



## **US LHC Accelerator Research Program**

***bnl - fnal- lbl - slac***

# Plans for Electron Cloud at BNL and LBNL

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## Some Input and Context

- Input from CERN people at ELOUD04 (April 19-23) <http://www.cern.ch/icfa-ecloud04>
    - G. Arduini, V. Baglin, J. M. Jiménez, D. Schulte, F. Zimmermann
  - Meeting at LBNL, April 26
    - A. Drees, U. Iriso, M. Furman
  - CERN APC mtg. Minutes (March 19)
  - Individual suggestions from FZ and GA
  - ESGARD has approved CARE program, including:
    - ELAN (CLIC and TESLA; D. Schulte)
    - HEIHB (SuperLHC and VLHC; F. Ruggiero):
- “**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.**”



## Some Issues

- EC survives for a long time at SPS (~few s)
- $e^-$  flux at wall for dipole magnet ~3x simulations both warm and cold detectors
- Measured  $e^-$  spectrum “could agree better with simulations”
- Old vs. new ECLOUD simulations show some discrepancies
  - some comparisons with other codes carried out (after ECLOUD02)
  - qualitative agreement, but differences not explained (for lack of dedicated effort)
- $e^-$  flux dependence on vac. chamber height: peaks at 80 mm (=max. achievable)
- Main “knobs”: bunch length, batch spacing, vac. chamber height, N
  - should be plenty to constrain the model significantly
  - need to constrain SEY model; devise experiment (ie., build-up and dissipation of the EC)
  - revisit satellite bunch scheme



## Partial List of Electron Cloud Tasks

- Main goal: specify optimal LHC conditioning scenario
  - Conditioning of cold surface at LHC likely to be very different from warm at SPS
  - What to do if beam screen SEY does not condition as hoped
  - First attempt at defining scenario
- Tasks at RHIC (suggested by “all” CERN people)
  - Install CERN EC detector in a RHIC cold magnet (J. M. Jiménez, A. Drees)
  - Measure  $\Delta v$  along batch (U. Iriso)
  - Simulate ECE at RHIC, calibrate code(s), understand warm vs. cold EC
    - UI to learn POSINST; go to LBNL, and/or MF to BNL
  - Understand conditioning process in cold sections vs. warm
  - Understand global parameter space (eg., EC density vs. a few parameters)
  - Understand physics of map simulation technique



## List (contd.)

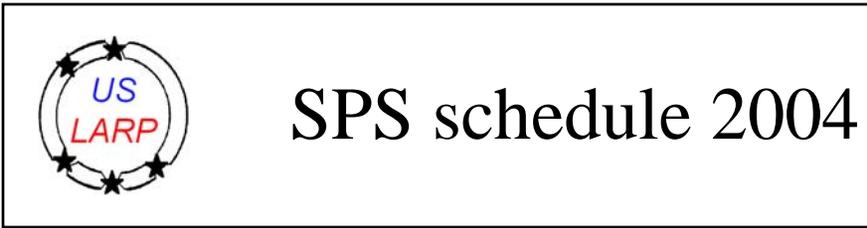
### ➤ SPS

- Devise experiment to be compared against upcoming SPS measurements to constrain SEY model
  - eg., build-up and decay time of EC vs.  $N$ ,  $s_B$  and batch gap length (FY04-05)
  - Estimate EC build-up and decay in quads (SPS plans to install “sweeping” detector) (FY05+)
- US-LARP personnel to participate in scrubbing SPS MDs (next week)
- Reproduce measured spectrum and spatial distribution (FY05)
- Reproduce calorimeter results (FY05)
- Understand POSINST-ECLOUD differences (FY05) (suggested by FZ)
- Think about BTF measurements (requested by GA)
- Think about microwave transmission measurements of EC density (suggested by FZ)
- Measure ion desorption count and composition by ion bombardment (requested by JMJ: send one person to CERN for a year to do measurements)



## List (contd.)

- Better measurements for simulation input (requested by FZ)
  - SEY at low energy (<20 eV); reproduce CERN data (Cimino-Collins)
  - Photoelectric yield and photon reflectivity (cold vs. RT; B-field effect) for actual sawtooth beam screen samples; resolve existing discrepancies (at ALS?). *Further discussions with CERN needed before proceeding.*
- LHC
  - CERN will install an ECE diagnostic bench in IR4 (J. M. Jiménez) similar to SPS.
  - Simulate and predict! Good for LARP to play important role in this.



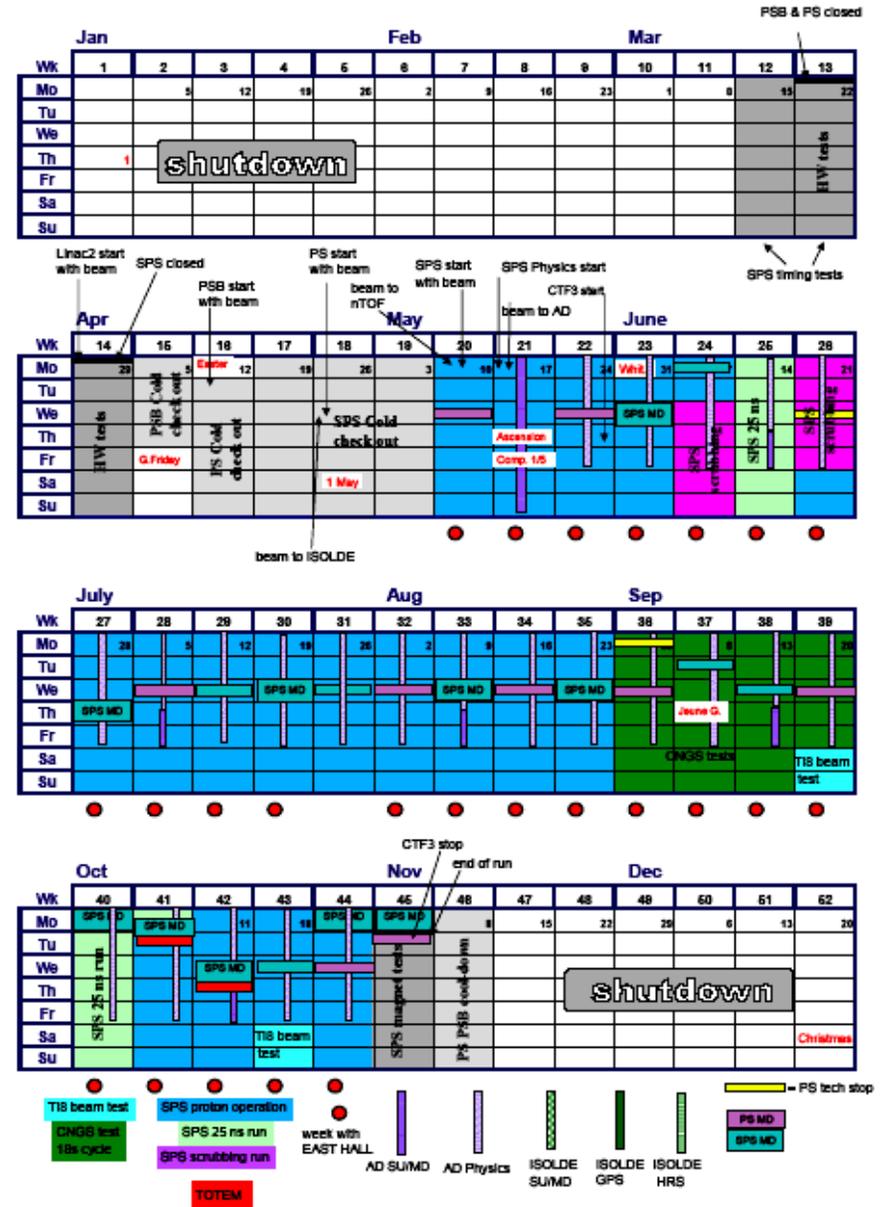
## Scrubbing runs (weeks 24 & 26):

- $N=(0.3-1.3) \times 10^{11}$ , min.  $\epsilon$ , fixed  $\sigma_z$ , 1-4 batches,  $s_B=25$  or  $75$  ns

## Some expected results:

- max. N and fill pattern at 25 and 75 ns for given cooling rate
- improve precision in measurement of conditioning efficiency for cold dipoles
- measure heat load and partial pressures in COLDEX
- EC build-up in quads
- EC build-up in TiZrV-coated chamber before activation (use artificial seed electrons)

## 2004 Accelerator Schedule





## More SPS MD details (from G. Arduini and J. M. Jiménez)

- Weeks 24 and 26: scrubbing (MD people have full control of beam)
- Week 27: beam stability, optimize the machine settings to get rid of the last 10-20% in emittance blow-up in order to get the nominal parameters. Measurements with COLDEX and electron cloud detectors and calorimeters.
- Weeks 29 and 31: coasts (with RF on) of 1-2 LHC batches at SPS injection energy ( $p=26$  GeV/c). Study the issues of long term emittance blow-up for the nominal LHC beam. Benchmark HEADTAIL or similar codes (which are predicting important emittance blow-up).
- Week 40: coast with 1-2 LHC batches (nominal intensity) at  $p=270$  GeV/c for similar purposes as above.
- Week 45: not yet defined.



## Our Plans

- SPS shifts during “scrubbing runs” (next week)
  - Ubaldo Iriso, Mauro Pivi, Miguel Furman
    - CERN contact: Gianluigi Arduini
- Deliverables for FY05:
  1. Participate in SPS EC experiments and studies (next week)
  2. Install cold EC detector in RHIC (10/04)
  3. Report on simulated reproduction of measured spectrum & spatial distribution of SPS e-cloud (4/05)
  4. Report first cut at defining optimal LHC conditioning scenario (6/05)
  5. Report on applicability of map simulation technique to LHC (9/05)
  6. Report on cold EC in RHIC (9/05)
  7. Report on simulated EC at IR4 diagnostic bench (10/05)
- FY05 budget: 0.3 FTE for LBNL plus 0.3 FTE for BNL