General considerations

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For the charged vetoes working group

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PADME Collaboration meeting

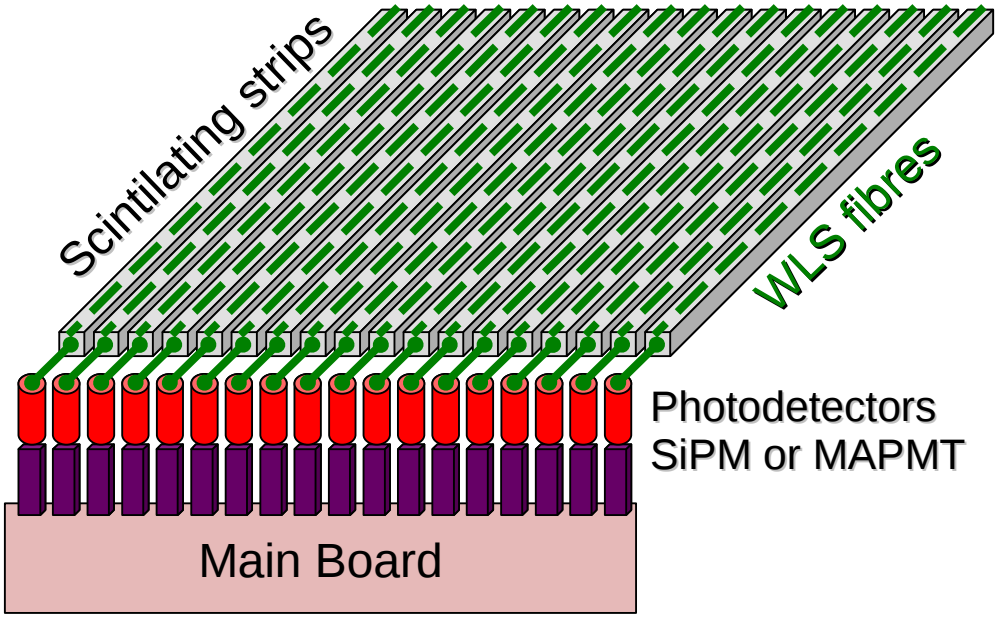
LNF-INFN

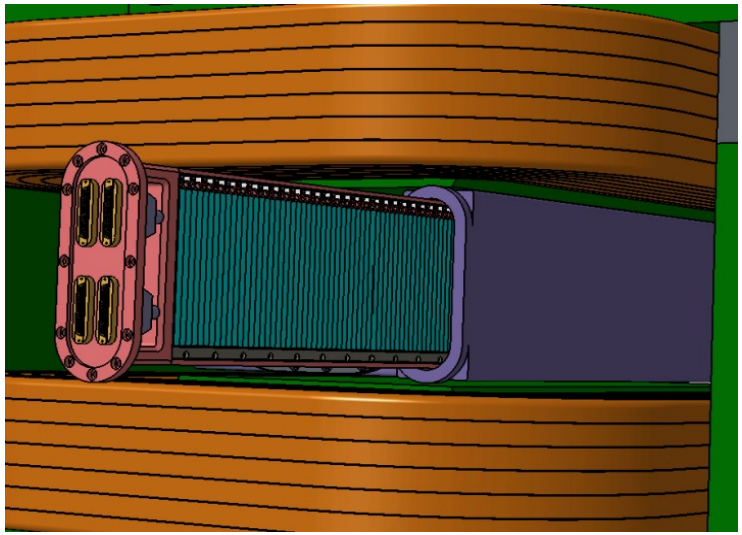
Outline

- Scintillator choice
  - FNAL/NICADD
  - UNIPLAST/Vladimir
- Scintillator arrangement
- High energy positron veto
- Conclusions

Basic design

- Plastic scintillator
- Light read out by SiPM?
  - WLS vs direct coupling
- O(1000) photons
- ~ 0.5 – 1cm thickness
- ~ 1 cm wide
- With time resolution better than **500 ps** …





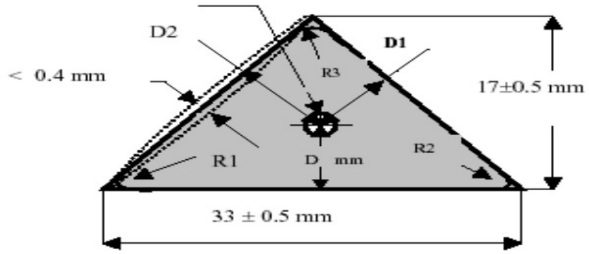
FNAL NICADD

- Scintillator co-extruded with a hole and TiO_2 coating
- Different possibilities
  - 1 cm x 1 cm - 1 hole
  - 1 cm x 4 cm - 1 hole
  - 1 cm x 4.1 cm - 1 groove
  - 1 cm x 4.5 cm - 2 holes
  - 1 cm x 5 cm - 1 hole
  - 1 cm x 5 cm - 2 holes

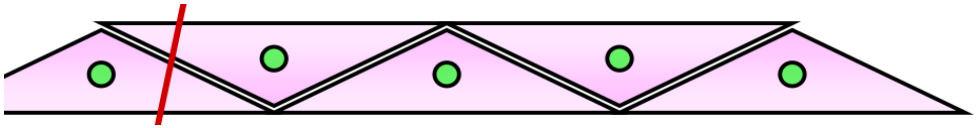
New production necessary

Available now

- Minerva shape



Minerva specs



R1, R2 = < 1 mm

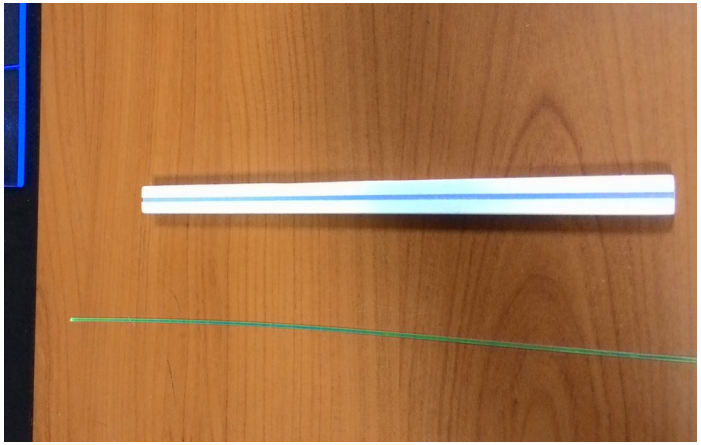
R3 = <1.2 mm

D,D1,D2 = 7 ± 0.2 mm

From talk of Victor Rykalin

Possibility to reconstruct the position using energy sharing

UNIPLAST, Vladimir



- Production of practically anything that has one of the sides 1 cm is possible
- Price: ~2 euro per piece, almost no matter the dimension
- PADME needs ~ 100 **(x2)** + 100 **(x2)** + 50 **(x2)** scintillator bars
- Price is not an issue!

Different solutions

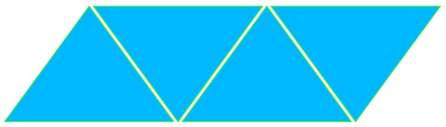
- NICADD, FNAL, USA
  - New production for scintillator with cross section 1 x 1 cm2 necessary
  - Alternative: Minerva shape - triangles
    - Used by CHANTI in NA62

- UNIPLAST – Vladimir, Russia
    - Cut from larger plates
    - 0.7 mm, 10 mm, etc...
    - Production is available NOW!
    - Precision on dimensions, uniformity, etc...

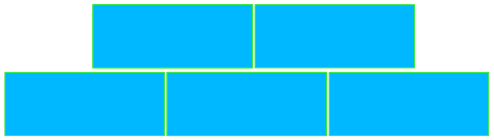
Possible solutions

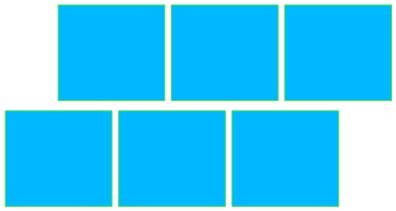
- The thickness of the co-extruded (or chemically etched) coating is ~250 um
  - Dead region between the bars ~0.5 mm – 5% of the total scintillator width
  - Difficult to be translated into inefficiency due to different angles
    - And the ineff. will depend on beam divergency, etc
- Possible “efficient” designs

Minerva



2 cm wide, staggered



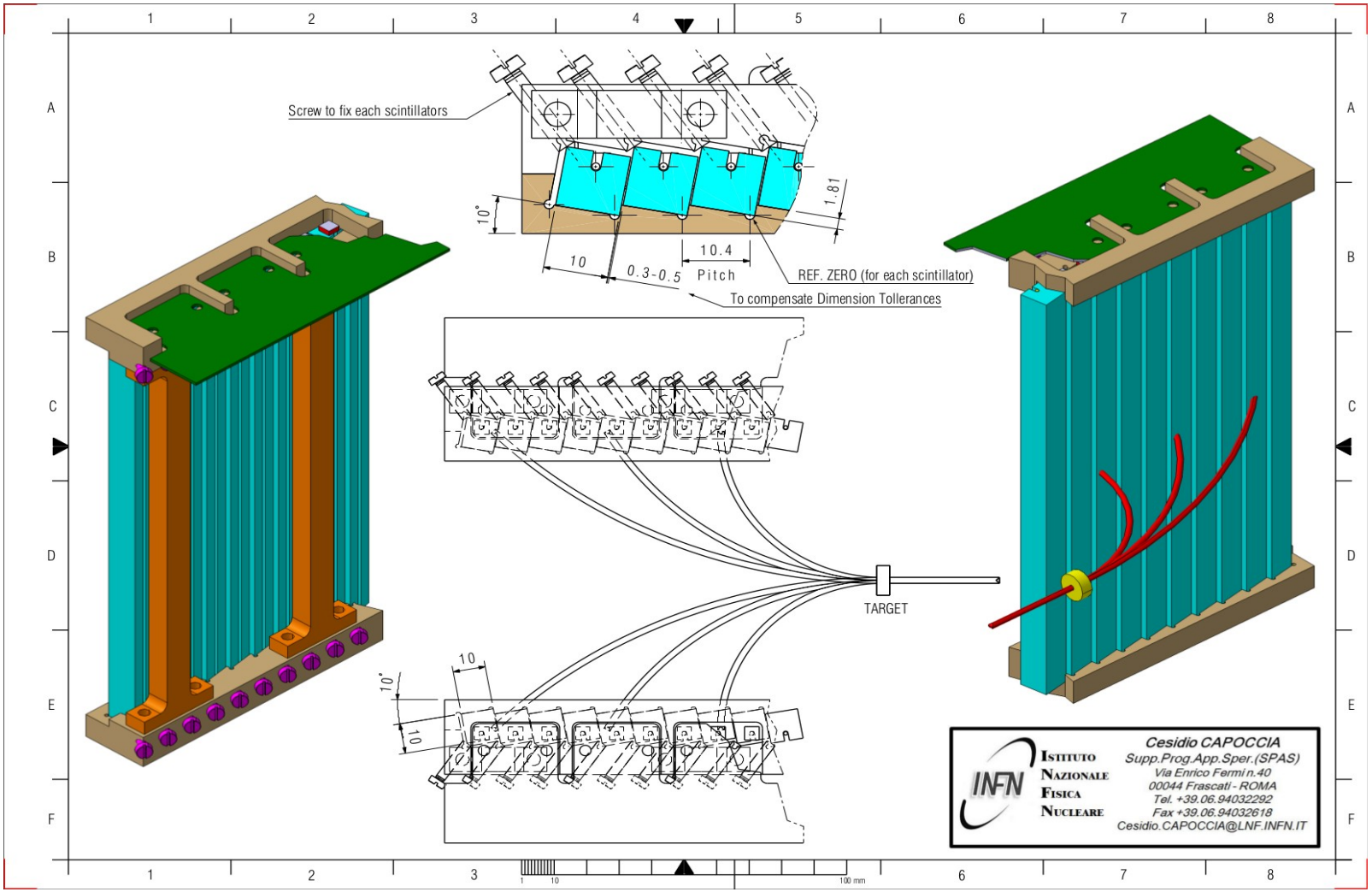


1 cm wide, staggered

  - Single layer vs double layer
    - double the number of channels?
    - Rely of energy sharing for position resolution – complicates the RO

Possible solutions

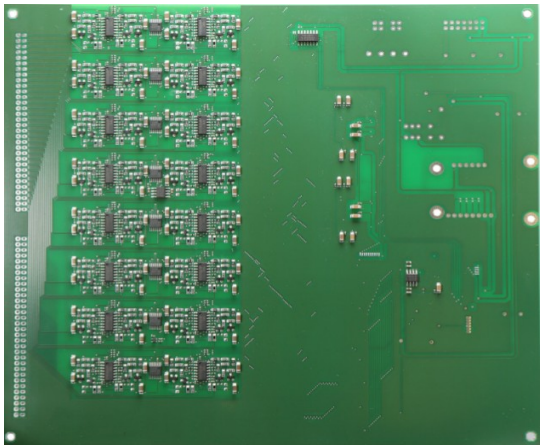
- Rotate each single bar at > 100 mrad

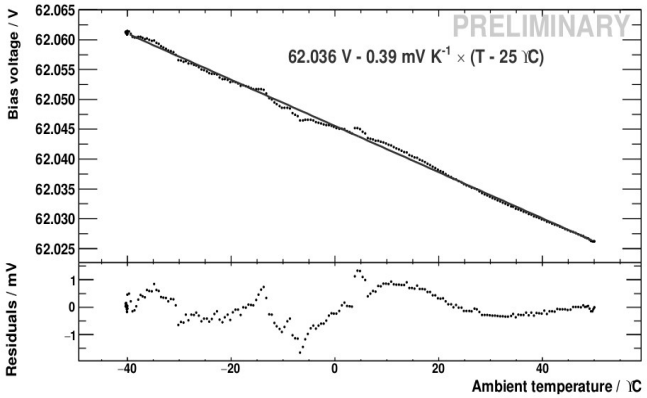


Readout: PS & FE

- SiPM PCB?

- HV possibilities:
  - Fabio suggestion for custom made HV circuit on the SiPM PCB
  - SiPM PS module, developed at RWTH Aachen University





64 channels
~ 10€ /channel

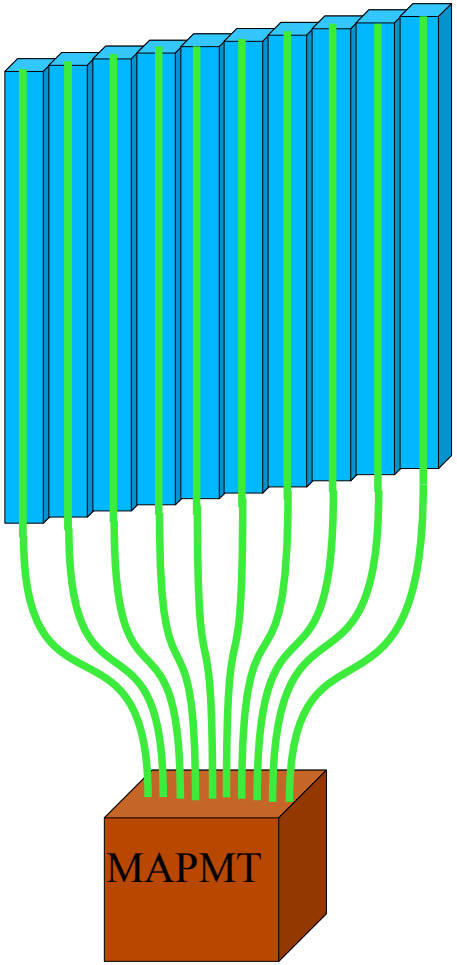
Johannes Schumacher et al, proceedings of ICRC2015

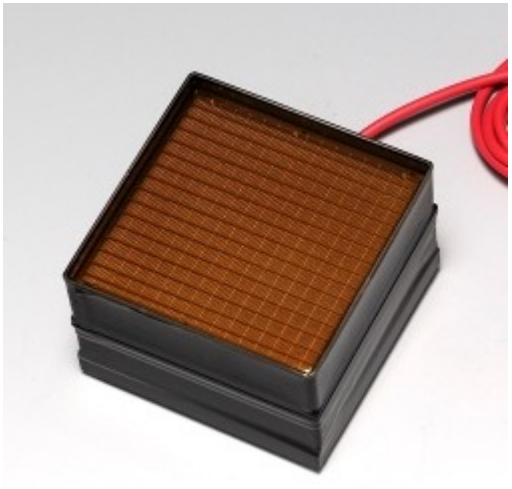
- Good temperature stability, only linear regulators on board, 1 mV voltage precision
- Ethernet communication
- Already in use (2 at south pole, 1 in Aachen)
- Group contacted to understand if new production is possible...
- However both solutions need an extra transimpedance preamplifier

At present it seems difficult to avoid the construction of a custom made circuit...

High energy positron veto

- Bars + fibers + MAPMT: Hamamatsu H9500, 256, from Paolo





P1 → P16

78	78	86	79	83	92	92	92	93	90	91	93	88	87	77	84
79	77	77	74	81	87	91	91	87	85	80	80	69	69	74	83
72	43	74	77	86	91	96	99	100	97	90	76	54	59	80	85
63	61	66	67	71	77	80	89	94	90	84	74	51	51	79	87
52	52	57	58	63	69	74	80	83	84	84	77	63	59	78	88
50	48	52	53	61	66	67	76	78	78	79	83	71	68	79	89
46	44	48	49	57	57	61	69	74	71	74	84	73	73	82	90
43	41	44	46	54	55	59	66	71	72	75	84	78	72	79	93
42	38	43	45	51	54	57	62	69	70	76	86	77	71	77	92
39	39	43	44	50	53	55	63	71	71	73	85	71	67	77	94
39	39	42	44	51	56	55	65	73	71	75	83	68	58	77	94
39	39	42	42	49	57	64	70	78	79	79	79	64	53	75	91
38	39	44	44	50	56	64	71	82	81	81	79	64	55	74	84
38	42	48	52	58	63	72	79	83	80	79	80	71	69	72	79
35	38	48	51	54	56	61	62	71	69	68	71	63	59	55	66
29	40	53	52	55	57	58	55	65	60	59	65	61	61	52	48

P16 ↓ P256

TOP VIEW

- Far from the magnetic field
- Enough? room for support/mechanics, etc...
- Many things to be checked:
  - Photocathode response, ph.e. yield
  - Time resolution (RO with FADC)
- Tolerates even thicker scintillator

Conclusions

- Production at UNIPLAST started even before we ordered anything …
  - 400 pcs available for transportation, waiting for the contract to be signed.
- Things to be tested
  - Efficiency
  - Resolution (mainly time)
  - Photoelectric yield (H9500)
  - Uniformity
  - Scintillator/WLS assembly quality
- Assemble a prototype ASAP when the scintillator arrives
  - And possibly use it continously at BTF