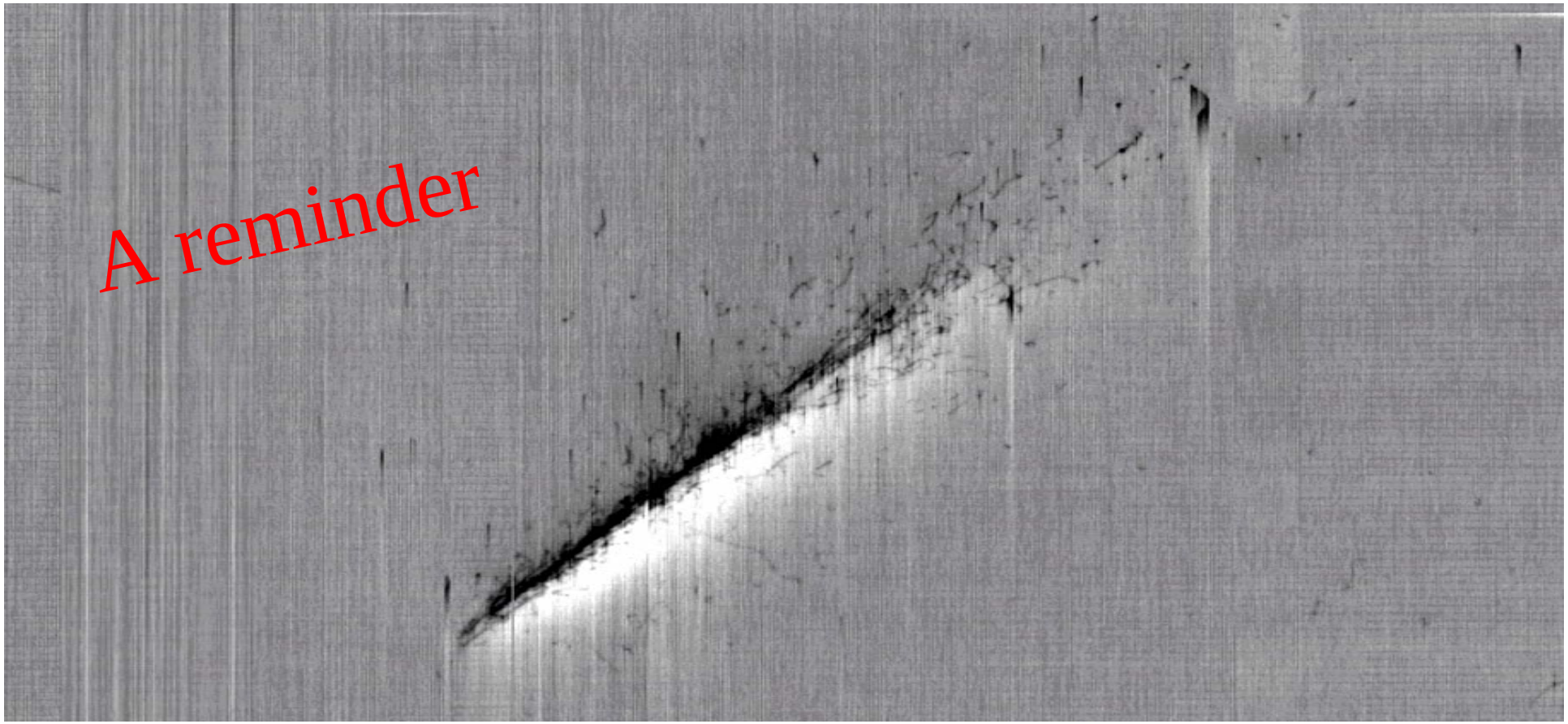
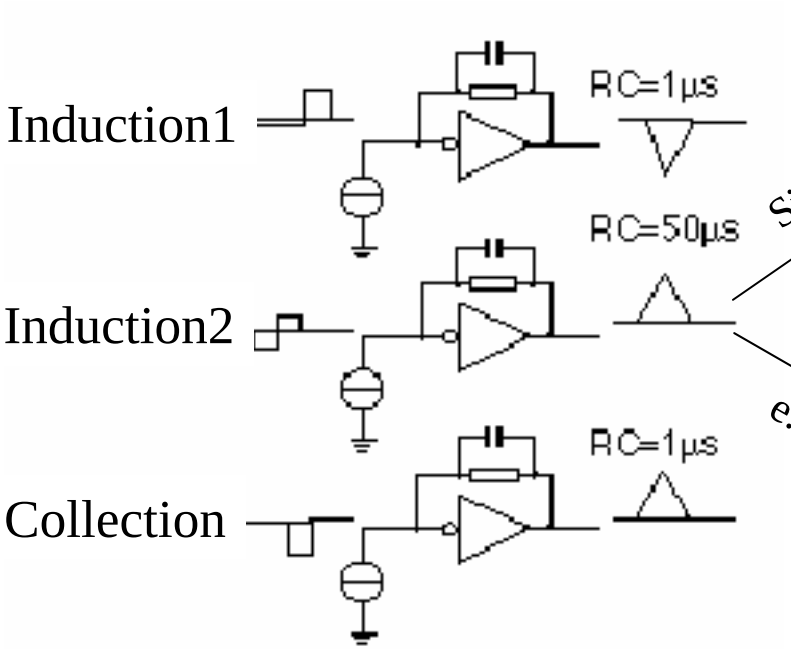
Up-grade of the V791Q boards

- Motivation:
  - Unwanted undershoot in induction2 signals
    - Degradation of tracking capability

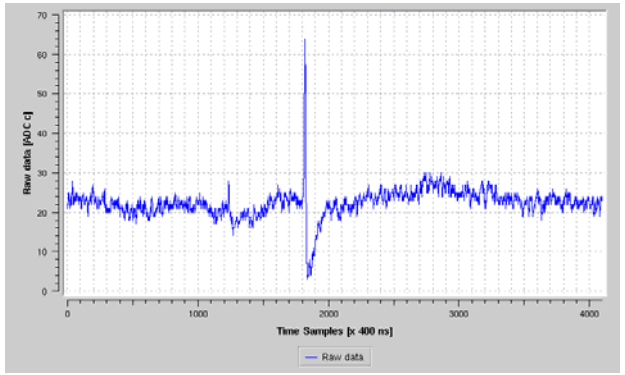


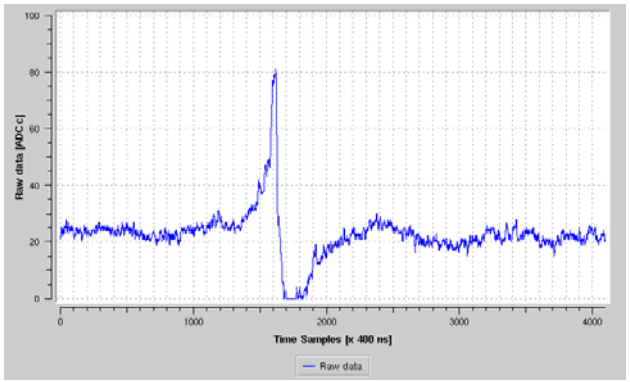
Signals from the Induction2 plane

Ideal



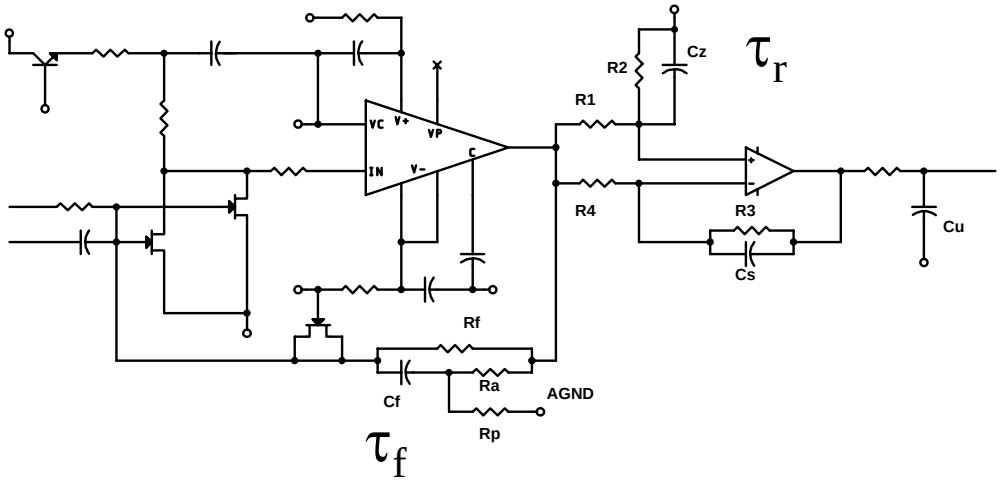
real



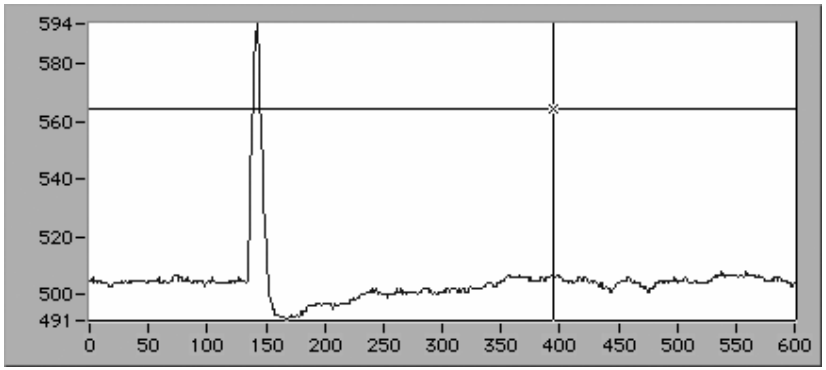


Why the undershoot?

- V791Q: charge sensitive amplifier to read bipolar signals
  - "interference" between preamplifier feedback time constant and "baseline restorer" time constants
  - Present configuration (a): τ_f=100μs, τ_r = 33μs (too similar)
    (R_f=100MΩ, C_f=1pF -- R_1=33kΩ, R_2=270kΩ, C_z=1nF)
  - > 15% undershoot



Response to t.p. (3μs width)

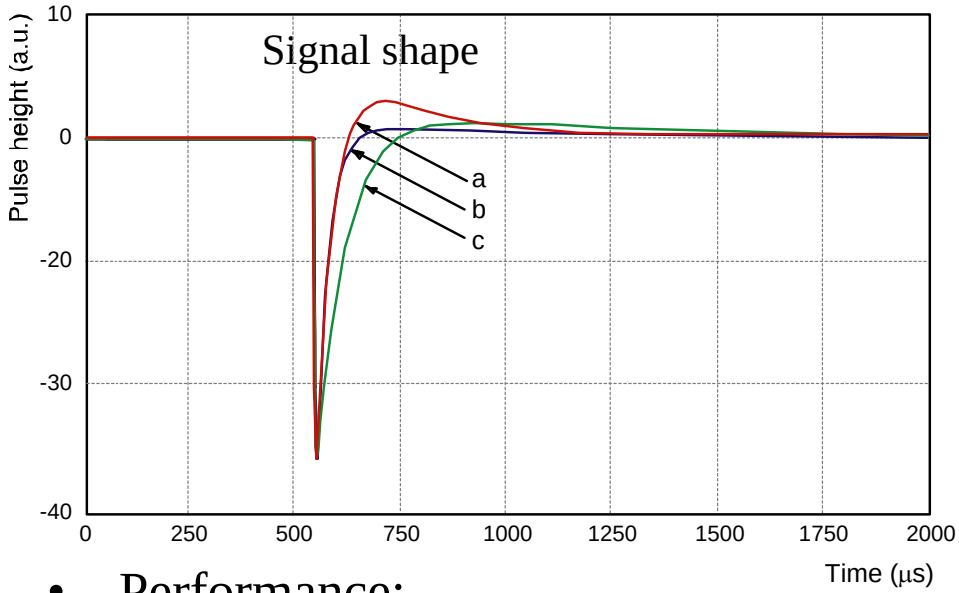


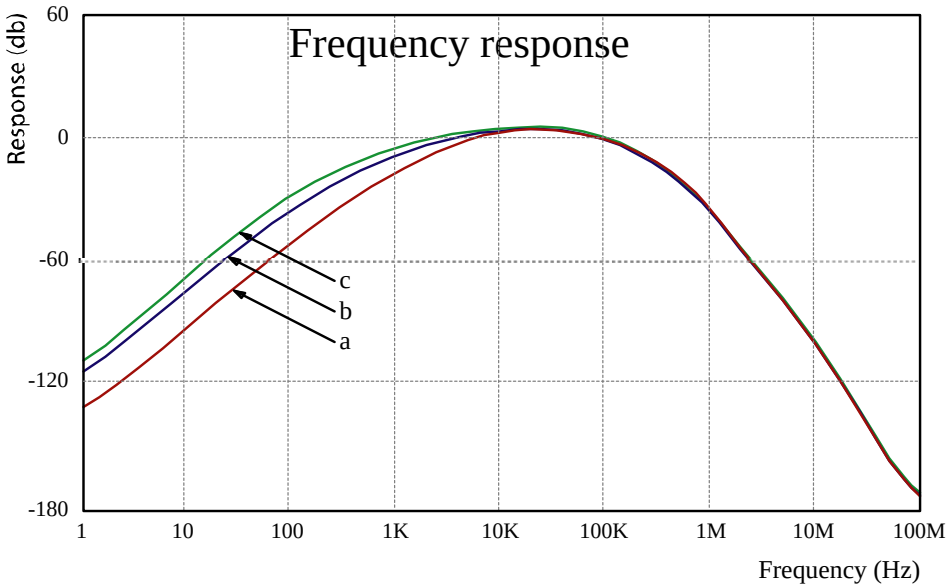
Time (400 ns)

- Solution: make $\tau_r >> \tau_f$,
- Drawback: increase in sensitivity to low frequency noise

Possible improvements

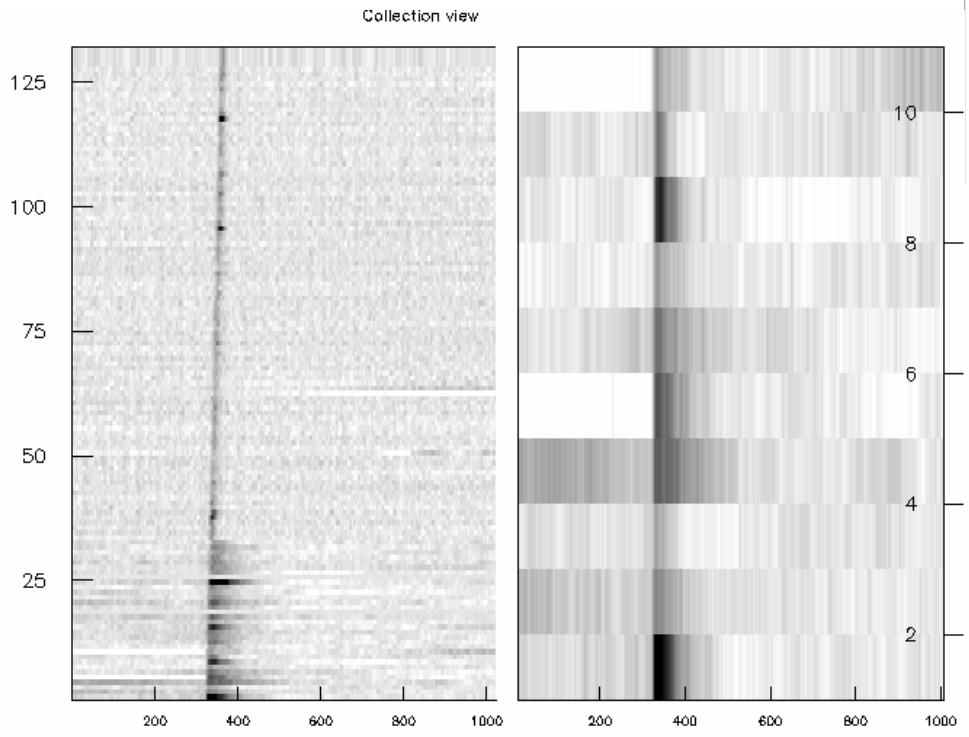
- Two configurations (changing only two discrete components per channel)
  - (b) τ_f=30μs, τ_r = 1000μs (R_f=30MΩ, C_z=30nF)
  - (c) τ_f=60μs, τ_r = 1000μs (R_f=60MΩ, C_z=30nF)

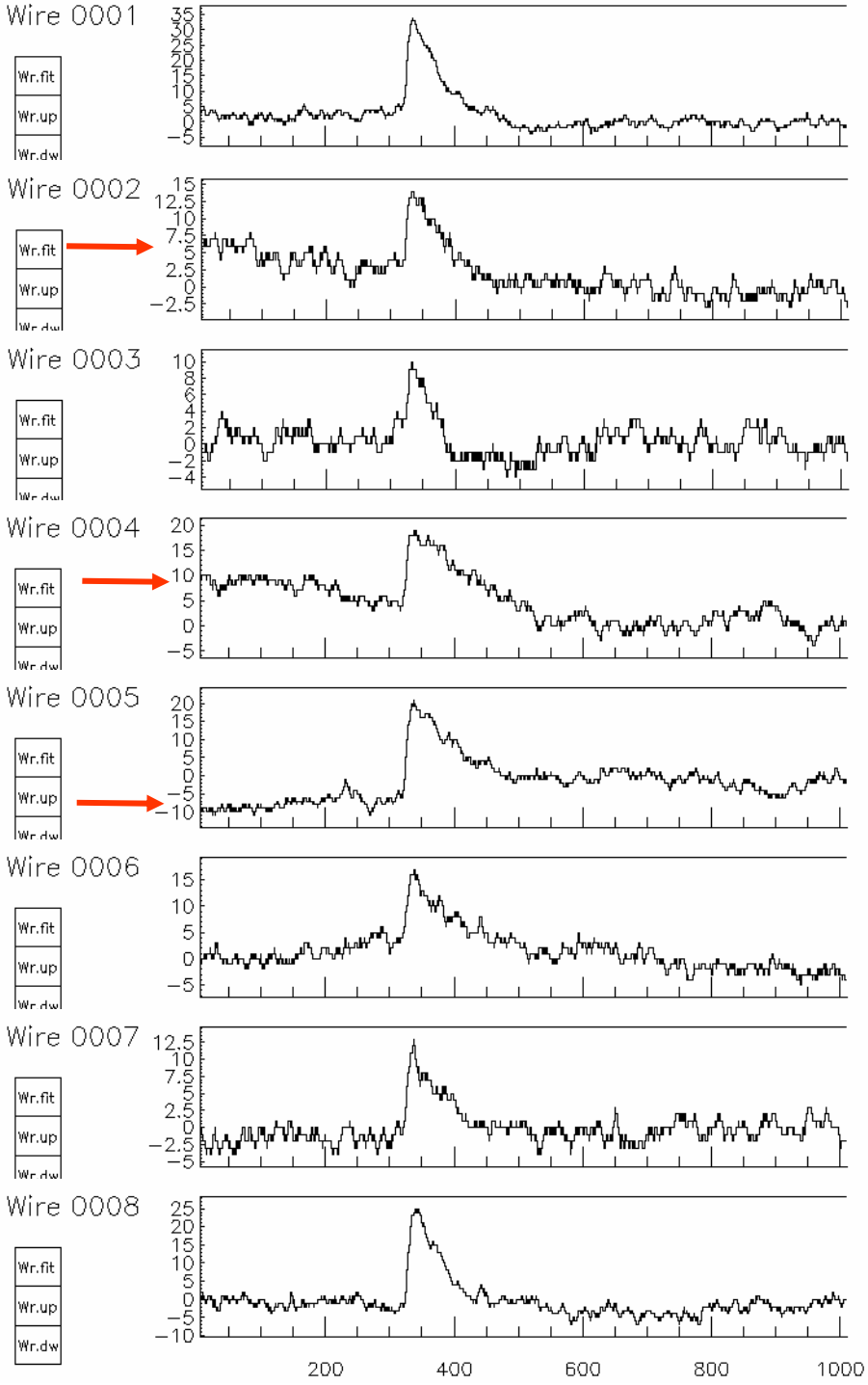




- Performance:
  - Pro: undershoot reduced at less than 4%
  - Contra: larger sensitivity at frequency < 10kHz (14 and 22 db at most respectively)
  - Signal reconstruction marginally affected (signal bandwidth > 10kHz)
  - Config. (c) vs (b): less distortions in long-lasting signals -- more sensitive to low frequency
- Proposal to adopt configuration (b) or (c) has been distributed
  - ICARUS-TM/2002-05

Low frequency noise



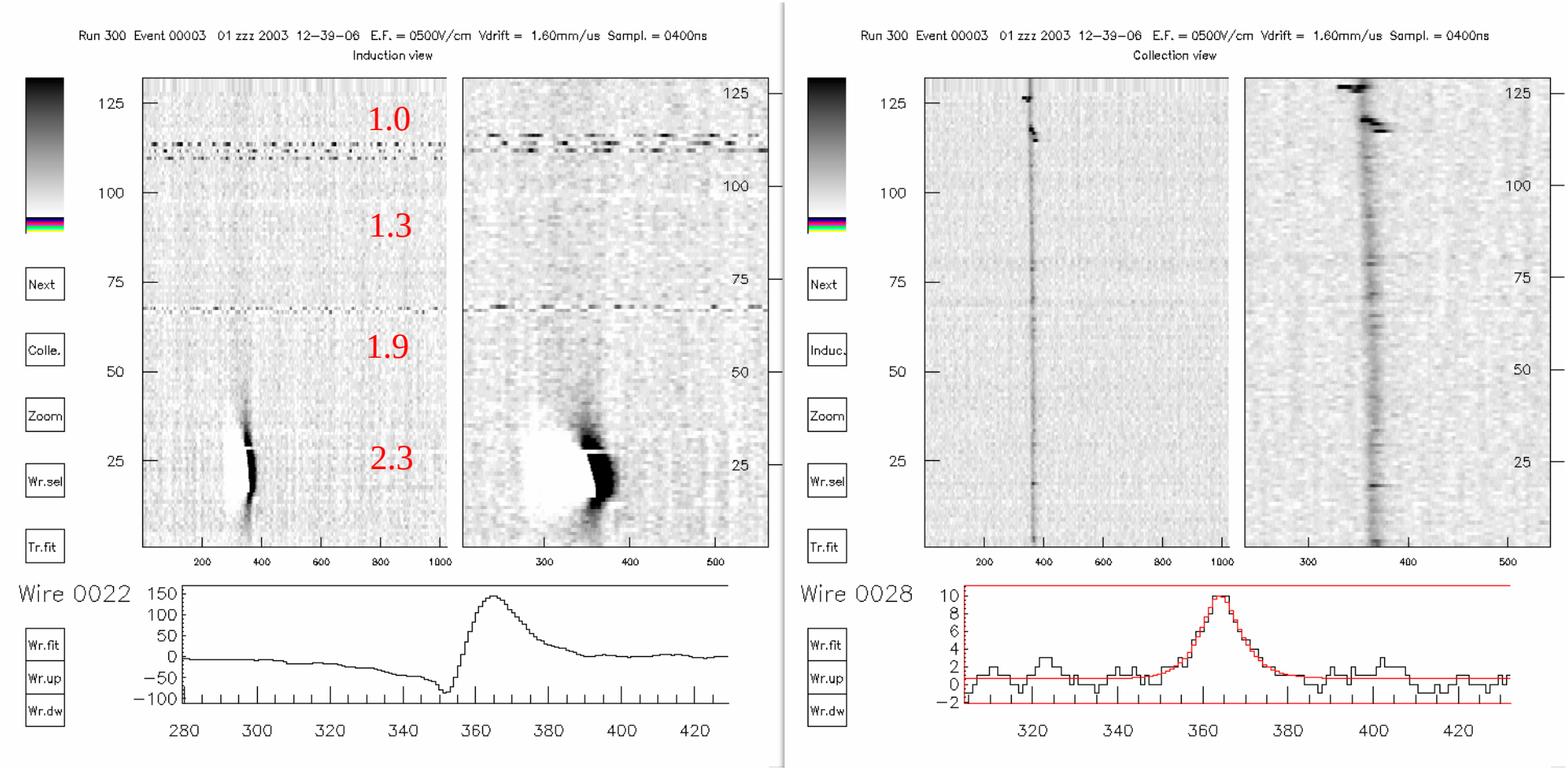


Comparison of
Standard vs Up-graded (c)
configurations

Possible increase of signal gain

- Present gain of ICARUS DAQ chain:
  - V791C (current mode) = 5.5 counts/fC
  - V791Q (charge mode) = 6.5 counts/fC
    - m.i.p. = 12 counts / 3 mm
    - e.n.c = 1.7 counts (in T600) (S/N = 7)
- Higher gain could help improving signal extraction (even at constant S/N) in case of:
  - Low energy depositions
  - Pulse height attenuation/broadening (due to electron lifetime/diffusion)
    - High frequency noise smoothened with specific filters (without altering signal shape)
    - Digitization noise less relevant
    - Contra: lower dynamic range
- Relatively easy implementation:
    - Acting on gain of linear amplifier after Multiplexing and before ADC (only for resistor per boards).
    - Gain up to 2.30 tested on 50 liter LAr-TPC

Gain increase on induction plane



ICARUS-TM/2002-05
January 20, 2003

Considerations on the ICARUS read-out and on data compression

S. Amerio, M. Antonello, B. Baiboussinov, S. Centro,
F. Pietropaolo, W. Polchlopek, S. Ventura

Dipartimento di Fisica dell'Università e Sezione INFN di Padova.
Via Marzolo 8, I-35131, Padova, Italy

Abstract

In this memo we propose some possible upgrades of the ICARUS DAQ system. The items concerned are:

- Modification of the response function of the preamplifiers mounted on the V791Q analogue board to eliminate unwanted undershoots;
- Increase of the gain of the front-end read-out to reduce the contribution of digitization to electronic noise;
- Lossless data compression algorithm suited for on-line application (at crate or board level) as well as for existing data.