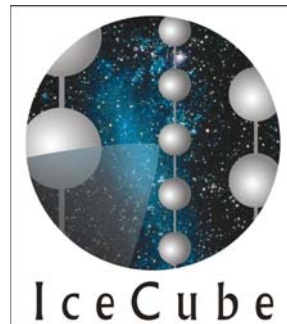
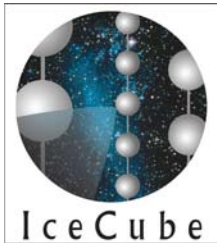


PMT HV Base Board Development

Nobuyoshi Kitamura
SSEC / UW-Madison

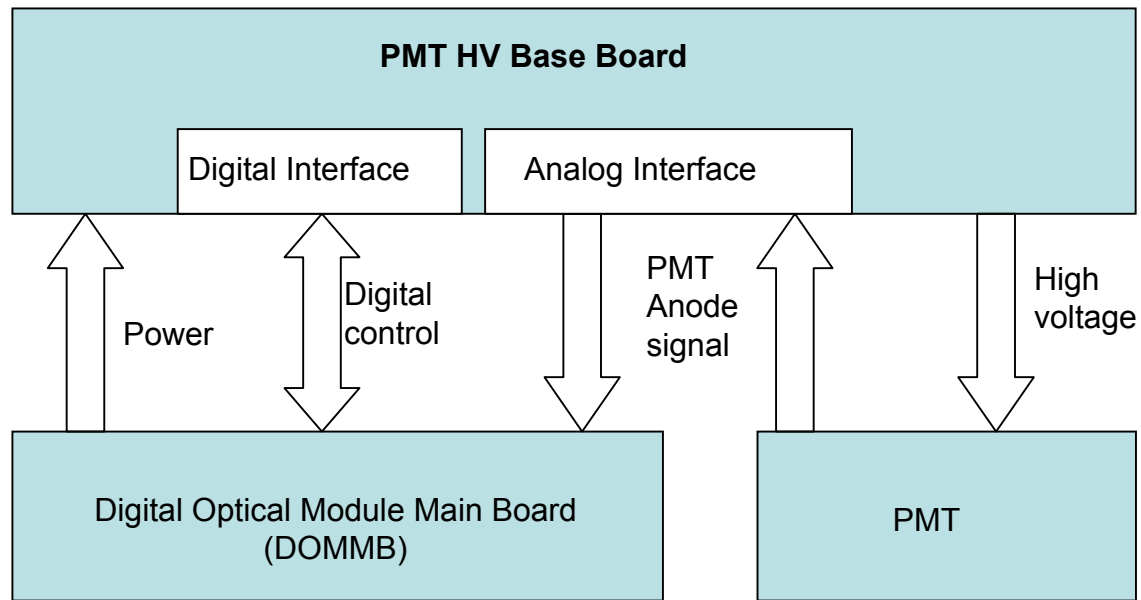


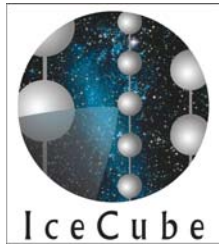
Laguna Beach, CA
March 30-April 1, 2003



PMT HV Base Board

Functional Overview (1/2)





PMT HV Base Board

Functional Overview (2/2)

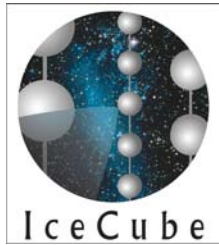


Analog functions

- +/-5V input, 1000-2000V output
- **Transformer coupling** for PMT pulses

Digital functions

- Adjustment and monitor of the HV output in 12-bit (0.5V) resolution
- Digital readout of unique **board serial number**



PMT HV Base Board

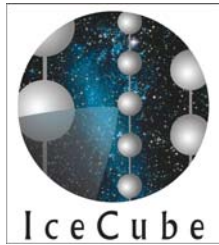
Dual-Track Strategy



Two configurations with *identical signal interface as seen by the DOM Main Board*

- ❑ **Single-board** configuration
 - All functionality on one-board, mounted on PMT

- ❑ **Passive base** configuration
 - Resistive bleeder chain & analog interface on PMT
 - Separate daughter board, carrying the HV generator & digital interface



PMT HV Base Board

Dual-Track Comparison

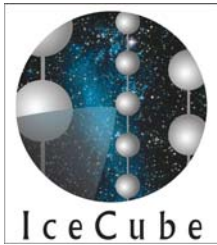


Single Board

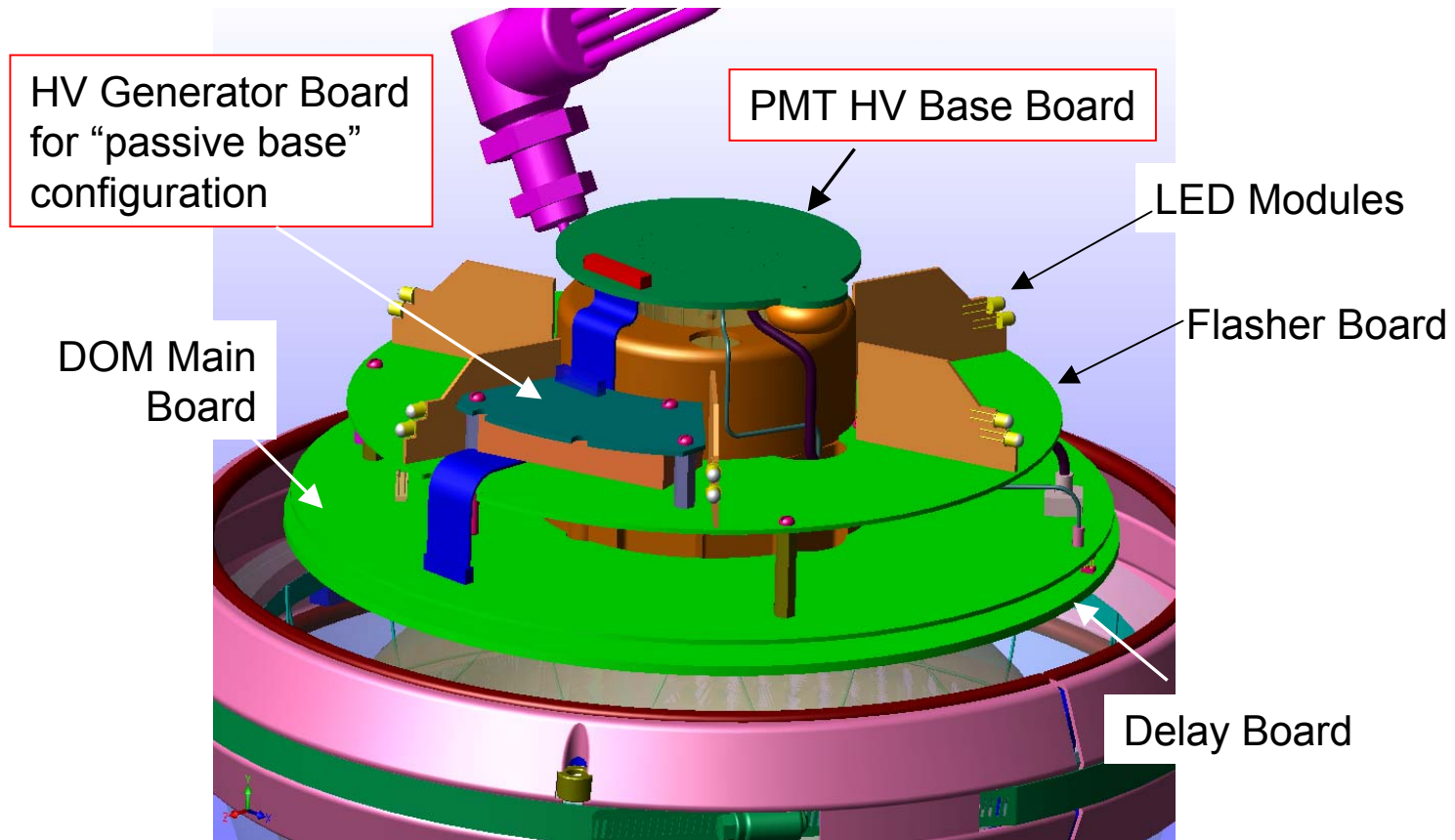
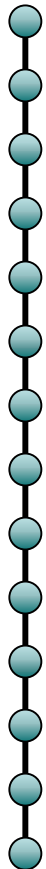
- Compact integration
- The 1st dynode voltage is fixed, independent of gain adjustment
- HV generator close proximity to PMT

Passive Base

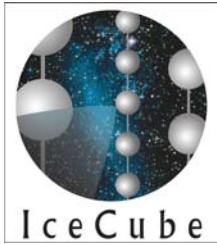
- Classical approach
- All dynode voltages scale with total A-K voltage
- Potential noise source is away from PMT pins



PMT HV Base Board Mechanical



3D CAD by Glen Gregerson, PSL



PMT HV Base Board

Vendors, Players & Schedule



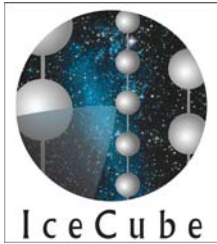
- ❑ **Vendor A** (Germany) to deliver the PMT base in single board configuration → **On time**

- ❑ **Vendor B** (US) to deliver the HV generator for the passive base configuration → **April 28**

- ❑ **Vendor B** to deliver the passive base → **April 28**

- ❑ **UW-Madison** to develop the daughter board for the passive base configuration → **Completed**

- ❑ **UW-Madison** to assemble the daughter board → **All components received**



PMT HV Base Board

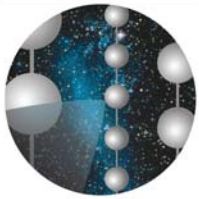
Single Board Configuration

All-In-One design

- Digital interface
- HV generator
- Voltage divider
- Toroidal transformer
- PMT pulse cable & connector

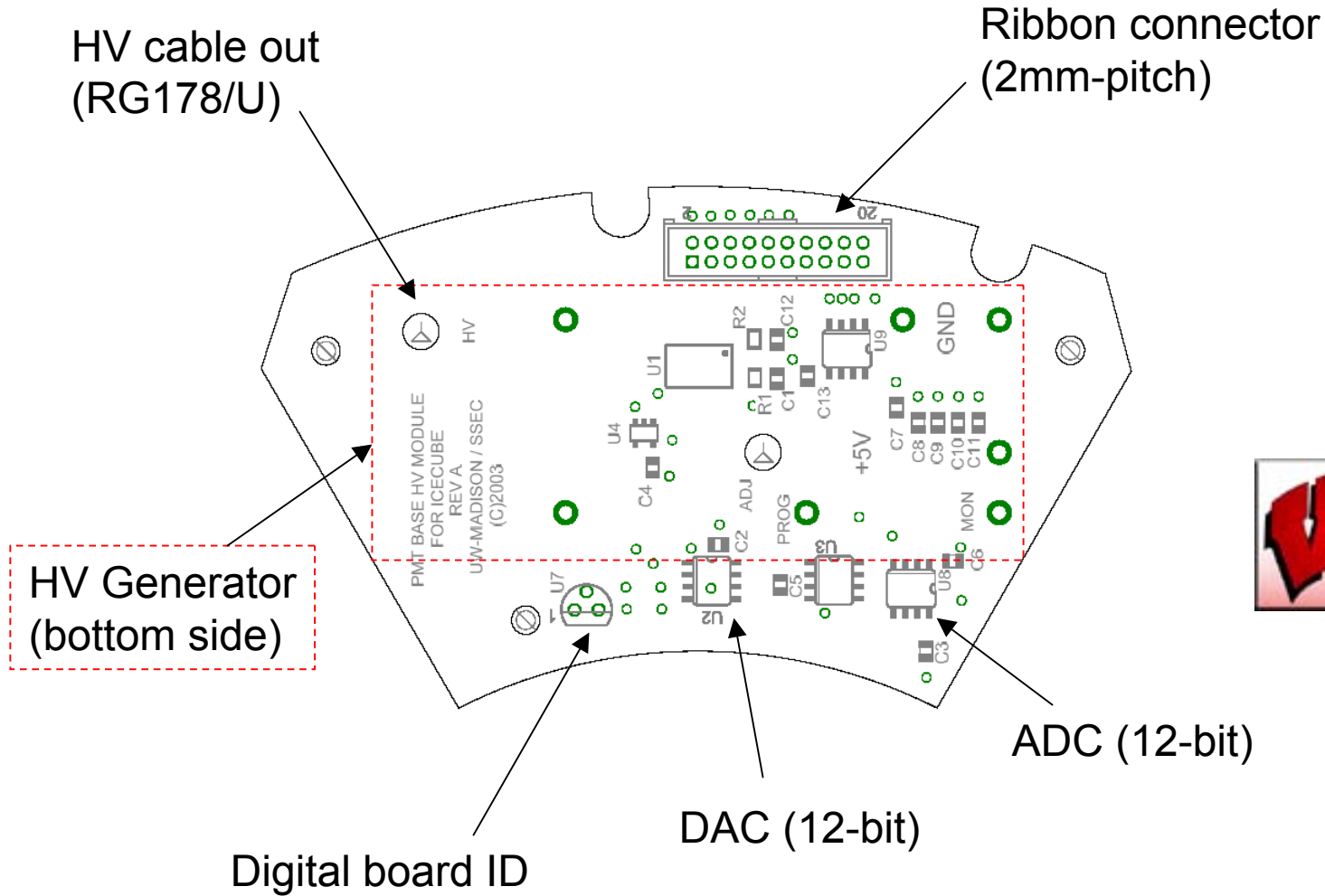
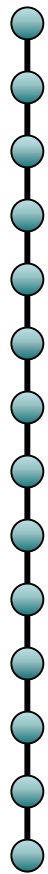
Fixed first-dynode voltage (700V). The prototypes in April '03 will have a potentiometer adjustment

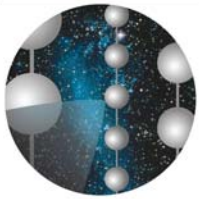
Isolation amplifier for split ground (more later)



IceCube

PMT HV Base Board HV Generator Board



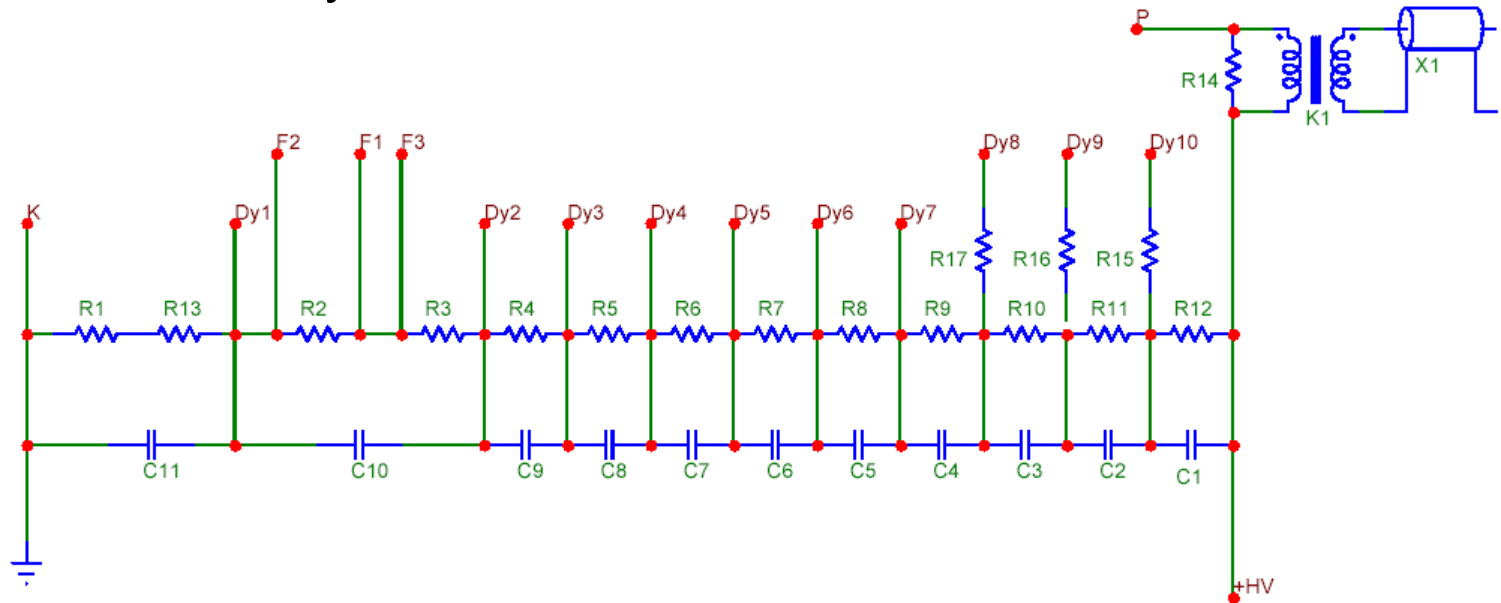


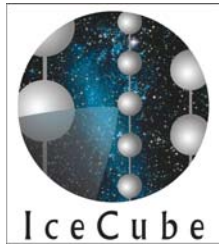
IceCube

PMT HV Base Board

Passive Base

- Total R = 150M Ω
- Hamamatsu “Special” Divider Ratio
- Plenty of C





PMT HV Base Board

Resolved issues

❖ Updates since August 2002 In-Ice Devices Meeting at UW-Madison

First-dynode voltage adjustability

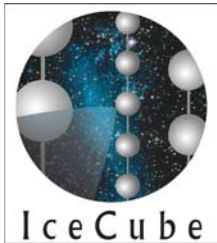
Fixed for “single board” configuration
Scale with total A-K voltage

Temperature

Operation: $-40\text{ }^{\circ}\text{C}$ to $+27\text{ }^{\circ}\text{C}$

Storage: $-55\text{ }^{\circ}\text{C}$ to $+45\text{ }^{\circ}\text{C}$

Vendor must report components meeting $-40\text{ }^{\circ}\text{C}$ but not $-55\text{ }^{\circ}\text{C}$.



PMT HV Base Board Issues



- ❑ **Split-ground requirement**

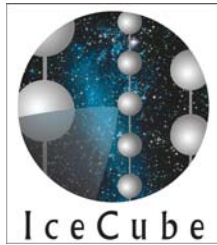
- Isolation AMP costs power and \$
 - Reduced regulator feedback gain

- ❑ **Toroidal transformer cable selection**

- RG178/U does not meet voltage requirement
 - Bulkier transformer expected after revision

- ❑ **“Quality Plan”**

- Must be defined and executed

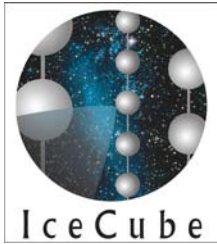


PMT HV Base Board Documentation

- PMT HV Base Board Engineering Requirements Document (ERD)
- PMT HV Base Board ERD Supplement
- PMT HV Base Board—DOM Main Board Interface Document

These documents contain:

- Engineering requirements
- Preferred embodiments (specifications)
- Justification based on science requirements



PMT HV Base Board

Conclusion

- The single board approach is on schedule.
- The passive base approach is behind schedule. Vendor C is being pursued.
- Quality Plan is a must.



Human Peace Sign from McMurdo Station. Jan. 19, 2003. <http://www.commondreams.org/headlines03/0119-02.htm>