

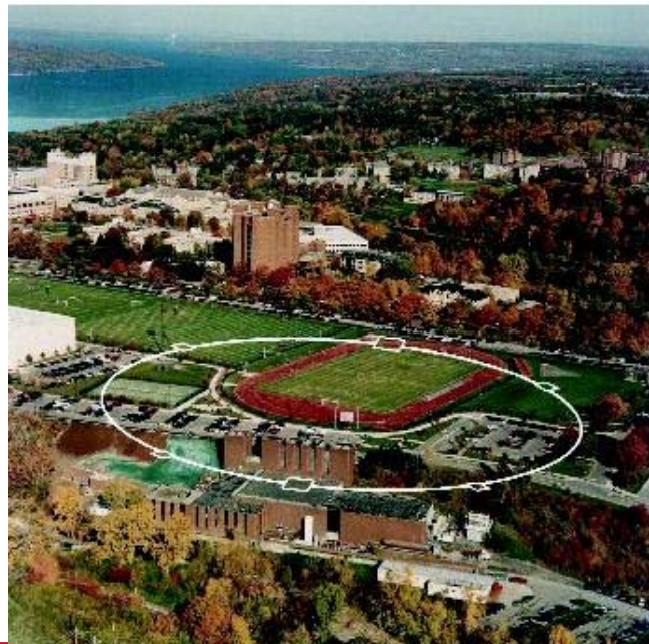


Cornell University
Laboratory for Elementary-Particle Physics

Simulations for RFA Studies at CESR-TA 7/9/2008

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Accelerator-Based Sciences and Education*





- **Three Programs:**
 - POSINST (Gerry Dugan)
 - ELOUD (Jim Crittenden)
 - Cloudland (Joe Calvey)
- **General Plan**
 - Compare simulations with each other using canonical parameters
 - Compare with data (L-3, B-12, B-14)
 - Use different simulations to predict and understand cloud growth in different conditions
- **Capable of simulating and performing experiments with a wide range of parameters**



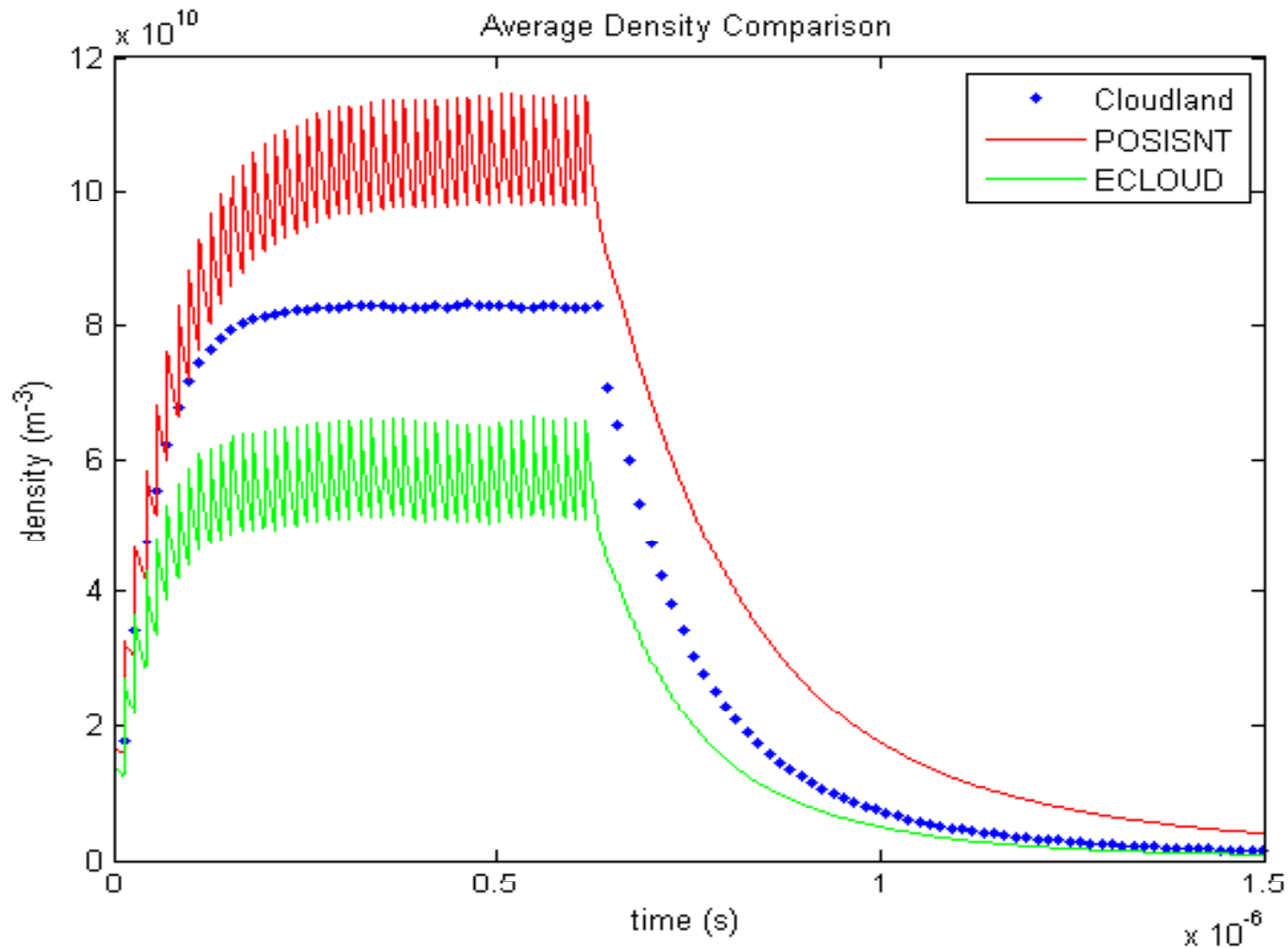
- **Beam Parameters**
 - Electrons at 5.3 GeV
- **Chamber Parameters**
 - Round, stainless steel pipe with 4.45cm radius
 - Field free
- **Photoelectron Parameters**
 - .07 photons/meter/particle
 - .1 photoelectrons/photon
 - 20% reflectivity
- **SEY parameters**
 - $\delta_{\max} = 2$
 - $E_{\max} = 310 \text{ eV}$
 - Mean secondary energy: 7 eV



- **Bunch Configurations:**
 - L3-1: 45 bunches, 14 ns spacing, 1mA/bunch
 - L3-2: 9 bunches, 280 ns spacing, 5mA/bunch
 - L3-3: 9 bunches, 280 ns spacing, 9mA/bunch
- **Parameters to compare:**
 - Average density vs time
 - Energy distribution
 - Current into wall vs energy, azimuth
 - Predictions for RFA measurements

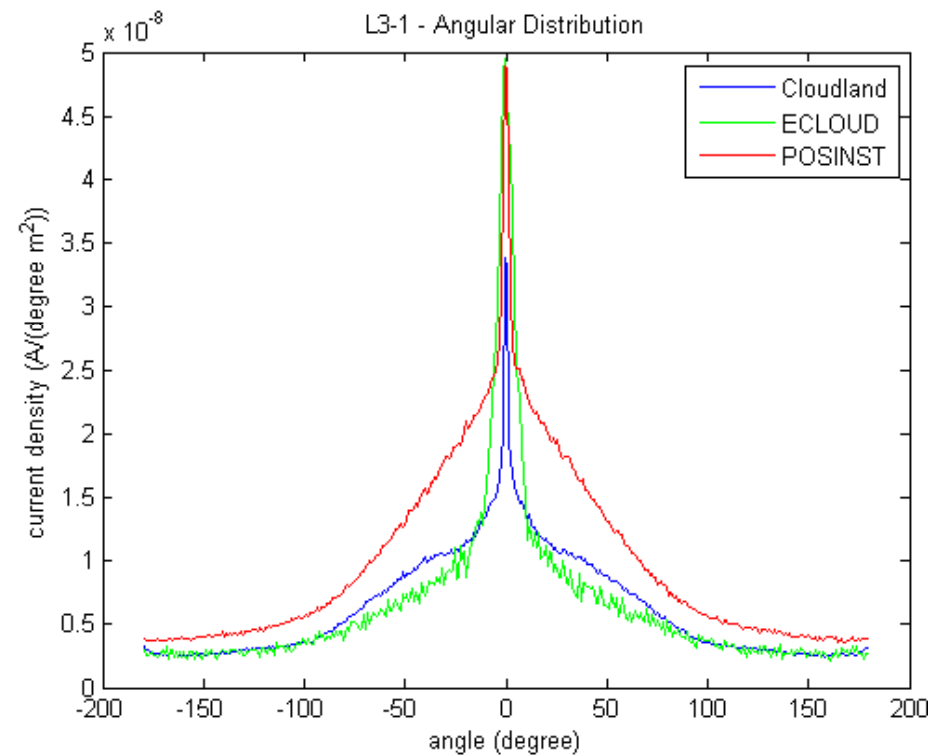
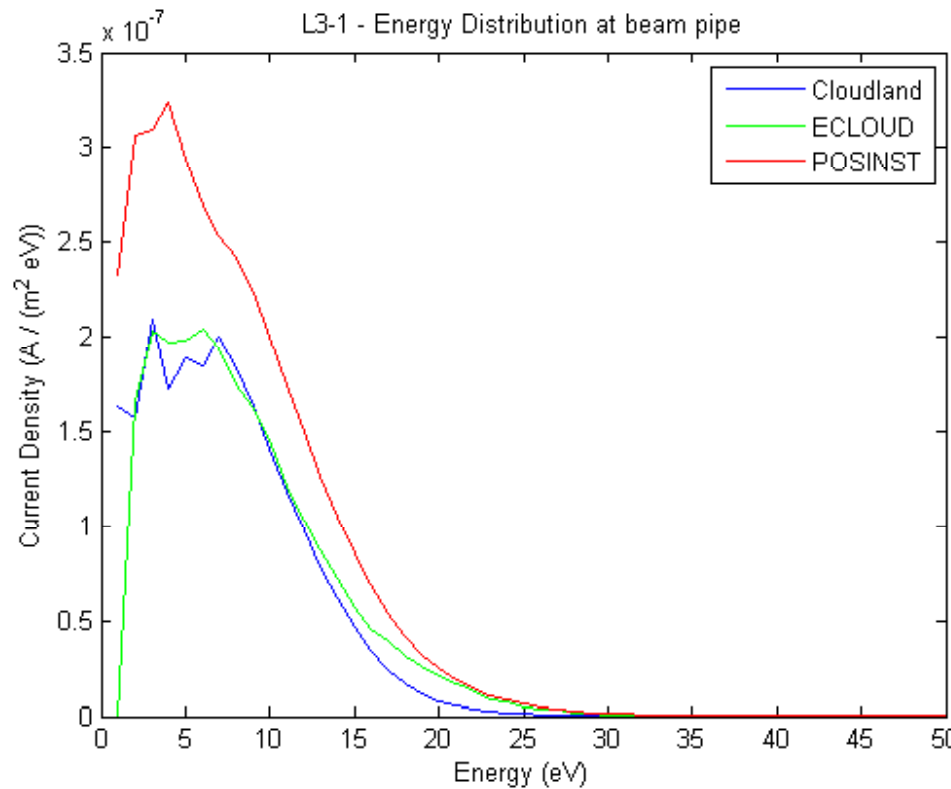


- Match within factor of 2



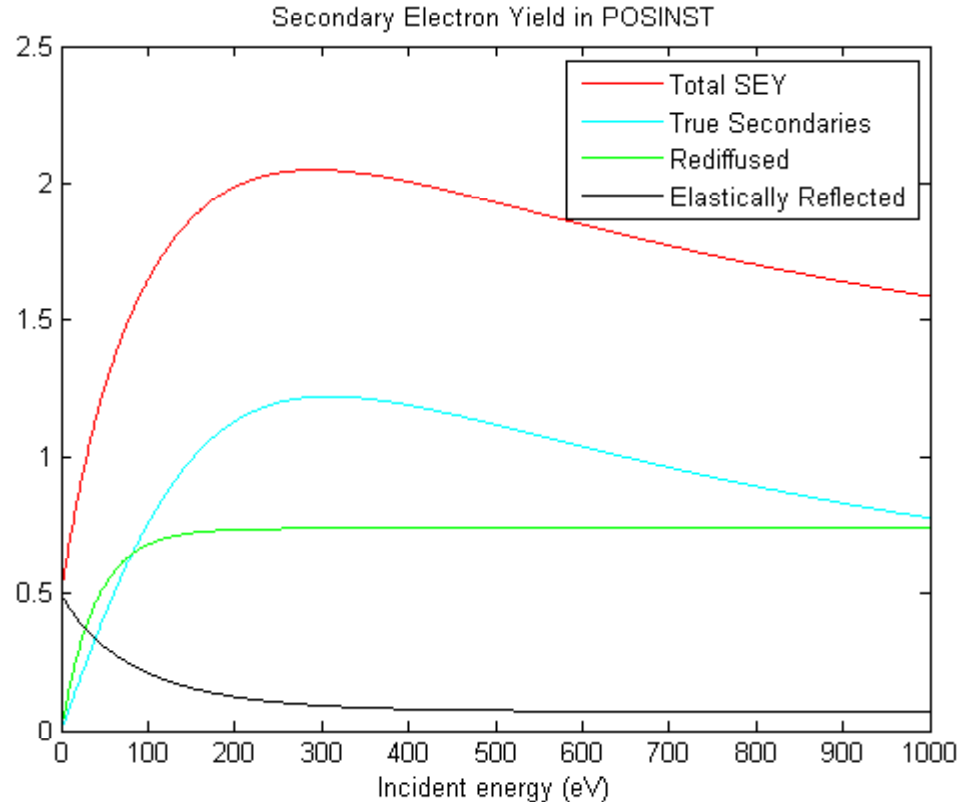


- Very few electrons $> 30\text{eV}$
- Distribution peaked where synchrotron radiation hits
- POSINST consistently predicts higher current



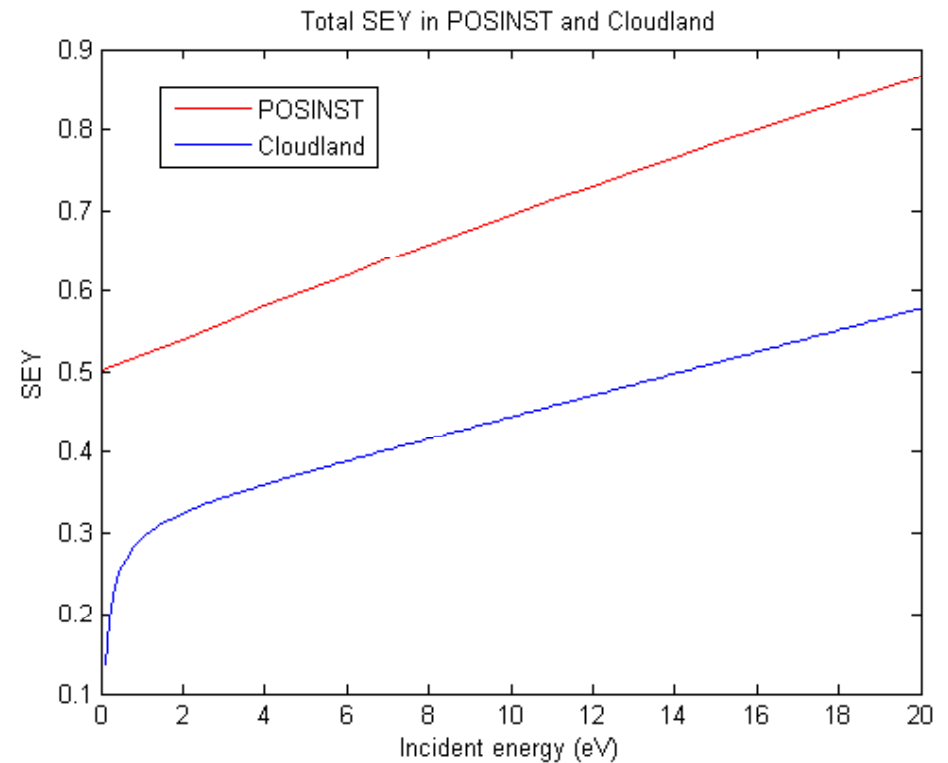
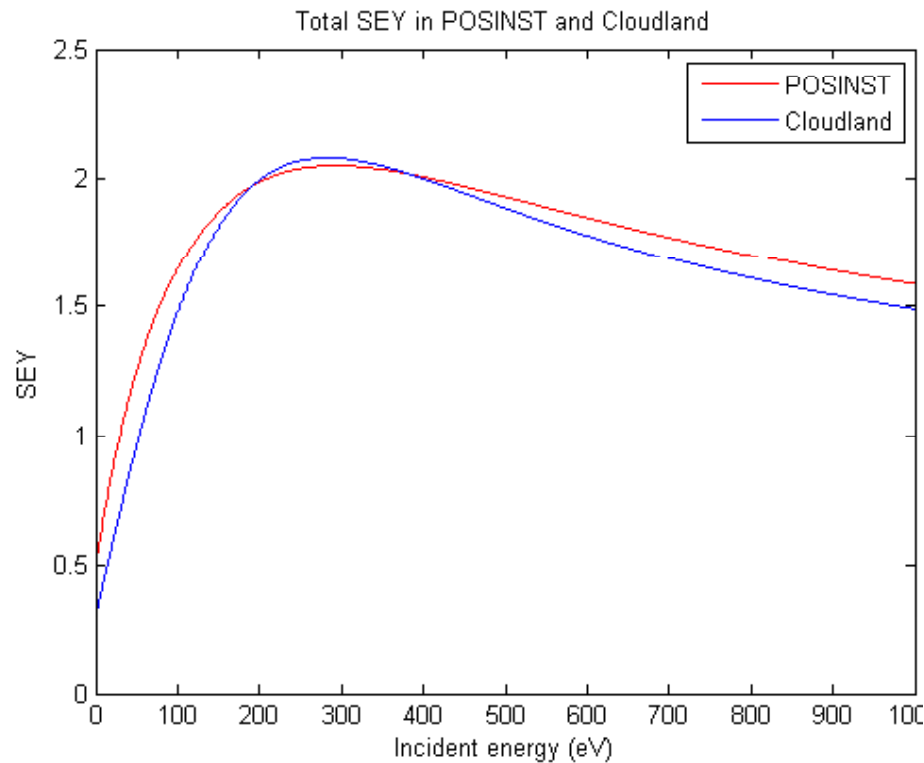


- Significantly variation between simulation programs
 - Whether rediffused electrons are included
 - How “true secondaries” and reflected electrons are weighted
- Probably main reason for discrepancies





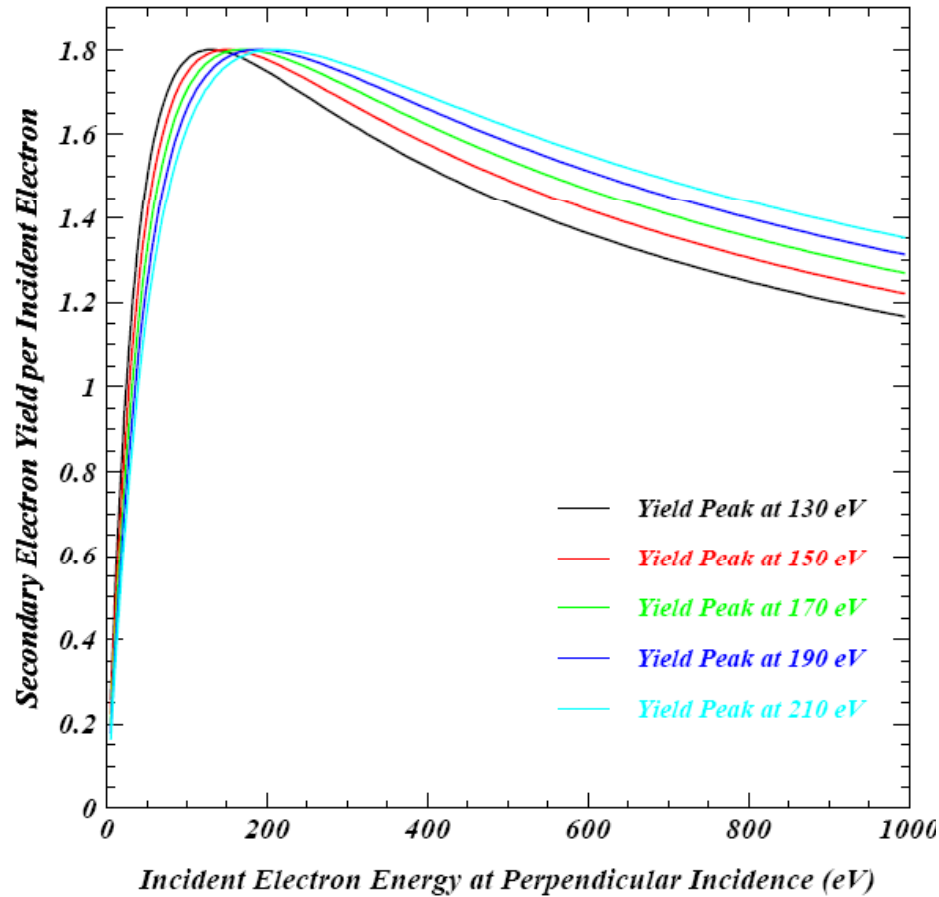
- Poor match at low energies
- Energy distribution of secondaries will be different



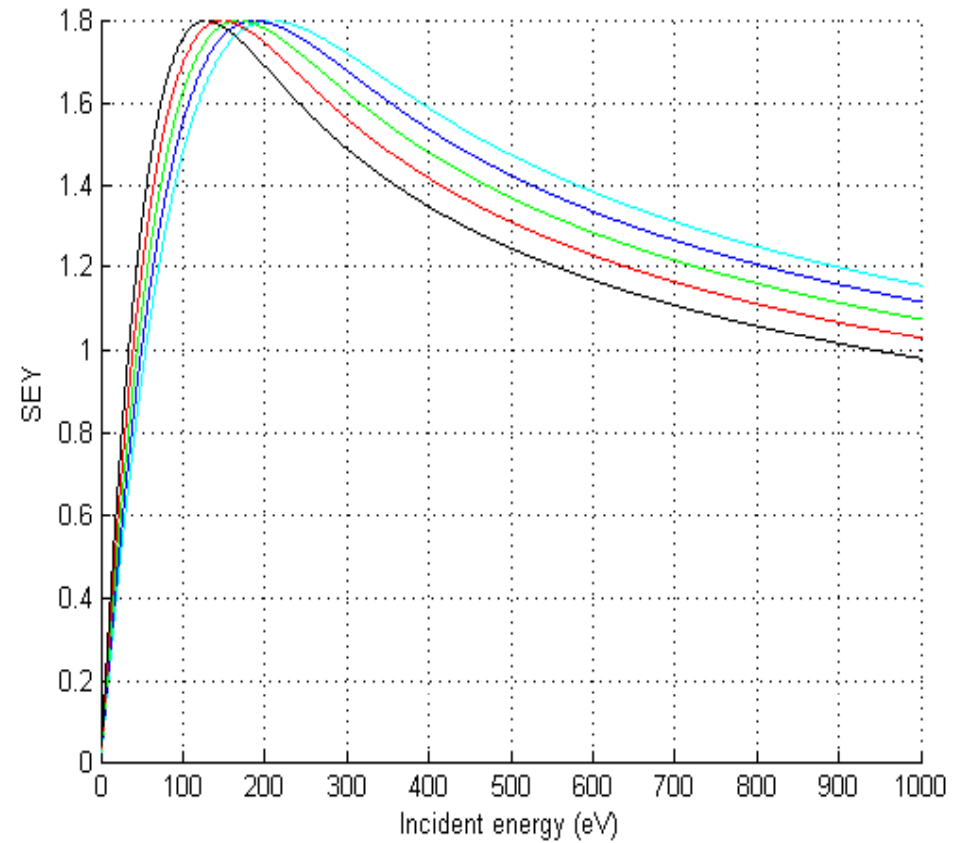


SEY: Cloudland vs E-CLOUD

Secondary Electron Yield for Peak Yield of 180%

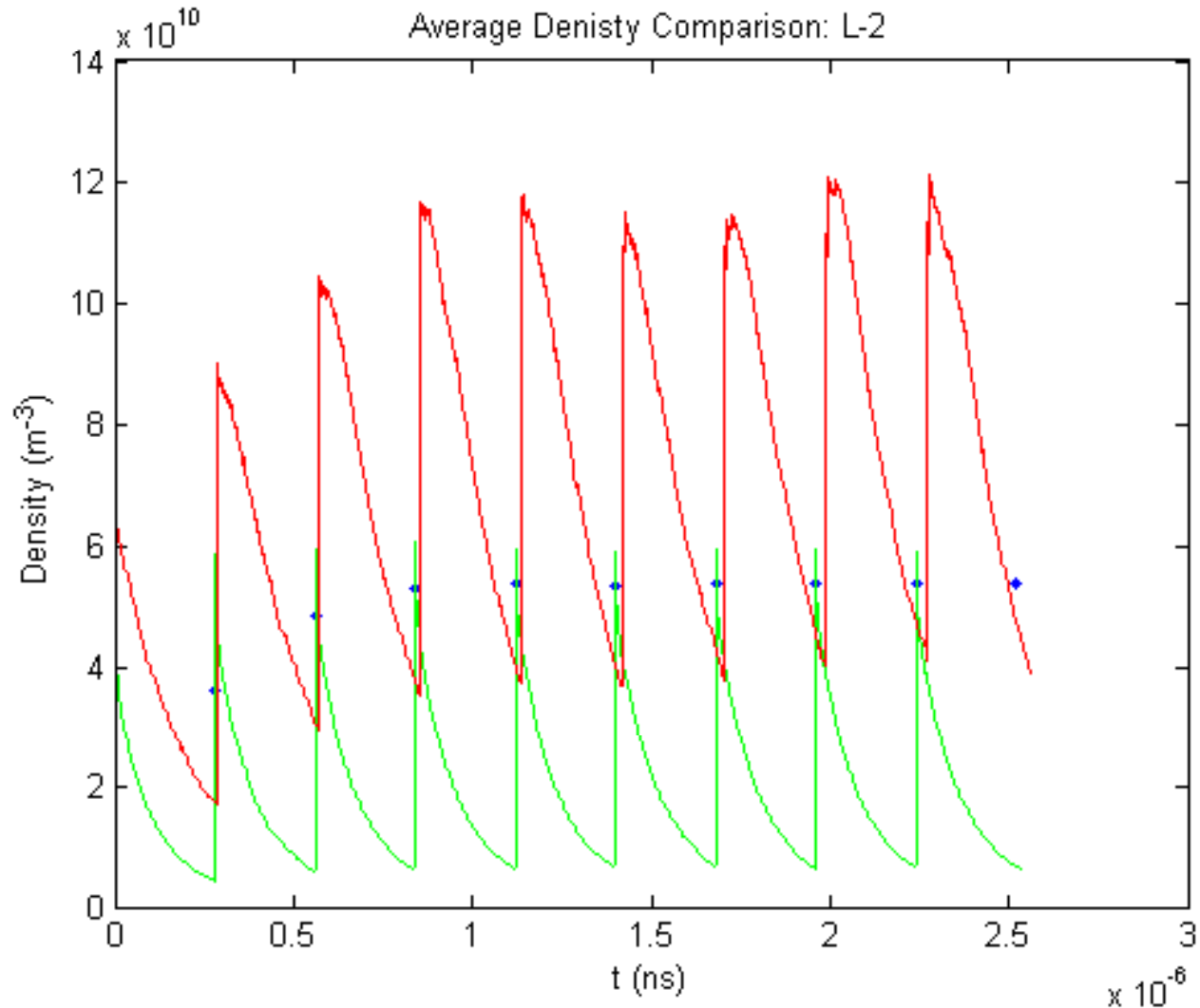


"True" Secondaries in Cloudland, $\delta_{\max} = 1.8$, $E_{\max} = 210$



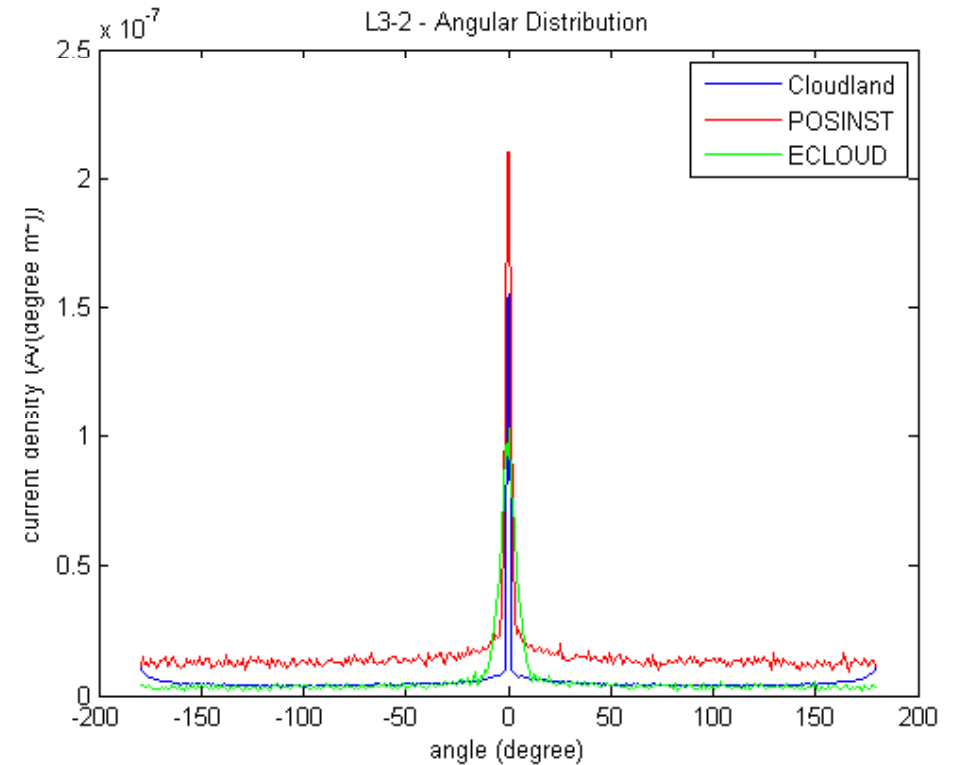
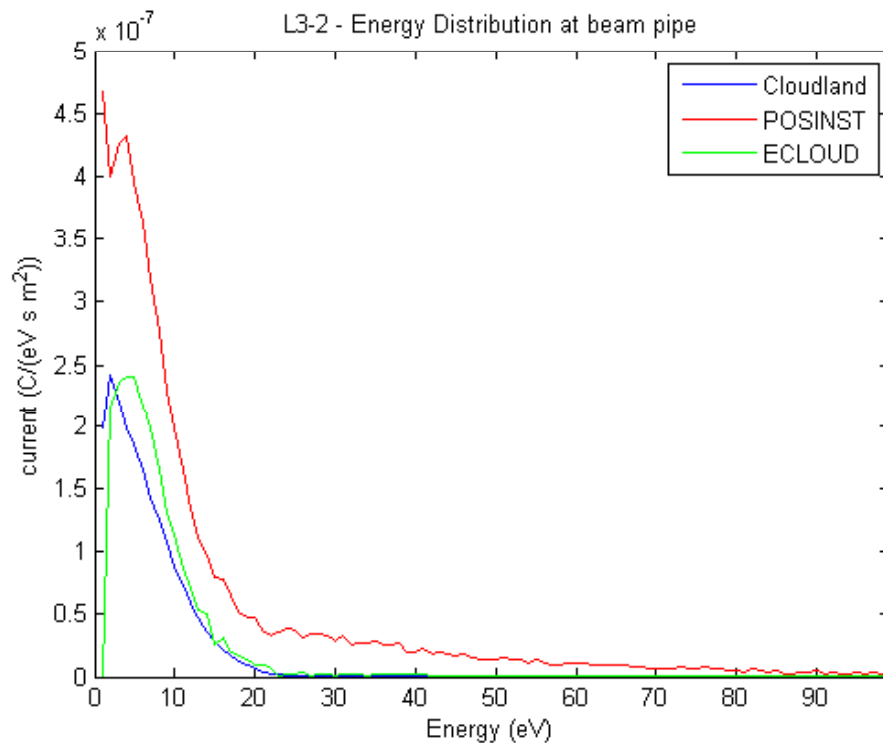


- **Mystery: different photoelectron generation?**



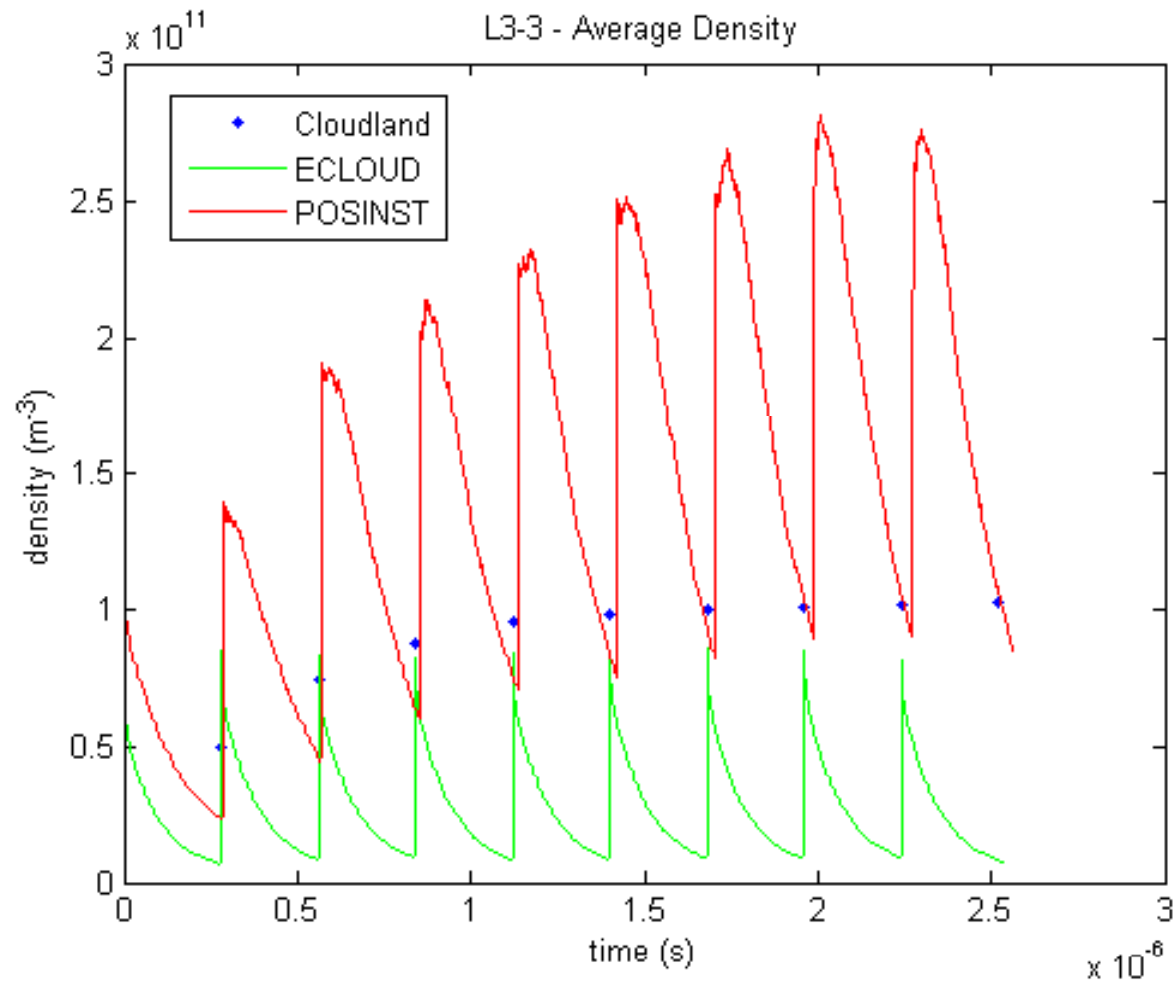


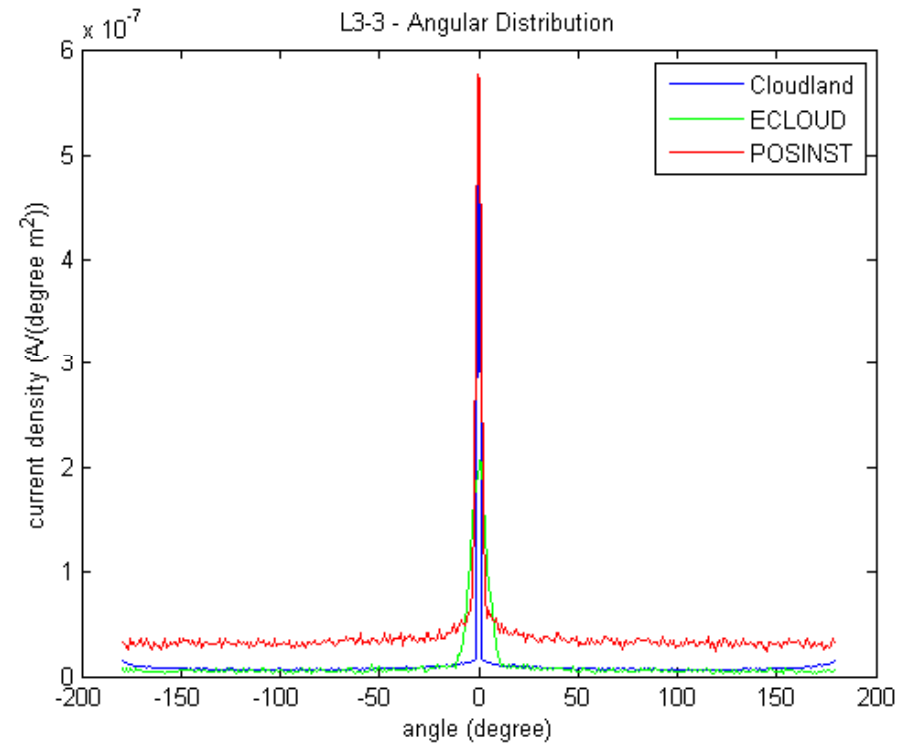
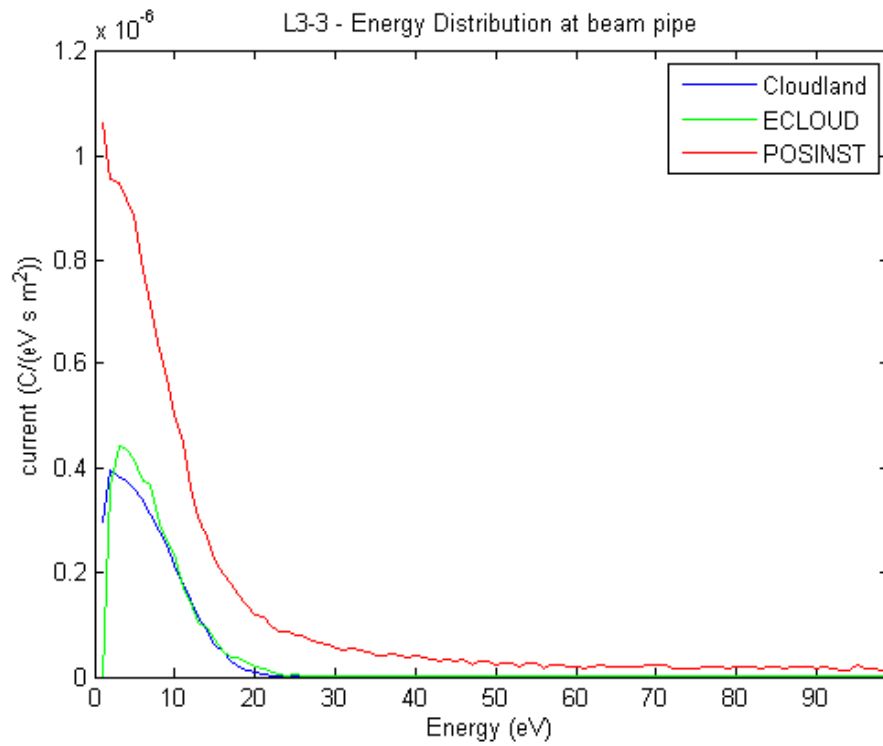
- Higher energy tail in POSINST- rediffused electrons?
- Angular distribution more strongly peaked than L3-1





- Even bigger photoelectron discrepancy



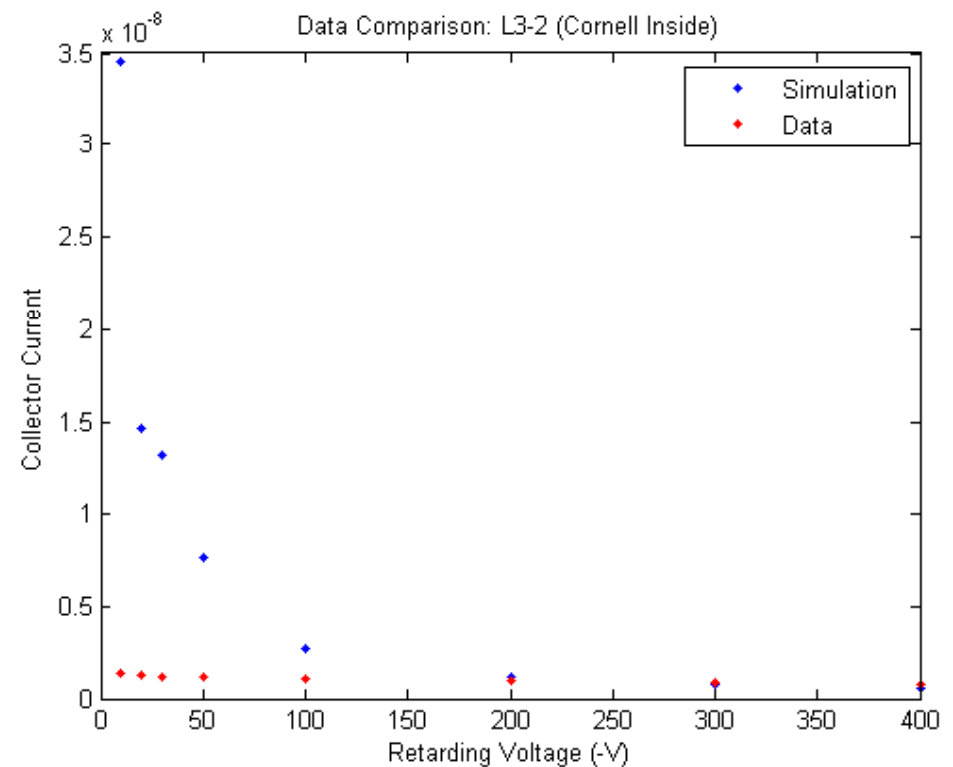
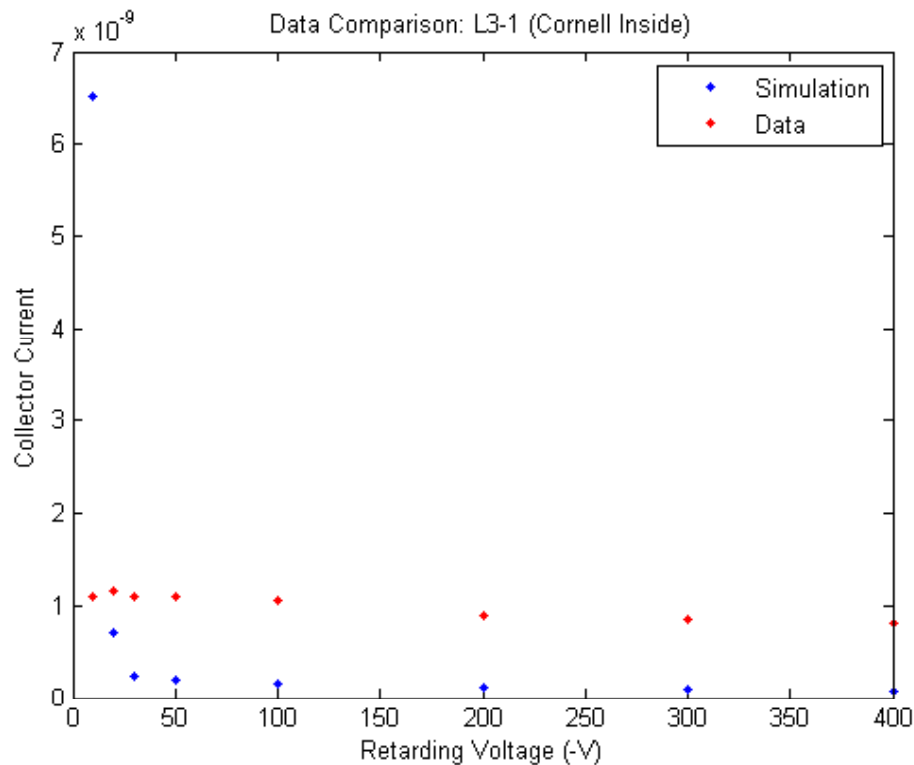




- Very preliminary
- RFAs are potentially quite complicated
- Three avenues
 - Idealized RFA
 - just energy and angle filter with certain efficiency
 - not generally a good match to data
 - Analytical model
 - can include SEY
 - collisions inside grid
 - energy loss in retarding field
 - Full Simulation (Jesse Livezey)
 - includes focusing effects of fields
 - can plug in results of cloud simulation



- Better fit than simple approximation
- Still way off for low energy
- Is the problem with simulation, data, or RFA model (or all 3)?





- For L3 parameters, all three simulations agree up to a factor of 2-3
- Differences are mostly due to different SEY models
- Higher bunch current, larger bunch spacing lead to:
 - higher electron energies (POSINST)
 - more strongly peaked azimuthal distribution
- Need to thoroughly compare simulations to data
 - We have a wealth of data from B12/B14
- Should collaborate more closely with more experienced simulators to achieve a deeper understanding of the codes