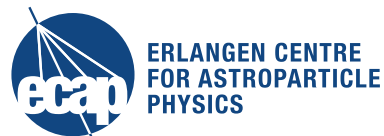
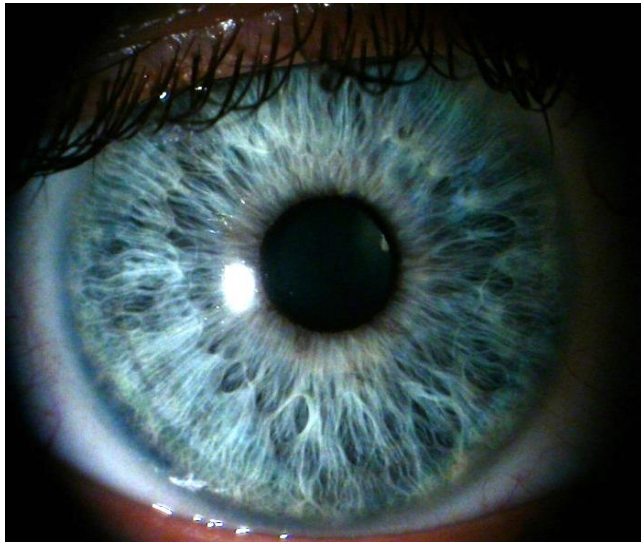


# mDOM – a multi-PMT Digital Optical Module for the IceCube-Gen2 neutrino telescope

ERLANGEN CENTRE  
FOR ASTROPARTICLE  
PHYSICS

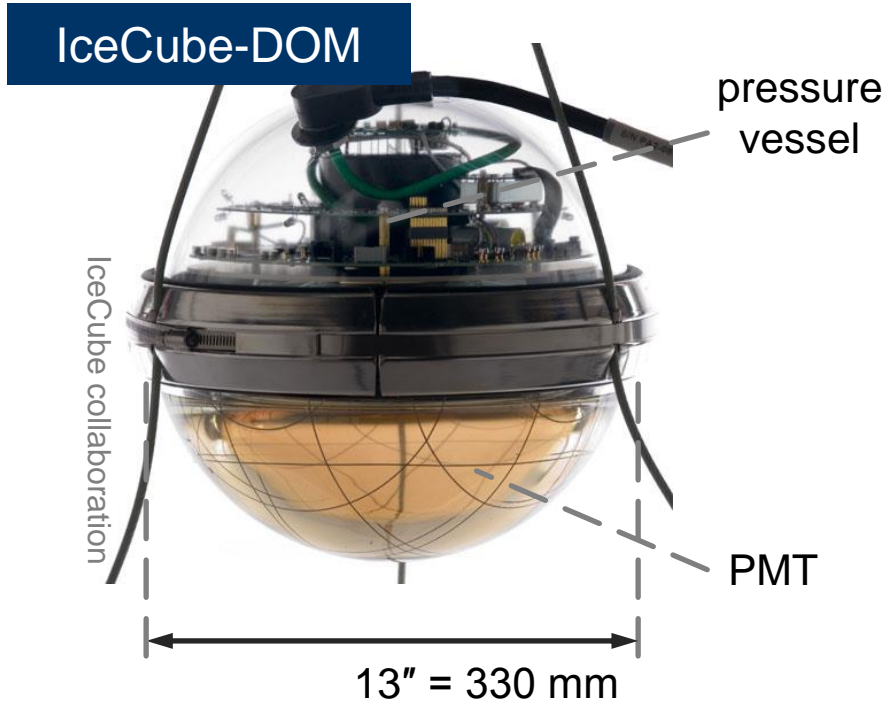
Lew Classen  
Dubna, 02.10.2018





Optical modules – the neutrino telescope’s eyes on the skies...

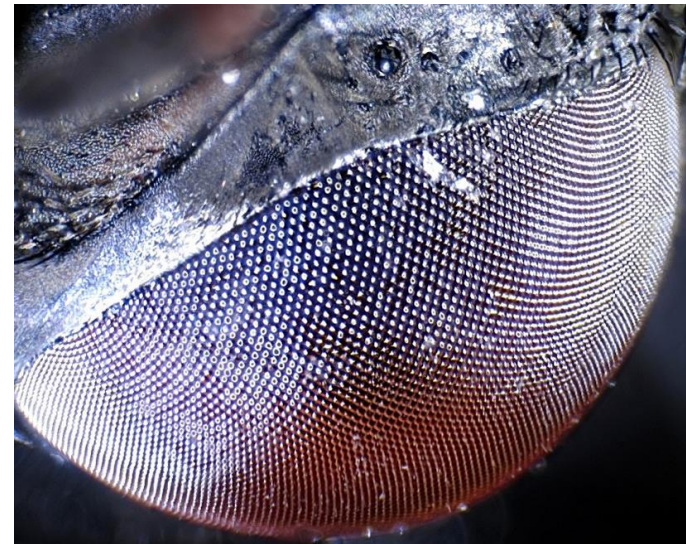
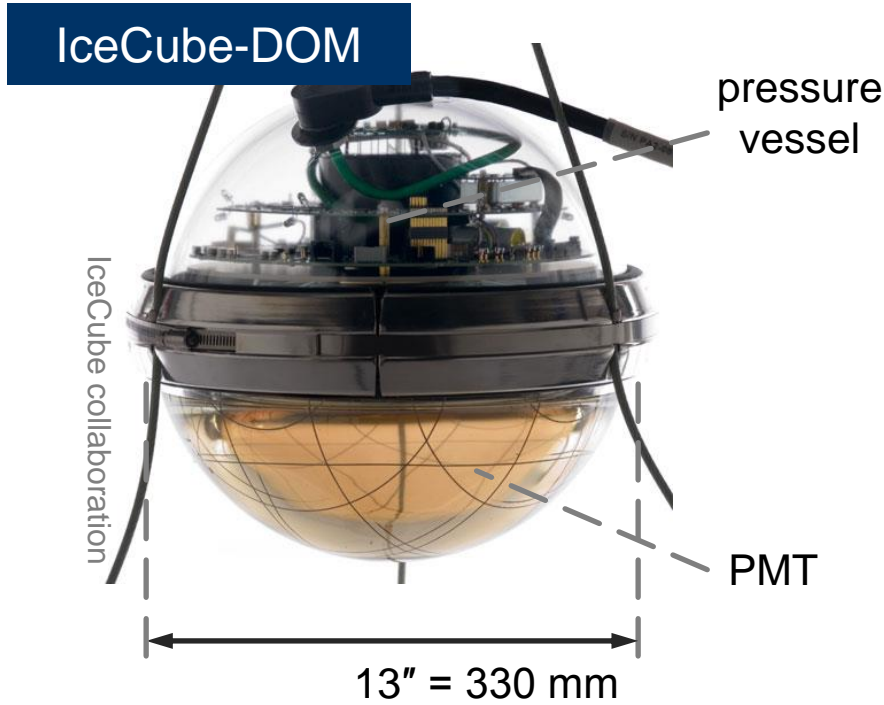
# Single-PMT layout



- “traditional” single-PMT design
- also used in Antares and the Baikal detector

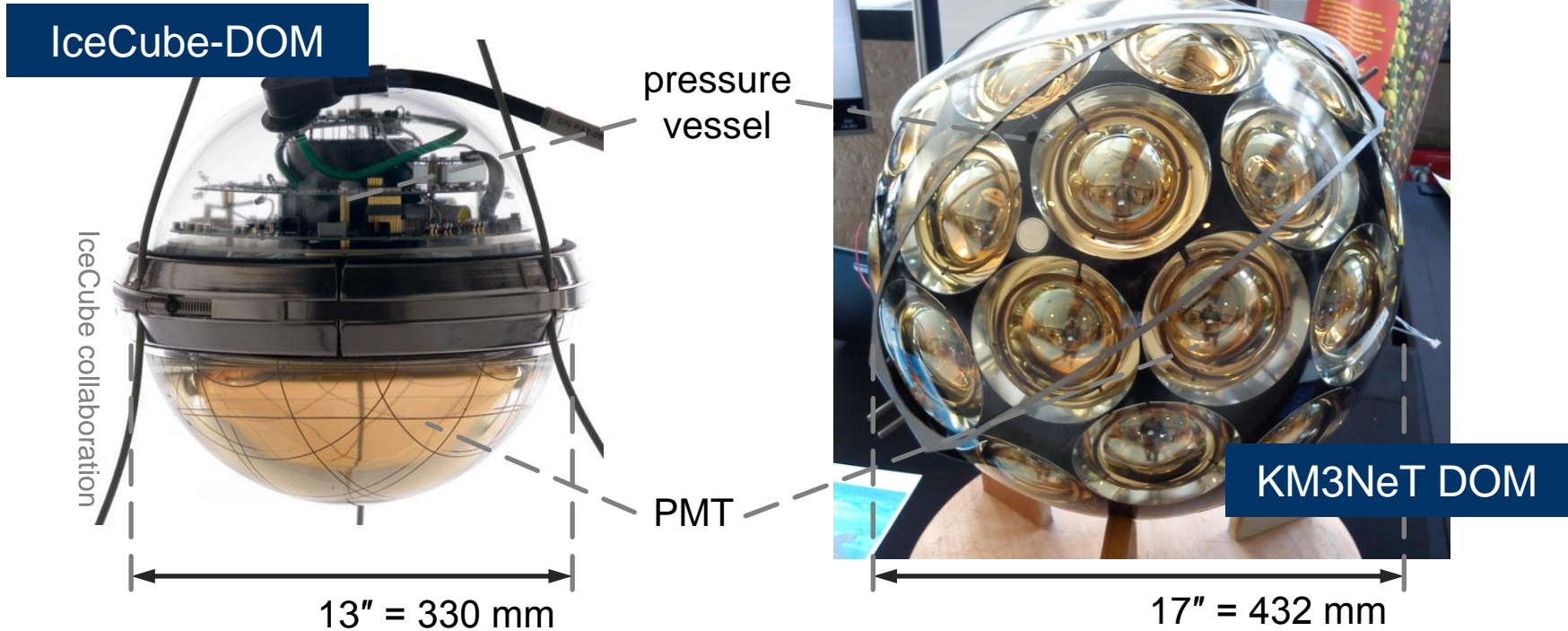
Optical modules – the neutrino telescope’s eyes on the skies...

# Alternatives?



But Nature also features alternative concepts...

# Multi-PMT layout



- **principle:** segmented sensitive area
- **result:** several advantages with respect to single-PMT design
- **idea:** transfer to IceCube upgrades

# Multi-PMT concept for IceCube

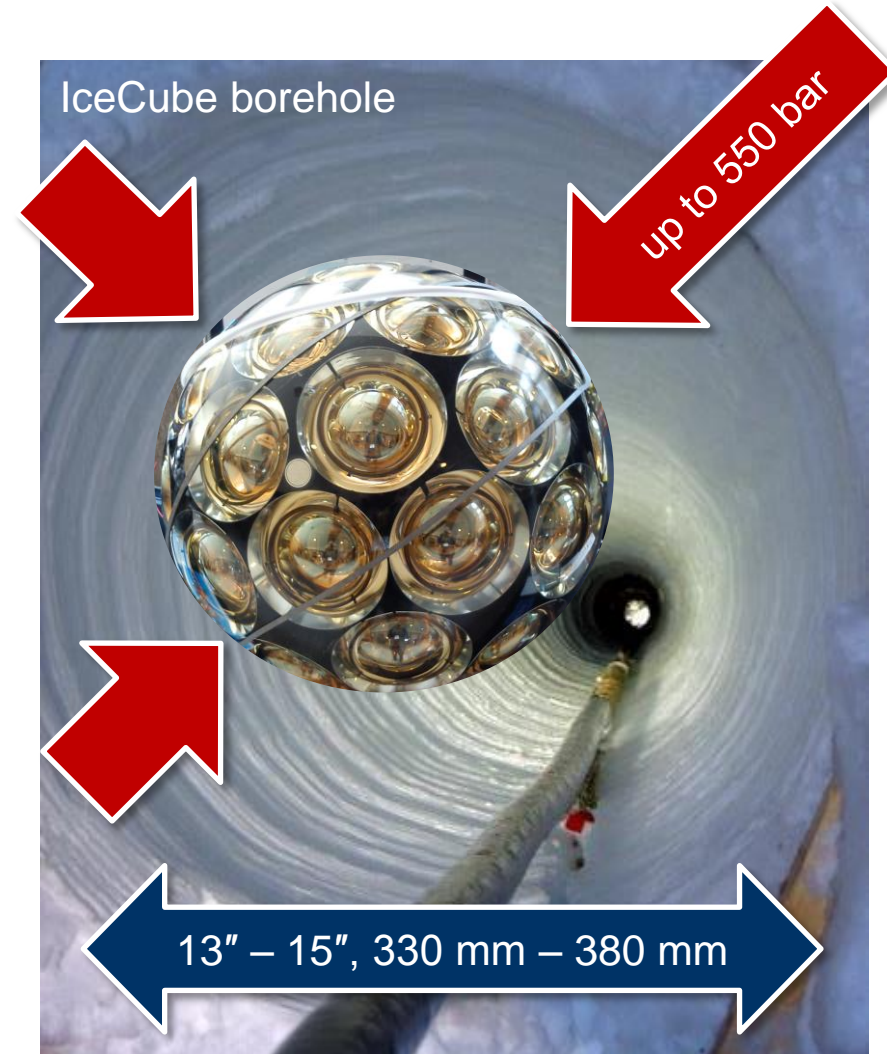


## challenges

- limited diameter
- pressure peaks during re-freezing
- temperature  $-10^{\circ}\text{C}$  to  $-45^{\circ}\text{C}$
- UV transparency
- little radioactive background

## to-do list

- redesign of pressure vessel, reflectors, support structure, ...
- PMT characterization and choice
- low-temperature tests
- simulation of module performance



IceCube collaboration

# Pressure vessel

- cylindrical design



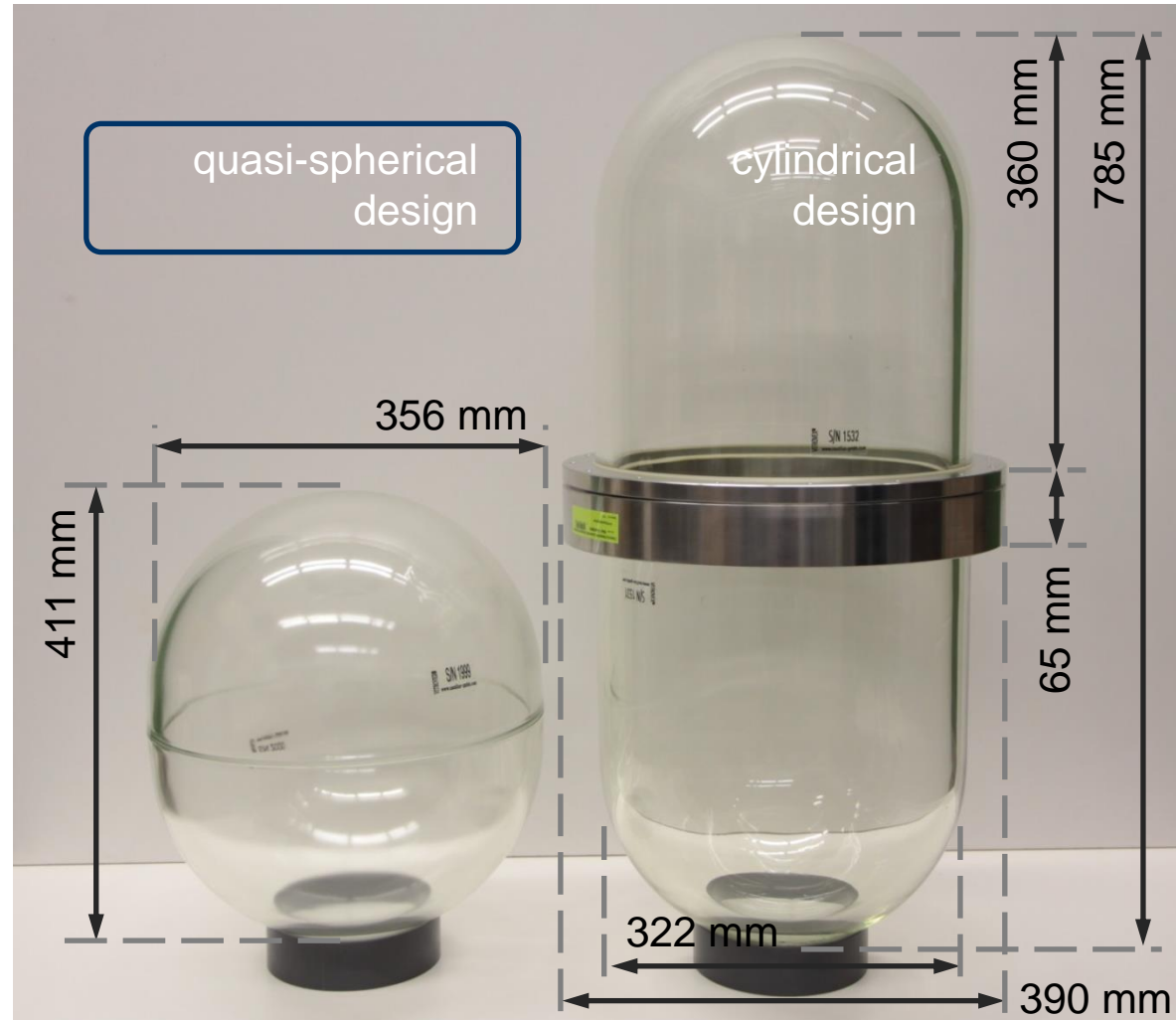
- quasi-spherical design



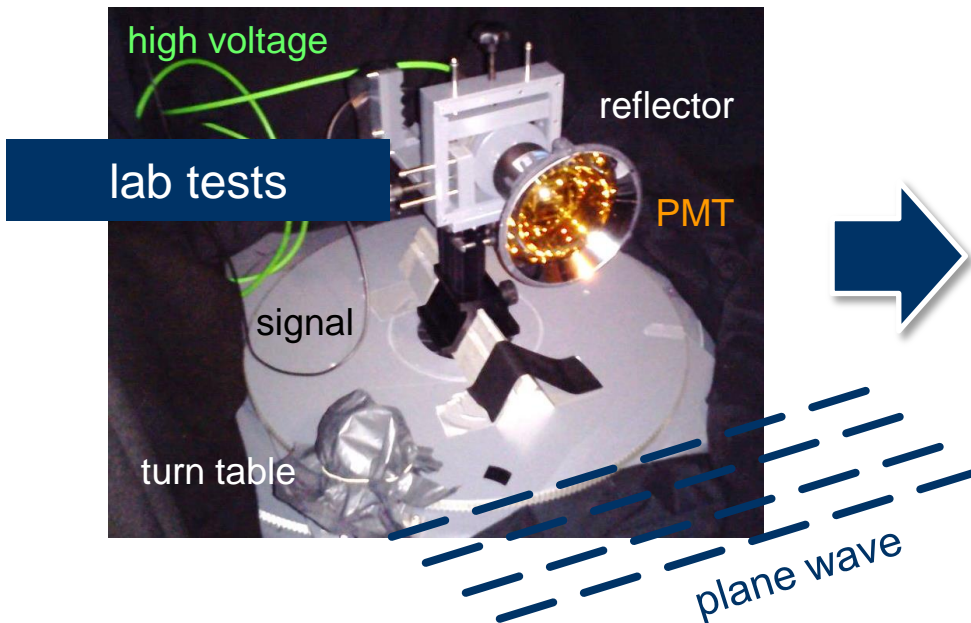
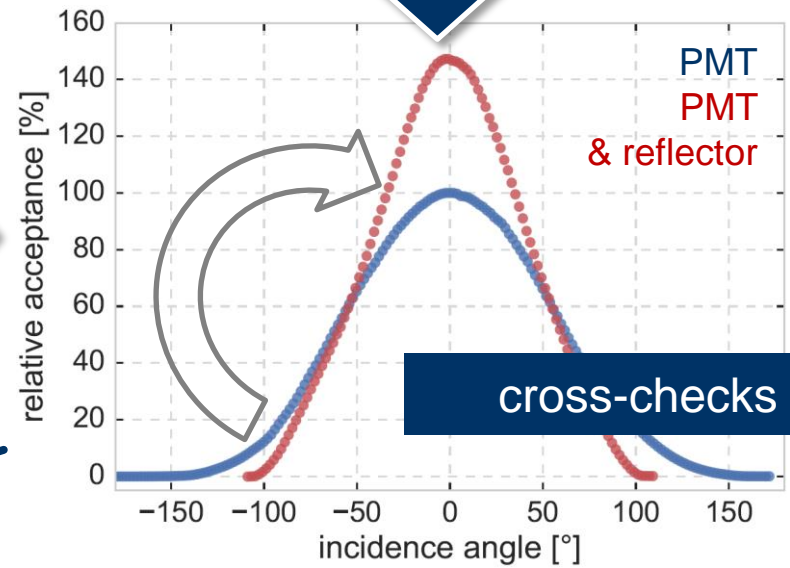
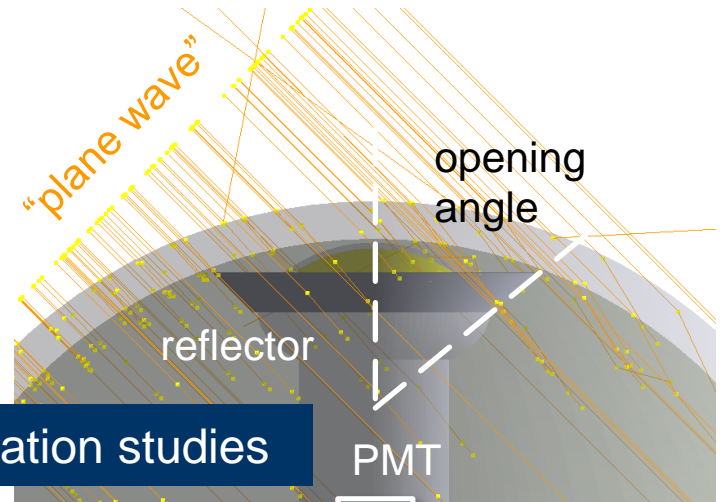
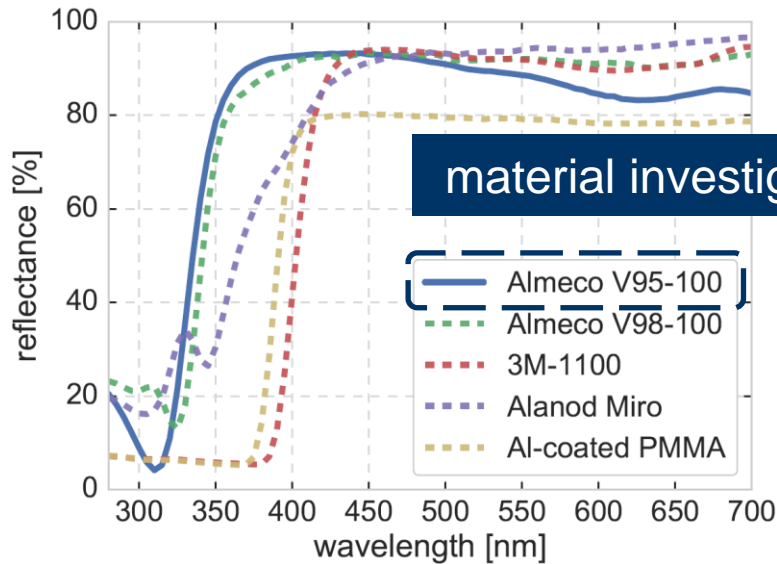
- 24 PMTs per module



mounting structure

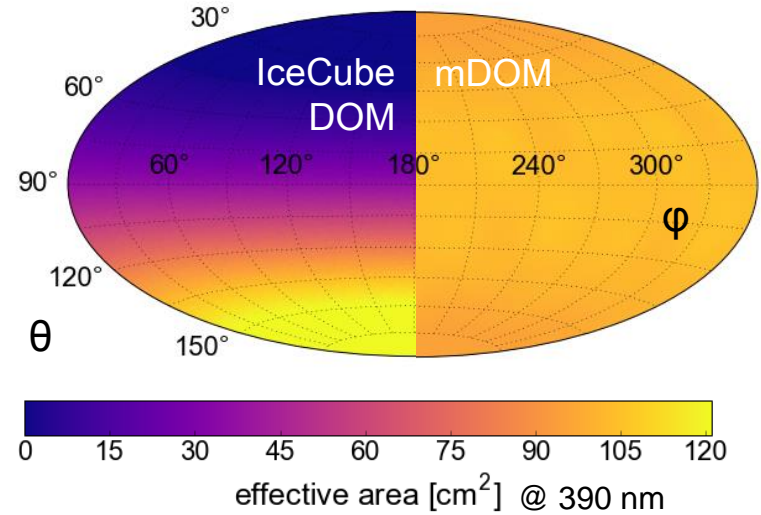
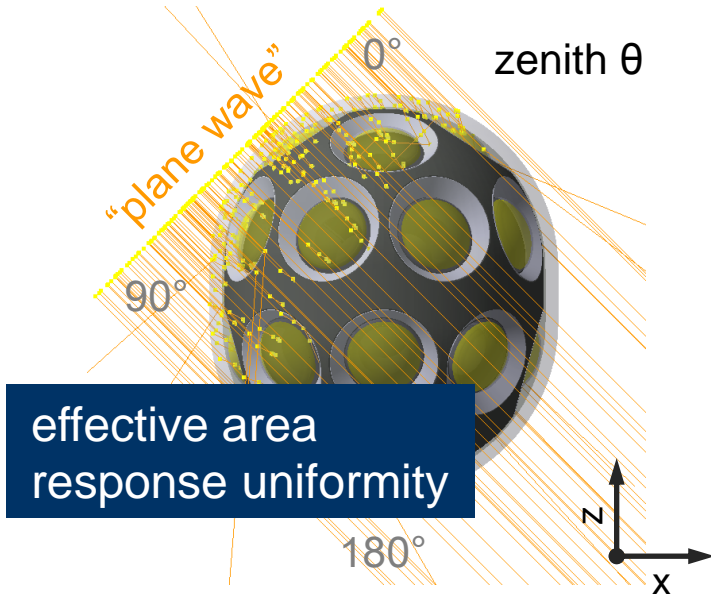


# PMTs & reflectors

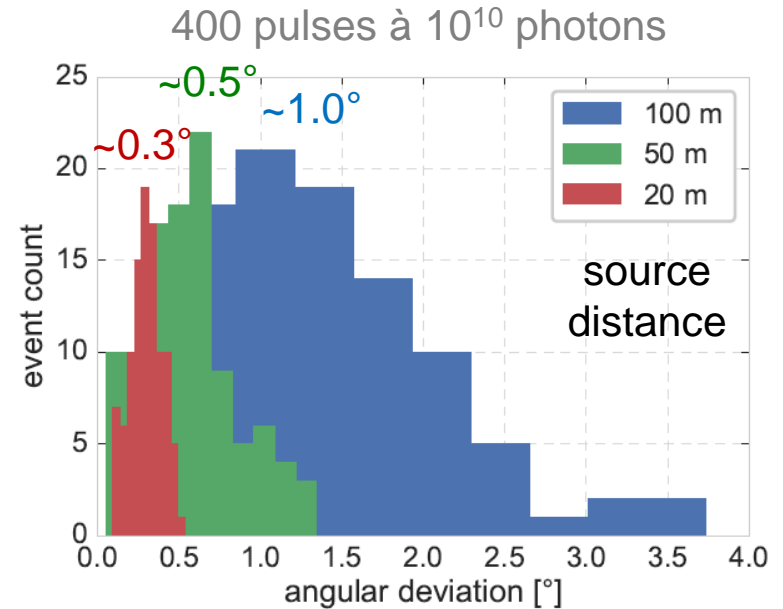
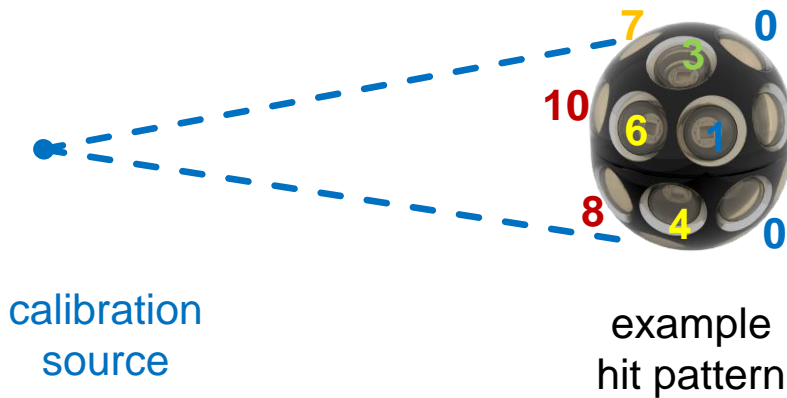




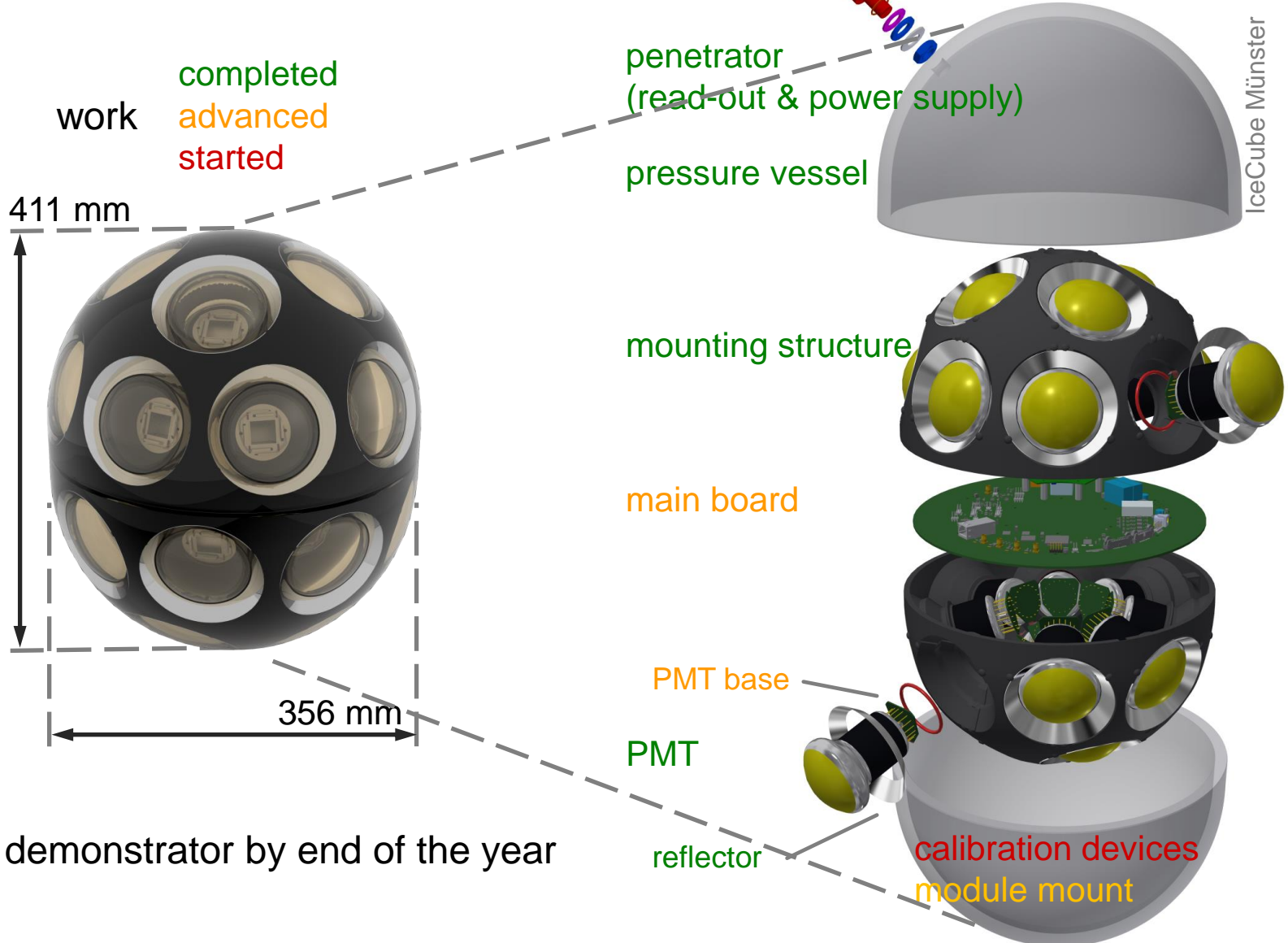
# Module performance



## directional reconstruction



# Status



demonstrator by end of the year

# Summary & outlook

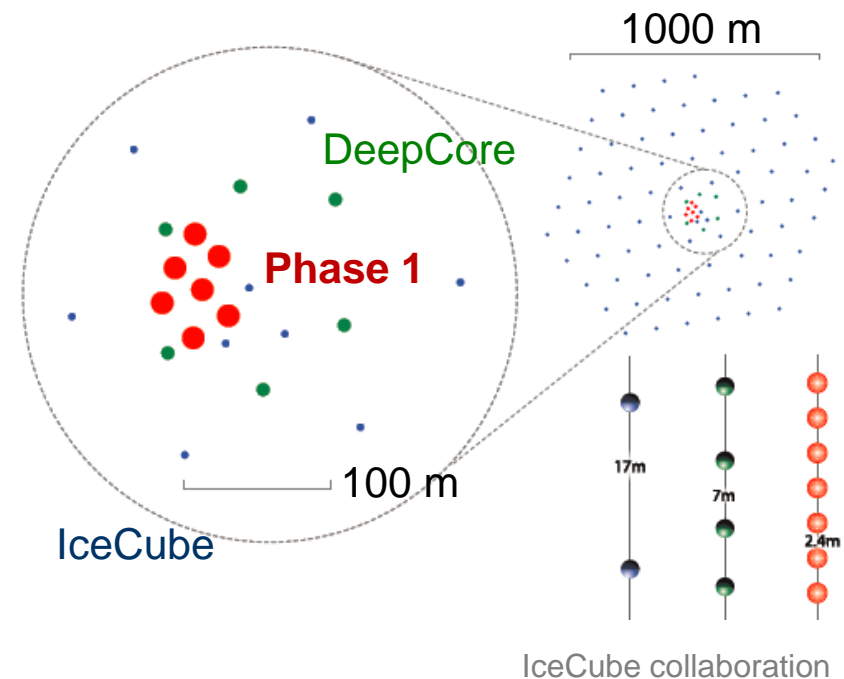


- glass vessel hardware
- PMT candidate characterization
- reflector design
- base prototype testing

- sensitivity characteristics simulation
- directional reconstruction
- $^{40}\text{K}$  self-calibration

topic not covered today

- follow-up studies in several “spin-off” Bachelor’s, Master’s and PhD theses in Erlangen and Münster
- DESY, Aachen and Mainz also got involved
- **mDOM** now one **baseline module for IceCube-Upgrade**
- Most recent news: see talks by A. Kappes and me in Detector session



# Special thanks to

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