

RD51 WG6

Production Industrialisation

Philadelphia

May 24 2014

MPGD projects in progress at CERN Workshop in 2017

•Production		
•SBS tracker	GEM 600mm x 500mm	150 GEM
•ALICE TPC upgrade	GEM 600mm x 400mm	700 GEM
•CMS muon	GEM 1.2m x 450mm	450 GEM
•BESIII	GEM 600mm x 400mm	30 GEM +read-out
•SOLID	GEM 1.1m x 400mm	8 GEM + 2 read-out
•CLAS 12	Micromegas 500mm x 500mm	30 Micromegas
•CBM	GEM 1m x 450mm	100 GEMs
•BM@N	GEM detectors 1.8m x 0.6m	12 full detectors
•Bonus 12	GEM	30 GEMs
•European Spallation Source	GEM	9 GEMs
•sPhoenix TPC Stonybrook	GEM	50 m2
•CMS GE2/1	GEM	prototype
•C rad industry	GEM	prototype
•Beomocular industry	GEM	10 GEMs
•Mcube muon detectors	Micromegas	12 x 50cm x50cm

•R&D

- ATLAS resistive Micromegas embedded resistors for high granularity high rate detectors
- CMS FTM multiple resistive well detectors for sub ns time resolution
- R-well detectors for CMS & LHC-B
- Embedded front end electronics in read-out boards
- Embedded resistors for high rate Micromegas ILC calorimeter
- Micromegas Picosec

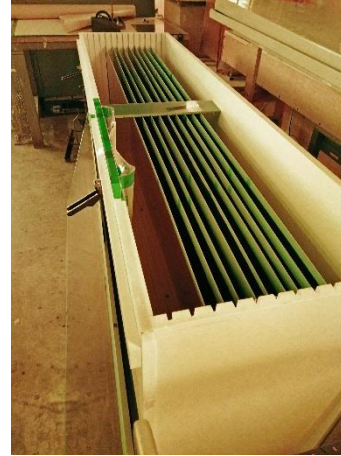
GEM Mass productions at CERN



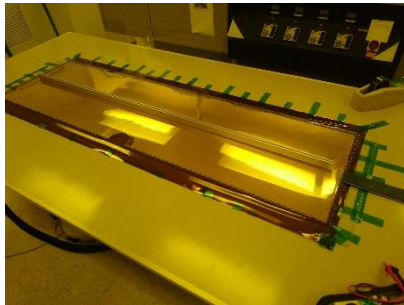
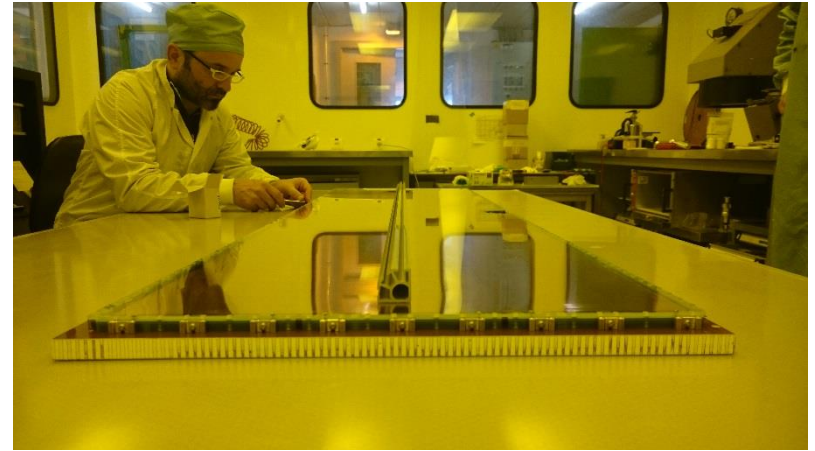
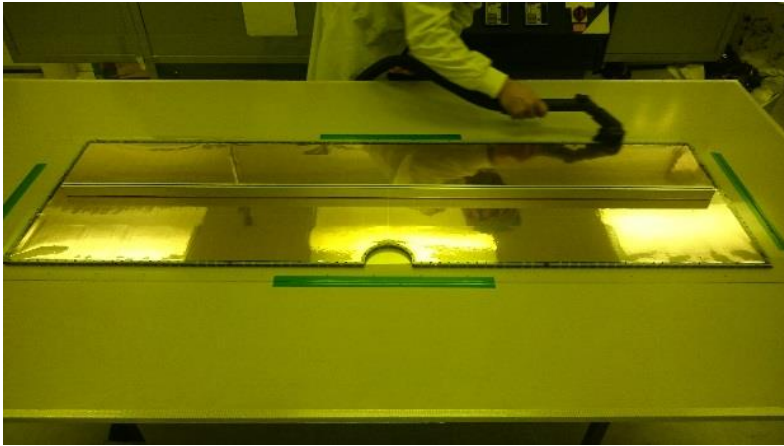
CMS production :
more than 230/450 GEM already produced
Production rate 20 GEM/month



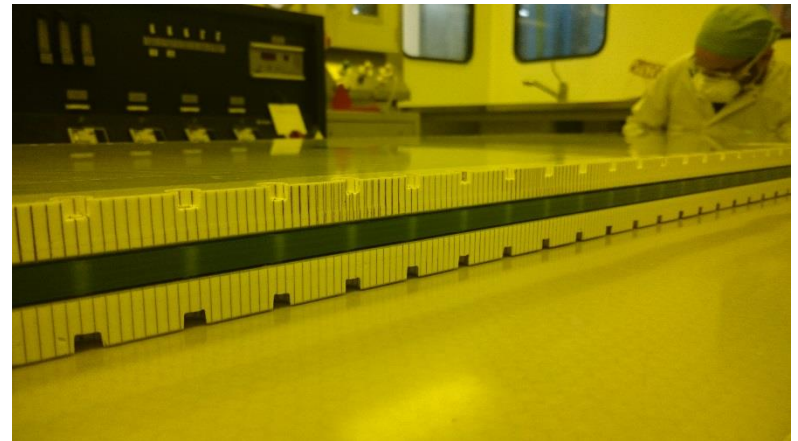
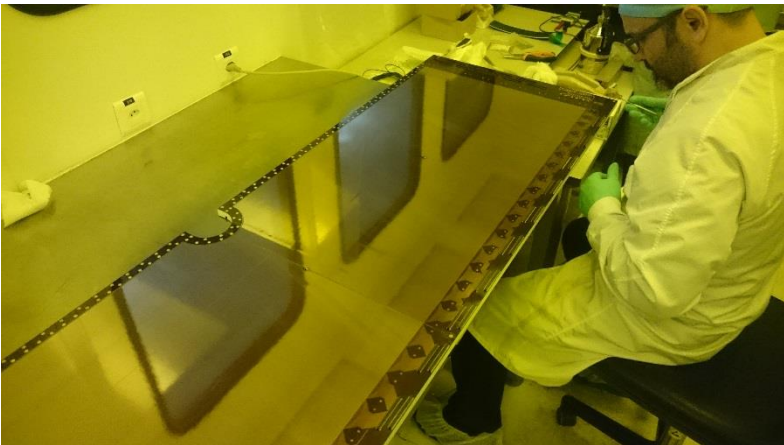
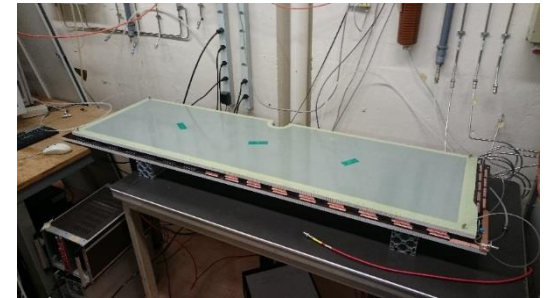
ALICE production:
more than 300/700 GEM already produced
Production rate 40 GEM/month

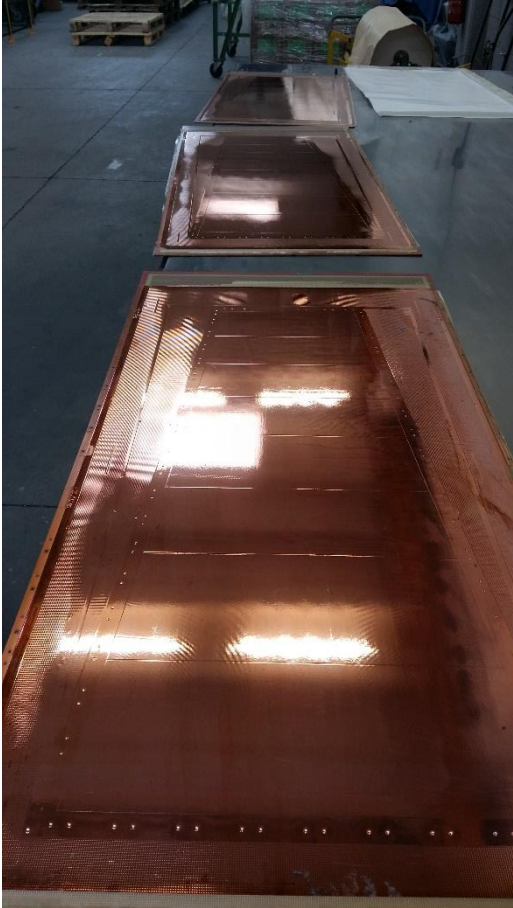


GEM UV tight "fridge" containing one batch of 14 GEM (1.8m x 0.6m max)

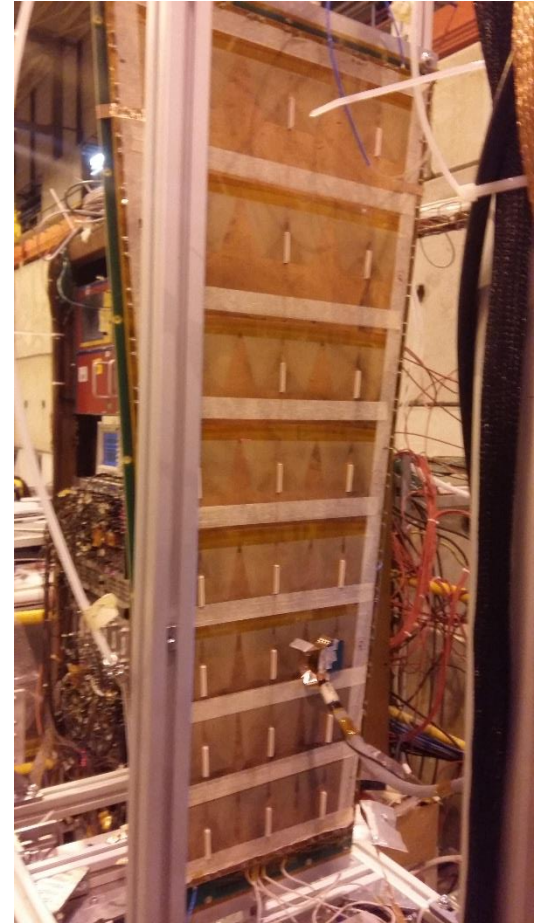


largest GEM detector
BM@N Dubna project 1.8m x 0.6m
Produced and assembled at CERN MPT

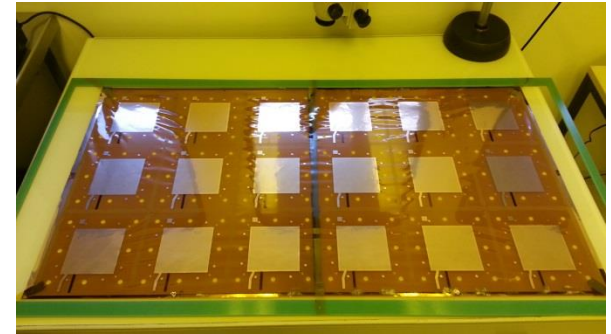




largest u-Rwell detector
GE1/1 active area



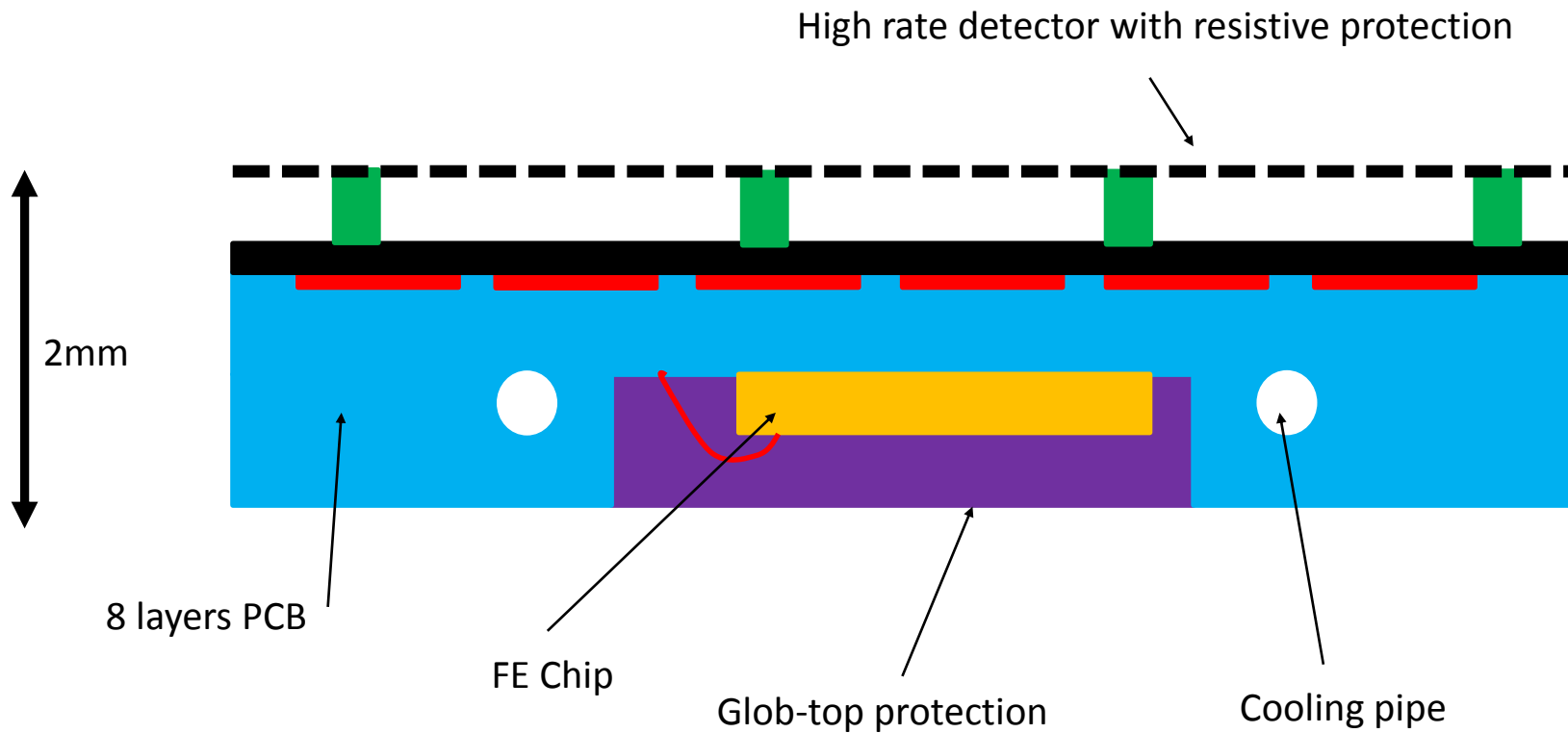
Single mask introduces cost reduction 10cm x 10cm GEM example



10cm x 10cm GEM low volume
- 300 CHF/piece

10cm x 10cm GEM high volume
- 80 CHF/piece

Embedded electronics in detector



CERN PMT Possibilities

- Tooling's ok for GEMs up to 1.8m x 0.6m
- Presently 6 technicians are producing GEM.
- Soon the team will grow to 7 persons.
- Max capacity around 70 GEM per month (1.8m x 0.6m).
- There is still some free slots this year
- The GEM-Team is also producing special Flex read-outs and u-Rwell.
- We have received requests for 2m GEMs !

Industry situation

Mecaronics (Korea): Feb 2017 RD51 talk conclusion

- 2017 Feb. ~ Jun.: MECARO - OPTIRAY contract
 - Large bipolar lithography (~\$0.5M) purchase
 - 3 months minimum to be built & delivered
- 2017 Jun. ~ Aug.: GE11 test production
 - 2017.06: production line completed & commissioning
 - 2017.07: test production (GE11 large type)
 - 10 GE11 GEMs : to be shipped to CERN for QC
 - 2017.08: final decision for Korean foil.
- 2017 Sep. ~ Nov.: GE11 production
 - 100 GE11 GEM (Larger one)
- 2017 early
 - another 100 GE11 (Smaller one?)

Micropack (India) road-map

RD51 talk (feb 2017)

- Road map
 - Thin GEM 100mm x 100mm
 - Awaiting enquiries from all related agencies & users/CERN for production lots
 - Thin GEM 300MM x 300mm
 - Trials for process stabilisation and testing should be initiated in March 2017. Submission of samples to CERN April/May 2017
 - Thick GEM
 - Awaiting enquiries for further requirements from users.

Techtra (Poland) :

RD51 talk conclusion (Feb. 2017)

- **Small GEMs & detectors:**
 - 1. Production of small GEMs with over 90% yield
 - 2. Production of small GEM detectors.
- **Big GEMs:**
 - 1. Good openings uniformity on first copper layer
 - 2. Good openings uniformity on Kapton layer
 - 3. Good leakage currents : below 1nA@600V@70cm²
 - 4. Electroetching process needs to be adjusted
 - 5. Kapton etching needs to be optimized.
 - 6. GEM handling & packaging needs to be improved
 - 7. Poor production yield, about 30%
 - 8. Long production time

Extra information concerning TECHTRA company

- GEM 10 cm x 10cm → regular delivery to CERN since 2 years
- In 2016 CERN have subcontracted GEMs to TECHTRA for a total amount slightly above 200 000 CHF
- GEM 30cm x 30cm double mask → Ok since 1 year
- GEM 500mm x 600mm single mask → OK since a few months but an improvement of yield is necessary.
- GEM 1.5m x 500mm already ordered
- Participation to CMS GE1/1 being organized

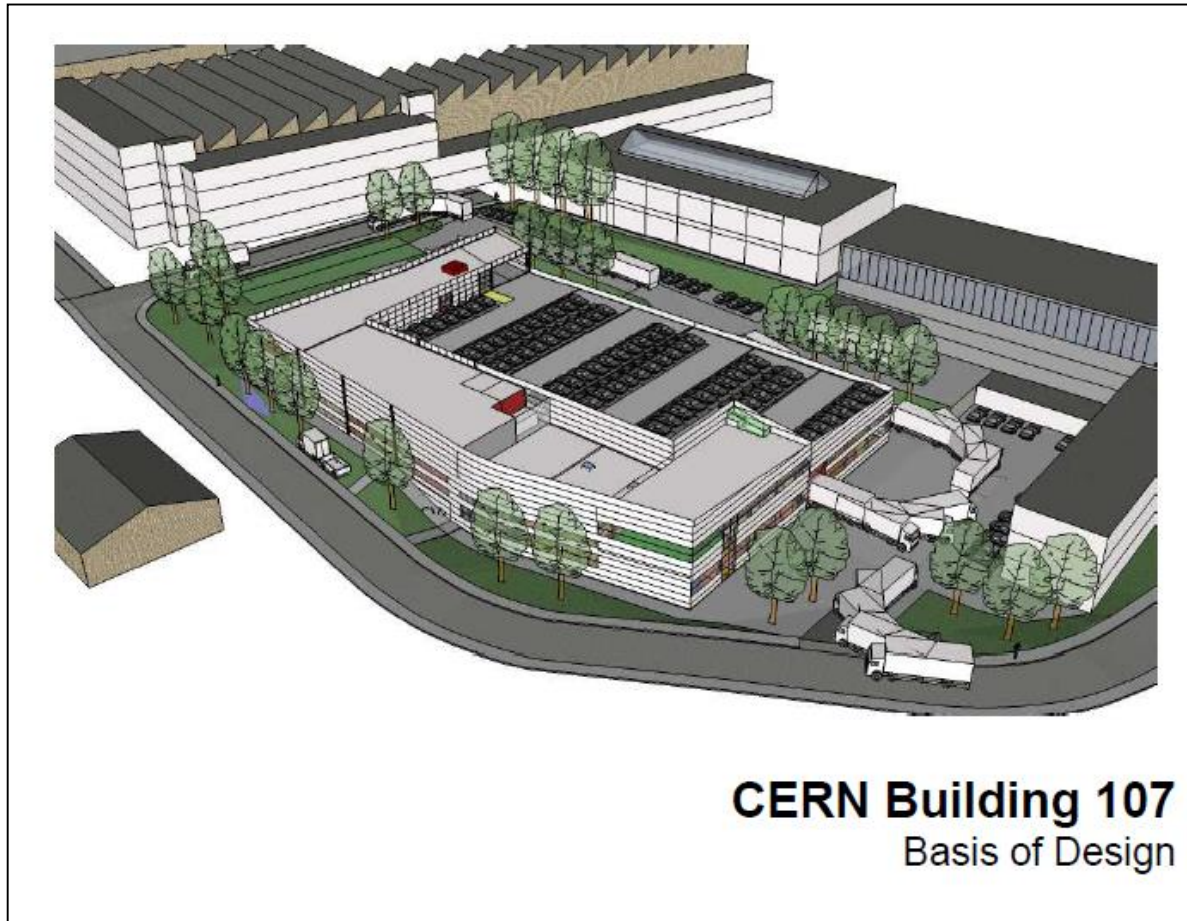
Industry Status summary

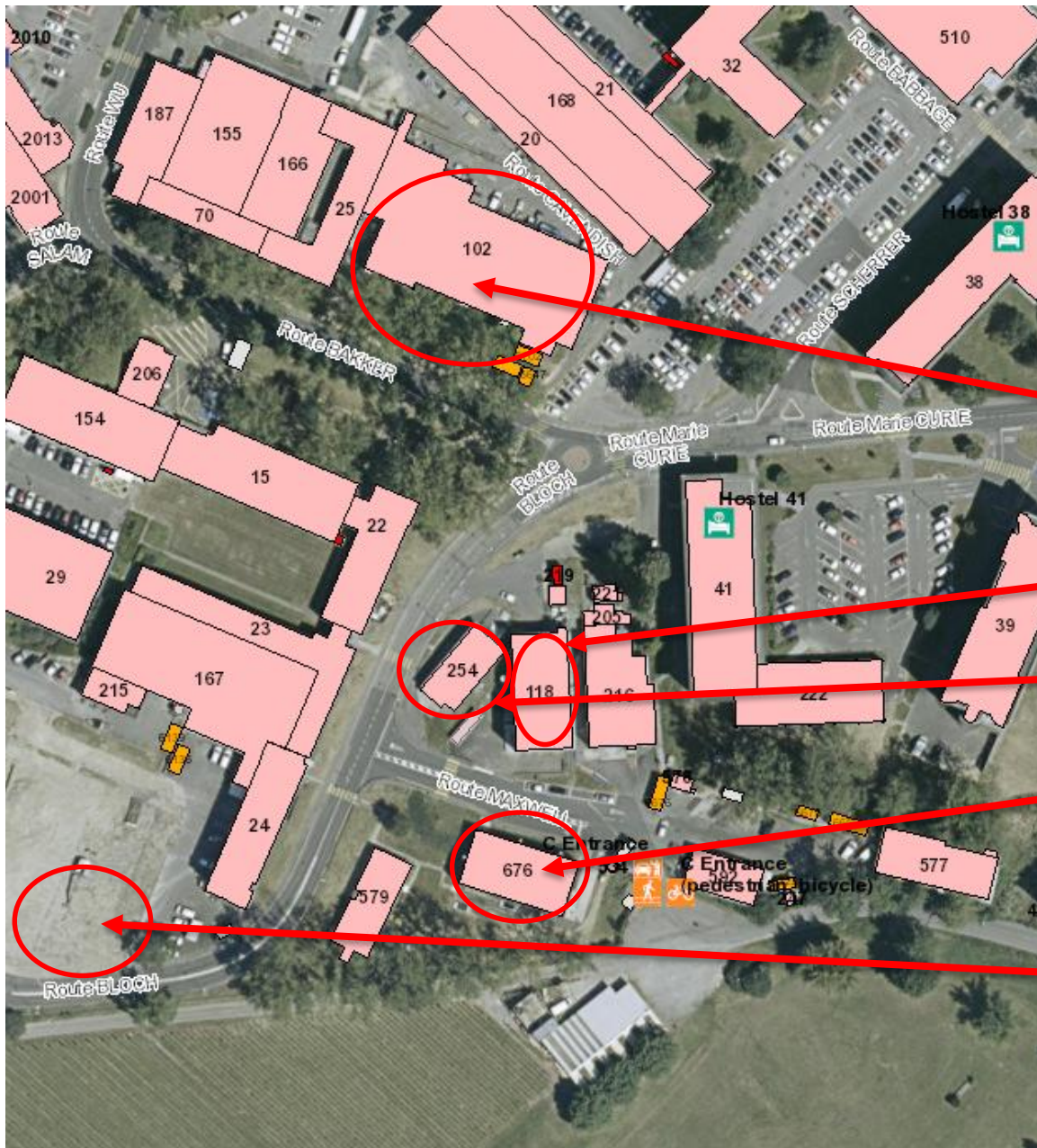
- Techtra - Poland
 - 10cm x 10cm up to 30 x 30 routinely produced
 - 60cm x 50cm GEM ready (30% yield, single mask technique)
 - 120 cm x 50cm in progress (ready fall 2017)
- Mecaronics - Korea
 - No problem up to 30cm x 30cm GEMs
 - Currently doing R&D on 50cm x 50cm (double mask technique)
 - Presently setting up the facility for larger GEMs
 - 120cm x 50cm GEMs expected for end 2017
- Micropack - India
 - 10cm x 10cm GEMs have been produced and tested positively
 - 30cm x 30cm recently produced , soon under test (double mask)
- Eltos - Italy
 - THGEM up to 60cm x 60cm
 - Resistive read-out boards for Micromegas up to 2m x 50cm
- Elvia - France
 - THGEM up to 60cm x 60cm
 - Resistive read-out boards for Micromegas up to 2m x 50cm
 - BULK Micromegas up to 50cm x 50cm

B107 status

Construction of the new workshop's building

Start : beginning 2012 expected completion date: beginning 2018





Main activity
Including clean room

Large UV exposure

GEM processes

Water treatment plant

B107

Move organisation

starting date beginning 2018

- Installation of new machines beginning 2018 , no modification of the activity in 102:
(3 months)
 - Etcher ,Developer, Stripper, Jet pumice, Plating line
 - Desmearing line ,Brown oxide line ,Large dryer
 - NI/AU line ,AU plating Bath ,CU plating bath ,Hoods etc
- Move plating activity (no stop)
- Transfer GEM missing equipments (1week)
 - 1 Laminator/Alcohol stripper/Electro-etching line/large exposure lamp
- Move Photolithographic equipment one by one (3 days stop per machine)
 - Laminators ,LDI
 - UV lamps ,ovens
- Transfer the CNC machines and test machines one by one (3 days stop per machine)
 - Driller ,Router
 - AOI ,Electrical tester
- Transfer Pressing equipments (3 days per equipment)
 - Large press
 - Std press
- Transfer photoplotter + developer (3 days stop)
- Transfer clean room equipment (1 week stop for clean room activities)
- Repair and transfer remaining equipment from 102

Move effective mid 2018

Conclusion

- Heavy GEM production at CERN but still some free slots
- Industry will probably deliver the first large GEM this year (1.2m x 0.5m)
- The new building will be nearly ended at the end of this year.