IPP MD Days 2025
Dedicated MDs: COLDEX

EDMS: 3229887

V. Baglin

Injector Performance Panel MD Days, CERN, 3rd February 2025

https://indico.cern.ch/event/1488714/timetable/#20250203.detailed

2024 Conditions

- Beam screen:
  - Since 2021 with “thin” a-C coating ~50 nm thick with 135 nm Ti underlayer
  - This is the HL-LHC base line for LSS1 and 5

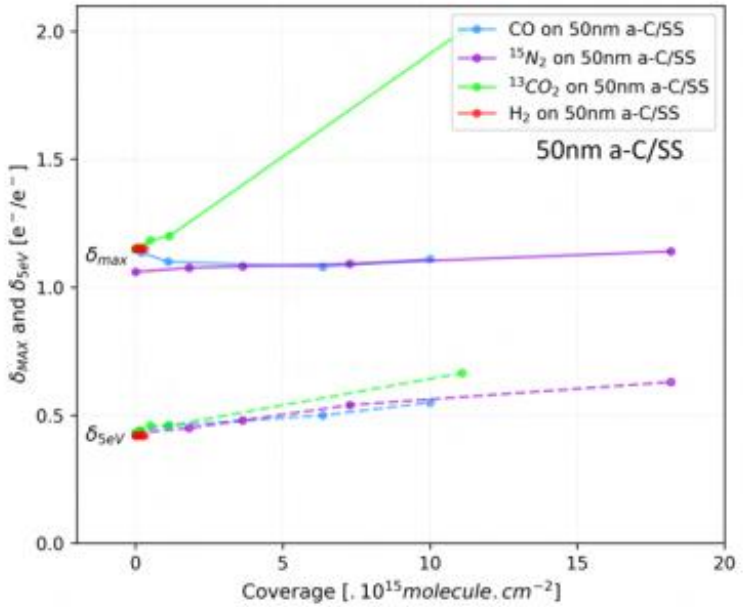
- COLDEX:
  - Full remote control COLDEX IN/OUT without tunnel access.

- Beams:
  - 1- 4 trains of 72 b, 1.6E11 ppb, at 26 GeV, nominal emittances - scan batch spacing during run (200-2500 ns)

- CB at 250 K, BS at 10 K

- CO_2 pre- condensation:
  - MD#1 on 29/5/24 : No beams
  - MD#2 on 31/7/24
    - Part 1: 20 10^{15} CO_2/cm^2
    - Part 2: 40 10^{15} CO_2/cm^2
  - BS at 10 K and CB at 250 K during gas injection

- Expect SEY larger than 2, so large heat load

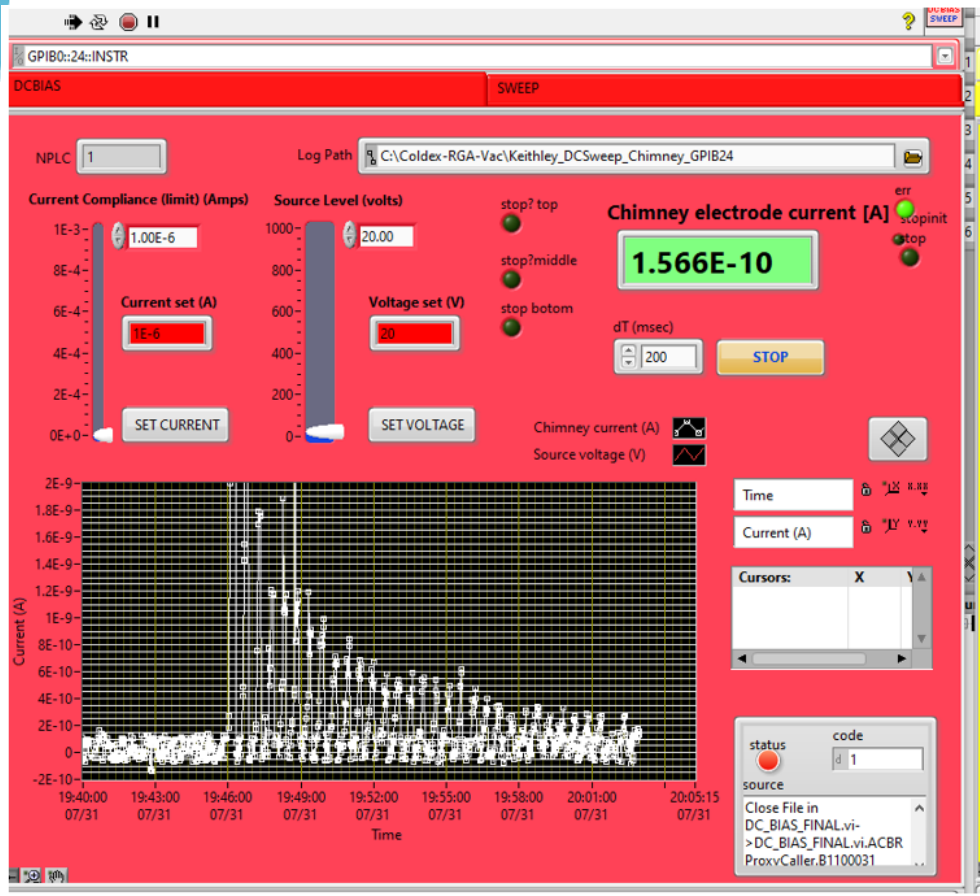


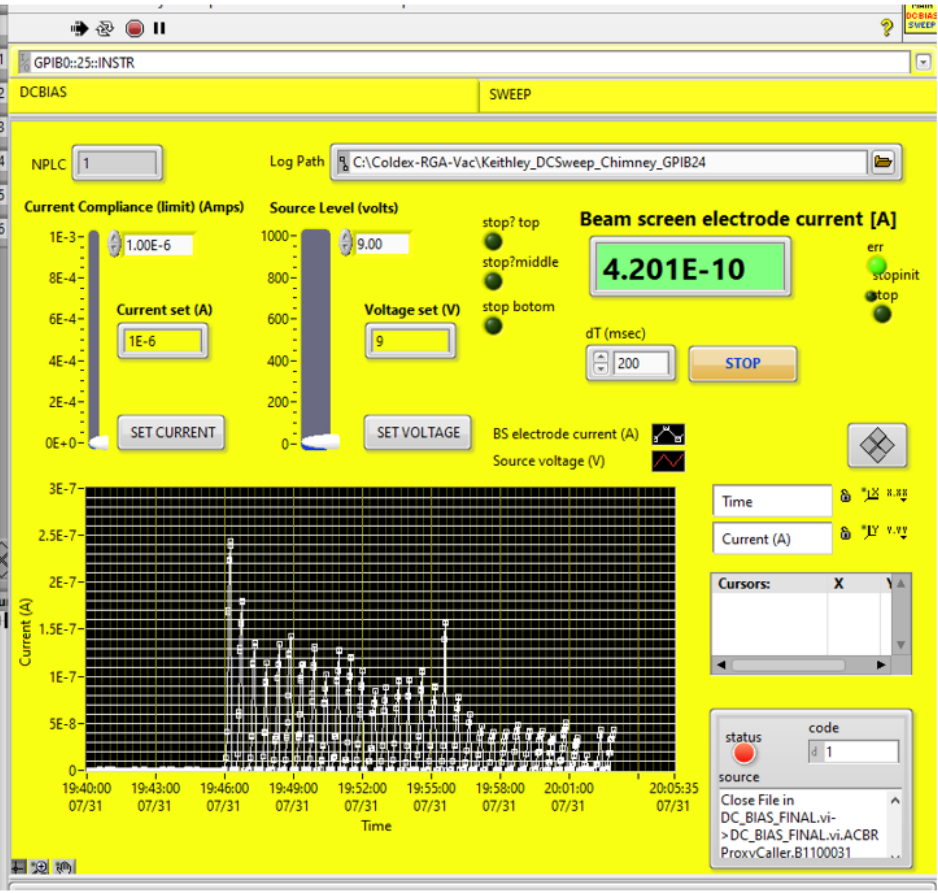
M. Haubner, PhD thesis, May 2023

MD2 Results – Coldex

- 4 batches – 1.8e11 ppb – 72 b/batches – spacing 250 ns

- Observation of electron current at Chimney and beam screen electrode
  - Electron cloud all along COLDEX for the first time with aC coating





MD2 Results – Coldex

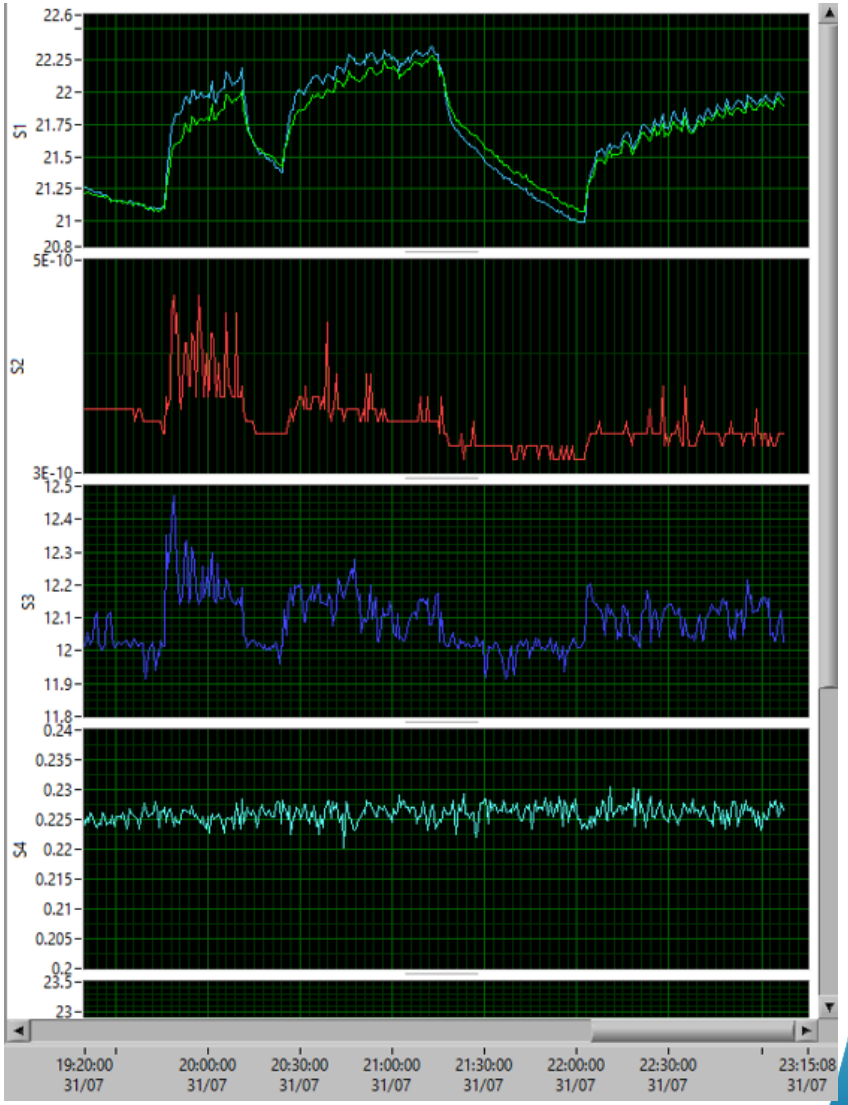
- 4 batches – 1.8e11 ppb – 72 b/batches – spacing 250 ns

- Heat load on RT aC WAMPAC
  - 0.75 ˚C temperature increases
  - ~ 0.1 W/m

- Pressure increases in COLDEX
  - Below 10^{-10} mbar

- Heat load in COLDEX
- Decreases with time
  - 0.2 K is equivalent to 0.1 W/m

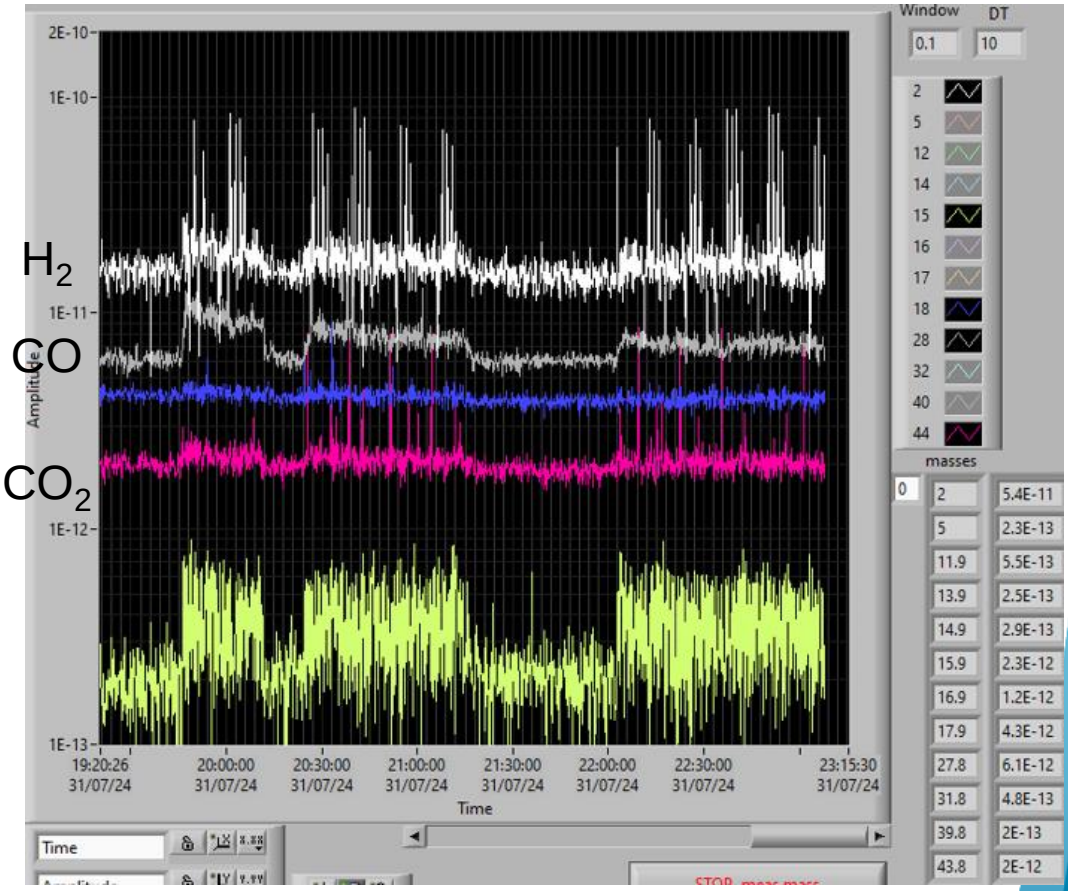
CO_2 adsorption promotes electron cloud but cleaning effect



MD2 Results – Coldex

- 4 batches – 1.8e11 ppb – 72 b/batches – spacing 250 ns

- Observation of partial pressures
  - CO_2 is cracked into O_2 and CO
  - CO is the larger than CO2



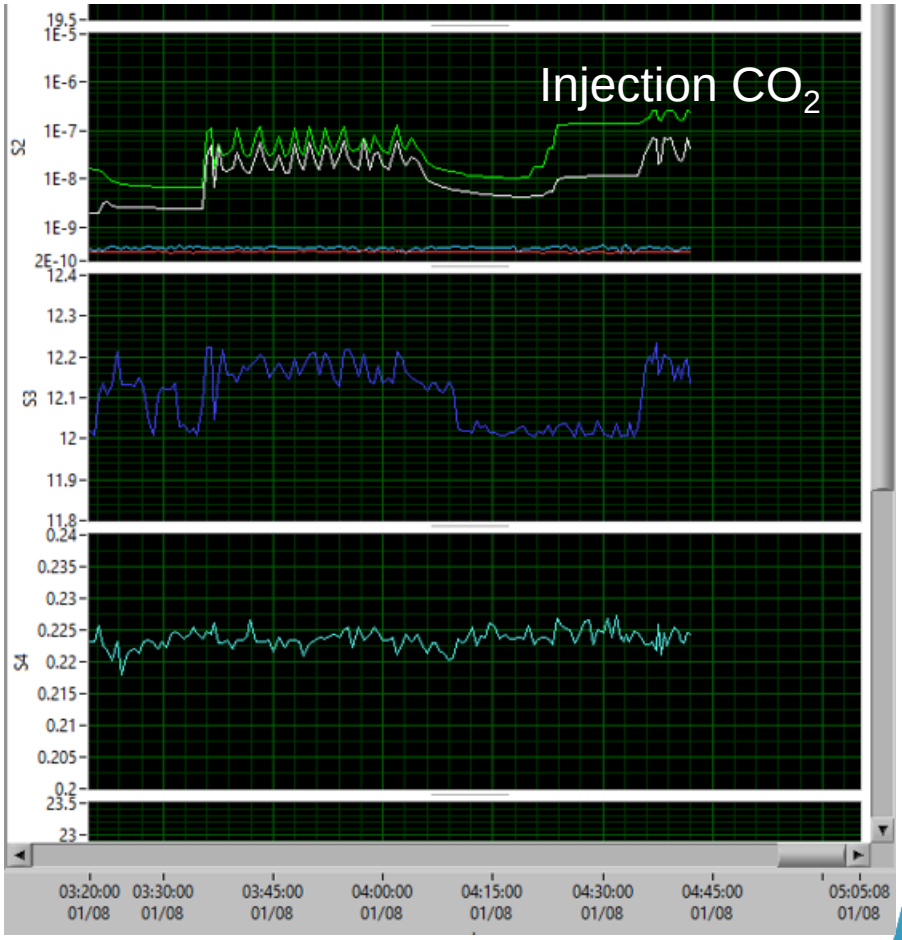
MD2 Results – Coldex

- 4 batches – 1.8e11 ppb – 72 b/batches – spacing 250 ns
  - + CO2 injection at 10^{-7} mbar

- Start injection at 4h20
- Beam ON at 4h35

- Similar heat load in COLDEX
- The gas injection does not seem to promote more electron cloud

High pressure operation in LHC will not trigger larger electron cloud



MD plans 2025

- Objectives:
  - Investigate effects due to CO and N_2 (mimic leaks) condensation
    - On Cu, measured SEY in the laboratory is
      - low for CO (less than 1.2) so low heat load
      - Large for N_2 (about 2)
    - but observation of large heat load in the past with COLDEX and CO
      ➔ important to check in-situ

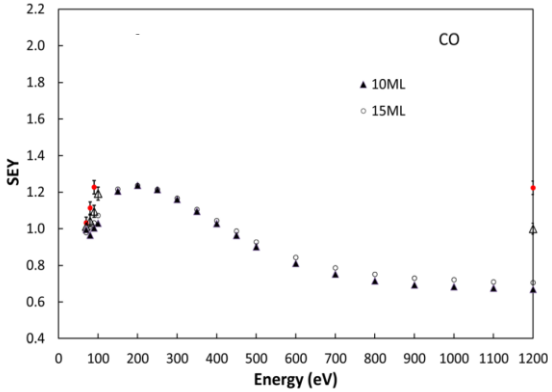


FIG. 4. (Color online) SEY of adsorbed CO on copper as a function of primary energy for different coverages.

M. Taborelli et al, JVSTA 30051401 (2012)

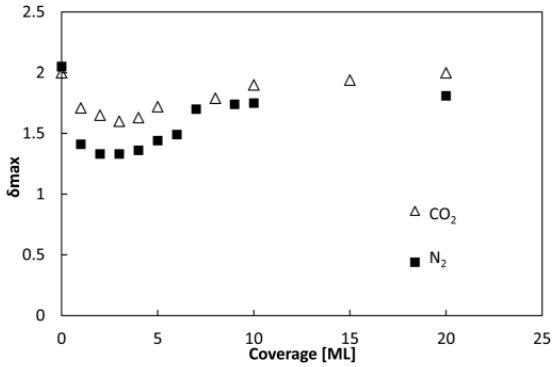


FIG. 9. Maximum yield δ_{max} as a function of CO_2 and N_2 coverage on copper.

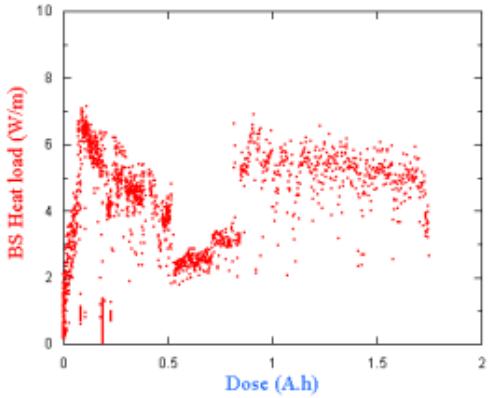


Figure 4: BS heat load when 1 to 4 batches circulated with 60 10^{15} CO/cm^2 condensed onto the BS.

COLDEX Cu beam screen – EPAC 2024

2025 Conditions

- HL-LHC type beams
  - Injection energy, long flat bottom (~ 20 s)
  - 25 ns bunch spacing
  - Require stable beams with 4-5 batches and as large as possible number of bunches (72 bunches/batch).
  - As close as possible to HL-LHC bunch intensities
  - Side by side and opposite batches filling scheme to disentangle impedance effects
  - Long period of stable beams with sequences of beam ON/beam OFF/beam ON is required to measure tiny signals (2-3 h are required to measure a point)

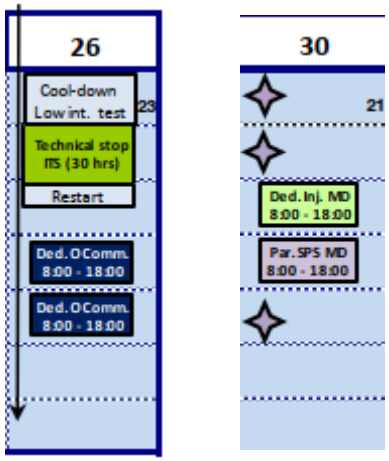
- CB temperature = 300 K
  - ➔ avoid condensation pumping on CB
- BS temperature at ~ 10 K

- With pre-condensed injected gas,:
  - MD1: CO injection while BS is at 10 K
  - MD2: N_2 injection while BS is at 10 K
    - ➔ Will close the COLDEX aC experimental program

2025 MD time proposal

- Two dedicated MDs
- Separated by more than 3 weeks to allow data analysis and surface preparation in between
- Tentative dates:

Monday 23 June



Wednesday 23 July

(Wednesdays 30 July & 13 August are alternative dates

- Keeping the COLDEX studies during the first semester allow to maintain the cool down time to 6 months
- Possibility for the crab cavities to perform studies in parallel

Acknowledgements

A big thank you from the COLDEX team to everyone involved:

- HL-LHC project, TE and VSC management and IEFC for their long-standing strong support
- MD coordinators & BE-OP for their flexibility and beam quality
- TE-CRG, TE-VSC-ICM, IVO, BVO and SCC for permanent support & expertise

Thank you for your attention!
Questions?

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