Instrumentation Radio - IF 10

Conveners:
Amy Connolly, Ohio State University
Albrecht Karle, University of Wisconsin-Madison

- Most LOIs submitted are on high energy and ultrahigh energy astroparticle physics or multi messenger astrophysics.
- Most papers/LOIs are on radio detection at high energies (> 30 PeV)
- Coordination with Cosmic Frontier: CF 7, Probes of fundamental physics.
- Discussed Radio detectors and optical Cherenkov detection method.
- One presented experiment, IceCube-Gen2 has an integrated approach of optical and radio over wide energy range.

IF 10 Session

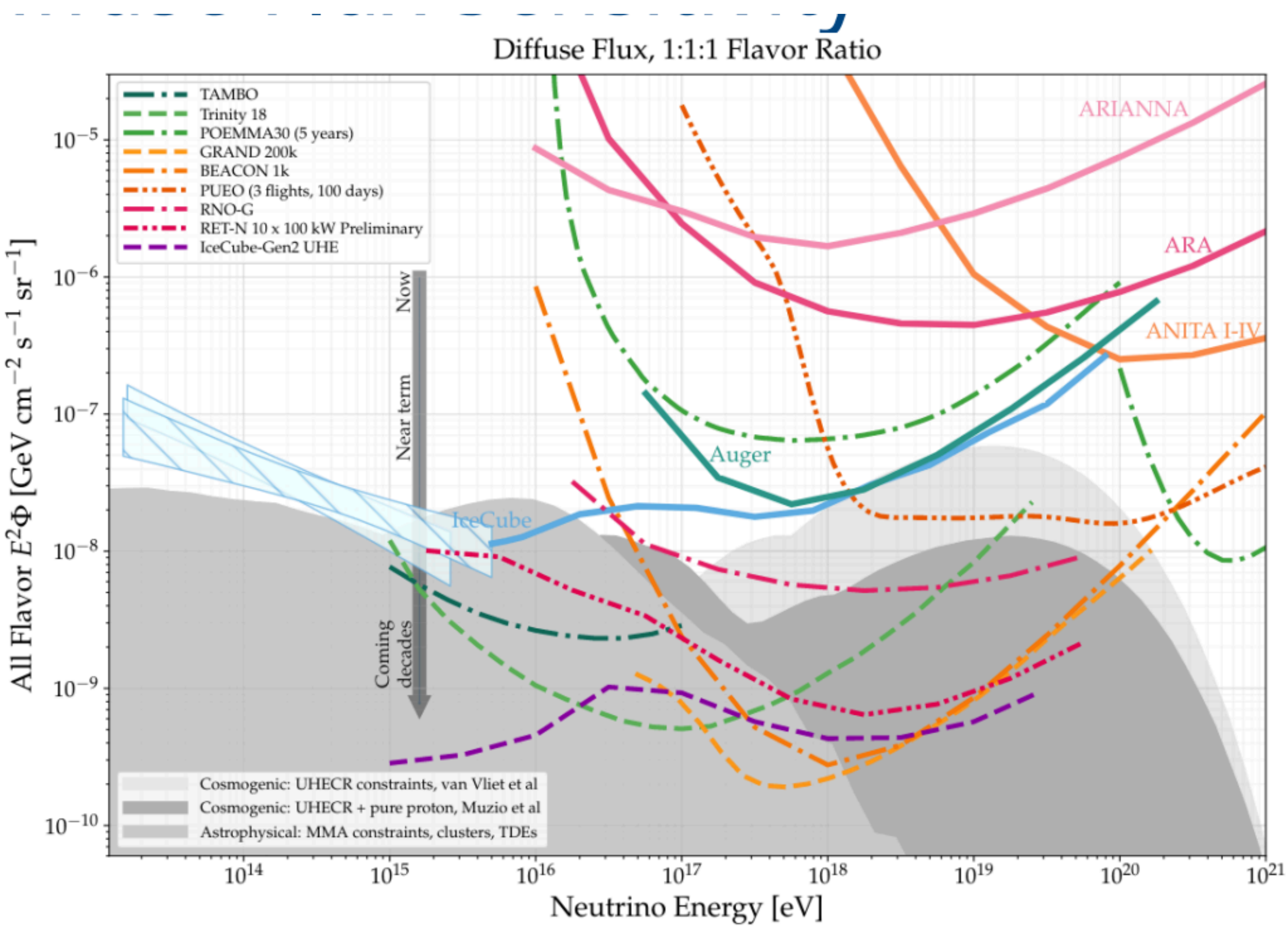
Date	**7/19**	
Room	**242 MGH**	
Time	Present	Discussion
8:00	Introduction and schedule	Albrecht Karle
8:15	Radio detection of neutrinos using ice as target, and detectors in ice	Brian Clark
8:35	Radio instrumentation for neutrino detectors using ice	Cosmin Deaconu
9:00	Radar detection of neutrinos in the ice	Steven Prohira
9:20	Air shower detection of earthskimming neutrinos	Nepomuk Otte
9:40	KIDs	Thomas Cecil
10:00	Break	
10:15	Radio air shower detection	Sijbrand de Jong
10:40	IceCube Upgrade	Michael DuVernois
11:05	IceCube-Gen2 Optical, techical with km3net and P1 in context	Carsten Rott
11:30	Round table discussion	Albrecht Karle

Instrumentation Radio - IF 10:
Science/sensitivites shown for diffuse neutrino flux >10 TeV energies

Sensitivity to diffuse neutrino flux is shown for detectors like:

air shower based:
Auger
GRAND
Trinity18
Beacon
POEMMA

and ice based:
IceCube
RET-N
RNO-G
PUEO
IceCube-Gen2



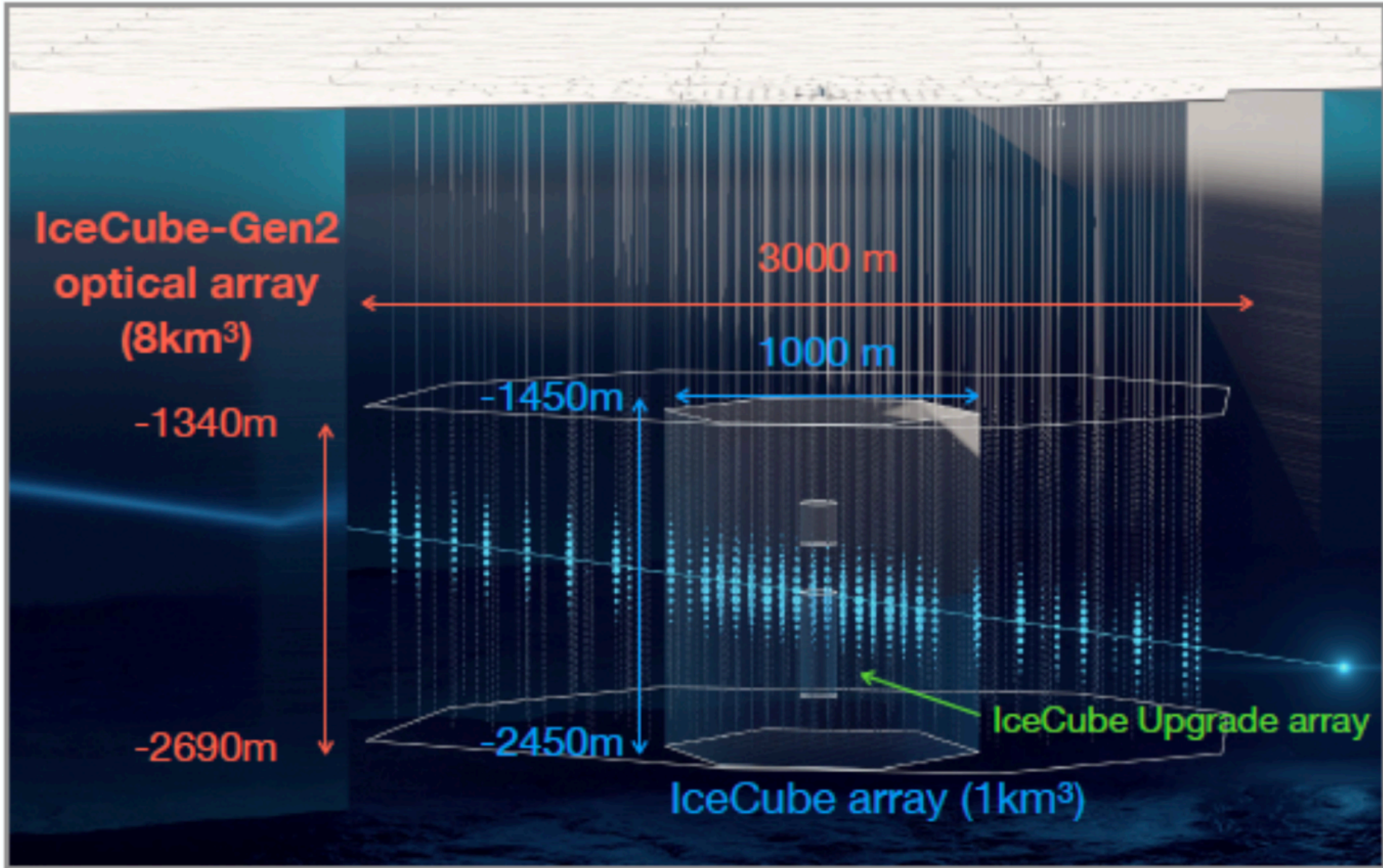
Radio instrumentation

- Radio detection technique is well understood and has reached maturity to design and plan and build science scale experiments.
- Systematics are sufficiently understood to allow planning of a large array. For ice based detectors: Ice properties will be more precisely mapped out during commissioning and running of the experiment.
- Due to the large channel counts, opportunities exist to reduce complexity, and thus cost and power consumption of readout electronics both for optical and radio readout.
  - Example: ASIC development for optical readout. Are there similar needs in the community?
  - Radio Frequency System-on-Chip technology may offer opportunities.
- Scalability: Neutrino and astroparticle experiments largely scale by increasing the number of stations. (examples: IceCubeGen2: ~10k optical sensors, ~400 radio stations, GRAND: 200k stations). This can be met by design for reliability and deployment.

- **IceCube-Gen2 Radio**: reference design established as a result of a multi-year community effort. R&D scale experiment RNO-G currently in the second year of construction in Greenland as stepping stone towards IceCube-Gen2.

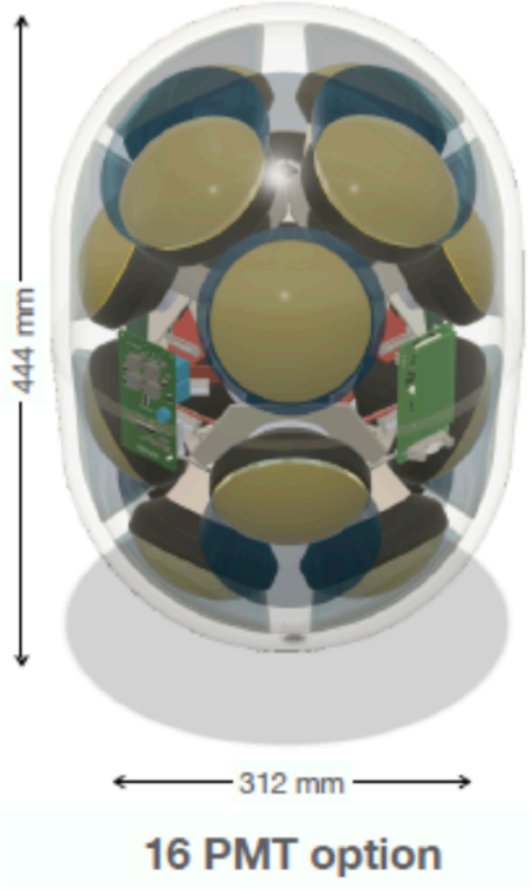
IceCube-Gen2

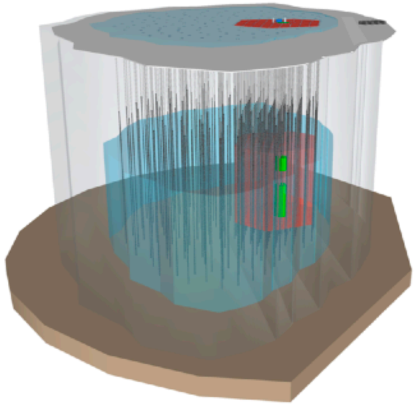
- **IceCube-Gen2 has a reference design** and is preparing a Technical Design document to be released this year and is ready for preliminary design.
  - Optical array, 8 km^3
  - Air shower array on top
  - Radio array, ~500 km^2

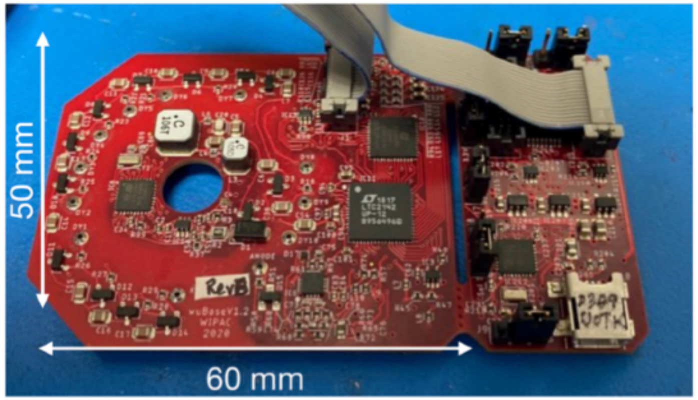


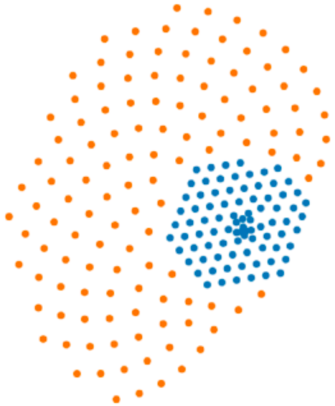
IceCube-Gen2 Optical

- **Optical sensor: 3 x sensitivity , pixels.**
- **Based on understood technology.**
- **Evolution from IceCube**

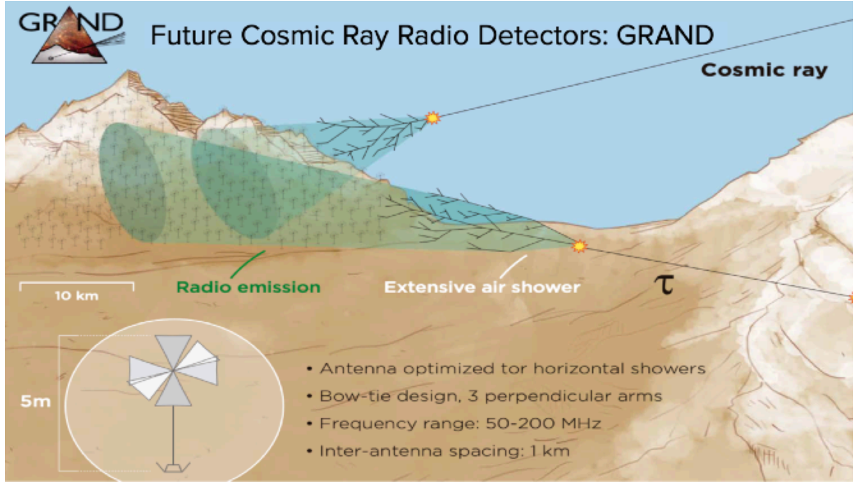




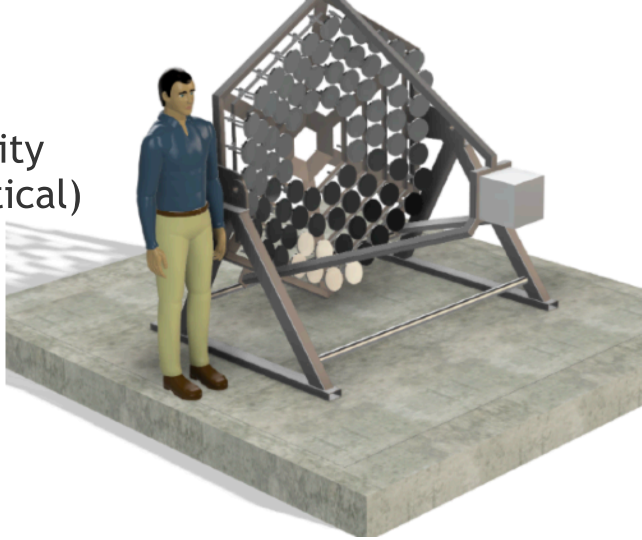




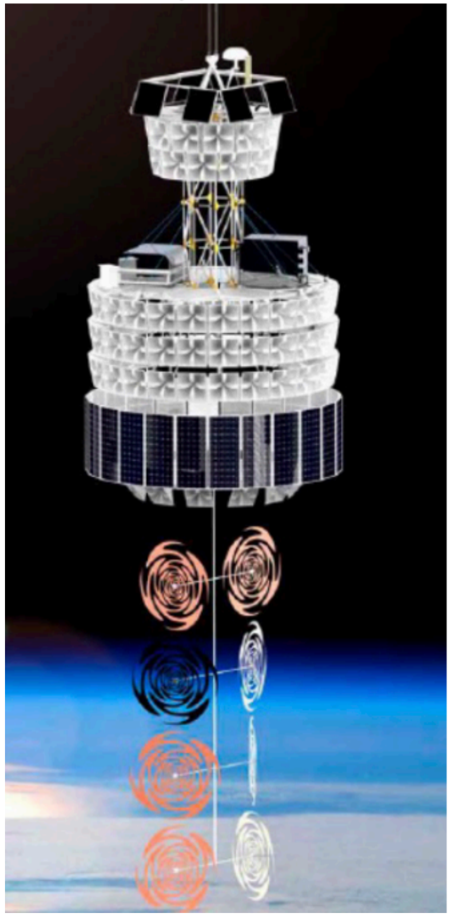
Radio detectors



Trinity (optical)

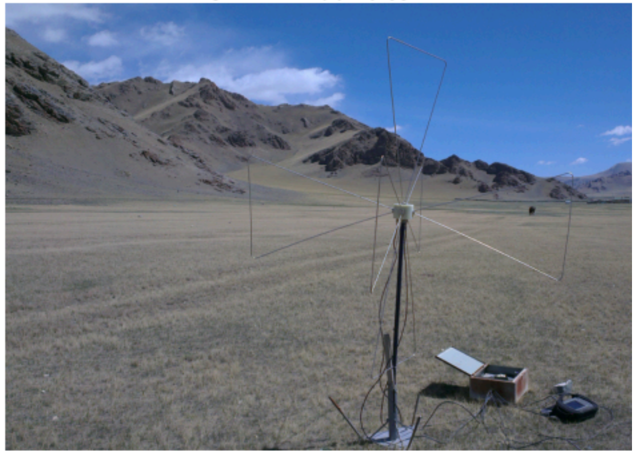


PUEO, including low-frequency dropdowns:

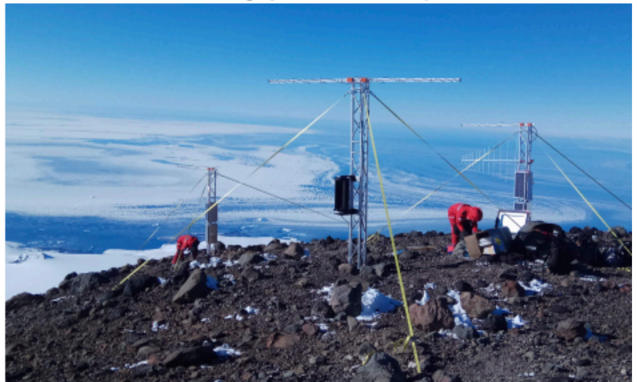


BEACON short crossed-dipoles

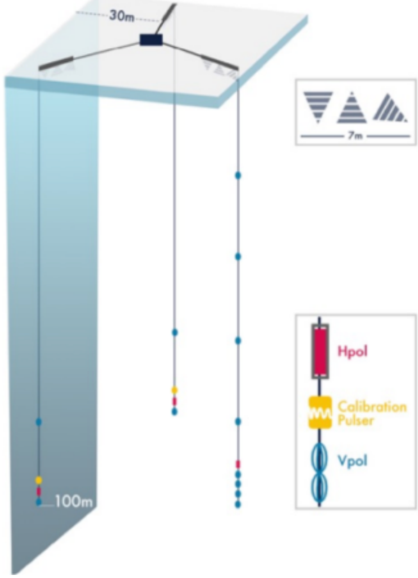
GRAND bowties:



TAROGE-M LPDAs:



RNO-G



Key Points

- *Instrumentation for radio detection has reached a maturity for science scale detectors.*

- *IceCube-Gen2 has incorporated the lessons learned into conceptual design that will be released as a Technical Design Report later this year. Further investment in R&D can reduce costs and possibly further optimize the design.*

- *Opportunities exist in optimizing for power and simplifications: eg ASIC based digitizer/readout.*

- *Remote power and communications approaches of large extended arrays can still benefit from dedicated R&D. (IceCube-Gen2 uses wired approach.)*