Modelling Cyclotron Resonances in ECLOUD

1) Comparison with CesrTA and PEP-II Measurements

2) Exploration of SEY parameter space

3) Next Steps

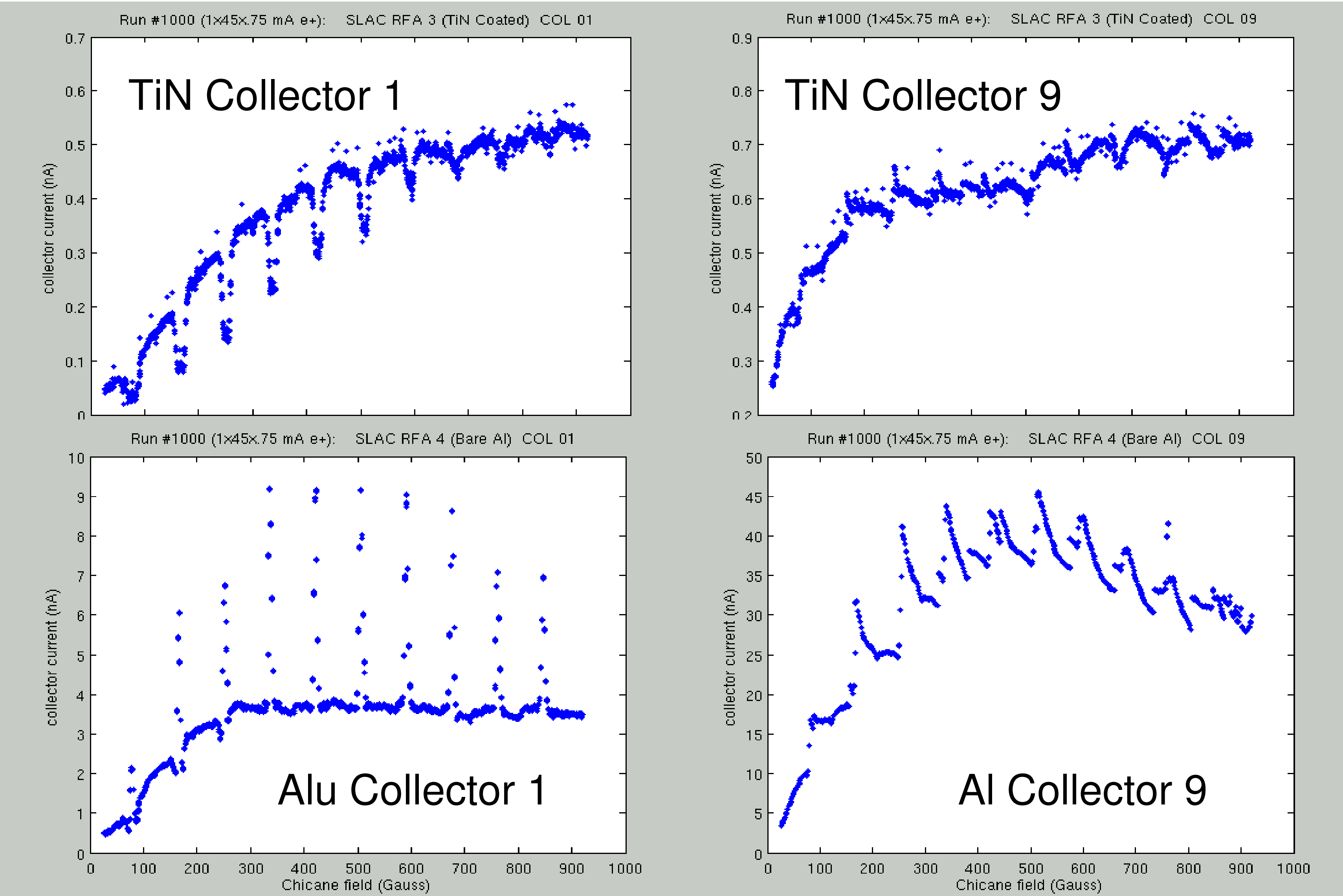
Jim Crittenden

Cornell Laboratory for Accelerator-Based Sciences and Education

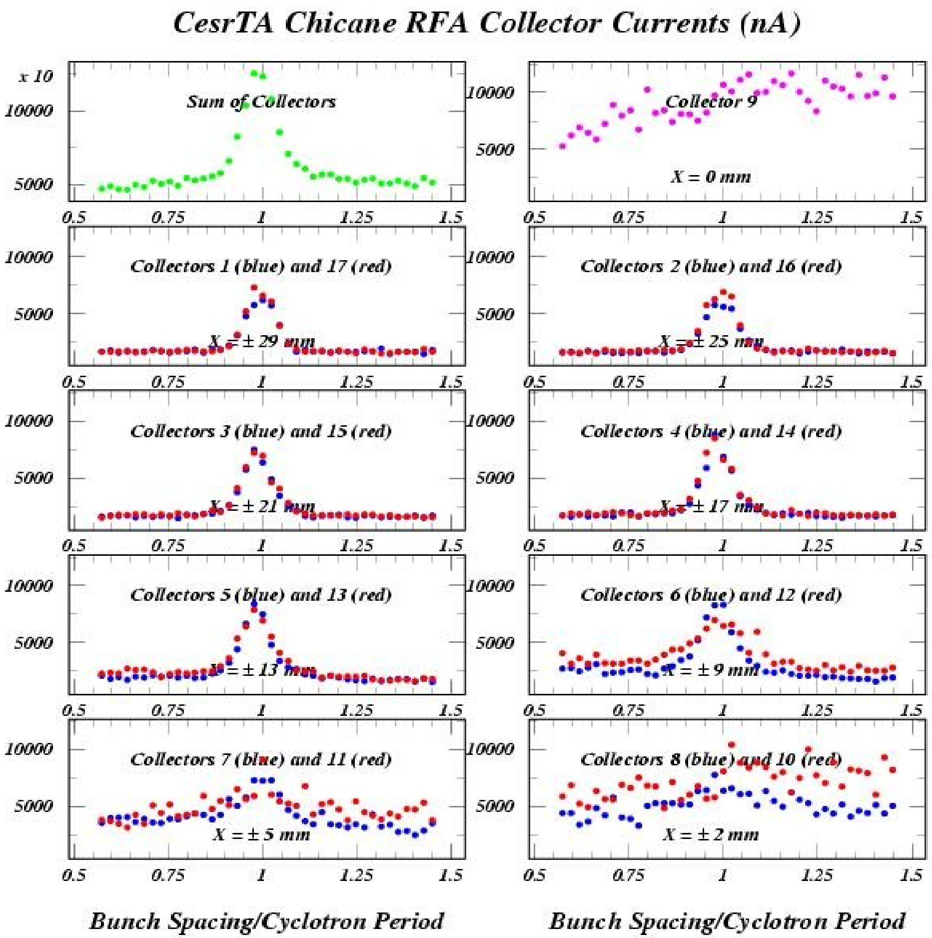
Electron Cloud Simulations Meeting

22 July 2009

June 2009 CesrTA Measurements
See talk by Joe Calvey, CTA09
4 ns, 2 GeV



ECLOUD Model for CesrTA Aluminum
$\delta(0)=1.0 \quad \delta_{max}=2.0 \quad E_{peak}=300\ eV$



Collector number defined by azimuthal impact position on wall.

RFA area and transparency used to calculate currents.

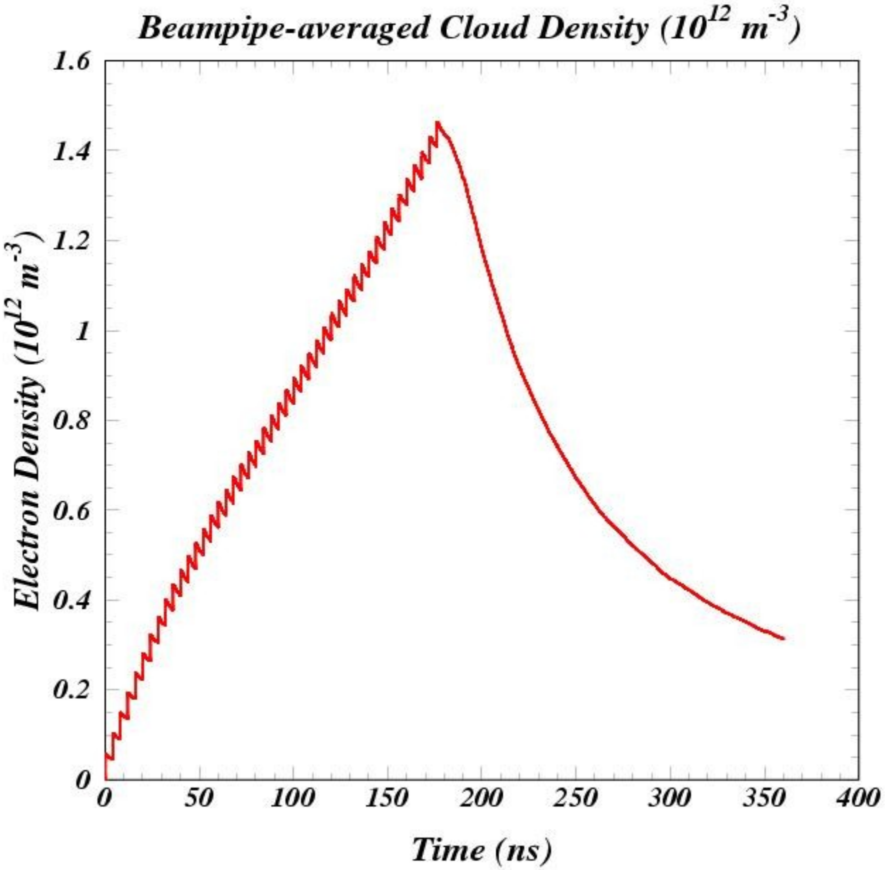
Summed over 90 bunches, 45 filled, 0.9 mA. with 4 ns spacing.

No modelling of kinematic acceptance or cloud/RFA interaction

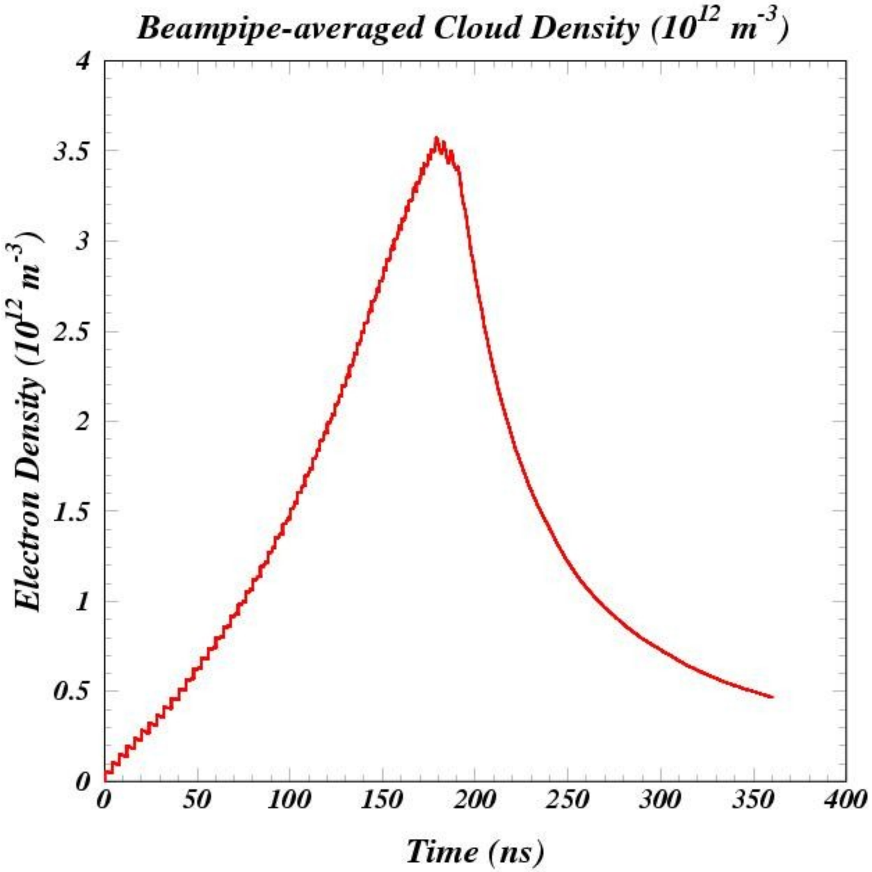
Resonant enhancement for uncoated Al chamber.

ECLOUD Model for CesrTA Aluminum
$\delta(0)=1.0$ $\delta_{max}=2.0$ $E_{peak}= 300$ eV

Off resonance / n=1.45 B=129 G



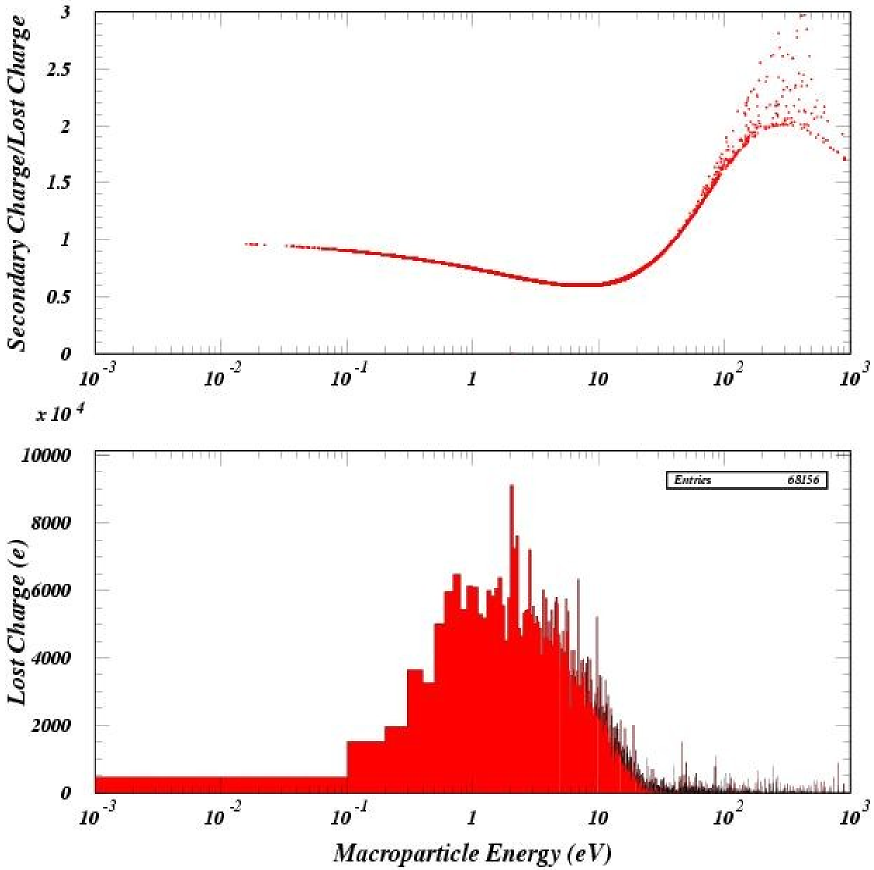
On resonance / n=1.0 B=89 G



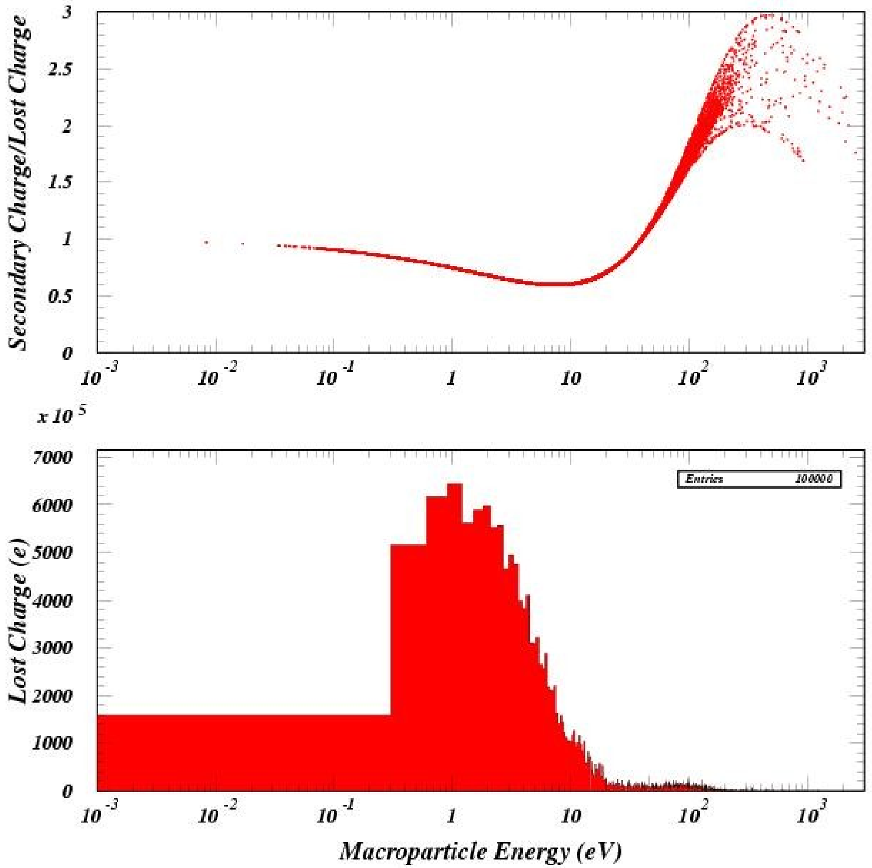
No saturation for CesrTA conditions.

ECLOUD Model for CesrTA Aluminum
$\delta(0)=1.0$ $\delta_{max}=2.0$ $E_{peak}=300$ eV

Off resonance / n=1.45 B=129 G

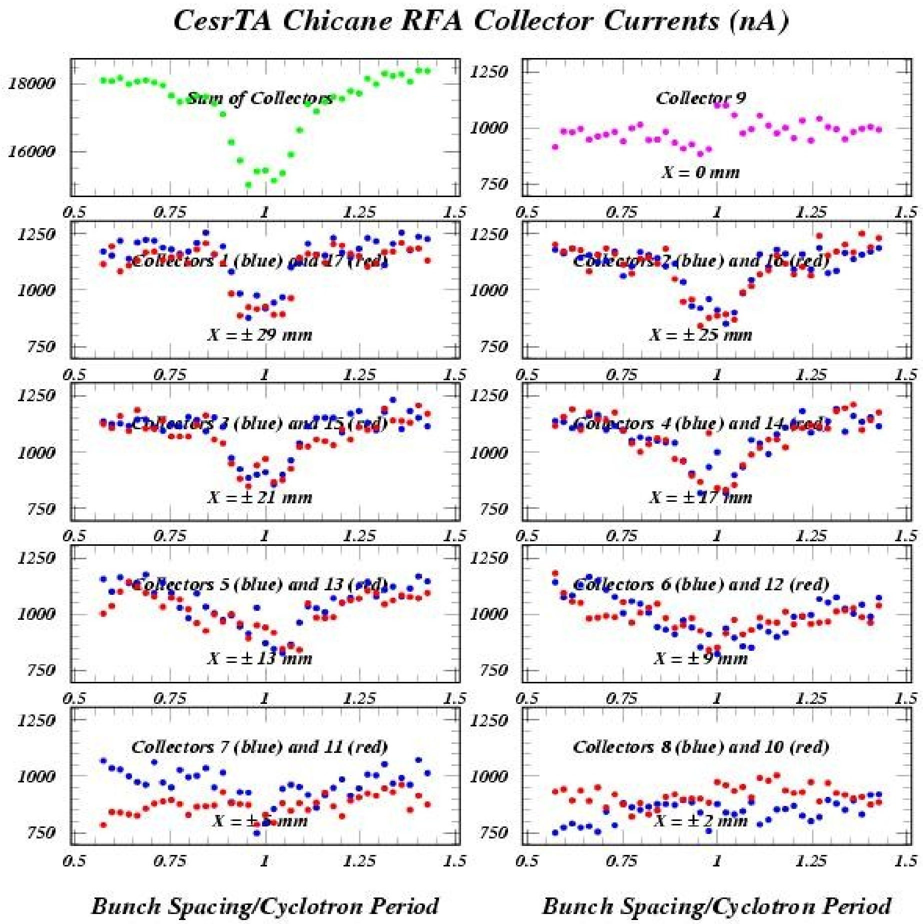


On resonance / n=1.0 B=89 G



The SEY curve for Al results in a higher yield region being populated by the resonant energy and grazing angle enhancement.

ECLOUD Model for CesrTA Aluminum
$\delta(0)=1.0$ $\delta_{max} = 0.4$ $E_{peak}= 500$ eV



Collector number defined by azimuthal impact position on wall.

RFA area and transparency used to calculate currents.

Summed over 90 bunches, 45 filled, 0.9 mA. with 4 ns spacing.

No modelling of kinematic acceptance or cloud/RFA interaction

Resonant enhancement for TiN-coated chamber.
To get resonant suppression, need $\delta_{max} < 0.6$.
Direct SEY measurements gave a value of 0.95 (Pivi, et al).

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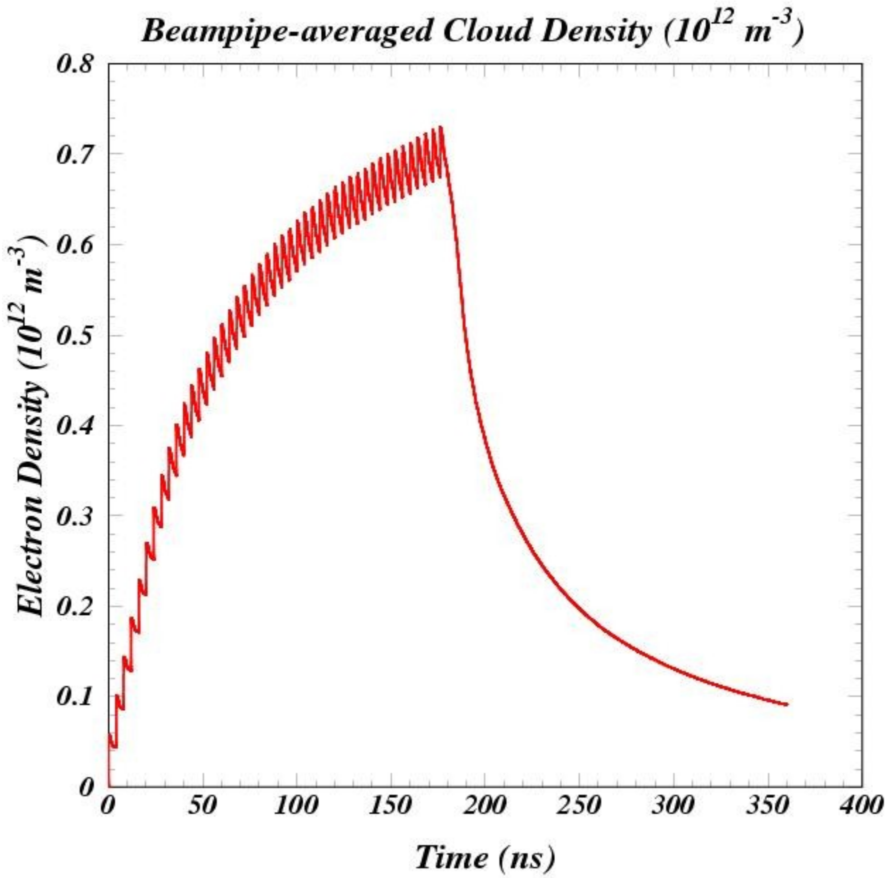
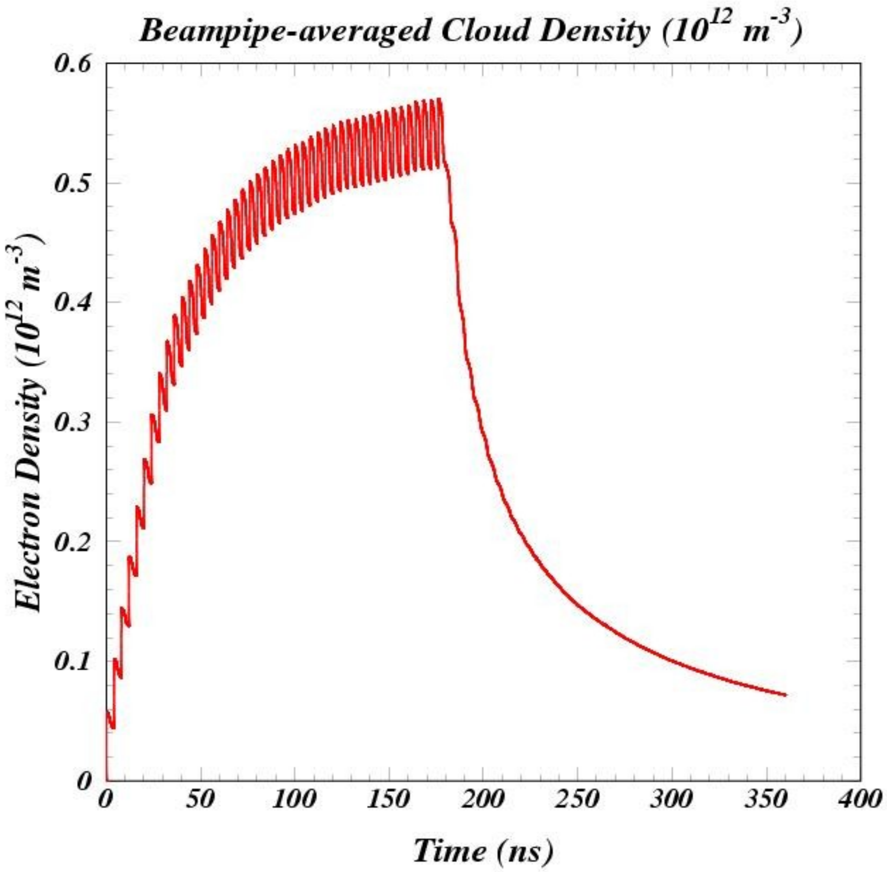
ECLOUD Model for CesrTA TiN
$\delta(0)=1.0 \quad \delta_{max}=0.4 \quad E_{peak}= 500$ eV

Off resonance / n=1.43 B=127 G



On resonance / n=1.0 B=89 G



TiN coating provides saturation, even on resonance.

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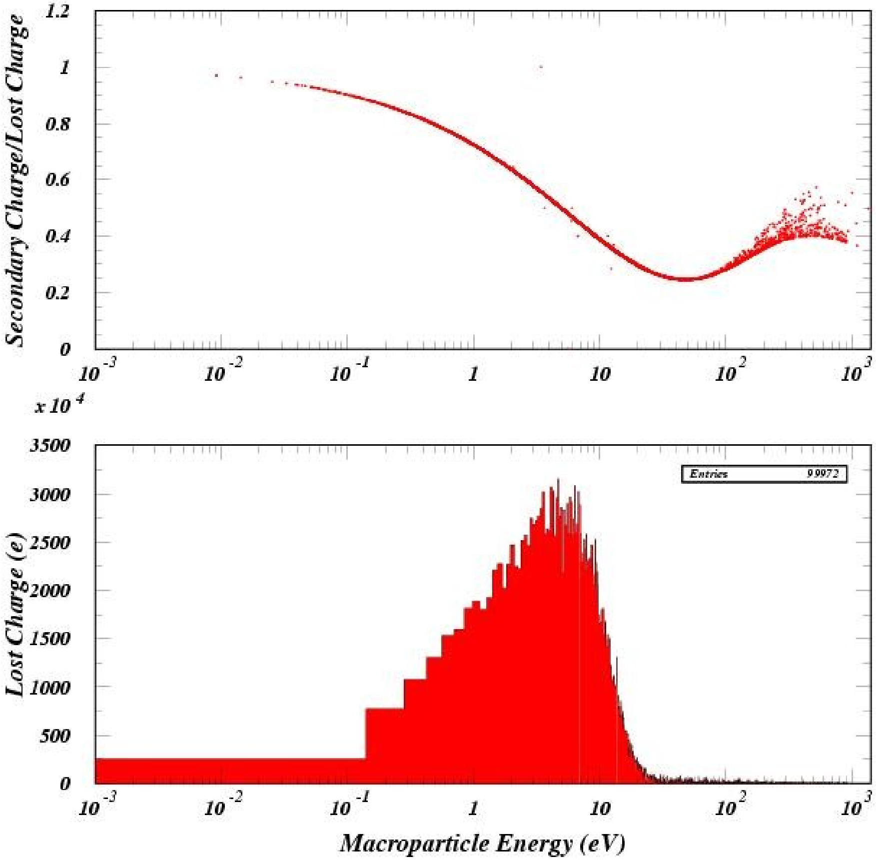
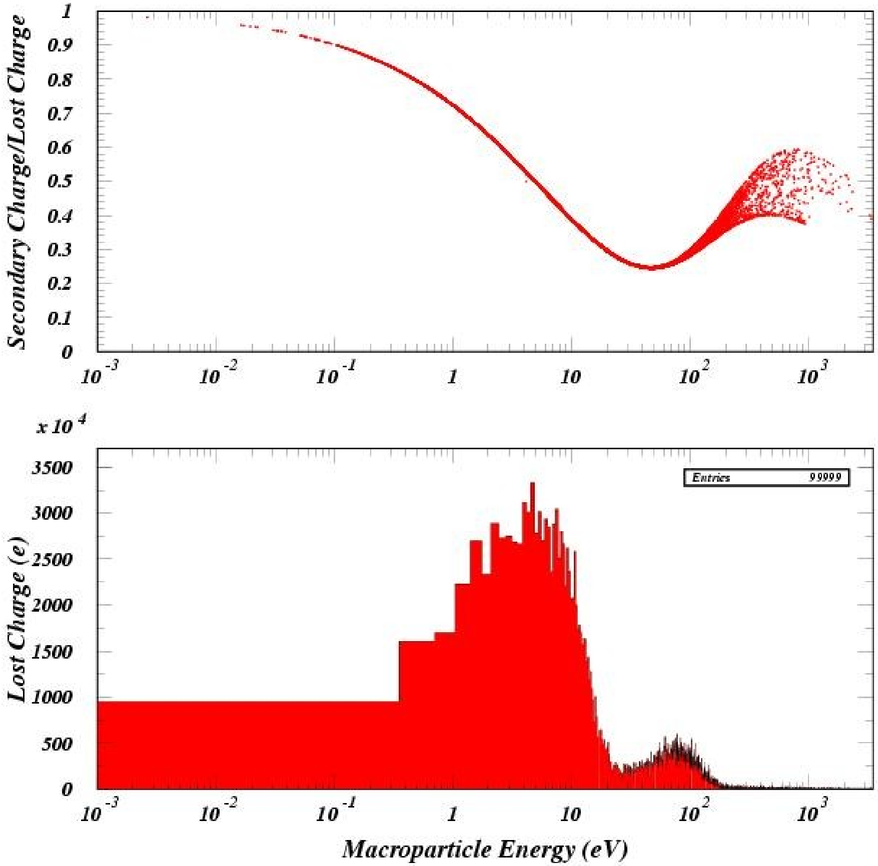
ECLOUD Model for CesrTA TiN
$\delta(0)=1.0 \quad \delta_{max}=0.4 \quad E_{peak}=500\ eV$

Off resonance / n=1.43 B=127 G



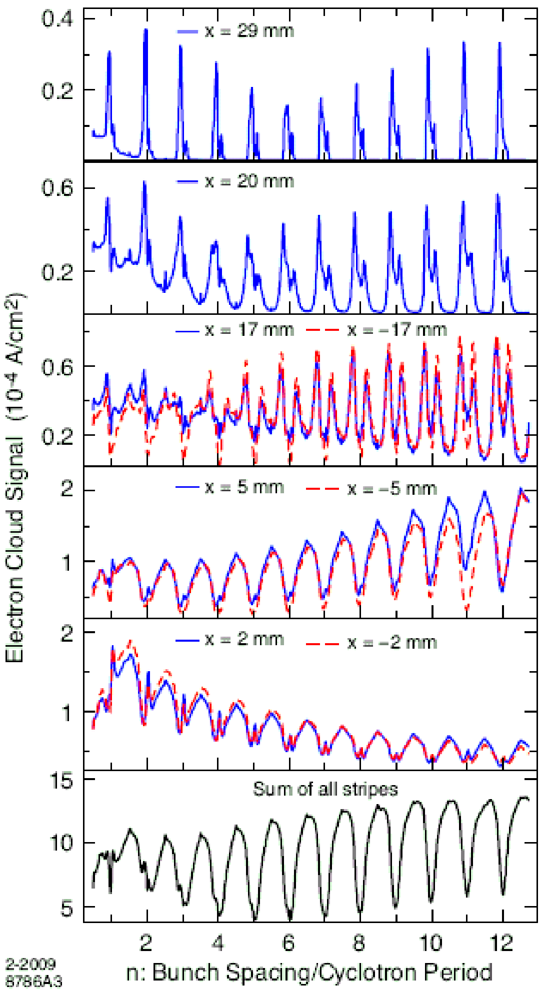
On resonance / n=1.0 B=89 G



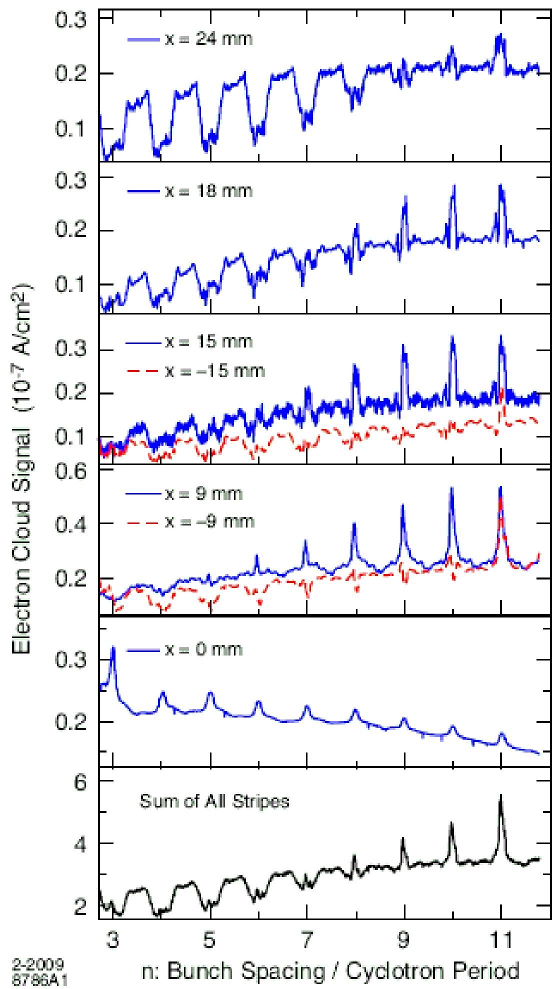
Resonant suppression results from competing effects.

Observation of Magnetic Resonances in Electron Clouds In A Positron Storage Ring, M.T.F. Pivi, et al, SLAC-PUB-13555

Aluminum



TiN-Coating



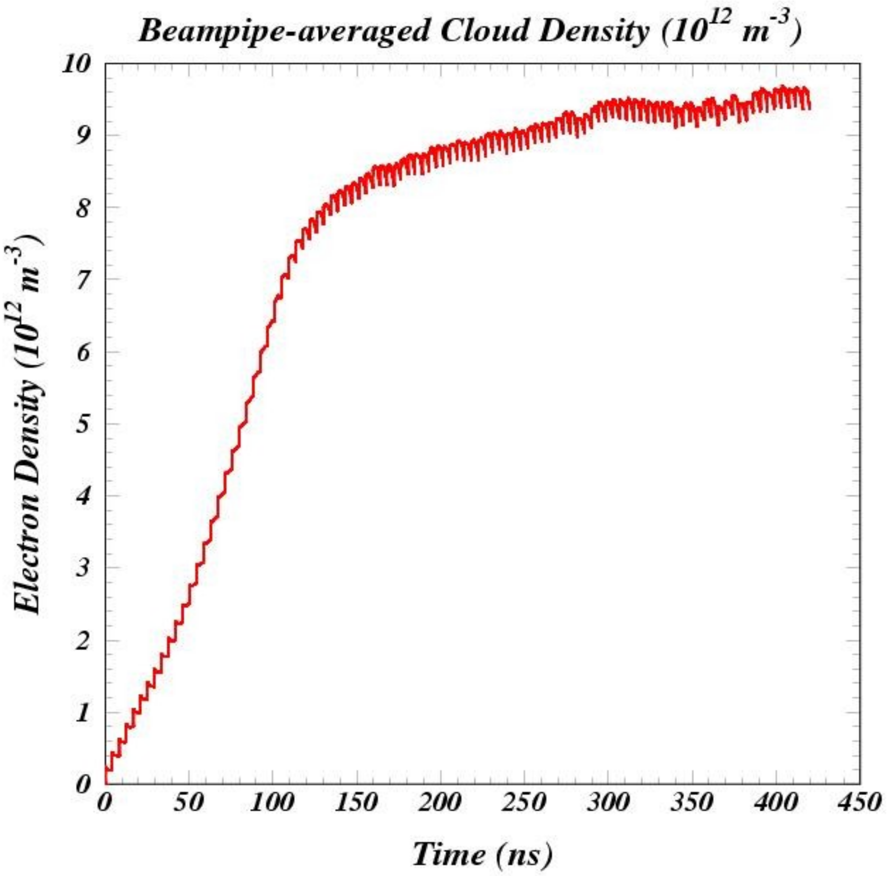
PEP-II e^+ beam

1722 4.2 mA bunches

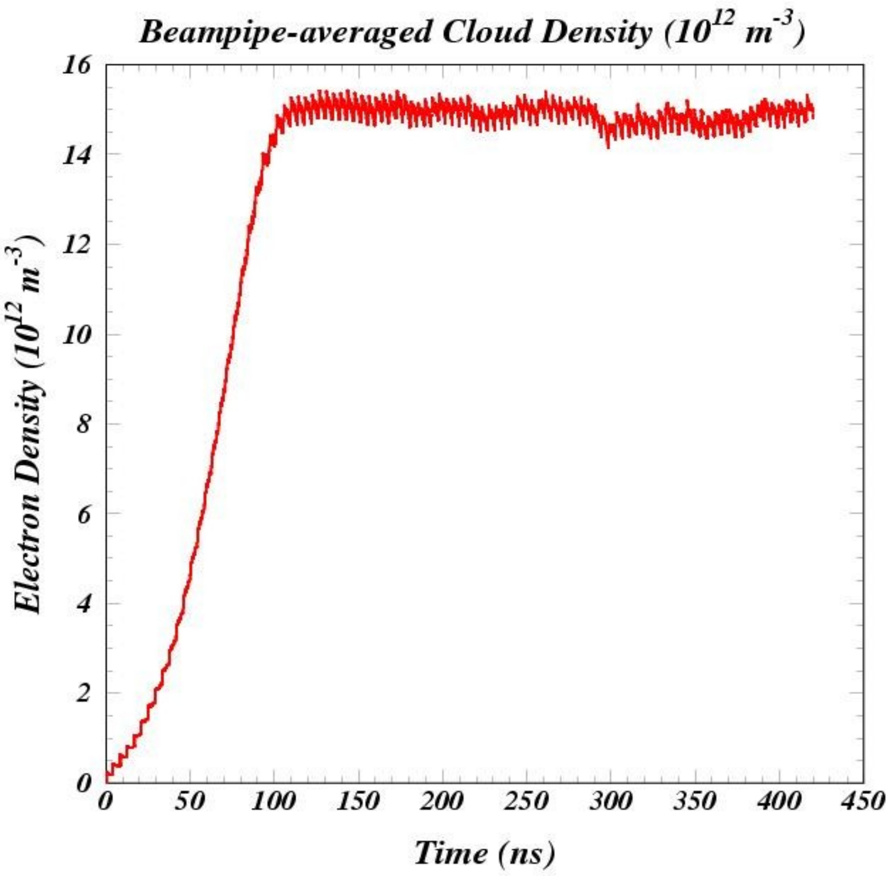
4.2 ns spacing

ECLOUD Model for PEP-II Al
$\delta(0)=1.0$ $\delta_{max}=2.0$ $E_{peak}= 310$ eV

Off resonance / n=4.4 B=364 G

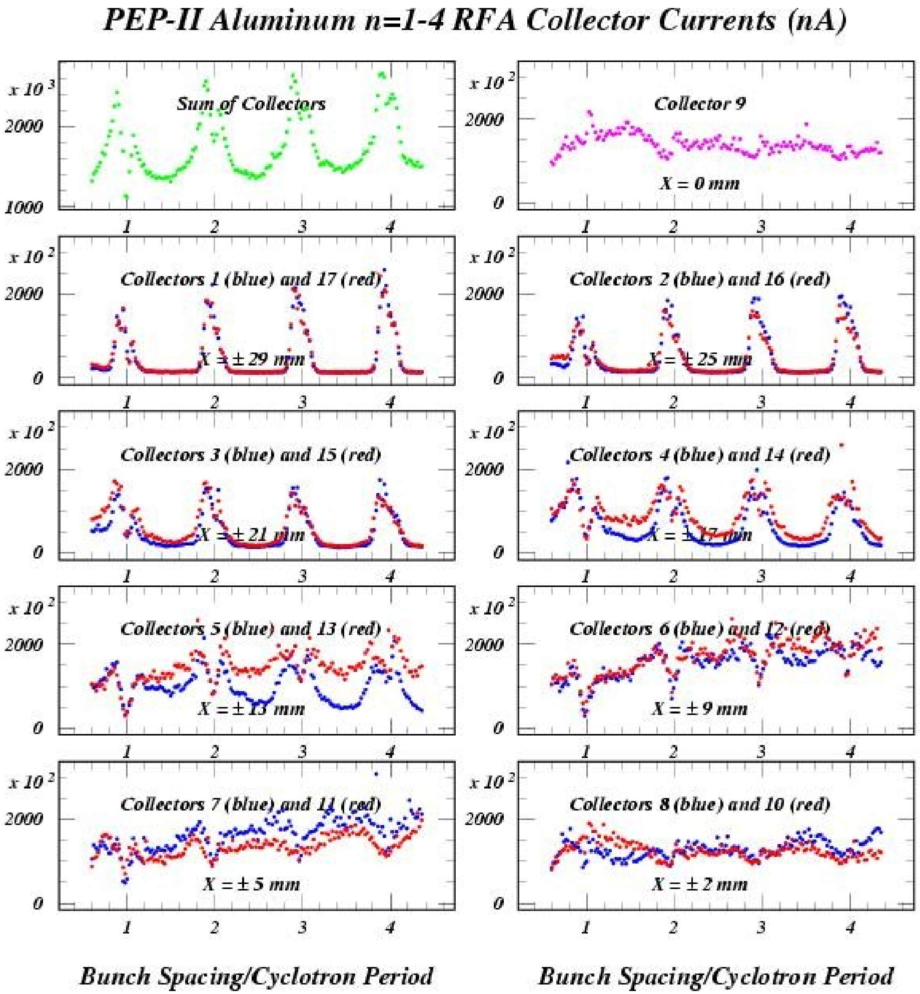


On resonance / n=4.0 B=341 G



ECLOUD finds saturation in PEP-II conditions, consistent with measurements.

ECLOUD Model for PEP-II Al
$\delta(0)=1.0$ $\delta_{max}=2.0$ $E_{peak}=310$ eV



Collector number defined by azimuthal impact position on wall.

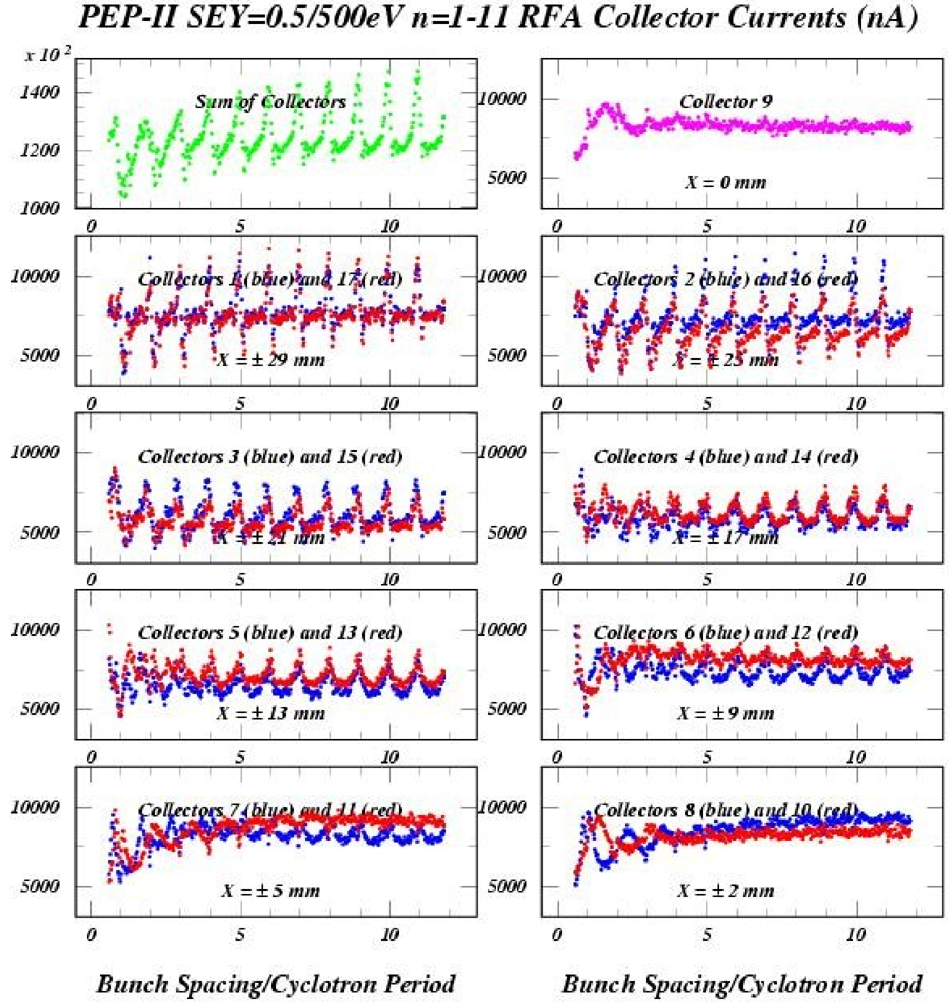
RFA area and transparency used to calculate currents.

Summed over 50 3.8 mA bunches with 4.2 ns spacing.

No modelling of kinematic acceptance or cloud/RFA interaction

ECLOUD fails to model the resonant suppression for the PEP-II Al chamber with the expected SEY parameters. It does model the dips in the low-n resonances, in agreement with POSINST.

ECLOUD Model for PEP-II Al
$\delta(0)=1.0$ $\delta_{max}=0.5$ $E_{peak}=500$ eV



Collector number defined by azimuthal impact position on wall.

RFA area and transparency used to calculate currents.

Summed over 50 3.8 mA bunches with 4.2 ns spacing.

No modelling of kinematic acceptance or cloud/RFA interaction

ECLOUD can model resonant suppression --> enhancement in the same chicane scan, but the comparison with the PEP-II measurements is not satisfactory.

Present Status and Plans

ECLOUD can model both resonant suppression and enhancement if the secondary yield curve has a minimum between low energy and the peak energy. At present we have studied primarily $\delta(0) = 1.0$.

We have mapped out the resonant behavior as a function of the SEY parameters δ_{max} and E_{peak} for PEP-II and CesrTA conditions.

Attempts to model the PEP-II measurements of SLAC-PUB-13555 appear to require lower yields than we expect, and the level of agreement is unsatisfactory.

Highest priority is now placed on modelling RFA acceptance and secondary yield, as coded by Joe Calvey.

We can hope/expect that iterative feedback between modelling and measurements during upcoming data-taking period will provide additional understanding of the physics of electron cloud development.