

# ADC study (1)

E17 meeting 30/Jul./2009

# Contents of this report

## Status

- ✓ CAEN V785N (VME 12bit peak hold ADC)

**Borrowed from SMI**

**Check DNL and INL**

- ✓ TKO Wilkinson type ADC

- **Modification of E570 one (now send back to company)**

**Lower 2 bit inverting → fixed**

**Differential non-linearity (odd-even effect) → under tuning**

**Bad-INL channels → under tuning**

- **new Wilkinson ADC is not delivered yet (ordered in May)  
(will be delivered in the next month).**

See Okada san`s  
report

[http://ag.riken.jp/  
e17/doc/wilkinson/](http://ag.riken.jp/e17/doc/wilkinson/)



# CAEN V785 differential non-linearity

Check for **differential** non-linearity of V785

## Setup

Func. Gen.



Linear sum



ADC

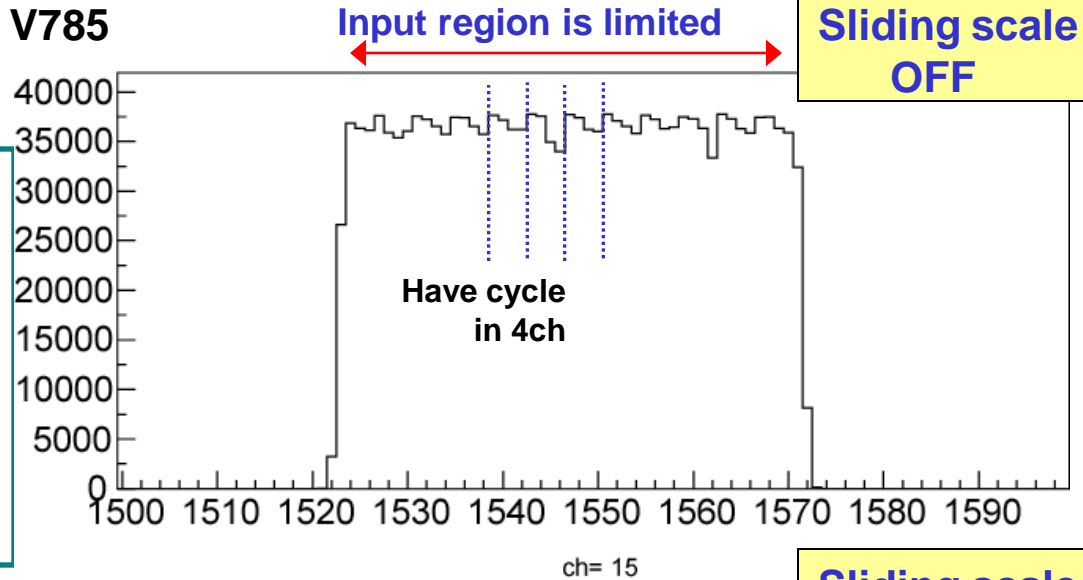
DC source



input

gate

clock

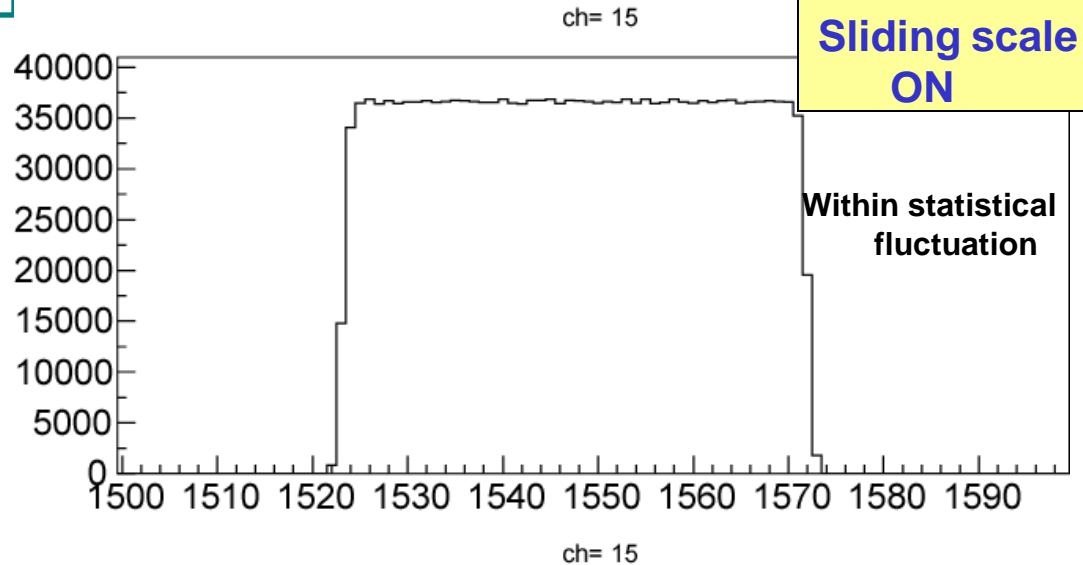


Func. Gen.

HP 33120A 50mVpp /12 bit  
 = 12  $\mu$  V  $\longleftrightarrow$  V785  $\sim$ 1mV/bin

DC source

YOKOGAWA ( $\Delta V \sim$  few  $\mu$  V)



**Sliding scale works well**

DNL is much smaller than statistical fluctuation ( $\sqrt{36000}/36000$ ) = 0.5%

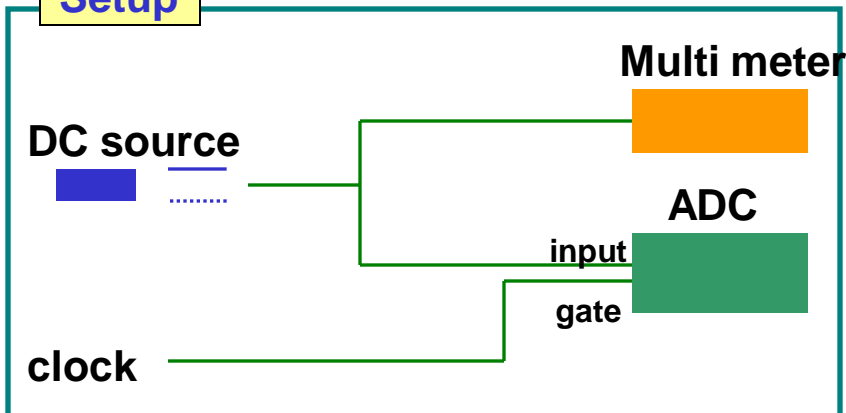
# CAEN V785 integral non-linearity

Check for **Integral** non-linearity of V785

Same setup with the meeting report on PH-ADC INL

Sliding scale  
ON

Setup



**Multi meter**

KEITHLEY 2700 (digit 6 1/2)

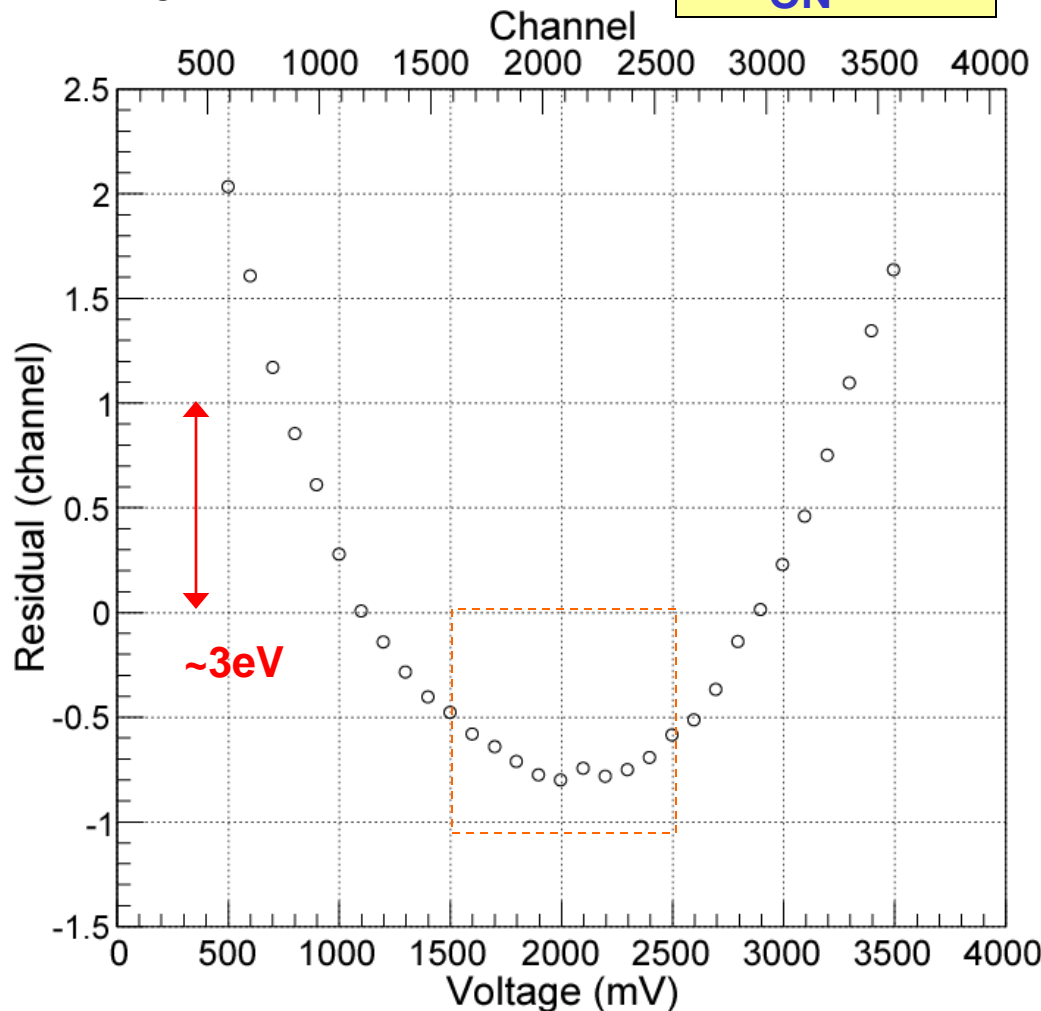
**DC source**

YOKOGAWA ( $\Delta V \sim \text{few } \mu V$ )

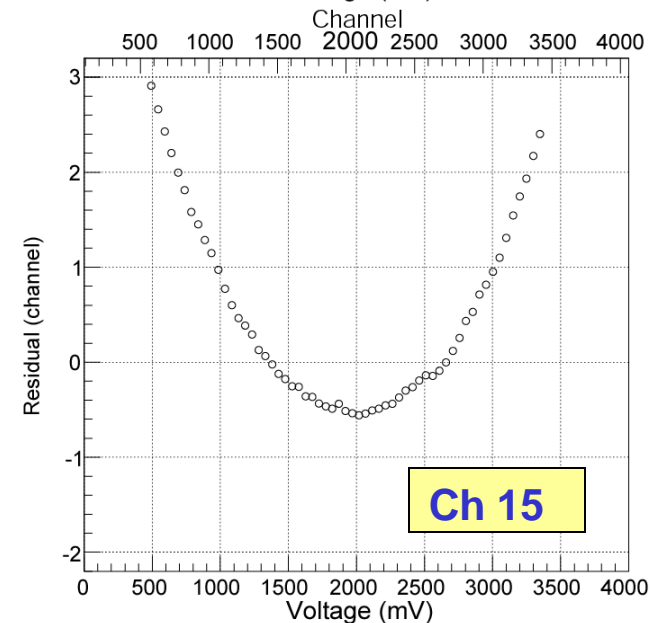
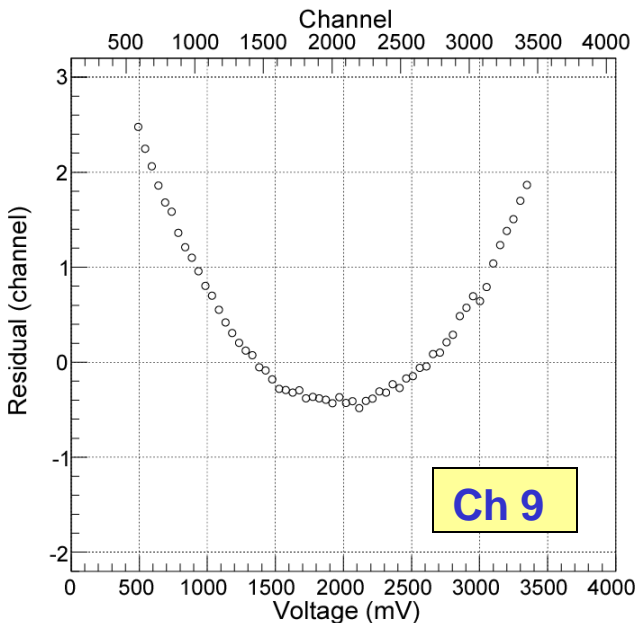
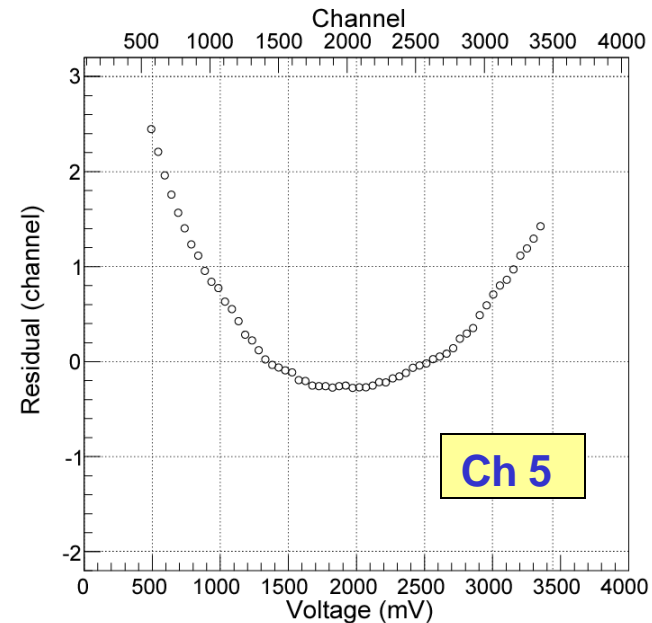
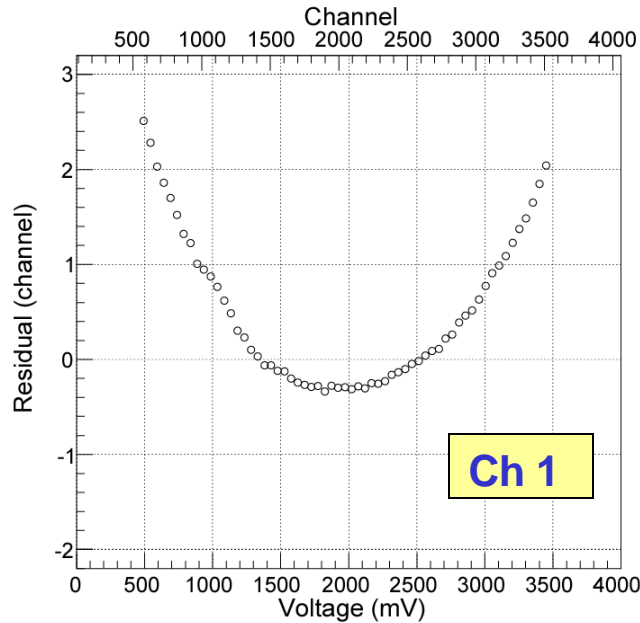
**Large quadratic INL**

→ Other channels?

→ Possible to correct or not?



# Other channels



Check all  
channels

All channels have  
almost same  
tendency

Important region is only  
the central region

E570 case:

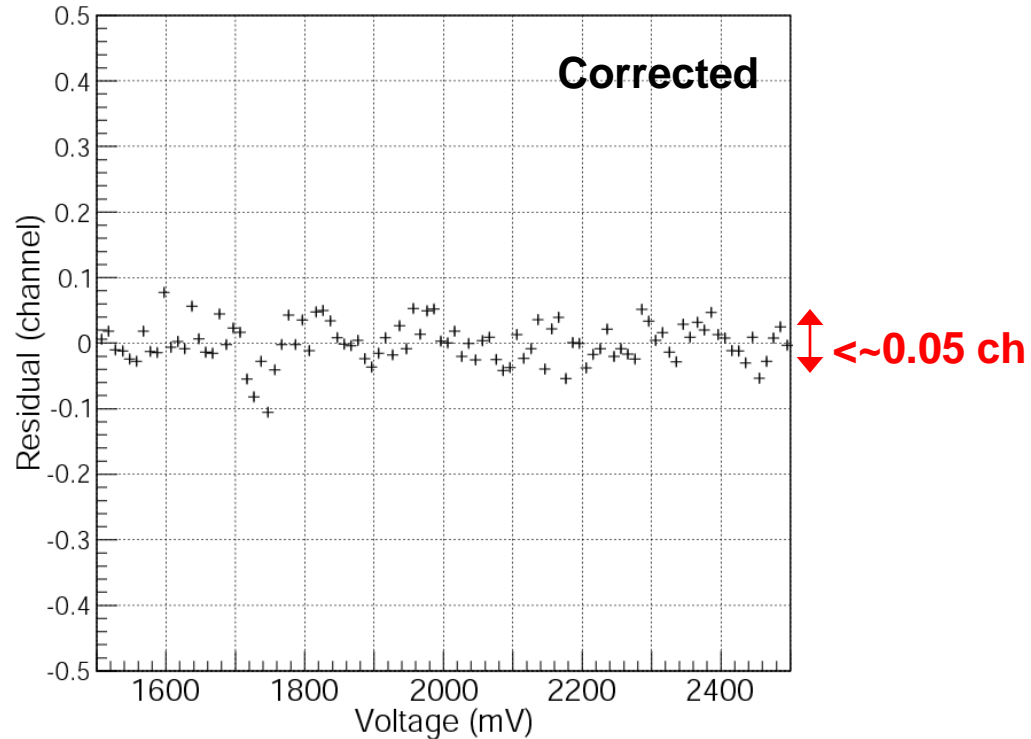
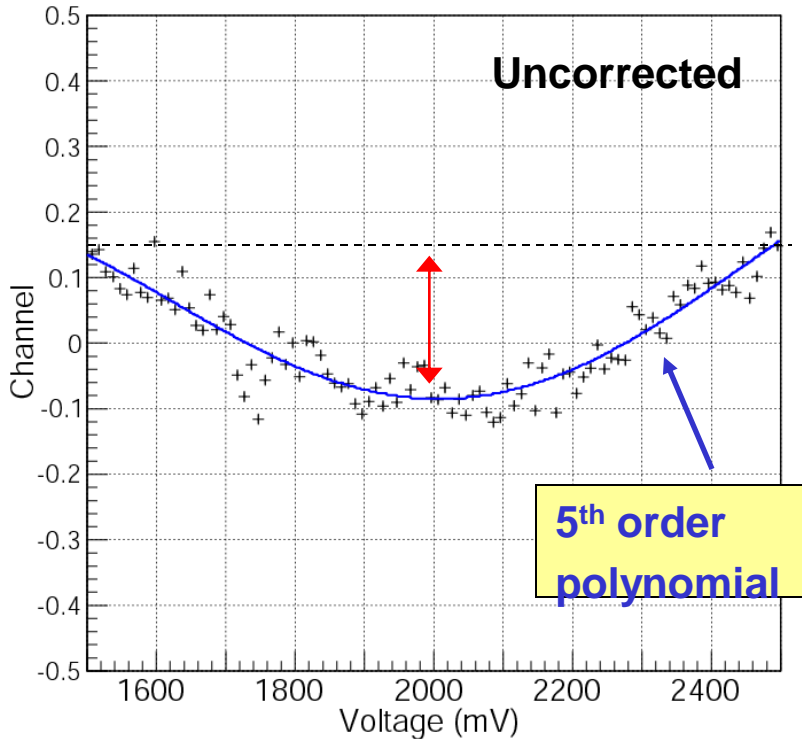
Ti ~1500ch

KHeX ~2000ch

Ni ~2500ch

# Central region

Region of interest: 1500 ~ 2500

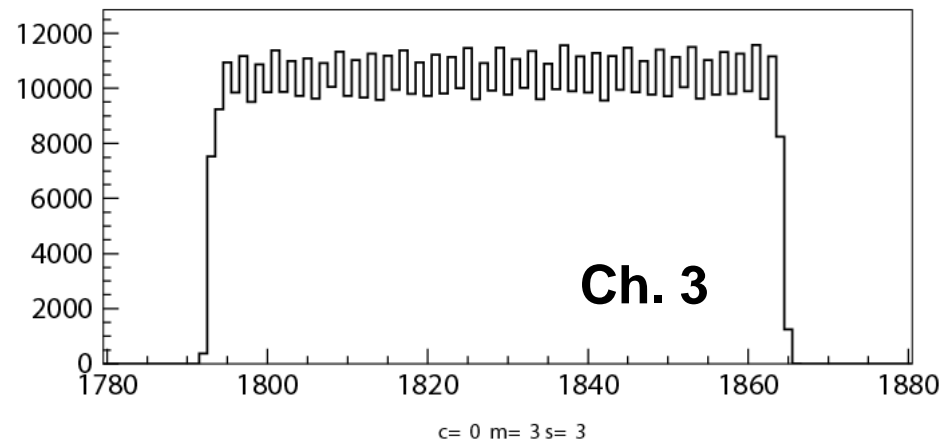
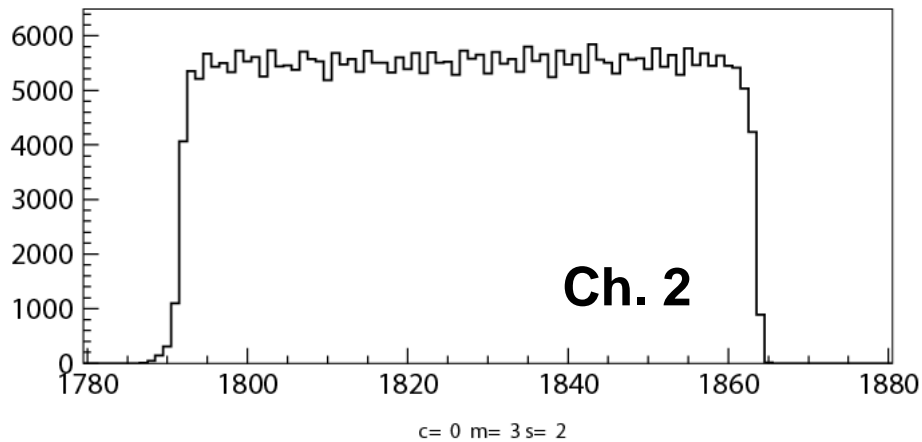
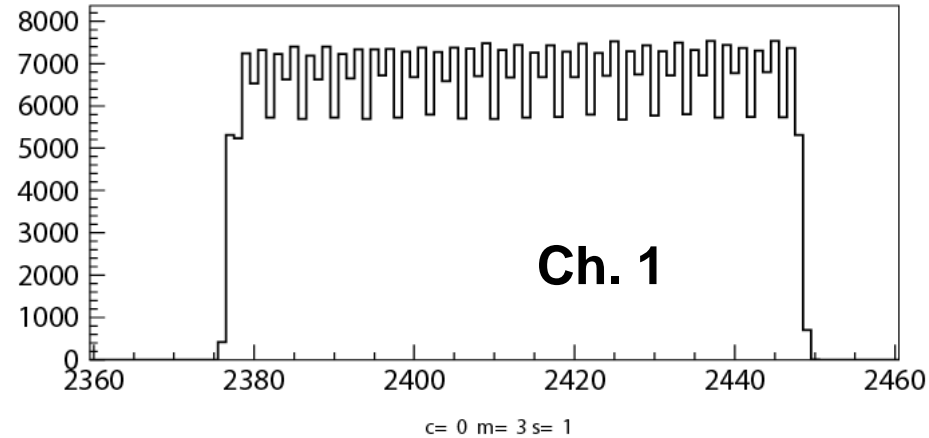
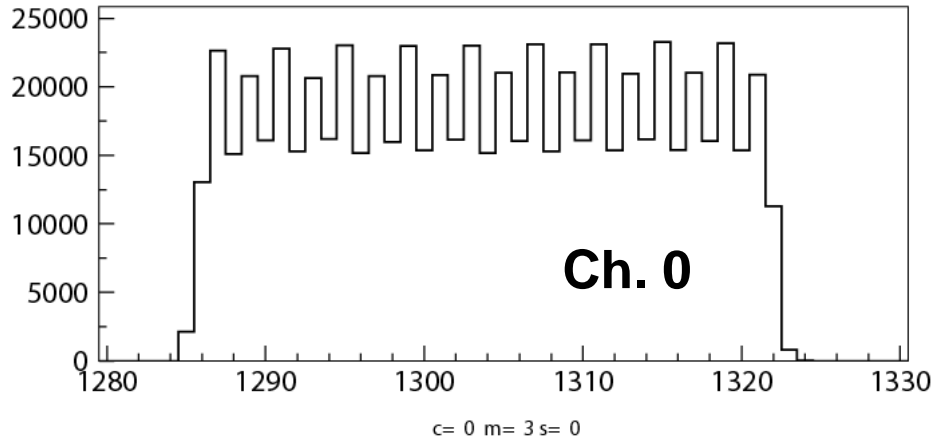


- ✓ After correction, INL ~ less than 0.05 ch ( $\sim 0.15$  eV)
- ✓ Bit effect (ex, jumping @2048) looks small ( $\leftarrow$  thanks to good DNL?)
- ✓ Fluctuation of channel comes from ambiguity of determining the channel center (one input value distributes in only a few bins)

# Wilkinson ADC: differential non-linearity

Same setup with V785 DNL measurement | large DNL

Still large DNL



Now, company in under tuning

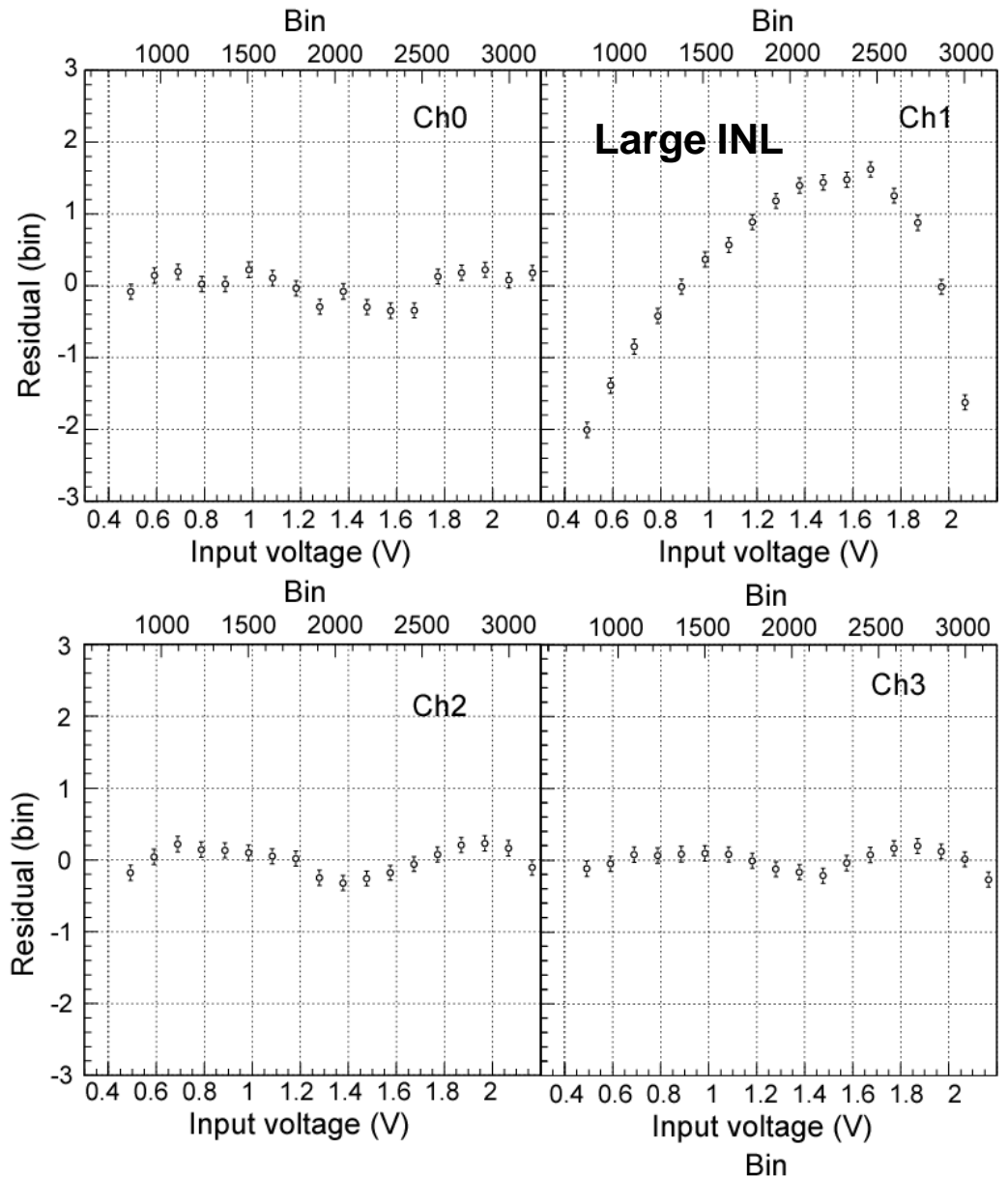
# Wilkinson ADC: integral non-linearity

Check INL with same V785 INL measurement

3 channels have large INL

→ Feed back to company

Further study should be done after fixing bad DNL





# Summary

- ✓ **TKO Wilkinson ADC : still under adjustment**  
**basically company engineer claims possible to repair**
  
- ✓ **CAEN V785N peak hold ADC :**  
**DNL looks fine ( $< 0.5\%$ ) ← much smaller than statistical errors**  
**(Ti, Ni peak height = 25000 count/8bins)**
  
- INL : needs an offline correction**  
  
**after correction : INL for the central bins will be less than 0.05 ch**  
  
**should be checked more carefully and numerically**