

Detector R&D Program Evolution

*Marcel Demarteau
HEP Division
Argonne National Laboratory*

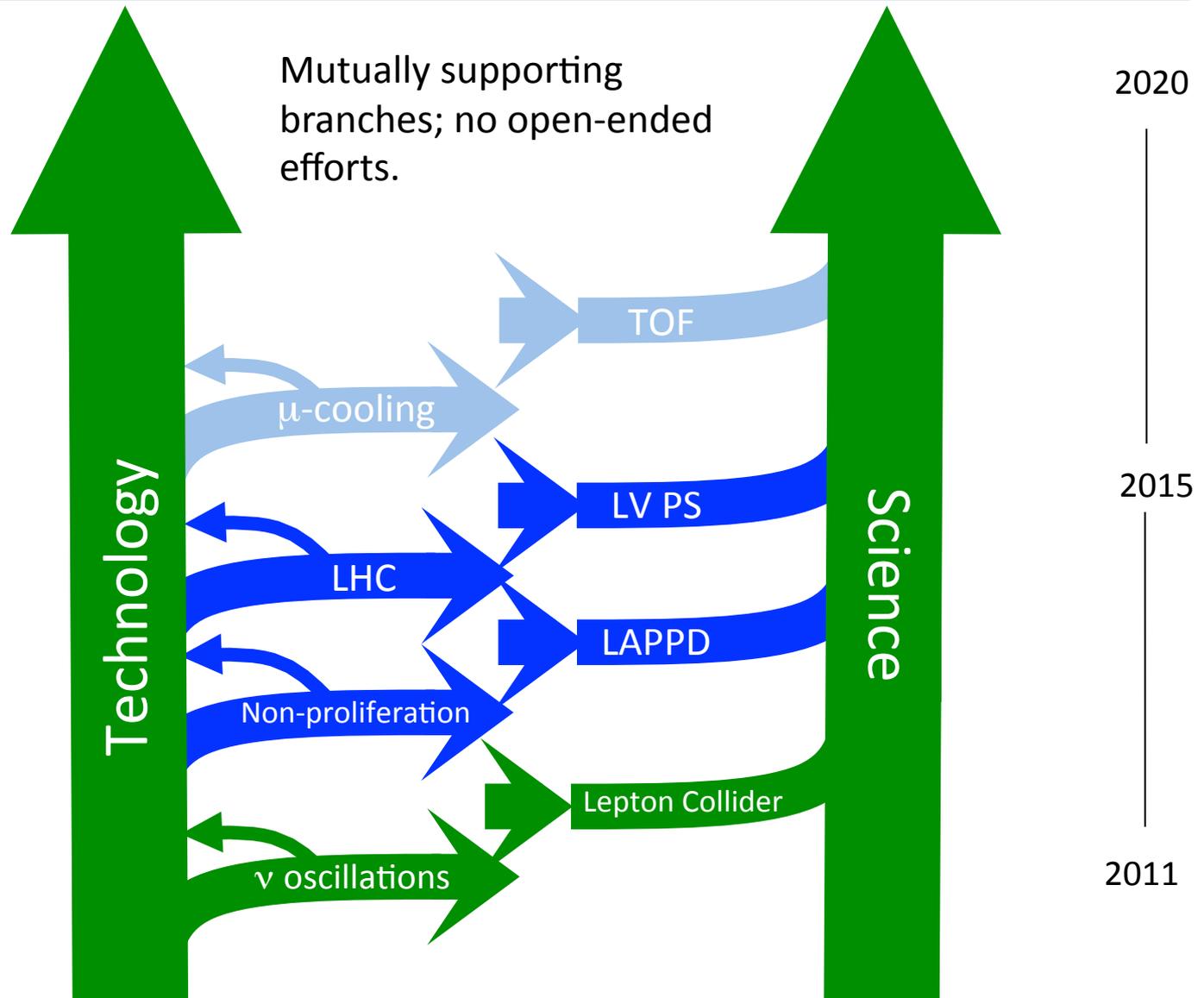
demarteau@anl.gov

Plan: Four-Prong Approach

- **Incremental Improvements**
 - Leveraging the strength of a multi-disciplinary laboratory, enhance the performance of new detector technologies (LDRD)
- **System Development**
 - After having established proof of principle, take the technology to a small scale real science project
 - Avoid a “valley of death” because of the timescale of science projects
- **Development of transformative technologies**
 - Identify an area in science where the development and application of a new technology would have a tremendous impact
 - Ensure that the technology has broad range of applicability
- **Align Development Above with Future Physics Program of the Division**
 - Maximum leverage of new efforts in support of future physics program

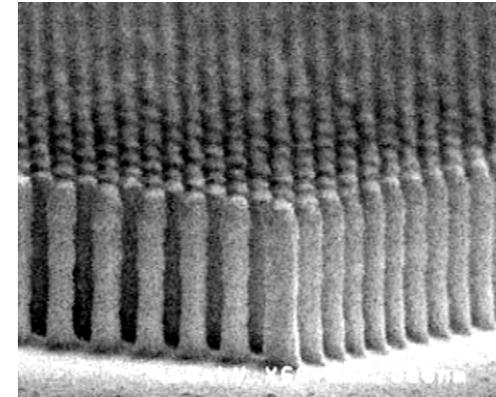


Interconnection



LAPPD

- The primary focus of the LAPPD project is large-scale neutrino experiments
- This development, however, opens many new avenues
- **‘Incremental Improvements’: High QE PC**
 - LDRD program to develop high QE photo-cathodes (\$200k/yr)
 - Focus on on GaAs/AlGaAs photo-cathodes (engineering of materials)
 - Indirect support for LAPPD program
- **‘Incremental Improvements’: PC with intrinsic UV filter**
 - Develop Thin Film Silicon Nano-particle UV Photodetectors with Uofl / UC
 - Depositing silicon nano-particles on a silicon wafer turns silicon from visible to UV detector (200-400 nm light)



Nano-structured photo-cathodes:
Increased band-gap
engineering capabilities

Materials by design

LAPPD

■ 'System Development'

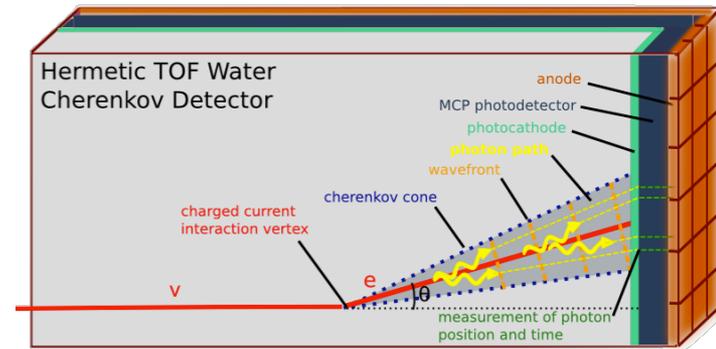
- LDRD Proposal submitted for small scale prototype neutrino detector for characterization of sensitivity of liquid scintillator or water based scintillator equivalent to LAr detector
 - Simulate and quantify the benefits of precise position and time resolution, understand particle ID and background rejection capabilities
 - Deliver mechanical design and LAPPD / liquid interface
 - Deliver small scale prototype for tests in Fermilab test beam

■ 'Program Alignment': Neutrino Physics

- Provides scientific leadership in future neutrino program

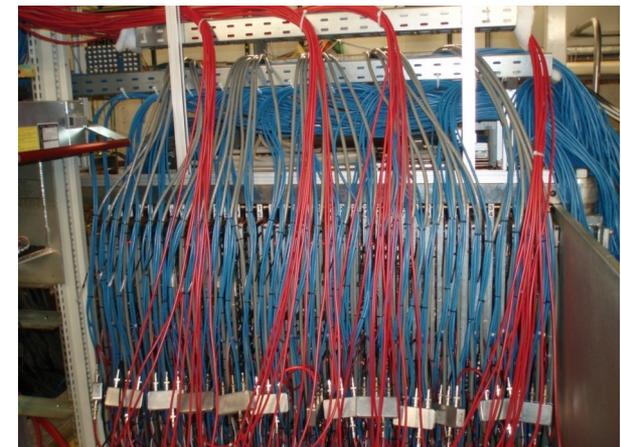
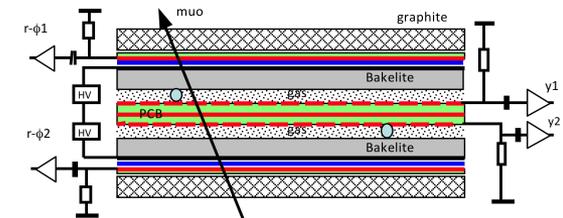
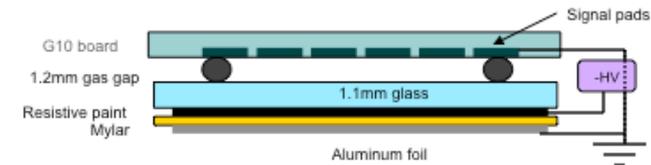
■ 'Program Alignment': Lepton Collider

- Supports the development of readout technologies for scintillation and Cherenkov signals for dual readout calorimetry



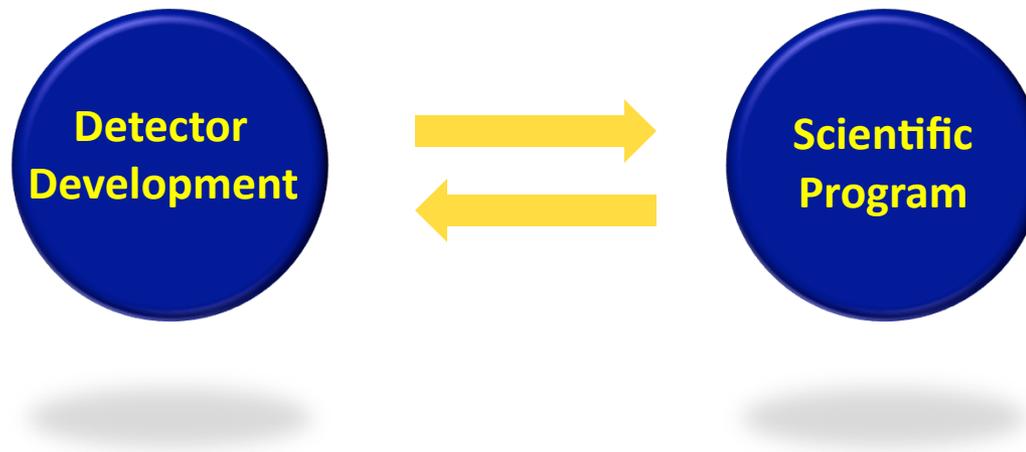
DHCAL

- The Digital Hadronic Calorimeter (DHCAL) is the most advanced Particle Flow prototype calorimeter within the CALICE collaboration; successfully taking data.
- **‘Incremental Improvements’: Single Glass Plate RPC**
 - Development of ultra-thin RPCs
- **‘Incremental Improvements’: Thin Gap RPC**
 - Exploring the possibility of development of large-area high rate thin dual gap Resistive Plate Chambers for application in ATLAS trigger upgrade
- **‘System Development’**
 - The prototype DHCAL, 51 layers, 450,000 channels, 306 25-foot long cables, is an ideal test bed for future developments of cable-less data transmission
 - Submitted CDRD proposal to implement and test free-space data transmission supporting ILC, LHC,
 - Wireless readout is also component of ATLAS upgrade



Mutually Enhancing Programs

- A strong bond is needed between the R&D and science programs. They have to mutually enhance each other; even more so at this point in particle physics



- Traditionally in particle physics, groups with strong detector components also had very strong scientific involvement in the experiments

National Program

- In addition, there is considerable involvement from the division in the shaping of the national program
- **DPF Taskforce on Instrumentation in Particle Physics (Ian Shipsey, Marcel Demarteau, co-chairs)**
 - Structure for a National Instrumentation R&D Strategy
 - Models for Entrepreneurial Instrumentation Science Strategy
 - Graduate Student and Post Doctoral Training
- **Primary authors on US strategy for Physics & Detectors at future Lepton Colliders (from Argonne: Harry Weerts, Marcel Demarteau)**
 - Develop and propose a US strategy for a future lepton collider and outline the issues that need to be addressed



Plans

- The goal of the detector development program is to strengthen the current, and enable the future scientific program in all three frontiers.
- At this juncture in time, a balanced R&D and physics program is essential for a sustained healthy particle physics program
- Our vision is to grow slowly; besides the LAPPD program, add in the near future one other ‘flagship’ detector development program
- Strengthen the synergies between current physics programs and sensor and detector development and leverage our R&D efforts

