On Extrapolating Noise to DUNE

R. Van Berg

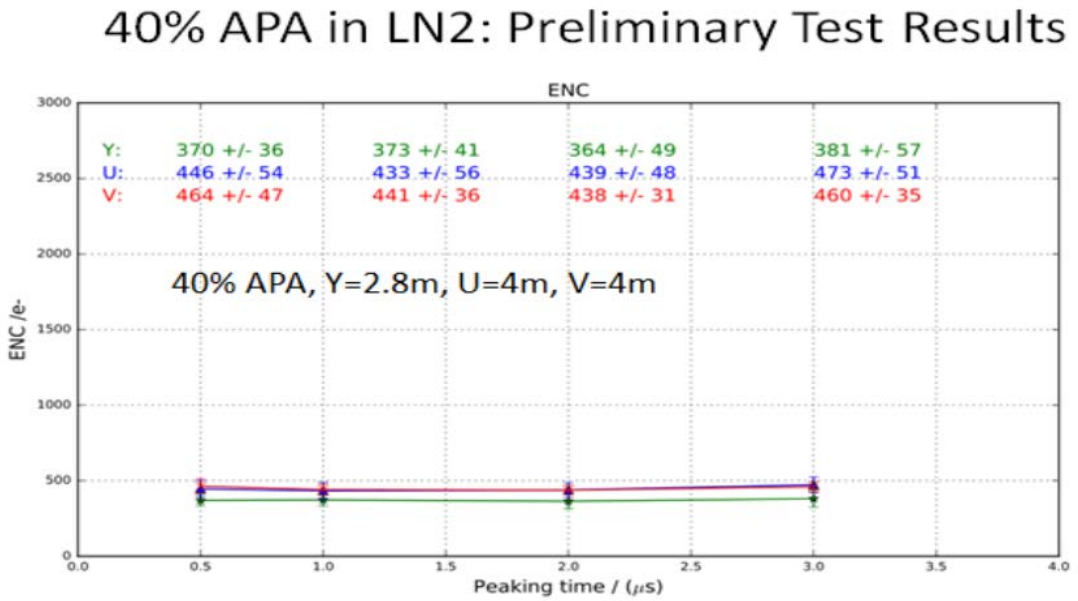
6/12/17

Extrapolating from 40% APA to DUNE APA

- Measurements taken at BNL cold box with old LBNE 40% APA give us a handle to predict what we should expect to see in protoDUNE (DUNE)
- Four prototype FEMBs + 1 WIB with revised chip set (P2 FE, P1 ADC)
- Preliminary numbers from S. Gao on 6/9/17 – private communication

- Updated from numbers shown at collaboration meeting after improvements in grounding and shielding

In LN2



Extrapolation Method

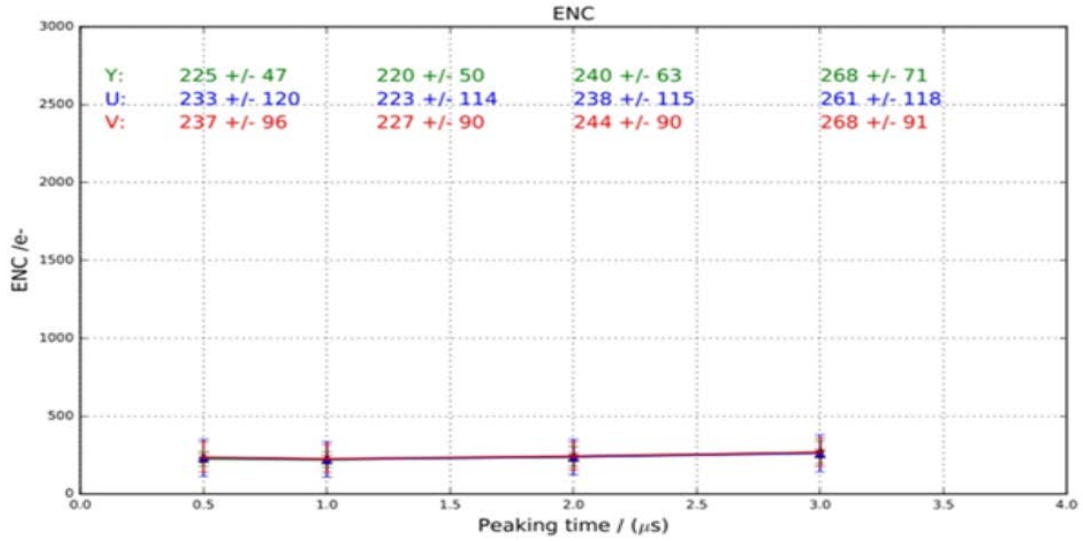
- 40% APA has 2.8 m collection and 4 m induction wires
- DUNE APA has 6 m collection and 7.4 m induction wires
- → Take slope from measurement, extend to longer wires

- Slope (for 2 us shaping) = (((438+439)/2)-364)/1.2 m = 62 e/m
- Present DUNE APA is 2.32 x 5.9 m and an induction wire is 7.4 m long
- → noise for a DUNE induction wire will be 459 e (62 x 7.4)
- However, 40% APA wires were in gas, not liquid, so x 1.5 for dielectric constant → 459 x 1.5 = 689 e

Extrapolation Continued

- Finally, need to add in offset (zero length/capacitance) noise
- From contemporaneous measurements at BNL avg = 241 e
- → total noise for an induction wire
  - = 689 + 241 = 930 e

FEMB in LN2



- ENC at LN2 Temperature
  - Cd = 0, no input capacitance

Conclusion

- 930 e is much better than 35T achieved
- About meets Dave Christian spec of < 1000 e
- Badly misses Milind Diwan spec of < 700 e
- Misses uBOONE number (using TECH NOTE 1016 one extrapolates to 401 e) **by factor of 2.3**
- Misses uBOONE number (using **arXiv.org > physics > arXiv:1705.07341** which extrapolates to 441 e) **by factor of 2.1**

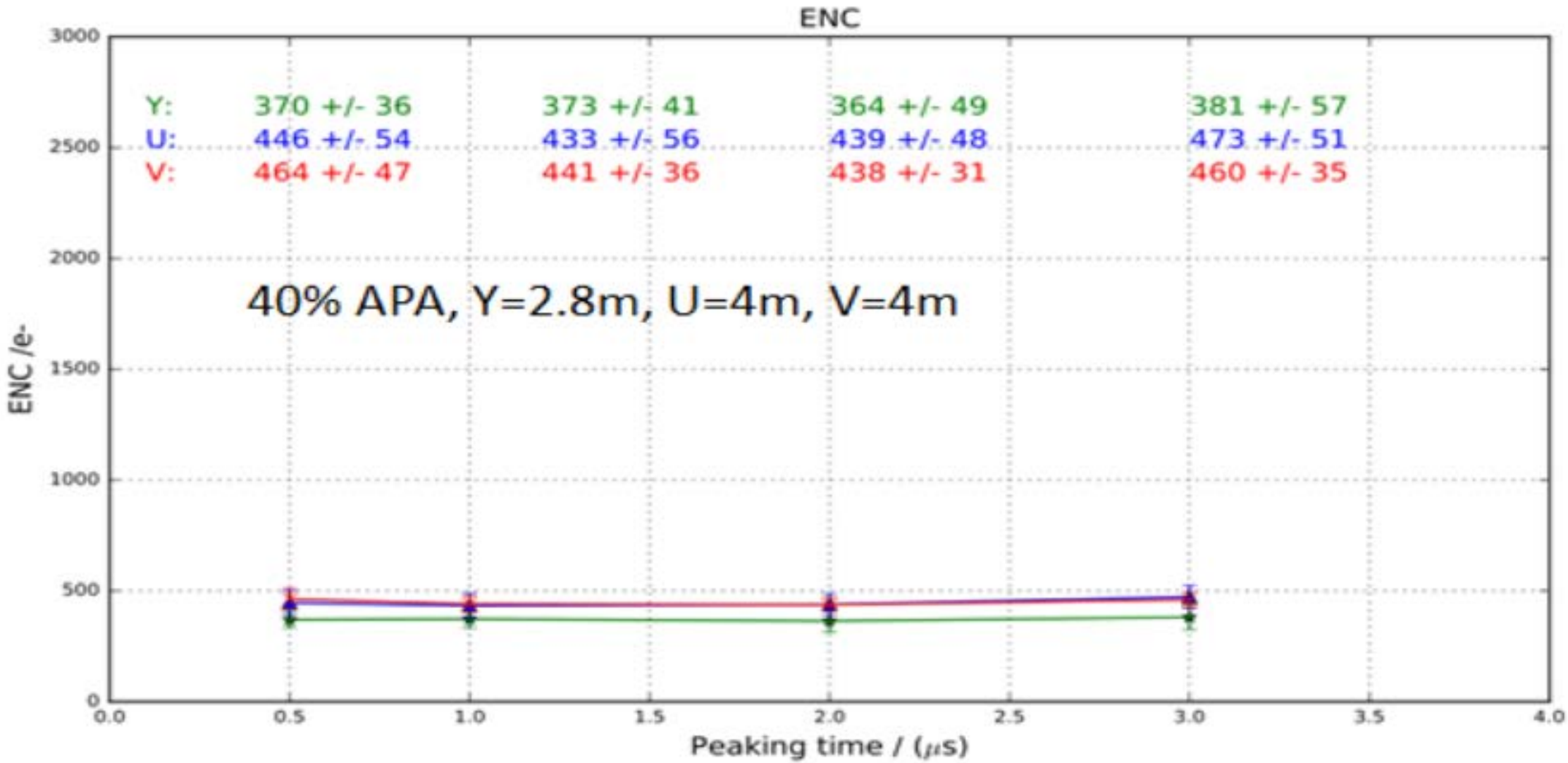
ALARA

- As
- Low
- As
- Reasonably
- Achievable

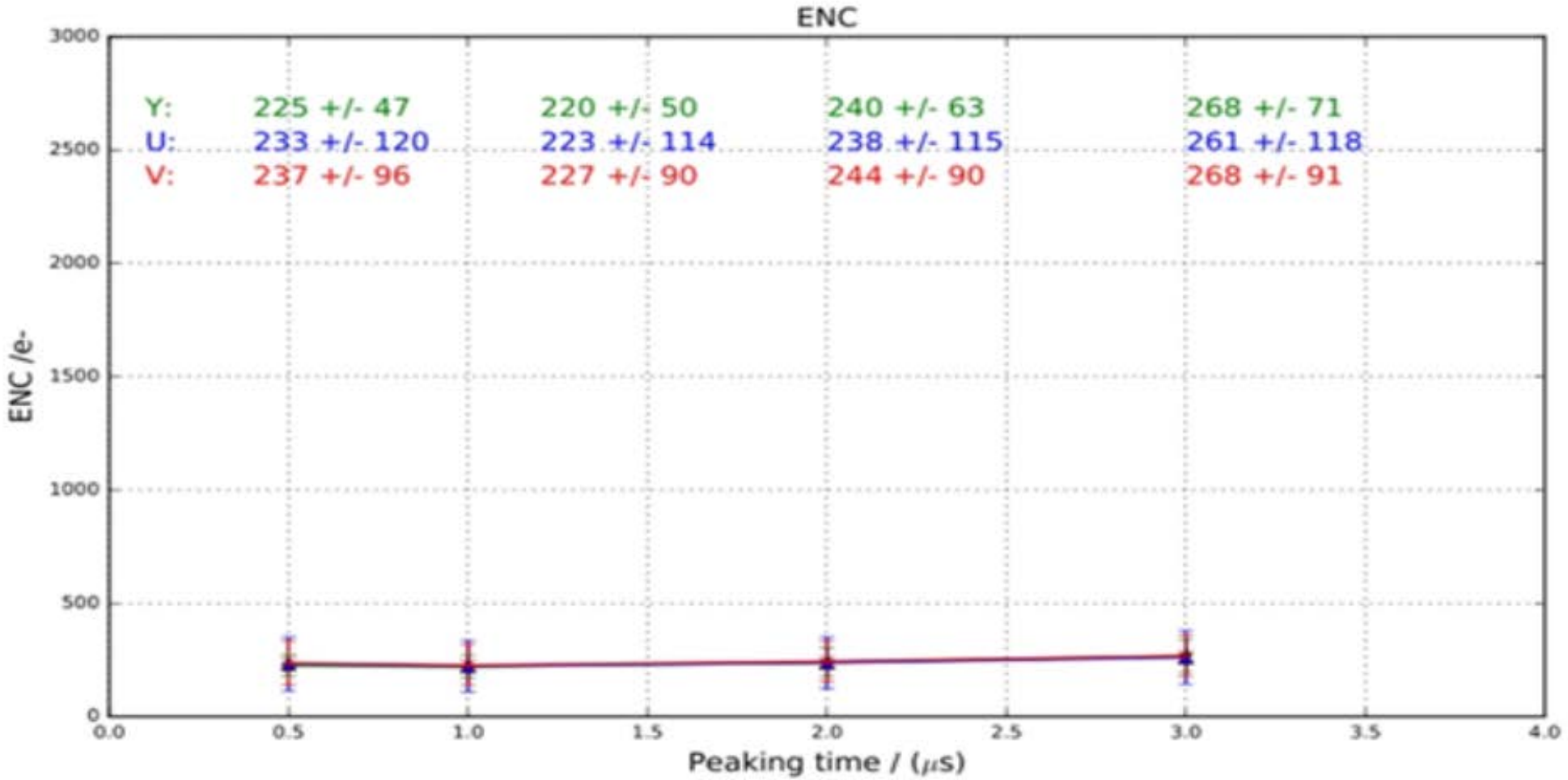
Backup

	0.5us	1us	2us	3us	
Y(X)	370	373	364	381	
U	446	433	439	473	
V	464	441	438	460	
<U+V>	455	437	438.5	466.5	Avg U V
e/m	71	53	62	71.25	for U/V
e/U/V	524	395	459	527	X 7.4 m
e/liquid	786	592	689	791	X1.5
w/offset	1018	815	930	1057	add offset from J-M35

40% APA in LN2: Preliminary Test Results



FEMB in LN2



- ENC at LN2 Temperature
  - Cd = 0, no input capacitance