Highlights from PAC09
May 4-8 Vancouver, Canada.

C. Carli, S. Gilardoni, D.Quatraro
G. Rumolo, B. Salvant, E. Wildner

PAC in numbers….

- **~1400** registered participants
- **> 150** scheduled talks over 5 days, organized in 3 parallel sessions, except the plenary sessions on Monday morning and Friday afternoon (but a few were skipped because withdrawn or for absence of the speaker)
- **> 1600** posters presented during the separated morning and afternoon poster sessions, parallel to the oral sessions
- Several satellite meetings taking place at the top floor of the Hyatt

PAC 09 Schedule - Final

Date	Monday, 4 May 2009			Tuesday, 5 May 2009			Wednesday, 6 May 2009		
Place	*FV BC Ballroom*			*Regency A+B*	*HR Plaza*	*HR Georgia*	*Regency A+B*	*HR Plaza*	*HR Georgia*
Chair	S. Koscielniak, TRIUMF			**S. Prestemon**	**P. Spentzouris**	**C. Johnstone**	**R. Keitel**	**F. Zimmermann**	**D. Findlay**
8:30	Opening Remarks: S.K. & Paul Schmor			Magnets for Nxt Gen LS	Tevatron Simulation-3D	Wakefield Linear Collide	New UI Capabilities	e-Cloud CMAD	MW Ops at SNS
8:45				R. Gupta	E. Stern	M. Hogan	K-U Kasemir	M. Pivi	J. Galambos
9:00	Why Accelerators?			Magnets for NS-FFAG	Electron-Ion Dynamics	R&D Toward NFMC	Cyber Threats	e-Cloud μ-waves	JPARC Main Ring
9:15	Michael Turner, U. of Chicago			N. Marks	D. Bruhwiler	M. Zisman	S. Lueders	F. Caspers	H. Kobayashi
9:30	Status of Tevatron Run II			LHC Magnet Performan	Maxwell-Vlasov Solver	Muon Collider Progress	Design for high availabili	e-Cloud resonances	PS2 Design
9:45	Valeri Lebedev, FNAL			L. Rossi	G. Bassi	R. Palmer	F. Willeke	C. Celata	M. Benedikt
10:00	*Status of LHC Commissioning*			Nb3Sn Magnets	Reduced Scale Range	FFAG & IDSNF	Longevity/middleware	RF deflectors CTF3	Fluidized Target
10:15	*Jorg Wenninger, CERN*			G. Sabbi	J-L Vay	Muon capture/bunching	Automation of MLS	SPARX RF Gun	Crystal Collimation
10:30	Break			Break			Break		
10:45									
Chair	Shin-ichi Kurokawa, KEK			**Y. Ishi**	**M. Berz**	**Hernandez-Garcia**	**L. Rossi**	**Y. Cai**	**G. Ciavola**
11:00	Probing Origins of the Cosmos			IFMIF/EVEDA	FFAG & PTC Spacechar	Cornell ERL Injector	ILC e+ source undulator	APS Chromaticity	ECR source review
11:15	Justin Khoury, Perimeter Institute			A. Mosnier	CHEF Improvements	I. Bazarov	J. Rochford	UVX Insertion Devices	T. Nakagawa
11:30	*RIBs for Astrophysics*			European ADS	Negative momentum compacti	Femtosecond e-	Cryo PM undulator	Twisted waveguide	SNS H- beam
11:45	*Alan Shotter, Edinburgh U. & TRIUMF*			J-L Biarrotte	e-bunch Transport	Diamond photo-cathode	T. Tanaka	3.9GHz Coupler Kicks	Charge-breader RIB
12:00	J-PARC Status								
12:15	Yoshishige Yamazaki, KEK & JAEA								
12:30	Lunch			Lunch			Lunch		
13:00									
Place	*Regency A+B*	*HR Plaza*	*HR Georgia*	*Regency A+B*	*HR Plaza*	*HR Georgia*	*Regency A+B*	*HR Plaza*	*HR Georgia*
Chair	**M. Sullivan**	**L. Rivkin**	**M. Lindroos**	**T. Grimm**	**E. Shaposhnikova**	**In-Soo Ko**	**J. Delayen**	**O. Bruning**	**I. Ben-Zvi**
14:00	KEKB High lights	Possible APS Upgrade	RIKEN RIB	Cornell ERL SRF	JPARC Low Loss	e- bunch diagnostic	High-gradient structures	Head-tail modes	Cooling in RHIC
14:15	K. Oide	M. Borland	N. Fukunishi	M. Liepe	A. Molodzhentsev	H. Loos	S. Tantawi	A. Burov	J. Brennan
14:30	B-Factory Lessons	NSLS-II Challenges	CARIBU Project	β<1 SRF Cavity	UNILAC codes	OTR diagnostics	CLIC X-band test	VEPP Resonance Cross	Timing ref distribution
14:45	J. Seeman	S. Krinsky	R. Pardo	M. Kelly	L. Groening	R. Fiorito	Multi-beam klystron	P. Piminov	M. Ferianis
15:00	BEPC-II Status	Beam Stability in SLS	FRIB: New Facility for R	ILC SRF Progress	Transverse Schottky	NSLS-II diagnostics	LLRF: Reconfigurable	RHIC Beam-Beam	CW Laser Wire
15:15	C. Zhang	C. Steier	R.C. York	R-L. Geng	6D Muon cooling	O. Singh	L. Doolittle	W. Fischer	Y. Honda
15:30	Super-B Project	Shanghai Light Source	High Power RFQs	STF Cryomodule	Cyclotron space-charge	Bunch length	Project-X LLRF	storage ring nonlinr dynamics	3D Profile Monitor
15:45	Dynamical Beta	Zhentang Zhao	A. Pisent	Eiji Kako	NSCL Isochronous ring	LCLS BPMs	Self-excited loop model	Advanced tools for FFAG desi	Tomography& spacecha
16:00	Break			Break			Break		
16:15									
Chair	**M. Tigner**	**A. Freyberger**	**S. Biedron**	**M. Fazio**	**G. Hoffstaetter**	**M. Futakawa**	**H-C. Hseuh**	**A. Noda**	**W. Blokland**
16:30	DAFNE Crab Waist	Status& Future of ERLs	MW Power Supply	Solid State RF Amp	Emittance Exchange	LHC Collimation	He Refrigerators	EMMA NS-FFAG	JPARC MR diagnostic
16:45	C. Milardi	R. Hajima	I. Marneris	M. Di Giacomo	R. Flliler	R. Assmann	V. Ganni	S. Smith	e-cloud at FNAL MI
17:00	LHC Crab Cavity	Multi-pass ERL	Solid state PS	Sheet Beam Klystron	μ-scope, Streak Camera	MW-class Target R&D	LHC Vacuum System	SNS Ring Ops	LHC Beam Instrumentat
17:15	Tevatron Luminosity	N. Vinokurov	D. Anderson	D. Sprehn	W. Wan	J. Haines	J. Jimenez	RFQ for ADS	Alignment of LHC
17:30	RHIC polarized proton	Cornell X-ray ERL	Lasers for Next Gen LS	IOT Design	Large Grain Cavity	MERIT at CERN	TLS Vacuum	e-linac for RIB	LHC m/c protect
17:45	RHIC beam-beam	Wisconsin FEL Initiative	M. Danailov	J-PARC MA cavity	ISAC-II High-Beta	K. McDonald	SESAME PS	HITRAP at GSI	ALS Interlocks
18:00									
18:15				Women in Engineering Reception				**HR = Hyatt Regency**	
18:30				*HR English Bay Rm, 34th Floor*				**FV = Fairmo**	
18:45									
19:00	Chairman's Reception								
	HR 34th Floor								
20:00									
21:00									

LSAFEL: Light Sources & FEL
BDEMF: Beam Dynamics & EM Fields
HEHAC: High-Energy Hadron Accelerators
SAI: Sources & Injectors
MAGNET
RFSYS: Radio-frequency Systems
ACCTECH: Accelerator Technology
APAC: Applications of Accelerators
COLLIDER: Circular Colliders
LEAC: Lepton Accelerators
LAMEAR: Low & Medium Energy Accelerators
CONTOPS: Controls & Operations
INSTRUM: Instrumentation
ADVCON: Advanced Concepts
PPHIB: Pulsed-Power, High-Intensity Beams
Special

Thursday, 7 May 2009

HR Plaza	*HR Georgia*
Special Forum/ Alan Todd	**S. Ozaki**
Accelerators for Environment Applications Douglas Wells, IAC	HIRFL-CSR J-W Xia
Accelerators for Security Applications A. Mishin AS&E	China SNS S. Fu
XFEL Project Management Thomas Hott, DESY	Accels in Korea W. Namkung
Techniques for Successful Project Management Suzanne Herron (SNS/ITER)	Accels In India V. Sahni
Break	
Stan Schriber/Steve Holmes	*HR Georgia*
Louis Costrell Honorary Session	
IEEE/NPSS Doctoral Thesis Award	
APS/DPB Doctoral Thesis Award	
Wilson Prize Satoshi Ozaki	
Lunch	
Prizes/Awards Invited Luncheon	

HR Plaza	*HR Georgia A*	*HR Georgia B*
H. Hama	**R. Davidson**	**G. Geschonke**
LCLS Commisioning P. Emma	DARHT-II Linac C. Ekdahl	2-Beam Linear Colliders R. Corsini
SCSS TA XFEL K. Togawa	Dielectric Wall Linac G. Caporaso	e- drive beam R. England
Jlab FEL Progress C. Tennant	Drift Compression I. Kaganovich	e- chirped beam V. Yakimenko
FLASH Operation 7th harmonic IFEL	Targets for WDM P. Seidl	e+ transport by plasma P. Muggli
Break *HR Plaza Foyer*		
V. Litvinenko	**F. Meot**	**J. Rosenzweig**
LNLS-2: New Brazil light	HIT/CNAO therapy T. Haberer	Laser-driven p beams
DIAMOND		laser wakefield e-beam
PLS-II at PAL	HIMAC therapy K. Noda	capillary discharge
RF deflector in QBA		XUV FEL
SPARC FEL experiment	PAMELA	Boosted-frame PIC
Duke gamma source	ERIT	X-band PBG
Cocktails	HR Regency Foyer, Balmoral FV BC Foyer	
Banquet *HR Regency Full* FV BC Ballroom		

Friday, 8 May 2009

HR Regency A+B	*HR Plaza*	*HR Georgia*
K. Yokoya	**S. Peggs**	**T. Roser**
CLIC Project Rogelio Tomas	RHIC Progress C. Montag	Coherent e- cooling V. Litvinenko
CESR-TA M. Palmer	Collider Initiatives R. Milner	Project-X S. Holmes
ATF2 Status A. Seryi	LHC Upgrade F. Zimmermann	FAIR Complex M. Steck
CTF3 Achievements	Tevatron Experience	AGS polarized p
ATF2 Optics Model	LHeC	LHC Injection
Break		
A. W. Zhang	**A. Dragt**	**S. Boucher**
CAEP Induction Linac J. Deng	Impedance Theory G. Stupakov	USPAS W. Barletta
SPS Kicker Magnet	Galactic Stability A. Chao	SPIRAL-II collaboration R. Ferdinand
Dielectric Wake Kicker		
Lunch		

HR Regency Full=A,B,C,D
Paul Schmor, TRIUMF
Experimental Results from FLASH M. Bogan, SLAC
Science of Ultra-fast Electron and Photon Sources S. Karsch, MPQ
The New Generation of Neutron Sources Thomas Mason, ORNL
Neutrino Factory: Final Frontier in Neutrino Physics? Alan Bross, FNAL
Progress Toward ILC Nicholas Walker, DESY
Closing Remarks, Paul Schmor

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Special

C. Carli

- Interest for PSB with Linac4
  - Discussions with people from SNS (ORBIT authors):
    - Problem with SNS injection foil (broken support)
    - Discussions on ORBIT upgrades (J. Holmes promised to work on the code):
      - Emittance evaluation without using lattice dispersion (short-term)
      - Larger ORBIT modifications to define lattice directly in ORBIT (without need to pass via a lattice program like MAD) and with time-dependence
    - Discussion on first benchmarks (strictly speaking triggered only by PAC09): quad fringe fields off for better agreement
  - Discussions on “beam-head” with different people working for H^- Linacs and charge exchange injections:
    - Piece of Beam at beginning of pulse sent to dump for stabilization of Linac RF ()
    - Nobody seems to need such a beam head
    - Schemes to ramp slowly the “average” current by generation longer and longer pieces with beam (with chopper)
- Editing of proceedings (…. e.g. Chamonix workshop)
  - Discussions with JACOW team and, in particular, J.Poole on general aspects
- Of general Interest (obviously very subjective)
  - Impressive Progress of Plasma acceleration (compared to situation when I was first at a big conference)
  - LHC very well represented (with some interesting informations learnt far away)
  - Tevatron Run 2 Peformance still increasing

S. Gilardoni

Simo highlights

- Tevatron Run II -> Most probably not enough luminosity to discover Higgs at 5 sigma but only, at best, at 3 sigma
  (Mh> 160 GeV/c2 but can discover only if Mh<180 GeV/c2). Run until FY 2011. Luminosity improvements thanks to better pbar production, stacking, cooling.
- J-Parc commissioning -> commissioning up to the Main Ring (0.04 10^13 protons) -> main problems is the linac RFQ and the RF in the rings -> too many discharges and material damage.
- AGS injection line -> similar problems as for us -> model too old and doubt about the matching -> studying stil ongoing
- Non-linear dynamics studies at VEPP similar to MTE studies -> concentrated on the 1/3 resonance. However, results less convincing than ours. Losses during resonant crossing whereas we have losses after crossing.

D. Quatraro

J.-L. Vay et al, “Application of the reduction of scale range in a Lorentz boosted frame to the numerical simulation of particle accelerator devices”

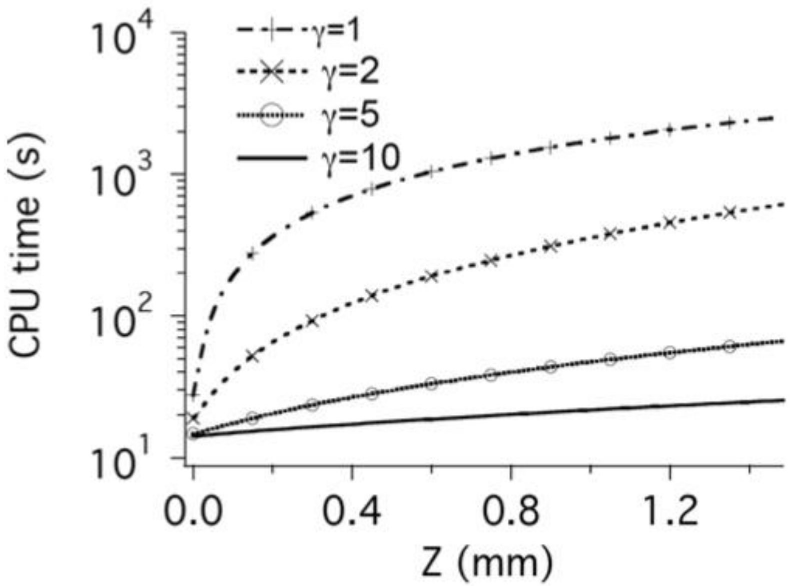


Figure 5: CPU time recorded as the beam crosses successive stations in the laboratory frame.

Using Lorentz transformations

$$\begin{cases} x' = \gamma(x - vt) \\ t' = \gamma(t - vx/c^2) \end{cases}$$

allows to minimize CPU time

In the picture the CPU time versus the speed of the frame (laser wakefield acceleration)

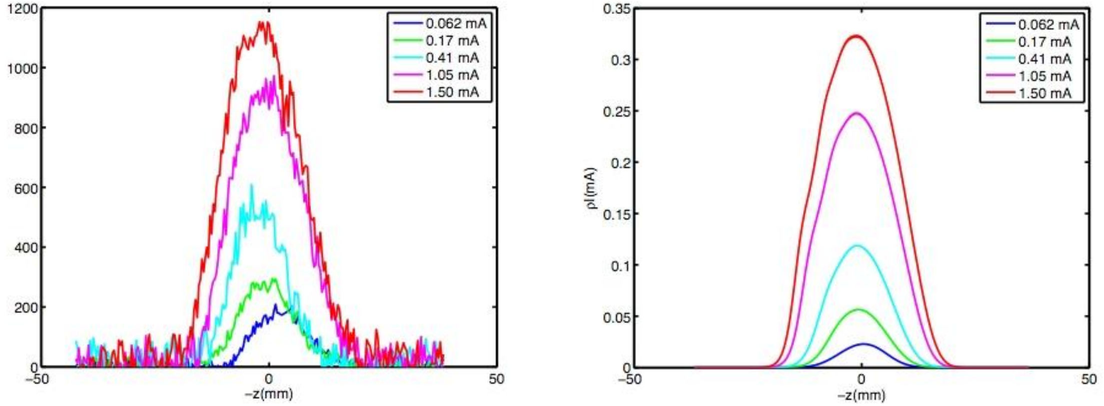
Usefull for PIC routines => HEADTAIL would profit

Might take a while to implement that in our code!!!

Yunhai Cai, et al (all people from SLAC and KEK),

"Measurements, analysis and simulations of microwave instability in the low energy ring of KEKB"

Numerical solution of the Vlasov equation and experimental data: using a Broad Band impedance they got info concerning the impedance of the ring.



Bunch longitudinal profile measurements and simulations

It is sth we can do at the PSBooster not only for measuring the impedance but also to validate low - energy impedance models!!

M. Pivi, "Detailed Electron-Cloud Modeling with CMAD"

- Since PAC07 CMAD is a parallel code for EC instabilites. It is exactly the extension we have done to date letting HEADTAIL get the MAD-X optic for particle tracking
- But CMAD has to advantage of being a parallel code: we already discussed that with Streun Andreas (PSI) but no follow-up actions

Parallelizing the code and using the Lorentz Boosted frame would take quite a while…and according to me writing the code from scratch…

Is it worth it??

A. Burov, "Head-tail modes for strong space charge"

Had a discussion (as we did at GSI) with Burov whether it is possible to apply his theory

Starting point: $Q_{S.C.}^{Sup.} \gg Q_S, Q_W$

PSB at 160 MeV

$$Q_S = \frac{R|\eta|\sigma_\delta}{\sigma_s} \simeq 6 \cdot 10^{-4}$$

$$\underbrace{Q_W^v / Q_W^h}_{\text{experimental}} \simeq 0.07/0$$

$$Q_{S.C.}^{Sup.} \simeq 0.3 - 0.5$$

Burov's theory could be applied: to discuss if we want to spend time validating his predictions

G. Rumolo

Invited: 3D simulations at Tevatron

Eric G. Stern

- Described the development of a comprehensive code with beam-beam and impedances (not clear about the 3D capabilities)
- Beam-beam studies with synchro-betatron resonances
- Impedance model seems very similar to HEADTAIL (using wake fields on a sliced bunch), but rougher

Invited: 3D simulations at Tevatron

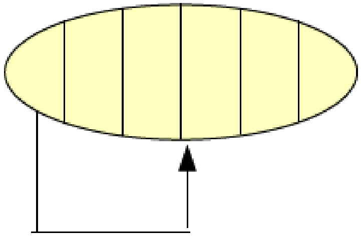
Eric G. Stern

dipole resistive wall

$$W=\left(\frac{2}{\pi b^3}\right)\sqrt{\frac{c}{\sigma}}\frac{L}{z^{1/2}}$$

kick

$$\Delta y_2'=N y_1 r_p W$$



Impedance generated instabilities

strong head-tail

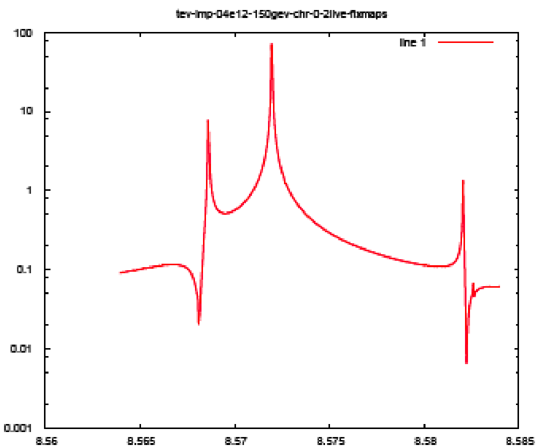
airbag distribution
two-particle model, fixed 20 cm separation
150 GeV
3 cm pipe

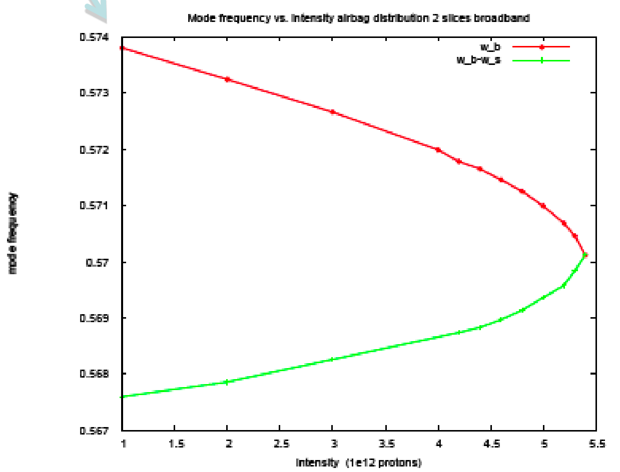
Stable motion when

$$\frac{\pi N r_0 W_0 L}{4(2\pi)^2 \gamma \nu_\beta \nu_s}<2$$

$$N\approx 4.72\cdot 10^{12}$$

???..
two particle model with fixed separation predicts mode coupling ???



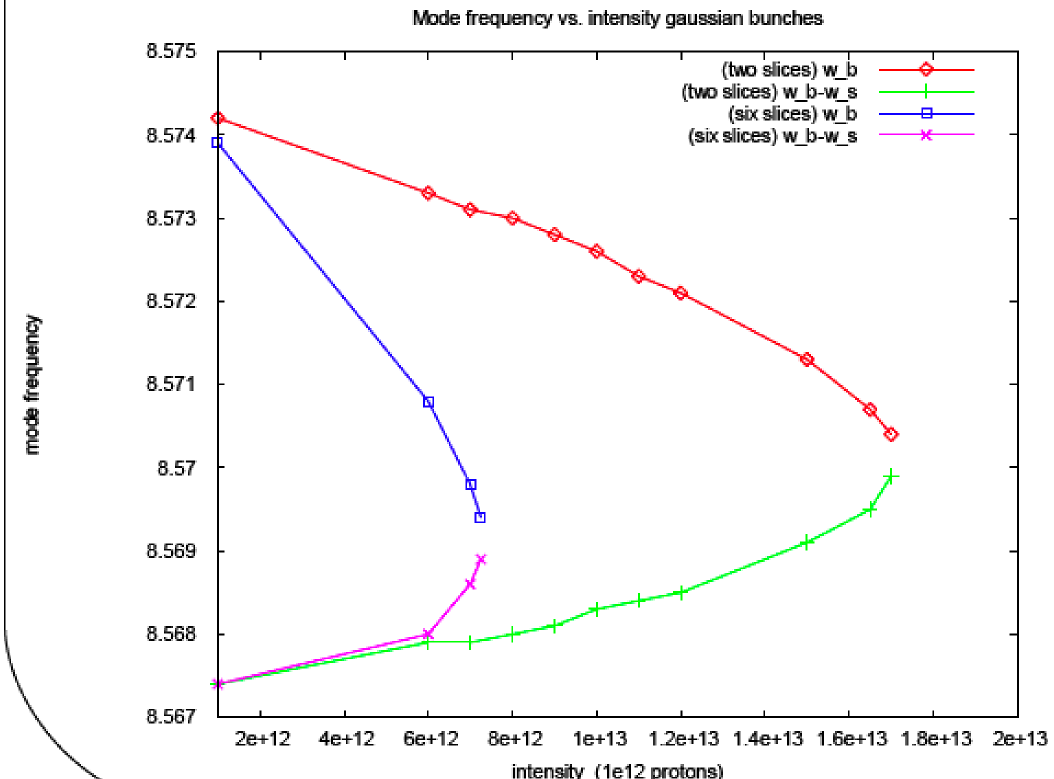


Invited: 3D simulations at Tevatron

Eric G. Stern

A little more realistic case

Gaussian particle distribution
two slices and six slices

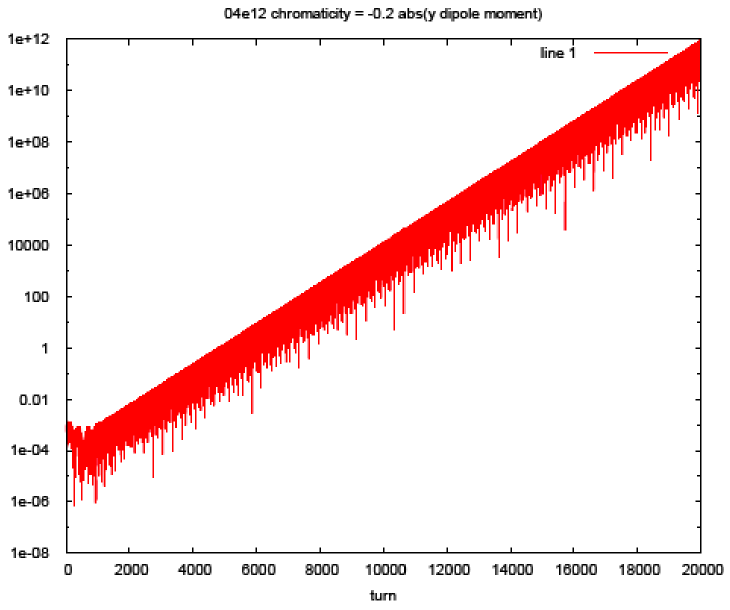


Chao's formula predicts stability limit $\approx 9.42 \cdot 10^{12}$

Invited: 3D simulations at Tevatron

Eric G. Stern

Turn on chromaticity and simulate...



Tevatron map from point 1 to point 2

$$M_{12} = -V_2 P S V_1^T S$$

$$P = \begin{pmatrix} \cos\mu_1 & \sin\mu_1 & 0 & 0 \\ -\sin\mu_1 & \cos\mu_1 & 0 & 0 \\ 0 & 0 & \cos\mu_2 & \sin\mu_2 \\ 0 & 0 & -\sin\mu_2 & \cos\mu_2 \end{pmatrix}$$

to apply chromaticity,
multiply by map:

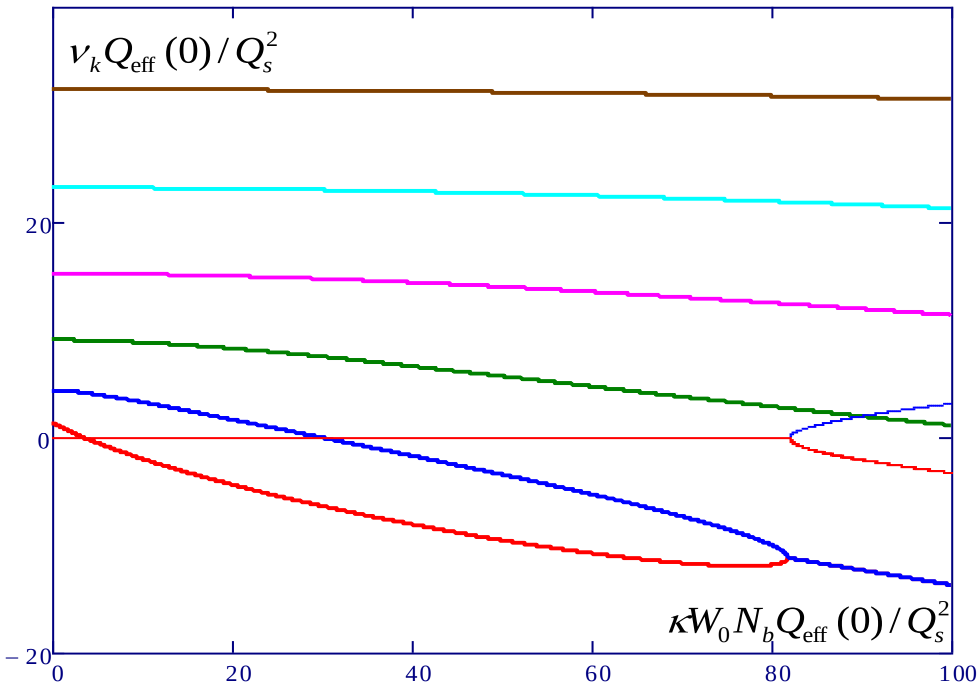
$$M_\xi = -V_2 P_\xi S V_2^T S$$

P_ξ calculated with phase advance $\mu_1 = \mu_x \delta \xi$

V_x transforms uncoupled representation of particle coordinates into physical coupled coordinates at point *x* using Twiss parameters

Some talks on head-tail modes with space charge (like at the GSI workshop in February)

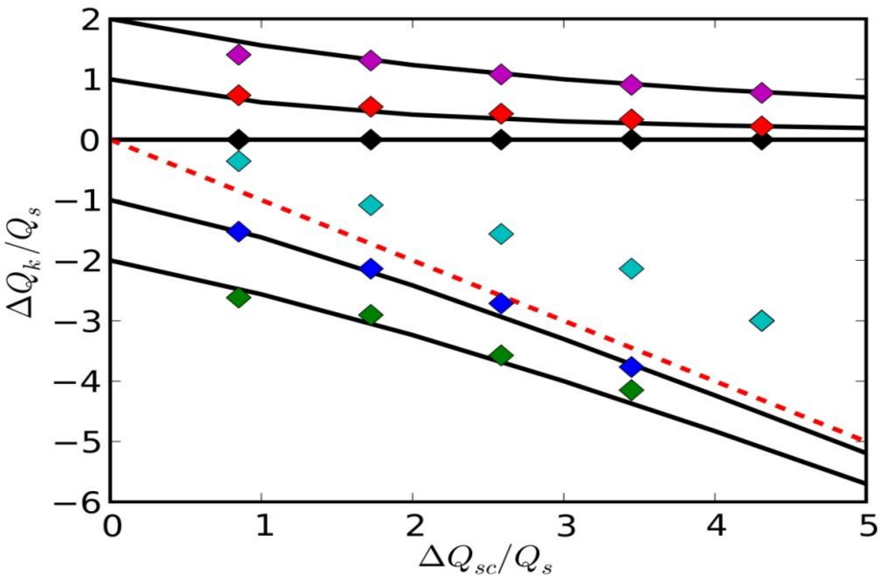
- A. Burov presented all the theory of coherent modes in presence of strong space charge (lots of equations and few plots)



- Strong space charge means that the space charge tune shift must exceed the synchrotron tune
- There is a significant increase of the TMCI threshold

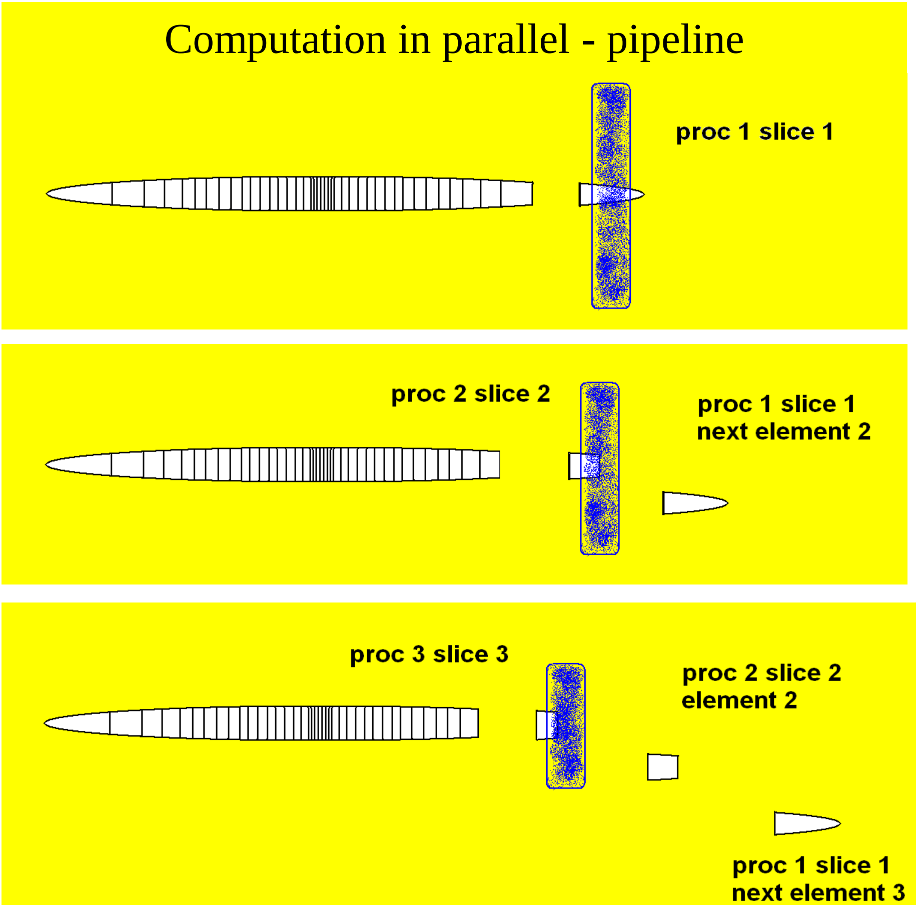
Some talks on head-tail modes with space charge (like at the GSI workshop in February)

- O. Boine-Frankenheim:
  - validates Blaskiewicz's model by his PATRIC simulations with space charge and impedance
  - Coherent modes extracted from the Transverse Schottky spectrum of the beam



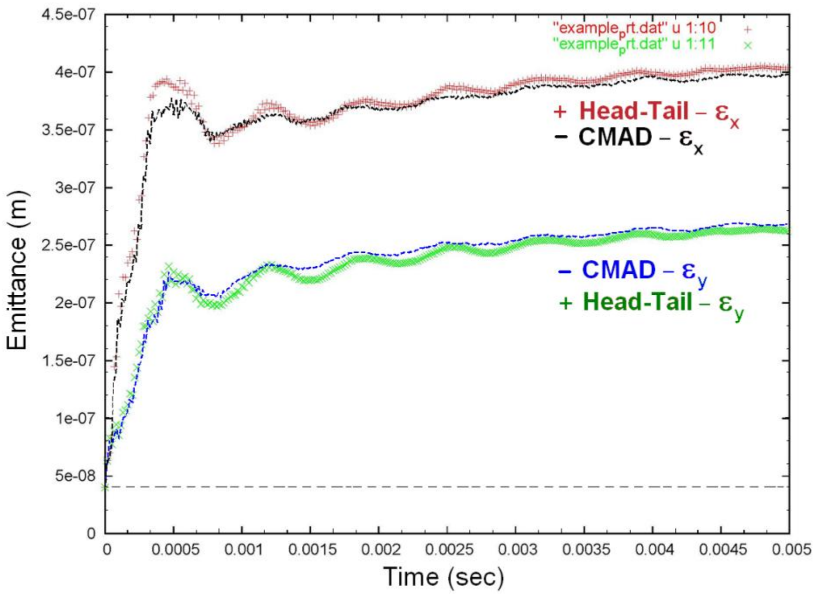
Electron cloud @ PAC09

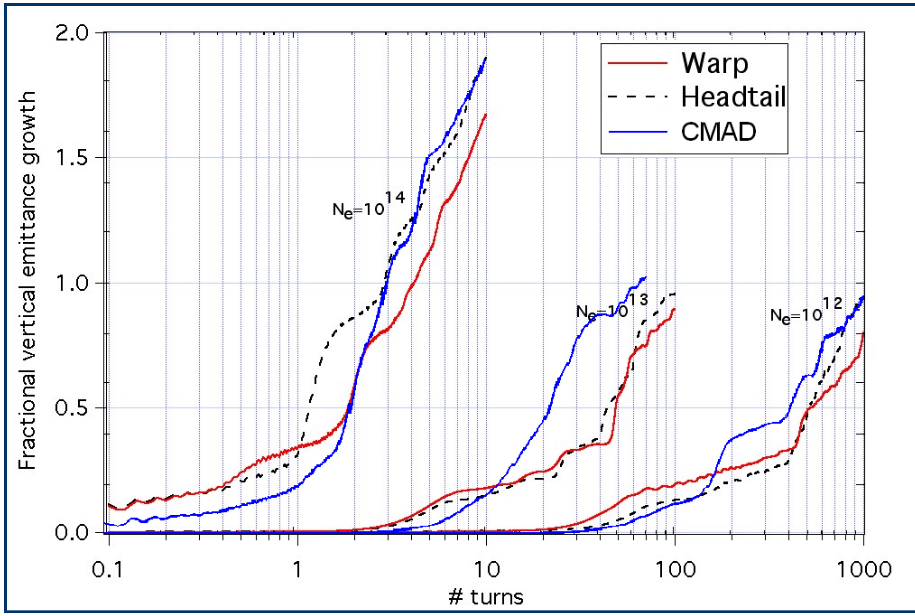
- M. Pivi presented his new code CMAD
  - Calculates electron cloud-bunch interaction in a fashion similar to the new HEADTAIL, i.e. mapping between different selected lattice stations, in which the interaction with the electron cloud happens
  - It has been conceived for parallel computation



Electron cloud @ PAC09

- M. Pivi presented his code CMAD
  - The code has been successfully benchmarked against HEADTAIL and WARP
  - It has been applied to electron cloud studies for the ILC damping rings





Electron cloud @ PAC09

- F. Caspers presented the technique of microwaves to measure electon clouds
- C. Celata presented the cyclotron resonances in dipoles
- Cesr-TA:
  - Experimental studies: measurements of 3D electron cloud distributions in wigglers, energy distributions of the electrons in different working conditions, tune shifts along both electron and positron bunch trains
  - Simulations: use the three codes ECLOUD, POSINST, CLOUDLAND to benchmark their results.
  - Plans: for the July run, measurements with the C-coated chamber produced at CERN. Take a closer look at instabilities and benchmark with codes (HEADTAIL, WARP, CMAD)
- Feedback system to fight electron cloud instabilities
  - General considerations and definition of specifications (J. Fox et al.)
  - Simulation study with HEADTAIL (J. Thompson et al.) to define gain and bandwidth needed to efficiently suppress ECI at the SPS
  - Simulation study with WARP (J-L. Vay at al.)
  - Results of SPS measurements with wide band pick up (R. de Maria et al.)

B. Salvant
Simulations of the BPMs

- Alexei Blednykh (BNL)
  - Does similar 3D simulations on longitudinal wakes of NSLS II diagnostics
- Ulrich Becker (CST)
  - Explained in detail the factor 4 issue. He will get back to me.
  - Showed the DFT issue.
  - Showed the problem of loss of units when getting 1D results. Said it was intended like that. In general, one has to be very careful when using 2 successive postprocessing steps on data.

CST got back to me and found that the factor 4 was an issue of the current version of Particle Studio

- Lukas Haenichen (TU Darmstadt)
  - Never uses the automatic mesher of CST… We always do!!!
- Andranik Tsakanian (Uni Hamburg)
  - Developed his own 2D electromagnetic solver since he found numerical dispersion error with CST.
  - Showed ways to reduce CST numerical error (refine at PEC boudaries)
  - He benchmarked his 2D code with theory for finite resistivity tube (same as Carlo)
- Reiner Wanzenberg
  - Also problems when benchmarking the transverse wake in Mafia and CST particle studio (also reported to CST at PAC)

Resistive Wall model

- Y.H. Chin
  - Is very interested in the delocalized impedance source model (Diego and Giovanni)
  - Is publishing on resistive wall finite length

- H. Hahn
  - → multi-layer by simple multiplication of matrices
    - → Could be more efficient numerically than solving the system
  - → Is concerned by the fact that E_z could go to 0 in the outer layer (to be checked), and therefore by the model we should use for air.
  - → would be glad to have our numerical values for collimators to benchmark his code

E. Wildner

Energy deposition in the High Lumi insertions LHC upgrade

G. Sterbini, J.-P. Koutchouk: Study of a Less Invasive LHC Early Separation Scheme

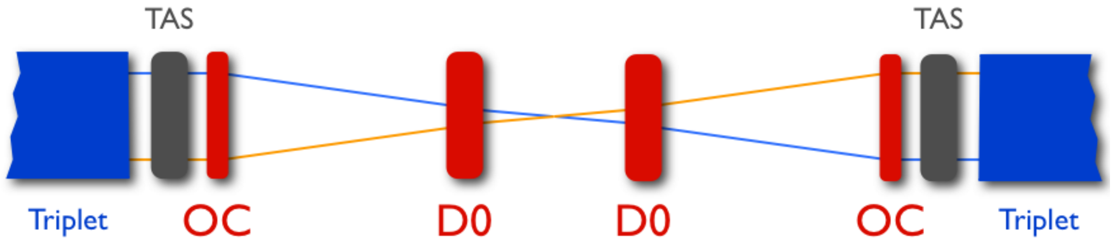
LHC Early Separation Scheme: four dipoles close to insertions to decrease crossing angle and reduce effect of parasitic interactions. Can be used for luminosity levelling. This presentation showed results from dipoles further from the IPs than earlier proposals presented (experiments do not want equipment close to interaction point), from 7 to 14 m.

E. Wildner, F. Cerutti, A. Ferrari, A. Mereghetti, E. Todesco, F. Broggi:
Analysis of Energy Deposition Patterns in the LHC Inner Triplet and the Resulting Impact on the Phase II Luminosity Upgrade Design

Possible by choosing a good layout/optics and a good shielding to cope with $L= 10^{35}$ cm^{-2} $s^{-1.}$

The Early Separation Scheme

It is a possible player for the Phase II LHC luminosity upgrade.



PRINCIPLE: It consists of 4 dipoles per IP (2 D0 + 2 OC): they can (1) reduce the beams crossing angle at IP, (2) alleviate the detrimental interaction between the beams (beam-beam effect) and (3) do luminosity leveling.

PROPOSAL: D0 at 14 m from the IP + OC at 21 m from the IP. DO is a 120 mm aperture ironless 9T Nb_3Sn 4.2K dipole in a 2m cryostat. Power deposition studies were performed: heat load on coils 28W @ $10^{35}cm^{-2}s^{-1}$, peak heat load lower than Nb_3Sn assumed limits. A 150 mm thick tungsten shielding in front of the D0 is needed.

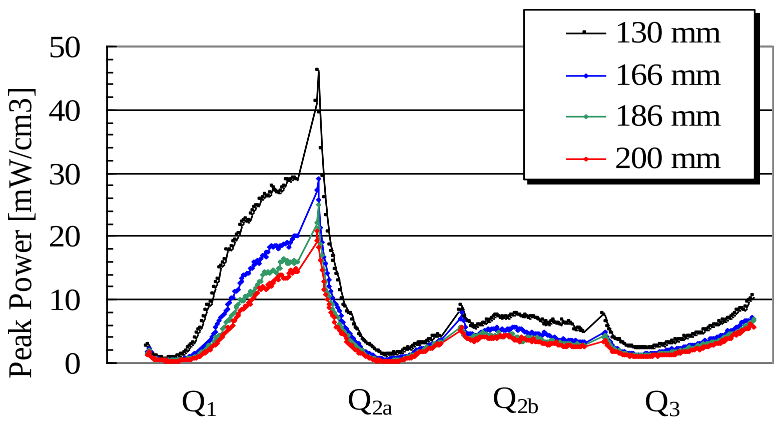
PERFORMANCE: it increases by 20% the integrated luminosity reducing at the same time the peak luminosity by 30%, with a consequent reduction of the pile-up in the detector and of the dynamic heat load on the IR magnets.

Parametric studies of energy deposition

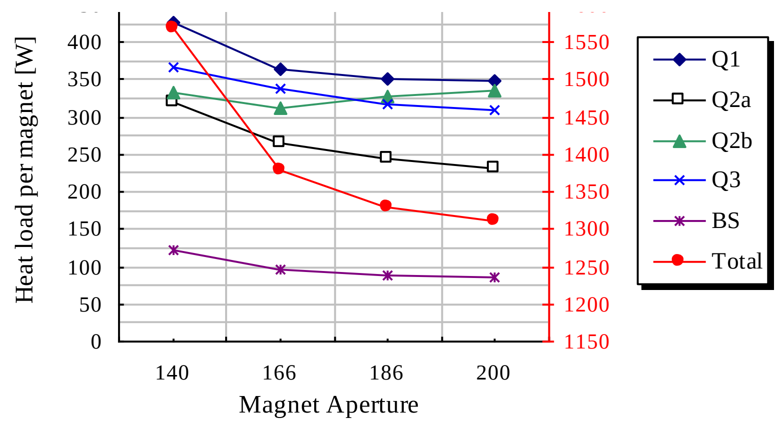
Vary length of triplet -> gives different quad field

Lower field give less energy deposition

Possible to insert liners in magnets for protection and/or disctibute heat load on a higher temperature cryo system.



Peak energy deposition in triplet coil for different triplet lengths. Scaled to have the same length



Heat load versus triplet aperture in Q1, Q2a, Q2b and Q3, beam screen and total load on magnets without beam screen

Neutrino Facilities

M. S. Zisman (LBNL): R&D toward a Neutrino Factory and Muon Collider

Review experimental results from MUCOOL (Muon Ionization Cooling R&D) , MICE (Muon Ionization Cooling Experiment) and MERIT (24-GeV proton beam incident on a target consisting of a free mercury jet that is inside a 15-T capture solenoid magnet) and discussion on proof of principle demonstrations of the key technologies required for a neutrino factory or muon collider. Progress in constructing MICE, including the coupling coils and cavities, and the future tests planned at MUCOOL were also discussed

R. B. Palmer (BNL): Progress toward a Muon Collider

R&D for a machine to cool, accelerate and collide TeV muon beams. This talk was a review of progress and showed how such a machine might evolvefrom programs to build high intensity proton sources and neutrino factories.

Many Posters on accelerator issues, in particular cooling of muons

Beta Beams not represented this time, we will do better for next (I)PAC