Status report about next "INFN" prototype

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on behalf of the IDEA Dual-Readout Calorimeter Collaboration
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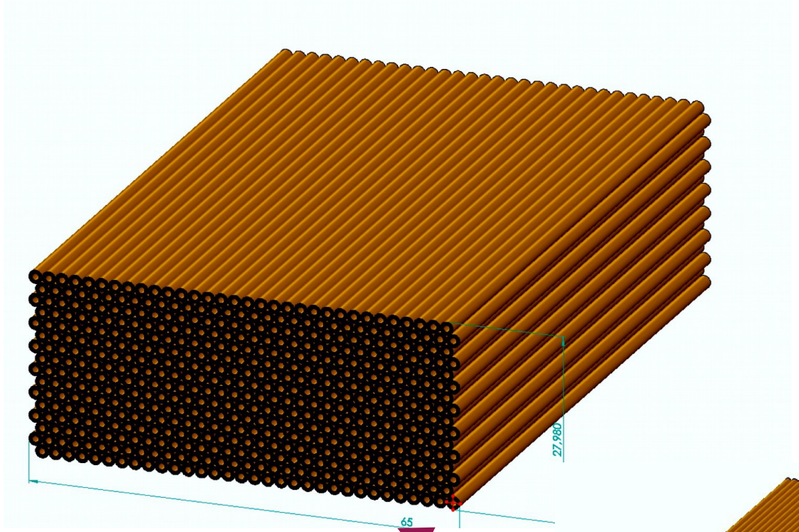
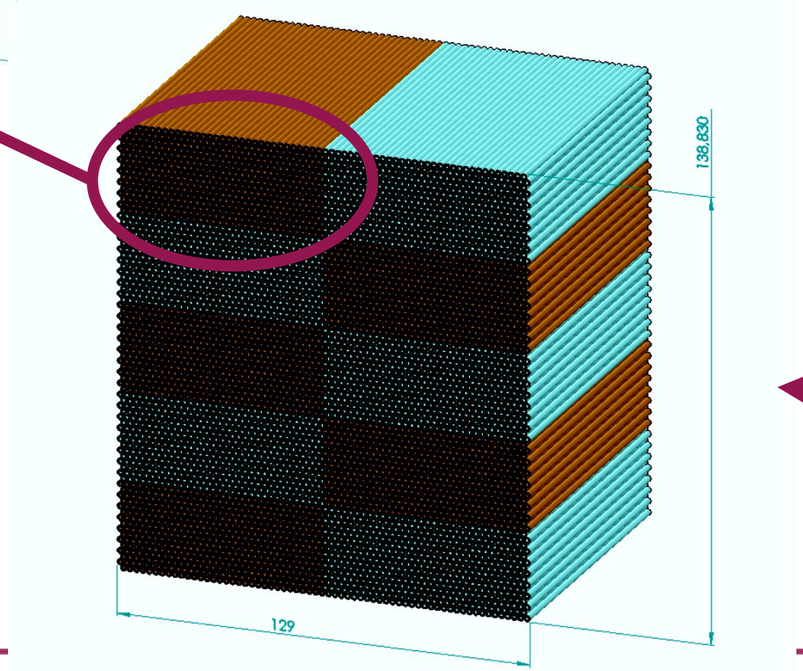
- Capillary procurement status
- Calculation on calorimeter parameters
- Fibers update

HiDRa2 – Hadronic Full containment DR Calo

1 Mini-Module (MM):
32 x 16 channel (512 ch)

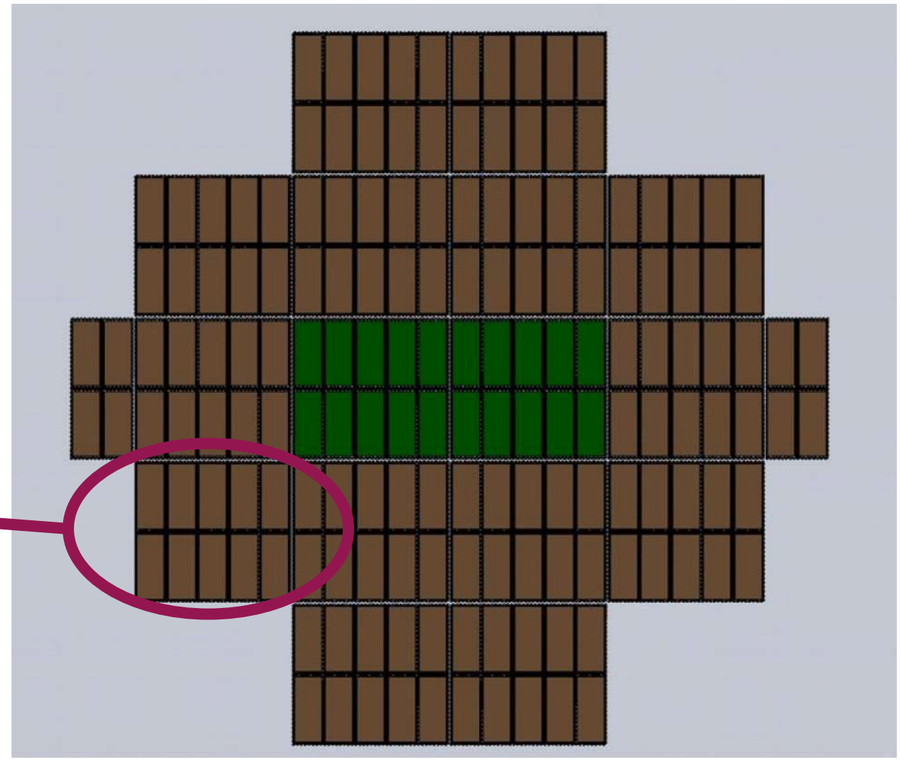


1 Module:
2 x 5 MMs
→ 10 FEE boards
(8-channel grouping)
~ 13 x13 x 200 cm^3



16 modules, ~ 65 x 65 x 200 cm^3

- 2 central modules with SiPMs
  → ~ 10 k SiPMs, ~ 20 FEE boards
- all others with PMTs
  → ~ 150 PMTs

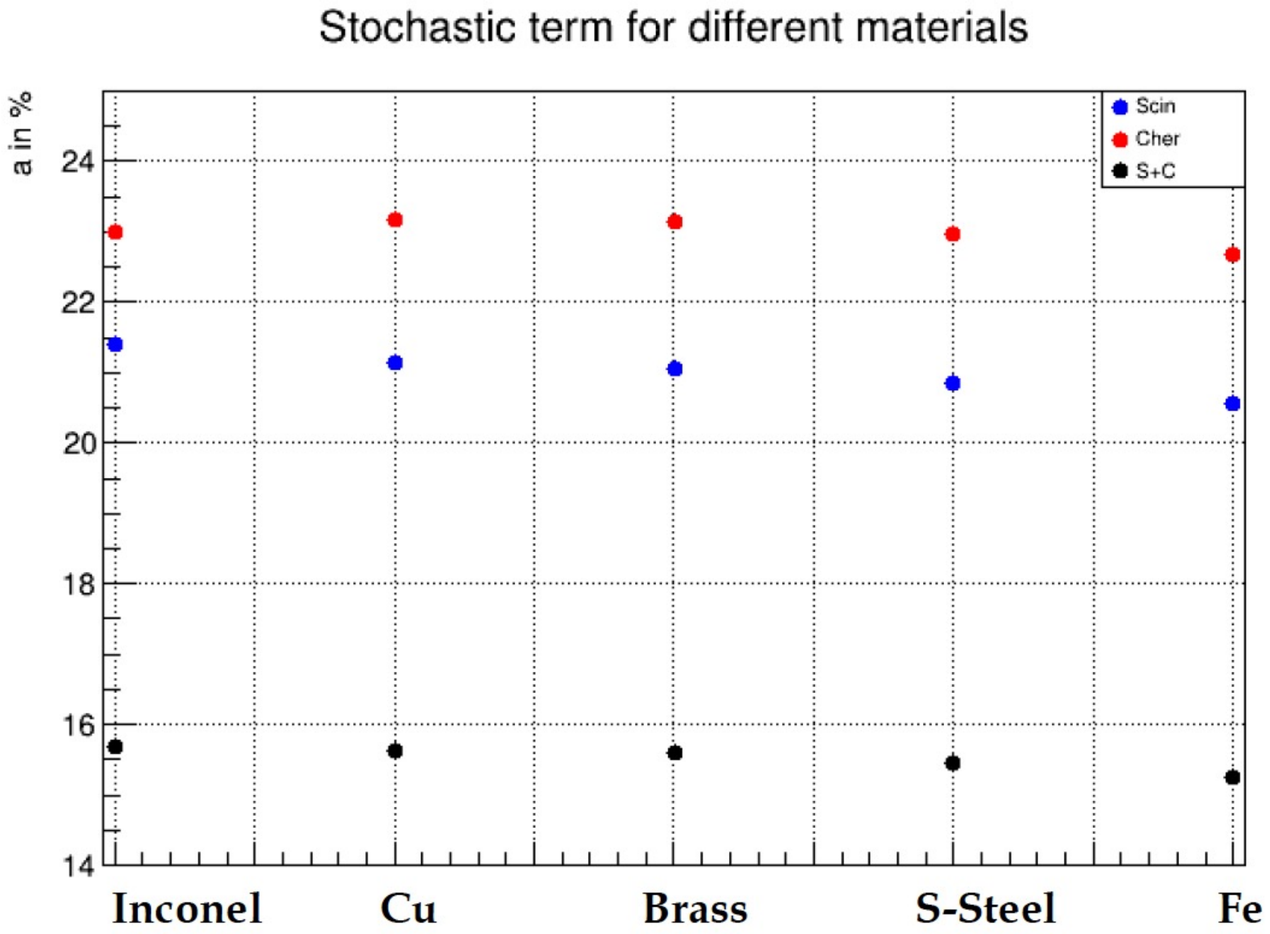


What do we have now?

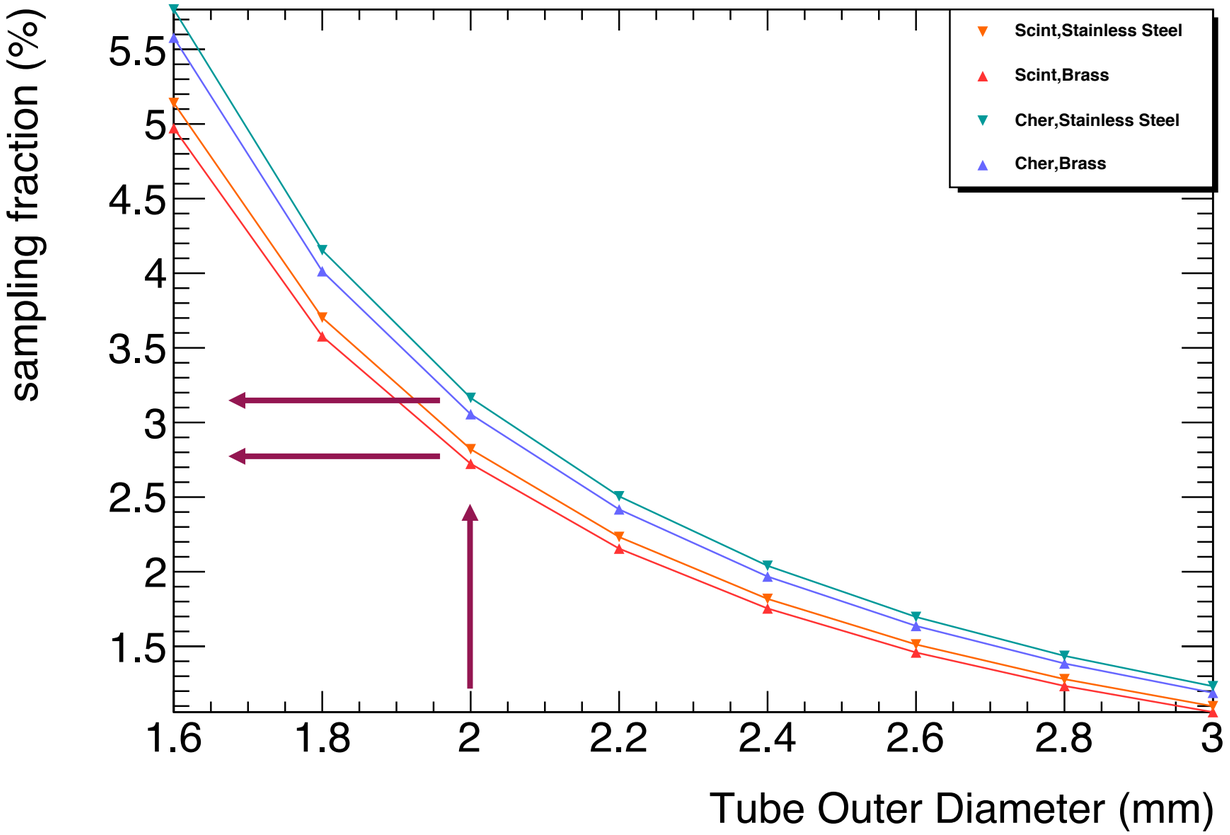
- Some studies has been done using "EM-size prototype" simulation for different material
  - only em resolution
- Some analytical calculation
  - sampling fraction
  - calorimeter parameters
- Feasibility studies from mechanical and electronic point of view
  - availability of capillary and fibres
  - SiPM boards interfacing

EM performance (first study)

Material	Z	Density g/cm3	Radiation Length cm	Moliere Radius cm
Brass	Cu:Zn::70:30 29, 30	8.53	1.492	1.64
Cu	29	8.96	1.436	1.568
Inconel718	Fe:Cr:Ni::33:17:50 26, 24, 28	8.2	1.634	1.66
S-Steel	Fe:Cr:Ni::74:18:8 26, 24, 28	8	1.740	1.689
Fe	26	7.874	1.757	1.719
Pb	82	11.34	0.5612	1.602
W	74	19.25	0.3504	0.9327
PMMA (C fiber)	H:C:O 1, 6, 8	1.19	34.07	8.422
Polystyrene (S fiber)	H:C 1, 6	1.06	41.31	9.409

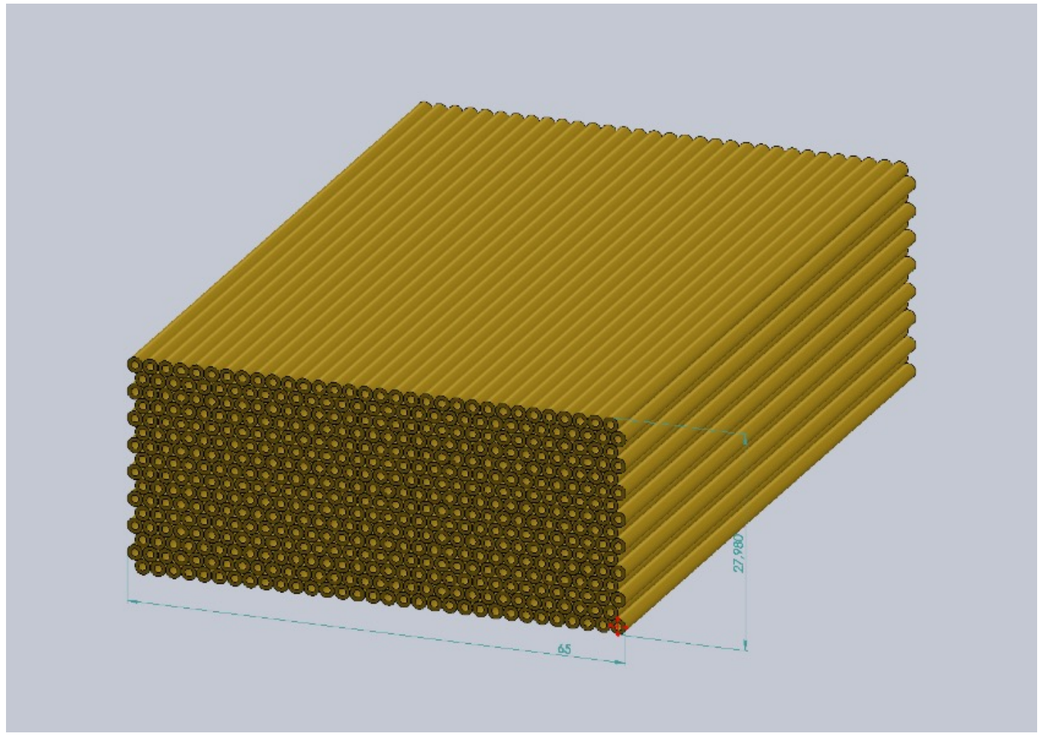


Capillary dimensions



Sampling fraction calculated for MIP (analytical calculation)

Analytical calculation of calo parameters



- Material: Stainless-steel 304 (Ni:Fe:Cr-12:68:20%)
- parameters: OD-ID capillary, Fibre diameter
- Output
  - f_{samp} (C and S)
  - contribution to resolution
  - Moliere radius
  - radiation length
  - Interaction length

$$\frac{\sigma}{E} = 2.7\% \frac{\sqrt{d/f_{samp}}}{\sqrt{E}}$$

Tube diam	tube hole diam	fiber diam	air frac	fiber frac	SS frac	fsamp_C	fsamp_S	e_resol samp	rho (mm)	X0(mm)	lambda(mm)	n_lambda in 2.5 m	n_lambda in 2m
2.00	1.00	0.90	16.83	8.84	65.48	2.59	2.31	0.43	25.03	26.80	241,85	10,3	8,3
2.00	1.10	1.00	17.27	10.91	60.90	3.39	3.02	0.39	26.48	28.70	255,17	9,8	7,8
2.00	1.20	1.00	22.29	10.91	55.88	3.67	3.27	0.38	28.69	31.23	276,2	9,1	7,2

Decision to be taken (asap*)

- capillary tube dimensions and material
  - baseline at present: stainless steel, 2mm OD, 1.1 mm ID, **2.5 m** long
  - is this ok? cross-check with
    - EM Energy resolution
    - HAD Energy resolution
    - impinging position effect on resolution
    - position resolution
  - Extract requirement on mechanics

* see later

Decision to be taken (asap*)

- grouping and calibration
  - 8-channel grouping to reduce number of RO channel
  - reduction of cell size + channel summing up → no access to dpp used for equalization
  - how to calibrate?
    - can we use muons for equalization + electrons for calbrations?

* see later

Timescale

- Assembly tooling and procedure proved on 20cm long maquette
- New ideas for SIPM integration ongoing
- We are ready to build a mini-module (16x32 tubes) – 20 cm long
- We are starting scaling up the tools (~ 1 month)
- Need to acquire capillary for 2 mini-modules (~ 1 month)
  - we still can change for HiDRa, but it would be optimal to use these test mini-module as the first two of the production.