The LIME prototype: status & plans

Francesco Renga
for the LIME working group

LIME

- More than a prototype
- A *platform* to:
  - test the performances of the CYGNO elementary module (33x33 cm^2 GEM, 50 cm drift, 1 camera, up to 4 PMTs)
  - test materials and construction approaches for CYGNO
  - test different field cage options
  - measure with high accuracy a variety of gas properties
  - develop future ideas

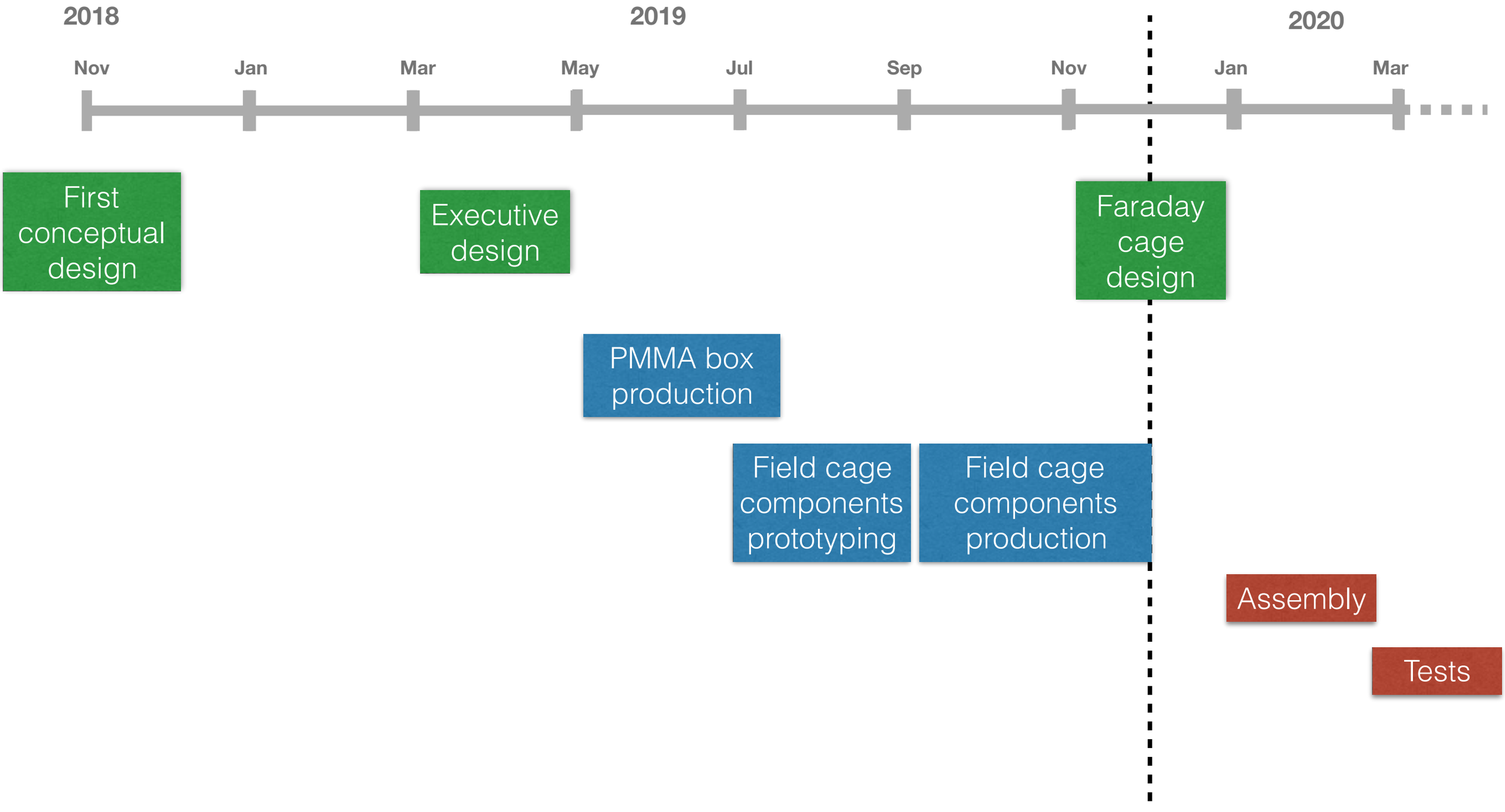
➡ Robust and versatile design

➡ Not just one prototype, but a *class of prototypes*

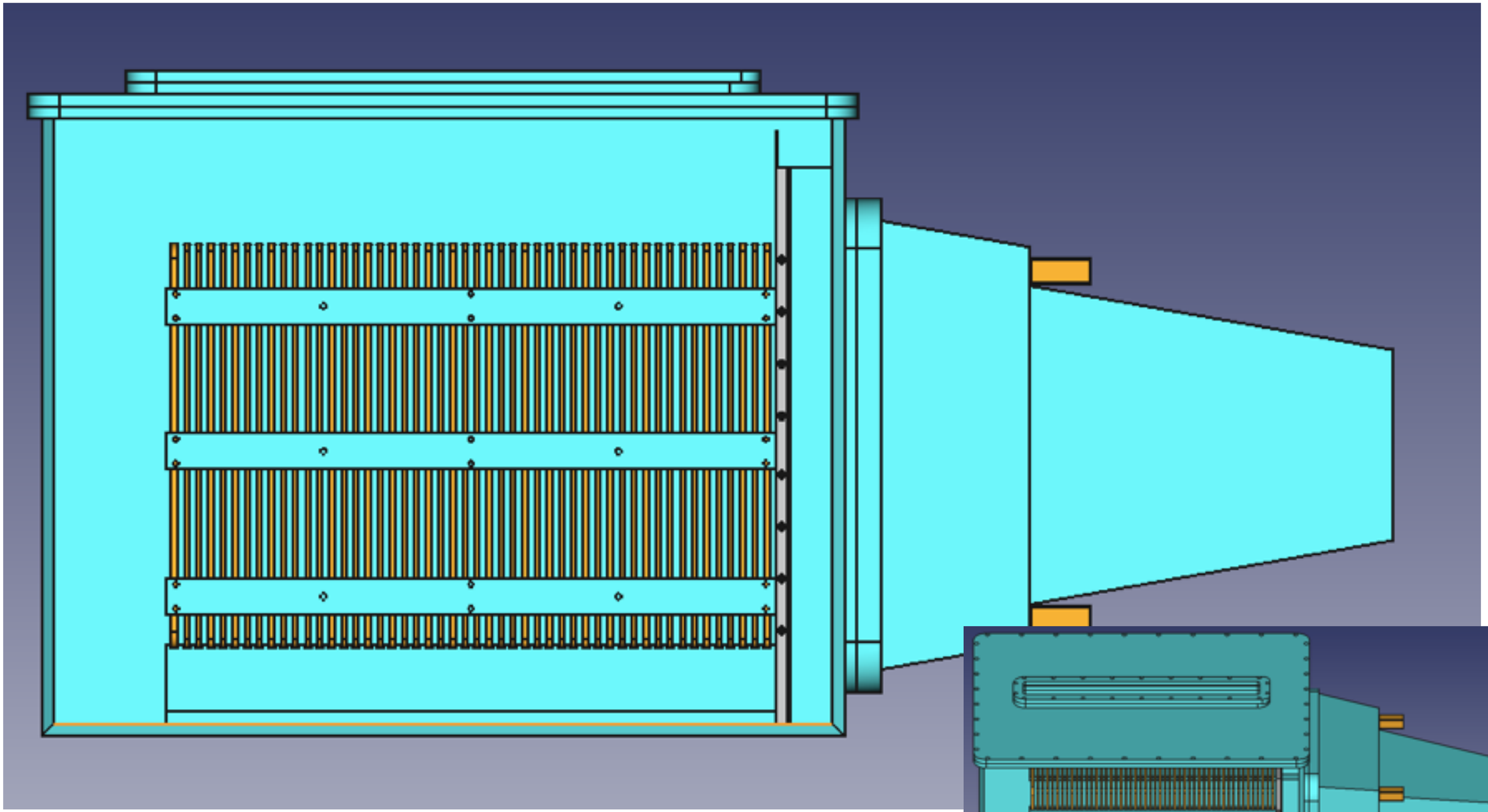
Design choices

- Only materials that are known to be procurable in radiopure version (PMMA, copper, etc.):
  - LIME will *not* be radiopure, but will allow to test all the other properties of materials for CYGNO (dielectric strength of insulators, gas contamination, etc.)
- Professional construction by a company specialized in PMMA assemblies, with a multi-year collaboration experience with INFN (Palazzi S.r.l.)
- Replaceable field cage supports to test different filed cages
- Removable GEM frame to test other kinds of multiplication stages

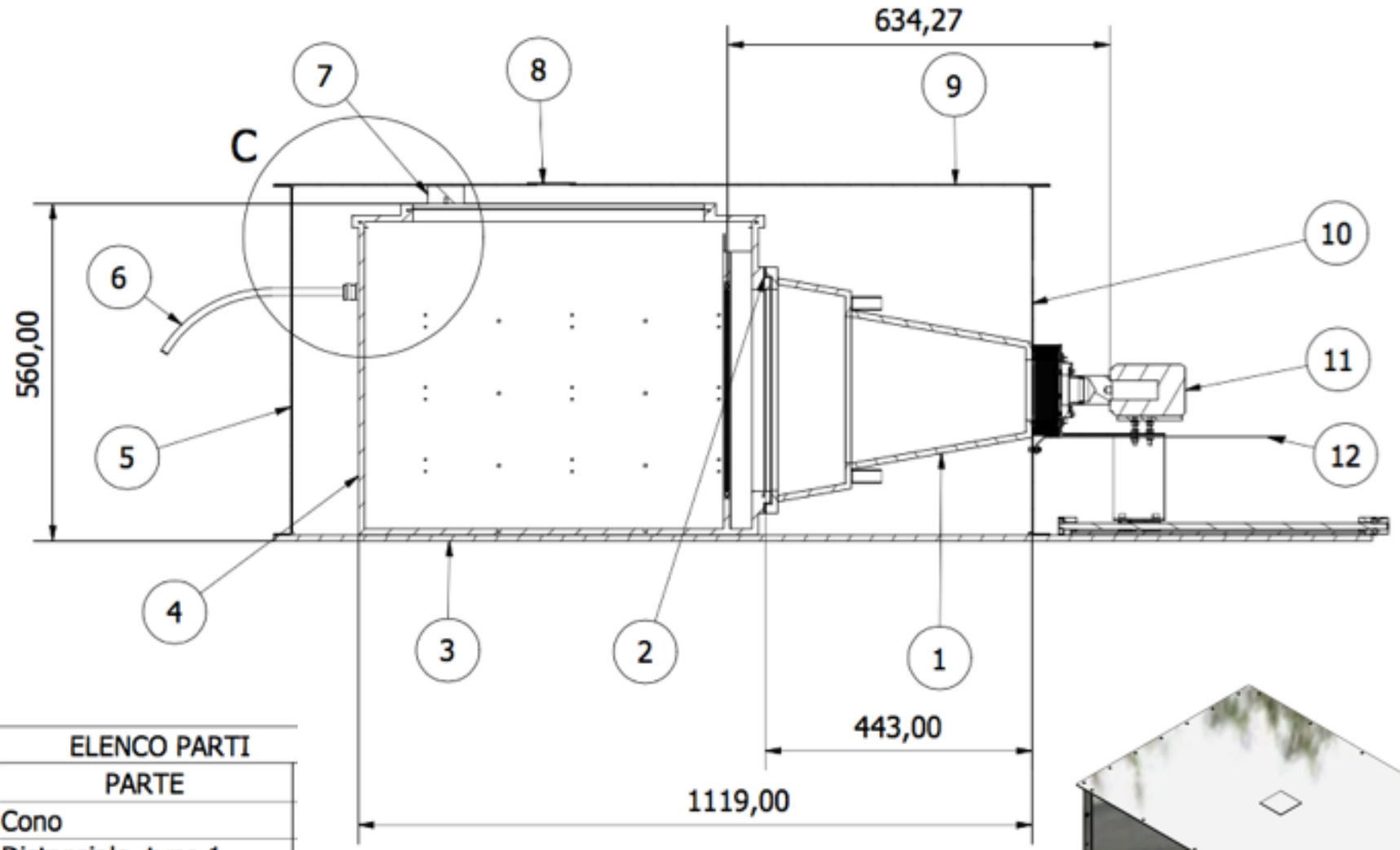
Timeline


2018
2019
2020
Nov
Jan
Mar
May
Jul
Sep
Nov
Jan
Mar
First conceptual design
Executive design
Faraday cage design
PMMA box production
Field cage components prototyping
Field cage components production
Assembly
Tests

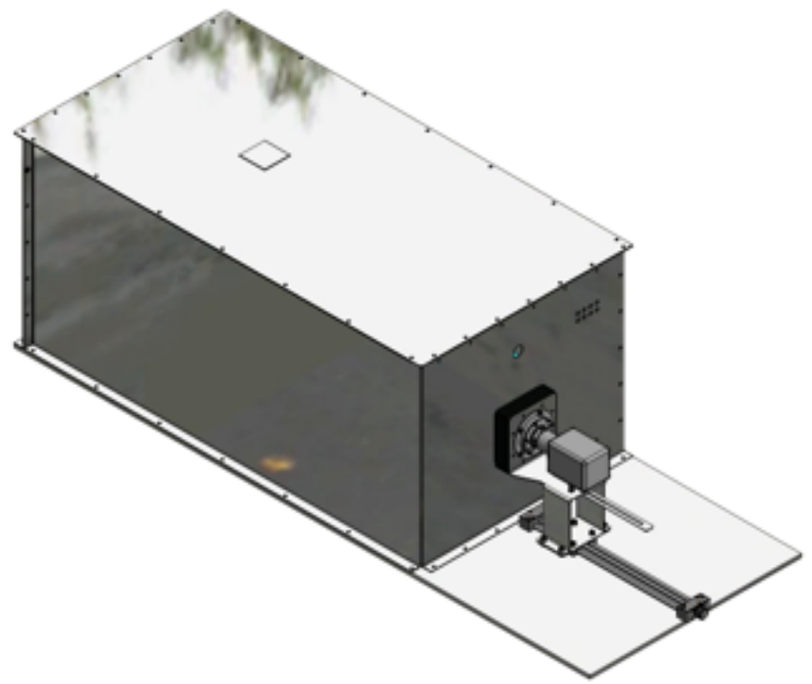
LIME design (I)



LIME design (II)



ELENCO PARTI			
POS.	MATERIALE	QTÀ	PARTE
1	PMMA	1	Cono
2	PMMA	12	Distanziale type 1
3	Alluminio 6061	1	Base LIME
4	Generico	1	LIME simpl
5	Alluminio 1050	1	Lamiera 2
6	Generico	1	Connettore HV
7	Generico	1	Sorgente
8	Alluminio 6061	1	Lastra
9	Alluminio 6061	1	Chiusura LIME
10	Alluminio 1050	1	Lamiera 1
11	Generico	1	Assieme camera LIME
12	Aluminum 6061	1	MAN3005RB



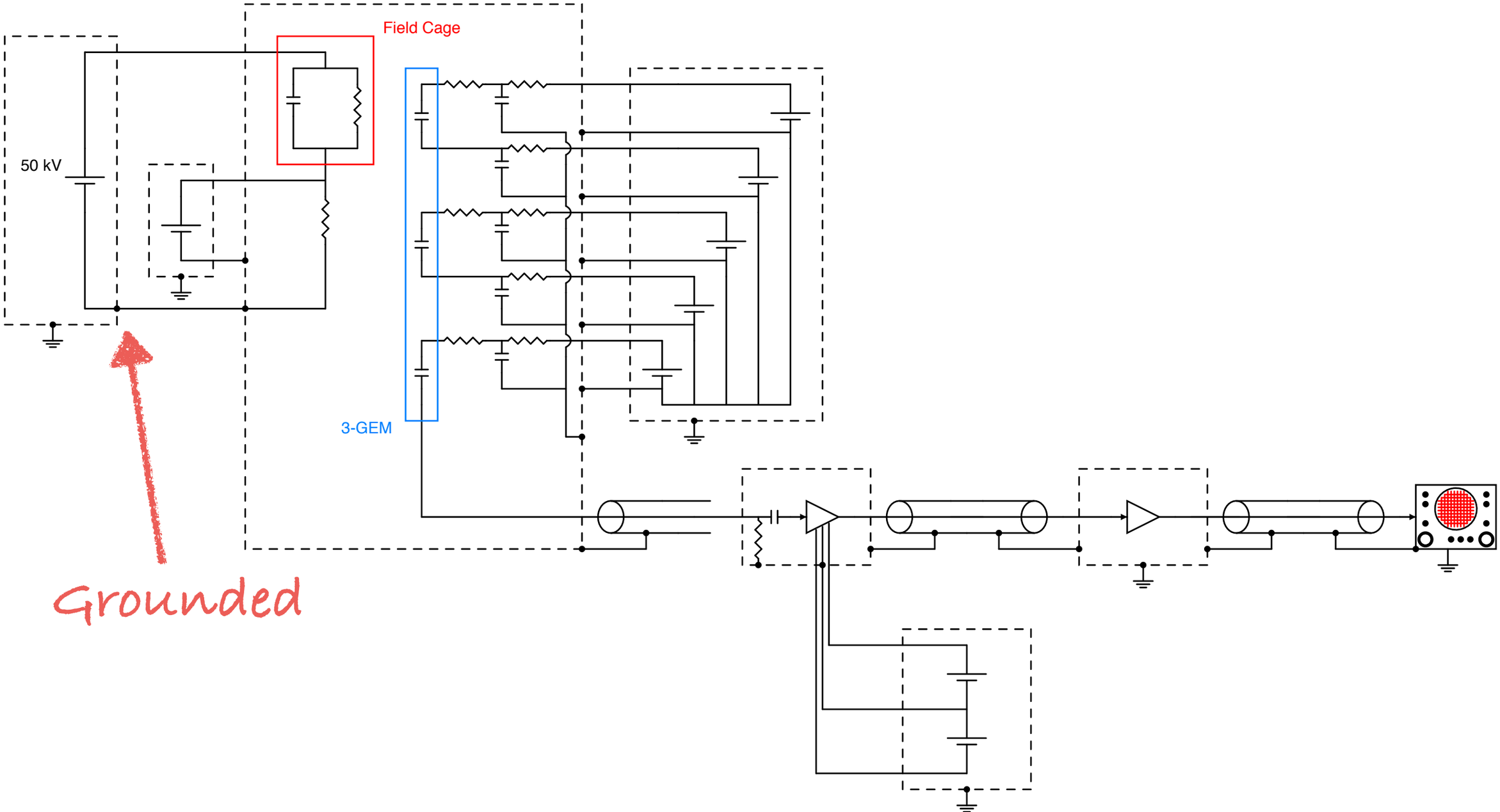
Current status

- PMMA box production completed:
  - very good gas-tightness
- GEM stack assembled:
  - some difficulties due to wrong design of components by CERN have beed faced
  - successfully completed and tested
- Field cage components (copper rings + cathode) have been produced
- Faraday cage and camera support design almost completed

Next steps

- Field cage assembly
- Production of Faraday cage and other small components at LNF mechanical workshop
- Electronic services preparation (HV connections, HV filters, signal connections, ground connections)
- HV test

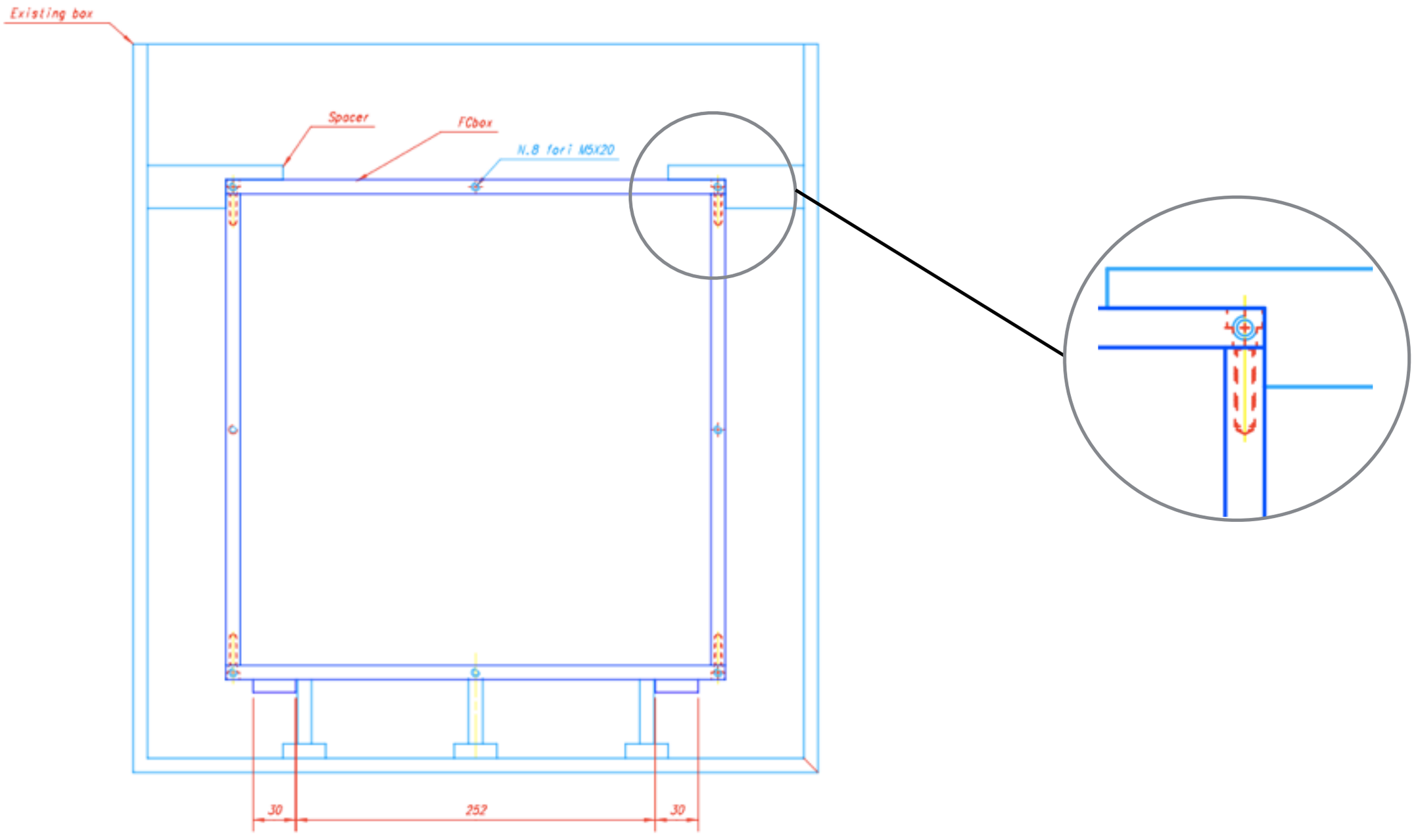
Grounding scheme



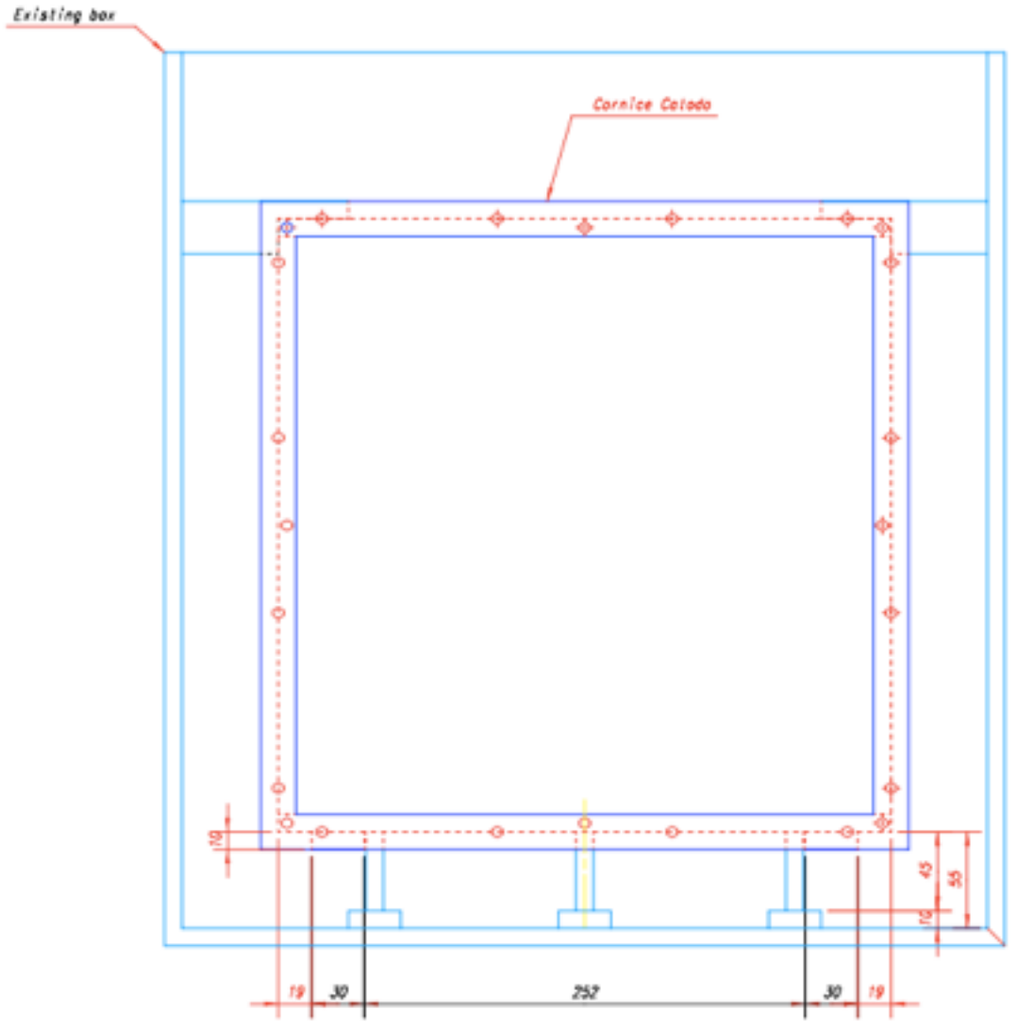
Resistive-foil field cage (I)

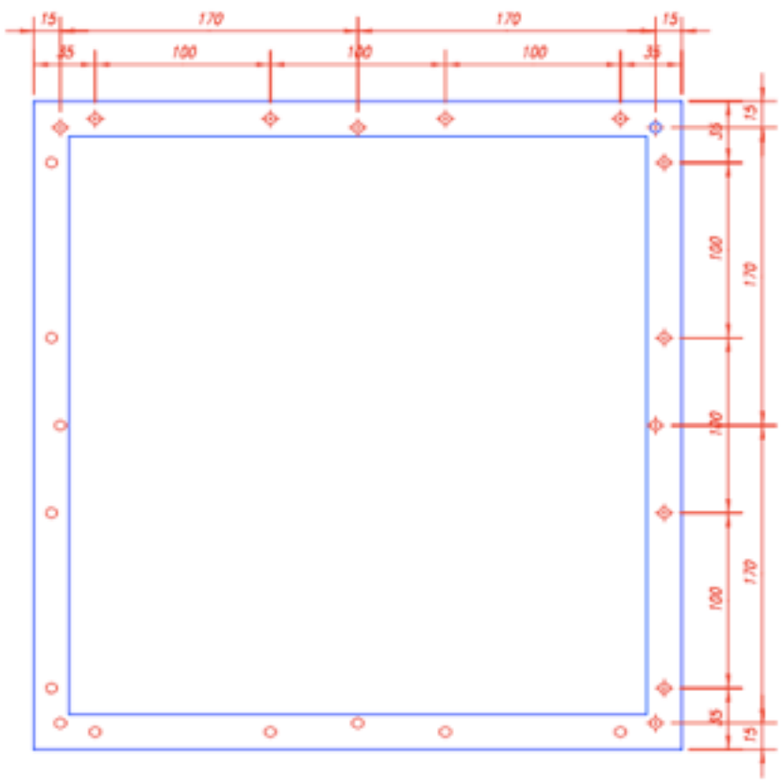
- The baseline field cage for CYGNO is based on a resistive-foil:
  - Achilles Vinylas PVC foil used by our Japanese colleagues
  - Nylon-6 and Nylon-66 (similar surface resistivity) under consideration
- Such an option is under test with MANGO, first look at images seems very promising
- The design of a new field cage made with this technique for LIME is almost completed
  - will also allow to mount foil cathodes

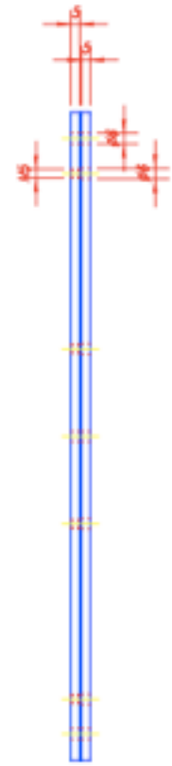
Resistive-foil field cage (II)



Foil cathodes







Future plans

- LIME-I will be tested with the copper field cage (February-March) and then the new field cage will be mounted:
  - the master prototype for assessing the performances of the CYGNO design
  - order @ Palazzi S.r.l. for the new field cage just placed
- LIME-II will be built with small modifications of the box (more thin windows), and the copper field cage will be mounted there:
  - a prototype for accurate measurements of gas properties with UV laser in Rome
  - order @ Palazzi S.r.l. just placed
- LIME-III under study for low pressure operations