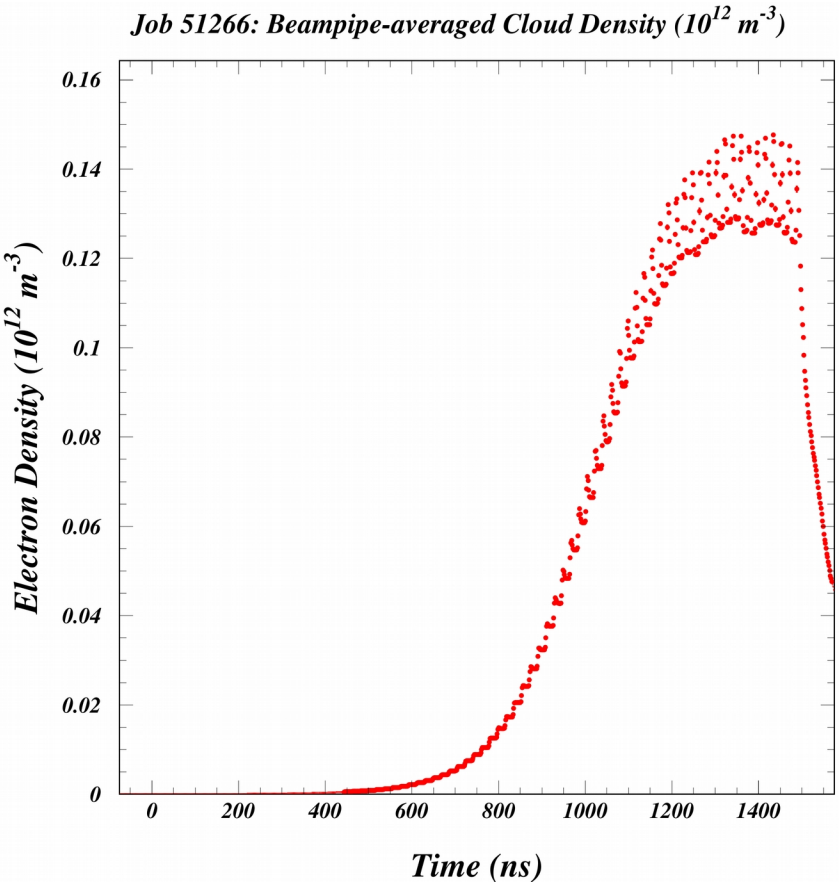
Study of Cloud Buildup Dependence on Bunch Population

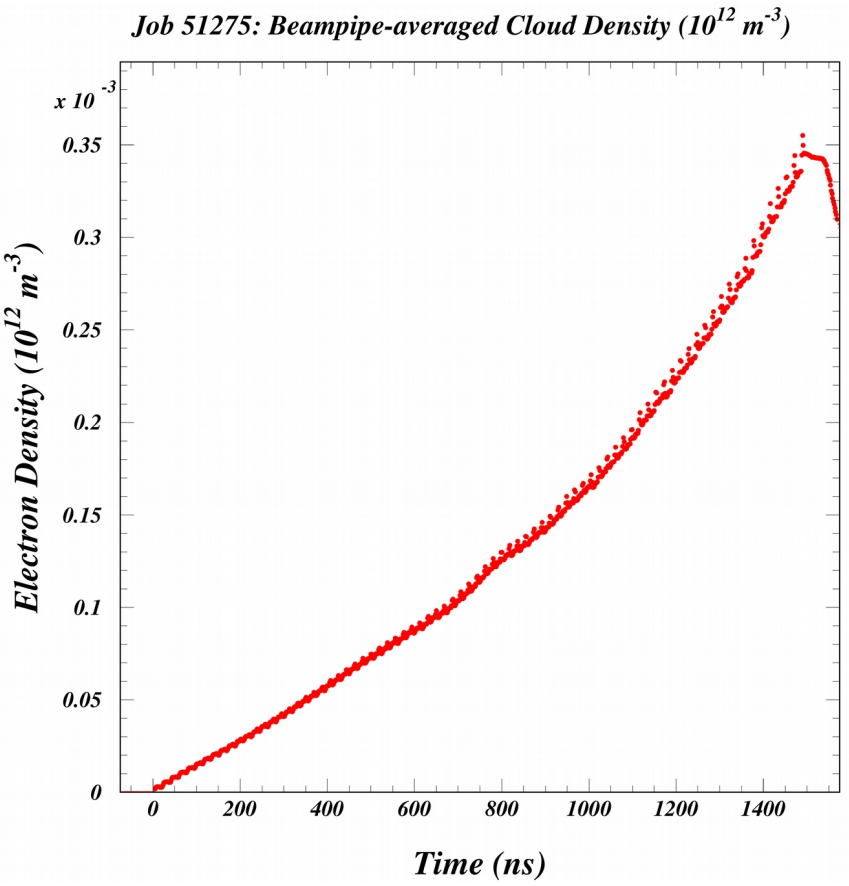
2 January 2017

Dramatic effect of bunch population on cloud buildup during first revolution

2.50e10 protons/bunch 1e4 electrons/bunch



2.26e10 protons/bunch 1e4 electrons/bunch



A change of 10% in the bunch population changes the cloud density after 80 bunches by a factor of 500 from 1.4e11 to 3.5e8/m^3.
I was trying to get your value of 6e9/m^3 (linear density 2e7/m) and overshot it by more than an order of magnitude.
Now let's look at why this happens.

Density during the first three bunch passages in first revolution

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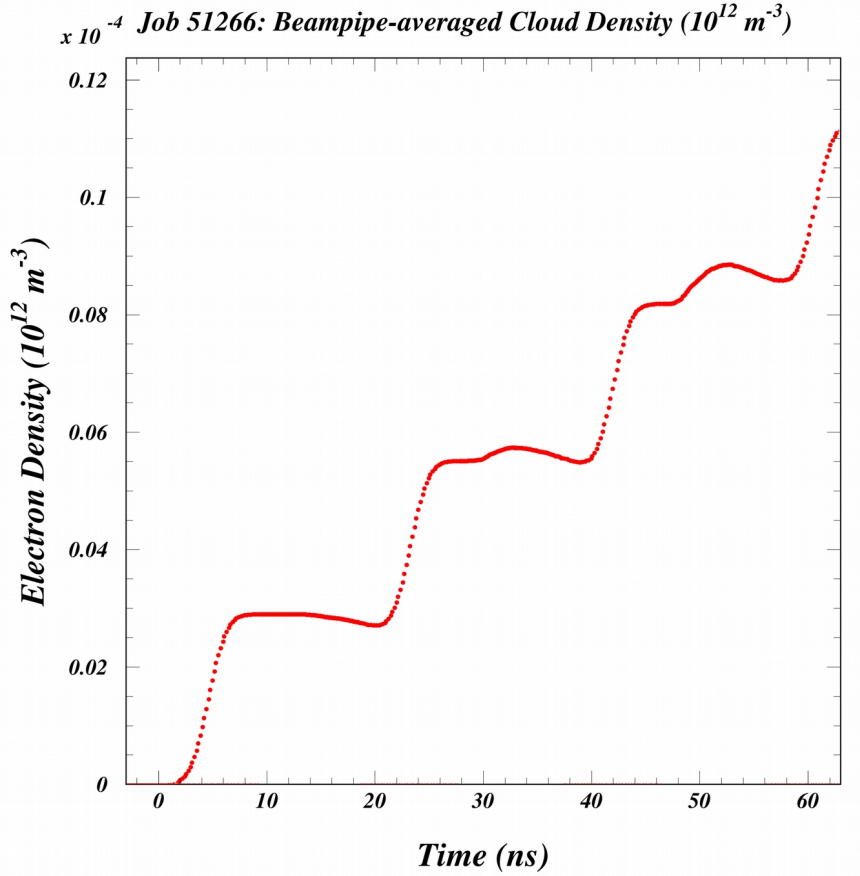

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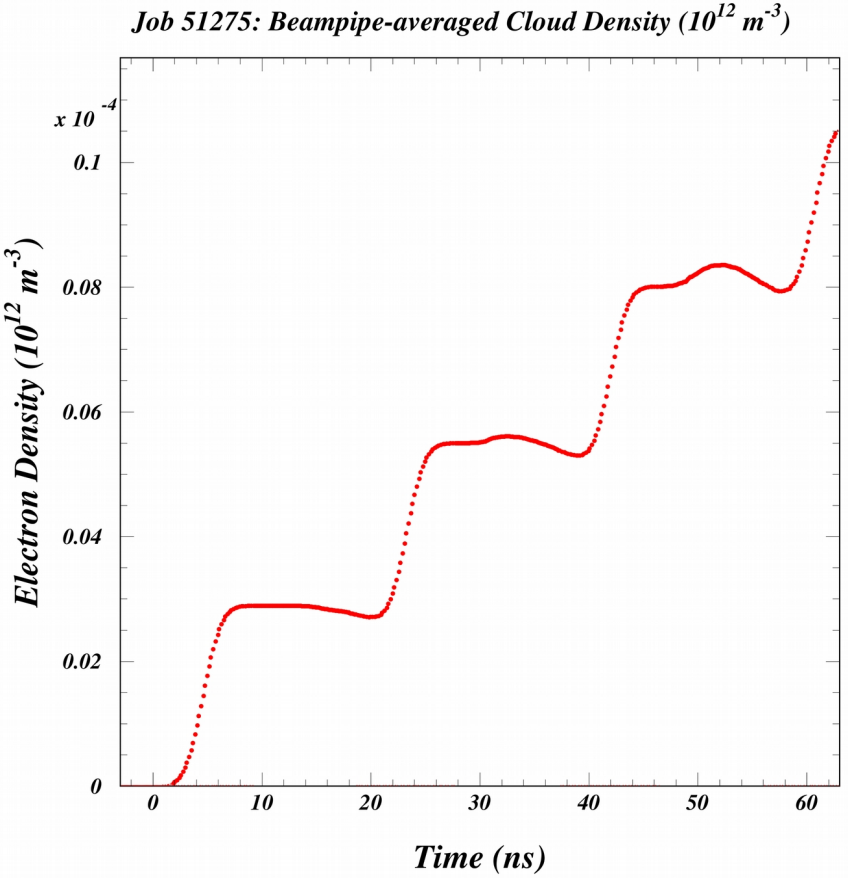

Each bunch passage contributes 1e4 electrons, which is a density of about 3e6/m^3. Between bunches 1 and 2 the cloud only maintains itself, but between later bunches the average SEY exceeds 1 and the density increases. Notice that at 61 ns, the densities differ by 5e5/m^3. This will snowball. Now let's look at SEY statistics.

Distributions for electron wall strikes during the first three bunch passages

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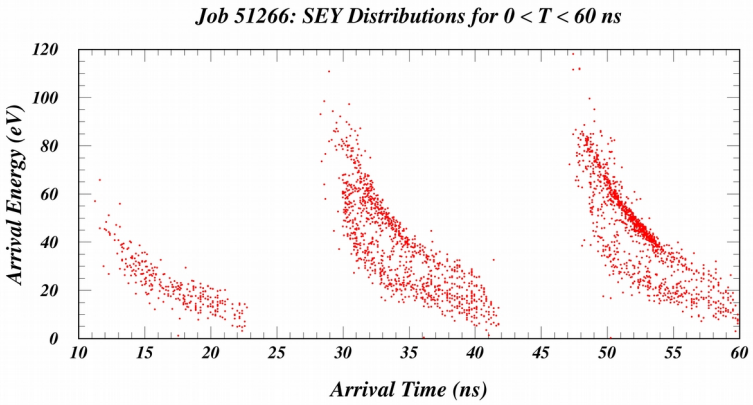

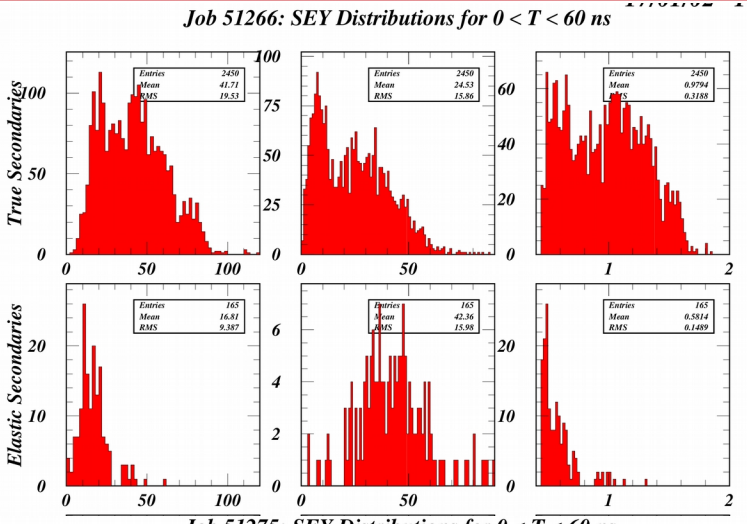

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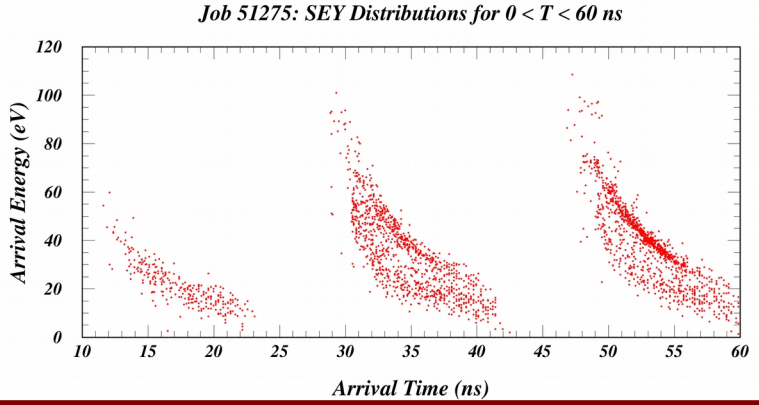

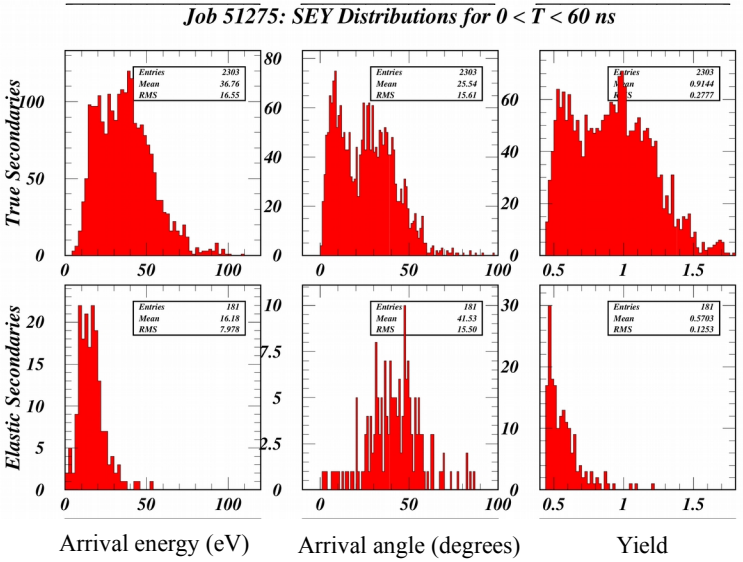

Our SEY curve crosses unity at an incident energy of about 40 eV. Electrons produced in the middle of bunch 1 receive only half of its integrated kick. The problem comes from existing cloud getting the full kick of the passing bunch. For the 2.50e10 bunches, the average arrival energy in the first 60 ns is 41.7 eV and the average yield is 0.98. For the 2.26e10 bunches, those values are 36.8 eV and 0.91. Notice that slower electrons arrive at the wall later.