some highlights and ideas from ECLOUD'04

almost all talks are posted on the web page

http://icfa-ecloud04.web.cern.ch/icfa-ecloud04/

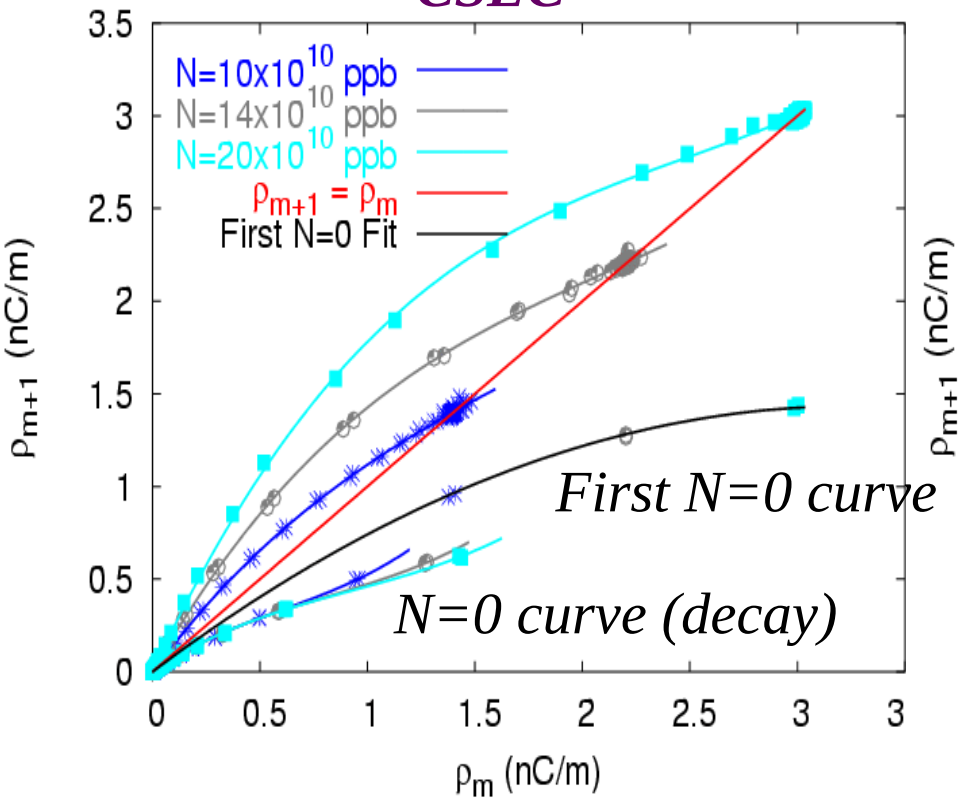
some highlights

- slow blow up seen in KEKB below TMCI threshold (H. Fukuma)
- beta beating due to electron cloud measured in SPS; negative detuning with amplitude (G. Arduini)
- BNL C-A/AP/147 (2004), S. Peggs and U. Iriso; can e-cloud codes create 1st and 2nd order phase transitions? Use maps to simulate e-cloud blow up, "MEC" maps for electron cloud [can the map become chaotic?]
- grooved surfaces (triang./rectang.) – SLAC calculations & prototype measurements

2. Can the EC be represented by maps?

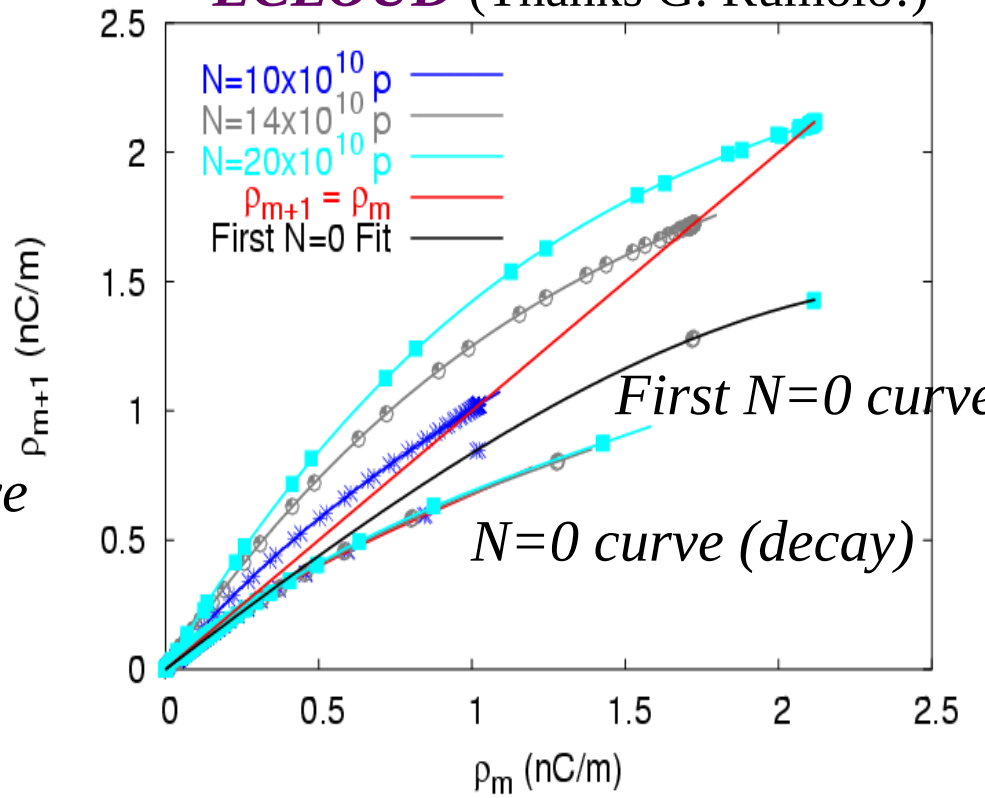
- Results for different N using CSEC (M. Blaskiewicz), and ECLOUD (F. Zimmermann). This is, results using different SEY parameterization:

CSEC



SEY from Furman & Pivi

ECLOUD (Thanks G. Rumolo!)

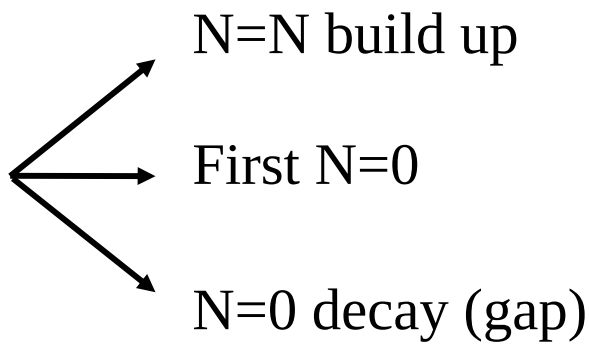


SEY from Cimino & Collins

Ubaldo Iriso

- Once we have a_i (i=1,2,3) as a f(N), we just need an algorithm depending on N_m, being m the bunch number in the bunch train

$$\rho_{m+1} = a_1 \cdot \rho_m + a_2 \cdot \rho_m^2 + a_3 \cdot \rho_m^3$$



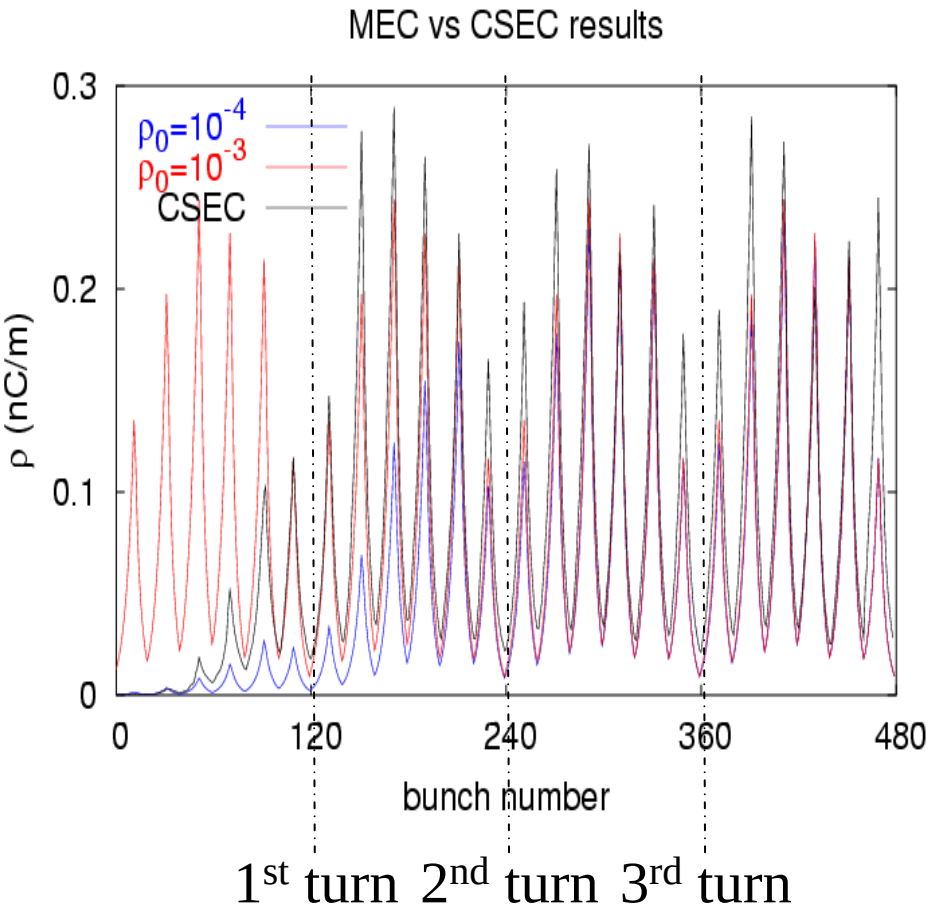
- Much faster than following ρ ***ns-to-ns*** using "typical" EC simulation codes (~1h vs ~1ms)

➢Question: What's the best way to distribute 68 bunches? Let's see:

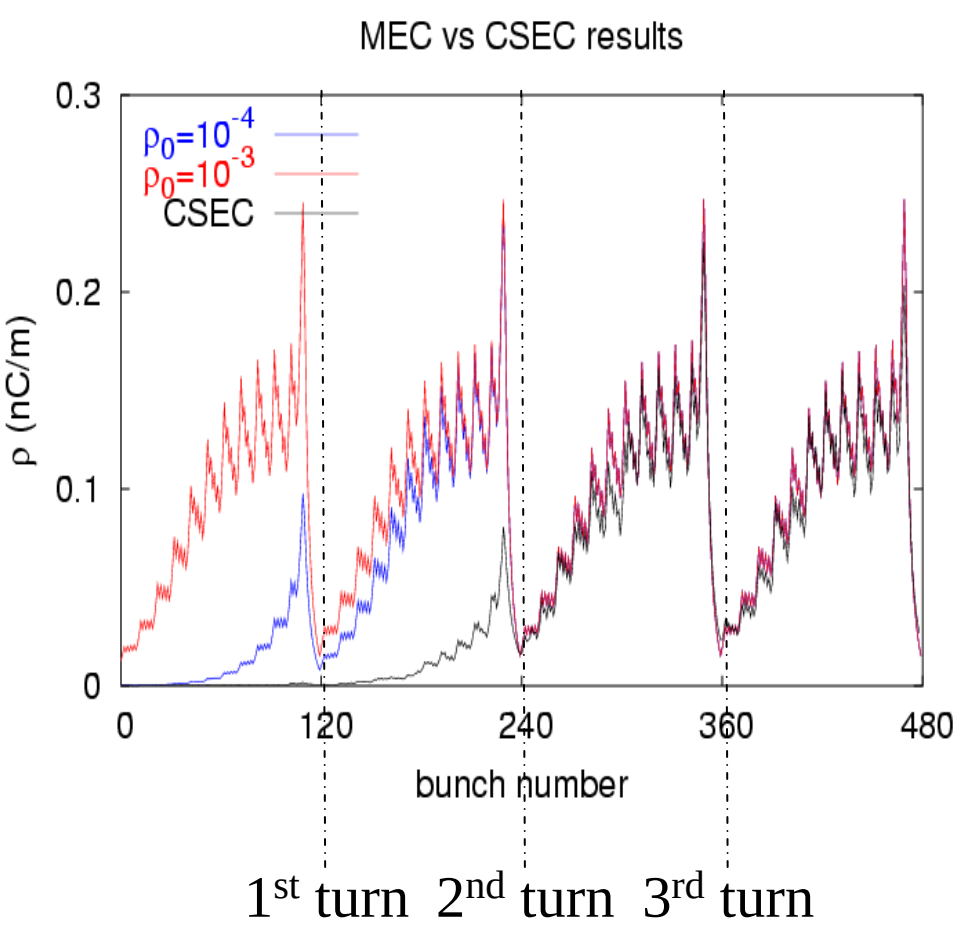
We have quite a few possibilities… 110!/(110-68)!68! ~ 10^30

Ubaldo Iriso

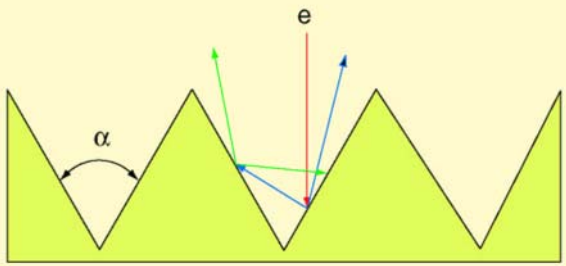
Bunch pattern: (3,12,8)



Bunch pattern:(3,2,0)(6,4,0)



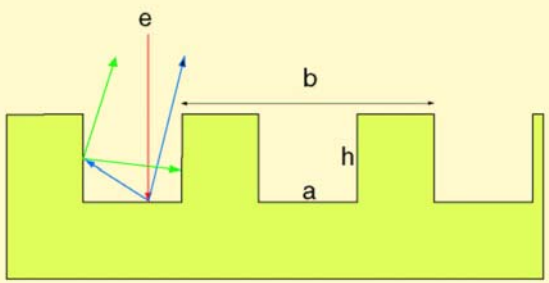
Triangular corrugations



Some secondary electrons will hit the wall and get absorbed. Blue—first generation of SE, green—second generation. A competing factor is that the incidence angle is $< 90°$, which increases the SEY.

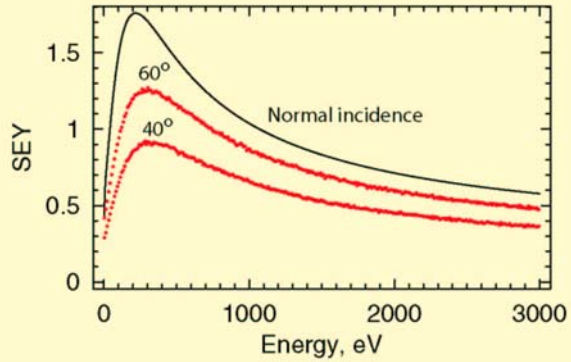
The effective SEY does not depend on the size of the grooves, it is only a function of angle α.

Rectangular corrugations

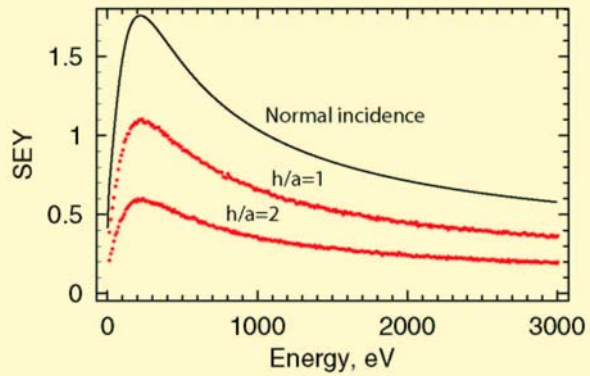


b – the period, h – the height, a – the width.

Triangular grooves, 40 and 60 degrees



Rectangular grooves, neglect ridges



Assume $b = a$

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Effect of magnetic field

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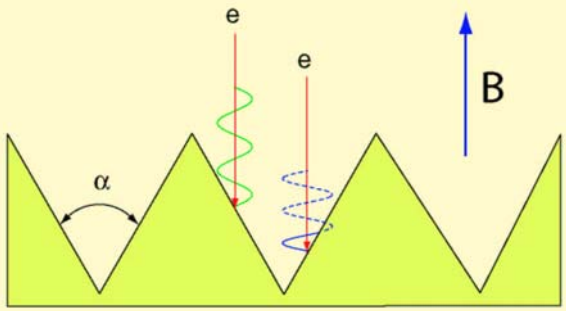

For 200 eV electron, the Larmor radius r_L in 1 Tesla field is about 25 microns. In the limit when $r_L \ll$ size of grooves, the effective SEY does not depend on r_L and is only a function of α.

Triangular grooves, 60, magnetic field

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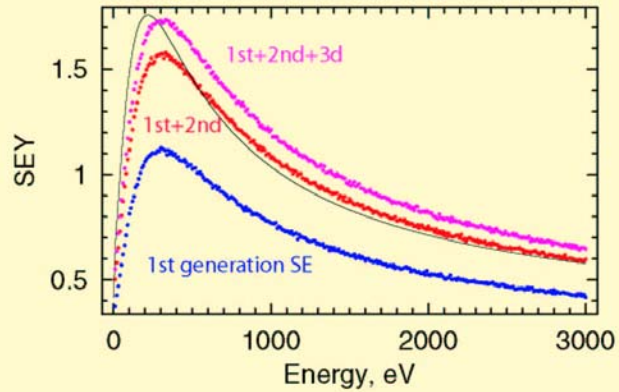

Copper, max SEY 1.75, 60 degrees triangular grooves.

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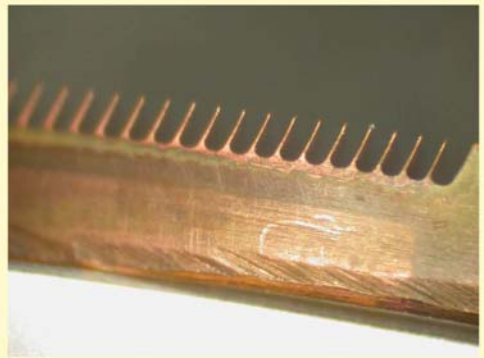
Experiment at SLAC

R. Kirby, M. Pivi and F. Le Pimpec are making experimental measurements of the SEY for grooved surfaces.

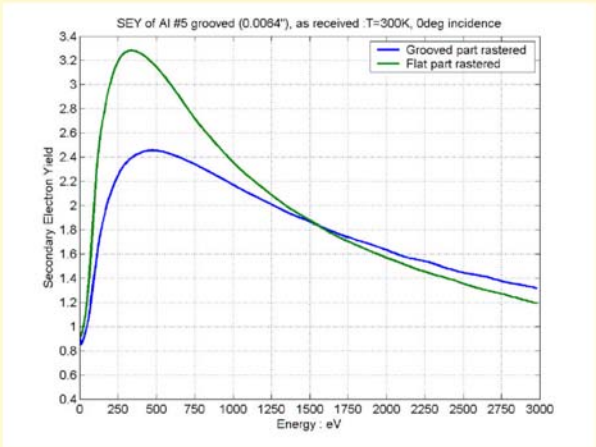
Aluminium sample with α = 40 and depth about 1mm.

Experiment at SLAC



Copper sample

Experiment at SLAC



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ECLOUD code

- compute SPS tune shift expected from measured and simulated flux at wall & compare with measured value
- do we need GUI?
- post latest version on the web/unify with Daniel
- energy contour plots (L. Wang, G. Bellodi?)
- 50% difference due to re-diffused e- - check?
- effect of beam instability on e-cloud build up (S.H.)
- stronger multipacting in larger beam-size direction
- two mode frequencies in wake: electron bounce frequency, gyration frequency, frequencies vary as function of solenoid field (L. Wang); emission pattern important (uniform or localized)
- no resonance for Super-KEKB if Bz<90 G (L.Wang)
- is elliptical chamber better than round chamber?

coasting beam or long bunch

- Yelectron = omegae Te Ybeam? (K . Ohmi)
- electron diffusion (K. Ohmi)
- combination of multipacting & instability (M.B.)

controlled experiments

- e- cooler experiment – try again?
- hot filament as controlled e- source, for coasting beam? (Tom?)
- done at PSR, longit. motion across magnet was measured (B. Macek)

analytical work & HEADTAIL simulations with Elena

- large interest in Elena's pinch calculation (e.g., by G.Stupakov et al.) - can we solve the general nonlinear problem?
- extend simple simulation to flat beams
- longitudinal motion of electrons? – needs estimate
- adiabatic invariant, nonlinear oscillation frequency, energy gain – expressions from L. Wang
- dynamic adaptation of grid size in HEADTAIL
- compare analytical estimate and simulation (analytical number pessimistic, Ali)
- distribution more important than average density
- fully 3D PIC code

#kicks in HEADTAIL

- need to take care of tune spread, then could use 1 kick? (S. Heifets)
- pendulum, 50 years ago, Chirikov, stochastic motion (SSC 1turn maps, 10 turn maps etc.) optimum choice of #kicks (S.H.)
- multiple kicks over 1 betatron period then rest of turn as rotation (A. Chao)
- scaling ~ rho/Qs
- it is easy to see that integer tune can be reduced (M.B.)
- is kick dependence due to longitudinal motion? (T.R.)

LHC e- cloud

- charge exchange with background gas?
- re-diffused electrons
- do we have energy distribution inside the stripes?
- longitudinal wake due to e cloud (K. Ohmi)
- longitudinal coupled bunch instability (K. Ohmi)
- which code was used by S.S Win? What is the difference to L. Wang's code?
- does a solenoid work inside the quadrupole? [my results from KEK, line density & central density suppression by solenoid in quadrupole] – should we consider this for LHC?
- difference between sec. e- and photo-e-? (KEKB/PEP-II, H. Fukuma)

LC e-cloud

- need more optimistic conclusion for CLIC
- tune spread due to e-cloud in CLIC DR?
- effect of coupling for TESLA (model in HEADTAIL)
- e-cloud TESLA, NLC, CLIC – K. Oide
- CLIC – new parameters
- overview plot of threshold vs. spacing

e-cloud diagnostics

- tune shift, emittance, oscillations
- can closed orbit bumps be used to measure e-cloud impedance?
- R. Macek – response to excitation at PSR
- measure BTF@various modes – Elmar V.? (G.A.)
- KEKB & PEP-II think about new monitors…
- measure local density in beam path (PEP-II)
- e-yield and distribution inside magnets (KEKB)
- how to detect e- at beam position?
- fast measurement of e- yield, detect signal in bunch gaps and train gaps, decay time of cloud, channel plate to amplify e- signal

collaboration with USC

discussion with T. Katsouleas
- develop predictive model of LHC for 2000 turns (field-free region: growth -> no growth with dipoles 28 days run)
- develop reduced models that are useful
- develop "30 minutes" model

1) LHC model
Bx,y,z(s) field profile, pusher
Beta(s) for FODO
Spatial structure, stripes, etc/
Pipe impedance
Elliptical chamber (may slow down the code)

USC cont'd

2) Useful reduced models

- single kick with increased density
- hybrid PIC for 1 turn + 100 single kick turns?
- semi analytical: feed PIC into 2-part. Model
- mapping

3) 30 minute model?

others

- CLOUDMAD code
- 1 example with higher pressure rise for RHIC NEG coating
- S.Heifets: solenoids today's best solution - do they work at higher current?
- talk by Dobrin on plasma scattering effect?
- NEG resistivity – Manos Karantzoulis
- SR distribution – DAFNE program?

collaborations

- advertisement for code comparison (EPAC paper) and for ESGARD collaborations
- update web site
- draft letter to be sent out
- add coasting beam or long-bunch example (resembling SNS)
- various parallel 3D codes in progress:

  PARSEC (A. Adelmann)

  WARP/POSINST (Tech-X, LBNL, LLNL)

  ORBIT (SNS et al.)

European Steering Group on Accelerator R&D (**ESGARD**)
[CEA, CERN, CNRS-Orsay, DESY, INFN-LNF, etc.] http://esgard.lal.in2p3.fr/

→ **Within the SIXTH FRAMEWORK PROGRAMME of the EUROPEAN UNION**

Coordinated Accelerator Research in Europe (**CARE**)

3 Networking & 4 Joint Research Activities

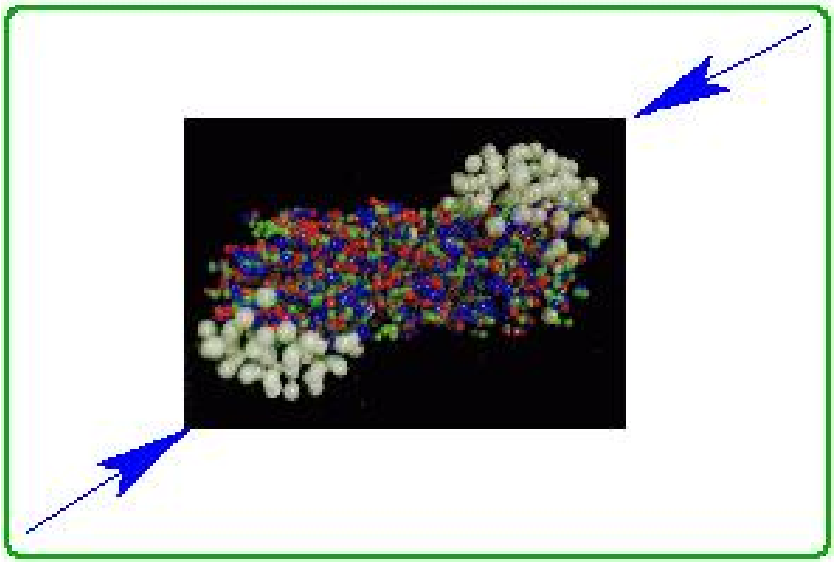
Addressing Electron Cloud:

N2: Electron Linear Accelerator Network (**ELAN**);
TESLA and CLIC (Deputy Coordinator D. Schulte)

N4: High Energy High Intensity Hadron Beams (**HEHIHB**);
SuperLHC, VLHC (Coordinator: F. Ruggiero;
Deputy Coordinator for HEHIHB WP3: F. Zimmermann)

"...**electron cloud… codes** need **comparisons and benchmarking by beam measurements** and are of **common interest** for high-luminosity hadron colliders and high-intensity synchrotrons… …establish a working infrastructure in Europe parallel to the proposed US-LARP programme, which has as objective to streamline R&D work in the 3 big national labs in the US with the additional benefit of contributing to LHC upgrade studies. A **parallel US-LARP and CARE approach** would facilitate further the important information flow and **worldwide collaboration** efforts." [excerpt from N4 WP3 proposal]

HEHIHB



Participants to the CARE N4 Activities:

*(other collaborations that could address e-cloud exist, e.g.,**Int'l ATF Collaboration**)*

Country	Number of institutes	Number of persons
France	2	9
Germany	5	26
Italy	7	20
Japan	1	6
Netherlands	1	5
Poland	1	2
Spain	1	3
Sweden	1	3
Switzerland	2	4
United Kingdom	1	3
U.S.A.	3	25
Russia	2	4
CERN	1	33

Joint abstract on code comparisons submitted to EPAC'2004

Review and Comparison of Simulation Codes Modeling Electron-Cloud Build Up and Instabilities

E. Benedetto, F. Ruggiero, D. Schulte, F. Zimmermann, CERN;
G. Rumolo, GSI, J. Bellodi, RAL; K. Ohmi, S.S. Win, KEK;
A. Ghalam, T. Katsouleas, USC; V. Decyk, W. Mori, UCLA;
M. Furman, LBNL; Y. Cai, M. Pivi, SLAC;
M. Blaskiewicz, L. Wang, BNL; …

other contributors welcome!!

"Several computer codes written at various laboratories are employed for modeling the generation and the consequences of an electron cloud. We review the most popular of these programs, which simulate either the build of an electron cloud or the instabilities it produces, and we compare simulation results for identical, or similar, input parameters obtained from the various codes."