



**OPTICAL SYSTEM CALIBRATION:
MAKING A PLAN**

BEN JONES

CALIBRATION OF THE OPTICAL SYSTEM

Broadly speaking, there are three sets of quantities we need to calibrate:

- 1) PMT system properties
- 2) Liquid argon optical properties and simulation validation – No TPC data
- 3) Liquid argon optical properties and simulation validation – With TPC data

PMT SYSTEM CALIBRATIONS

From random triggers:

Pedestals

SPE rate

Baseline noise spectrum

From flasher runs:

Gain of high and low channels

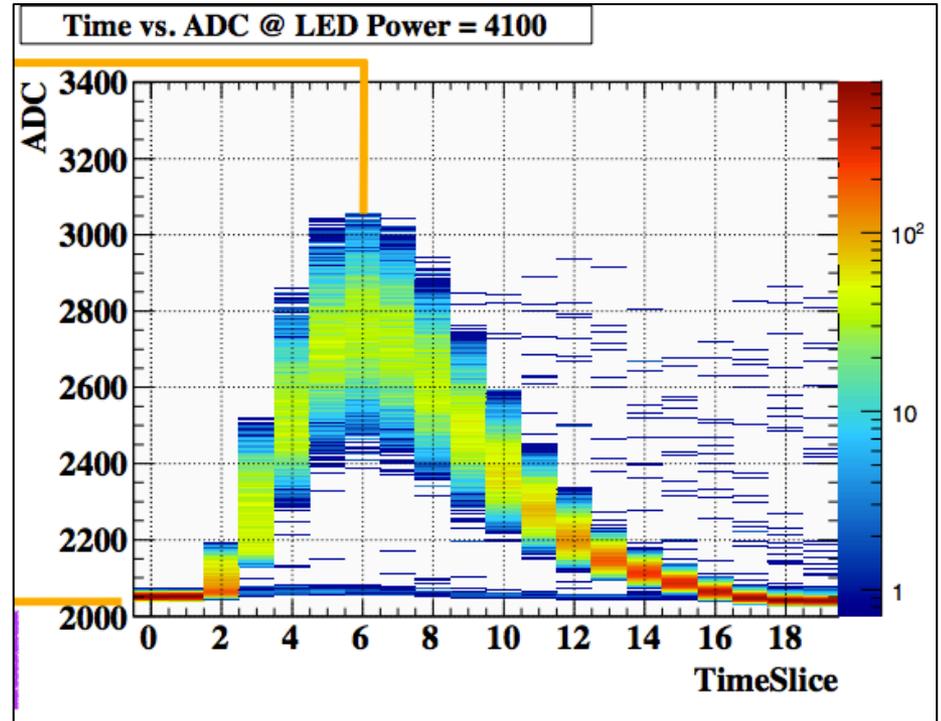
Relative time offsets / jitter

SPE pulse shape per channel

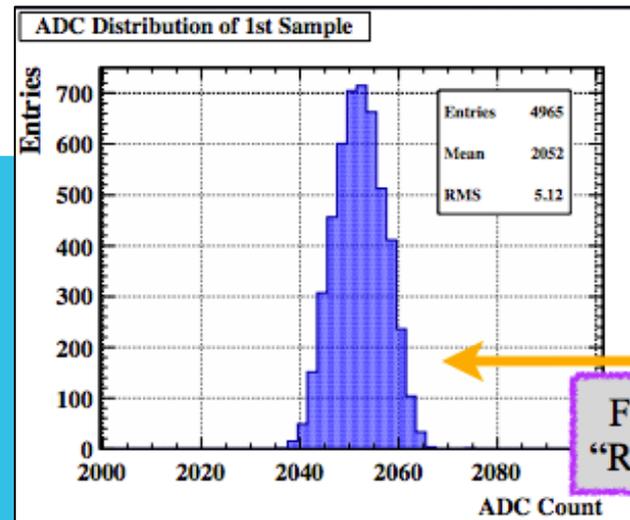
Light crosstalk (plate-to-PMT)

Relative linearity per PMT (0-20 PE)

SPE shape studies from Kazu using BoVST data



Pedestal mean and fluctuation measurement



We need to make sure we have code to extract pulse areas, times, pedestals, baseline fluctuations on day one. Kazu has made inroads into this problem already

PMT SYSTEM CALIBRATIONS

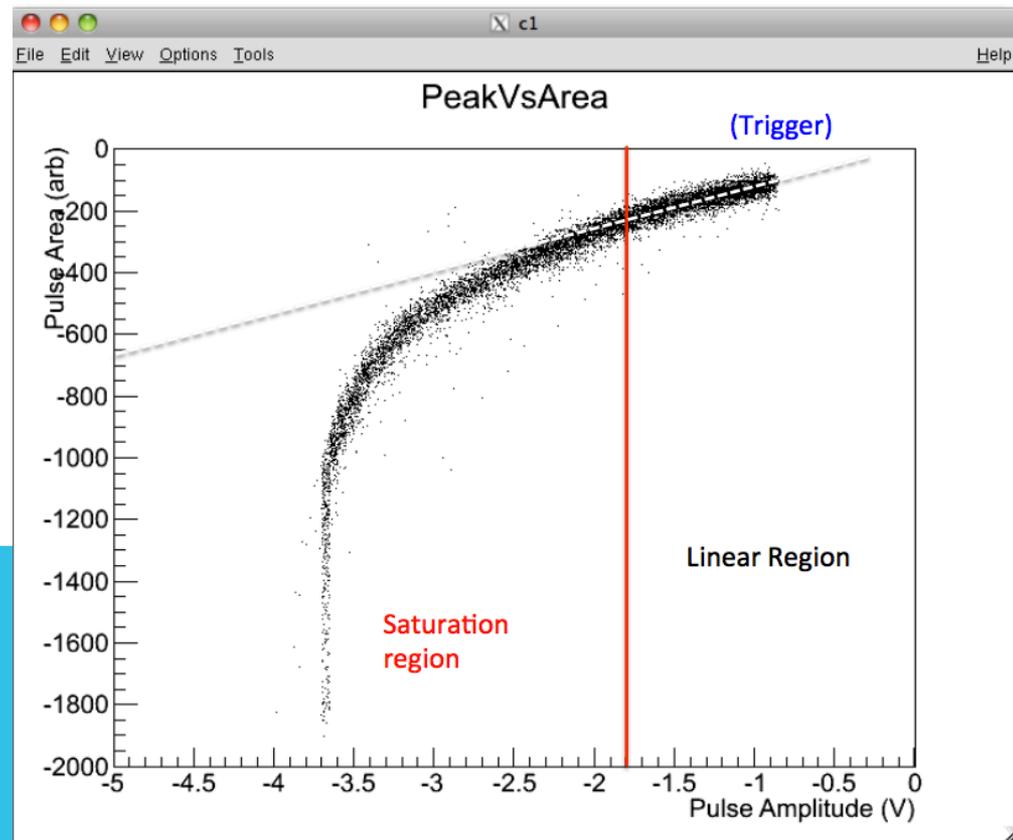
From self-triggers

Saturation scale

Shape linearity per PMT (20-400PE)

Crosstalk study a la Gabriel?

Saturation study from BoVST



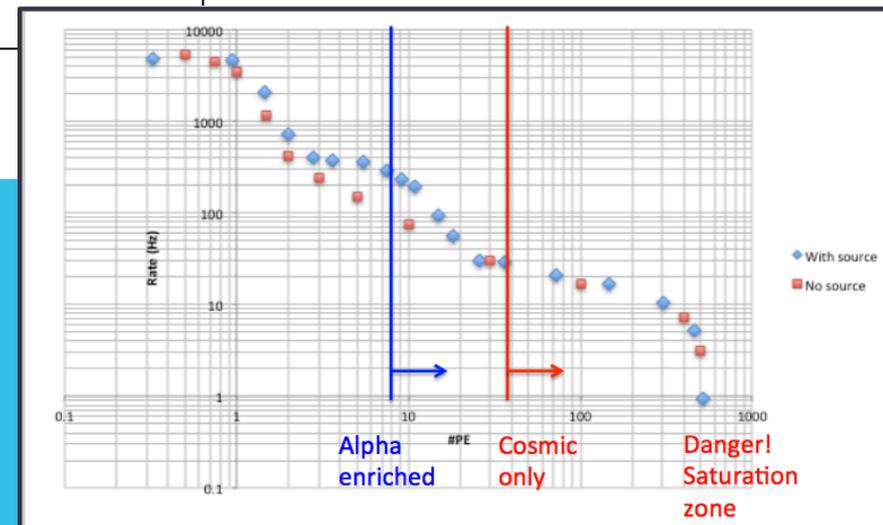
LIQUID ARGON OPTICAL PROPERTIES ETC

a) Properties we can measure without the TPC (during commissioning runs)

Many of these properties may be better measured using a scope than the full readout chain
– both to get collect high statistics and get a finely binned measurement.

- Average scintillation time constants
- Prompt / late ratio distribution
- Amplitude / area plots
- Area spectrum of all cosmic / noise pulses, by channel
early cosmic+optical MC validation sample
- All the above should be
 - a) measured both with E Field, and without E field
 - b) compared between paddles and PMTs

*Rate vs charge plot
from BoVST*



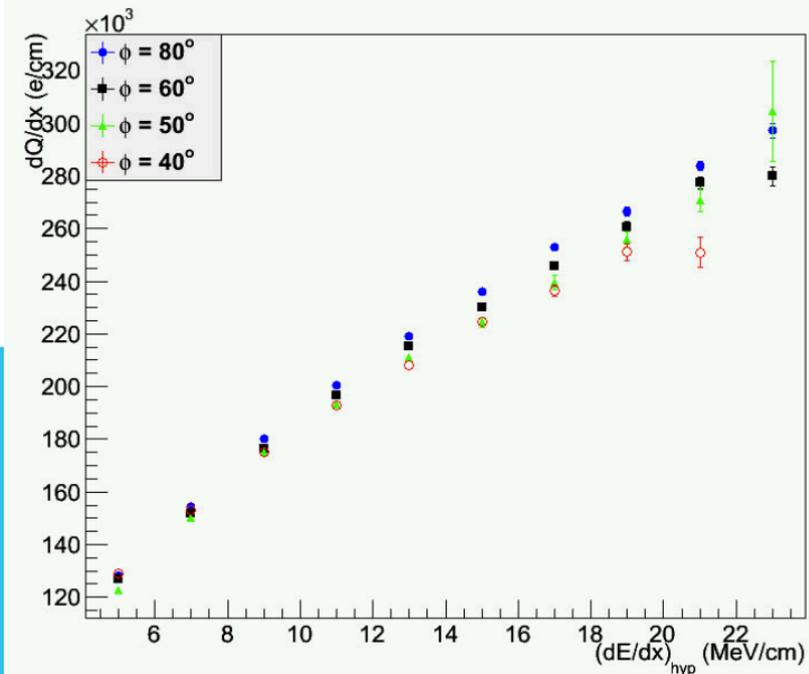
LIQUID ARGON OPTICAL PROPERTIES ETC

b) Properties measured by comparison with TPC data (ongoing in analysis phase)

For these, we will extract information from a full analysis of detector data in LArSoft

- Pulse shape vs dEdx for matched tracks
- Scintillation yield vs charge yield for through-going muons
- Flash geometry vs through going muon angle
- Recombination vs angle and energy
complementary to Bruce's argoneut analysis
- Absorption length of our argon to 128nm light.
not trivial due to Rayleigh scattering.
- Michel electron based calibration
- Data driven flash-finding efficiency
- *etc etc etc*

Charge recombination vs angle from ArgoNeuT – does light agree?



WHAT DO WE NEED TO DO?

For discussion – here is a starting point

- Quick LED driven test of all channels (~1-2hrs?) after endcap weld
- Quick LED driven test of all channels (~1-2hrs?) after move to DAB
- Quick LED driven test of all channels (~1-2hrs?) after fill
- During recirculation period, exercise real flasher calibration runs
- Once at purity, two weeks running with PMTs and no E field (one week scope only, and one week with readout and scope)
- With E field on, one week PMT commissioning run with scope readout, and then transition to readout only
- Most other PMT calibration activity will be able to interleave with TPC commissioning, assuming we can read out the system.
- Once we have real data, there will be many interesting and important optical physics topics to work on. If you would like to help, please talk to me or Matt!