# Welcome to Penn



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- Founded by Benjamin Franklin
- We are in David Rittenhouse Lab

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- Which is why you all know his name

## Welcome to the Workshop on Hybrid Cherenkov/Scintillation Detection Technologies



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- In collider world, they call this a "dual readout" detector (meh...)
- Bi-Light detector? Not Bilight...

## Welcome to the Workshop on Hybrid Cherenkov/Scintillation Detection Technologies

### 1971

Organic Scintillators and Liquid Scintillation Counting

> Edited by Donald L. Horrocks and Chin-Tzu Peng

How do we get rid of that annoying Cherenkov light??

#### ORGANIC SCINTILLATORS

pulses from a conventional liquid scintillator; the spectral mismatch only adds to the difficulty in detecting the Cerenkov events.

A second problem is the fact that Cerenkov radiation is emitted in a defined geometrical configuration given by:

$$\cos \theta = \frac{1}{\beta n}$$
(4)

Ross(3) has shown that even in the highly reflective counting chamber of a typical liquid scintillation counter, a significant geometrical effect is still observed. This directional response explains why the typical counter gives much lower counting efficiencies when used in the coincidence mode. Most systems have their photomultiplier tubes at an angle of  $180^{\circ}$ . Thus, when sensitivity is highest in one direction, the  $180^{\circ}$  sensitivity is at a minimum. If an isotropic photon distribution could be obtained from Cerenkov events, the coincident counting efficiency would be distinctly improved.

A possible answer to both of these problems may rest in the use of a waveshifting compound in the Cerenkov generator. Many investigators have already studied the use of waveshifters to increase the counting efficiency. Heiberg and Marshall(4) used 2-amino-6,8-naphthalene-

## Workshop Goals

- Survey recent technical developments in hybrid detection
- Provide a broad overview of existing hybrid detection successes
- Discuss the best paths forward for technical developments
- Outline reference designs for a large-scale hybrid detector
- Come up with a better name than "hybrid Cherenkov/scintillation detector"?

Design of a large-scale detector will certainly depend on physics goals. (And there could be more than one!)

We would like to encourage the workshop atmosphere---ask questions!

- I. Introduction and Overview
- II. Scintillator Developments
  - 1. Panel: Scintillators
- III. Analysis Techniques and Results

### Day 2

Day 1

- IV. Photon Sensors and Collectors
- V. Readout Instrumentation
  - 2. Panel: Sensors and Instrumentation
- VI. Prototypes and Demonstrators 1

### Day 3

VII.Prototypes and Demonstrators 2 VIII. New(er) Ideas

3. Panel: Detector Reference Design(s) IX.Summary and Paths Forward

Scintillator Panel

- 1. What are the most promising new cocktails for hybrid detection, and why?
- 2. What are the tradeoffs between pure LS, WbLS, mineral oil+LS, LAr/Xe, etc., as media for Cher/Scint detection in a big detector?
- 3. How is radiopurity affected by material choice?
- 4. How tunable are the wavelength spectra of future cocktails?
- 5. What would be the ideal cocktail?

Plus questions from attendees!

Sensors and Instrumentation Panel

- 1. What are the requirements for realistic photon sensors in a big detector?
- 2. Are there any future sensor prospects not yet considered for a hybrid detector?
- 3. What are the best sensor options, or what mix?
- 4. How important is spectral sorting? What is needed, if anything?
- 5. What are the requirements for readout schemes: timing, multi-pe resolution, power, deadtime, pixelization, quantum efficiency, etc.?

Plus questions from attendees!

#### **Reference Design Detector**

1. Build your own detector:

Number of sensors and type and size, timing, target material, readout scheme, size, photon collection and/or spectral sorting, location, "reasonable" cost, etc.?

- 2. "Warm vs. Cold"? How does LS, WbLS, etc. compare to LAr/LXe?
- 3. What remains to be demonstrated---what is the critical path (other than funding) to design a complete detector?
- 4. What are the primary decision points?
- 5. What simulations or techniques are still needed?

Plus questions from attendees!

## Logistics

- Coffee breaks in lobby behind A4.
- Lunches on your own:



- Registration fee (\$50) to Gabriel!
- Dinner Wednesday at The Post---Also
  +\$50 to Gabriel if you go to dinner
- Dinner is 6-8pm



## Acknowledgments

- Ari McManus, Millicent Minnick, and Mike Reilly here at Penn for help organizing things locally
- CAEN for helping to sponsor event
- Workshop Organizing Committee
  - D. Asner, G. D. Orebi Gann, R. Svoboda, A. Weber, M. Wilking, M. Wurm

We are hoping to do this annually and will let you know where the next meeting will be before the end of this one!



Chagrined a little that we have been hitherto able to produce nothing in this way of use to mankind; and the hot weather coming on, when the electrical experiments are not so agreeable, it is proposed to put an end to them for this season, somewhat humorously, in a party of pleasure on the banks of the *Skuykill*.<sup>25</sup>

#### EXPERIMENTS AND OBSERVATIONS ON

#### ELECTRICITY,

PHILADELPHIA in AMERICA, BY

BENJAMIN FRANKLIN, L.L.D. and F.R.S.

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