

# DUNE-FD-DAQ power estimates: A scaling exercise using MicroBooNE as an example

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(with input from L. Bagby, W. Ketchum, and E. Church)  
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# MicroBooNE ROE + DAQ hardware layout

DAQ room, everything on building ground, total of 5+1 racks, housing:

9 TPC SEB

Near, SMC

1 PMT/TRIG  
SEB

Network

1 EVB

Accel.  
timing

ROE+DAQ  
teststand

WS01, WS02,  
IPMI

Only **optical connections** between two sites:

TPC:  $9 \times (2 + 0.5) \times 6$  Gbit/sec

PMT:  $1 \times (2 + 0.5 + 0.5) \times 6$  Gbit/sec)

Raw binaries shipped from platform to DAQ room sub-event buffer servers (w/ PCIe).

Accelerator timing signals sent to platform from DAQ room.

Detector enclosure, (almost) everything on isolated, detector ground, a total of ~15 racks, housing:

TPC ROE  
Crates x 9

PMT/TRIG  
ROE

ASIC power,  
Wire bias

HV

Purity Mon

Laser Calib

Muon  
tracker

**8256 wires**

**32 PMT + 4 paddles (x4 split)**



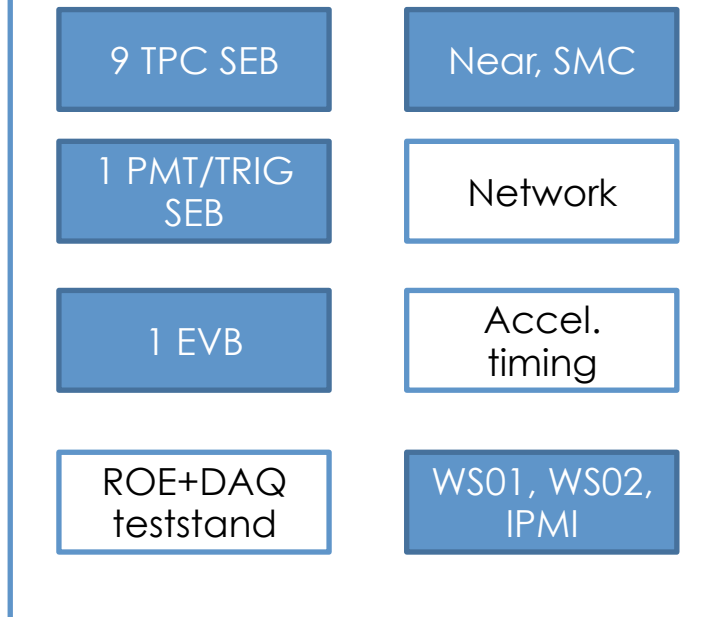
[Pictures from ~1 year ago,  
during installation]

DAQ room



# DAQ room data rates & power consumption (I)

DAQ room, everything on building ground, total of 5+1 racks, housing:



The DAQ racks are side-by-side. They house 10 SEB + EVB + Near + SMC + WS01,02 + IPMI machines. Each powered by 208V/3 $\phi$ /30A.

Separate HVAC system in the DAQ room (humidity and temp. control). Each rack equipped with fans.

TRIGGERed TPC data rates w/huffman compression from on-platform ROE are  $\sim 300$  MB/s, distributed across 9 SEBs, and are subsequently to EVB (no additional processing in SEBs!).

SN stream at  $\sim 400$  MB/s stored into SEBs (no additional processing), then deleted if no SNEWS SN alert.

**8256 wires**  
**32 PMT + 4 paddles (x4 split)**

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Earlier this year, during running with TRIGGERed TPC data readout only, at 16 – 160 MB/s, 4 PDUs registered current at ~12-14 Amp per PDU. The 8 TPC SEBs (2U) in a single rack registered ~3.4A/SEB. Full spin tests can draw 7A/SEB. That rack is particularly warm...

→ Reasonable to assume a minimum of 6.7 kW just for servers, and for no further data processing (e.g. compression or triggering).

## Scaling to DUNE-FD:

Each APA (2560 wires):  $0.31 \times 6.7\text{kW} \sim 2\text{ kW}$

Each 10-kton (150 APAs, or 384k wires): ~300 kW  
(w/ no data processing; only receiving, assembling and shipping of data)

**8256 wires**

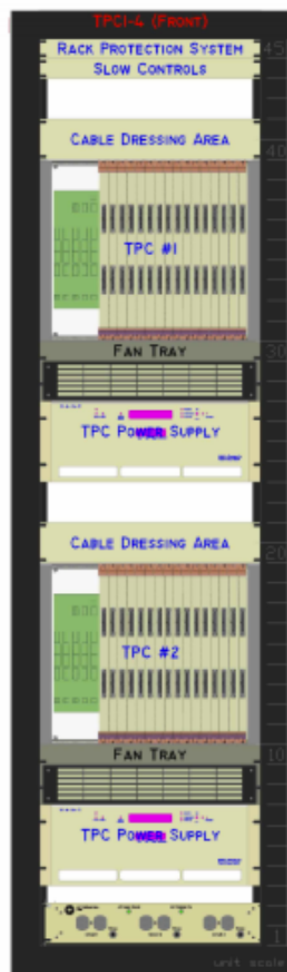
**32 PMT + 4 paddles (x4 split)**

# Platform electronics power consumption

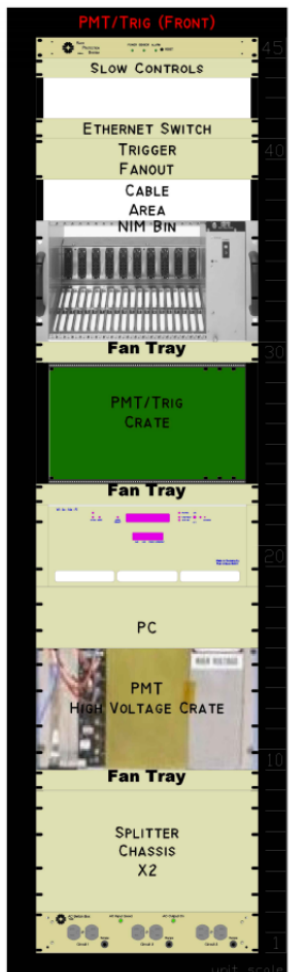
Each ROE rack is powered up by 208/3 $\phi$ /30A.

TPC and PMT ROE Crates powered by Wiener PL508; ~2/rack.

Each crate (TPC) uses ~360W during normal running → 1 kW/rack minimum.



TPC ROE x 4.5 racks



PMT/TRIG ROE uses 1.5 racks

Detector enclosure, (almost) everything on isolated, detector ground, a total of ~15 racks, housing:

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Crates x 9

PMT/TRIG  
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ASIC power,  
Wire bias

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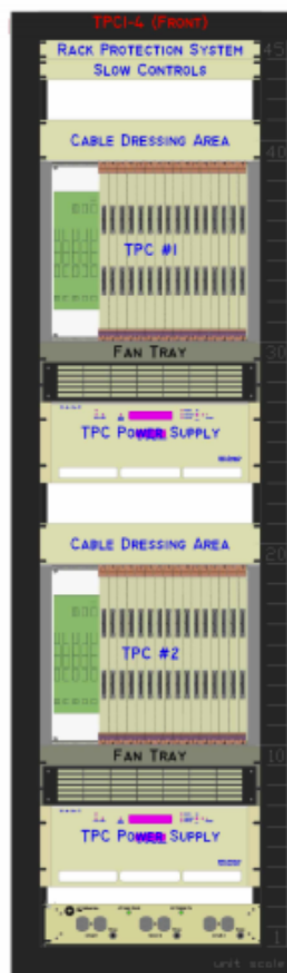


# Platform electronics power consumption

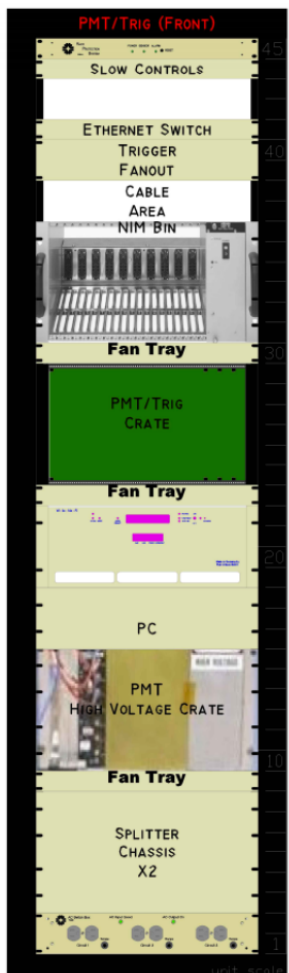
Each ROE rack is powered up by 208/3 $\phi$ /30A.

TPC and PMT ROE Crates powered by Wiener PL508; ~2/rack.

Each crate (TPC) uses ~360W during normal running  $\rightarrow$  ~0.7 kW/rack minimum.



TPC ROE x 4.5 racks



PMT/TRIG ROE uses 1.5 racks

## Minimum for powering:

TPC ADC, FEM processing modules,  
Data transmitters;  
ASIC Low Voltage, Wire bias;  
PMT HV, shaper, ADC, FEM, Data  
transmitters;  
Clock, trigger logic (NIM):

$$= (5 + 1 + 2 \text{ racks}) @ 0.7\text{-}1.5 \text{ kW/rack} \\ = (6\text{-}12) \text{ kW}$$

x 50 (for MicroBooNE  $\rightarrow$  10kton FD)

$$= 300 - 600 \text{ kW per 10kton FD}$$

(does not include LASER calib, TPC HV,  
purity monitoring; does not include AC)