WP2 : Field Cages

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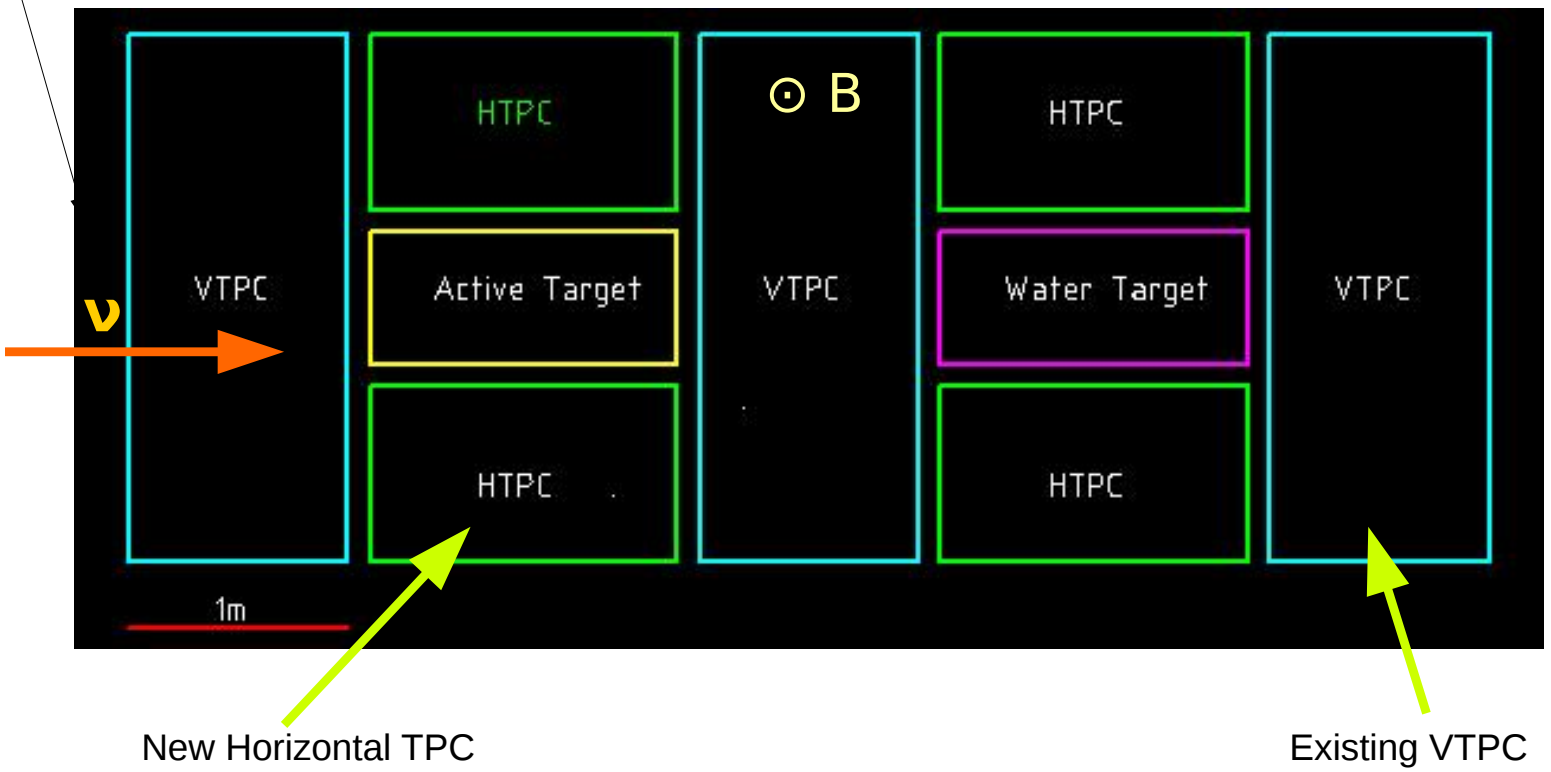
Outlook:

- Horizontal TPCs
- Technical Solutions
  - Light Field Cages (Aleph,ILC,HARP… ?)
  - Evaluation of the costs (just started)
- Time scale & manpower
  - Design (just started)
  - Prototyping & Test beams (Italy+ CERN(?))
  - Construction (Italy)
  - Assembling & Test (CERN)
  - Shipping in Japan
- Resources & funding requests

* Material of this talk ➔ Emilio

The baseline design for the upgraded ND280

All this inside the EM calorimeter and the UA1 magnet



4 new Horizontal TPCs

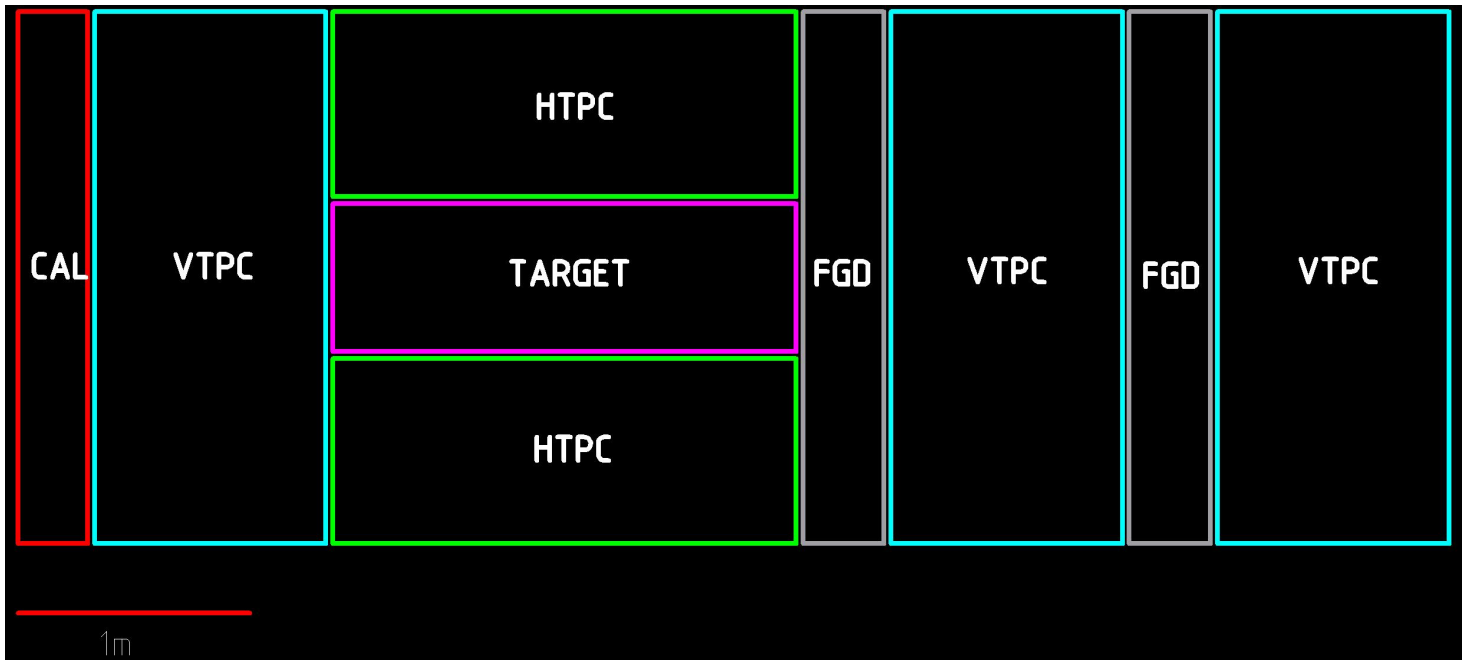
* Design still under optimization

HTPC

Parameter	Value	Comment
Overall dimensions	2 (x) x 0.8 (y) x 1.3 (z) m**3	4 identical TPC
Volume	2.1 m**3	Each
Drift Length	90 cm	Cathode in the middle
Pad area	~1 cm**2	
Sensitive area tot	7.3 m**2	Tot 4 TPC
N MM	~ 66	Tot 4 TPC with MM ~35x35 cm**2 each
N channels	7.3 10**4	Tot 4 TPC

* From Marco Zito

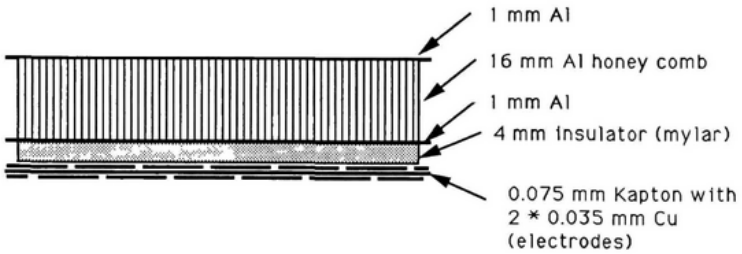
A possible alternate configuration



Provide ~4t of instrumented target with excellent acceptance both for forward/backward and high angle tracks.
Minimize reshuffling of detectors. Concentrate on upstream part. Keep most of the current ND280 tracker untouched.

Aleph / ILC scheme:

Strip layers glued / embedded in the mechanical structure (typically: composite materials)



Insulator from a thin Mylar foil winded around many times using a higly resistive glue

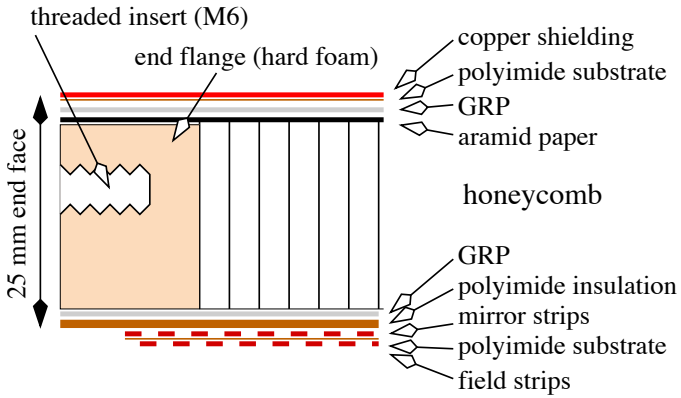
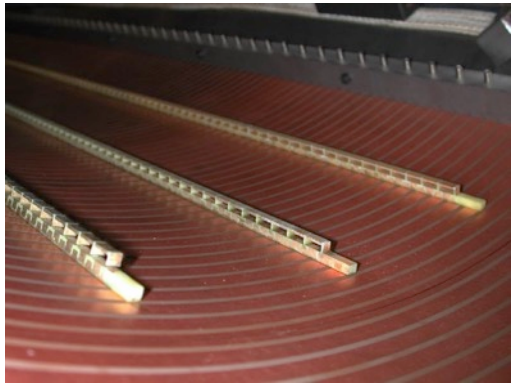
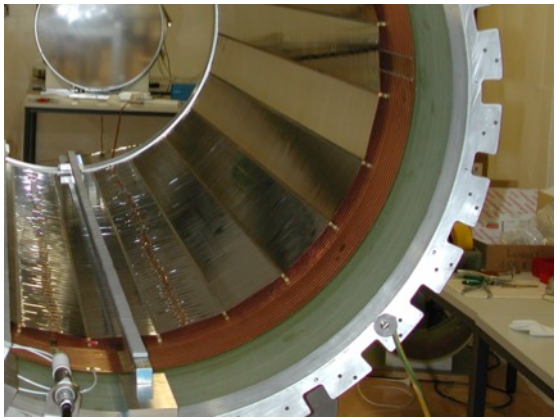


Figure 7: *Cross section of the Large Prototype field cage wall.*

HARP scheme:

One strip layer is glued to the mechanical structure, additional layers as mylar strips stretched on light supports





Field cage: ALEPH example

Dimensions
- cylinder 4.7 x 1.8 m

Drift length
- 2x2.2 m

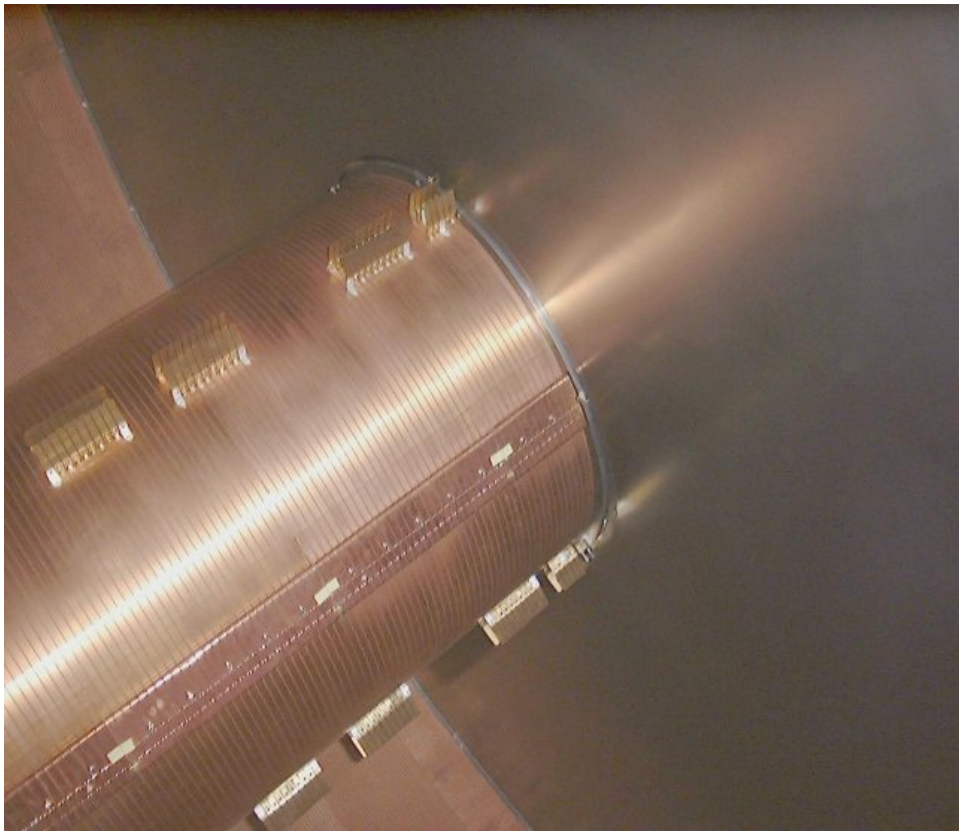
Electric field
- 110 V/cm

E-field tolerance
- $\Delta V < 6V$

Electrodes
- copper strips (35 μm & 19 μm thickness, 10.1 mm pitch, 1.5 mm gap) on Kapton

Insulator
- wound Mylar foil (75μm)

Resistor chains
- 2.004 MΩ (±0.2%)



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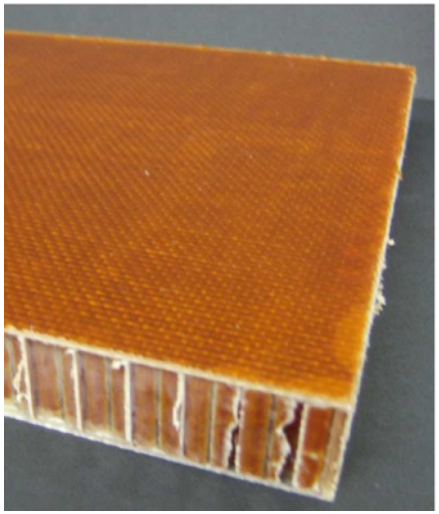
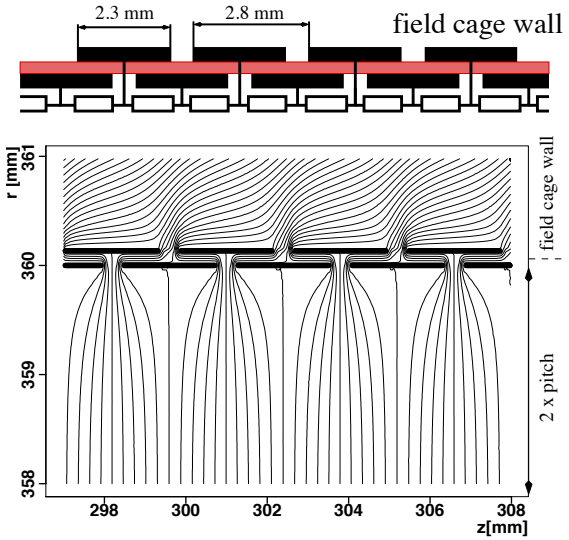
the case of the ILC TPC field cage

- It is claimed that the material budget for the ILC TPC is 1% X_0. This would be OK for us too.
- The mechanical construction is however less obvious:
  - The ILC field-cage is made out of honeycomb panels covered by reinforced plastic for rigidity and gas tightness
  - Inside the drift volume, kapton sheets with metallized strips provide both insulation and field shaping
  - 100μm precision in planarity is mandatory to limit the field distortions within 50μm.
  - the overpressure at design conditions is 10 mbar.

field-cage materials





- 23.5 mm thick
- packed in between 2 layers of GRP (glass-fiber reinforced plastic)
- in planar configuration already at 5 mbar overpressure the non-planarity reaches the limit
- the intrinsic rigidity of the cylindrical configuration takes care of this limitation, but it might be a problem for us
- careful studies are needed – or alternative configuration with more rigid (but heavier) materials
- non-uniform field region OK (2x strip pitch ~ 5mm)

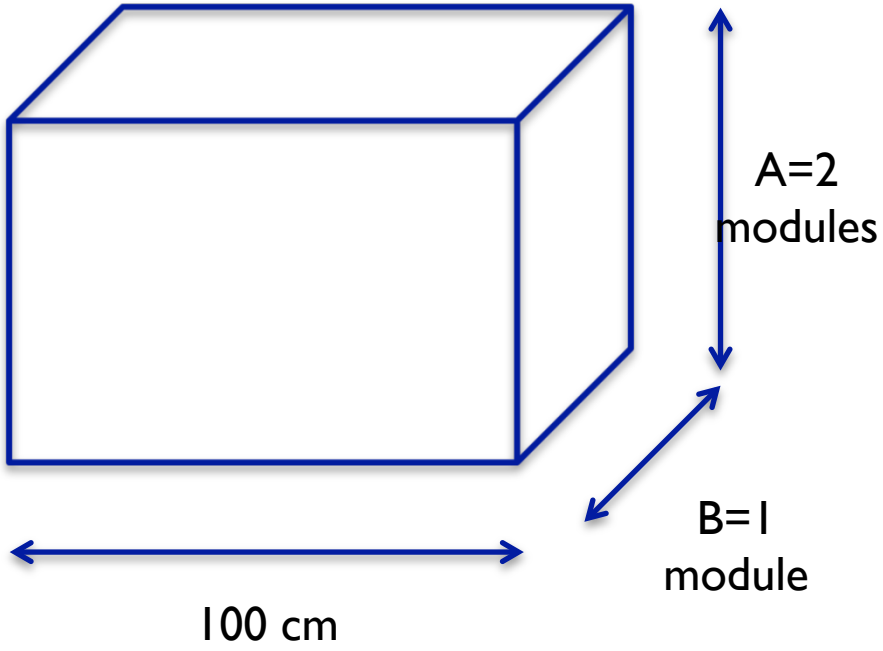
SO ...

- ILC TPC is assumed to operate at 10 mbar overpressure (notice: higher than our present TPCs – might be OK but ... just to know)
- we must seek a careful balance between contrasting requirements: light construction, rigidity, gas tightness ...
- ... knowing that a "squared" construction is more difficult than cylindrical when it comes to mechanical precision and deformation under overpressure
- reducing the number of boxes to the minimum (... two? one?) would greatly reduce the number of potential pitfalls with joints, tolerances, dead volumes, alignment, energy calibration ... and associated systematics

Goals:

- Find the best compromise in term of
  - Acceptance
  - Uniform field region
  - HV insulation
  - Amount and choice of material (including composites)
  - Rigidity
  - Easy integration, …
  - ?
- Technical design needs discussion and information exchange for
  - Cycle different configurations through simulation
  - Integration of readout modules
  - Position of gas inlets/outlets
  - Surrounding support structure
  - Accessibility in basket
  - Etc etc

First stage



- AxBx100cm
- Can host 2 MM chambers
- Realistic drift length
- Integration tests @ CERN (?)

TO BE DISCUSSED

- Prototype with final technical choices
- Smaller size but large enough to fit 2 readout modules
- To be used as verification of the construction technique
- And also useful for integration tests
- Timeline: 10/2018

Timeline (t.b.d.)

- 2017 baseline design & TDR
  - First sketch (and costs) of the prototype (09/2017)
    - => Starting point "A la Aleph"
  - Funding request for the prototype (09/2017)
    - If successful => money available from 01/2018
  - Simulations, first evaluations of the project costs
- 2018 prototype, test
  - Final decision about the set up
  - Funding request (2 year budget)
  - if OK → then start of construction
- 2019-2020 construction / assembly
- 2021 Shipping

* Under optimistic budget/timing assumptions

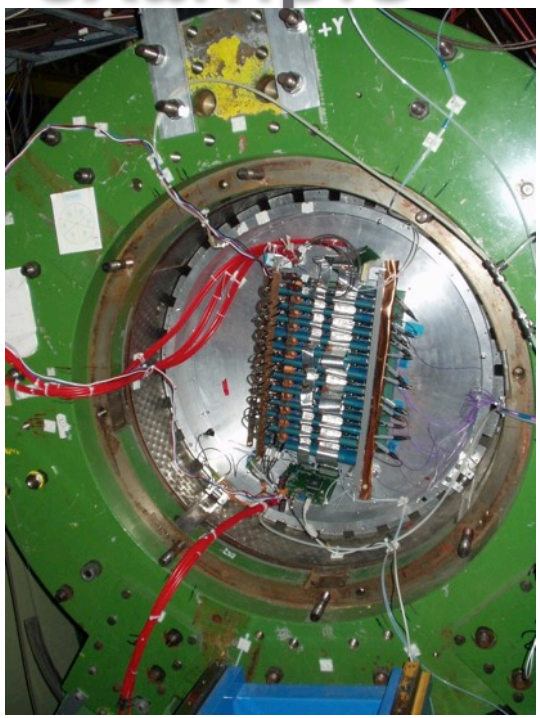
Organisation

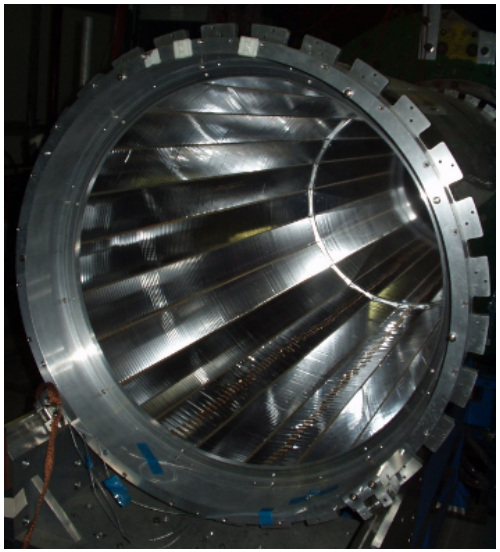
- Resources & funding requests
  - The Padova and Bari INFN workshops are confirmed to be available to do the construction
  - We have also man power resources (in the same labs) for the design (and simulations)
  - The project was presented at the meeting of the INFN committee the 12th of April => outcome positive, but we have not yet discussed the budget.
  - First request this summer
- Contact persons : E. Radicioni, G.M. Collazuol (deputy)

Backup

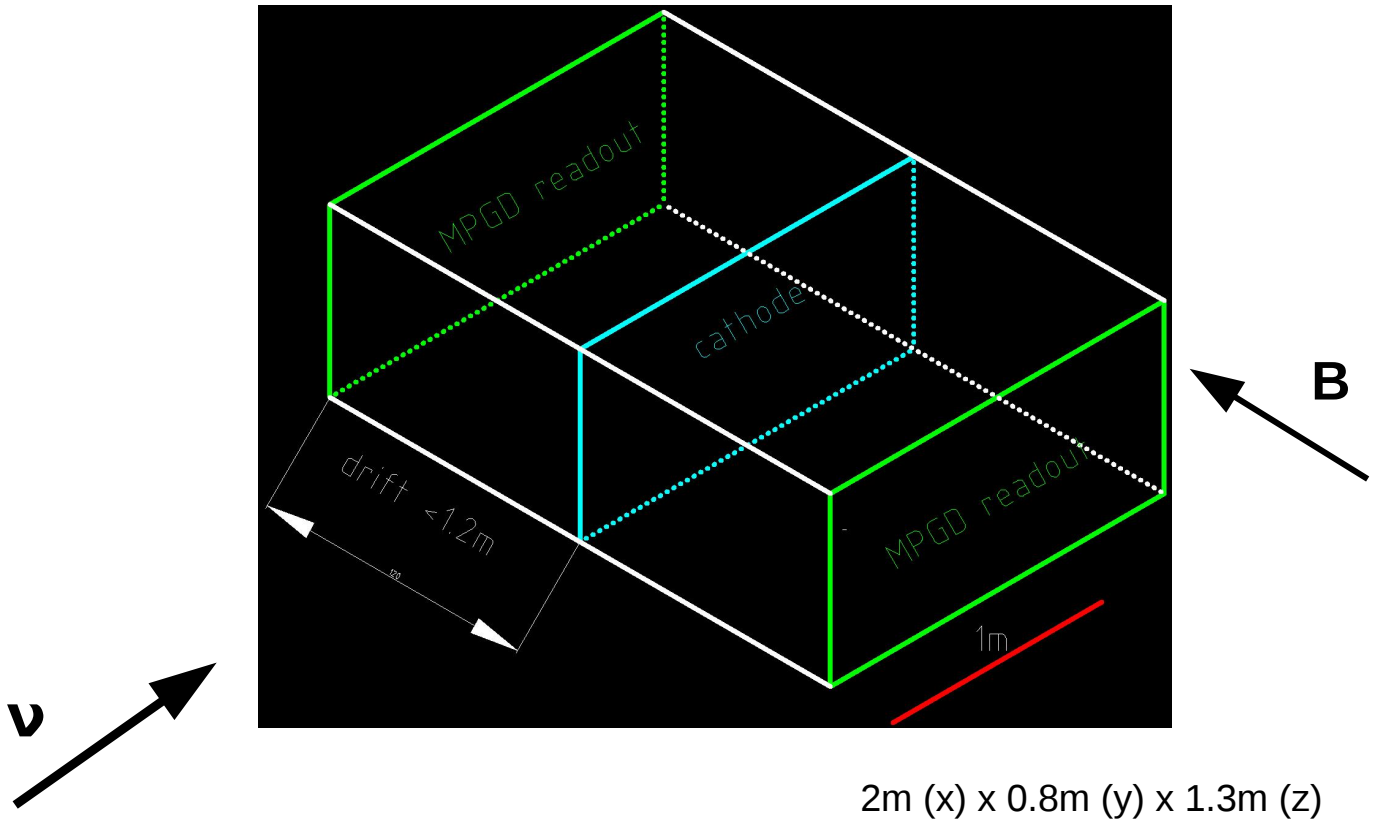
Field Cage: the Harp example

- Designed and constructed for the HARP experiment
- 2 sets (Mylar and Cu) strips inside a Stesalit cylinder
- ca. 150 cm long
- ca. 80 cm diameter (uniform field)
- extremely compact: < 2cm total thickness dead space





New Horizontal TPC layout



2m (x) x 0.8m (y) x 1.3m (z)

* Design till under optimization