ICD LED Run Status

- Purpose
- ADC to GeV Conversion
- Basics of ICD LED Pulser
- Taking Runs
- Looking at the data
- What's next?

Alan L. Stone
Louisiana Tech University

Purpose of LED Runs

- **Long term monitoring of PMT response**
  - **The photomultiplier tubes for the Run II ICD sub-detector were *recycled* from the Run I ICD boxes**
  - **Each channel was individually *tuned* in order to achieve a mean MIP peak on the cosmic ray test stand**
    - **Only lever arm is the high voltage setting**
  - **Over a dozen PMTs have already been replaced**
    - **About a dozen channels have failed or dropped significantly in gain since the end of the Oct-Nov shutdown**
  - **Establish a real world baseline for the full ICD – from scintillator tile to the BLS card**
    - **Determine correction for channel to channel variation**

ADC to GeV Conversion

Interlude borrowed from
talk given by Andy White
16 Jan 2002 at Jet Energy Scale Mtg

- **Specific energy loss (dE/dx) in the Bicron BC-400 scintillator (PVT)**

  $dE/dx_{min} = 1.956(g/cm^2) \times 1.032\ g/cm^3 = 2.02\ MeV/cm$

- **Mean MIP peak in test stand ADC counts for 368 channels was 135.7 (aim was 140!)**
- **Relative gain factor between calorimeter preamps (used on the test stand) and the ICD preamps was 3.8.**
- **Extra amplication of 8.7 used to boost signal on test stand**
- **Factor of 10 between least count of test stand ADCs and the calorimeter ADCs. Least count for test stand ADC is 1 mV and calorimeter ADC is 0.1 mV.**

ADC to GeV Conversion

Interlude continued

- **The *cosine* factor accounts for angle from normal to an ICD tile relative to a straight line drawn from the IP through the center of a tile. There are three numbers, one for each ieta bin spanned by the ICD:**

ieta	cosine factor
12	0.592
13	0.633
14	0.671

NOTE: sampling fractions also include this angular factor, so one must be careful not to apply it twice!

- **Thickness of all ICD tiles are 0.5 in (about 1.27 cm).**

ADC to GeV Conversion

Interlude continued

- **Average MIP peak position in calorimeter ADC counts is given by:**

  $(135.7 \times 10) / (3.8 \times 8.7) = 41.0$ counts

- **The energy deposition in an ICD tile is given by:**

  (Cal. ADC count / 41.0) $\times$ (2.02 MeV/cm $\times$ 1.27 cm)

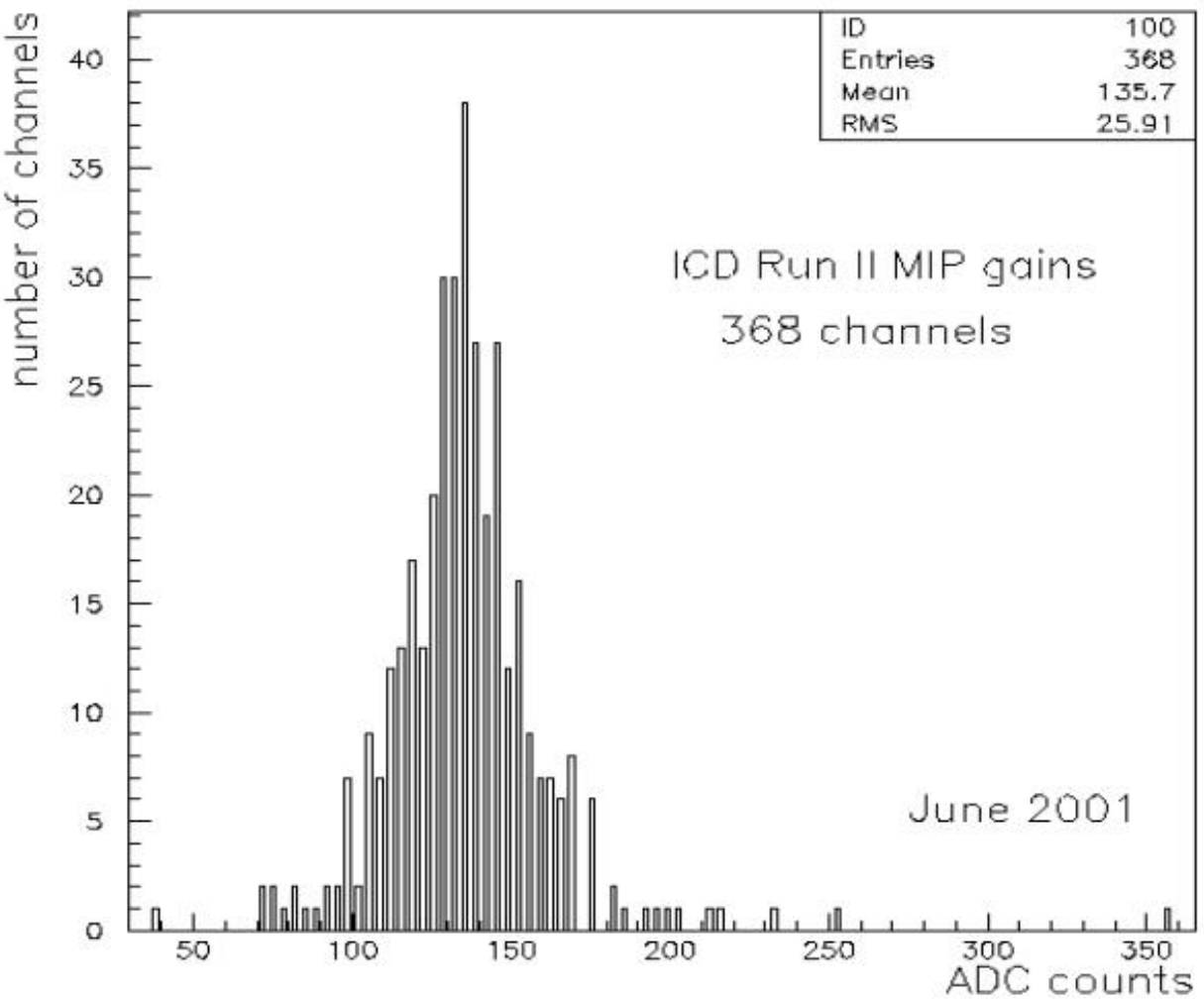
- **The result is:**

  (Cal. ADC count $\times$ 0.06257) [MeV]

= (Cal. ADC count / 15982) [GeV]

ICD tiles – test stand results

compiled by Mark Sosebee



The Basics of the ICD LED Pulser

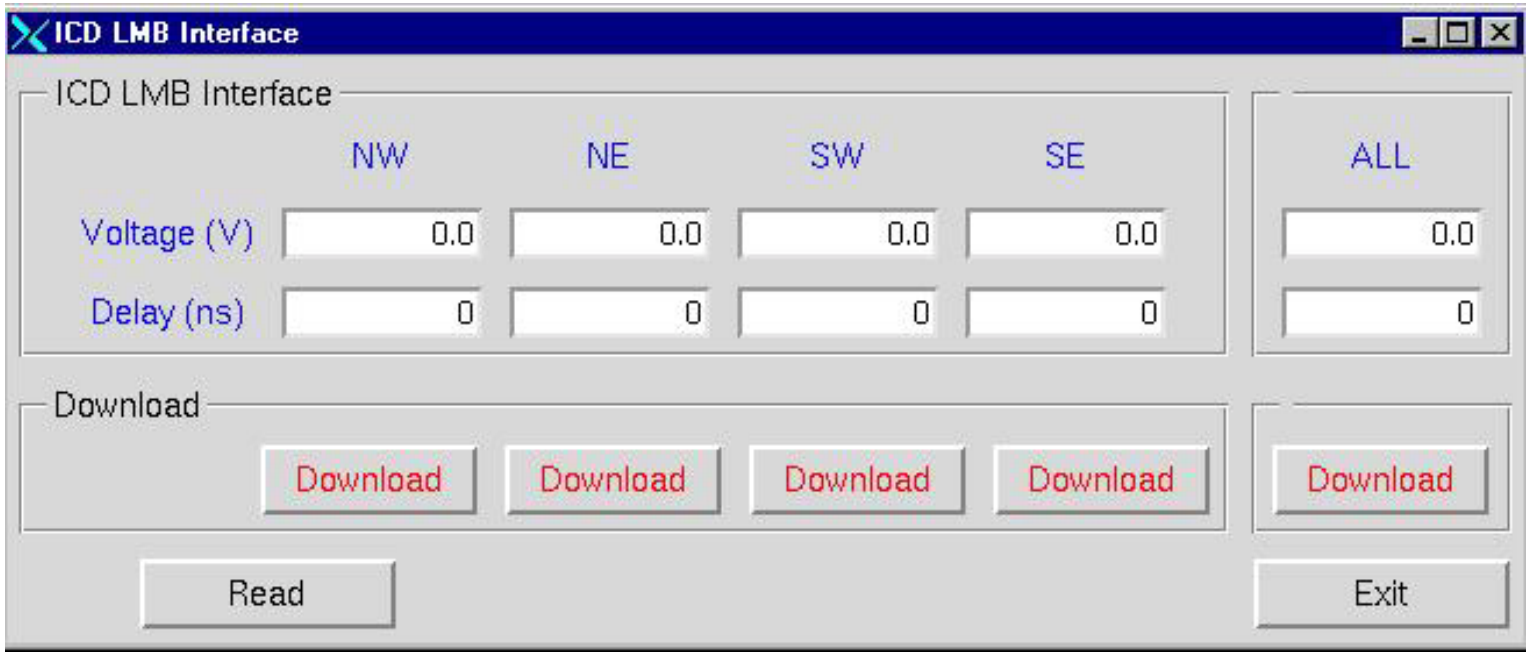
- **Scintillator LED Pulser (SLP) – *borrowed* from the Muon calibration system**
  - **ICD shares VME board with FPD – sits in MCH308**
  - **Accepts external NIM test pulse trigger**
  - **VME controlled channel enable, trigger, amplitude and delay**
    - **Steve Doulas provided the documentation and expertise!**
    - **Excellent GUI created by Marc Hohlfeld!**
  - **DC offset resistively coupled to a TTL signal pulse**
    - **TTL pulse triggers a transistor which discharges a capacitor into a group of four LEDs**
    - **DC offset provides the bias voltage for these LEDs**

Taking ICD LED Runs

- **Detailed instructions now part of the Cal Shifters' Guide** (thanks to Florencia for getting cal_elec to work!)
  - Needs to be given priority during periods without beam
  - A baseline still needs to be determined
    - What is the optimum delay time (between 0 and 170 ns)?
    - What DC offset(s) should be used?
      - The turn-on voltage as seen on the oscilloscope directly from the electronics is about 6.6 Volts.
- **The LED pulser needs to be issued a command to turn off during the prepare-for-run-1.1 download**
  - There is currently no alarm to check that the ICD LED pulser is off during global data-taking

More on LED Pulser Runs

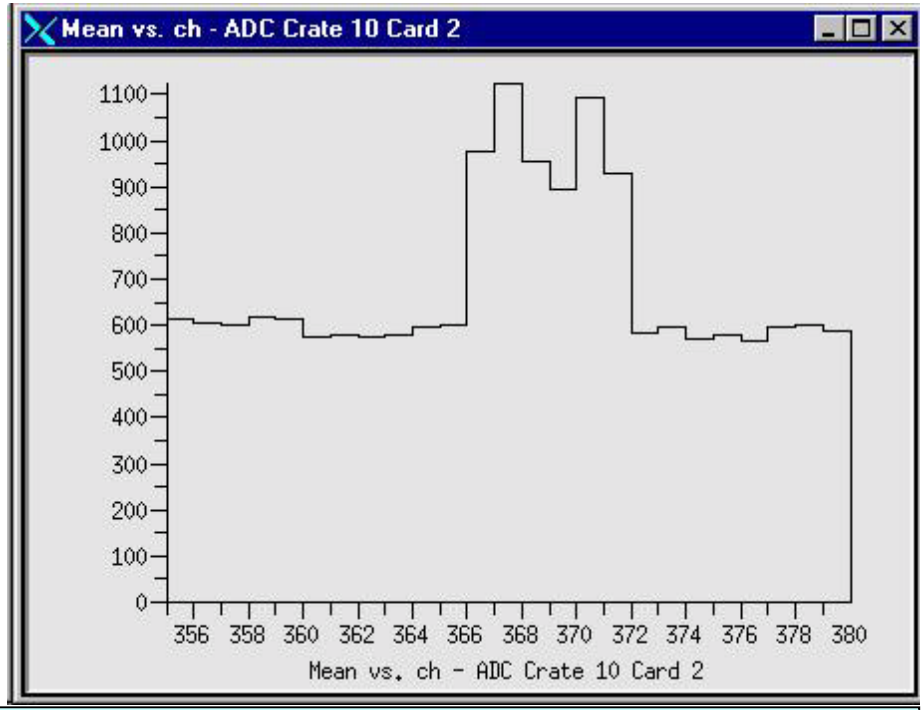
```
> setup d0online
> cd /home/d0icd/vme
> ./lmb_int.py &
```



- **Voltage is adjustable up to 10.0 Volts in increments of 0.2 Volts**
- **Delay is adjustable from 0 to 170 ns in increments of 2 ns**
- **All Download is preferable – Read *feature* sets ALL to zero**

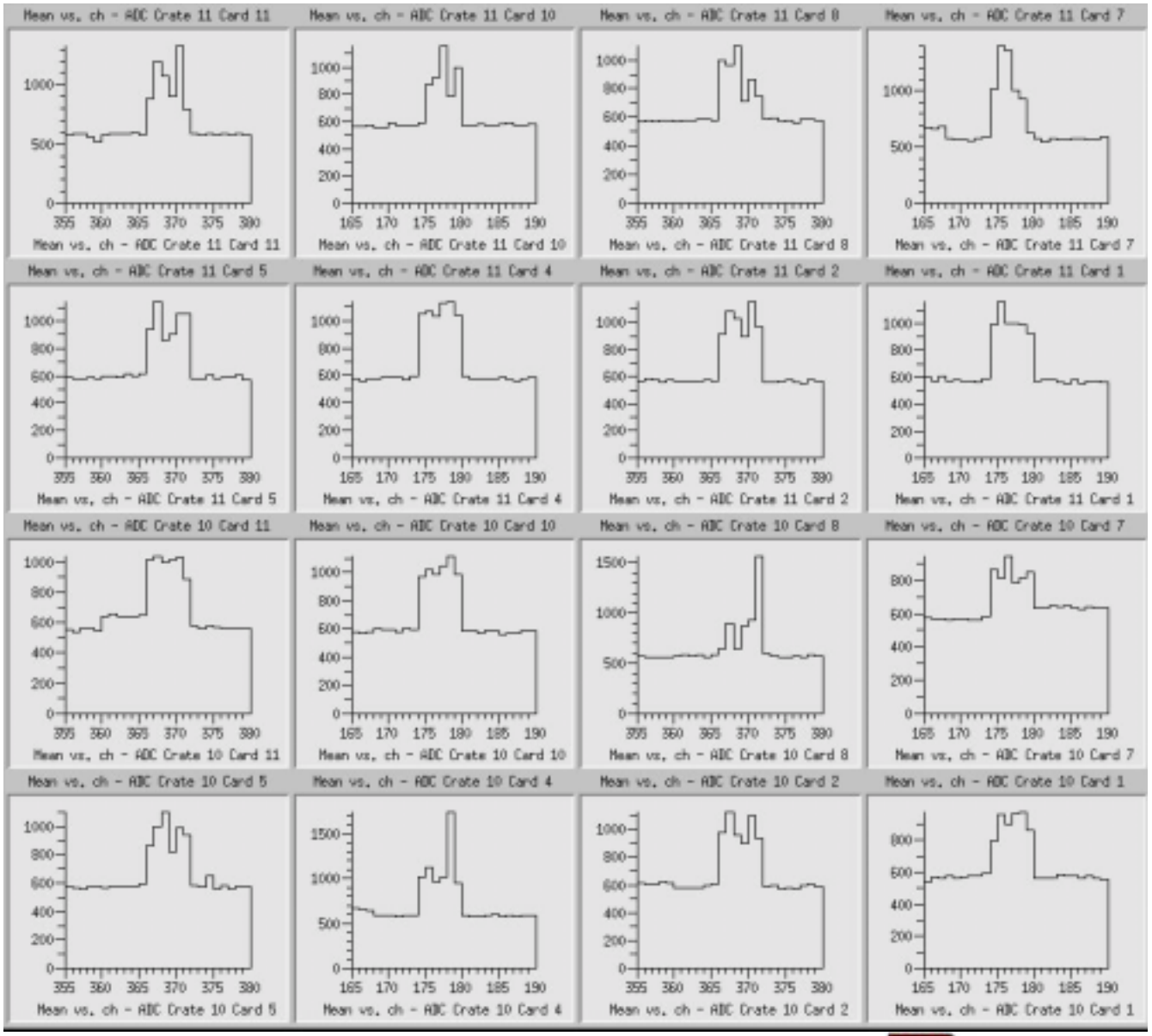
What has been done?

- **Several LED Runs taken by Pierre Petroff on Jan 23rd**
  - **First test of instructions revealed that cal_elec was not working well enough**
- **Stephanie Beauceron took the full set of runs (six DC offsets at six different time delays) on Feb 6th!**
  - **Too much work – need to reduce the number of steps**
  - **hbook saved files very useful to make plots/printouts offline**
- **Lee Sawyer created SAM datasets**
  - **still need more effort offline**

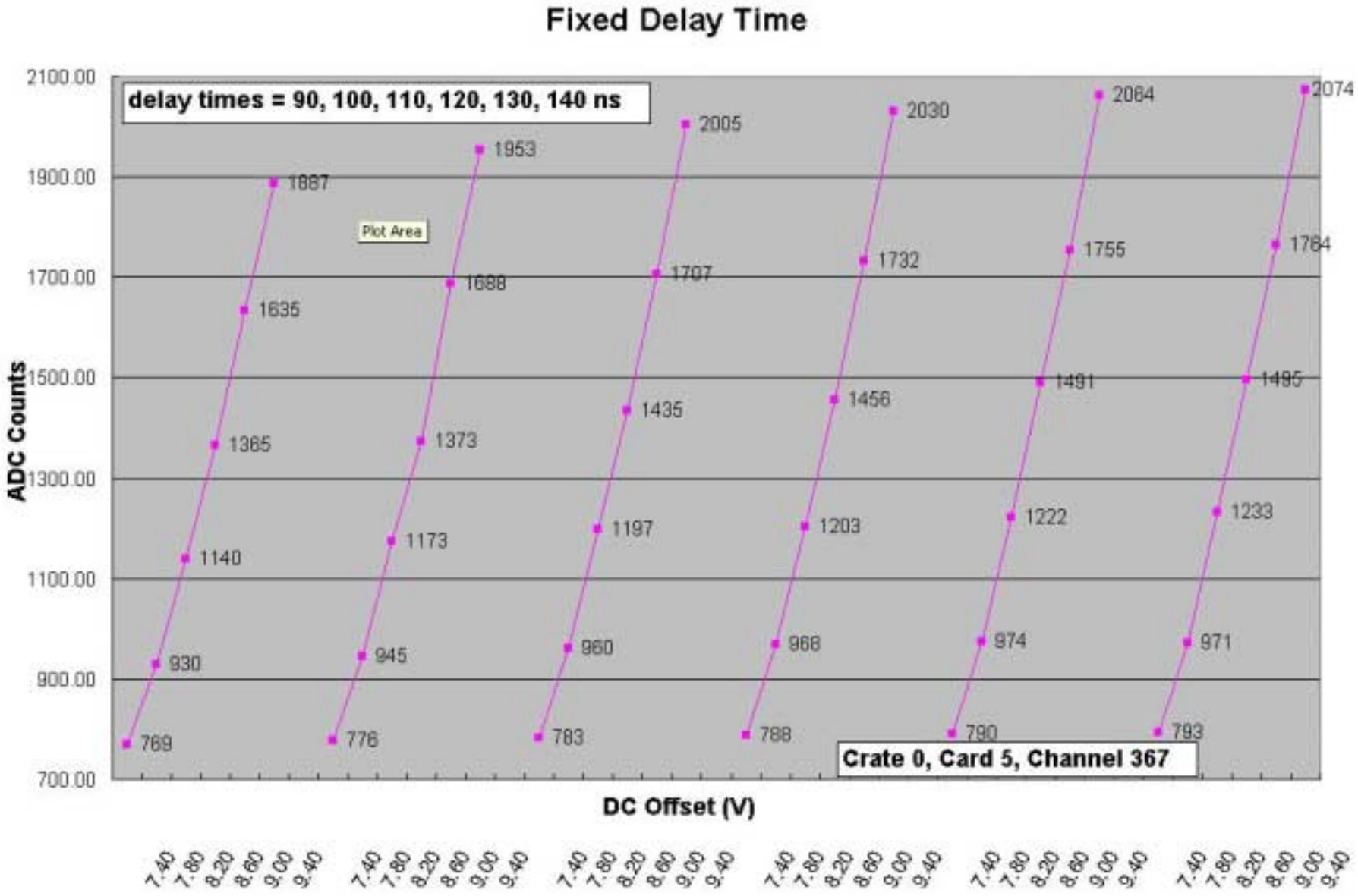


Ted Elzroth determined ADC count value for one good channel from each Cal Crate in which the ICD is part of the readout - [Crates 0,1,4,5,6,7,10,11]. Did this for each DC offset & time delay setting – $8 \times 6 \times 6 = 288$!

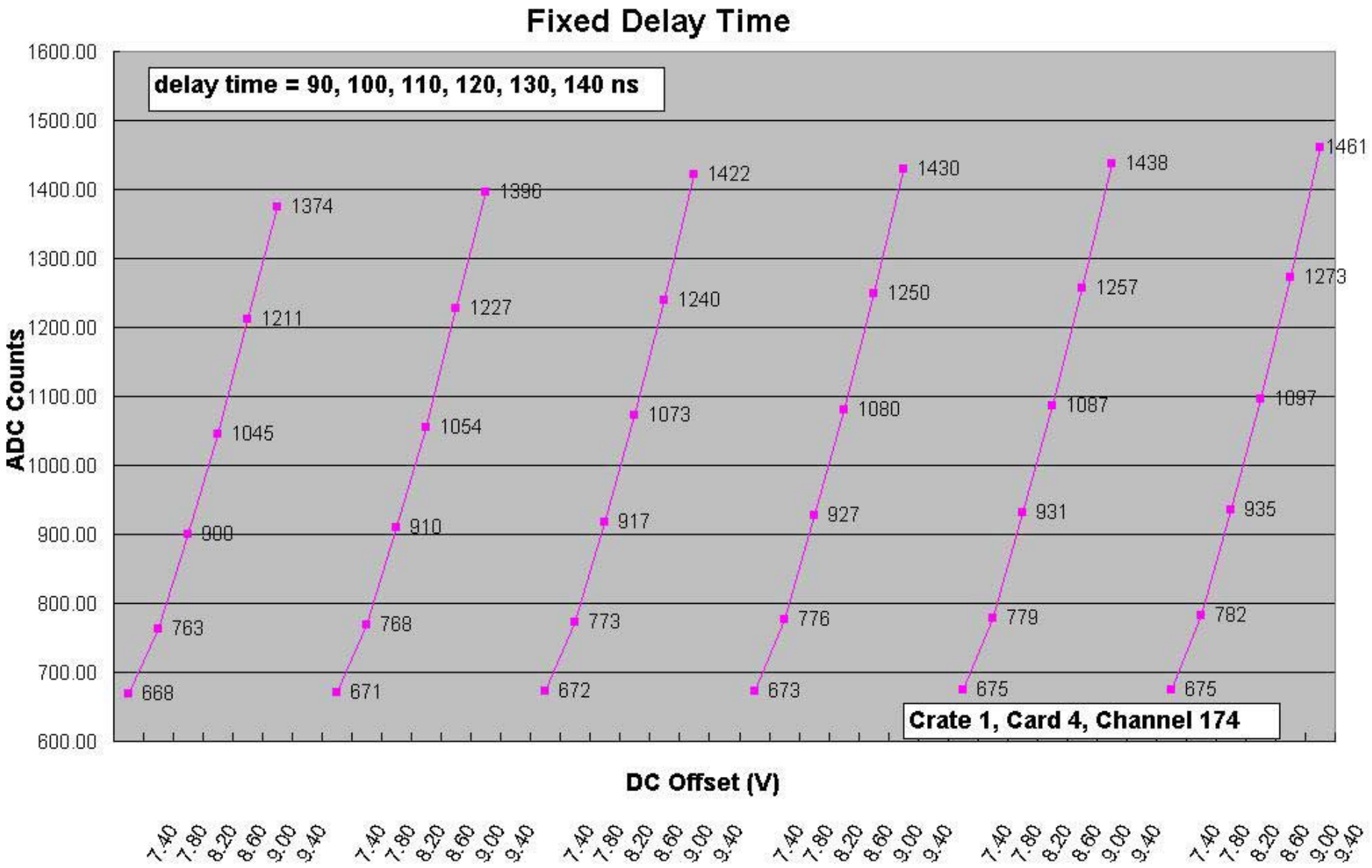
All ICD channels in Cal Crates 10 & 11 readout



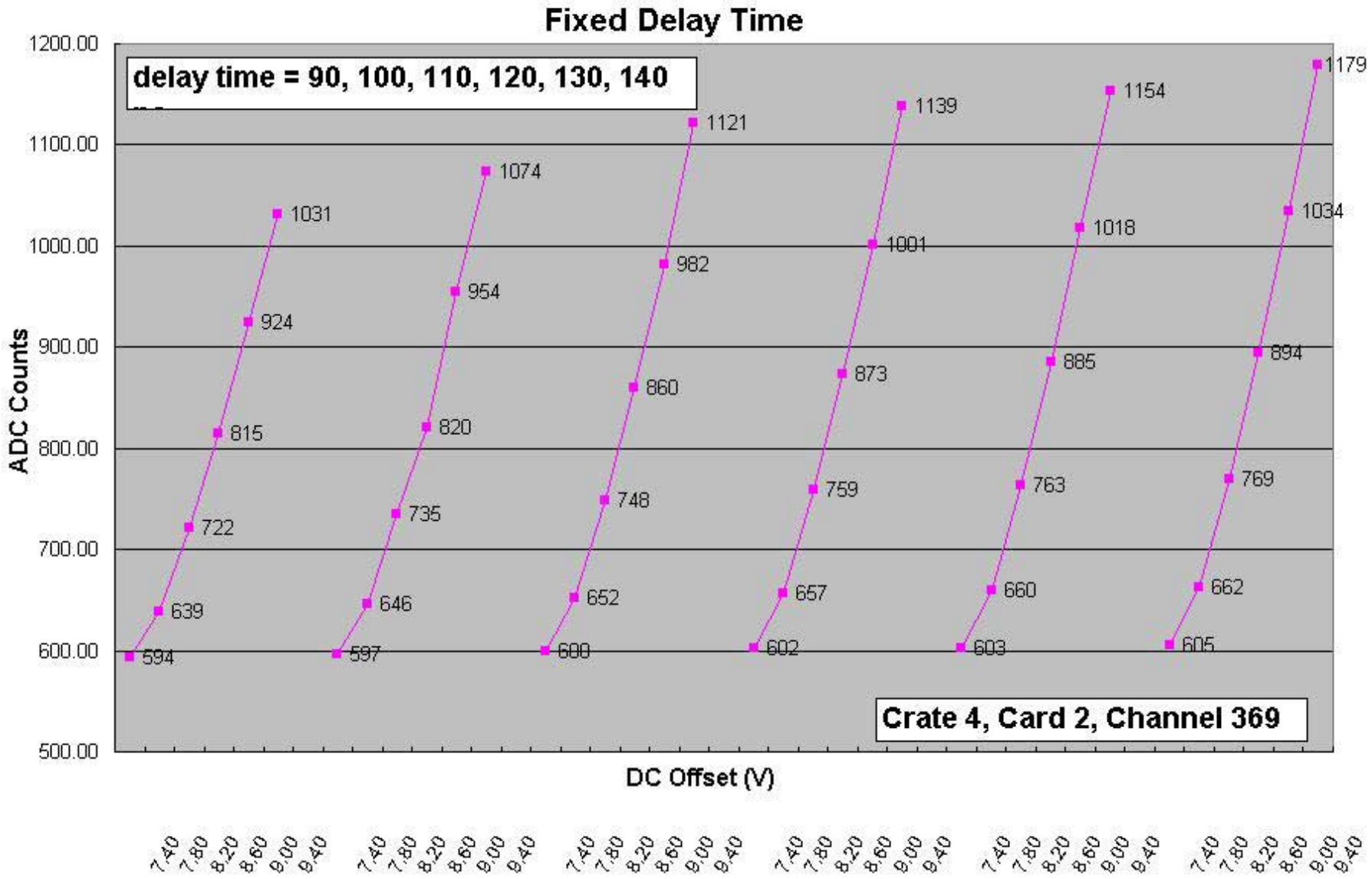
ICD in Cal Crate 0



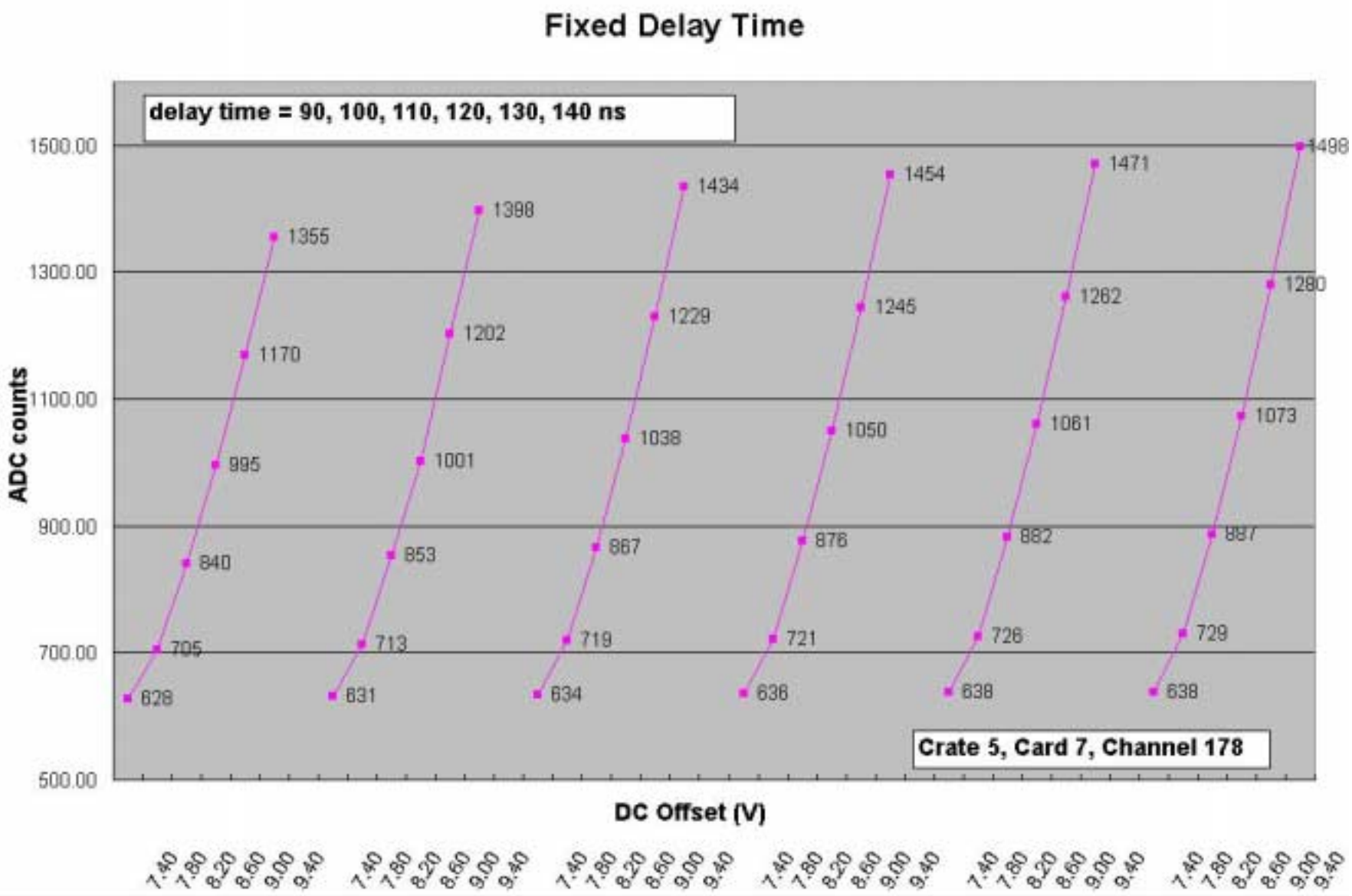
ICD in Cal Crate 1



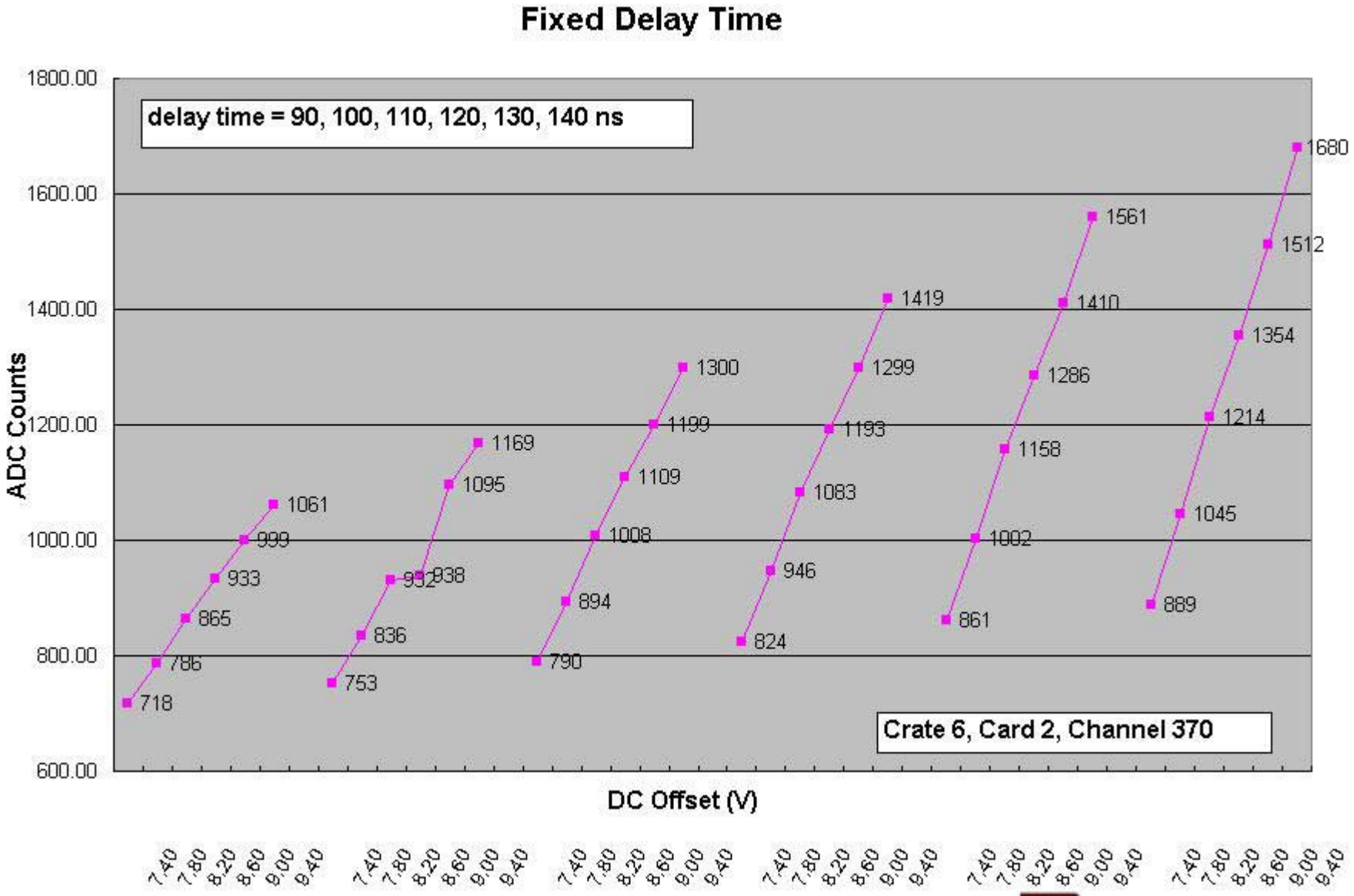
ICD in Cal Crate 4



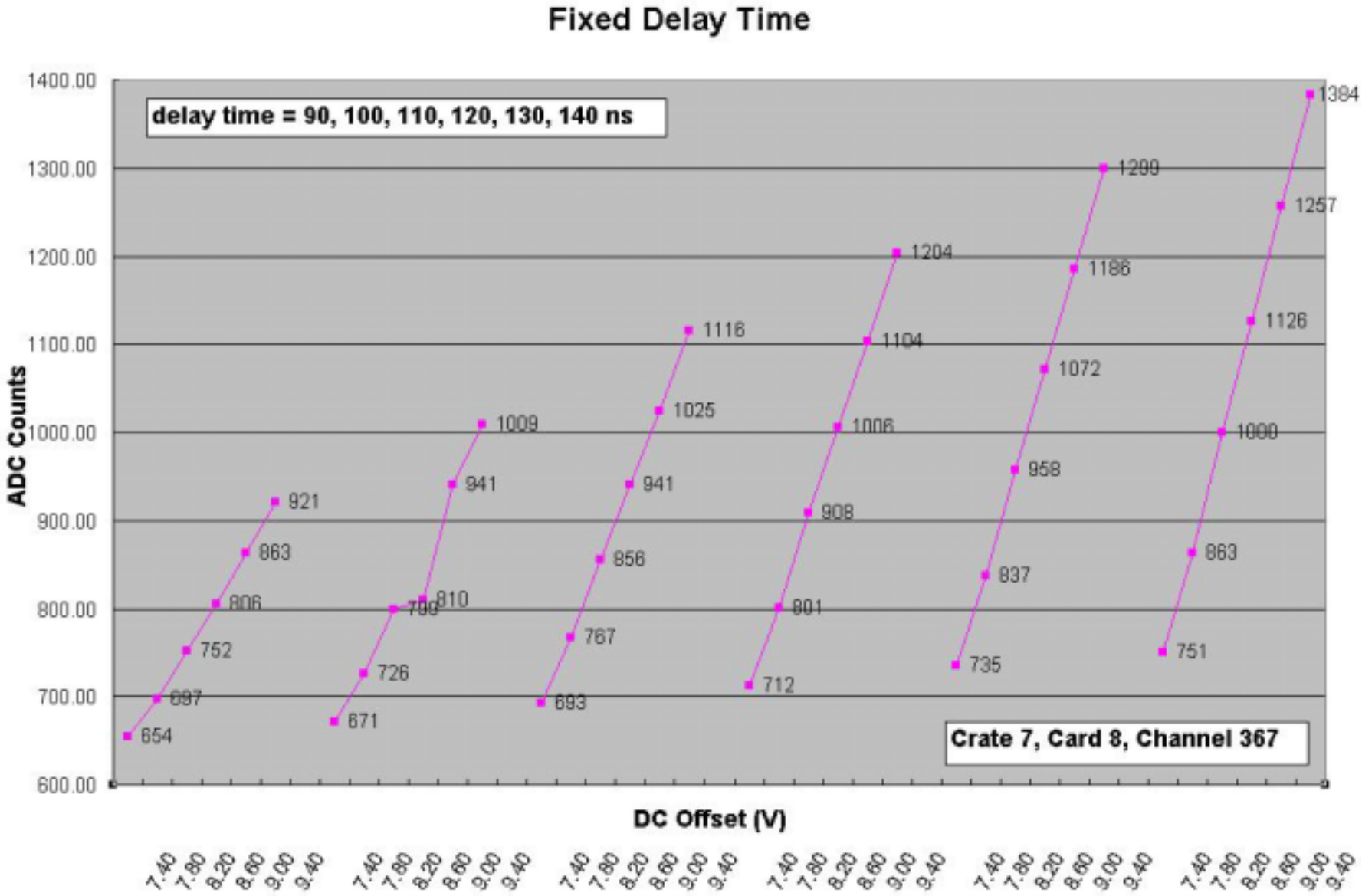
ICD in Cal Crate 5



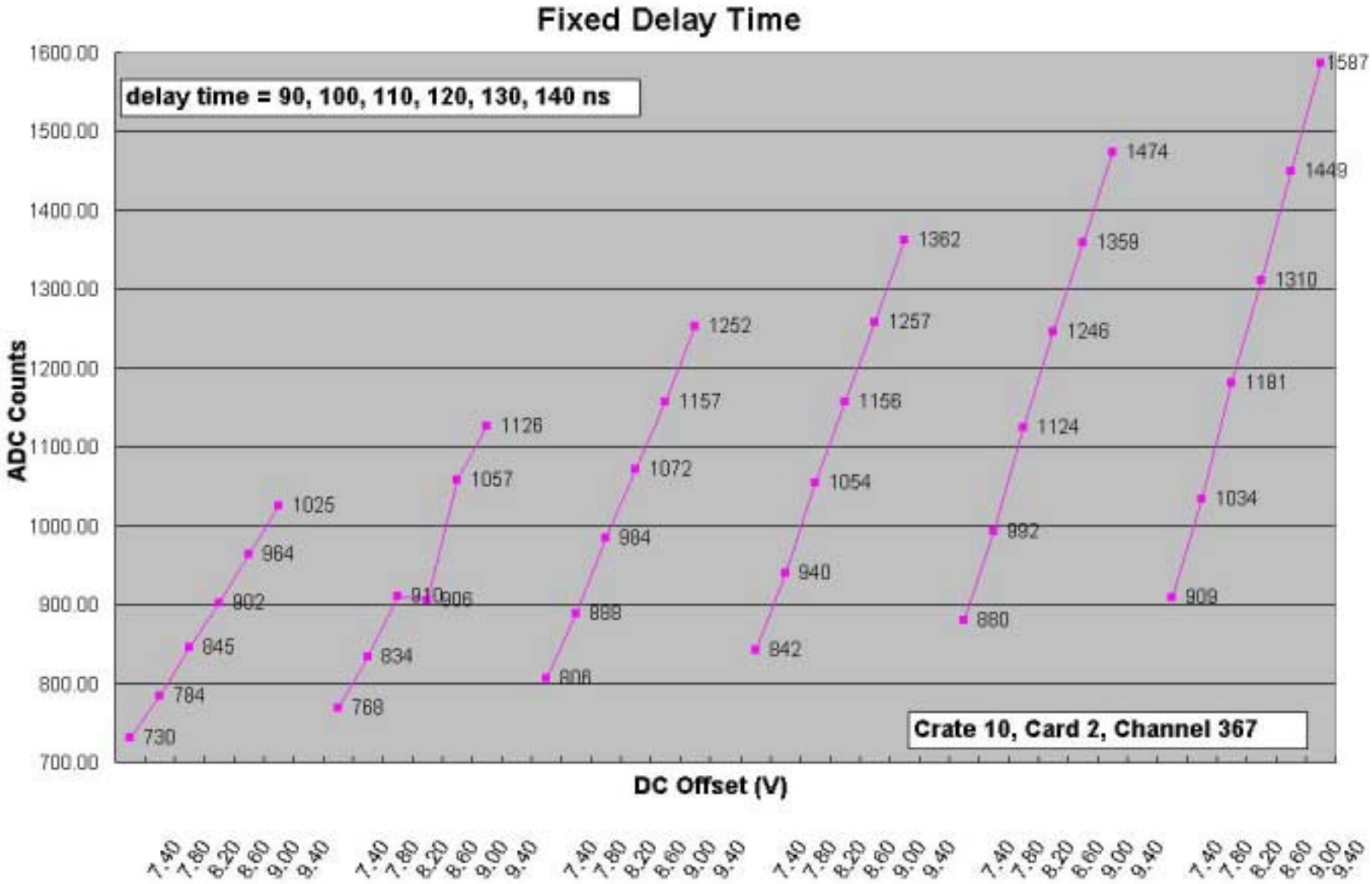
ICD in Cal Crate 6



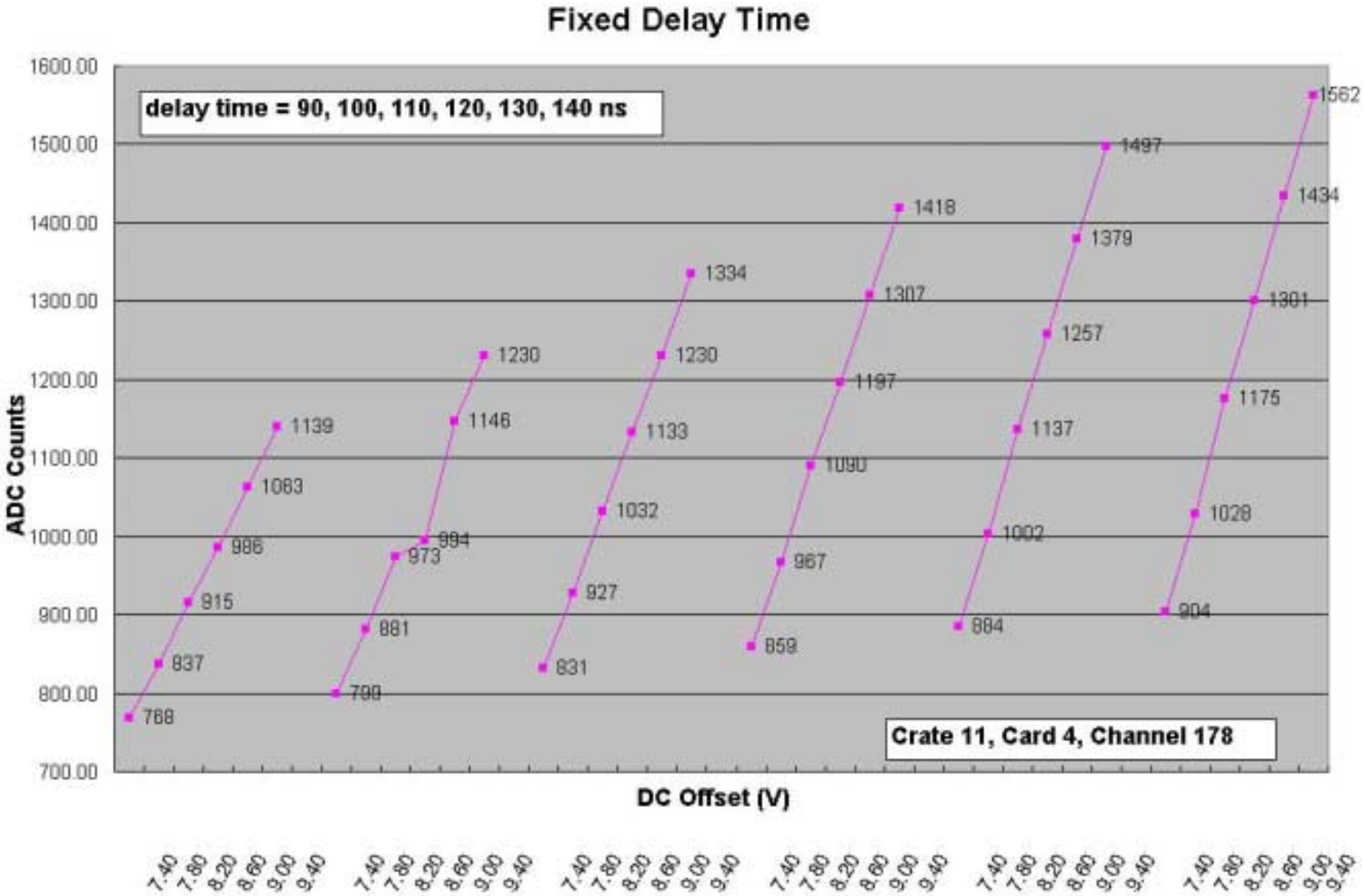
ICD in Cal Crate 7



ICD in Cal Crate 10



ICD in Cal Crate 11



Next Step

- **Take another series of runs**
  - **Step through delay times of 120-170 ns**
  - **Fewer DC offsets: 7.8, 8.2, 8.6 and 9.0 V**
  - **Fewer events per run to speed up the process**
  - **Do the plots and printouts offline**
- **Why is there a significant timing difference between the ICD channels in different Cal crates?**
  - **Possible error? Current method requires strict bookkeeping from the renaming of hbook files to filling the spreadsheet**
  - **SLP cable length difference between East & West**
- **Purchase & test new PMTs**