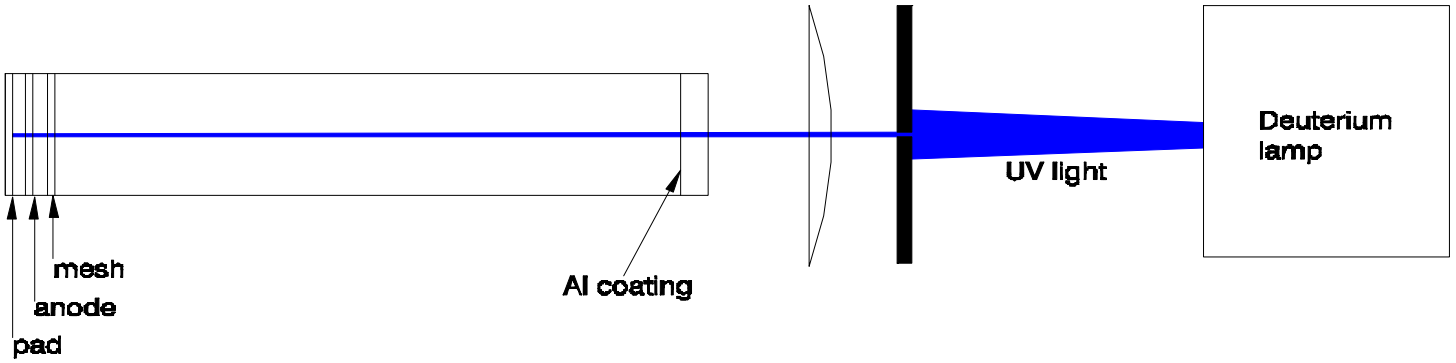
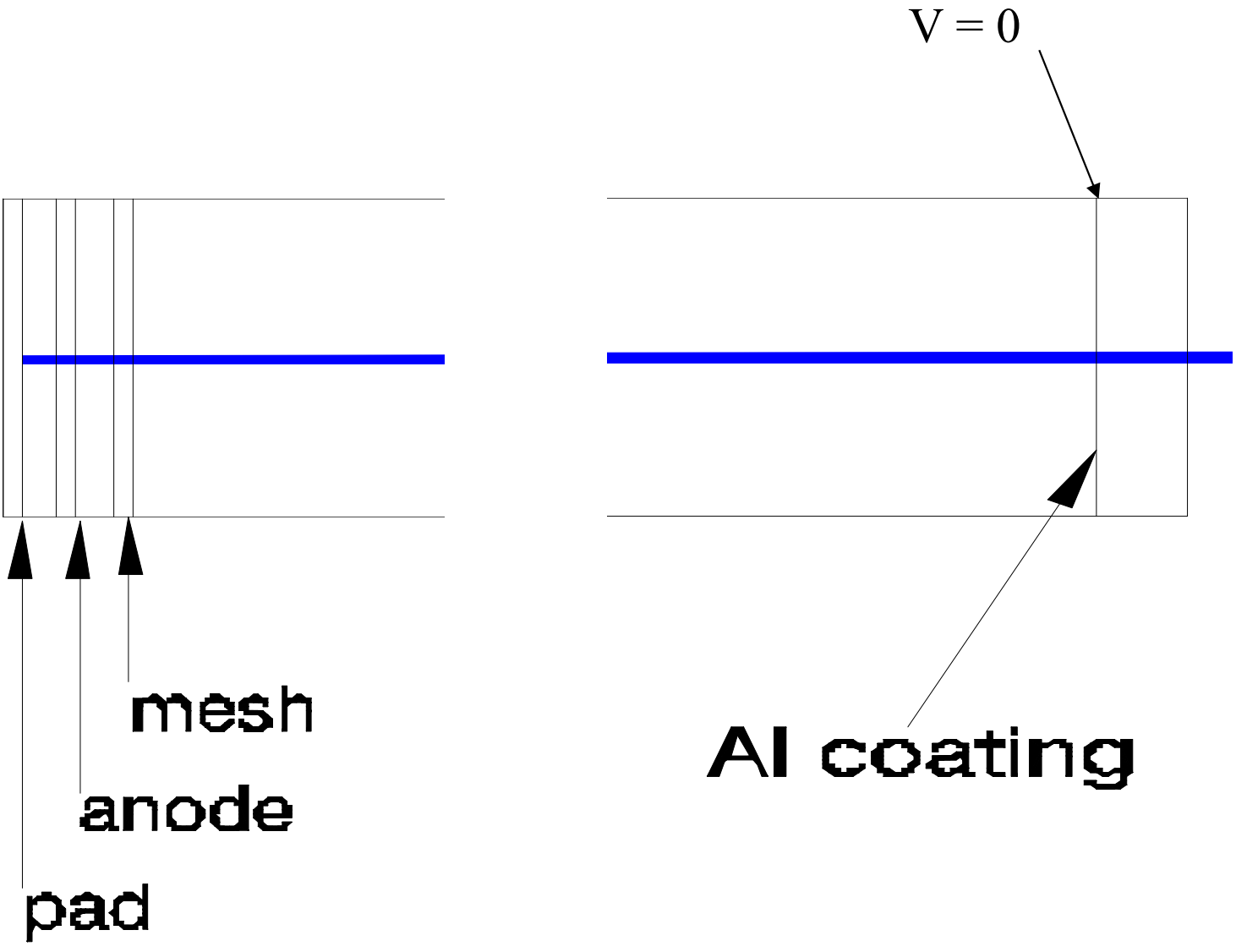
Prototype TPC Tests

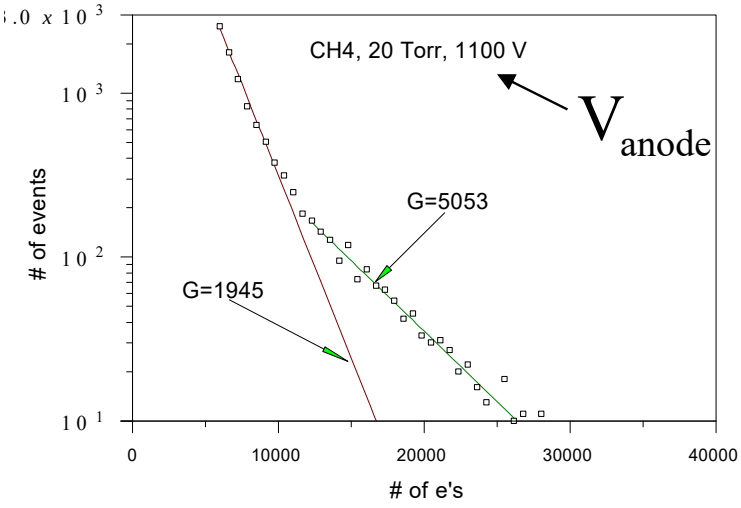
C. Lu 12/9/98

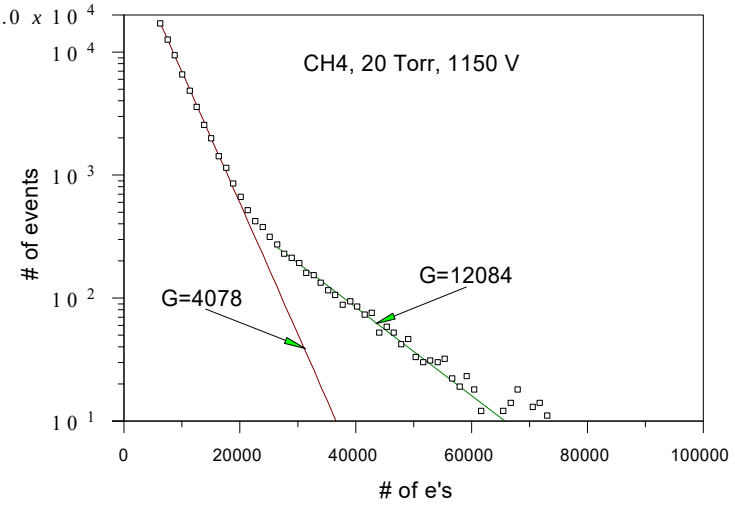


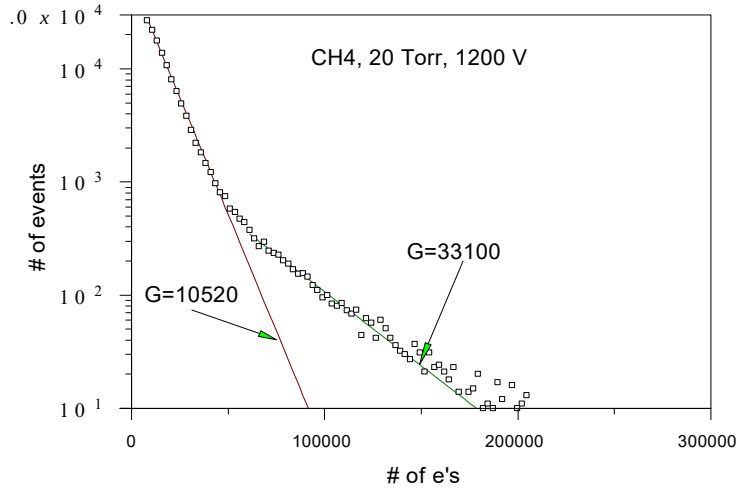


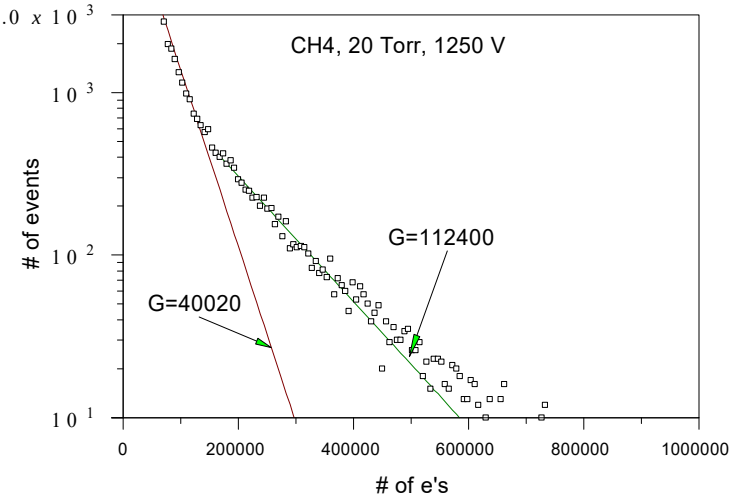
Gas gain test for the low pressure chamber

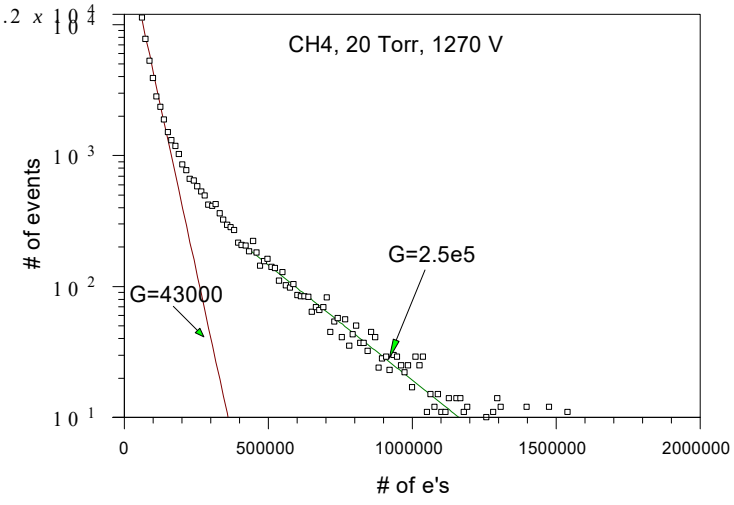
The chamber is constructed with the following parameters:
D_{anode} = 20 μm, Gap = 4.5 mm, anode wire pitch = 2 mm.
For 20 Torr CH_4 gas, the pad signal charge spectra under various voltage combinations are shown: ($V_{mesh} = V_{pad}$ = 20 V)

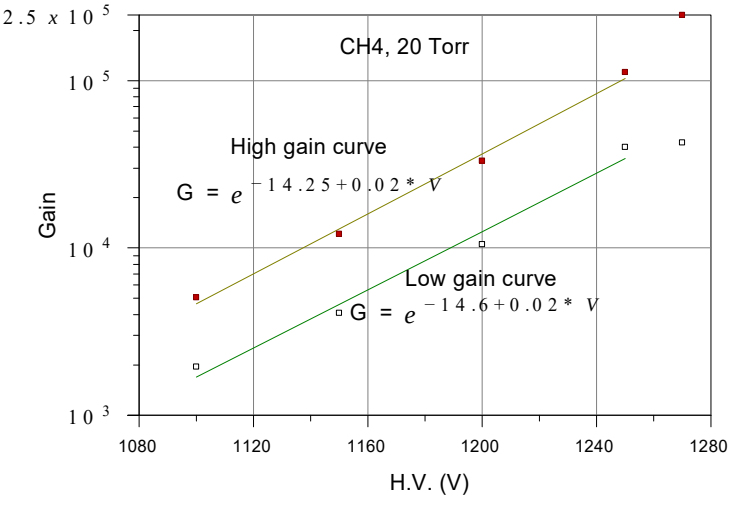






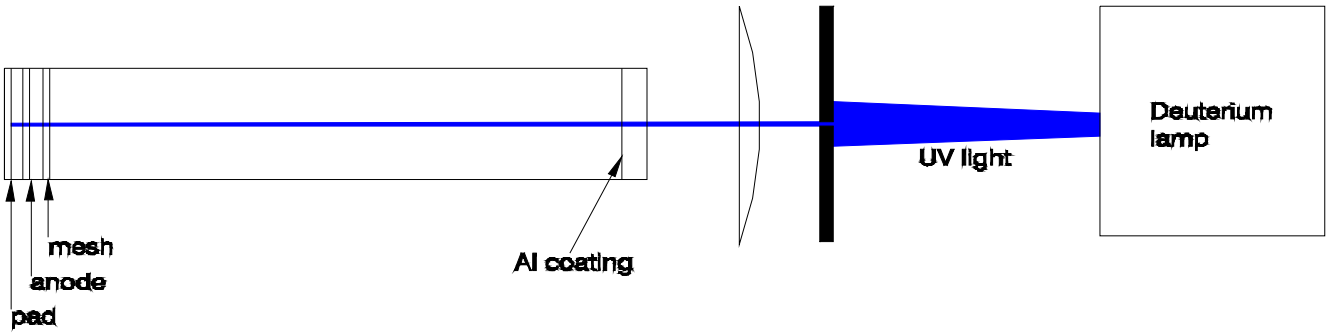






Two Gain Components

The ratio of the low to high gain parts of the spectra is about 1/3. The reason for two gains is as follows:



The deuterium lamp light shines on both the Al-coated window and on the solder-coated pad plane, and photoelectrons are emitted from both.

The avalanche from the pad photoelectron is mostly on the pad side of the anode, so the induced signal is big.

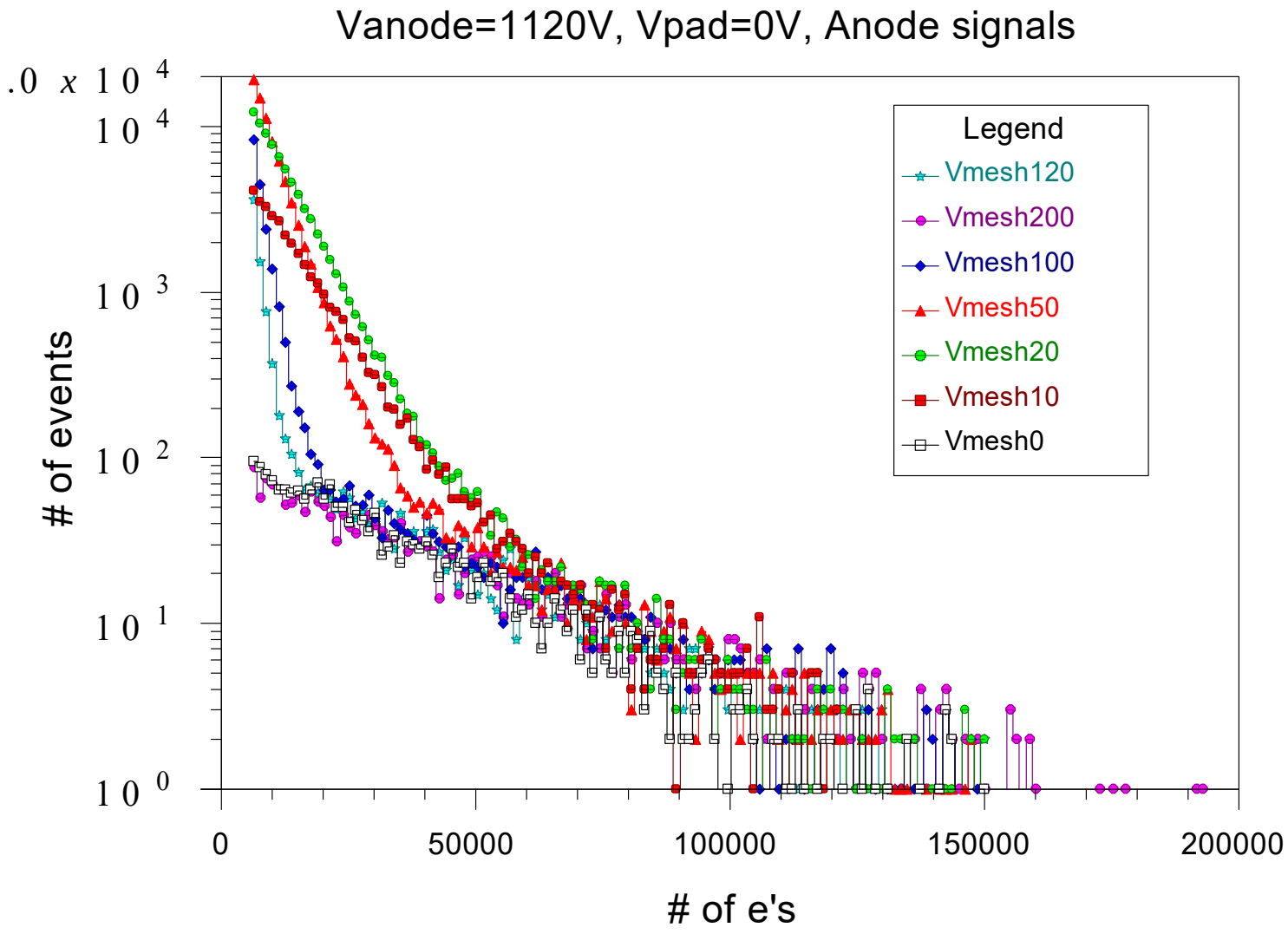
Our test suggests that 3/4 of induced charge appears on the near side of the anode, and 1/4 on the far side.

Therefore, the spectrum on the pad should have two components: window photoelectrons with relative gain 1, and pad photoelectrons with relative gain 3.

More Evidence for the Two Gain Components

We kept the pad photoelectron signal constant, and varied that of the window photoelectron:

The anode wire voltage was fixed, the pad plane was grounded, and the mesh voltage was varied.



Only the low gain component changes!

Longitudinal Position Resolution

Use 300-ps pulse of UV light from a Nitrogen laser.

Eject electrons from the Al-coated window.

Drift 10 cm to mesh and into gain region.

Measure the drift time, and convert to distance.

Position resolution without magnetic field is ~2.8 mm.

V_{drift} = 100 V, so drift velocity = 1/2 saturation.

20 Torr CH_4 = 1/38 atm; so diffusion obeys $D = 38D_0$.

Expect $\sigma = 0.15\,\text{mm}\sqrt{\frac{10 \cdot 38}{1/2}} = 4\,\text{mm}.$