Progress status of EMR Assembly @ Geneva

MICE meeting
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1. EMR production status
2. EMR simulations (FEA studies)
3. EMR @ RAL

University of Geneva: A.Blondel, J-S Graulich, V.Verguilov, Coralie Husi, F.Masciocchi, L.Nicola, R.Bloch, N.Geisig, P.Béné, F.Cadoux thanks to collaboration with Fermilab, Trieste and Ghislain Grégoire
Module M0 prototype under Testing

Module/Plane assembly+testing @ DPNC. See JSG’s talk for details/results….
First test module (2 crossed planes, 2 0.8mmØ fibers/bar, earlier configuration).

Wooden Black Box with scintillator underneath)
New modules in production

After bar re-machining (within 0.1mm precision) + drilling + white painting, everything moves to the gluing “facility” (downstairs)

Guide for fiber insertion and gluing
(20 bars in a row)

Everything foreseen for a safe handling

Coiling system to limit the fiber bending radius

Gluing Rack (20 bar each)
New modules in production

**Fiber distribution**: big wheels received from the company and hooked up to the wall… Makes the life easier (fiber insertion, cutting to length, pliers to hold fiber in position,…)

- Fiber wheel (received from company)
- Pliers row
New modules in production (organization)

The 7 gluing stands awaiting in their rack (3 out of 7 will go to the Testing room soon…)

20 bar gluing per day Max! (due to preparation)

3 stands ready for plane assembly (fiber bundle coiled around the jig, each fiber in a protective sleeve (black))

4 stands already used for plane assembly (ready for fiber gluing)

Organized in a way to damp the production flow (different job stands)
New modules in production (Plane assembly)

Example of a module mounting (aluminum profile connected thru corner blocks)

1 stand for plane assembly / 1 stand for Module assembly and storage
New modules in production (Module assembly)

Module being assembled (awaiting the PMT connector gluing and electronic integration). The first one with fibers of 1mm in diameter…to be tested soon with cosmics!

Alu profiles, CNC machined in house (totally: 100 needed)
The parts close to PMT’s

PMT, FEB electronics, shielding tube…after a few iterations with Ghislain Gregoire to design the magnetic shielding! **Design work can now be finalized right now…**

Basic idea (FEB assembly to the plane)

- FEB
- PMT
- New FEB
- New shielding tube
- Silent blocks for FEB mounting
The whole EMR assembly

EMR features:
- 24 modules
- 1 module is made of X&Y planes
- Nearly 11 km of WLS fibers (1.2mm diam.)
- 48 multianode PMT
- 48 single pixel PMT
- 28 Kg per plane (1.4 Ton totally)

As a recall…to understand the shielding issue coming next!

EMR Outer Box
Movable frame (existing part)
KL
Shielding tubes
2 months ago: Information given about Magnetic stray field around EMR **stopped** the design progress (thanks to Ghislain Gregoire). Worst case at **1200 Gauss** (nearby KL)...to 300 Gauss for the last PMT location downstream!! ⇒ **NO INDIVIDUAL** Shielding tube could withstand such a field (saturation of a single Armco tube near 300 Gauss, 1mm thick tube)

Meshing of KL, Virostek plate, Tof2…

Nota: 10 cm downstream ⇒ 400 Gauss less!
EMR area: Magnetic field issue [2]

Situation today after several iterations: see below the whole FE model (which includes a new deflecting plate, the so-called **Blondel’s plate**...50mm thick, upstream EMR and )

![Diagram]

**Configuration magnétique selon MICE Note 153 (Nov. 2006)**

Blondel’s plate (for EMR)

190 Gauss (without any individual shielding tube)

This part not needed
EMR area: Magnetic field issue [3]

Situation today after several iterations: Latest proposal (Blondel’s plate as simple as it is here)

Simplified model … in order to add individual shielding for EMR (see next)

NOTA: Following studies with the simplified model to see the effect of adding an individual shielding tube @ PMT location (knowing the factor of safety we have between blue and red plots…)

The complete model (config. without details on individual shielding tubes for EMR…due to huge number of meshes)
Situation today after several iterations: Latest proposal (B field at PMT location inside a tube of 1mm thick). **Simplified model.**

Strange effect due to saturation with Mumetal (better results with Armco)
Multipixel PMT is sensitive / tube axis (Y axis here…)
⇒ We still need to get info on the single pixel PMT …

**Baseline for EMR shielding:**
- 1 global plate (50mm thick in Armco or equivalent)
- Individual tube for each PMT (1mm thick in Armco)
…doesn’t change our design! Slight adaptations only…
EMR simulations (FEA studies on mechanics)

- FEA model of the whole EMR
- 3D model (shell and beams)
- Meshing
EMR simulations (FEA studies)

Sagging and stresses look good (60x60mmx3mm cross section beams). It showed the need of reinforcing the 4 corners (connections between modules) by means of aluminum corner beams. Several configurations studied:
- Transportation loads (horizontal)
- Rotation to get it upright @ RAL
- 1G Loading when vertical (in situ)

Case 1: Horizontal

Used for EMR rotation

Simply supported on 2 sides (boundary conditions)

Max stress here (good margin of safety)

Total Weight: 1450 Kg from FEA model
Case 2: Vertical load (in situ @ RAL).
Nota: no « contact » taken into account here (conservative approach)
EMR simulations (FEA studies)

NEXT STEP: add the new Blondel’s plate to the EMR outer box (1.9x1.9m)
⇒ FEA’s to be updated accordingly.

**The idea**: make the EMR box as a structural support for Blondel’s plate (it’s a 2mx2mx1m block / about 1.5 Tons!)
But this plate will be assembled separately in situ (onto the EMR box, interfaces to be foreseen). About 1 ton to be fixed…get an estimate of the magnetic load!

Downstream part to be removed
Building/platform issues

EMR Box

Thanks to Tim for the « environnement » STEP file...
EMR Integration @ RAL

Building/platform issues (close up on EMR…we need about 1900mmx1900mmx1000mm)
EMR Integration @ RAL

Building/platform issues (seen from one side…)

- EMR Box
- EMR active part
- Cable tray
- Trolley

Could it be modified or removed?

+ the Blondel’s plate to be inserted and supported!!
So, there is a pb /Trolley…
Building/platform issues (seen from the Top...)

Useful to anticipate/accommodate with crane works (sling fixations, rotations, movements,...)
The **EMR Outer Box** will comply with the different steps (moving downstream).

So, we have to work closely with Tim, Andy,… to make sure that no interference with platform occurs…anytime! CAD works first and soon (to freeze the Outer Box).