Electron Cloud Stuff with Transverse Beam Islands

- Neetish Pradhan
  BE-ABP-HSS
  (University of Mississippi)
The Scenario

- Gotta ramp up those particle accelerators!
- Beams previously in bunches 50 ns apart.
- In 2015: bunch spacing to be decreased to 25 ns.
- But, problems!
The problem: Electron Clouds

- Electrons given off:
  - Proton beam interacting with residual molecules
  - Synchrotron radiation: due to transverse acceleration by bending magnet
- Primary electrons: accelerated by passing beam, strikes chamber wall
  (accelerated to few 100 KeV)
- Secondary electrons given off: may be accelerated by next bunch of beams
- Shorter bunch → more likely next bunch will arrive in time
- So secondaries strike wall as well, and so on... electron avalanche!!!
- Cause problems: beam instability, heat load, etc.
The solution: Scrubbing

- Electron avalanches mitigate themselves!
- SEY: secondary electron yield – of surface
  - Decreases after prolonged exposure to electrons
- So the beam itself reduces electron cloud buildup
- Dedicated
  “scrubbing runs”
  to maximize
  EC buildup in
  the beam chamber
- Fig: decreasing SEY
My Job

- Pyecloud: developed by Giovanni Iadarola
- Run simulations – find how beam properties affect electron cloud formation.
- Find the best candidate for scrubbing.
Five islands are more than one!

- Idea: 5 island beam would cover more cross-section than a single beam
- Using beam file generated by Dr. Massimo Giovannozzi

Fig:
5 islands in phase space
Propagating through SPS
Comparing with original beam

- Confirmed coverage of more cross-section
- Also found higher total flux for same intensity! (non-linear effects)
Alternative: three islands

- Also tried a 3 island beam (wrote algorithm to separate the islands)

- Electron flux more evenly distributed
Results (comparing electron yields)

More analysis to be done!

5 beamlets seem best right now
Acknowledgements

• Supervisors:
  – Giovanni Iadarola
  – Massimo Giovannozzi

• Pics stolen from Giovanni's thesis