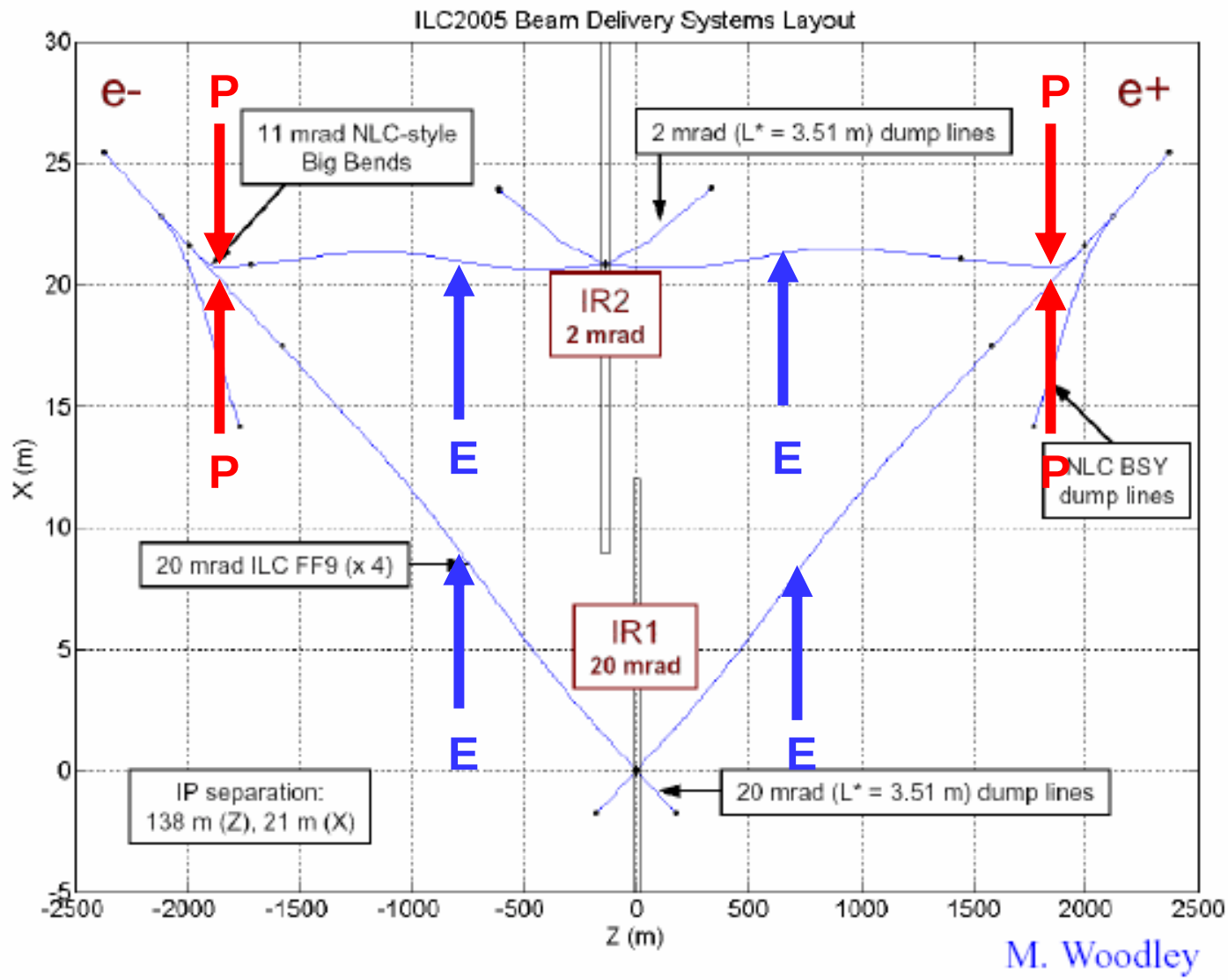
International Linear Collider
at Stanford Linear Accelerator Center

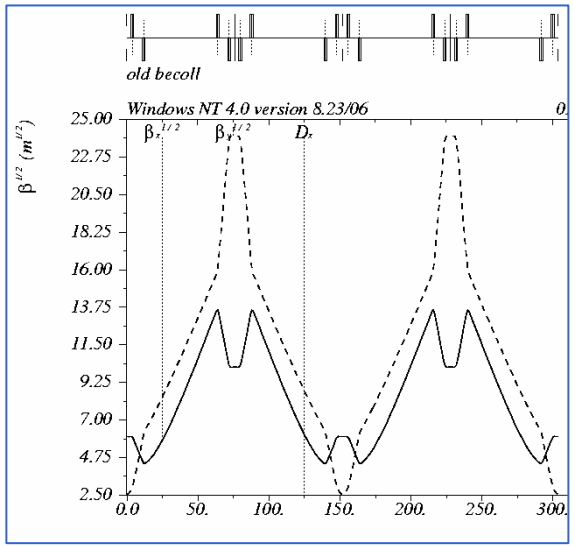
LCWS '05
Machine Detector Interface
Design Updates

Tom Markiewicz
SLAC
22 March 2005

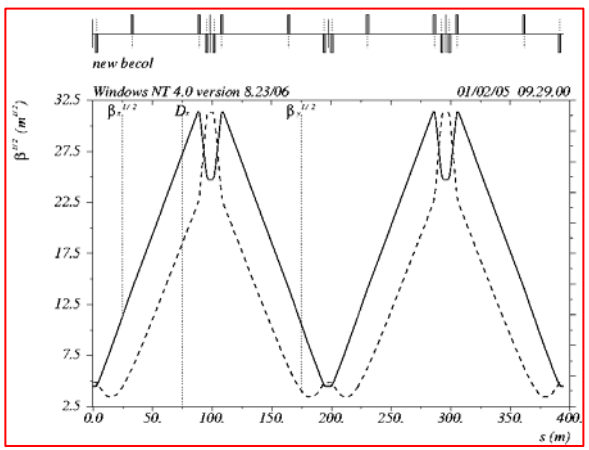
ILC WG4 "Strawman" Layout of BDS with 20 mrad and 2 mrad IRs logically complete



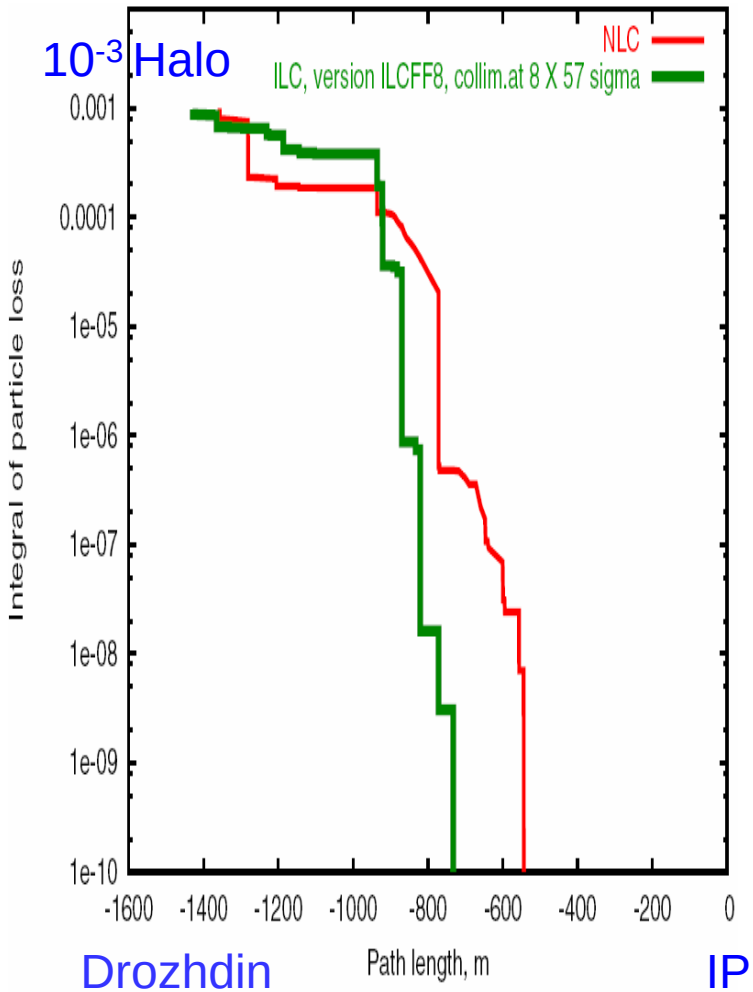
Warm LC Collimation System Design Updated to Profit from Cold Bunch Structure: Expand Beam Size at Spoilers to Make them "Indestructible"



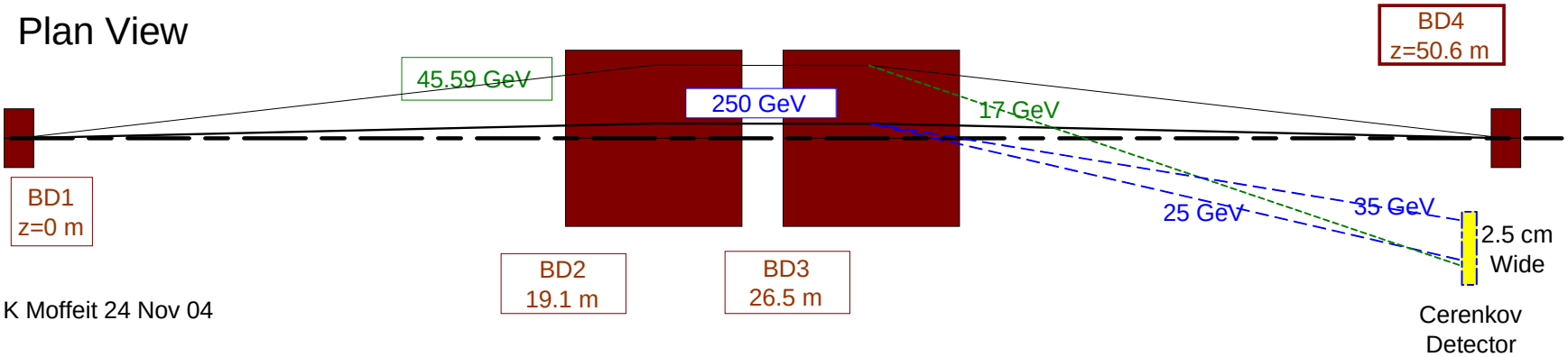
ITRP NLC Betatron Collimation Lattice optimized for consumable spoilers:
At max $\beta_x^*\beta_y$=6E4 m^2



ILC Lattice (FF9): At max $\beta_x^*\beta_y$=6E5 m^2 suitable for passive survival spoilers

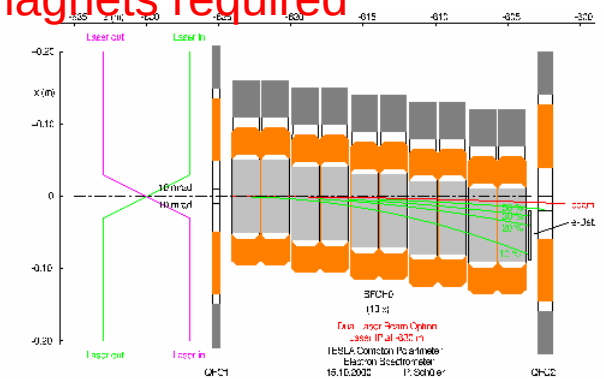


Pre-IP Chicane-based Polarimeter

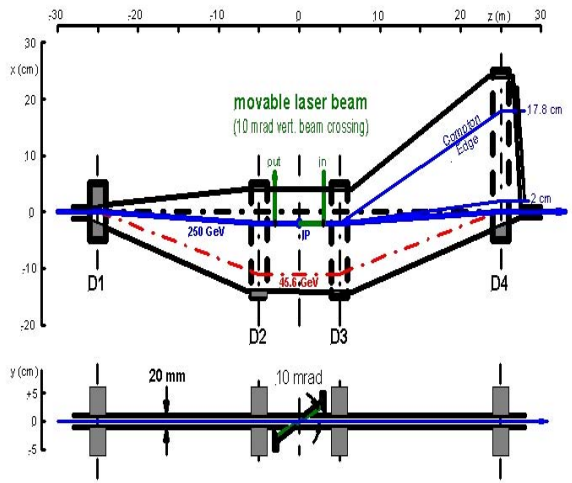


- Requires ~50 meters length
- Same B-field at Z-pole, 250 GeV and 500 GeV running
- Same magnet design as for upstream energy chicane
- Good acceptance of Compton Spectrum at all energies without changing laser wavelength

Upgrade to TESLA Design:
Minimal space and no special magnets required

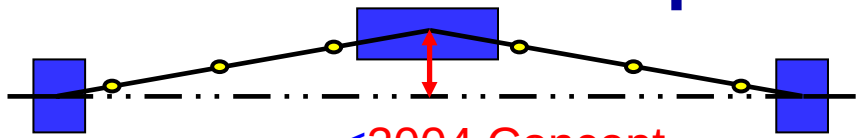


Model studies based innovative moveable laser beam, detailed vacuum chamber & detector design ongoing (Meyners)

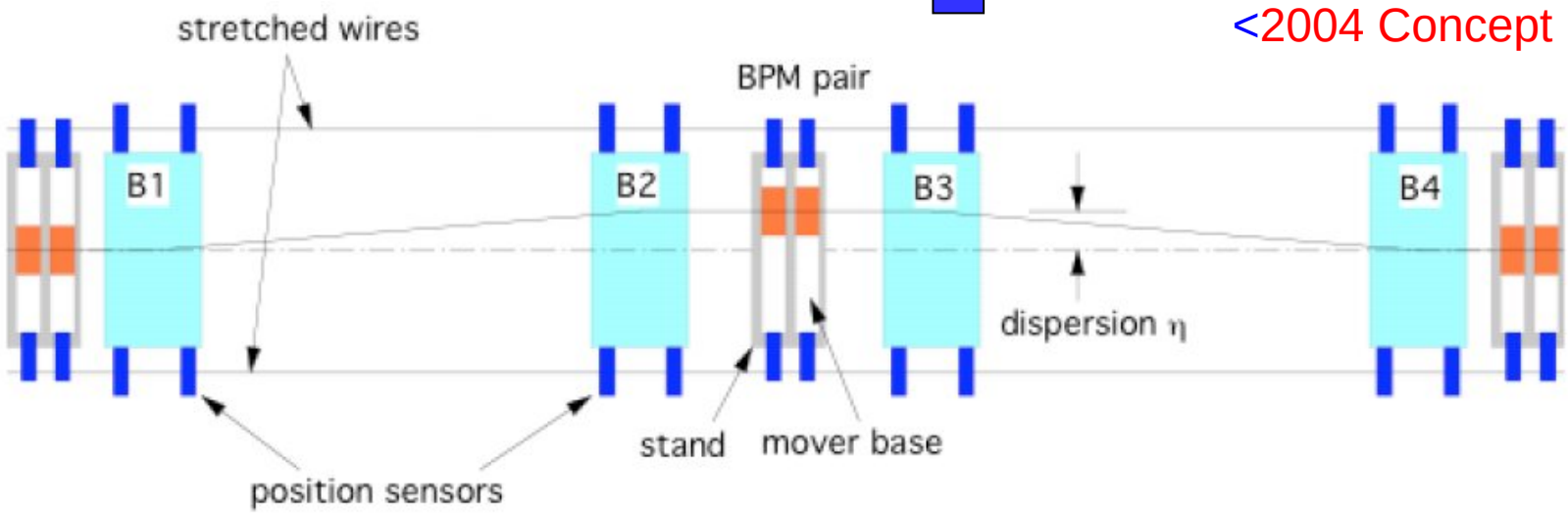


Pre-IP Energy Spectrometer Developed

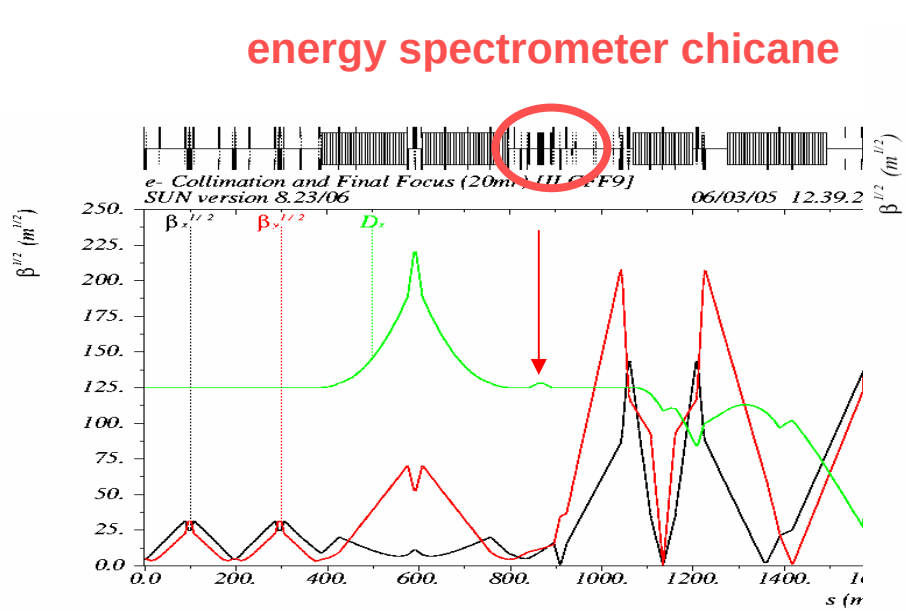
Hildreth

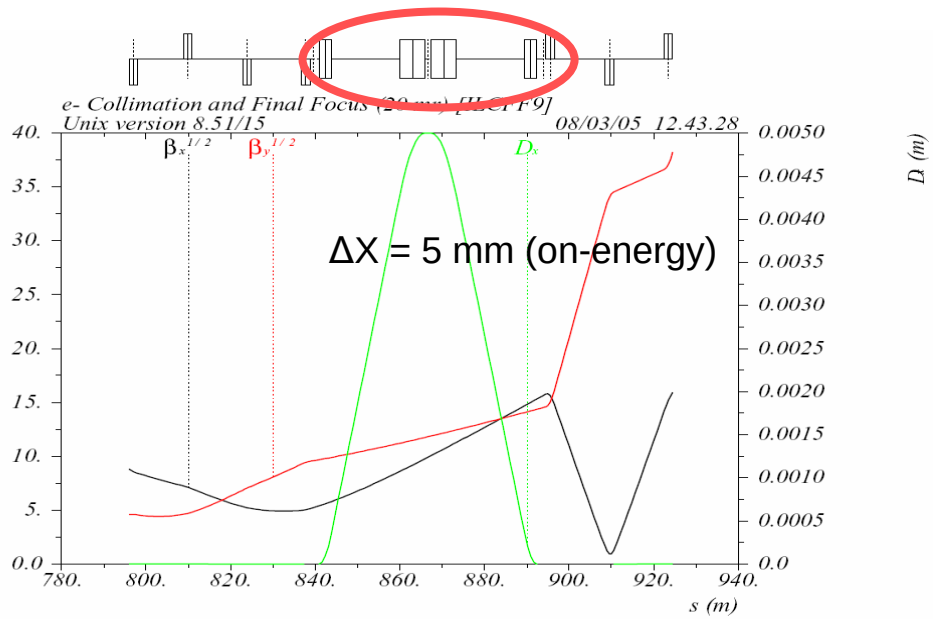


<2004 Concept



energy spectrometer chicane

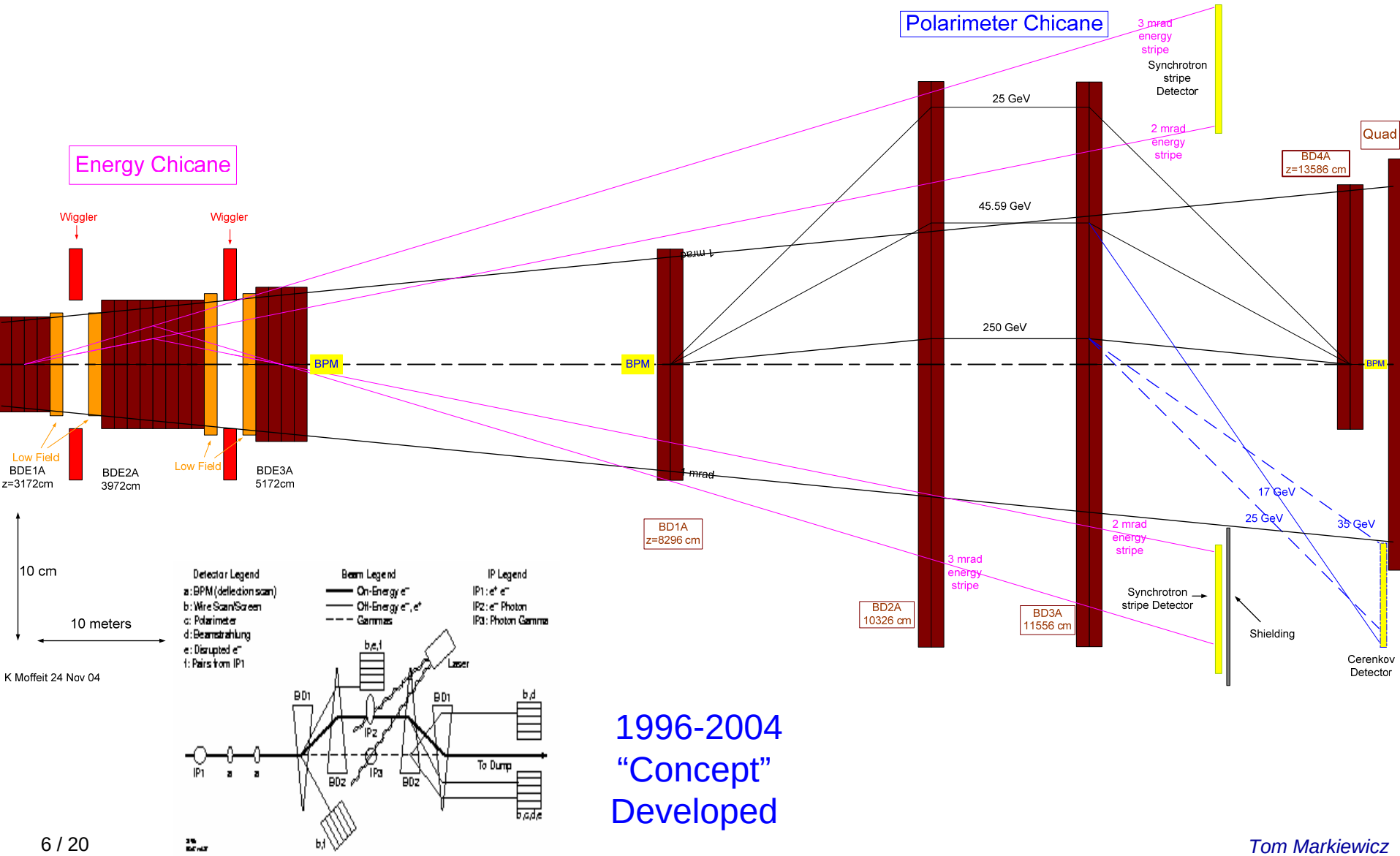




International Linear Collider at Stanford Linear Accelerator Center

Detailed Layout of Energy & Polarimeter Chicanes in 20mrad Extraction Line

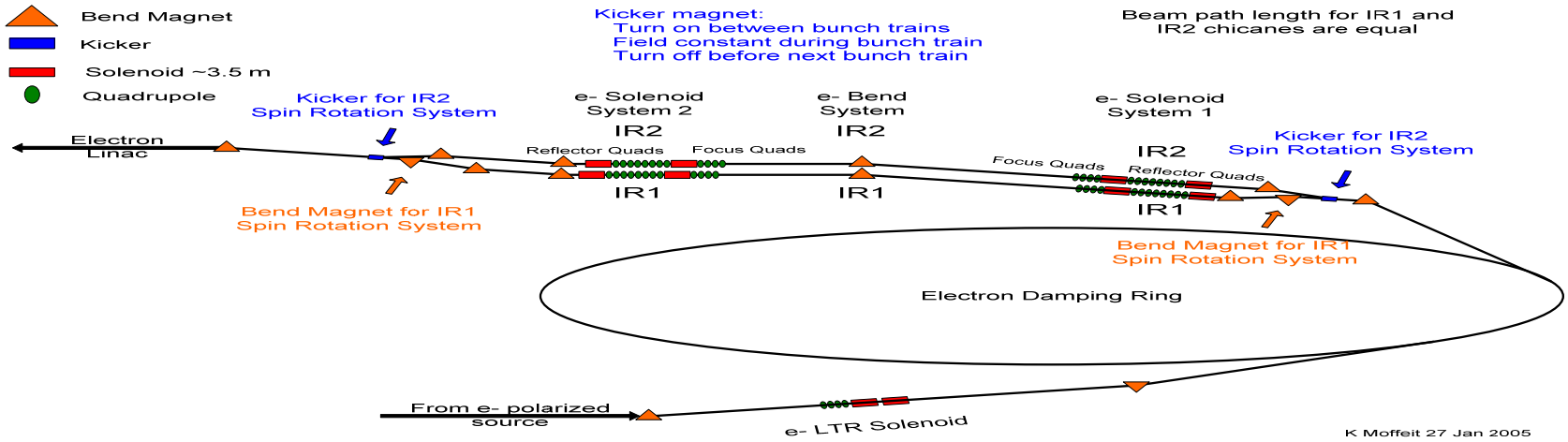
Moffeit

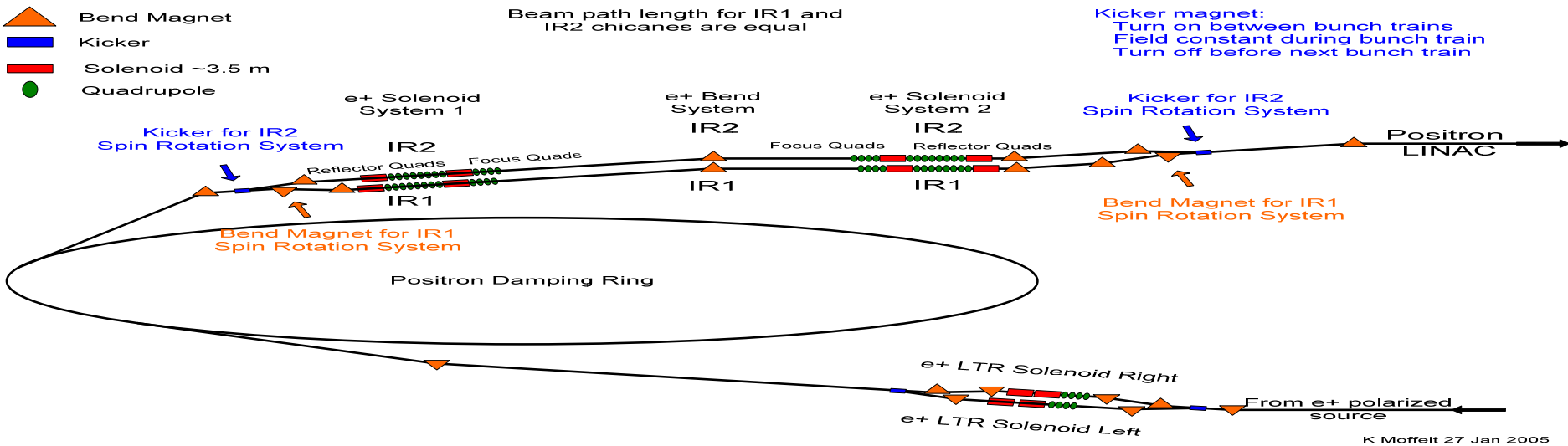


1996-2004
"Concept"
Developed

Electron/Positron Spin Rotation for 2-IRs

Moffeit

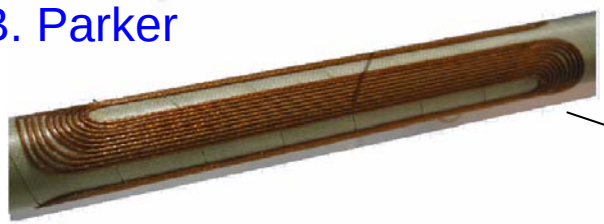


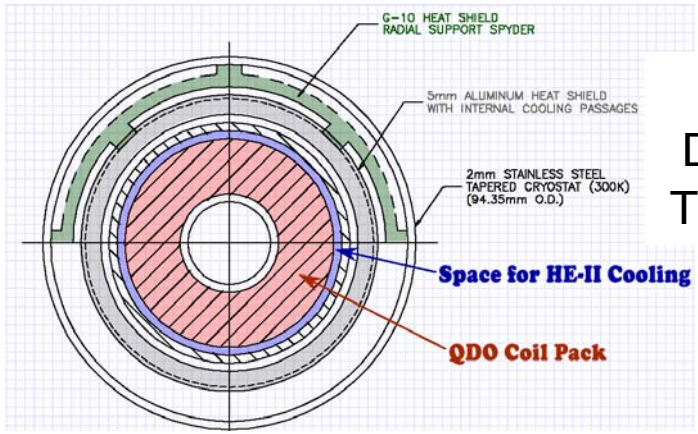


Final Doublet Magnet Design

Successful tests of winding **7-wire cable at 10mm radius** beampipe &
Use of SF **(1.9°K) He-II**
Lead to **MORE COMPACT COIL CONFIGURATIONS** and
open up **NEW design options**

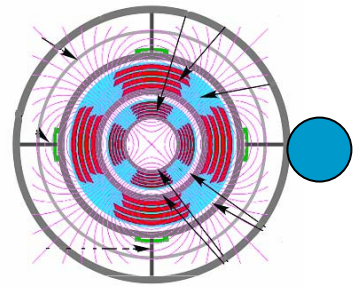
B. Parker

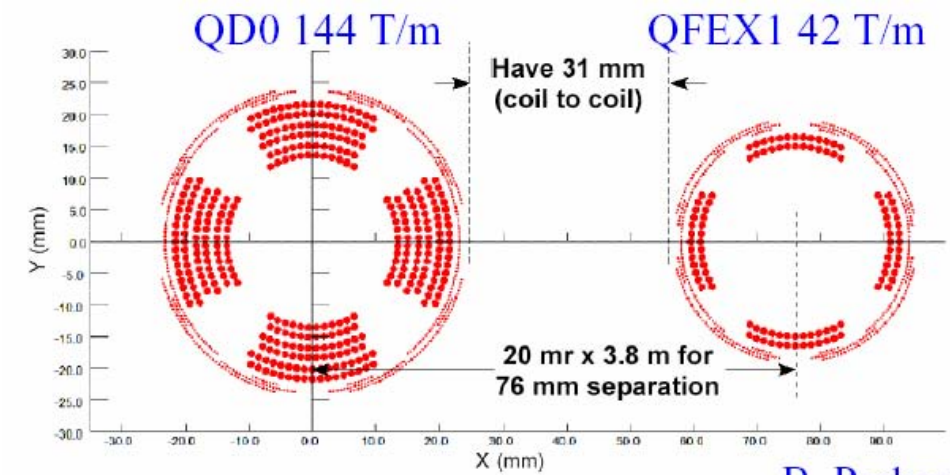




Ultra-Compact Design w/ Radial Taper in 3 z-steps

2004 SC QD0 Design
Single-strand at r=10mm
7-strand at r=20mm

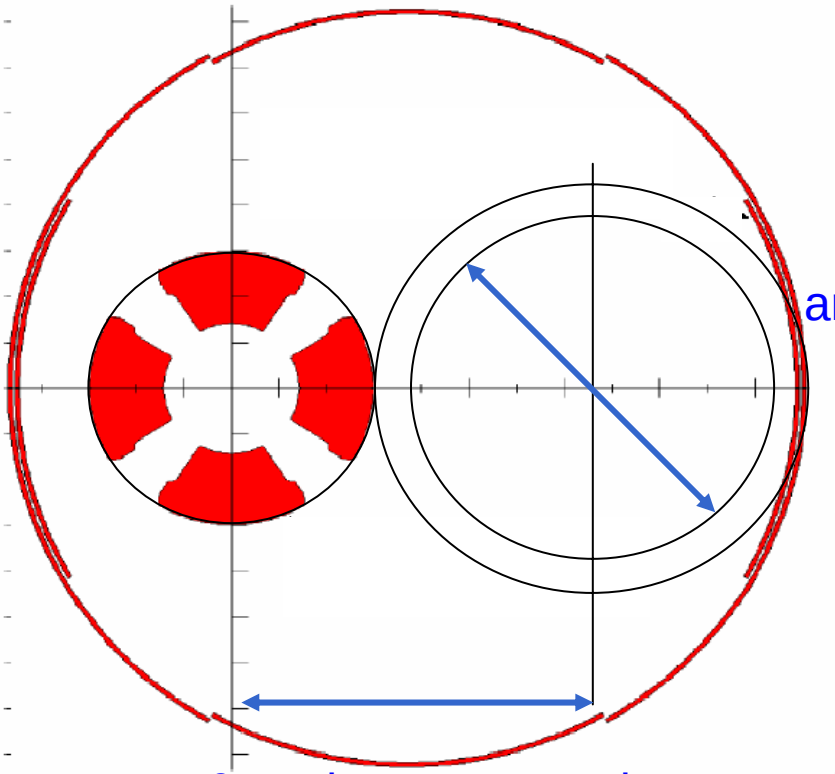




New 20 mrad X-ang design has QD0 AND 1st Extraction Quad at same L* in separate cryostats

γγ accommodated within 20 mrad

B. Parker

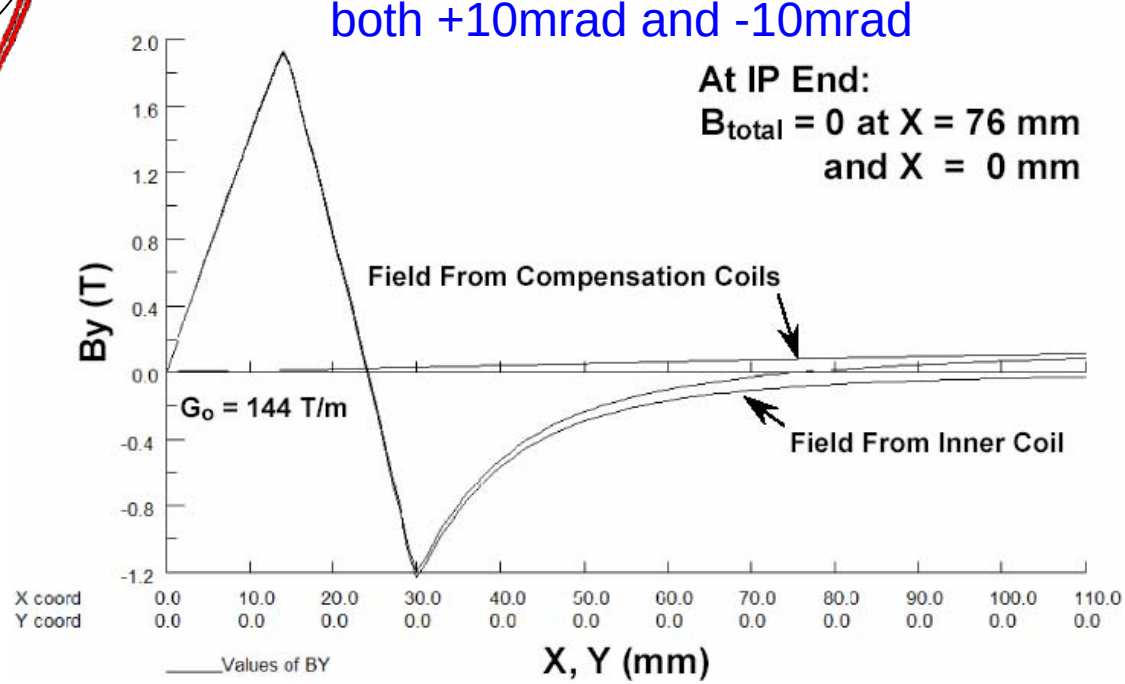


76mm beam separation
at 20 mrad

Straw-Man Configuration
Discussions on Merits/Risks of
25mrad continue

76mm = ±10mrad
around extraction line

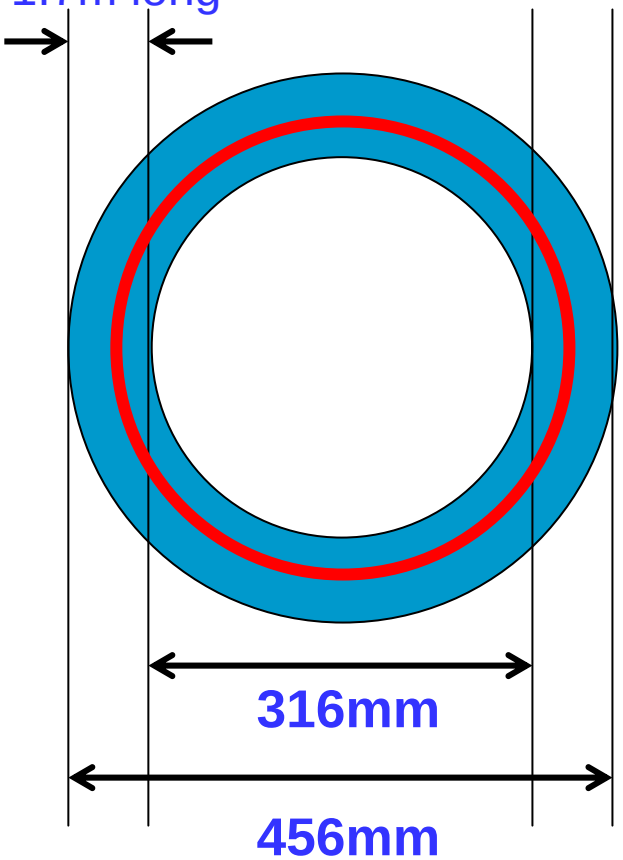
Outer Quad and Dipole Zero By at
both +10mrad and -10mrad

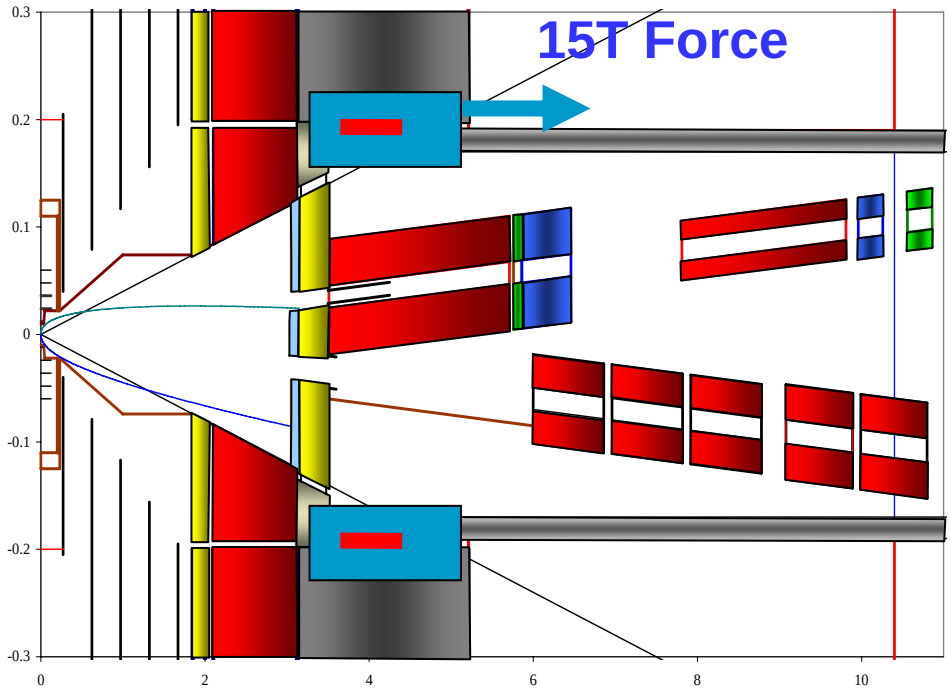


COILS at IP Side of QD0
at z=3.8m

Anti-solenoids

Reminder: A. Seryi & Y. Nosochkov showed (PRSTAB 8, 021001 (2005))
If QD0 sits in Fringe of Detector Solenoid
σ_y(Solenoid) / σ_y(0) ~ 30-40
Independent of crossing angle





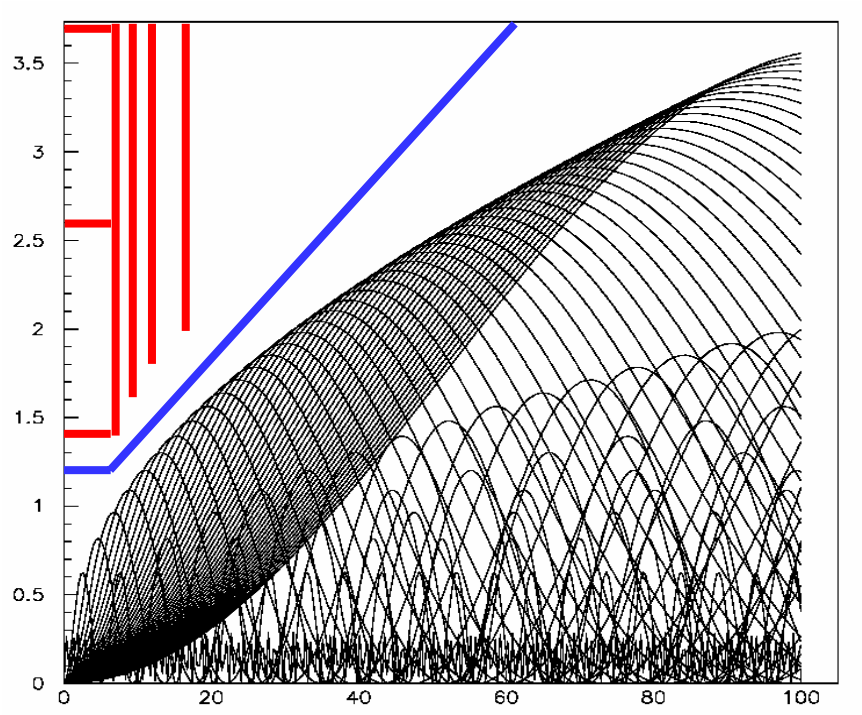
Four 24cm individual powered 6mm coils,
1.22m total length, r_{min}=19cm

σ_y(Solenoid) / σ_y(0) ~ 1.4

VXD / Beam Pipe Tweaked for SiD

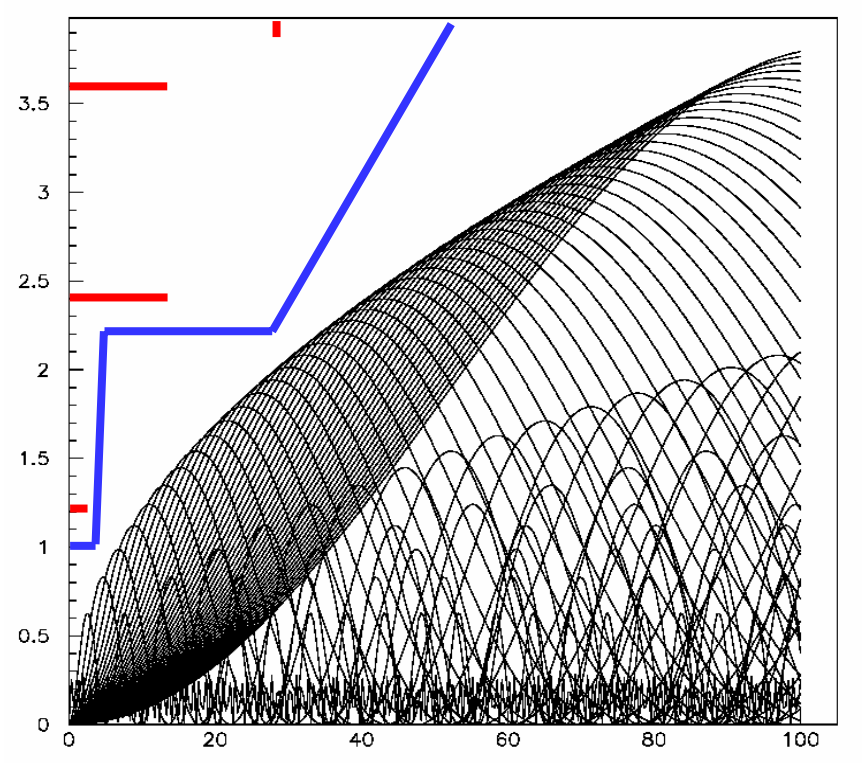
Maruyama

New SiD VXD with
12mm radius beampipe



Pair region plotted for
ILC Nominal IP Parameters
5 Tesla, 20 mrad

Old SiD VXD with
10 mm radius beampipe



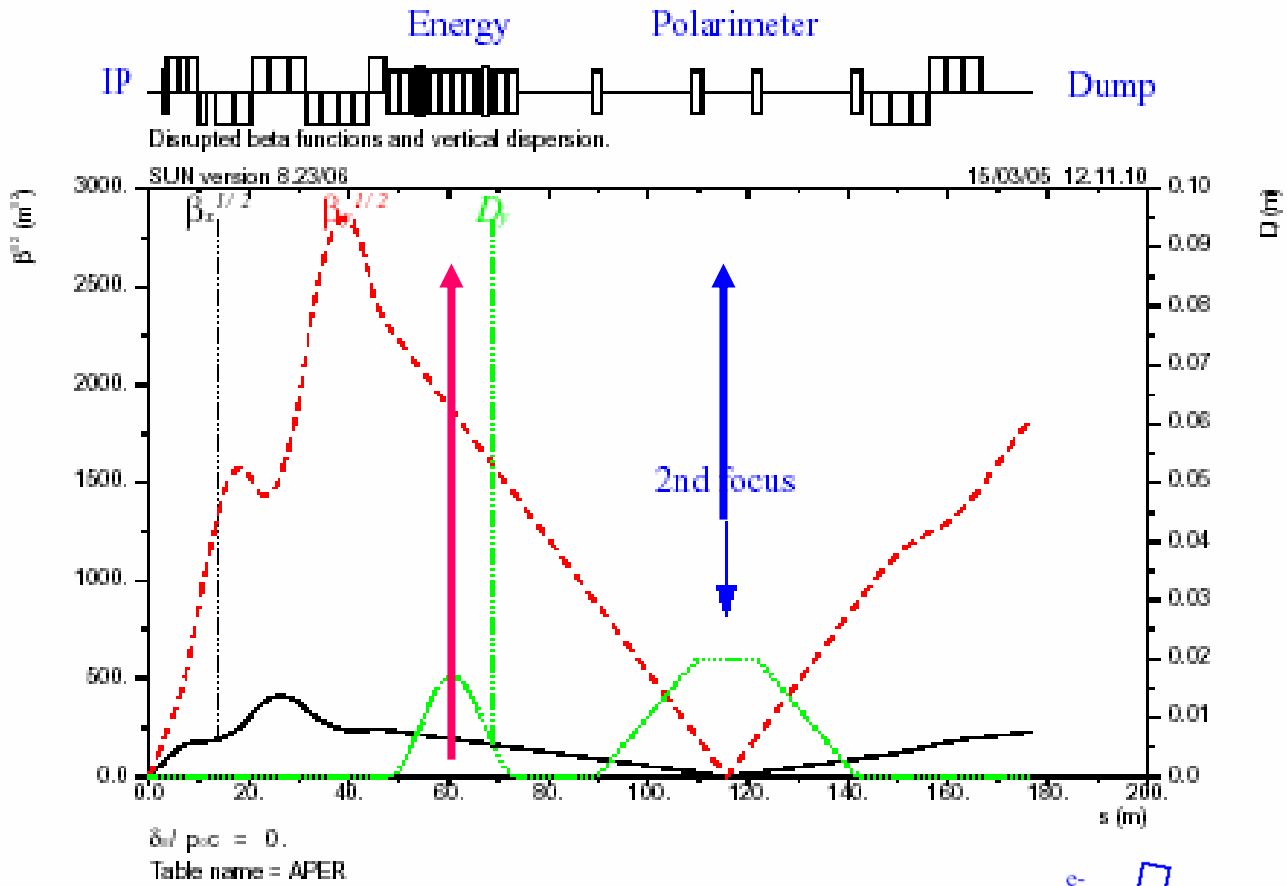
Pair region plotted for
NLC IP Parameters
5 Tesla, 20 mrad

Excerpt from ILC-WG1 Parameter Tables Nominal to High Lum Sets

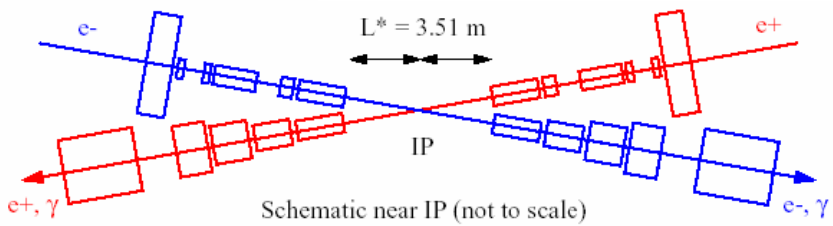
500 GeV 11.3 MW	Nominal	HighLum
Lum	2.0E38	4.9E38
dB	2.2%	7%
Ng	1.3	1.7
Upsilon	0.046	0.133
P-g	250kW	790kW
1 TeV 18.1MW	**Nominal**	**HighLum**
Lum	2.8E38	7.9E38
dB	5.0%	18%
Ng	1.4	2.2
Upsilon	0.109	0.376
P-g	900kW	3.2MW

Also,
variation and duty factor of divergence angles, photon power, etc. as beams move into and out of collision (study loss as a function of dy)

20 mrad Extraction Line Modified for Magnet developments, Newest IP Parameters & Double Chicane



- L*=3.51 m for 1st quad in the incoming and extraction lines
- 1.75 m free space to fit crab cavity on incoming line
- Larger magnet apertures



Y. Nosochkov

Particle Loss in 20 mrad Extraction Line

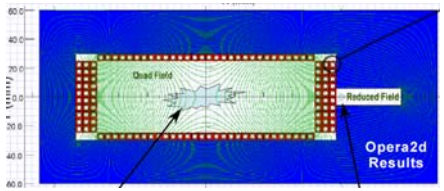
Nosochkov

E_{cm} (GeV)	Params	Δy (nm)	Max e x'/y'(urad)	Max g x'/y'(urad)	Emin/ E0	Power loss F-D / D-F
500	Nom.	0	530/250	370/210	0.36	0/0
500	Nom.	200	470/670	370/540	0.36	6.4/1.4W
500	High	0	1270/430	720/320	0.17	1.8/3.5 kW
500	High	120	1280/1420	780/1230	0.17	14/10 kW
1000	Nom	0	500/160	270/150	0.2	120/460 W
1000	Nom	100	420/570	420/570	0.19	3.9/2.0 kW
1000	High	0	2010/490	940/300	0.063	48 / 49 kW
1000	High	80	1730/1590	970/1200	0.062	325/274 kW

First Design of "Complete" 2mrad IP to Dump Extraction Line

SLAC-BNL-UK-France Task Group

Warm Panofsky Quad



Shared Large Aperture Magnets

BYCHIC

Disrupted beam & Sync radiations

QEXF1

SF1

SD0

QF1

QD0

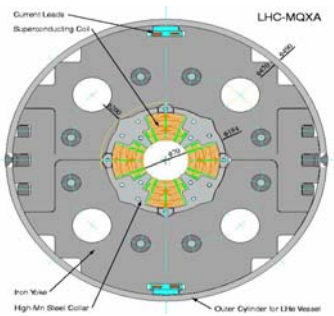
60 m

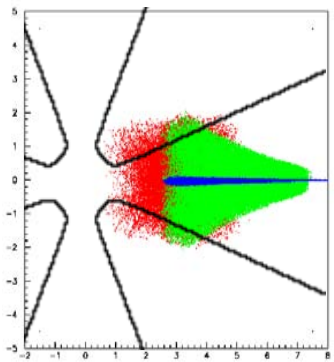
Beamstrahlung

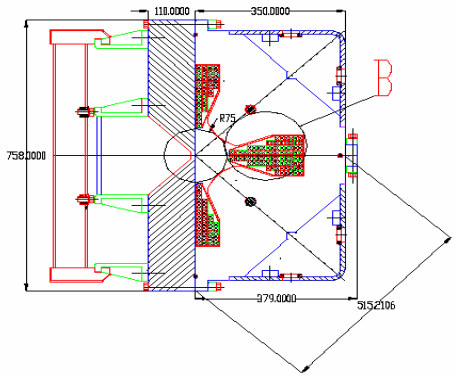
Incoming beam

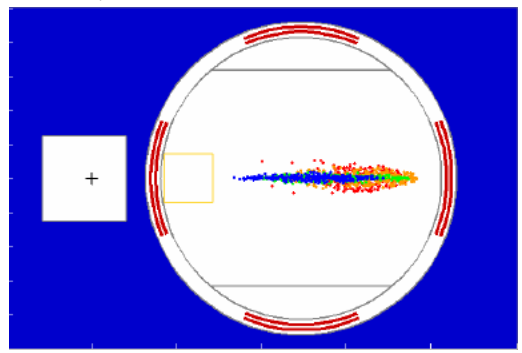
Current Sheet Quad

Super Septum Quad

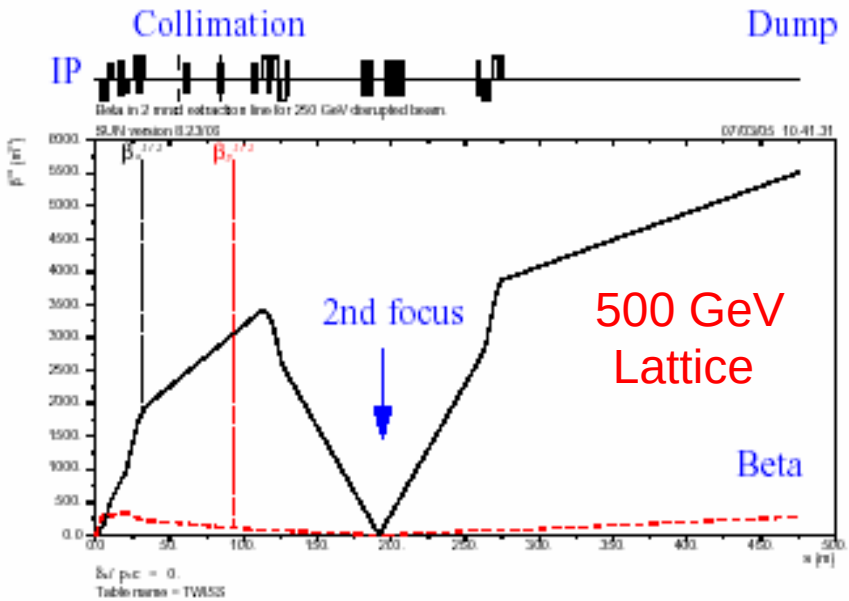


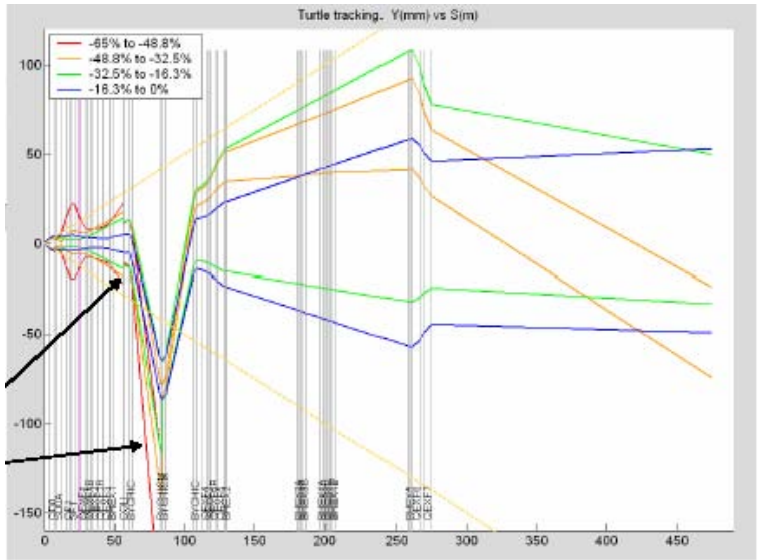






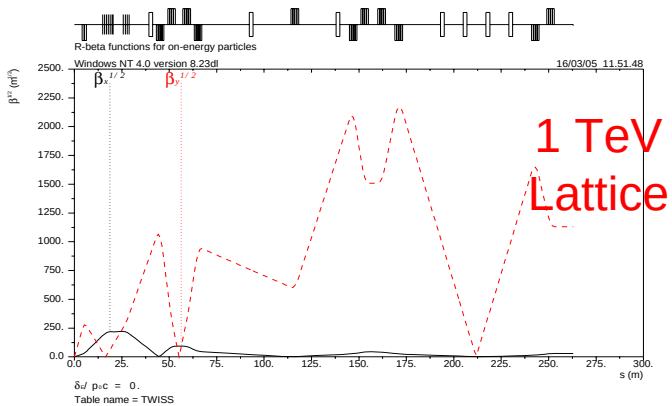
First Loss Studies in 2 mrad Crossing Extraction Line





Magnets, Chicane, Optics to Chicane focus require optimization

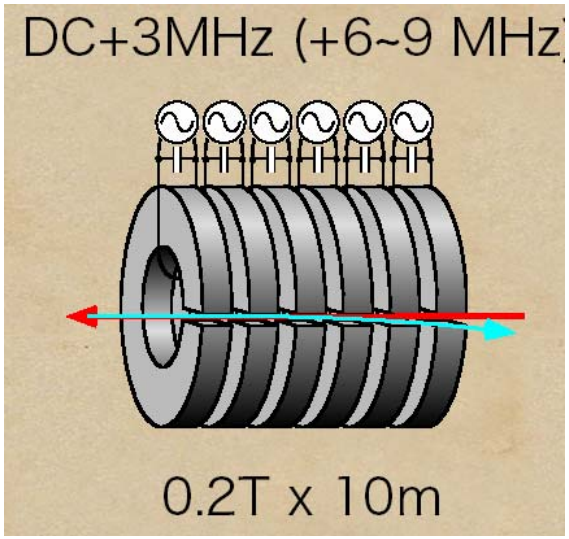
Collimators at 56m (1.3kW) / 84m (23kW) for low E tail of nom 250 GeV beam & cooling for SR on Beam pipe (z=30-60m, 5kW) need study



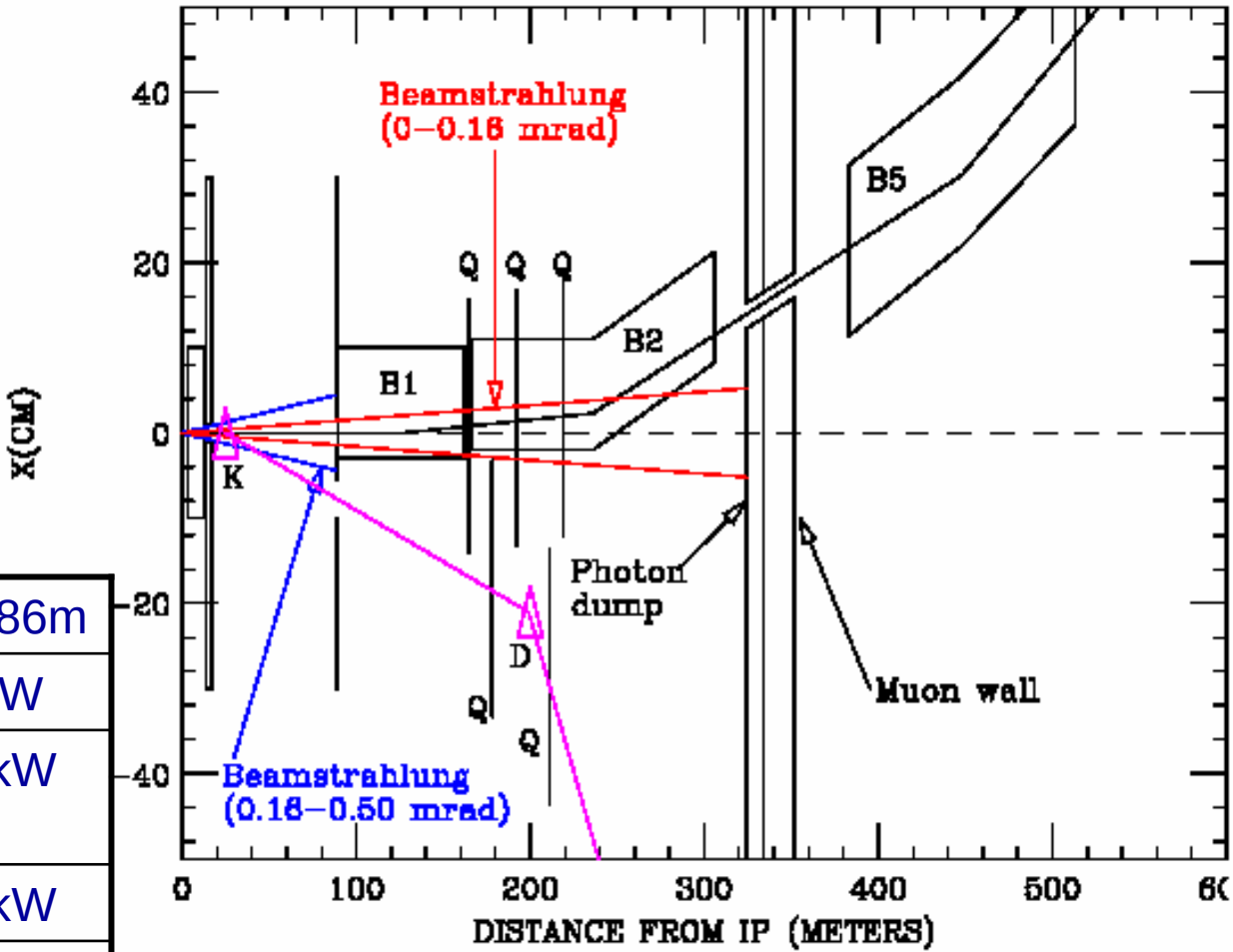
Beam Losses	QD0	QEXF1
500, Nom., dy=0, dy=200nm	0	0
500 GeV, High Lum, dy=0	250W	50W
500 GeV, High Lum, dy=0	350W	400W
1 TeV, Nom, dy=0, dy=100nm	0	0

Zero mrad Crossing Angle Study
RF Kicker Design and Extraction Line Analysis

Iwashita



Keller

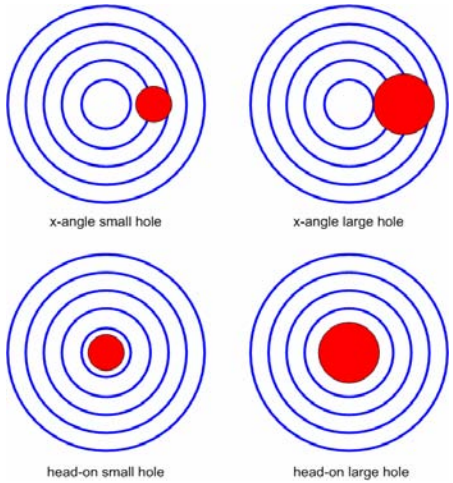


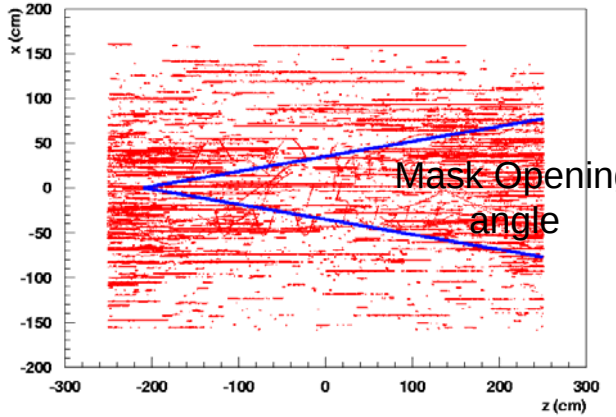
500 GeV	Kicker	Coll@86m
Nom, dy=0	0	80 kW
Nom, dy=200nm	5 kw	405 kW
High dy=0	3 kW	735 kW
High Lum, dy=120nm	450 kW	2.3 MW

Utility of Kicker to clean up dark current bunches
MPS Issues

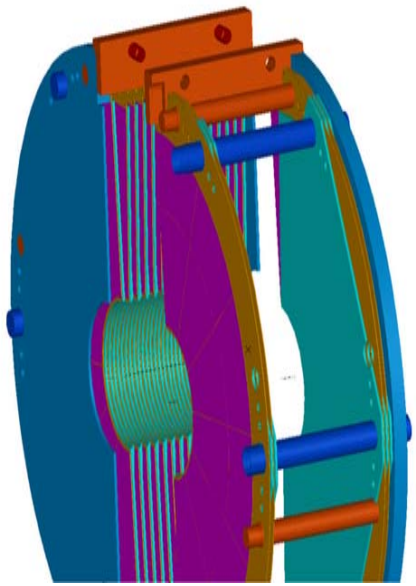
Examples of Forward Detector Studies and Physics / Background Implications

Effect of L*, Crossing angle & aperture size on backgrounds, electron ID
Buesser

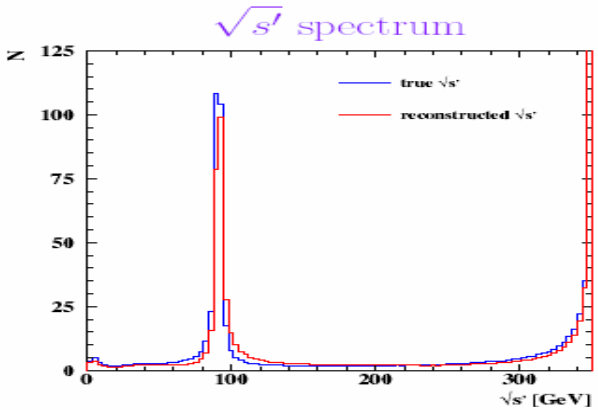




Mask Opening angle

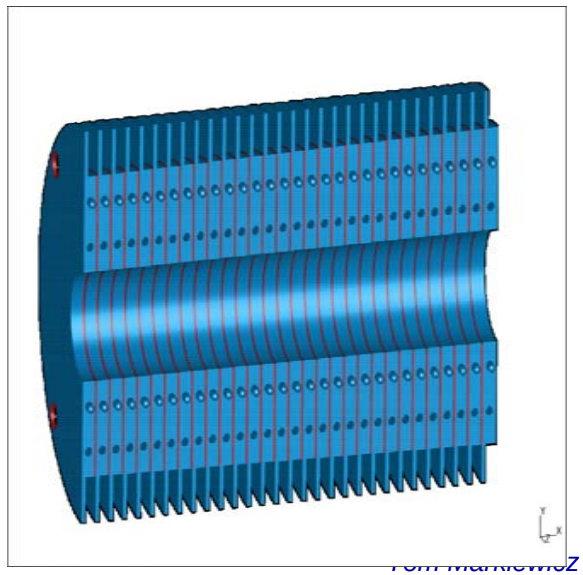


Lumi-Cal
Mech. Design to insure Alignment accuracy (Lohmann)

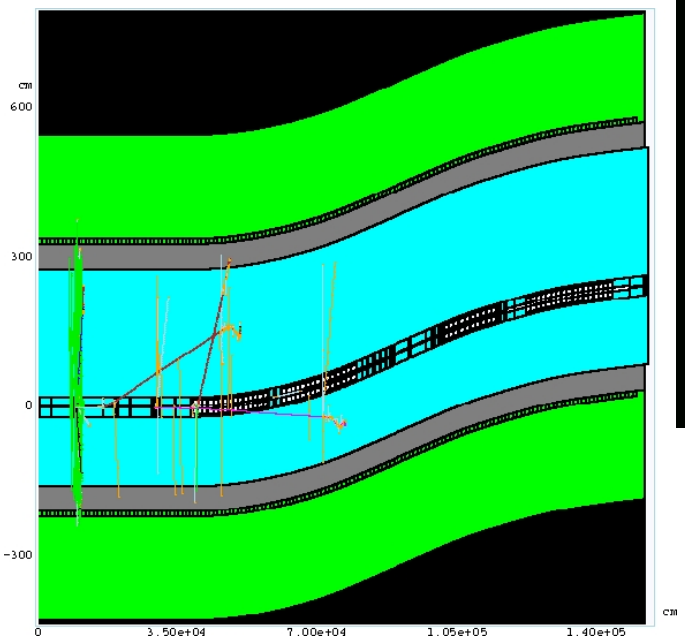


Radiative Return Measurement of E_{beam} knowledge of detector L/R to <1E-4 (Moenig)

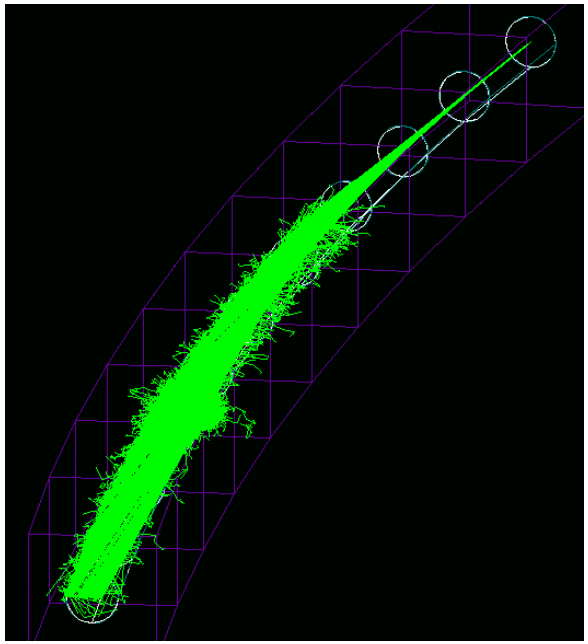
W-Diamond BeamCal



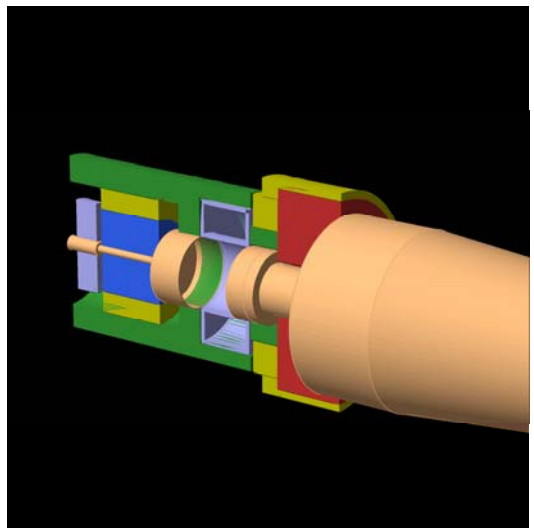
Tool Development: Background Studies



MARS implementation for BDS: Activation, Shielding, Muons (Kostin)



GEANT4 Based Beamline Simulation BDSIM with SR, muon, neutron production processes (Blair)



Forward LD Geometry in GEANT4 (Buesser)

Concluding Remarks

ILC-WG4 / WWS-MDI have been working at a furious pace since ITRP decision to understand enough detail of complete design to convert strawman to CDR baseline:

- Much communication
- ~2 months between design iterations at intl workshops
- June UK meeting, July Korea meeting, Snowmass, November Vienna ECFA

Result is a design which, to first order, satisfies the concern of all players that we investigate layout parameter space fully

- Much work required to evaluate, understand and improve physics capability, performance flexibility and engineering requirements of each IR with each detector
- My apologies for concentrating on progress of IR layout without explicitly showing results of studies presented

Opinions of the larger community, based on these studies, will be required before any baseline decision can be made

Interface to CF / Engineering Beginning