SWGO
The Southern Wide-field Gamma-ray Observatory

MultiPMT electronics proposal

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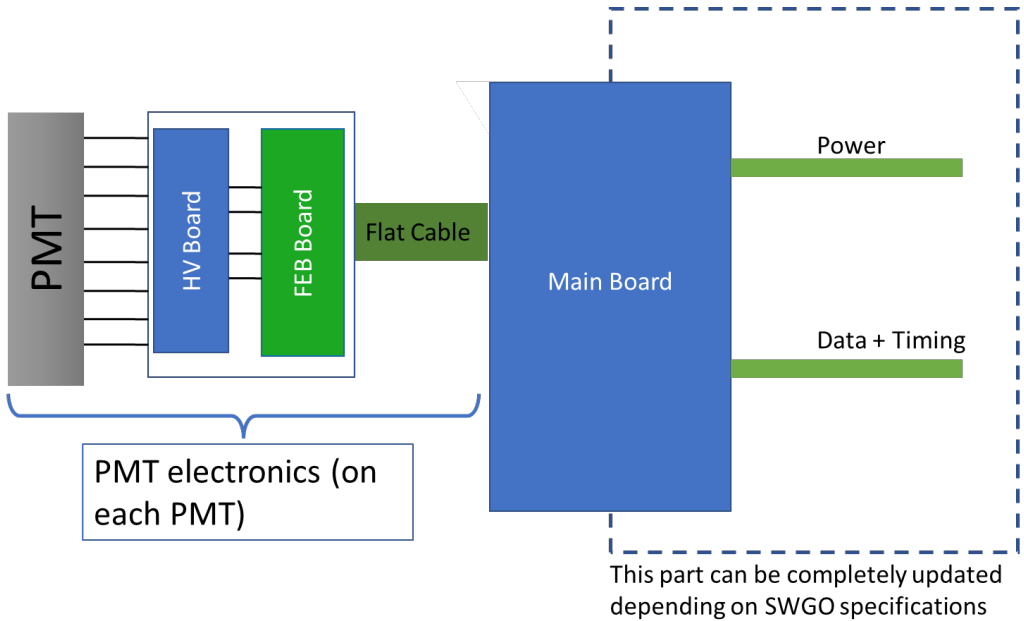
Description

- *What it is*
  - We implemented a proposal for an electronics chain to be adopted in the multiPMT proposed by Naples group
  - Electronics is fully hosted inside the vessel (only 2 cables exit from the module, network/timing & power)
- *Compatibility*
  - Designed for the 3" PMTs, can be adapted to other PMTs
  - Timing can be adapted to White Rabbit if requested

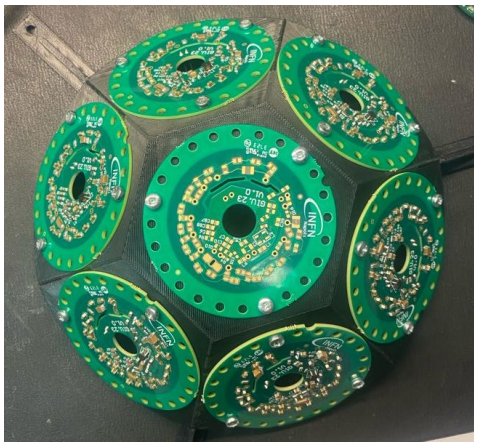


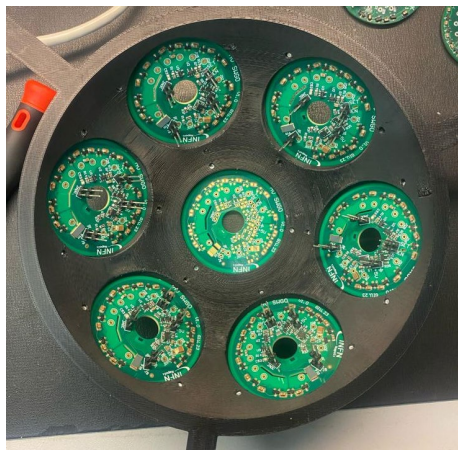
Advantages / Performance

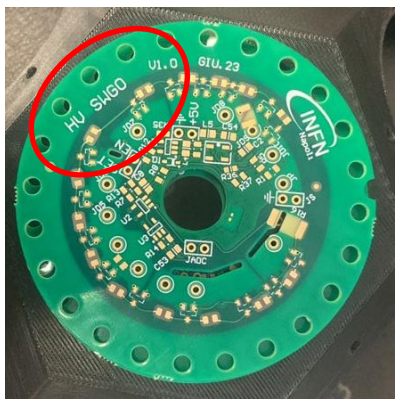
- Electronics close to the PMT reduces noise and increase performances
- Much less power consumption -> less operating cost
- Possible heat source in the water to increase temperature – > reduce freezing
- Scalable to any number of small PMTs with low cost base and Front End. Testing after integration with the PMT, reducing commissioning time.
- Meets minimum requirements (no Waveform only)
- Project mature from HK and already funded from INFN for SWGO development

HV Board

- Active board that generates up to 1500V with less than 4 mW of power consumption
- 3-1-1….2-2 voltage divider for the 3’’ R14374 PMT from Hamamatsu
- ESD diode to protect the FE and limit the PMT signal voltage
- RFID chip to assign a unique serial number to each board in production
- At 15 degrees the MTTF is 196 years
- 15 boards produced and tested in the last weeks for the first multiPMT prototype, they work as expected
- Shape of the board optimized to be mounted in the PMT support designed for SWGO multiPMT. Possibility to also orientate angle between first dynode and earth’s magnetic field
- More board in next weeks after first prototype tests

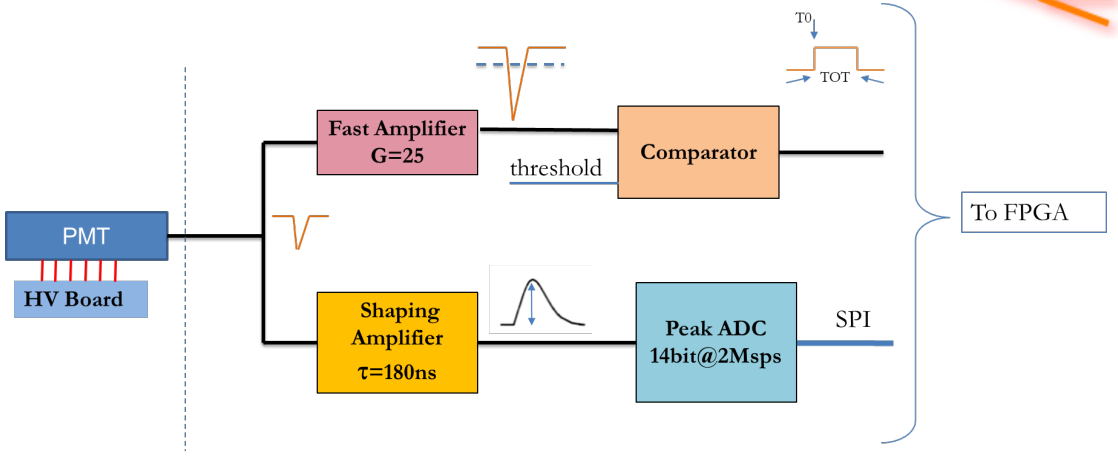


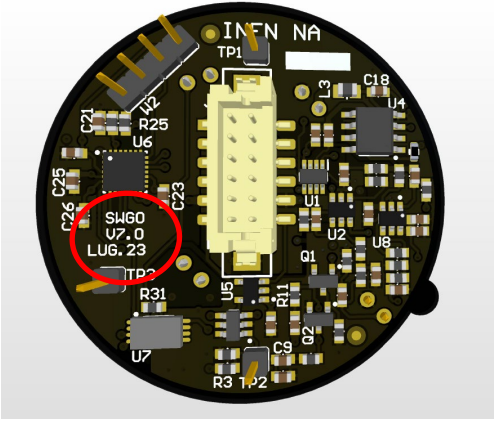


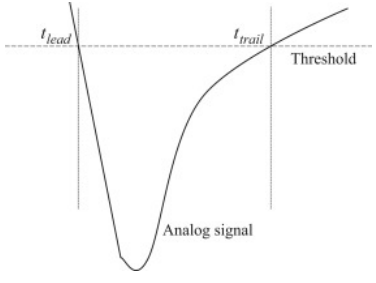


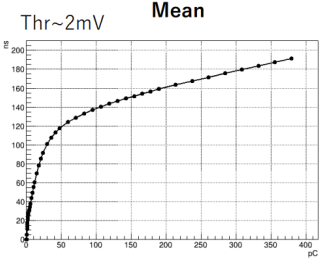
FE Board

FE board includes the analog FE and the MCU to control the HV board.
For every hit we get charge, Time of Arrival and Time over Threshold
Charge dynamic range is 300 pe, possible improvements in next revisions
Time resolution 200 ps @ 1 pe.
ToT can be used also to extract charge and dynamic range here is almost unlimited, even if the trend is not linear.
MTTF is around 650 years at 15 °C
15 boards now in production.



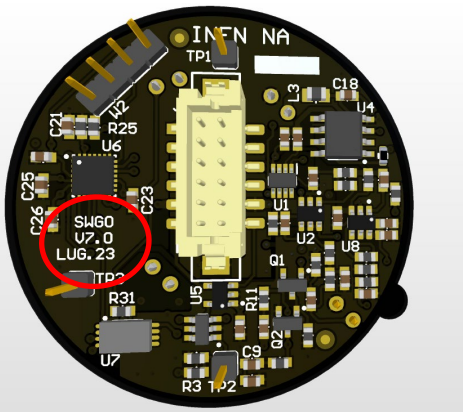


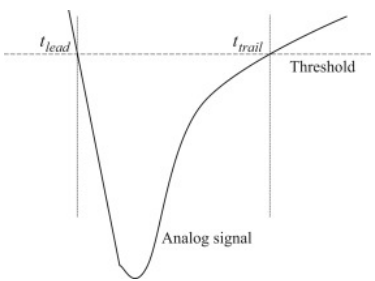


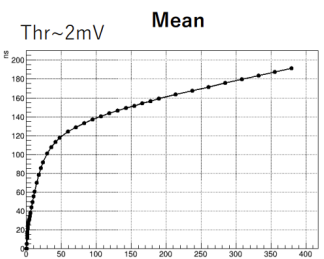


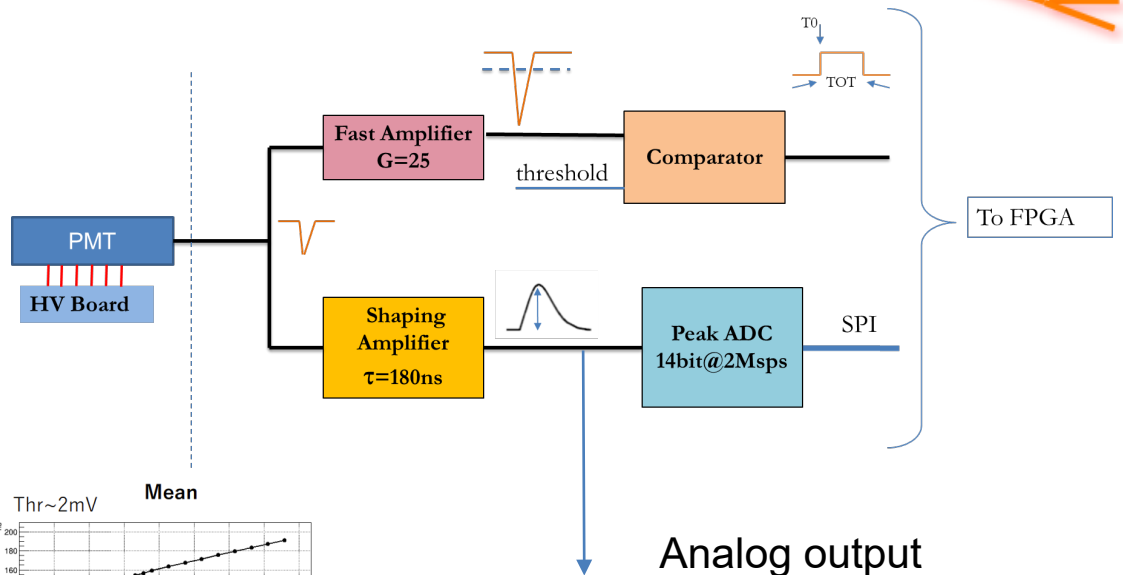
FE Board update

We are evaluating the possibility to add an analog output to the FE to collaborate with our colleagues in USA from Ice Cube. They can add to our idea their digitizer and we can work together in SWGO to have the multiPMT approved as the SWGO detector









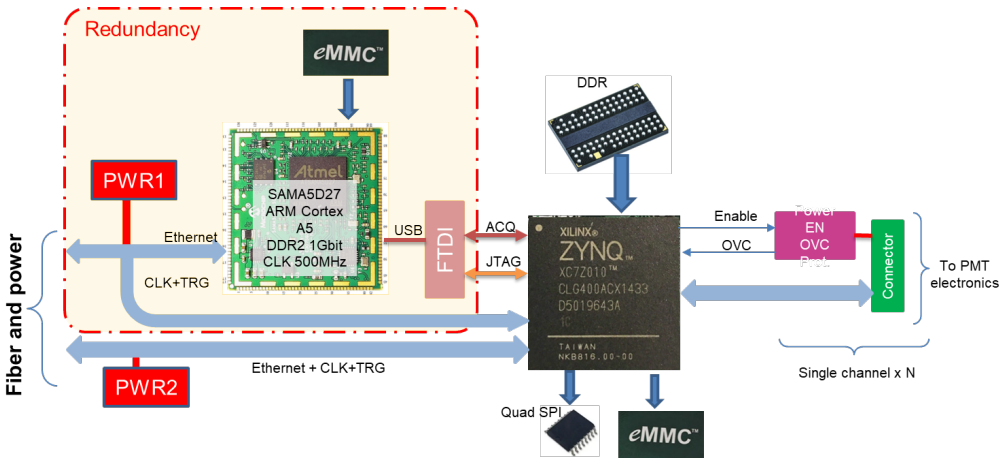
Photosensor and Electronics

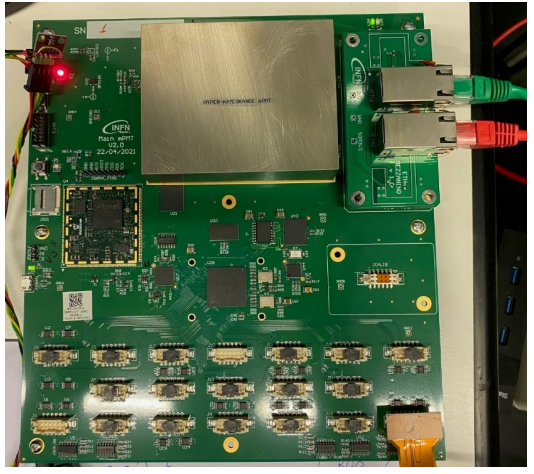
Placed order for 500 R14374 3'' Hamamatsu PMT
Need to develop automatic procedure for testing boards and PMTs

New master student (Matteo) working on python script to acqire and analyze PMTs, possibility to integrate the work in a final automatic testbench for 3''.

Huge experience on mass production testing from Auger in Naples

Main Board

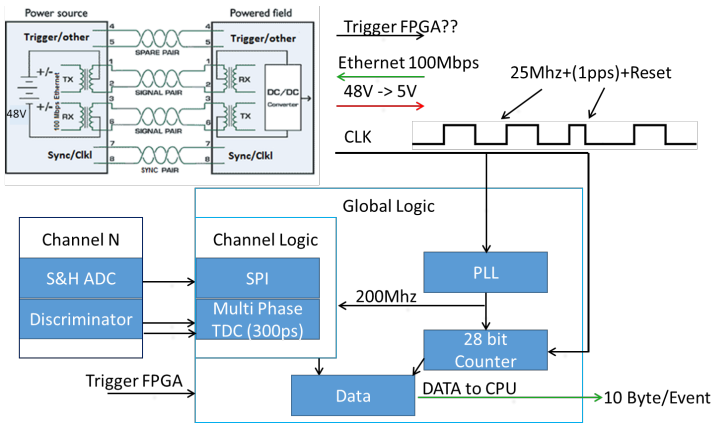




Main Board development started after Prague. Some news today, more by the end of the year

Will include the possibility to have the Flash ADC on board for waveform acquisition using a plug in board

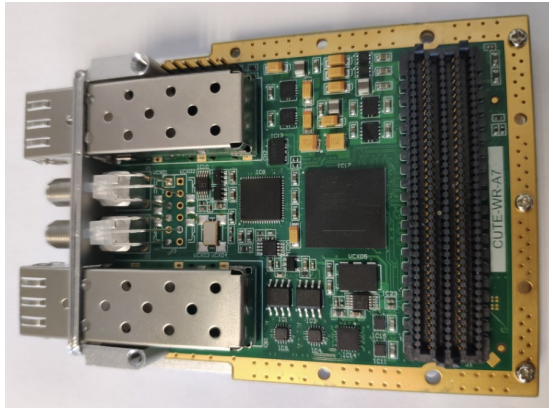
Main Board



We can decide to add the necessary hardware, so DAC (like AD5662BRMZ-1) and clock generator CDCM61004RHBT, to the existing board or we can decide to use a standalone mezzanine to speed up the development, like the one developed for LHAASO.

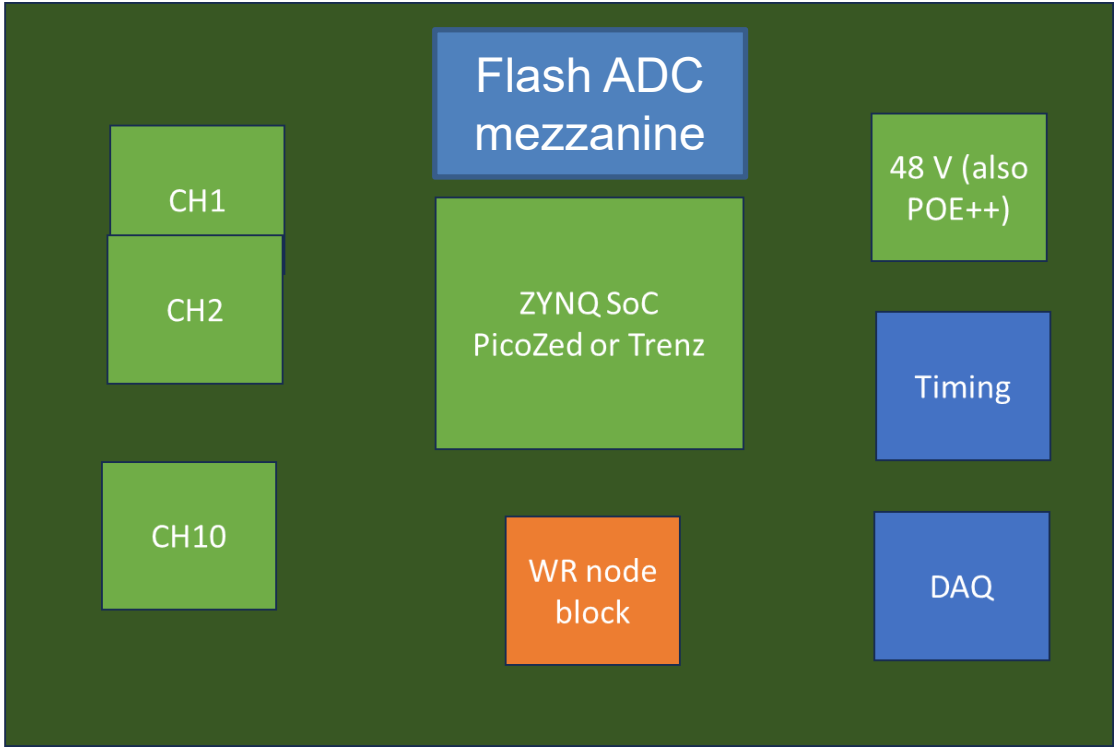
Currently the board expects a clock and a PPS, the clock can be the current 25 MHz or any other clock.
WR logic generates an output reference clock and a PPS, so the logic behind our board is already compatible with WR.

We just need to add the WR hardware to the board.



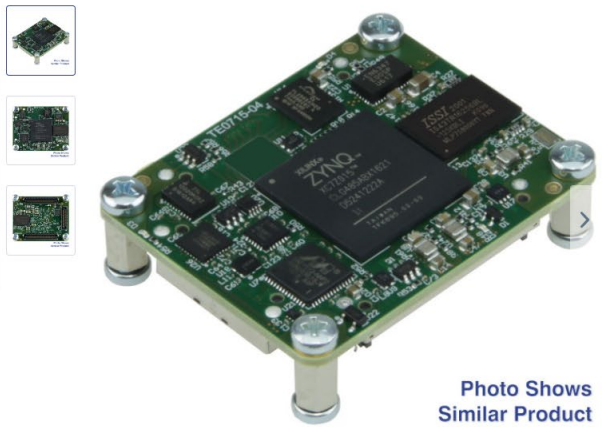
Main Board diagram

- Green: implemented and ready to be used
- Orange: schematic ready, will be on board just in case, but no need to be used
- Blu: still to be decided the physical layer and the protocol



MB SoM

SoC Module with AMD Zynq™ XC7Z015-1CLG485I, 1 GByte DDR3L, 4 x 5 cm



€329.00 (391.51 € gross) *

Prices plus VAT plus shipping costs

Ready to ship today,
Delivery time appr. 1-3 workdays

1 | Add to shopping cart

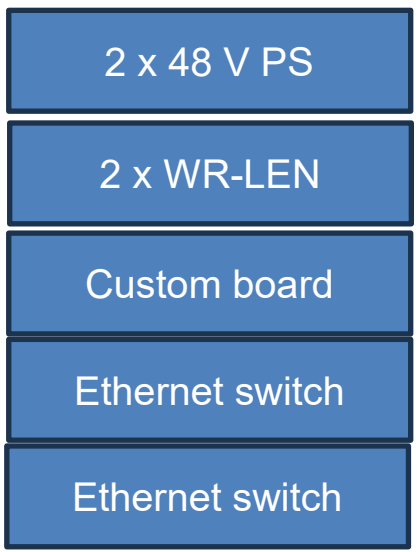
Remember

Order number: TE0715-05-51I33-A
In Stock: 40
Article status: Full production

Quantity	Unit price
To 9	€329.00 (391.51 € gross) *
From 10	€296.10 (352.36 € gross) *
From 25	€279.65 (332.78 € gross) *
From 50	€263.20 (313.21 € gross) *
From 100	€246.75 (293.63 € gross) *
From 250	€230.30 (274.06 € gross) *
From 500	€213.85 (254.48 € gross) *
From 1000	€197.40 (234.91 € gross) *

Placing order for this SoM, expected in few weeks to start development of firmware and software
New master student (Fabio)

Possible Field node



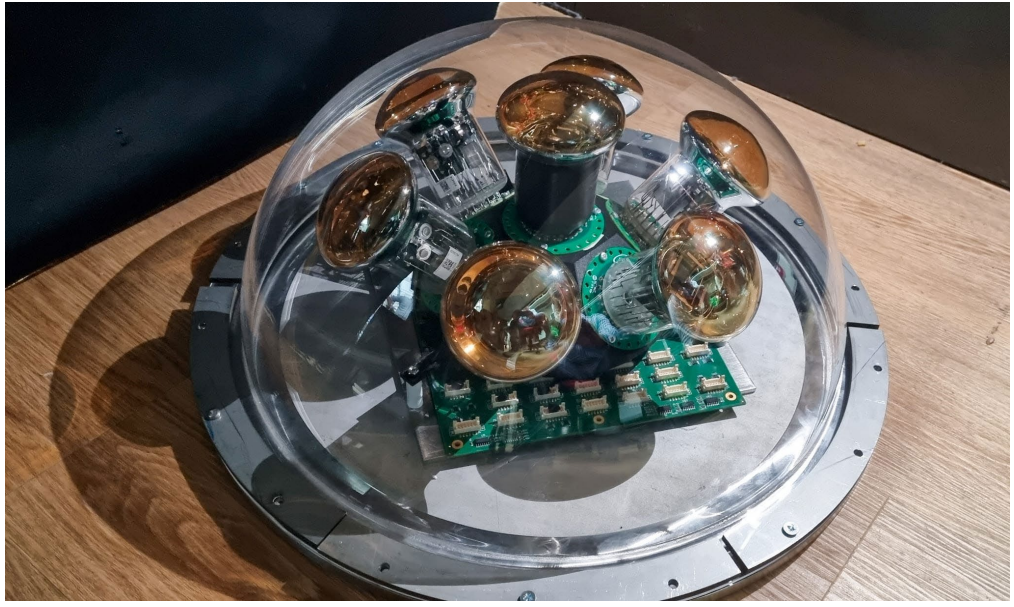
Custom board to convert WR-LEN to custom timing and to be a patch panel for connection and similar

Industrial electronics with rating -20 to 80 °C so no heating and cooling is needed, just maybe small fans

Cabling and connectors

We plan to have a junction box really next to the tank (or out of water for ponds and lake) where we connect the underwater cabling system to the ground (or buried) cabling system
Direct connection then to the Field node.
Cable underground can really reduce the risk of lightning.
Cost also reduced since no special cables are required, we can use plastic tube hoses to host normal external cables.
Ideas are welcome to improve this scheme!

The first SWGO prototypes



BACKUP

Development Plan

towards large scale production

- *Next steps are*
  - → Full test and characterization of first HV and FE prototypes (in lab and in WCD tanks available within the collaboration)
  - → The small batch of gen2-prototypes to be operated on proposed sites
  - → Main Board development for the choosen timing system and power system
- *Large scale production plan/sketch*
  - → Small batches production to validate changes and iterate the design. Testing of all the boards before integration by the production company with automatic tesbenches developed by us