Fermilab

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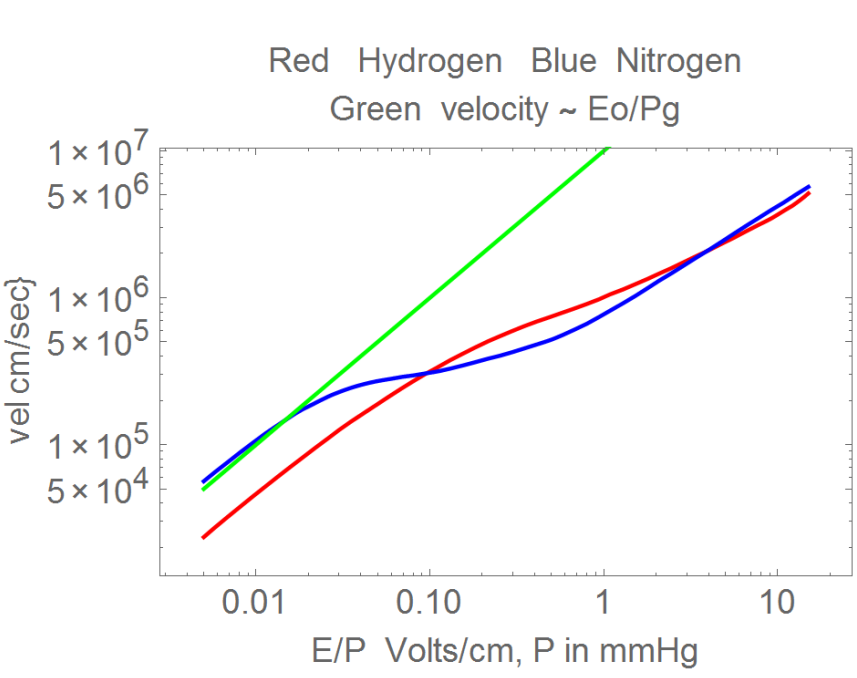
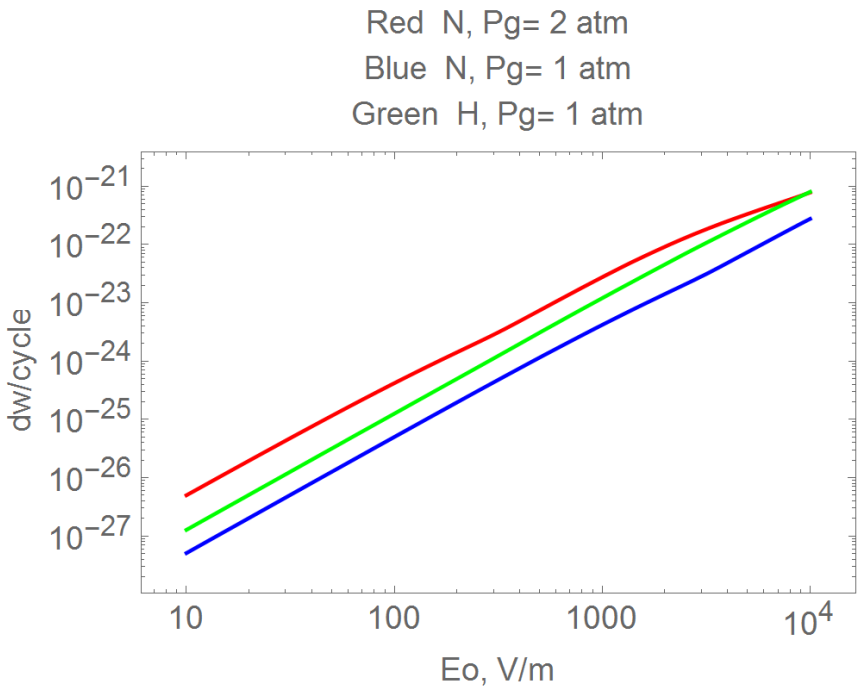
Hadron Calorimeter Questions

AVT

8-26 2016

- Some Data on mobility





In[246]:= `Do[los[k 1000, 14, 2.8 × 1000, 10, 1, k], {k, 20, 100, 20}]`

Eo	Pg	c	a	frf	ind	ind2
20 000	14	10	7.57084	2800.	1	20
dw	den[0,0]	jcav	dj[0,0]	djt	djt/jcac	
2.76777×10^{-21}	9.57301×10^{7}	2.53745×10^{-7}	1.71842×10^{-10}	3.27091×10^{-9}	0.0128905	

Eo	Pg	c	a	frf	ind	ind2
40 000	14	10	7.57084	2800.	1	40
dw	den[0,0]	jcav	dj[0,0]	djt	djt/jcac	
7.08525×10^{-21}	9.57301×10^{7}	1.01498×10^{-6}	4.399×10^{-10}	8.09679×10^{-9}	0.00797729	

Eo	Pg	c	a	frf	ind	ind2
60 000	14	10	7.57084	2800.	1	60
dw	den[0,0]	jcav	dj[0,0]	djt	djt/jcac	
1.29289×10^{-20}	9.57301×10^{7}	2.28371×10^{-6}	8.02713×10^{-10}	1.41933×10^{-8}	0.00621501	

Eo	Pg	c	a	frf	ind	ind2
80 000	14	10	7.57084	2800.	1	80
dw	den[0,0]	jcav	dj[0,0]	djt	djt/jcac	
2.04674×10^{-20}	9.57301×10^{7}	4.05992×10^{-6}	1.27076×10^{-9}	2.16378×10^{-8}	0.00532961	

Eo	Pg	c	a	frf	ind	ind2
100 000	14	10	7.57084	2800.	1	100
dw	den[0,0]	jcav	dj[0,0]	djt	djt/jcac	
2.95335×10^{-20}	9.57301×10^{7}	6.34363×10^{-6}	1.83364×10^{-9}	3.0478×10^{-8}	0.0048045	

In[250]:= `Do[los[k 1000, 14, 2.8 × 1000, 10, 2, k + 1], {k, 21, 101, 20}]`

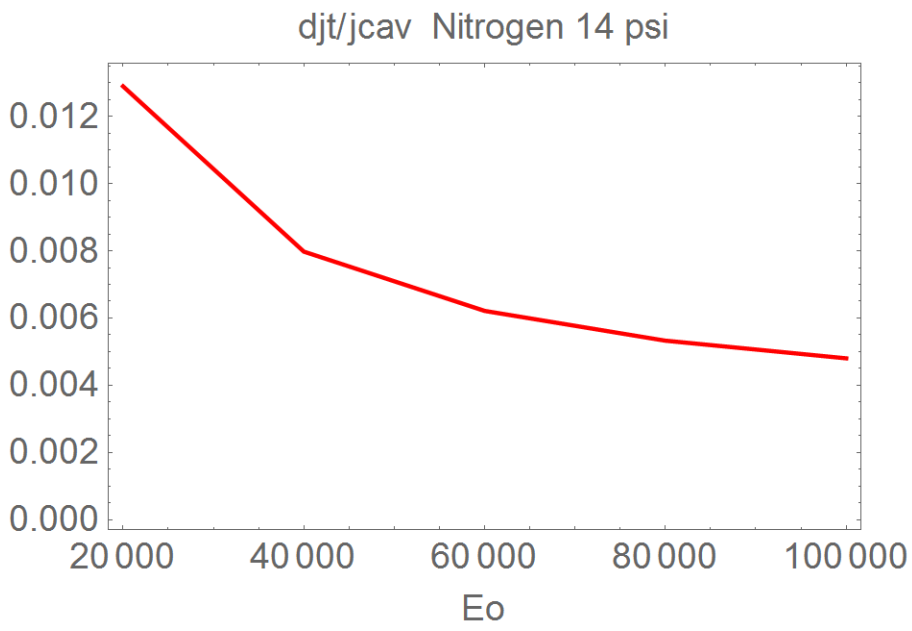
Eo	Pg	c	a	frf	ind	ind2
21 000	14	10	7.57084	2800.	2	22
dw	den[0,0]	jcav	dj[0,0]	djt	djt/jcac	
3.86757×10^{-21}	9.57301×10^{7}	2.79754×10^{-7}	3.59692×10^{-11}	5.87223×10^{-10}	0.00209907	

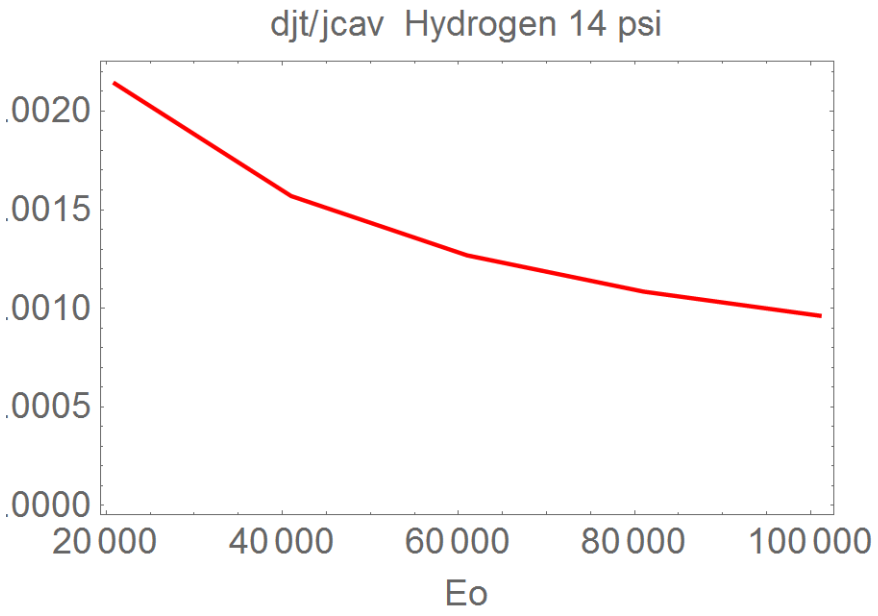
Eo	Pg	c	a	frf	ind	ind2
41 000	14	10	7.57084	2800.	2	42
dw	den[0,0]	jcav	dj[0,0]	djt	djt/jcac	
1.03516×10^{-20}	9.57301×10^{7}	1.06636×10^{-6}	9.62718×10^{-11}	1.65274×10^{-9}	0.00154988	

Eo	Pg	c	a	frf	ind	ind2
61 000	14	10	7.57084	2800.	2	62
dw	den[0,0]	jcav	dj[0,0]	djt	djt/jcac	
1.82607×10^{-20}	9.57301×10^{7}	2.36046×10^{-6}	1.69829×10^{-10}	2.96692×10^{-9}	0.00125692	

Eo	Pg	c	a	frf	ind	ind2
81 000	14	10	7.57084	2800.	2	82
dw	den[0,0]	jcav	dj[0,0]	djt	djt/jcac	
2.76611×10^{-20}	9.57301×10^{7}	4.16205×10^{-6}	2.57254×10^{-10}	4.48422×10^{-9}	0.00107741	

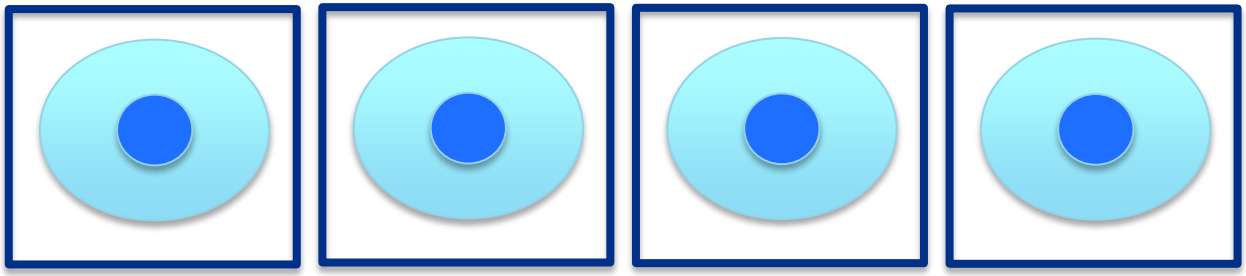
Eo	Pg	c	a	frf	ind	ind2
101 000	14	10	7.57084	2800.	2	102
dw	den[0,0]	jcav	dj[0,0]	djt	djt/jcac	
3.82291×10^{-20}	9.57301×10^{7}	6.47114×10^{-6}	3.55539×10^{-10}	6.19401×10^{-9}	0.000957175	

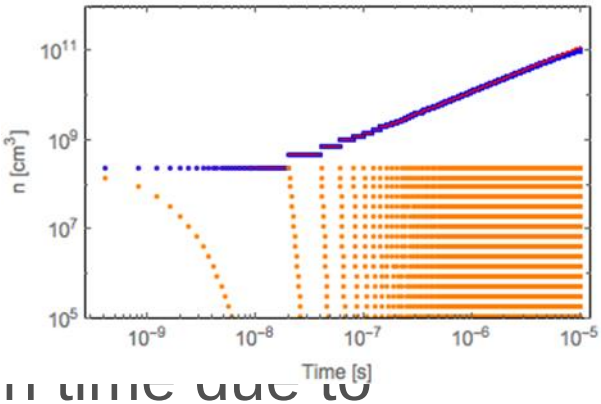




The cavity considered is a box 7.5 cm x 7.5 cm x 10 cm. The E field is along the 10 cm side and the field is aligned with the beam direction. Frf = 2800 MHz. Q? 28000 cycles in 10 usec! Do you put in short bursts of RF in 20 ns gaps? Probably not. Need power input!!

When these are stacked together they sample the beam:





- Some Questions on readout
- 1. Measure Energy loss or freq shift?
- Energy loss
- 2. The density in the cavity is decreasing in time due to recombination. This can be used to determine the number of cycles averaged over. If this is set to be 10 bunches = 200 ns there would be essentially 50 samples during the 10 usec dump. Tune the recombination for the 200 ns and the cavity length so that 10 bunches give 1% loss or a 50% drop in cavity voltage over 10 usec.
- 3. Messy. As the voltage goes down. So does the energy loss per cycle. Non- linear response. Do you feed energy to cavity during the dump?

- Frequency Shift readout.
- 1. Cavity frequency response to change in dielectric constant is very fast…essentially 1 cycle.
- 2. The frequency shift will integrate the beam if there is constant cavity voltage and no recombination.
- 3. But cavity voltage is dropping due to Q and energy loss.
- 4. Need to operate where E/P <.02 V/cm/mmHg where the mobility is a constant independent of Vrf. See plots on slide 2. This will also reduce electron dw/cycle and hence cavity loading. E=15 V/cm and 760 mmHg give "E/P" = .02. Hydrogen linear to higher E/P and less ne.
- 5. Response time set by how long it takes to measure freq.