Electron Flux in Dipole Fields

APEX workshop, Nov 9-10, 2005

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- CERN-BNL Collaboration
- Mechanical Design and IR10 Layout
- Status and Schedule
- Experimental Plan

CERN-BNL Collaborative Effort

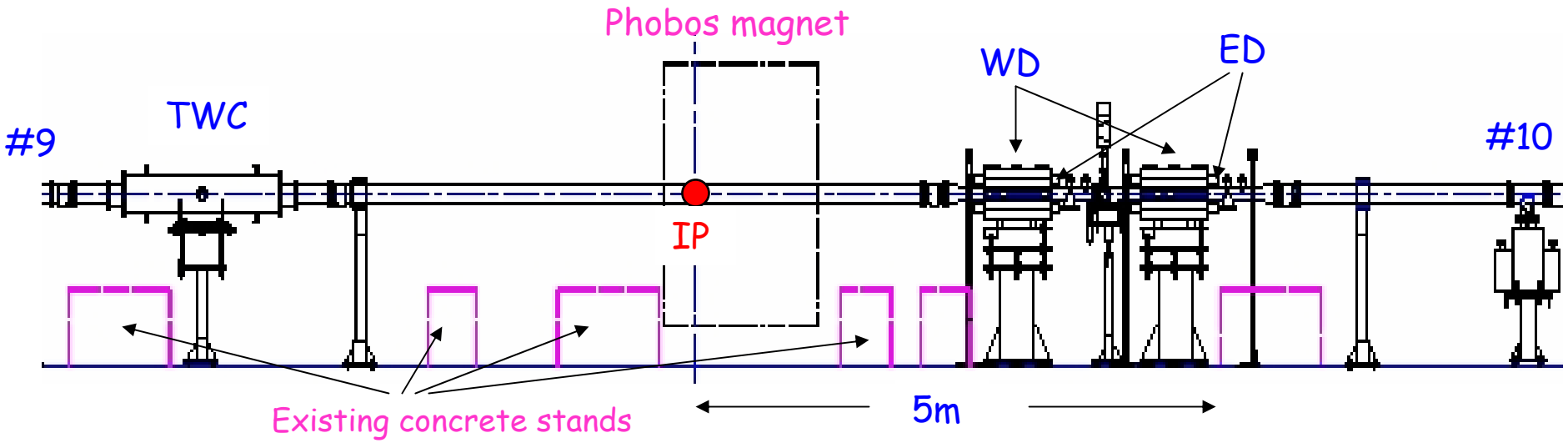
- The objectives of the BNL/CERN Collaboration as stated in the collaboration agreement report are:

- *"… installation of a set of detectors including a strip detector to compare the electron cloud build up in the SPS and in RHIC with protons using the same types of detectors in both field free (FF) and dipole field (DF)."*

- *"The baseline is a strip detector (SD) with a lateral resolution of 1 mm which covers half of the full perimeter of the circular chamber. To help in the understanding of the results provided by the strip detector, it is foreseen to install additional probes like shielded pick-ups, charge (ions or electrons) collectors, retarding field detectors (RFD) and residual gas analyzer to study the build up and the energy distribution of the electrons in the cloud and the vacuum behavior. These detectors will also provide turn-by-turn measurements. An unshielded pick-up shall be installed to trigger the readout electronics."*
- *"The strip detector shall be installed in a remotely controlled dipole magnet in order to be able to study the electron cloud build up in both field free and dipole field conditions. A PC computer will control the data acquisition."*

New IR10 Layout

(constrained by PHOBOS magnet and concrete stands)



To remove

Phobos detectors, and 3 x 4m beryllium beam pipes (special Be WP)

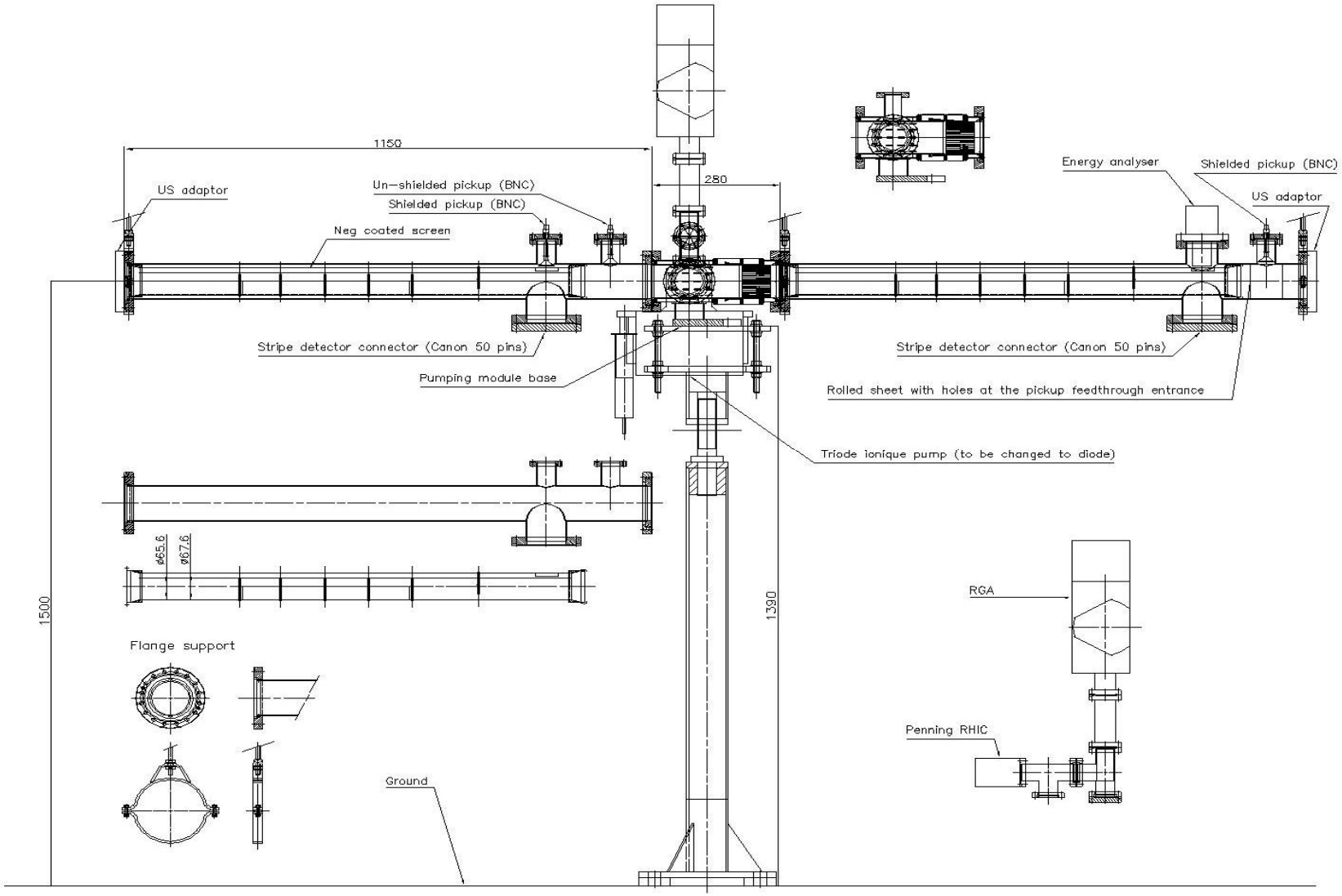
To Install

Traveling wave schottky pickup (TWC) @ #9 side

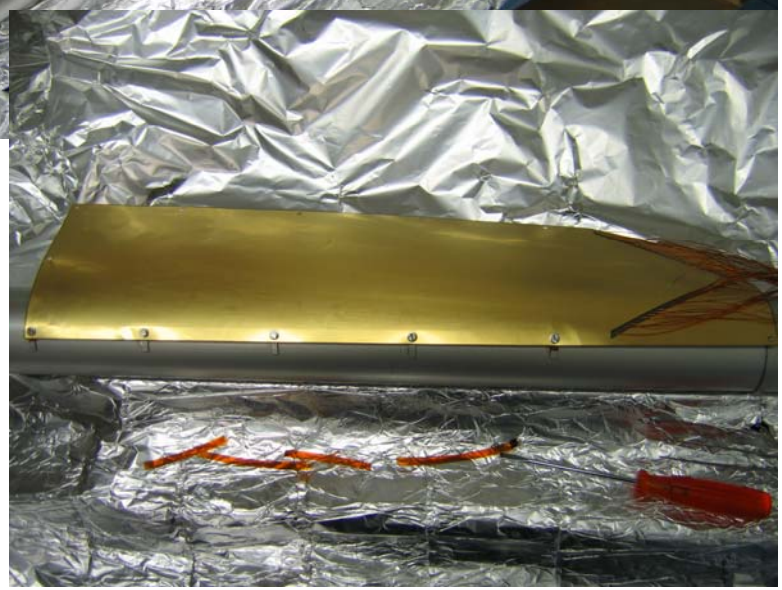
Two electron detectors (ED) and two warm dipoles (WD) @ #10 side

8.5m NEG coated 5" Φ stainless pipes

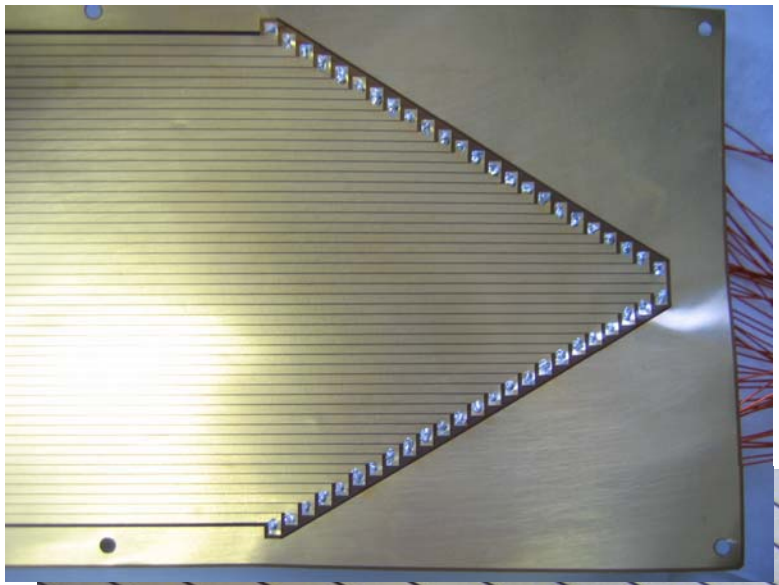
Mechanical Design
Assembly Drawing

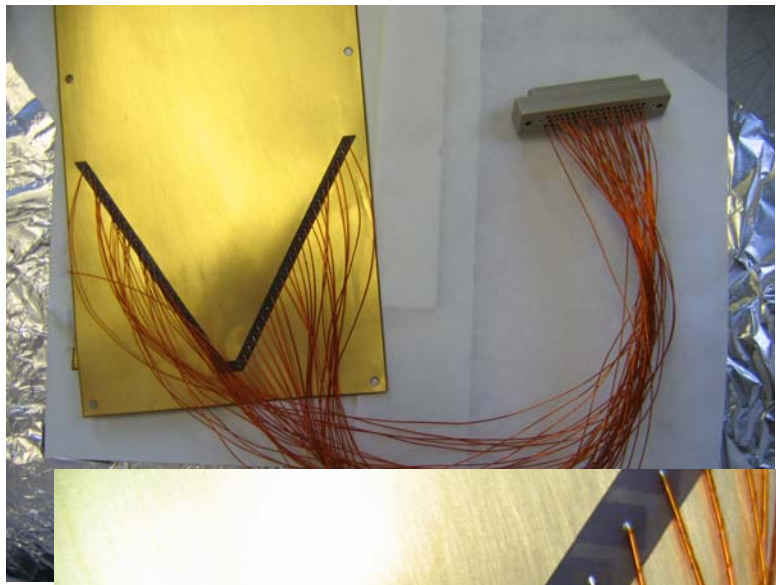


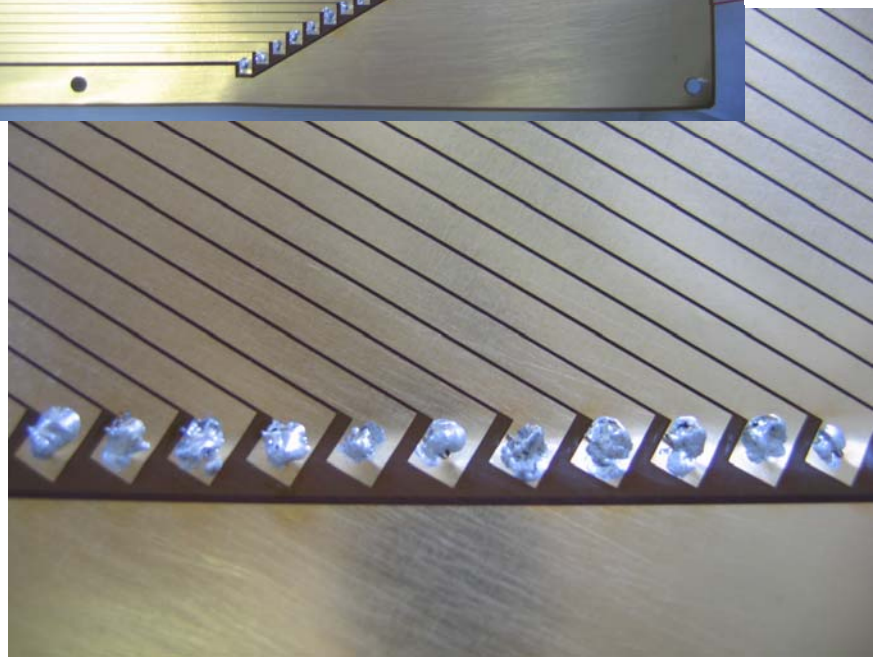
Mechanical Design
Picture of the SD Insert Screen

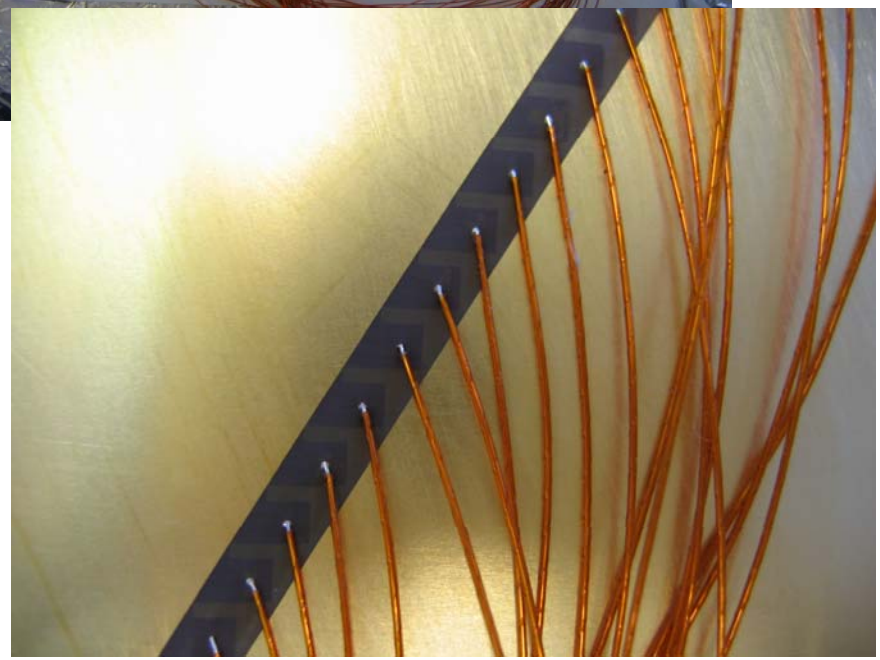


Mechanical Design
Picture of the SD Collector

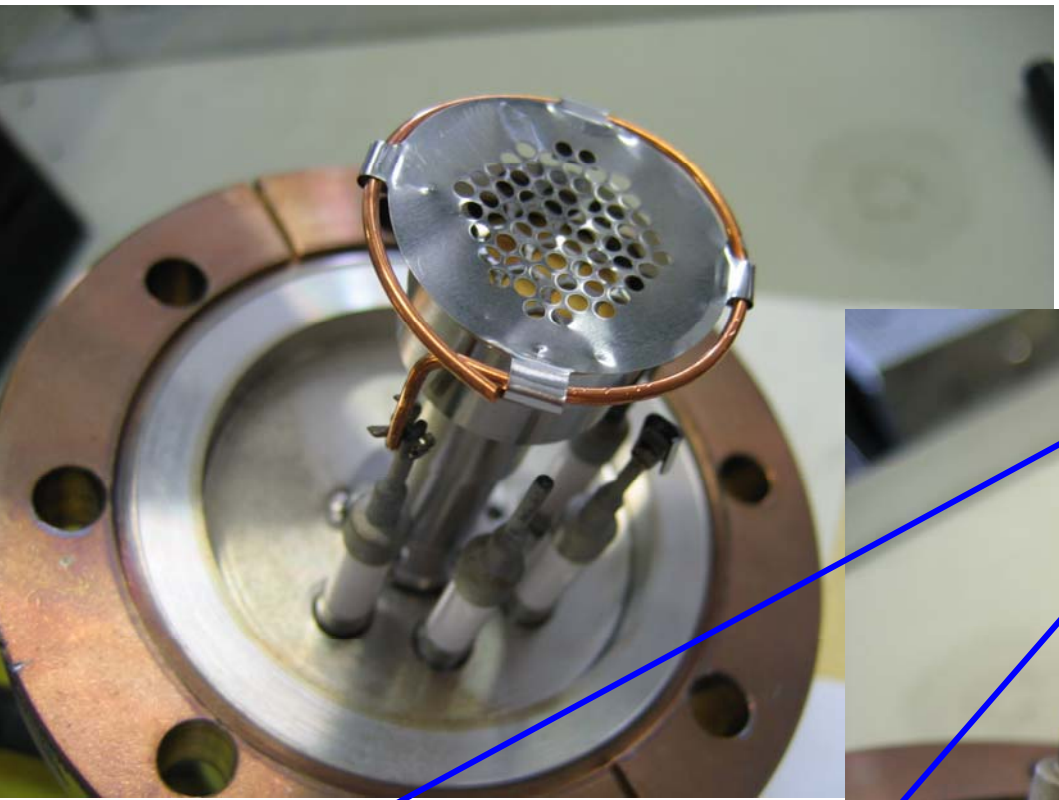


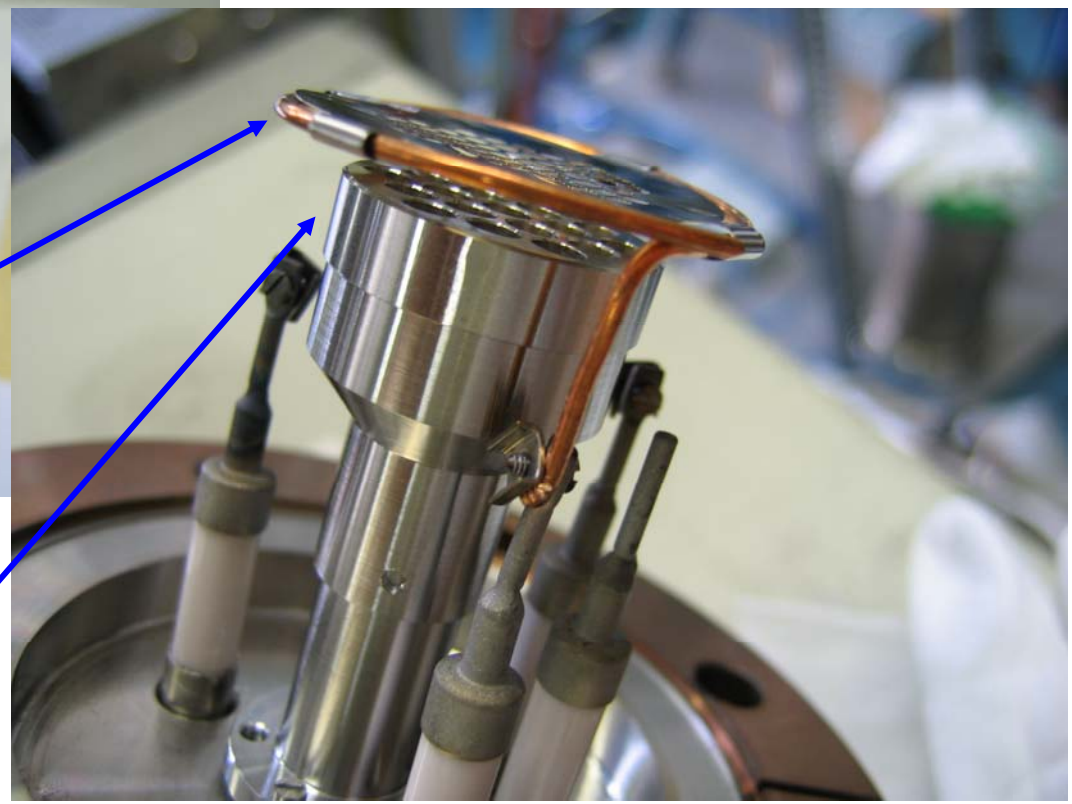






Mechanical Design
Retarding Field Detector Pictures





Filtering grid
GND Grid to avoid capacitive coupling between Collector & Filter
Collector inside the “Cage”

Mechanical Design
Picture of the Pick-ups (shielded or not)

Electronics & Control Interface

- Characteristics
  - 1 rack with 8 cards of 16 channels each.
    - ⇨ 3 cards required / SD detector
    - ⇨ 1 card for pick-up & RFD acquisitions
    - ⇨ 1 spare card
- Status

  The rack is assembled and available at CERN. It is not here yet in order to be able to check the Control interface system and the acquisition software before shipping.
- Control Interface
  - Mobile PC computer running under LINUX
  - implementation (beam sync clock triggering?) still under discussion

Acceptance tests and Vacuum Performances

- Vacuum performances after 48 h bake out at:
  - Non-NEG coated chamber: 200°C
  - NEG coated chamber: 150°C
  - Instrumentation modules: 250°C
  - ⇨Final pressure with 40 l/s pumping speed (NEG not activated): 1 10^{-9} mbar
  - ⇨with (near) NEG activated: ~ 10^{-10} mbar

Schedule and Status

PHOBOS schedule:

- removing PHOBOS detector components and survey completed.
- IR10 handed over to CAD by beginning of October

C-A Schedule:

10/10-12: Disconnect and remove Be beam pipes
Remove WD from YO5 to IR10
10/13-14: Install central beam pipe, warm dipole stands, and TWC stand
10/17-21: Install & survey warm dipoles and electron detector chambers
10/24-28: Assemble other vacuum components, pump down, test

Done

10/31-11/10: Prepare for bake (in progress)
11/14- …: in-situ bake entire IR10 (earliest beginning: next week)

Nov: Cable pulling and termination,
Nov: Magnet bus and water connection

Experimental Goal

- common interest of LHC and RHIC in the results of the study
- hardware (superior by x100 to existing devices in RHIC) will remain in RHIC
- detailed study of electron cloud effect beyond what has been done:
  - filling pattern effect
  - electron survivors (in the gap)
  - identification of the filling pattern providing the highest luminosity
  - code bench marking
  - vacuum composition
  - electron energy distribution

Proposal

measurements:

- need 2 times 6 hour shifts
- measure with one or two circulating beams (provides smaller bunch spacing) => installation in IR10
- need variety of filling patterns and intensities at flattop (100 GeV or 250 GeV)
- measure build up with and without dipole field (up to 200 Gauss) with identical equipment (warm dipoles are installed)

before/after:

- do simulations for both machines (SPS and RHIC) using US and CERN codes:
  - SPS measurements were done with identical detector
- compare RHIC data with simulations and data from SPS

Beam Experiment Proposal

Experiment Number:	05-08
Beam Experiment Title:	Surviving electrons in gaps
Spokesperson(s):	A. Drees, M. Jimenez
Status:	Proposed
Team:	M. Jimenez, A. Drees
Experiment Goal:	Study electron cloud build up in RHIC with protons in both, field free (FF) and dipole field (DF) conditions with the new electron detection system from CERN (to be installed in shutdown 05). In particular study the electron survivors in the gap as a function of the filling pattern in FF and DF.
Benefits:	General accelerator physics: Compare electron cloud build up in the SPS and RHIC using the same types of detectors (code benchmarking). Upgrade: predict operational limits due to electron survivors in RHIC. Performance: understand actual performance limits due to electron cloud better (x100 more sensitivity of new detectors, capability of measuring energy distribution in the cloud, analyze vacuum with residual gas analyzer).
Experiment Description:	Measurements shall be made with one or two circulating beams at top energy (100 GeV or 250 GeV). With one circulating beam we`ll need a smaller bunch spacing to enhance multipacting probability. We need to turn on and off the local dipoles. We want to measure the build up and the enegy distribution of the electrons in the cloud together with the vacuum behavior as well as the decay of the cloud in varying gaps.
Resources:	
Instrumentation:	To be installed: two new dipole magnets and controls. CERN type strip detector, retrading field detector, shielded pick-up, charge collector and gas analyzer together with acquisition electronics and controls. Unshielded pick-up or beam sync link for t
Application:	RHIC injection, beam sync module to be done: controls applications of new hardware (see above)
Time:	2 half-shifts of 6 hours each in proton run FY2006
Personnel:	A. Drees, M. Jimenez, W. Fischer, R. Michnoff (?), R. Lee, D. Hseuh
Plan for Data Analysis:	- compare results from RHIC with results from SPS - compare results with simulations (code benchmarking) - both with FF and DF * measure cloud density as a fct. of gap length * measure electron enegy distribution * study vacuum composition and evolution * study build up of cloud as a fct. of filling pattern