	LUNCH
1:45 - 3:15	**Backgrounds** (K. Buesser, T. Maruyama Convenors)
3:15 - 3:40	COFFEE
3:40 - 5:15	**Backgrounds** (K. Buesser, T. Maruyama Convenors)
5:15 - 6:00	**Detector Concepts Overview** (Mark Oreglia, U. of Chicago)
6:00 - 8:00	**RECEPTION** (in Auditorium Breezeway)

Friday, January 7

TIME	TOPIC
8:30 -9:10	**Beam Optics, Collimation Overview** (Shigeru Kuroda, KEK)
9:10 - 10:40	**Crossing Angle** (A. Seryi, T. Tauchi Convenors)
10:40 - 11:05	COFFEE
11:05 - 12:30	**Crossing Angle** (A. Seryi, T. Tauchi Convenors)
12:30 - 1:30	LUNCH
1:30 - 3:35	**Beam RF Effects** (M. Woods Convenor)
3:35 - 4:00	COFFEE
4:00 - 5:15	**Very Forward Region** (W. Lohmann, H. Yamamoto Convenors); Links to talks
5:15 - 6:00	**Luminosity Optimization Overview** (Philip Burrows, QMUL)
6:00 - 6:30	Bus (30 people) + private cars to Chef Chu's Restaurant
6:30 - 8:30	**Dinner** at Chef Chu's Restaurant - cost is $20/person (please pay for this by Thursday 2pm!) - cash bar
8:30 - 9:00	Bus (30 people) returns to SLAC

TIME	TOPIC
8:30-10:00	**Very Forward Region** (W. Lohmann, H. Yamamoto Convenors); Links to talks
10:00 - 10:30	**Monte Carlo Data Repository** (Glen White, QMUL) 5' + 10' discussion **Lumi spectrum "challenge"** (Eric Torrence, U. of Oregon) 5' + 10' discussion
10:30 - 11:00	COFFEE
11:00 - 12:10	**Energy and Luminosity Spectrum** (S. Boogert, K. Kubo Convenors)
12:10 - 1:10	LUNCH
1:10 - 2:30	**Energy and Luminosity Spectrum** (S. Boogert, K. Kubo Convenors)
2:30 - 4:00	**Parallel Session**: i) Crossing Angle, IR Layouts, Beam Optics ii) Luminosity Spectrum, Energy, Polarization iii) Backgrounds, Very Forward Region, Beam RF Effects - work planning session: names, tasks for work towards Snowmass mtg - Convenors for each of 6 Main Topics prepare 1 summary slide
4:00 - 4:30	COFFEE
4:30 - 5:00	**Communications**--BDS list, MDI forum, other (Tom Markiewicz, SLAC) 5' + 10' discussion **MDI WG organization** (Toshiaki Tauchi, KEK) 5' + 10' discussion --within World-Wide Study, Detector Concepts, ILC Accelerator & GDI, across regions --goal of one single global MDI WG? continue with existing WGs?

Experiment ↔ machine ⇒ strong mutual impact



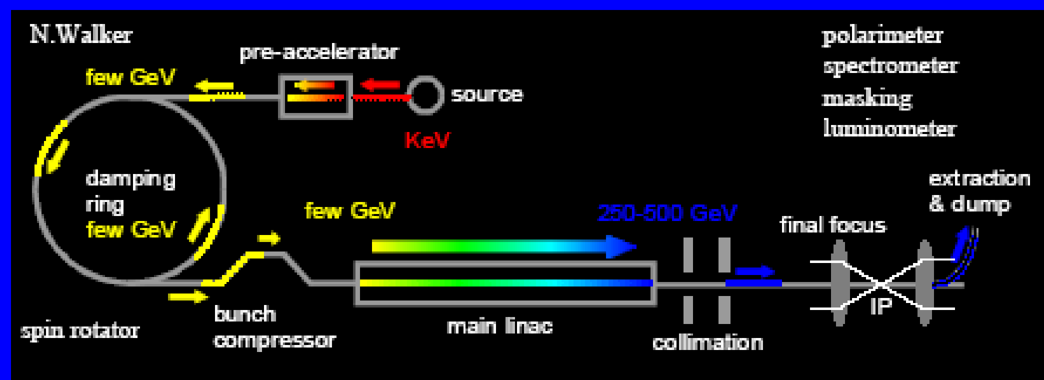
- MDI within regional detector and machine groups
  - ⇒ combine forces for ILC → CDR → TDR
  - ⇒ milestones : **MDI-WS**, LCWS'05, Snowmass'05,…
- Many critical questions → WWS & GDI (BDS)
- Joint sub-groups for main topics – interests ? resources ?

Main MDI topics ⇒ session convenors

- Energy and luminosity spectrum — S. Boogart, K. Kubo
- Polarimetry — K. Moffeit, K. Mönig
- Very forward region — W. Lohmann, H. Yamamoto
- Backgrounds — K. Büsser, T. Maruyama
- IR layout, crossing-angles — T. Tauchi, A. Seryi
- Beam RF effects — M. Woods

open system…
beam-beam effects…

"the experiment starts at the gun"



Main session goals

1. Review in detail each other's designs, viewpoints,…
2. Agree on specifications ($\rightarrow$ physics argumentation)
3. Common evaluation criteria ($\rightarrow$ exchange, cross-check)
4. Define and plan work for critical items
5. Formation of joint ad hoc teams to work together
6. Focus on common base-line designs for CDR $\rightarrow$ TDR
7. Design options, variants, backups, generic R&D…. ?

Keep talks short and focused to allow significant discussions !

Important connected topics $\Rightarrow$ overview talk

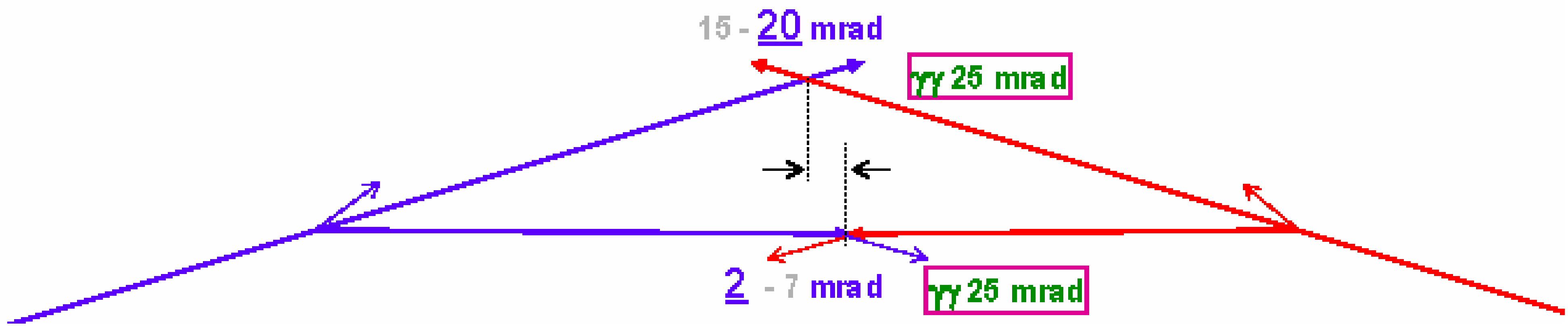
- Physics options (+ other issues) — A. de Roeck
- Detector concepts — M. Oreglia
- Beam optics & collimation — S. Kuroda
- Luminosity optimization — P. Burrows

Additional talks $\rightarrow$ joint tools for MC, communication, future organization ?

G. White, E. Torrence, T. Markievicz, T. Tauchi

Strawman BDIR

Tentative, not frozen configuration, working hypotheses, “strawman”



- Need more than quick studies
- Must start designing something concrete to understand consequences of certain decisions
- Two angles needed to explore parameter range

Lumi, Energy Measurement Goals

T. Barklow

Luminosity, Luminosity Spectrum

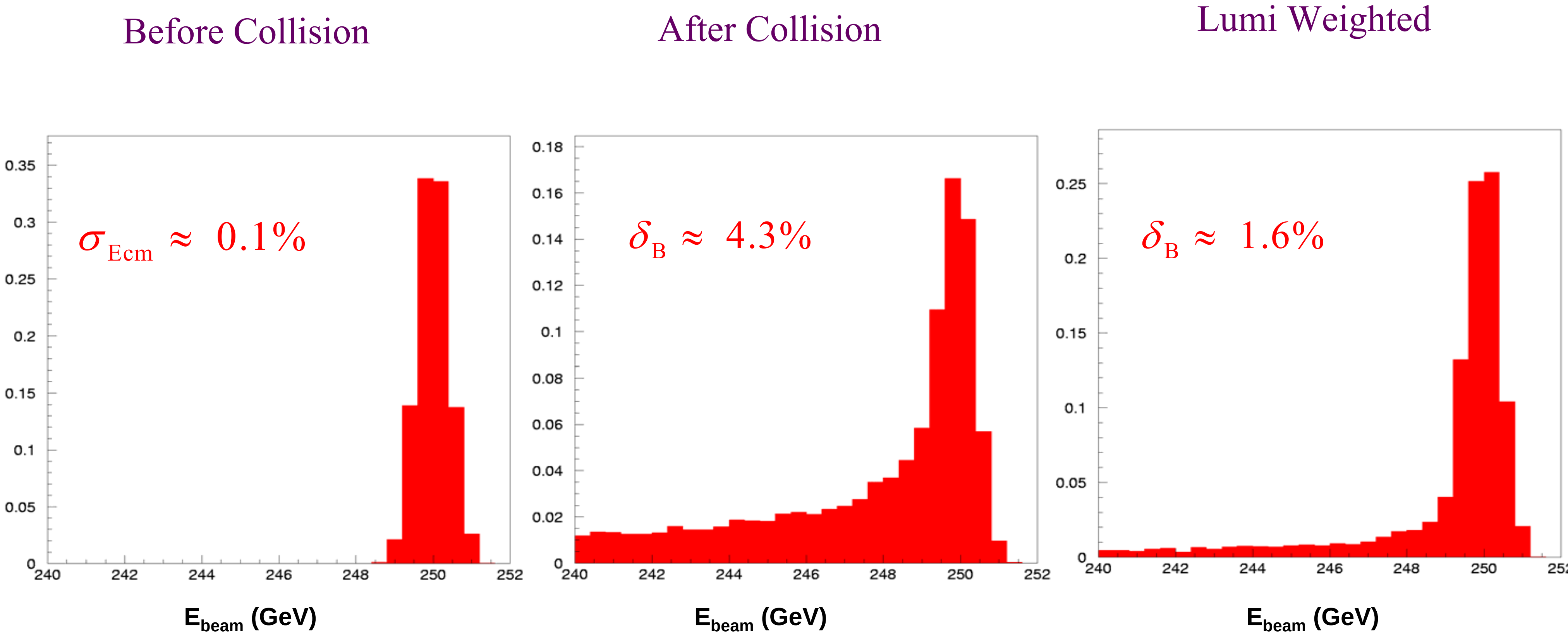
- Total cross sections: absolute $\delta L/L$ to ~0.1%
- threshold scans : core width to <0.05% Ecm ~ 50% σ_{Ecm} and tail population $\delta L/L$ to < 1%

Center of Mass Energy

- Smuon mass: 1000 ppm (24 Mev for 220 GeV smuon)
- Top mass: 200 ppm (35 Mev)
- Higgs mass: 200 ppm (60 MeV for 120 GeV Higgs)

*The optional Giga-Z program requires better precision for luminosity and beam energy measurements, such as $\delta E_{cm}/E_{cm}$ = 50 ppm for a 5 MeV W mass or 10^{-4} (absolute) A_{LR} measurement.

Beam Energy Profiles $\langle E_{beam\ (incoming)} \rangle = 250$ GeV

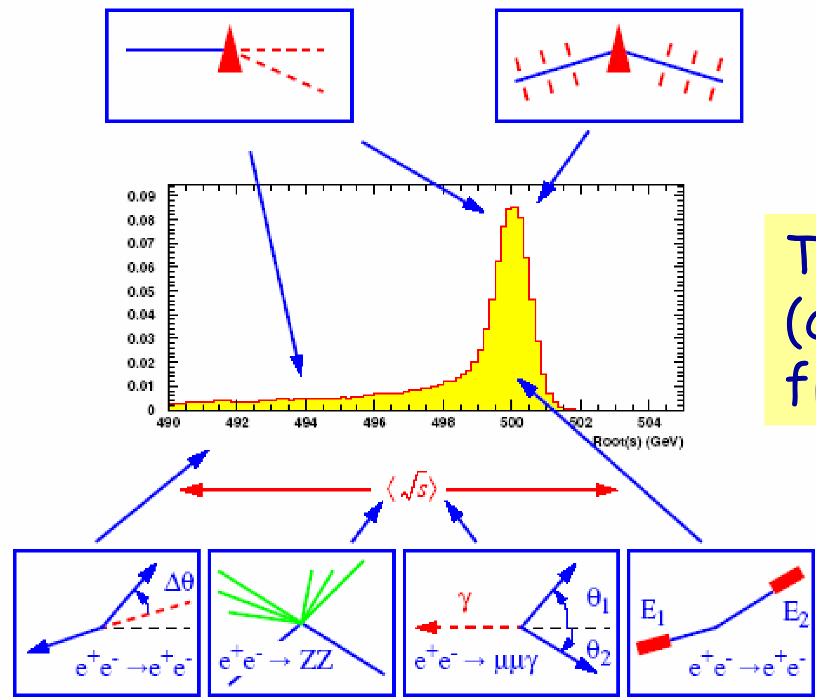


Physics Error Summary

	δM(sys) in GeV δE_{cm} = 200 ppm	δM(stat) in GeV
t quark (thresh)	0.035	0.021
175 GeV $\tilde{\chi}_1^+$ (thresh)	0.035	0.013
224 GeV $\tilde{\mu}_R^-$ (endpoint)	0.004	0.034
120 GeV Higgs (recoil)	0.200	0.117
120 GeV Higgs ($q\bar{q}b\bar{b}$)	0.056	0.046

The Luminosity & Energy measurement Challenge

Energy measurements



E. Torrence

Trying to get organized (common use of simulated files etc.)

Goals

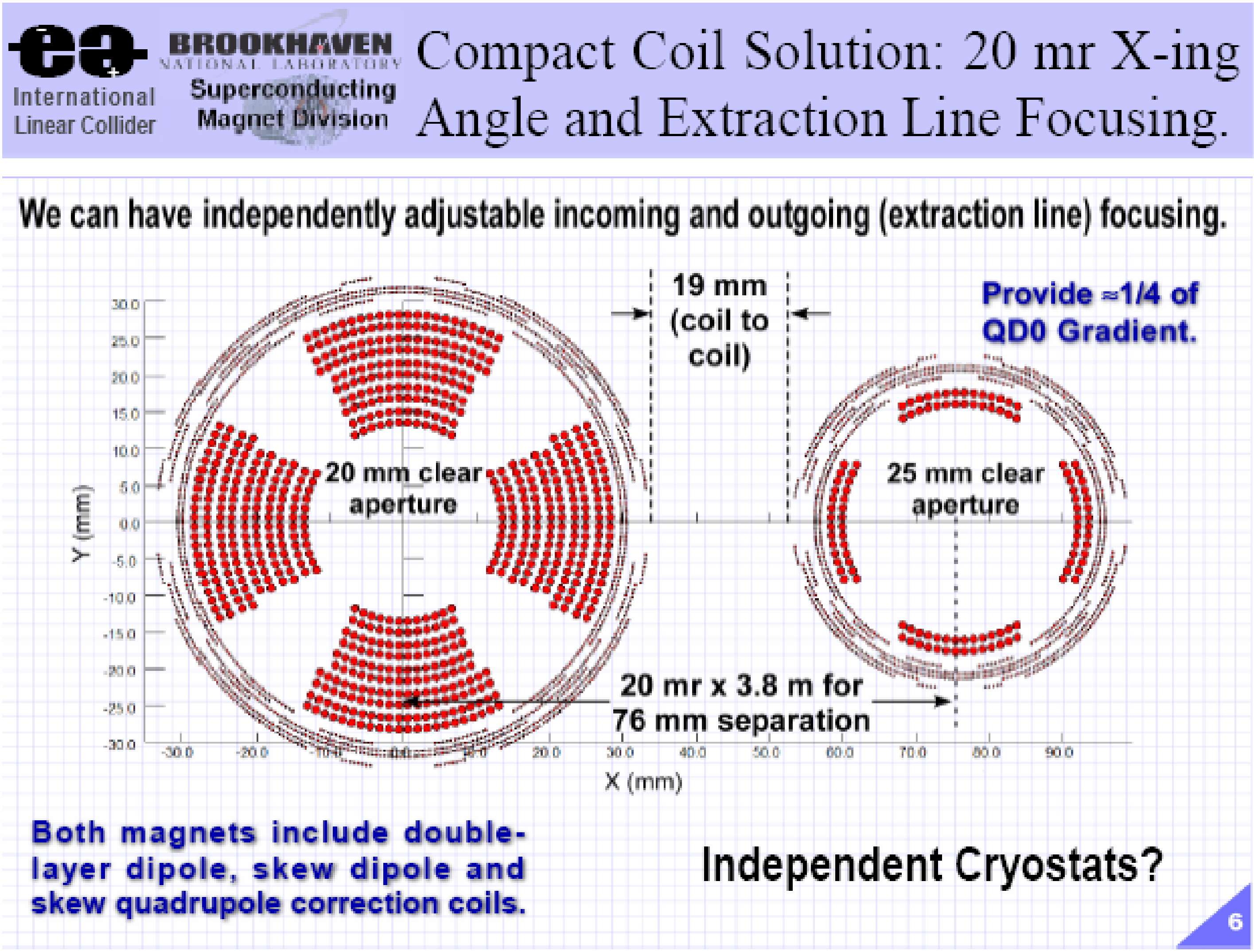
- Demonstrate that we can extract a physics quantity (m_H, m_t) using only experimental observables
- Understand the technical issues in extracting and using the $dL/d\sqrt{s}$ information in a physics analysis
- Expand interest in this subject worldwide
- Better coordinate existing efforts

Caveats

- We should concentrate first on something simple as a learning experience but ensure an outcome
- This can also be used as leverage to improve the global tools for simulation and analysis
- Full-blown "mock data challenge" is not really a good idea at this time

New Improved Compact SC Quad FF Design

B. Parker



ATF Laser-wire Motivation

G. Blair

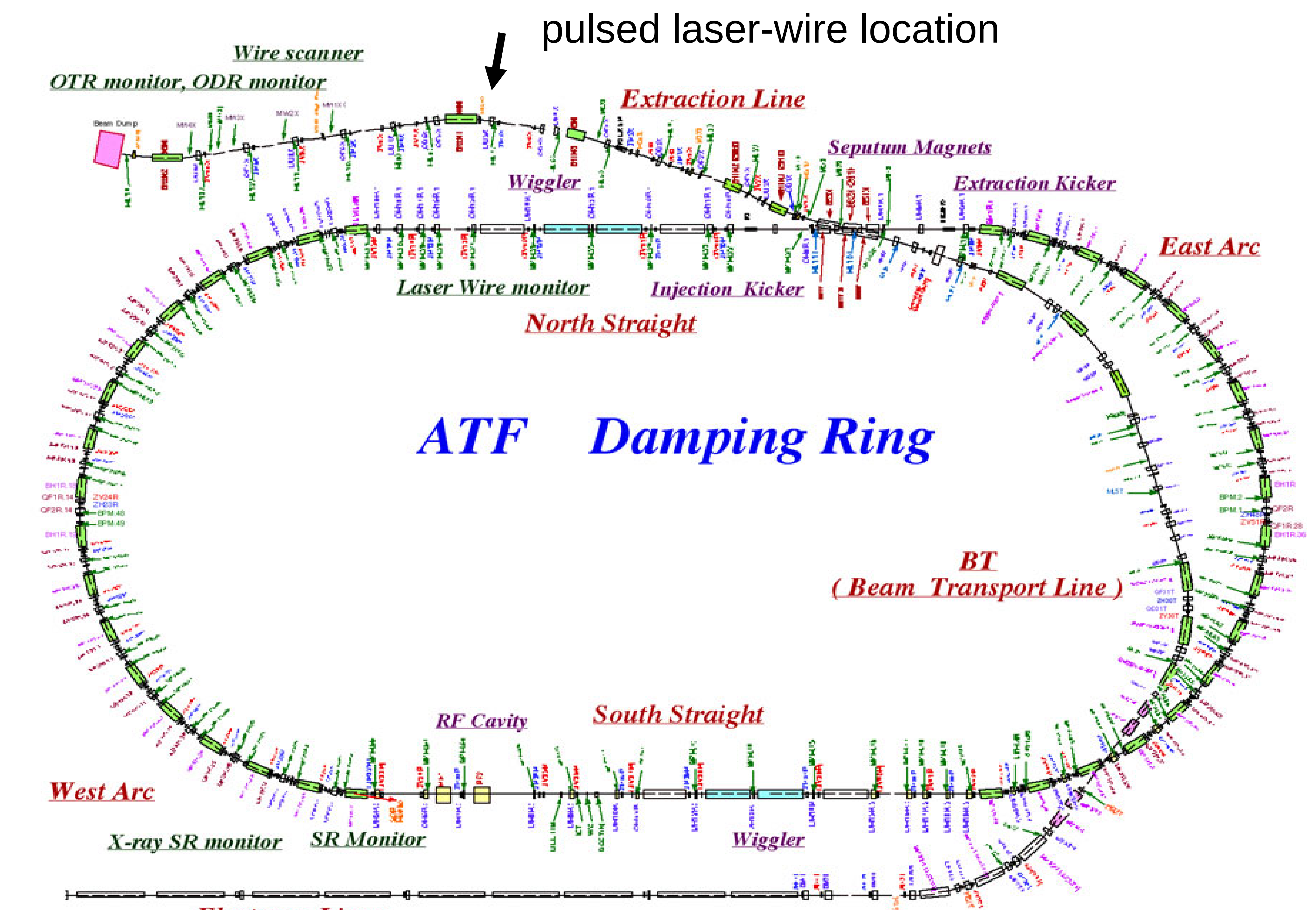
J. Frisch, Nanobeam 2002: For a 1% measurement, laser wavelength is given by:

$$\lambda = \frac{4}{9}\pi \frac{\sigma_y^2}{\sigma_x}$$

So, for the current ILC design, λ should be $<\sim$360 nm (driven by aspect ratio considerations) and laser spotsize $<\sim\sigma_y/3 = 0.6\ \mu m$

At ATF, we will aim to measure 1 micron electron spotsize with green (532 nm) light.
This is *almost* what is required for ILC.

Ideally, increase ILC σ_y to about 3μm, but this means increasing the BDS length by at least 70m – and may have other optics implications.



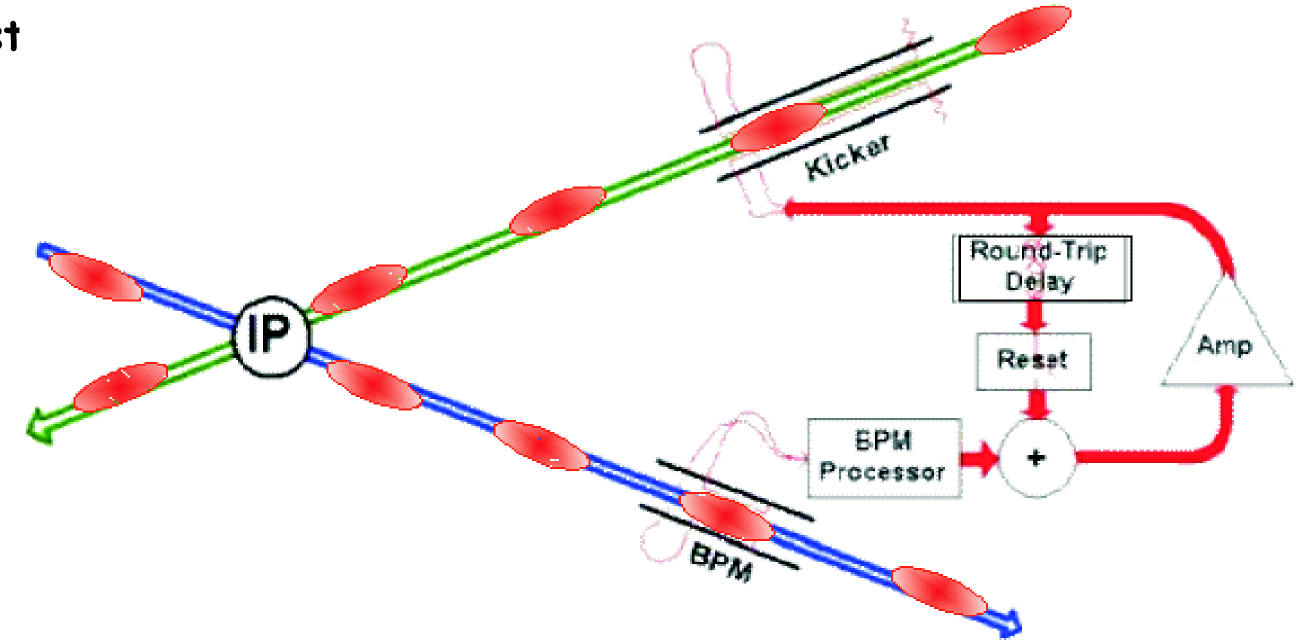
pulsed laser-wire location
Wire scanner
OTR monitor, ODR monitor
Beam Dump
Extraction Line
Septum Magnets
Wiggler
Extraction Kicker
East Arc
Laser Wire monitor
Injection Kicker
North Straight
ATF Damping Ring
BT
(Beam Transport Line)
RF Cavity
South Straight
West Arc
X-ray SR monitor
SR Monitor
Wiggler

Intra-train Beam-based Feedback Concept

P. Burrows

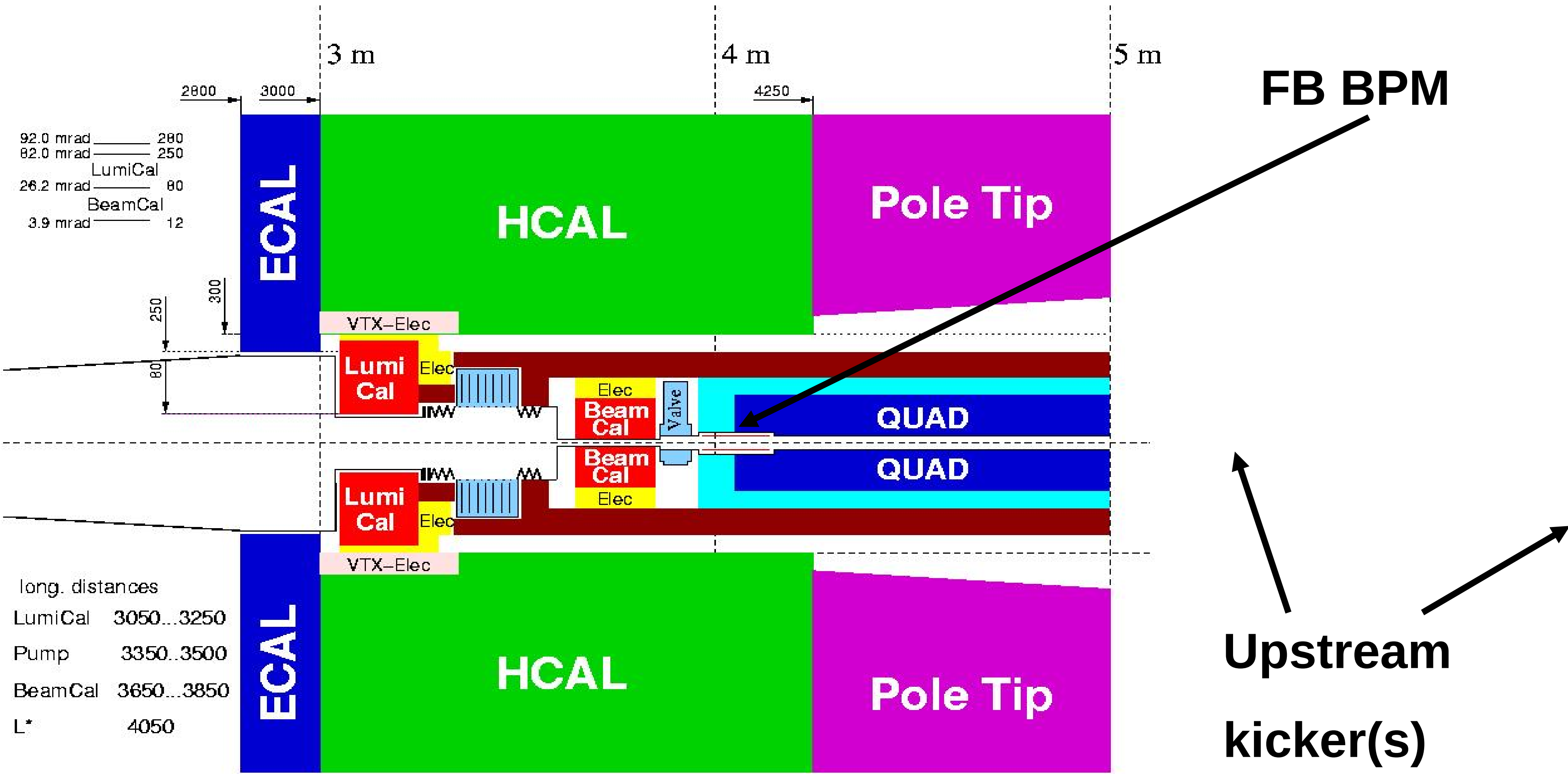
- Intra-train beam feedback is last line of defence against relative beam misalignment

- Key components:
- Beam position monitor (BPM)
- Signal processor
- Fast driver amplifier
- E.M. kicker
- Fast FB circuit

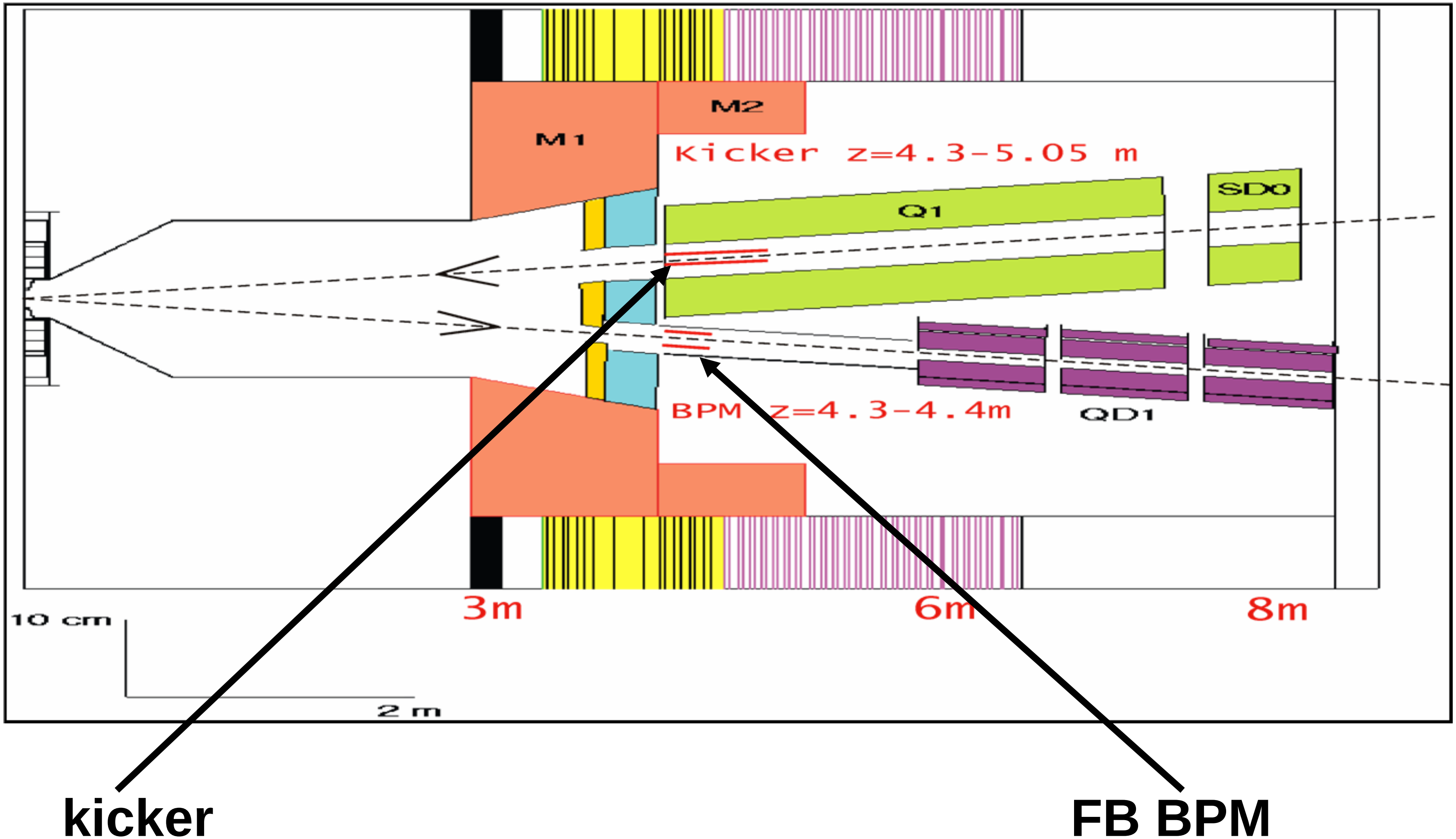


TESLA TDR: principal IR beam-misalignment correction

Zero-degree crossing angle (TESLA TDR)



'Large' crossing angle (NLC)



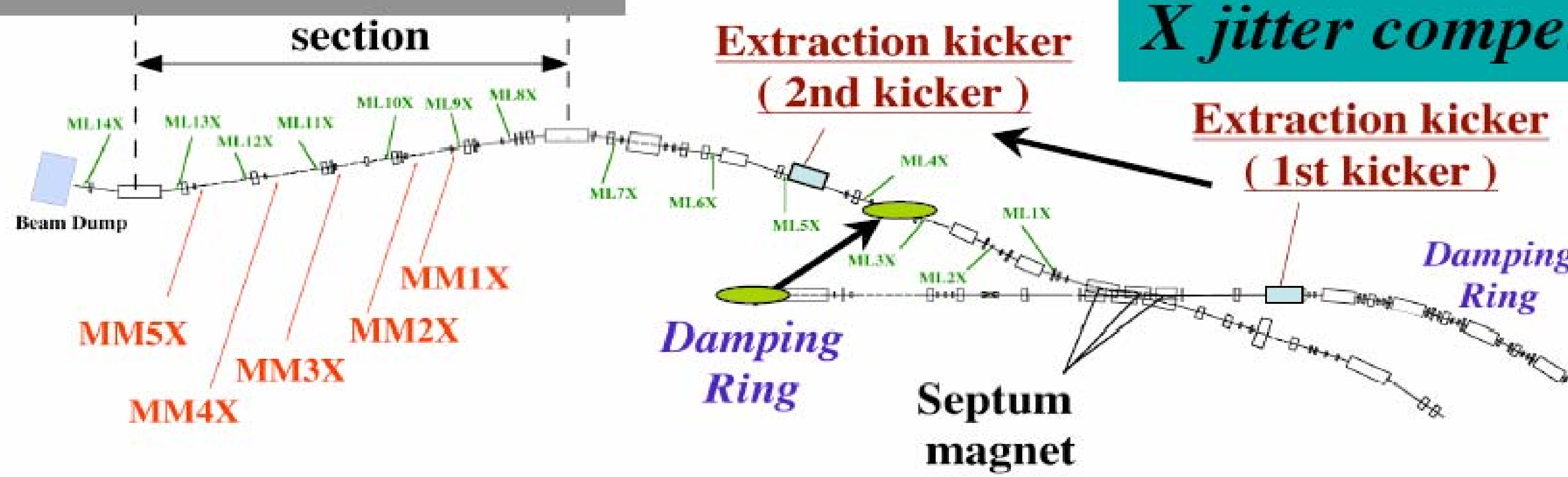
Feed-forward system in y
(useful prototype for ILC?)

Layout of KEK-ATF Extraction Line

Intra-bunch

nm Fast Feedback

Double kicker
X jitter compensation



μm Feedforward
(DR BPM -> EXT Line new stripline kicker)

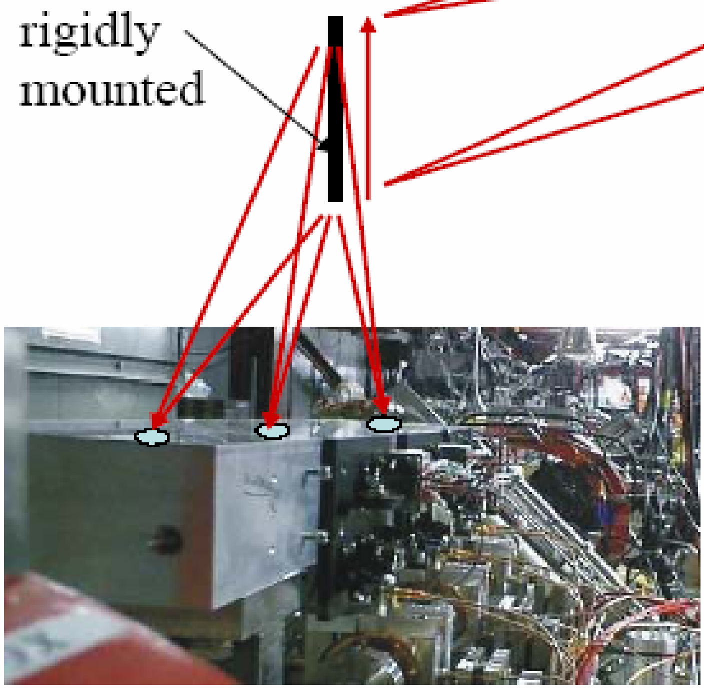
proposed by H. Hayano

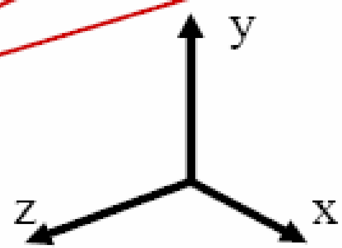
Tauchi

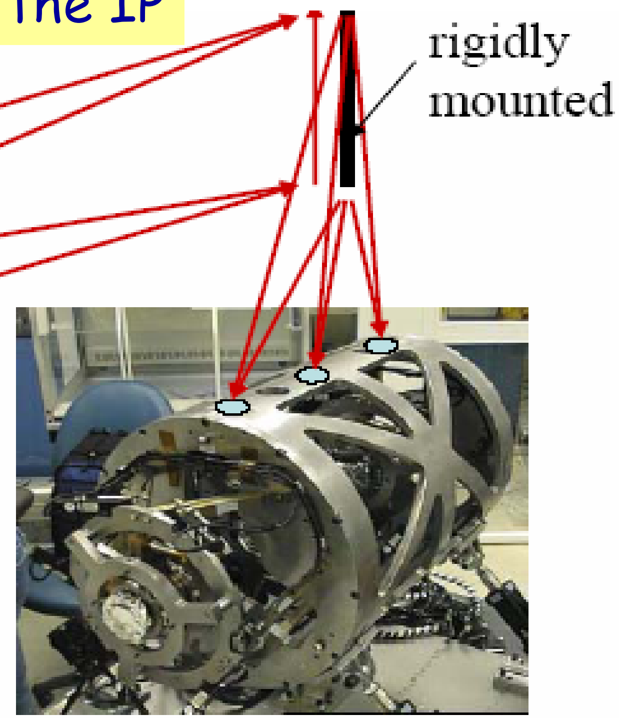
Possible optical anchor scheme (Oxford): simulations in progress

ATF: Lock the two sets of triplets
Test for locking towo final quads on opposite side of the IP

- We are considering two different setups:







<u>Cartoon for Setup 1:</u>
2-dimensional Grid of distance meters (Michelson Interferometers)

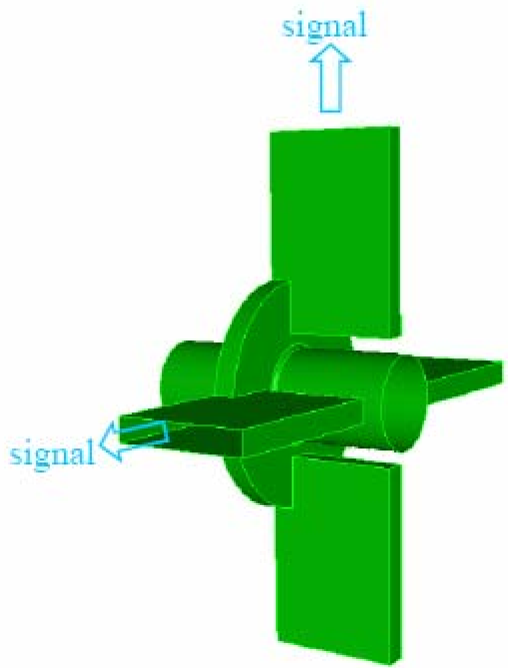
Urner

High Resolution Cavity BPM design

- A resolution of better than 100 nm obtained

Y. Honda

Cavity BPM With TM_{11}-mode Selective Coupler



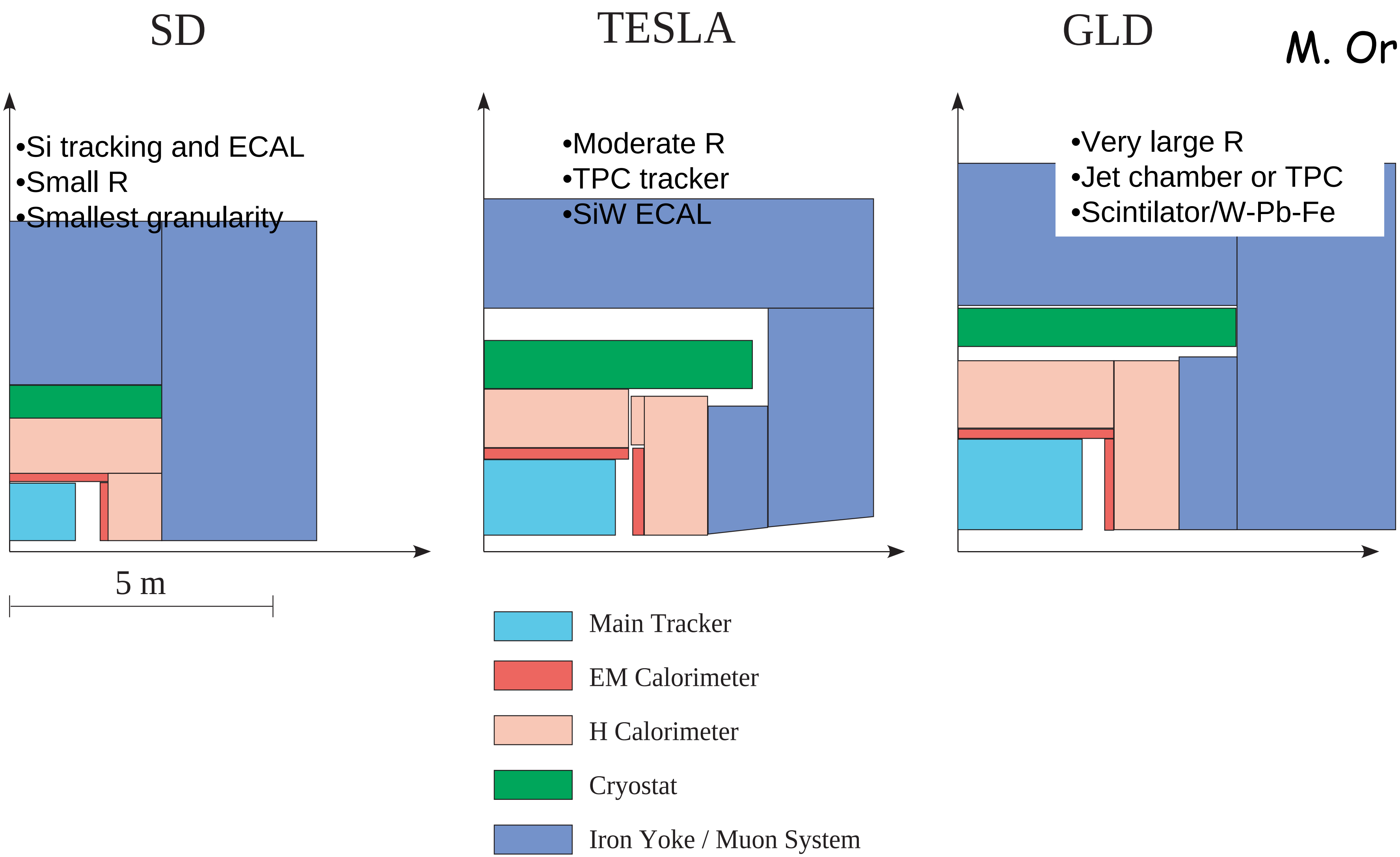
The X-Band Design

- Dipole frequency: 11.424 *GHz*
- Dipole mode: TM_{11}
- Coupling to waveguide: magnetic
- Beam *x*-offset couple to *y* port

- Couple to dipole (TM_{11}) only
- Does not couple to TM_{01}
- May need to damp TM_{01}
  - Low Q with narrow cavity gap
  - OR, use stainless steel to lower *Q*

Detectors:Comparison of 3 Concepts

M. Oreglia



Detectors: Summary of MDI Issues

- Detector designers need input from MDI experts:
  - Minimum VTX radius (smaller than you'd like!)
  - Masking optimization and best model (MC tool) for backgrounds
  - Feasibility of crossing angle options
- Detector designers need MDI experts to appreciate:
  - Need for small on systematic $\langle E \rangle_{lumi}$
  - Need for reduction in low-angle background
  - Need for diagnostic instrumentation
- This talk continues with a description of current designs
  - New tools are causing all to be rethought
  - I've completely neglected the special requirements of a detector optimized for γ–γ or e-γ collisions
    - Even worse low-angle background problems

ILC Parameters & options

Several years of intense physics studies have led to:

ADR

- Baseline ILC
  - Minimum energy of 500 GeV, with int. luminosity of 500 fb^{-1} in the first 4 years
  - Scan energies between from LEP2 till new energy range: 200-500 GeV with a luminosity ~ $\sqrt{s}$. Switch over should be quick (max 10% of data taking time)
  - Beam energy stability should be to less than 0.1%.
  - Electron beam polarization with at least 80%
  - √ Two interaction regions should be planned for
  - Should allow for calibration running at the Z ($\sqrt{s}$ = 90 GeV)
  - Upgrade: Energy upgrade up to ~ 1 TeV with high luminosity should be planned
- Options beyond the baseline: enhance the physics reach
  - √ Running as an e-e- collider
  - √ Running as a $e\gamma$ or $\gamma\gamma$ collider
  - √ Polarization of the positron beam
  - √ Running at Z^0 with a luminosity of several $10^{33} cm^{-2} s^{-1}$ (GigaZ)
  - √ Running at WW mass threshold with a luminosity of a few times $10^{33} cm^{-2} s^{-1}$
  - √ (not in the document) Extendability to multi-TeV??

The Photon Collider Option

Summary letter sent to the ISCLC in July 04, after LCWS04

Special requirements for a Photon Collider at the ILC

- Crossing angle between the beams should be O(25-30mrad), for the removal of the disrupted beams, (angle > disruption + R_{quad}/L ~0.01+6/400 ~ 0.025)
- Product of horizontal and vertical emittance should be as small as possible to allow for high $\gamma\gamma$ luminosity
- Final focus: as small as possible spot size at IR (reduce horizontal β function by order of magnitude compared to e+e-)
- Beam dump: cannot deflect photon beam $\rightarrow$ narrow photon beam in a straight line from the IR
- Modified detector in the region $\theta <$ 100 mrad, including the vacuum pipe and vertex detector
- Space needed for laser beam lines and housing

Proposal of the PC study contact persons and workgroup convenors

- Design the 2nd IR optimized for a PC, but keep full compatibility of the FFS to allow to run also in e+e- mode (horizontal β function).
- Detector to be designed to operate in both modes, with easy transition

Multi-TeV collider

- CLIC two beam acceleration presently thought to be only feasible way to multi-TeV region ⇒ CTF3 under construction/operation at CERN
- MDI related issues to keep in mind if one plans for a facility that should be upgradable to a multi-TeV collider in future
  - crossing angle needed of ~20 mrad (multi-bunch kink stability; see tomorrow)
  - Present desing: Long collimator syst. (2 km on each side) and final focus (0.5 km)
  - Energy collimators most important.
    Fast kicker solution not applicable. Maybe rotating collimators …
  - Gentle bending to reduce SR & beam spot growth→ construct the linacs already under an angle of ~ 20 mrad
  - Internal geometry differences of the collimation system and final focus, allow for enough space in the tunnels (O(m))

Summary of Polarimetry WG

Polarimetry

- 3 ways to measure polarisation: upstream, downstream, data
- issues to understand:
  - difference of incoming, outgoing and luminosity weighted polarisation
  - correlations between electron and positron polarisation
  - polarimeter corrections for data methods
- more concrete questions:
  - is downstream polarimetry with 2 mrad crossing angle possible?
  - if no, is upstream polarimetry enough?
  - can we believe CAIN for depolarisation?
  - do we understand the polarisation transport well enough?
  - backgrounds
  - light sources for different polarimeters (backgrounds, correlations)
  - switching between IRs, how, how often?
  - real designs
  - common issues with beam energy/lumi spectrum: correlations between beams, momentum-polarisation correlations

Summary - Forward Instrumentation

$L^* = 4m$

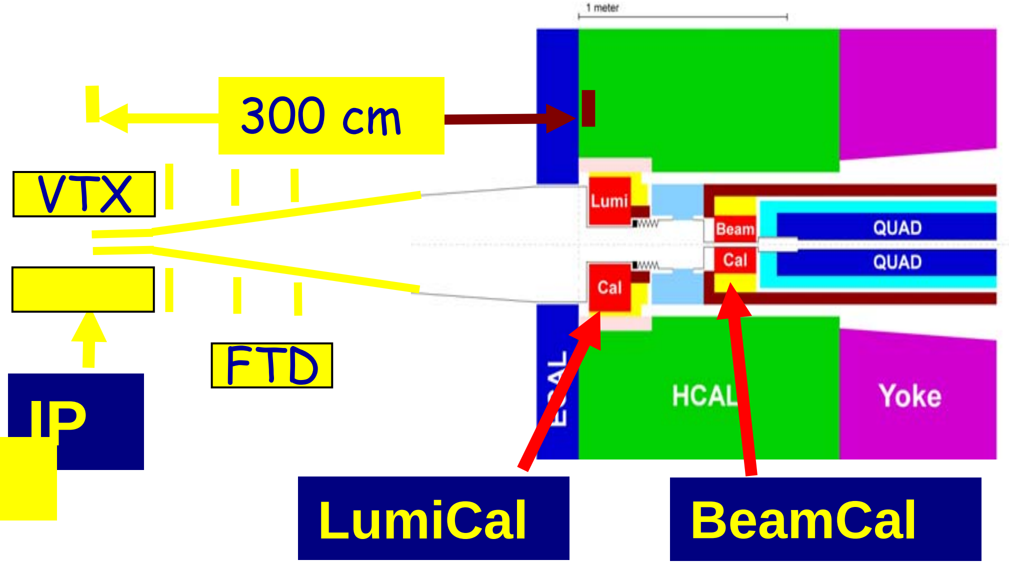
High precision Lumi measurement

Physics wishes

$$\Delta\mathcal{L}/\mathcal{L} \sim 2 \cdot 10^{-4}$$

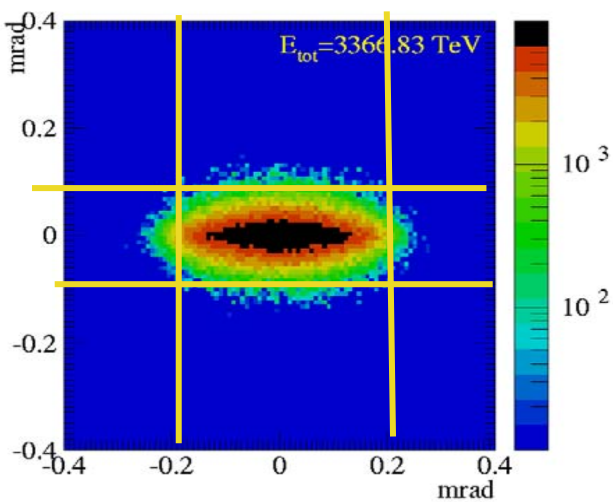
$$\frac{\Delta L}{L} = \frac{2 * \Delta\theta}{\theta_{min}}$$

Bias in θ!

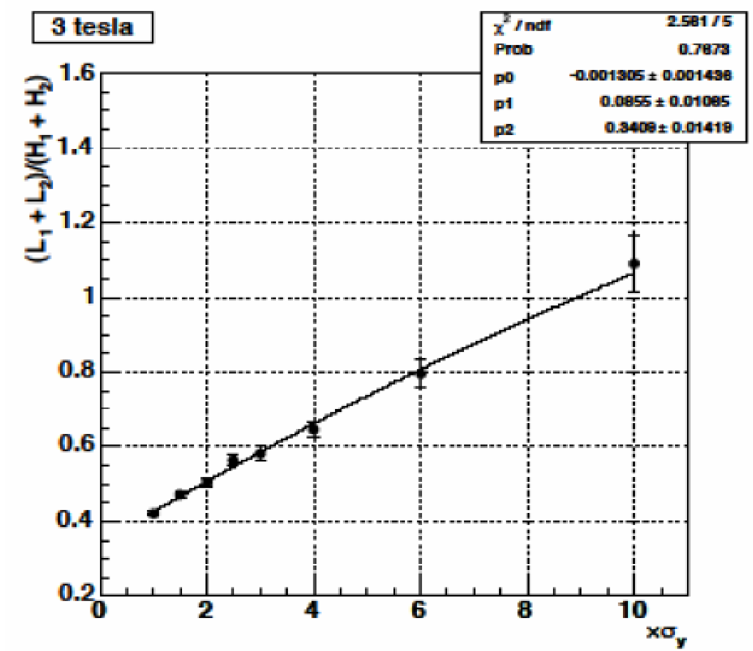


precision hardware → needs space

Beam diagnostics



Large potential!
More mutual understanding needed



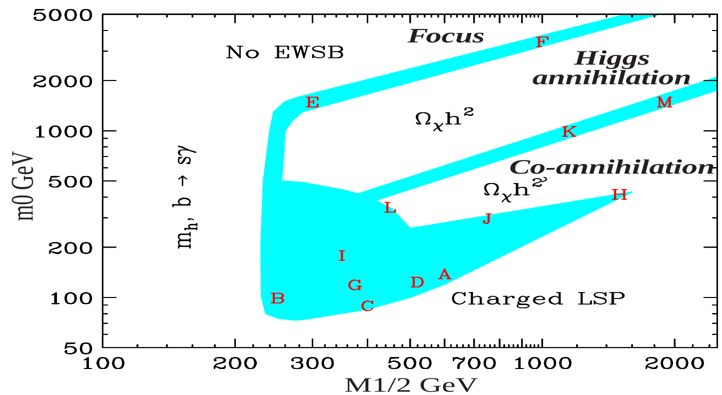
Goal: Complex diagnostics system

Dark Matter ↔ SUSY ↔ LHC + LC

WMAP cosmic microwave background radiation measurement lead to :

$\Omega_{\text{total matter}}\,h^2 = 0.134 \pm 0.006$ and $\Omega_{\text{baryon}}\,h^2 = 0.023 \pm 0.001$ PDG July 2004

→ mSUGRA with WMAP constraint $0.094 < \Omega_{DM}\,h^2 < 0.129$ (2 sigma)



M. Battaglia et al. Eur.Phys.J.C33:273-296,2004

Model	A'	B'	C'	D'	E'	F'	G'	H'	I'	J'	K'	L'	M'
M1/2	600	250	400	525	300	1000	375	935	350	750	1300	450	1840
m0	107	57	80	101	1532	3440	113	244	181	299	1001	303	1125
$\tan\beta$	5	10	10	10	10	10	20	20	35	35	46	47	51
μ	773	339	519	−663	217	606	485	1092	452	891	−1420	563	1940
$m\chi$	242	95	158	212	112	421	148	388	138	309	554	181	794
me_R, μ_R	251	117	174	224	1534	3454	185	426	227	410	1109	348	1312
$m\tau_1$	249	109	167	217	1521	3427	157	391	150	312	896	194	796
$\tau_1 - \chi$	7	14	9	5	1409	3006	9	3	12	3	342	13	2
$\Omega_{DM}h^2$	0.09	0.12	0.12	0.09	0.33	2.56	0.12	0.16	0.12	0.08	0.12	0.11	0.27

→ for quasi mass-degenerate neutralino (χ) and slepton (τ), both χχ and χτ (co-)annihilations combine to regulate the amount of relic DM

→ $N(\tau) / N(\chi) \sim \exp(-20\Delta m/m) \sim 1 \Rightarrow \Delta m < 10$ GeV and $m < 400$ GeV

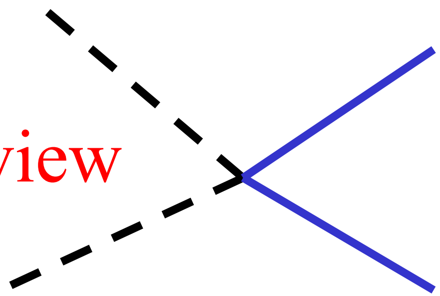
→ attractive mechanisms also beyond mSUGRA D.Hooper et al. Phys.Lett.B562(2003)18

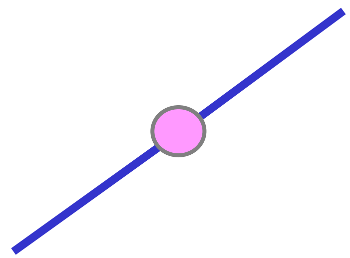
Detection of $\tilde{l} = \tilde{\mu},\tilde{\tau}$ sleptons for small Δm

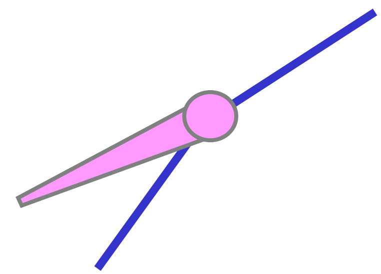
P.B. et al. hep-ph/0406010

signal	major background : $\gamma\gamma$
$ee \rightarrow l\,\chi^0\,l\,\chi^0$	$ee \rightarrow (e)(e)\,l\,l$
$\sigma \sim 10$ fb	$\sigma \sim 10^6$ fb

Transverse view







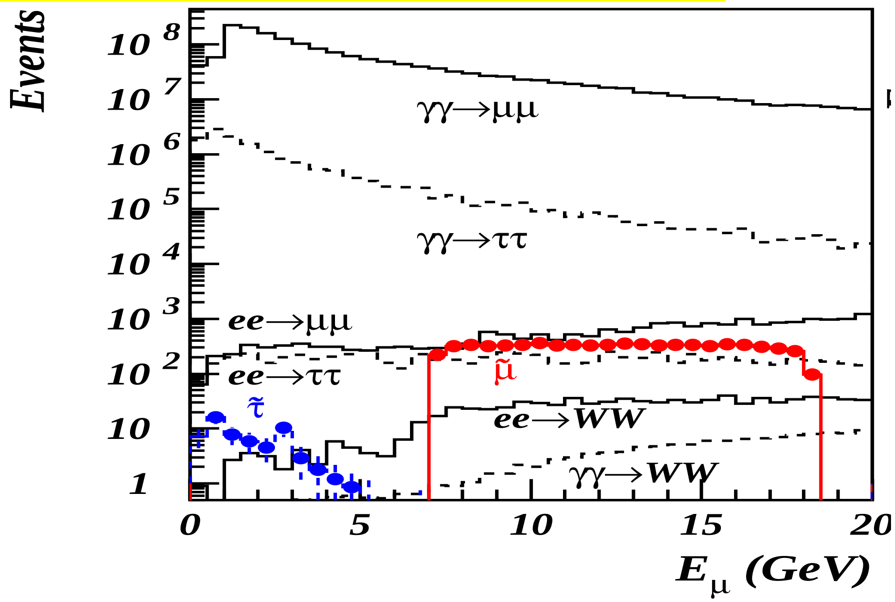
Near threshold $E_l \simeq \gamma\,(1 \pm \beta)\,(m_{\tilde{l}}^2 - m_{\tilde{\chi}}^2)\,/\,2\,m_{\tilde{l}} \sim \Delta m\,\gamma\,(1 \pm \beta)$

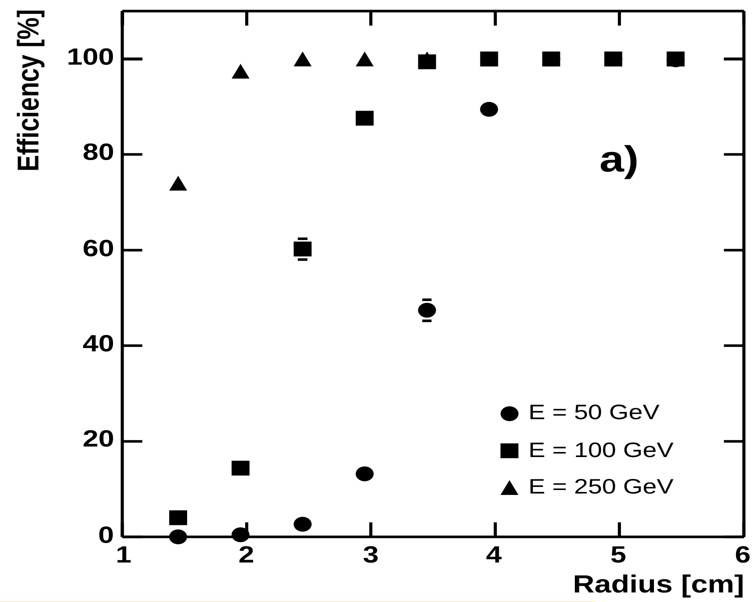
$\gamma\gamma$ background $\rightarrow$ must tag spectator electron (e.g. for Δm=5 Gev):

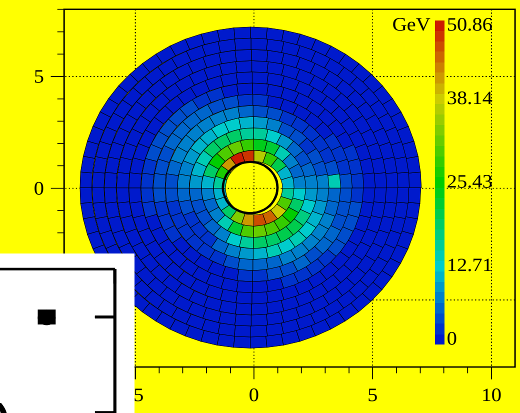
$\theta \sim \Delta m\,\gamma\,(1 - \beta)\,/\,E_{beam} \times$ factor $\sim$ 5-10 mrad (factor = 1 < 1 for μ τ)

Summary - Forward Instrumentation

Hermeticity – electron and photon detection



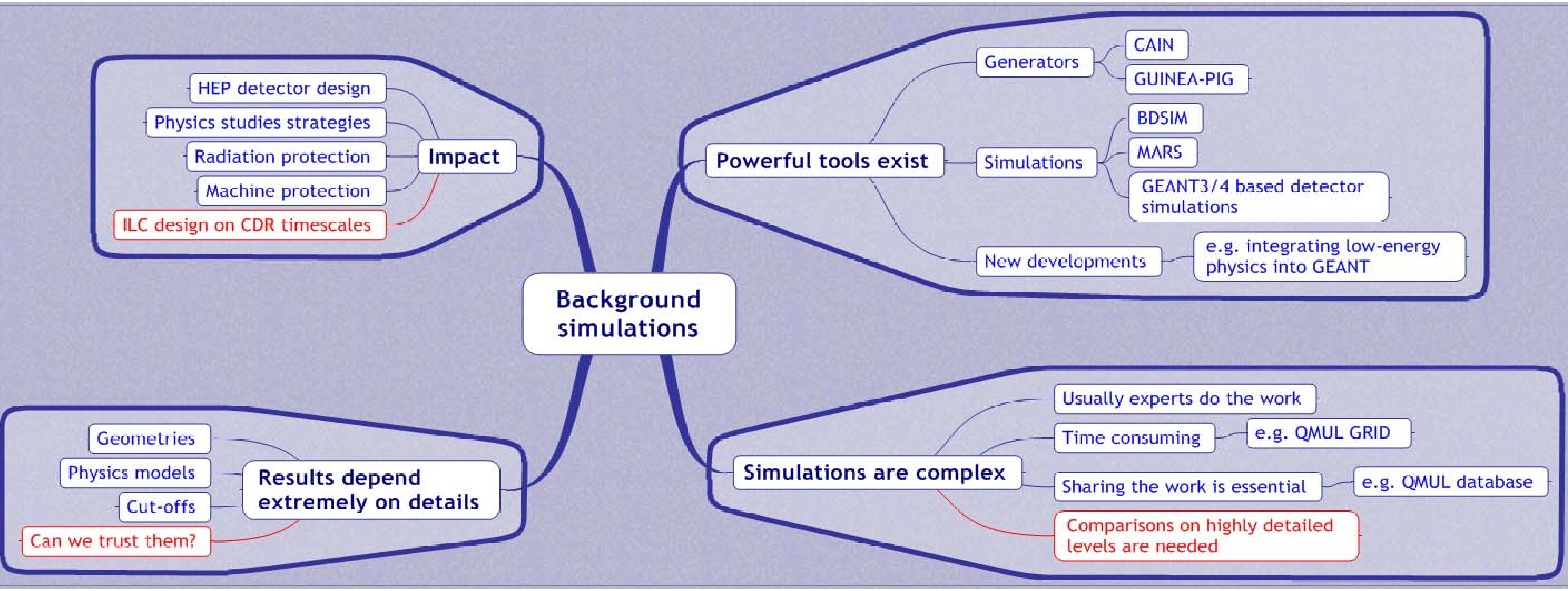




First steps towards sensor tests, alignment control

Completing the design studies (more realistic, backgrounds, x-angles,..)
Integration of these (or similar) detectors into the ILC detector(s)
Engineering design (technology choices)
Sensor tests
Testbeam studies with prototypes
Close interaction with machine designers (use for diagnostics, detector space)

Background WG: The MindMap



Biggest problem: the parameter space is infinite!

- Beam parameters
- Detector concepts
- Geometries
- etc.

Background WG:How to proceed

- Install an international backgrounds working group
  - Work together in comparing our results
  - Try to get estimates for uncertainties
  - Identify open tasks (e.g. beam-gas backgrounds)
  - Assign names
- Try to set up tutorial sessions for the BDIR workshop and Snowmass to teach interested people in how to do background simulations for their specific needs
  - Experts will still provide expertise
  - Users can work out their special needs, e.g. special detector geometries, etc.

Beam RF Effects Summary

Significant impact on:

- RF shielding for beamline and detector components
- Detector design
- Signal Processing and DAQ architecture

Beam rf effects have had a significant effect at previous colliders:

ex. SLC, PEP-II, HERA, UA1

beampipe heating and EMI from HOMs

Detector physicists MUST study this seriously together with the accelerator experts

Beam Test at SLAC ESA to further investigate this is proceeding:

- with SLD's VXD3 and with simpler beampipe
- strong desire for this from international vertex community
- can provide important information for VXD design and for signal processing/DAQ for all LC Detector systems

Working group participants: M. Woods, C. Hast, N. Sinev, R. Arnold, S. Worm, S. Smith, D. Cussans, Y. Sugimoto, T. Nelson, S. Parker, …

IR Layout, crossing angles: Work plan

- Lumi performance of two IRs (to LCWS) of the strawman
- 2mrad extraction design continue
  - communicate (phone; by weekly, first in two weeks)
  - viable IR magnets (incoming+ extraction)
    - use most resent BP's dual SC quad or new PM or other
  - common criteria on losses in different places
- 20mrad extraction redesign with most recent super-fluid dual SC quads
- All the optics available to all the group
- Beam dumps (1TeV)
  - People: P.Bambade/K.Buesser; Ban (KEK); N.Nakao,D.Walz (SLAC)
  - technology choice for beam dumps
- gg- option: create IR layout with latest BP's compact quad with 20 mrad;
  - may use DID optimal for disrupted beam, not incoming beam
- Diagnostics optimization
  - Laser wire locations; Shintake mon. upstream?, with BDS tuning
- Crab cavity location optimization and RF design
- Layouts of BDIR (with all details eg. beam dumps) & civil eng.
- Feedback optimization (location, +horizontal, +background)
- E-spectrometer into BDS; post linac extraction; BDS optics repository
- Further work on ATF2 project
- Energy deposition studies
- Collimation performance and optimization
- Test beam preparations (ESA)

Energy & Lumi-spectrum session summary

- Interested people
  - Machine/Particle/Diagnostics
- Important issues
  - Beam line diagnostics
    - Straw-man design (upstream/downstream energy spectrometers)
      - use and impact on physics results
      - **Required** beam tests
    - BPM Specification/requirements
      - eg 100 nm, single bunch resolution, systematic effects (ESA/ATF)
    - Linac energy spread (are there designs for a dedicated diagnostic)
    - E-z correlation diagnostics (is it needed)
  - Physics analysis
    - Bhabha acolinearity is not enough
    - Require other physics processes ZZ, Zγ, etc
    - Realistic beam simulation (Lumi-spec/energy Monte Carlo “challenge”)
    - Common frame work
  - ECM Bias
    - Beam collision dynamics simulations, how well can this be done
    - Radiative returns can monitor
- Overlap with polarization
    - Correlations between beams
    - Common extraction line design in BDSIM (SR spec/Polarimeter)

Timeline

E. Torrence

1st ILC Meeting	MDI Workshop	LCWS	BDIR Workshop	Snowmass

You Are Here ↑

- LCWS - 18-22 March, Stanford
- BDIR Workshop (WG4) - 20-23 June, RHUL
- Snowmass - 13-27 August, Colorado

"CDR" by end of the year?
We must be ready for that possibility

Goals from Snowmass

- Conceptual design largely complete
- Matrix of parameters and relative merits/impacts filled in
- Identify (few) remaining questions to answer by end of 2005
- Tie up loose ends before CDR

In Conclusion:
Good progress toward conceptual design

MDI needs to maintain good communication as designs (machine and detector) become more concrete

Lets get back to work…