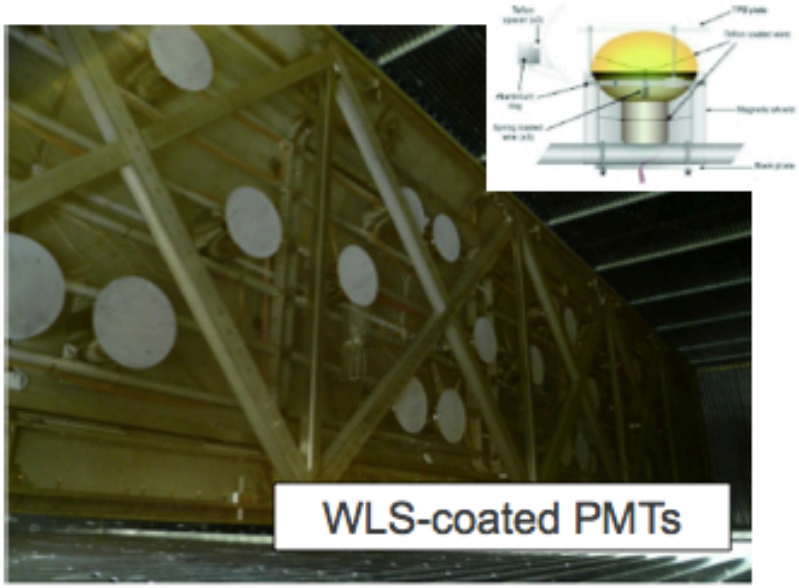
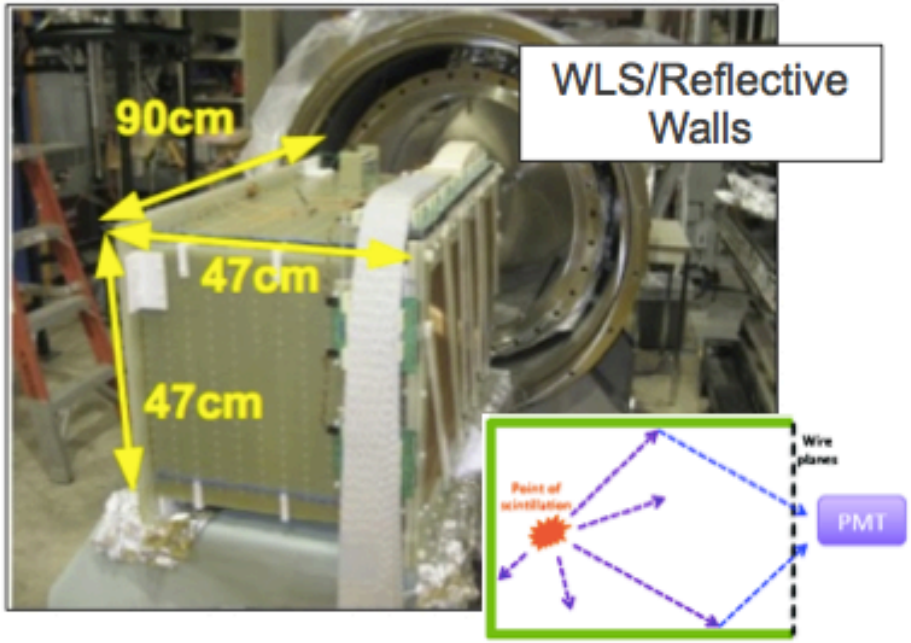
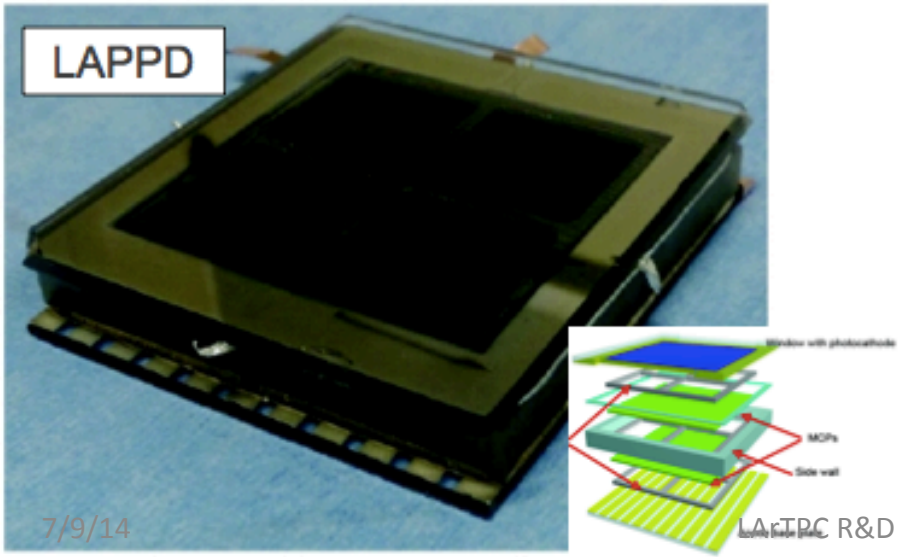
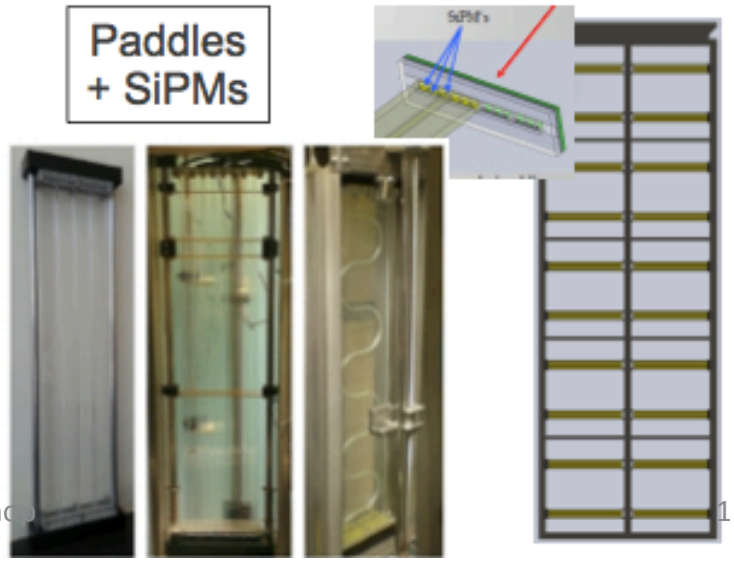
Four Major Technology Paradigms





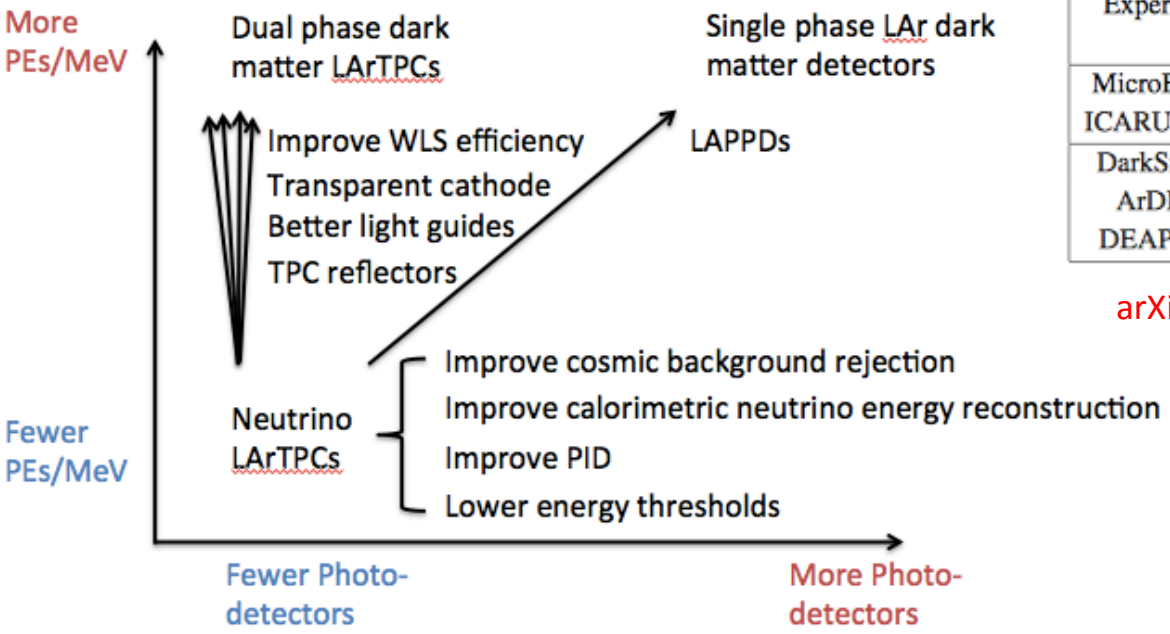




SBN and LBN experiments have different light collection needs

- Large underground LArTPCs sensitive to more types of non-accelerator events
- Cosmic background rejection more challenging for surface LArTPC

How much light? Photo-detection granularity?



Experiment	Fiducial mass (tons)	Light yield (PEs/MeV)	Light collection efficiency
MicroBooNE	87	~2 at 500 V/cm	$\sim 1.3 \cdot 10^{-4}$
ICARUS T600	500	~1 at 500 V/cm	$\sim 6 \cdot 10^{-5}$
DarkSide-10	0.01	$9 \cdot 10^{3}$ at zero field	$1.8 \cdot 10^{-1}$
ArDM-1t	0.85	$2 \cdot 10^{3}$ at zero field	$4 \cdot 10^{-2}$
DEAP-3600	1	$8 \cdot 10^{3}$ at zero field	$1.6 \cdot 10^{-1}$

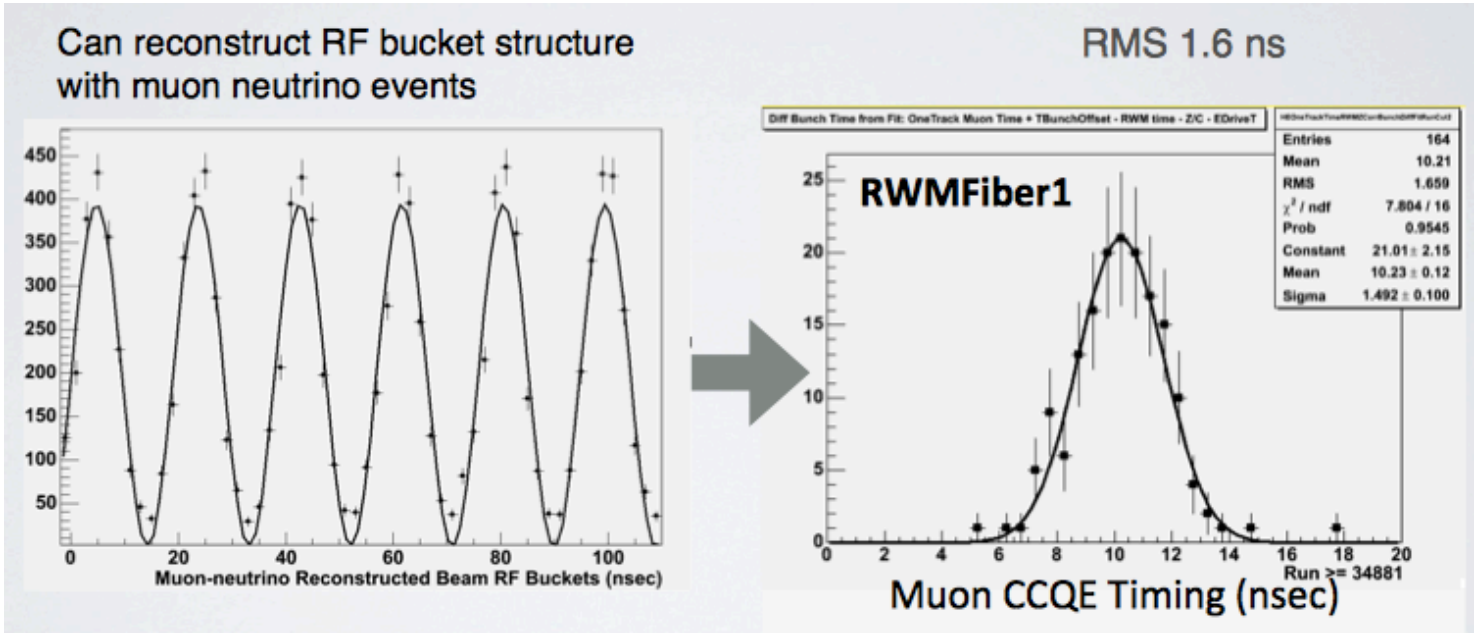
arXiv:1405.0848 → 10^{-3} light collection efficiency

What can you do with better time resolution?

What is the fundamental limit? Time resolution not limited to τ_{prompt}~6ns.

MiniBooNE can now resolve the RF structure of the Booster beam:

- May be an important handle on low energy excess background rejection
- Key handle on light dark matter searches



Other possibilities?

- Separate prompt Cerenkov light from scintillation light
- Enhanced cosmic background rejection

Are there dopants that can be used to enhance light collection in large LArTPCs?

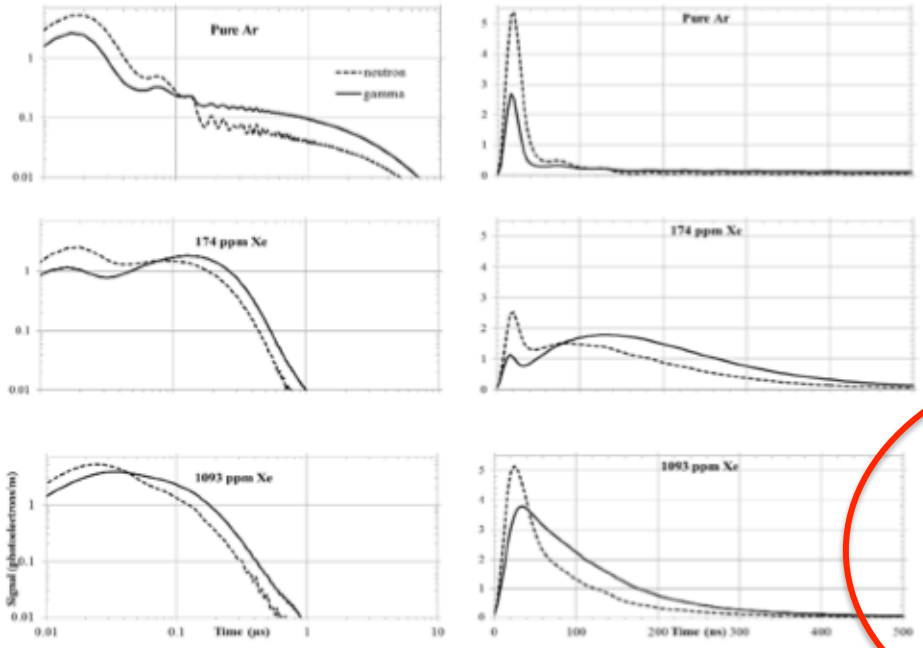
From B. Jones's Talk

Excitation Transfer to Xenon

See also Kubota, et. al. NIMA 327 (1993) 71., Pfeiffer et. al., JINST 3 (2008) P08007

100 ppm

1000 ppm



From **JINST 9 (2014) P06013**
Wahl et al

15% increase in light collection at 10 ppm

Excitation can also be transferred to a dopant which then decays with a photon.

Eg xenon : first studied by ICARUS, and more recently for dark matter detection (left) Cennini, et. al. NIMA 432 (1999) 240.

175 nm rather than 128 nm emission gives a moderate improvement to light collection capability (depends on WLS coating)

Also brings late light to shorter timescales

Cost of 10 ppm Xe in a 34 kton LArTPC detector cost O($5M)
LBNE photo-detection system budget O($10M)