Attività e richieste

2020

Alexis Pompili

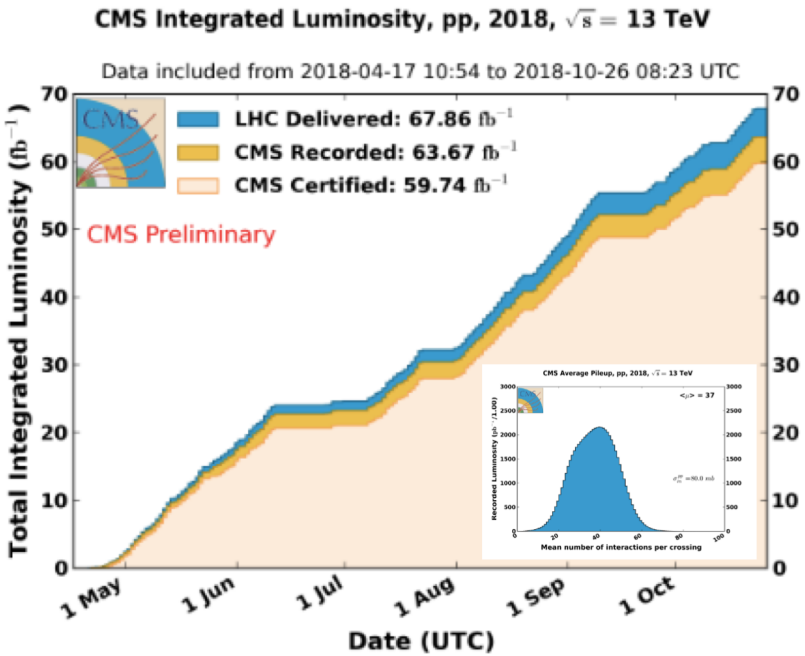
(in rappresentanza del Gruppo CMS-Bari  **)**

19 giugno 2019 - Riunione Gr.I/INFN-Bari - Aula multimediale

End of Run-2 & Status of CMS - I

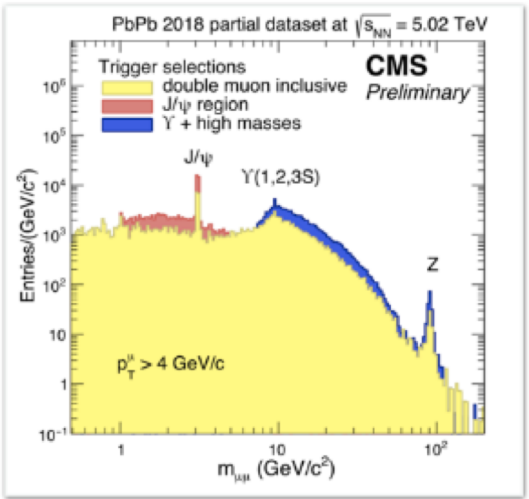
The LHC machine and the CMS detector had very well performing in 2018 data taking:

pp run



- ~ 94% recording efficiency
  - recorded/delivered
  - peak luminosity grazing 2x10^{34} Hz/cm^2
- ~ 95% validation efficiency
  - validated/delivered

PbPb run

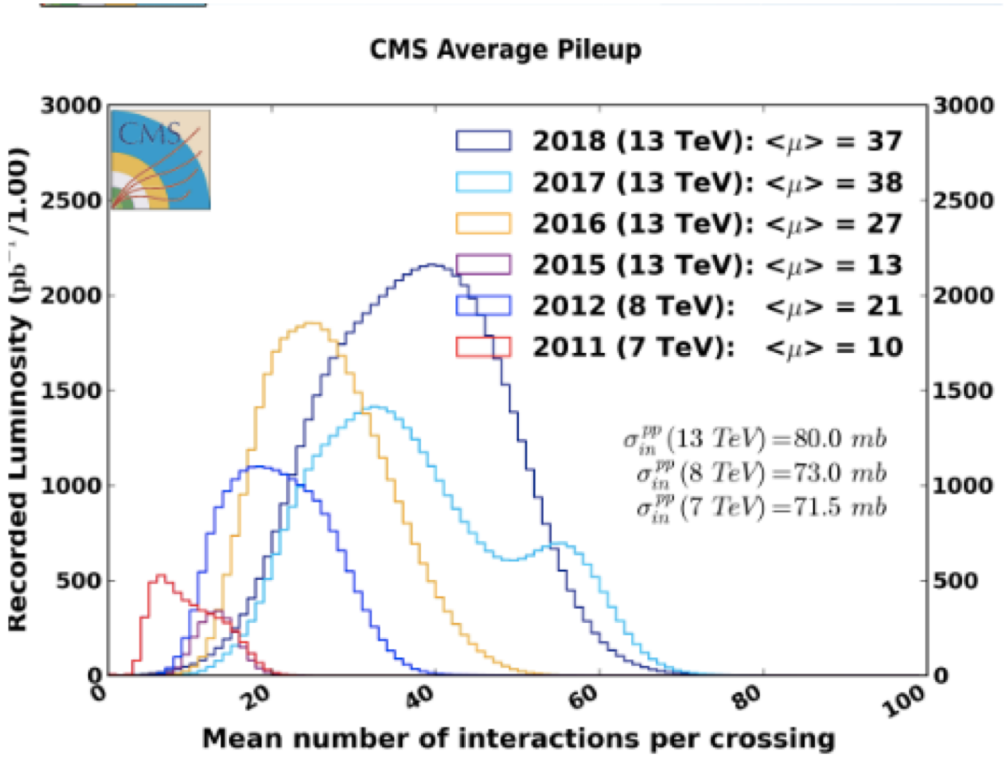


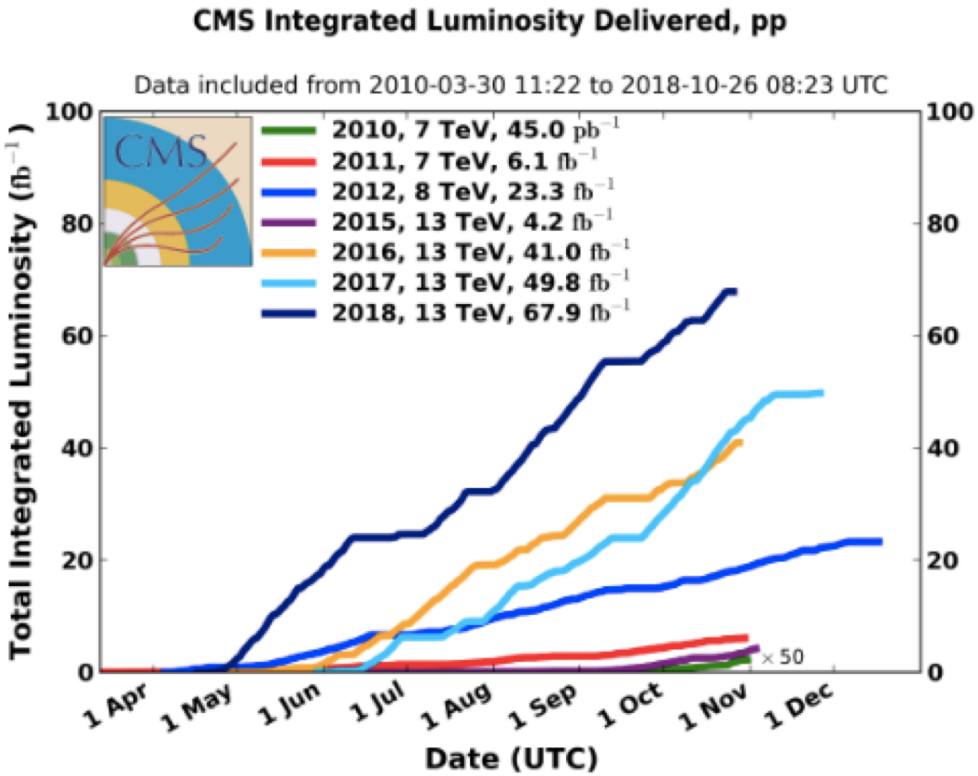
- Collected luminosity ~ 1.80 nb^{-1}
  - about 4.5 billions minimum bias triggers
  - Data quality good: 95% data taking efficiency

L. Silvestris : Run Coordinator

End of Run-2 & Status of CMS - II

Runs 1-2 summary:

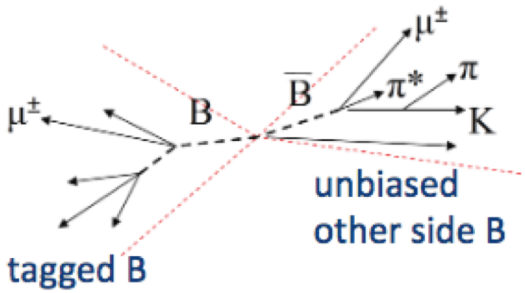




	Int. lumi	<μ>
7 TeV	6.1 fb^{-1}	10
8 TeV	23.3 fb^{-1}	21
13 Tev	162.9 fb^{-1}	37

End of Run-2 & Status of CMS - III

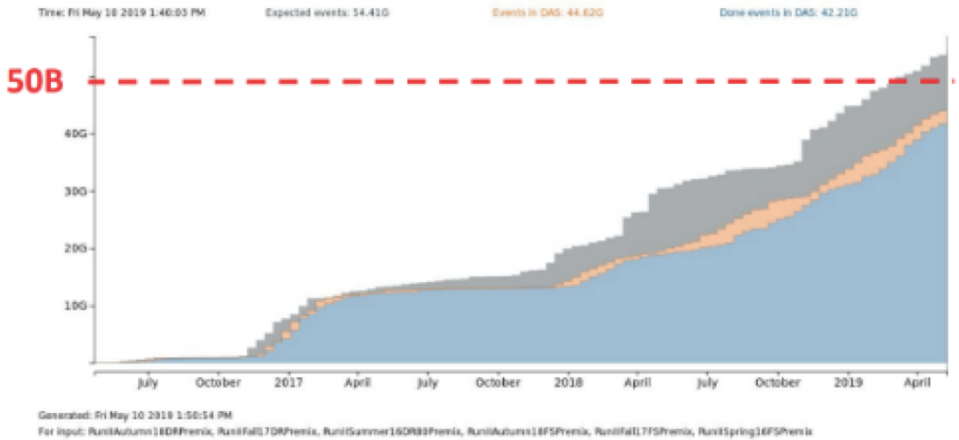
2018 Non-orthodox data taking : B-parking - a swiss knife for Heavy Flavour studies



Plan: store a large unbiased B hadron sample by tagging on the «opposite side» B

- CMS parked (→ no prompt reconstruction) 12 billions of B triggers, a sample 20x larger than Babar's
- Fit within available computing resources
  - Up to 6 kHz additional rate to tape

Offline & Computing



O+C systems were able to cope for simultaneous

- data taking with larger-than-expected parking and Heavy Ions data taking
- support for analyses, with 50kCores at any moment (out of 250kCores total)
- preparation of samples for Phase-II TDRs
- evolution of our software and services
- preparation of 50B ('17-'18) MC events

Long shutdown periods are the most busy for computing :

- Full Run-2 reprocessing

- Get prepared for Phase-2: adapt to GPUs, FPGAs, via an heterogeneous framework

End of Run-2 & Status of CMS - IV

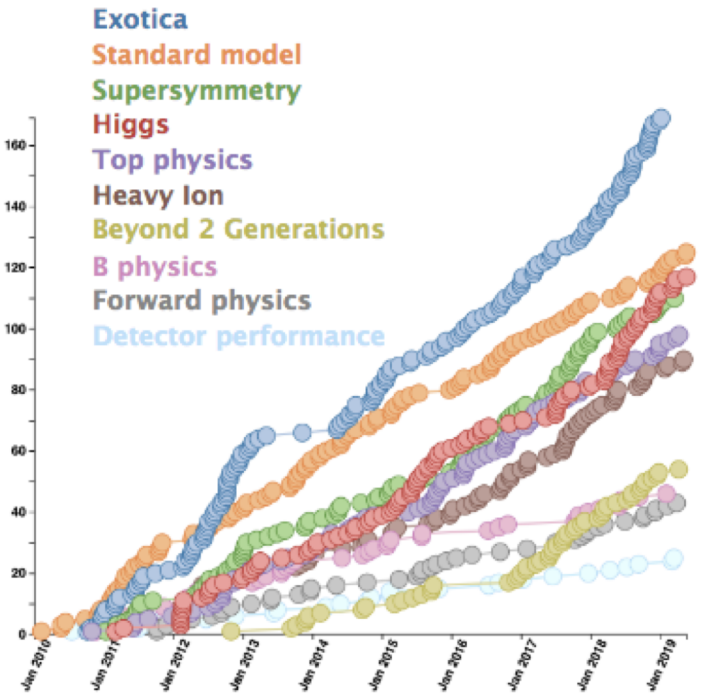
Impressive physics output :

From L.Malgeri @ LHCP2019

876 papers on collider's data out of 901 published

We just celebrated the 900th submitted papers last Friday (and we are now at 901)!

- 141 papers submitted in 2018 (new record!)
- first LHC full run2 statistics paper submitted on on Feb. 1, 2019 (Phys. Rev. Lett. 122 (2019) 132001
- 9 results with full Run 2 data
- ~50 new results since the beginning of 2019
- in the following only few selected results shown



- Summary at:

  http://cms-results.web.cern.ch/cms-results/public-results/publications/

CMS-Bari - participated actively to some of them

- also provided ~10 Collaboration Wide Reviews (and participated to ARCs)

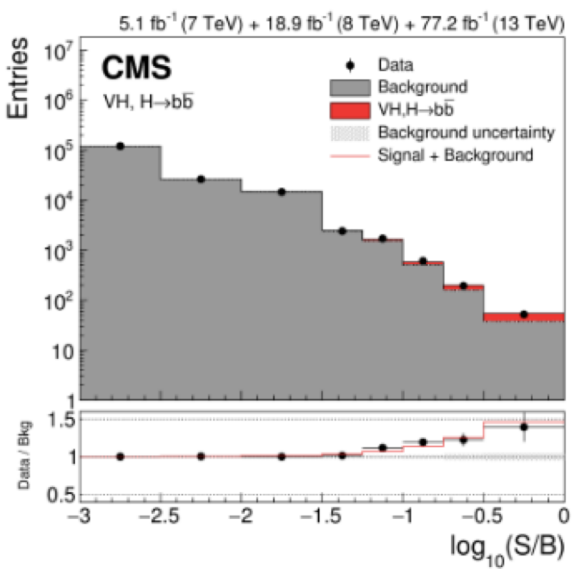
Physics Highlights - I

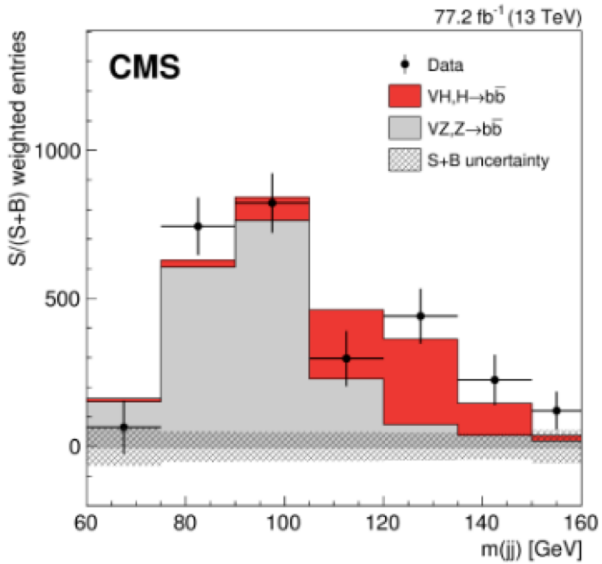
Since last year : Higgs to bottom Yukawa couplings

Channel	Date
H→ττ	May 2017
pp→ttH	Apr 2018
H→bb, pp→VH	Aug 2018

$H \to b\bar{b}$ observation :

PRL 121 (2018) 121801





- Both ATLAS and CMS have observed it (>5σ)
- Very complex analyses (multivariate techniques used in every step)

Notes:

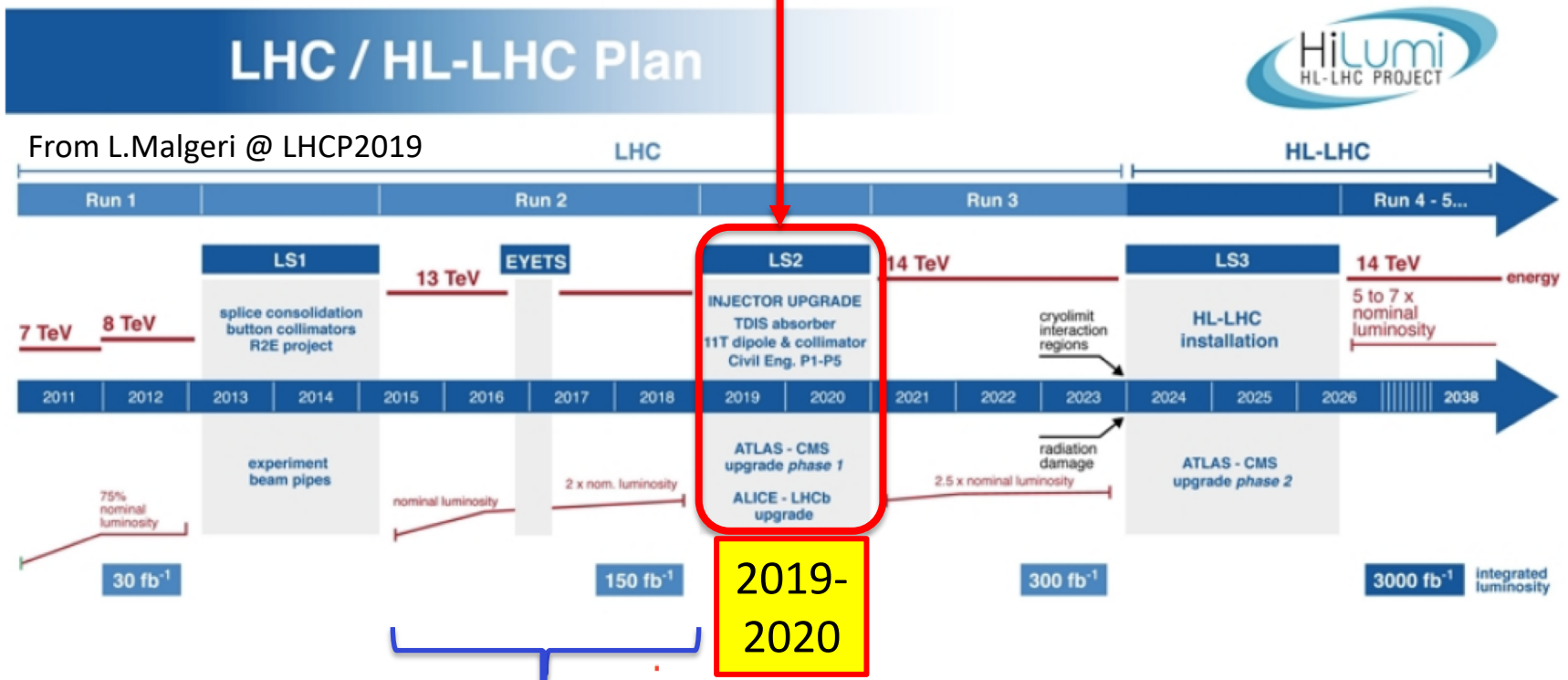
- in CMS the first DNN based analysis
- in CMS first analysis based on 1kB/ event data format (0.1% of the raw format!)

Physics Highlights - II

- **Many other important results** (for instance among them, recently@ LHCP2019)
  - **Updated results on ttH**
  - **Z production cross section @ 13TeV** (testing high order EW & QCD corrections)
  - **search for low mass resonances** (ISR tag in trigger to explore low mass region)
  - **search for delayed jets** (long-lived particle in SUSY models can originate jets far from IP)
  - **search massless dark photons coupling to Higgs**
  - **observation of** $B_c(2S)$ **and** $B_c^*(2S)$ **states and measurement of** $B_c(2S)$ **mass**

Long-shutdown (LS2) has started in 2019

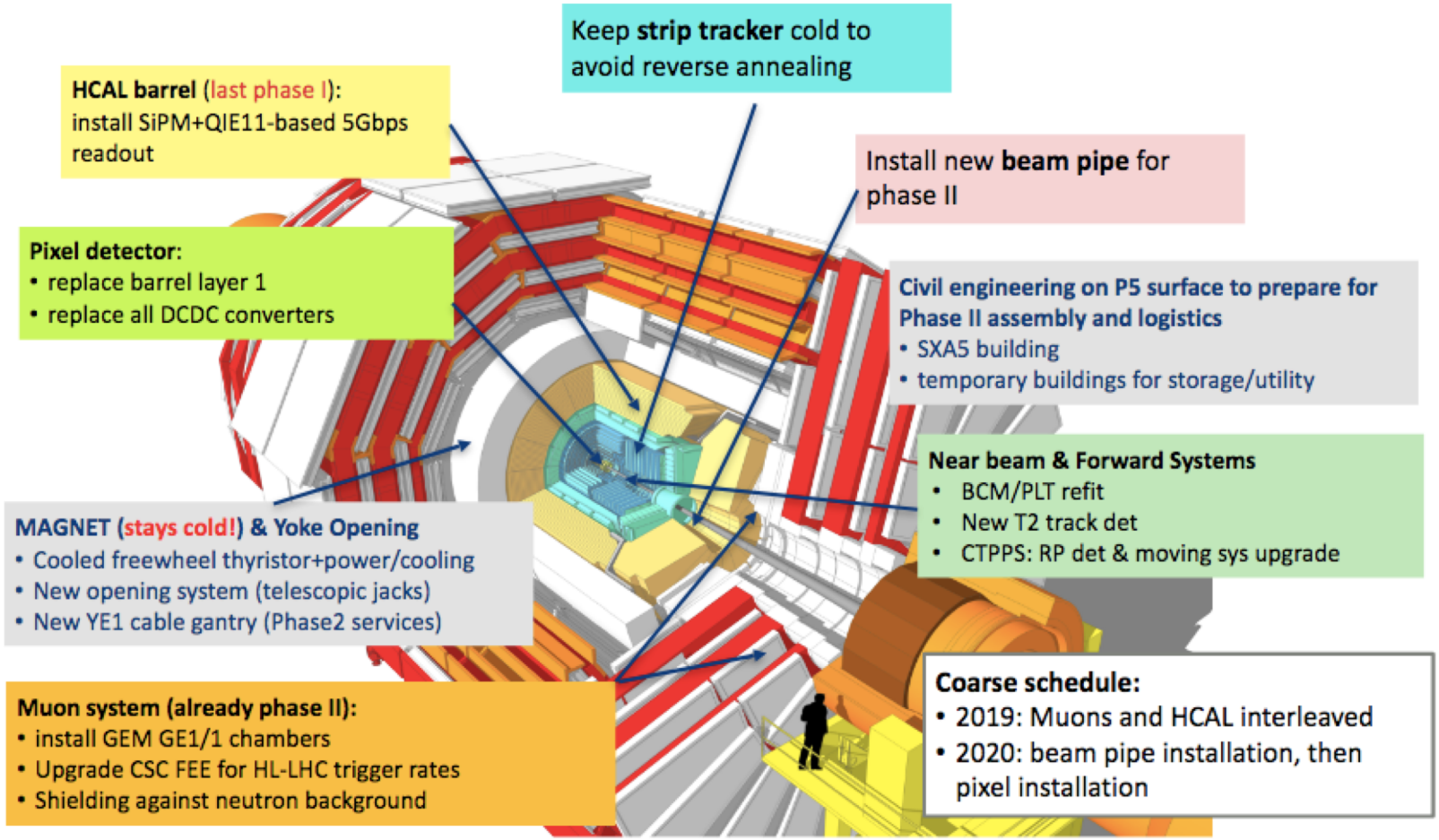
LS2 will continue through 2019 till full 2020 :



Run 2	2015-2018	Run 3	2021-2023	Run 4-5
<μ>~37		<μ>~55		<μ>~140-200
L up to 2.0E34 Hz/cm^2		L up to 2.0E34		L up to 7.5E34

Long-shutdown (LS2) will continue in 2020

LS2 will continue for 2020; activities foreseen:



From L.Malgeri @ LHCP2019

Phase-1 upgrade is almost done (and in line with the planned schedule providing benefits already during Run-2)

Phase-2 upgrade started (Run-3 will benefit from part of them; will be continued in LS3 -2024/5)

CMS HL-LHC Upgrade (Phase-2)

Technical proposal CERN-LHCC-2015-010 https://cds.cern.ch/record/2020886
Scope Document CERN-LHCC-2015-019 https://cds.cern.ch/record/2055167/files/LHCC-G-165.pdf

L1-Trigger/HLT/DAQ

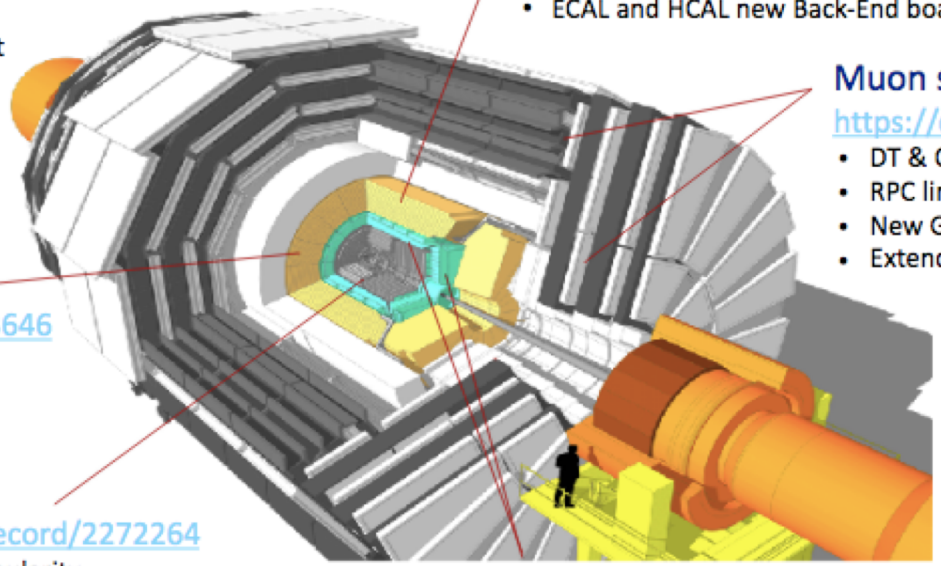
https://cds.cern.ch/record/2283192
https://cds.cern.ch/record/2283193

- Tracks in L1-Trigger at 40 MHz
- PFlow-like selection 750 kHz output
- HLT output 7.5 kHz

Barrel Calorimeters

https://cds.cern.ch/record/2283187

- ECAL crystal granularity readout at 40 MHz with precise timing for e/γ at 30 GeV
- ECAL and HCAL new Back-End boards



Muon systems

https://cds.cern.ch/record/2283189

- DT & CSC new FE/BE readout
- RPC link -board
- New GEM/RPC $1.6 < \eta < 2.4$
- Extended coverage to $\eta \simeq 3$

Calorimeter Endcap

https://cds.cern.ch/record/2293646

- 3D showers and precise timing
- Si, Scint+SiPM in Pb/W-SS

Beam Radiation Instr. and Luminosity, and Common Systems and Infrastructure

https://cds.cern.ch/record/2020886

Tracker https://cds.cern.ch/record/2272264

- Si-Strip and Pixels increased granularity
- Design for tracking in L1-Trigger
- Extended coverage to $\eta \simeq 3.8$

MIP Timing Detector

https://cds.cern.ch/record/2296612

Precision timing with:

- Barrel layer: Crystals + SiPMs
- Endcap layer: Low Gain Avalanche Diodes

Innovative and extremely challenging new capabilities:

- **Highly granular endcap calorimeter**
- **Level 1 track trigger**
- **Timing detector**

From L.Malgeri @ LHCP2019

Current analysis activities with CMS-Bari involvement

Data Analysis Activities - I

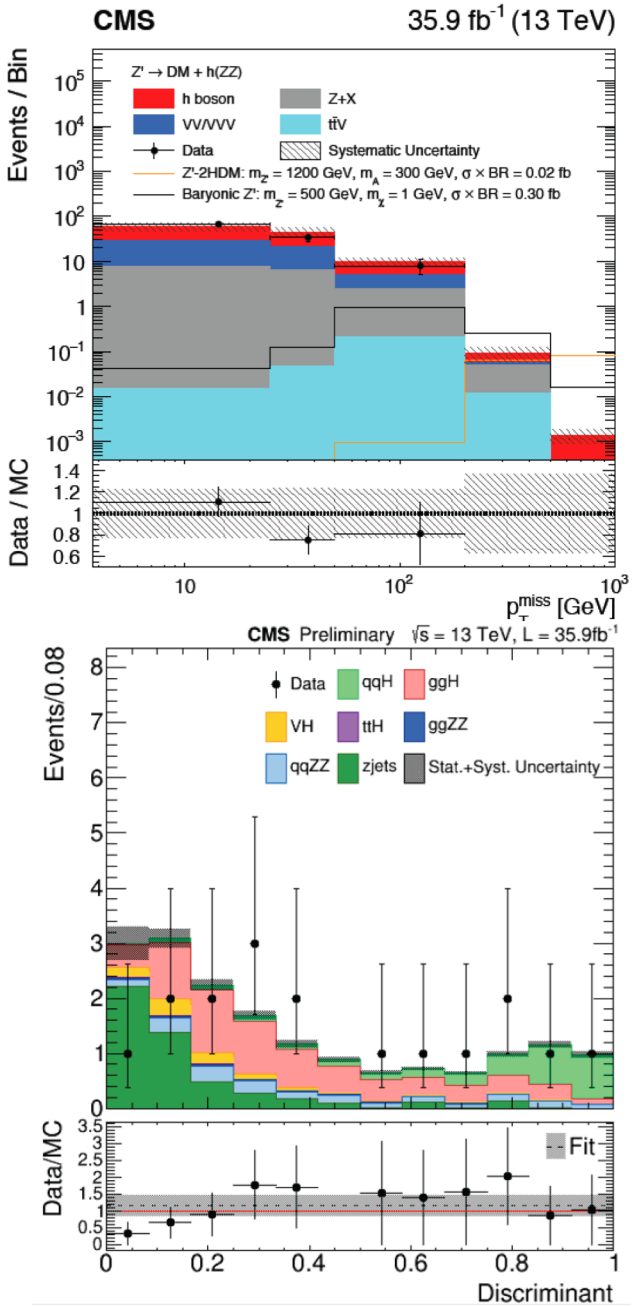
Higgs Physics + DM search

- Ricerca di materia oscura con la segnatura di "MonoHiggs", H+MET, con H→ZZ→4l (**R. Aly, N. De Filippis**)
  - Analisi con dati 2016 pubblica EXO-18-009 e finalizzata in un paper EXO-18-011 (Final reading) in combinazione con le altre analisi monoHiggs
  - Analisi dati 2017 e 2018 in corso

- Misura della sezione d'urto di produzione del bosone di Higgs in topologia di fusione di bosoni vettori: VBF H→ZZ→4l (**W. Elmetenawee, N. De Filippis**)
  - AN_2018_120 con i dati 2016
  - analisi con dati 2017 and 2018 in corso

- Determinazione *self-coupling* dell'Higgs attraverso la ricerca di eventi di produzione di **HH→bbZZ→ bb4l** (A. Taliercio (now in Louvain) **I. Margjeka, N. De Filippis**)

+ studi finalizzati nello Yellow Report per HL-LHC: "**Higgs Physics at the HL-LHC and HE-LHC**", https://arxiv.org/abs/1902.00134



- **N. De Filippis: "Higgs Future Analysis" convener**, Sept.2018-20

Data Analysis Activities - II

B-physics & quarkonia

L. Cristella + A.Pompili + A. Di Florio + V. Mastrapasqua (similfellow junior) + N. Sur (TIFR)

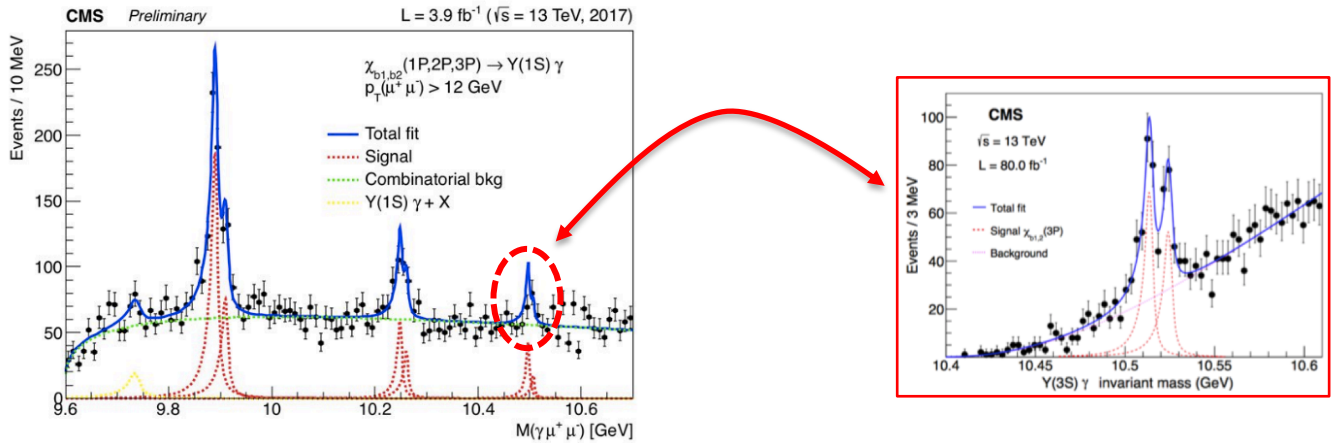
- **charged exotic *Z* spectroscopy with the 3-body decay** $B_d^0 \to J/\psi K\pi$ **(full amplitude fit on GPUs) [**BPH-14-003**]**
- **enough statistics with 2012 data -** going to pre-approval

A. Di Florio + A.Pompili - **inclusive search for exotic *X(4140)* state & partners** in the final state $J/\psi\phi$

- use late 2017-2018 data **(dedicated triggers) -** going to preapproval

S. Lezki + A.P. + A. Di Florio + CMS CINVESTAV(Mexico City) [Progetto MAECI Italia-Messico 2018-2020]

- **inclusive search for exotic X_b state [beauty partner of X(3872)]** in the final states $\chi_{b1}(1P)\pi\pi$ & $\Upsilon(1S)\pi\pi$
- use 2017-2018 data



A. Pompili "B-Physics" convener, Sept.2019-21

+ CMS representative in HFLAV cross-experiment group since 2018 [https://hflav.web.cern.ch/ **]**

More Data Analysis Activities & Computing activities

- **To be mentioned (for activities till end 2018)**

  Search for high-mass resonances into two muons (contribution to dilepton final states) [$Z' \rightarrow \mu\mu$]

  F. Errico[(1)] + R. Radogna[(2)] + A. Colaleo (contributing within Z' task force)

  [(1)] now in CMS @ Florida Univ. [(2)] now @ University College London (no more in CMS)

- **R. Venditti + F. Simone + A. Colaleo + P. Verwilligen (+ laureande : C. Aruta, L. Lorusso)**
  starting a new search : $\tau \rightarrow 3\mu\ (LFV)$

- **Deep Learning for tracking (with GPUs usage): A. Di Florio + A. Di Pilato (*dottorato industriale*)**

- **Statistical analysis studies (using *GooFit* on GPUs): A. Di Florio + A. Pompili**

  - Clustering technique to include Look-Elsewhere-Effect (LEE) in the global significance estimation
  - Check of Trial factors method for LEE (Gross-Vitells approx.)[presented to *XIII Quark Confinement: statistics session*]

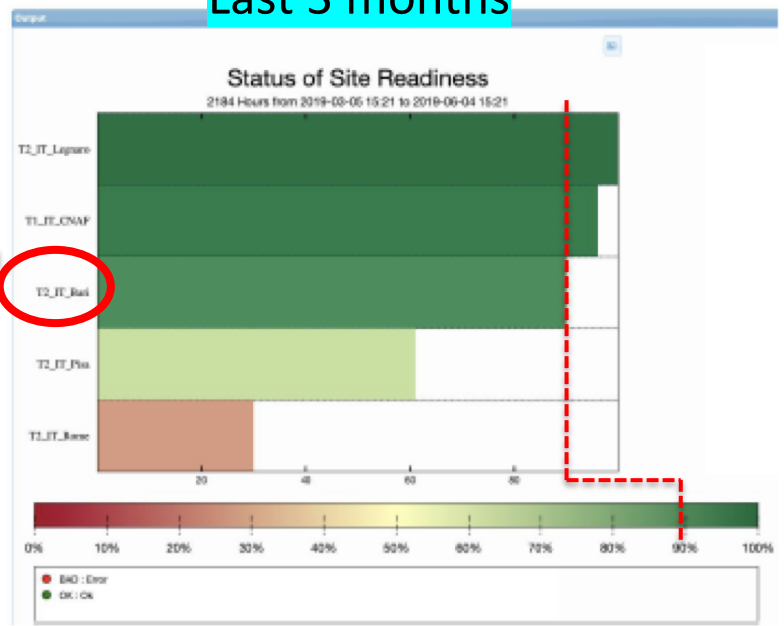
- CMS experiment has a workload management system that …
  schedules & executes production and user tasks in a distributed Grid infrastructure.
  Submission is performed via the tool CMS Remote Analysis Builder (CRAB),
  … developed & maintained by L. Cristella.

Computing infrastructure & activities (Bari Tier2)

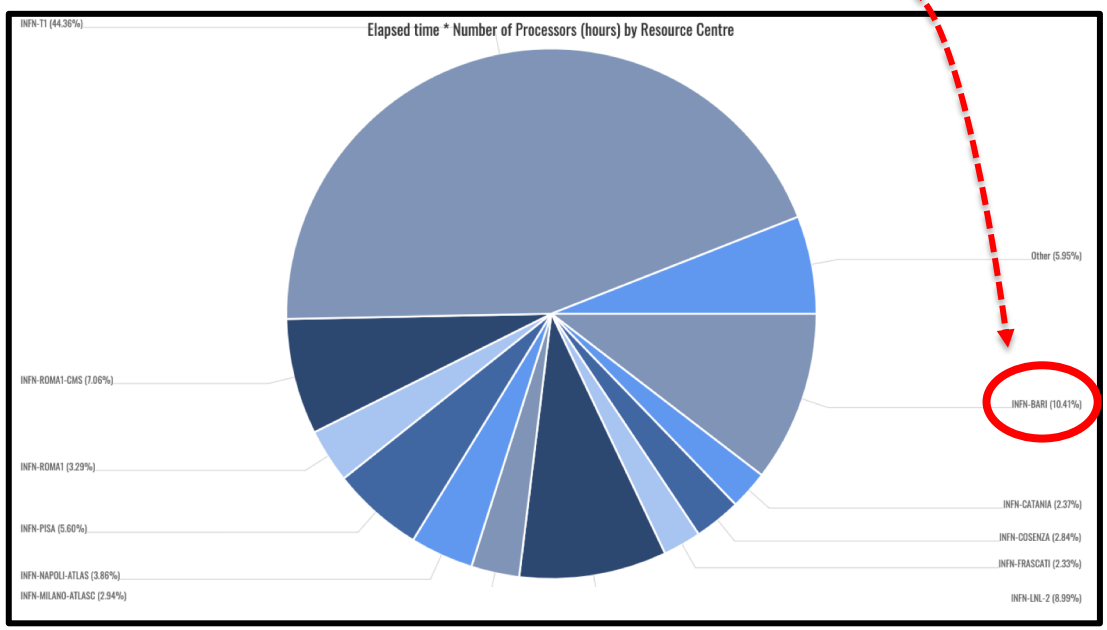
CMS-T2 operational status - I

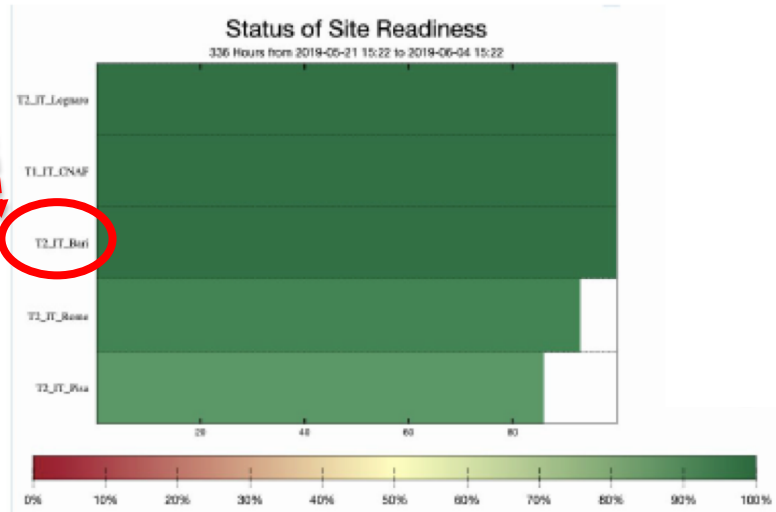
- **The Bari CMS-T2 is the 2nd best reliable site in Italy** (even considering long time periods)

Last 3 months



It is the 2nd site in Italy after the T1 as far as the CPU resources' usage is concerned :

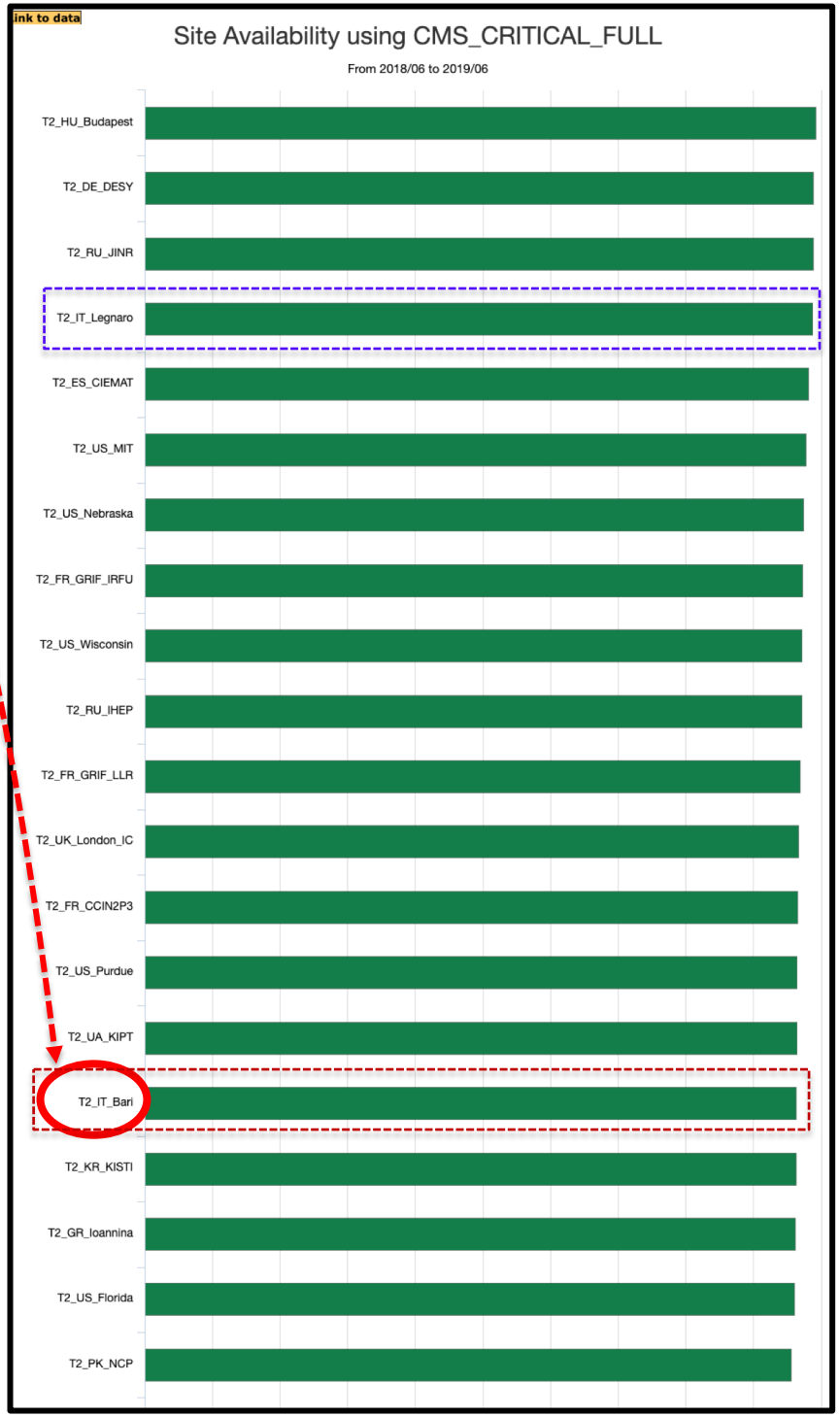




Last 2 weeks

CMS-T2 operational status - II

- The Bari CMS-T2 is a reliable site also considering the international «landscape»:



- G. Donvito is replacing G. Maggi as CMS-T2 manager

- G. Donvito, G.Maggi, L. Cristella (CMS side) *et al.*, but - regardless the official affiliations/tags – all IT group (staff & TD) collaborates, at different levels of involvement, to the maintenance of infrastructure and computing resources !

CMS-T2 : tenders' status & new resources

- New purchases on 2018 funds for the Bari T2 concern only storage : 600TBN (Lenovo) are arriving
- The situation of italian pledges is not good (well <13% of CMS)
  Italian T2s are requesting in 2020 to rescue the **cuts experienced in 2019**.
- Future purchases on 2019 funds (2020 requests), either for CPUS and storage,
  will be (fully) funded but on funds of PON IBISCO, for the Bari T2
- Let us consider the ***standard scenario*** (1. flat distribution of new resources among the 4 italian T2s,
  2. missing pledges to be fully rescued)

Richieste 2020 Tier2, scenario A

- Italia: 13% di CMS
- 1 TBN = 140€
- 1 HS06 = 10€

Recup. pledge	Fraz. pledge PON
1	0.25

	recupero D-pledge 2019 (kHS06)	recupero D-pledge 2019 (TBN)	Dismissioni 2019 (not granted)	Dismissioni 2020	Totale dismissioni CPU	Dismisioni 2020 disco	Totale CPU	Totale disco	CPU (euro)	Disco (euro)	Recupero pledges CPU 2018 (Eur)	Rete	Server	Totale (euro)
			kHS06	kHS06	kHS06	TBN								
Bari	2.75	217.5	0.00	4.6	4.60	640	7.35	857.5	73500	120050		5206.25	6774.25	205530.5
Pisa	2.75	217.5	2.55	4.75	7.30	120	10.05	337.5	100500	47250	8400	4196.25	5171.25	165517.5
Legnaro	2.75	217.5	4.05	6.9	10.95	704	13.70	921.5	137000	129010	18800	7335.25	9310.35	301455.6
Roma1	2.75	217.5	2.45	5	7.45	0	10.20	217.5	102000	30450	10600	3821.25	4635.75	151507
Totali	11	870	9.05	21.25	30.30	1464	41.30	2334	413000	326760	37800	20559	25891.6	824010.6

→ IBISCO

Spesa extra PON: 618481 €

CMS-T2 requests in 2019-21 (IBISCO for Bari)

- However the problem is that IBISCO tenders will be concentrated in just one (!) either for CPU & storage at the end of 2020 (or even beginning 2021); thus new computing resources will arrive **only** in 2021!
  This is a relevant issue because of the obsolescence of wide part of the CPUs .

- **In the next 3 years the Bari T2 will be bringing into production 2.7PB of disk & 4000 cores !**

  Considering only the resources pledged for CMS **it would be like doubling the current farm**.

- **IBISCO will be much wider than that! [** see G.Donvito's presentation on projects/external funds **]**

Tier2: acquisti/anno 2019-21 (overview richieste)

Assumendo zero recupero "d-pledge 2019" nel 2020

Disco/tier2 (d-pledge)	218	0	725	
Acquisti Disco Tier2 (TBN/anno)	2019	2020	2021	TOT (19-21)
Bari	358	640	1695	2693
LNL	394	704	1605	2703
Pisa	218	120	1075	1413
Roma	218	0	1225	1443
Totale	1188	1464	5600	8252
CPU/tier2 (d-pledge)	2.75	0	12.5	
Acquisti CPU Tier2 (kHS06/anno)	2019	2020	2021	Tot (19-21)
Bari	15.7	4.6	20.5	40.8
LNL	10.4	10.95	15.5	36.85
Pisa	3.5	7.3	22.9	33.7
Roma	7.3	7.45	15.5	30.25
Totale	36.9	30.3	74.4	141.6

- Assumendo gli incrementi pledge 2021/2019 della slide precedente
  - Incluso il d-pledge ½ del 2019 "ritardato" al 2021
- Incluse le dismissioni di CPU e storage
- N.B.: Per il 2019 i numeri sono quelli gia' finanziati

- D-pledge 2019 not granted (tier2 federation)
  - CPU: 11 kHS06
  - Disk: 870 TBN
- D-pledge: 2021-2019 (estimated)
  - CPU: 39 kHS06
  - Disk: 2028 TBN

Previsioni spesa 2021: ~ 546 k€ (storage) + 539 k€ (CPU) nel 2021 (extra PON)

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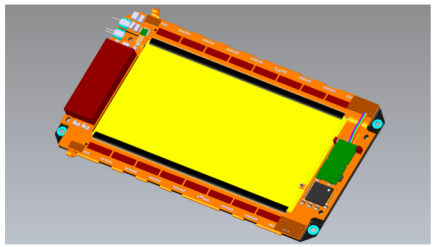
CMS Phase-2 Upgrade & related activities : TRACKER

INFN-Bari Outer Tracker (OT) Phase-2 contribution

Deliver Tilted Inner Tracker mounted, integrated and tested with 1956 PS modules
(≈ 40 m^2 surface detector)

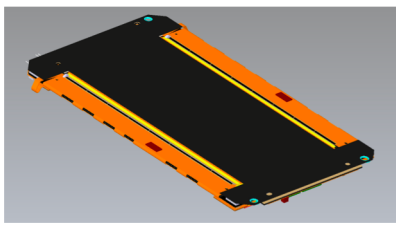


- Development and Qualification
  - Service Hybrid testing (Genova)
  - FE Hybrids testing (Catania)
  - Silicon Sensors Process Qualification (Perugia)

- Construction and integration of PS Modules (1956 installed)
  - module assembly, wire bonding and testing (**Bari**, Perugia)
  - module Burn in and Calibration (Pisa)
  - module mechanical integration and testing in 72 rings (Pisa + all)

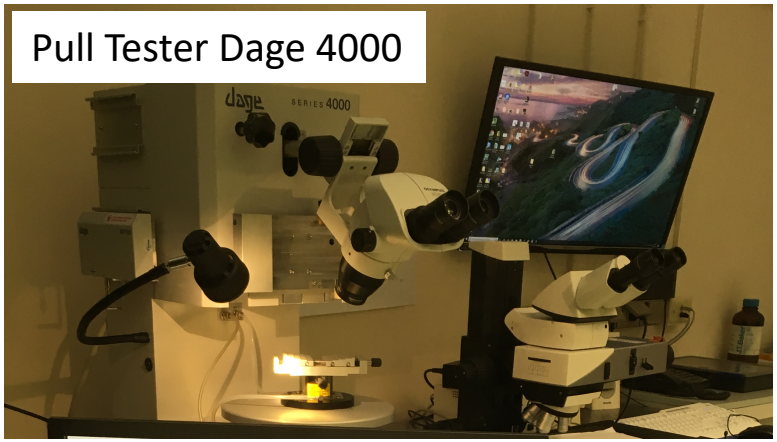
- **D. Creanza**
- **M. de Palma**
- **L. Fiore (Resp. of Center)**
- **S. My**
- **A. Mongelli**
  (Mech. Design Service)
- **Clean Room (P. Cariola)**
- **Mech. Service**

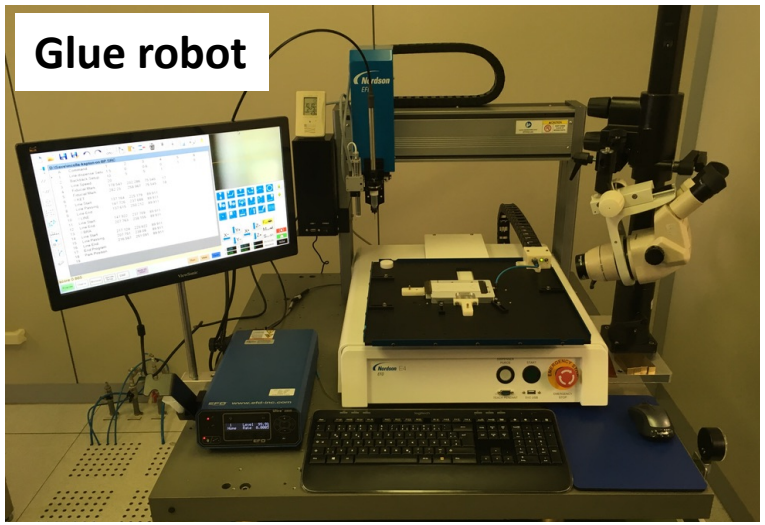
- Contribution to development, qualification of commons systems
  - Track Trigger electronics system (Pisa)
  - Power supply system (Firenze, Perugia)
  - DAQ and Control Systems (Pisa, Catania, **Bari**)
  - Safety System (Pisa)



D. Creanza is the Responsible Person of the OT module construction in Italy

OT activities : operational infrastructure

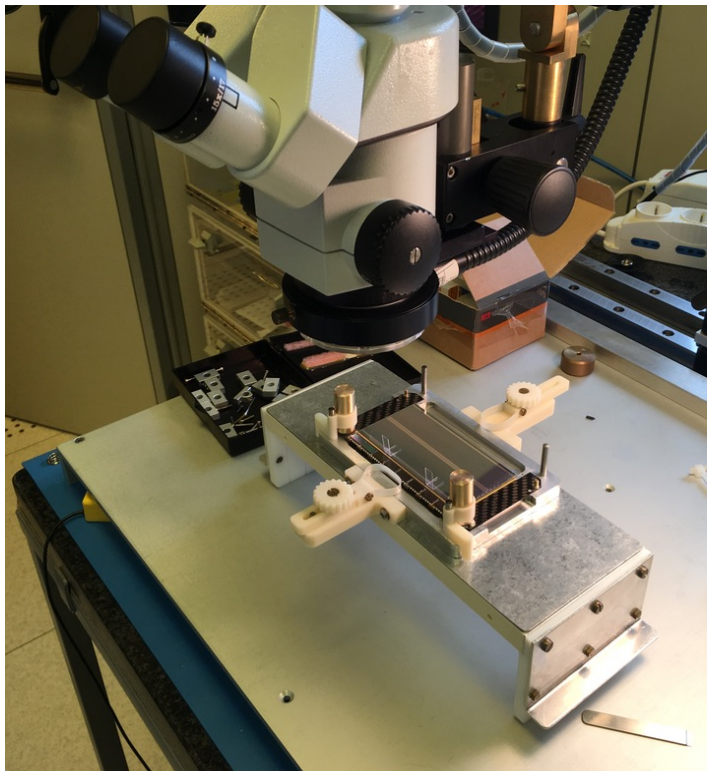


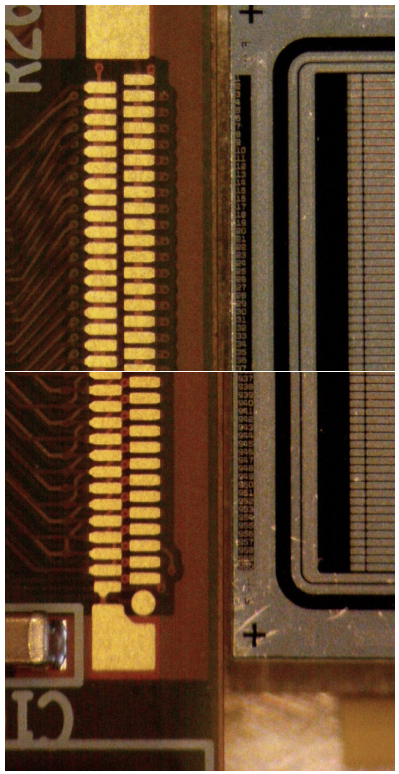


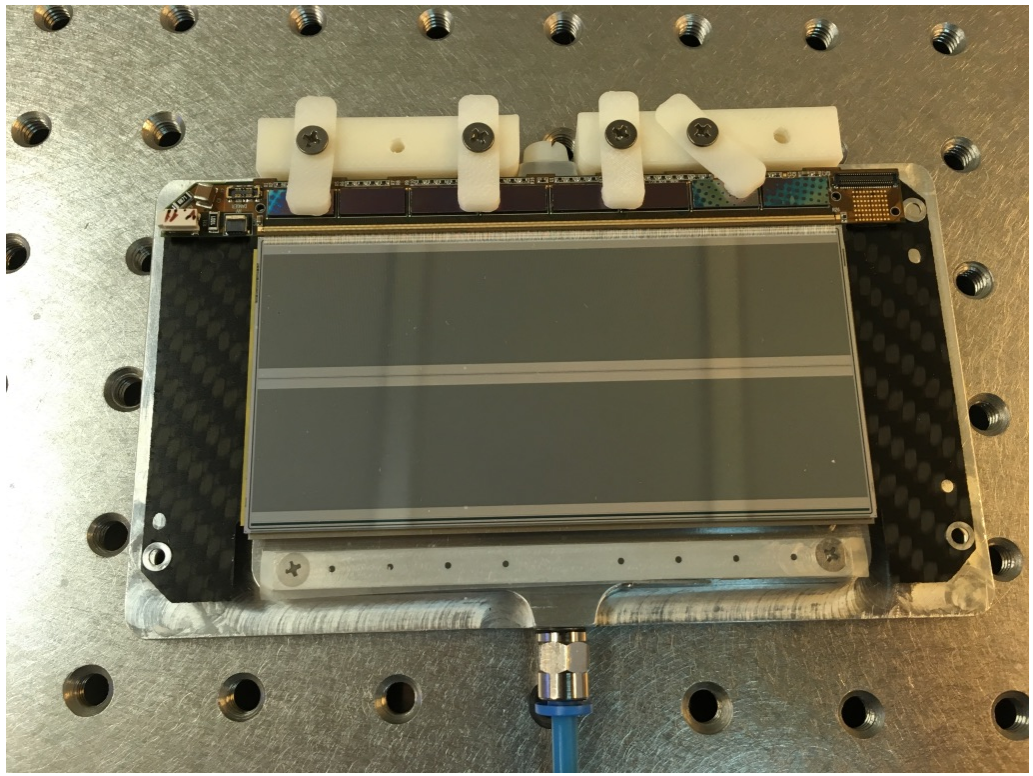
Recent purchase & setup of the Bari glue robot

- The Pull tester & the bonder were intensiveley used for the ALICE modules and now are ready to deal with the CMS PS modules

OT activities : test of readout hybrid assembly jig







The alignment of the hybrid bonding pads vs the sensor pads has been done necessarily using a microscope

Mechanical PS module after a bonding test

OT activities : 2019-2020 plan

- **So far : 2 mechanical modules has been assembled using the prototype jigs,**

  just to setup the infrastructure (assembly lines) in the Clean Room.

- In the fall of 2019 we should get the **final set of jigs**

- We plan to build at least 3 dummy modules within the end of 2019 to allow

  ... the assembly of the 5 functional modules during 2020, to qualify the Assemby Center

- So far we have only 5 PS-S dummy sensors (2 or 3 more are coming) and we are waiting

  for the full set of components.

OT activities : requests for 2020

- In order to get 5 **functional modules** done for the center qualification we need to:
  - finalize & optimize the assembly jigs
  - fine tune the test system
  - study meticulously the procedure for the modules' production

Correspondingly our personpower requests for 2020 are (evaluated in *mesi persona*):

SERVICE	REQUEST	Activity
Progettazione Meccanica	**6**	jigs' design
Officina meccanica	**3**	jigs' optimization
Camera Pulita	**12**	functional modules

- We are optimizing the 2020 funding requests together with the other Tracker sites
  ... under the coordination of the Tracker activity responsible (RA)

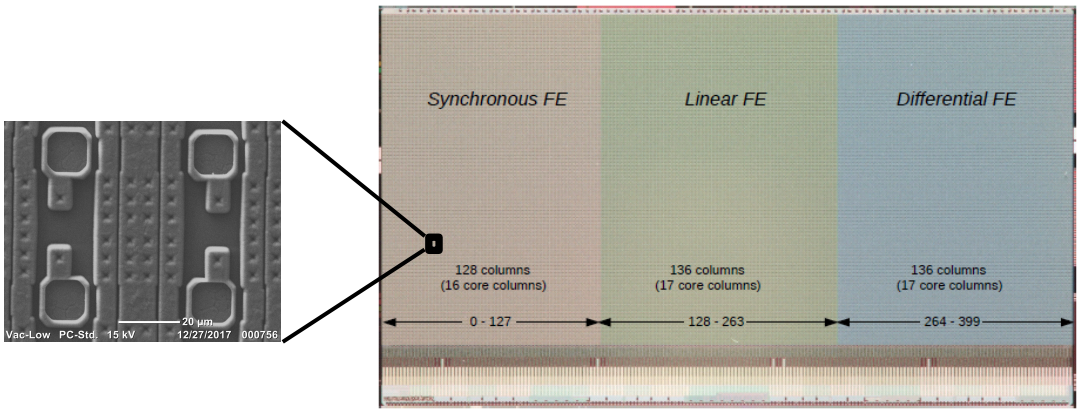
- In 2020 we'll have an «assegno di ricerca tecnologico» for 2 years
  (assigned on central funds and according to the plan in the CTS doc)

CMS Pixel Chip for Inner Tracker (IT) : development for Phase-2

Activity started in 2013 within the Collaboration ***RD53*** & the experiment ***CHIPIX65*** (INFN-Gr.V)

Purposes/timeline :

1. **Study of the radiation tolerance of the TSMC CMOS 65nm technology**, to evaluate the adequacy for the more inner layers of the tracker (radiation level > 500Mrad)
2. **Development of a Front-End library & IP blocks** on the basis of the CMS & ATLAS requirements/specs
3. **Design, production & test of a pixel chip demonstrator** (64x64) within Chipix65 (2016)
4. **Design, production & test of a pixel chip demonstrator** (large scale «RD53A») (2017-2018)
5. **Design of the «production» pixel chip for CMS & ATLAS** (2018-2020) on the basis of the measurements carried out on the RD53A demonstrator and of the final specs of the two experiments.



RD53A:

- **size: 20.066 x 11.538 mm**
- **400x192 pixel array**

CMS-Bari contribution to IT

- **Personpower : F. Loddo, G. De Robertis, M. Ince**

- **Responsibilities :**

  - since June 2016: F. Loddo is Project Engineer,
  with responsibility of the overall coordination and the chip integration

  - since May 2018: F. Loddo is responsible of the development of the pixel ASIC
  within the "IT coordination" for the Phase-2 upgrade

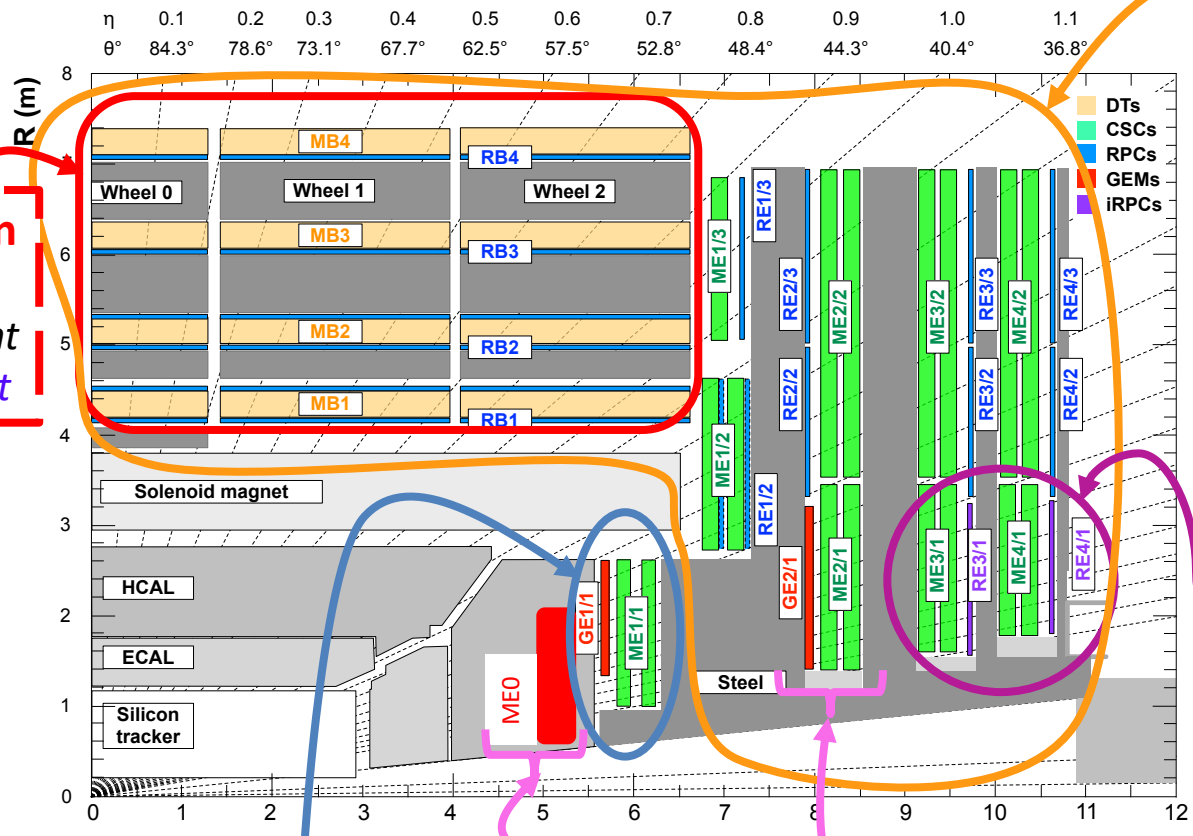
- **Design :**
  - 10-bit Digital-to-Analog Converter for the bias of the analog Front-End
  - architecture & implementation of the bias circuit
  - chip Floorplan
  - study & implementation of circuit design solutions
    to enhance the chip testability during the production phase

- **Activity foreseen in 2019-2020 :**
  - participation to the pixel chip design & submission to factory (foundry) foreseen for :
  - Q3 2019 for the Atlas version of the chip
  - Q2 2020 for the CMS version (CROC) of the chip

CMS Phase-1/2 Upgrade & related activities : MUON SYSTEM

- A. Colaleo, Muon System Manager
- G. Pugliese, RPC System Manager

Overwiew of CMS-Bari Muon system activities



4

RPC Leak Repair campaign

- *priority for CERN to reduce GWP exhaust to environment*
- *heavy CMS-Bari involvement*

5

RPC Ecogas Studies

- *poss. replacement R134 → HFO*
- *studies under bkg radiation in GIF++*

3

Improved RPC (RE3/1 & RE4/1)

- *prototype Tests*
- *services installation*

1

GEM GE1/1 Project (CMS Phase-1 upgrade)

- *Construct & Qualify 144 Triple-GEM detectors*
- *installation during LS2*

Priority of CMS during LS-2 all eyes are on us!

GEM Phase-2 upgrades: GE2/1 & ME0

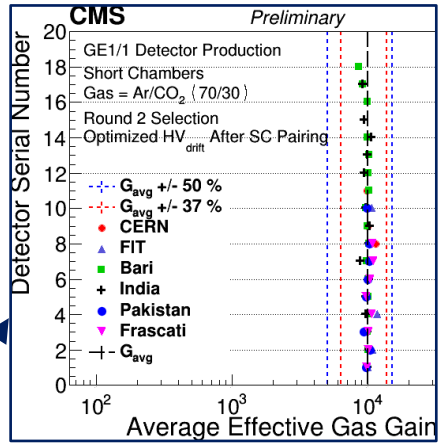
- *prototype Design & Construction*
- *discharge tests @ Neutron Facility*
- *simulation of various HW design*
- *simulation of HGCAL & Neutron Bkg*

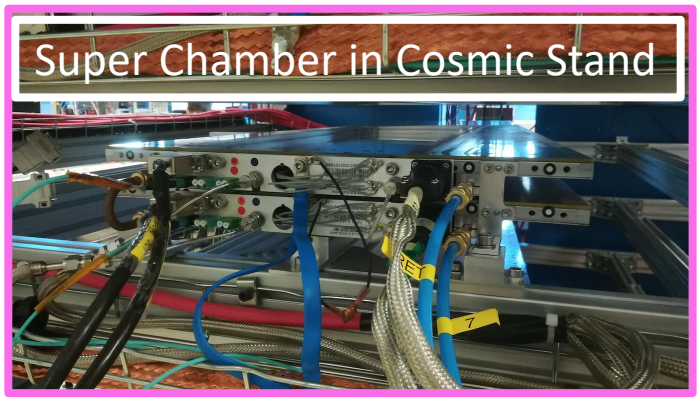
2

Construction & Test of GE1/1 detectors 1

- **GE1/1 Production finished** (160 constructed / 154 valid - 144 needed)
  - **Bari produced 18 chambers in 2018; first site to finish production**
  - also contribution in **testing & installing the chambers,** installing the services.
  - **A. Ranieri, S. Nuzzo, R. Venditti, A. Sharma, E. Soldani, P. Verwilligen, F.Simone**
    + technicians (M. Franco, N. Lacalamita, S. Martiradonna, D. Dell'Olio)
    + students (C. Aruta, F. Ivone)

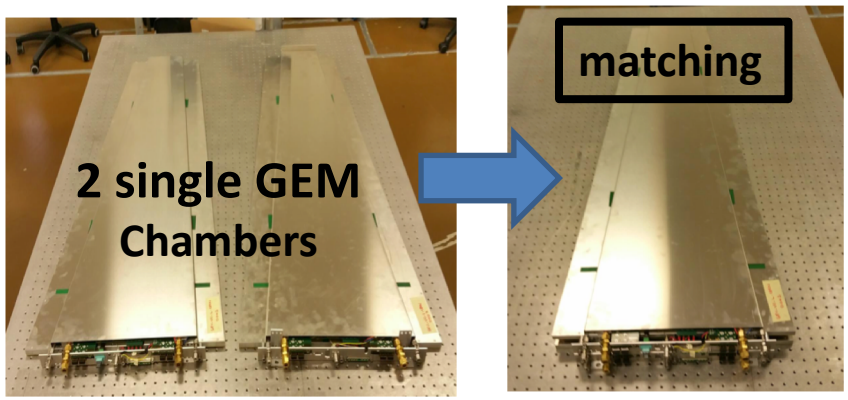
- **Super Chamber (SC) assembly ongoing:**
  - equip 2 chambers w/ electronics
  - **J. Merlin (GEM production manager), S. Nuzzo**
    + technicians (P.Dipinto, D.Dell'Olio)
  - *Analysis of Chamber data x matching*: **E. Soldani**

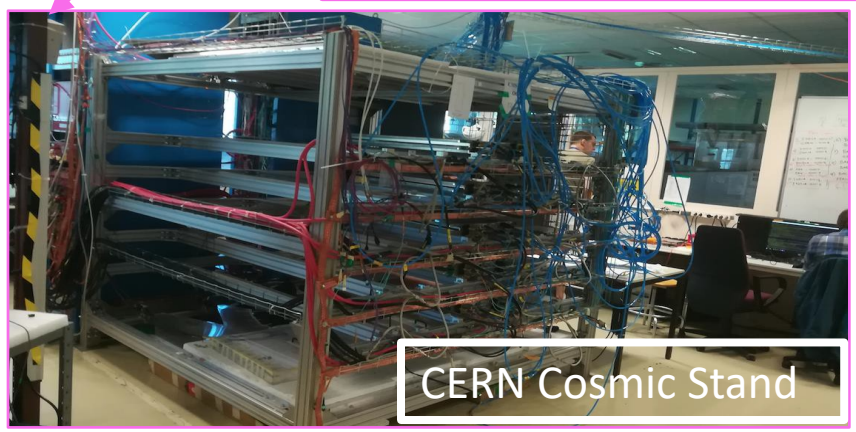




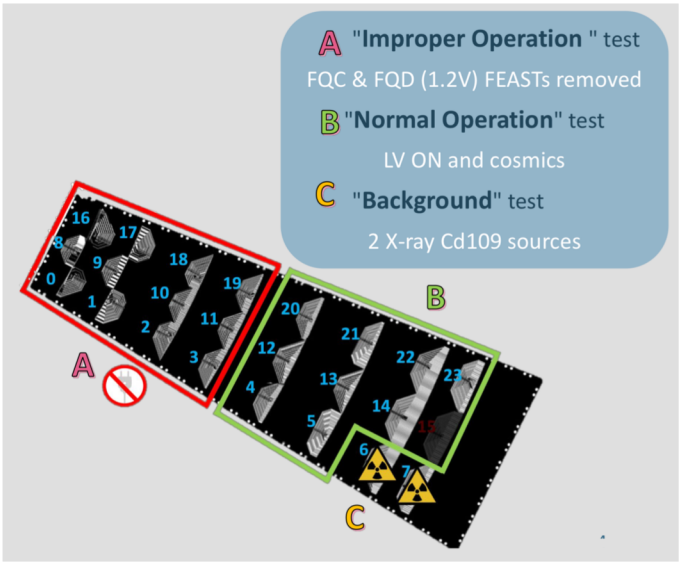
- **VFAT3 design, production/test & packaging**
  G. De Robertis, F. Licciulli (+ P. Mastrapasqua)

- **QC6-7-8 ongoing at CERN: Cosmic-Ray Stand**
  - *Bari physicists in leading role*: **M. Maggi (GEM Run coordinator), F. Simone**





GEM Sustained Operation Studies 1

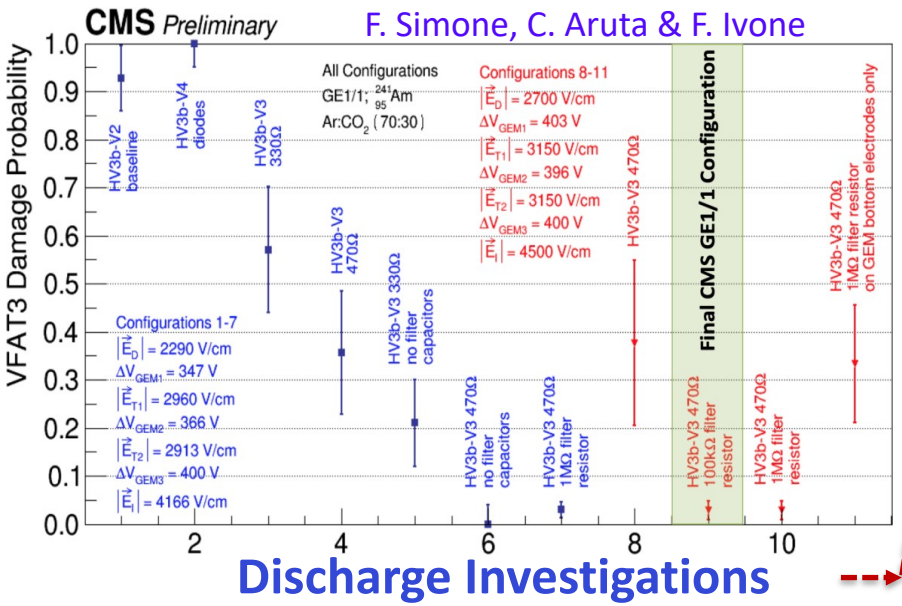


- **Slice-Test (2017-2018) was a success:**
  - Integration in central CMS operations (DCS & DAQ)
  - Experience in running GEMs under high background
    --> found abnormal channel dead rate

Creation of workgroup to reproduce in Lab & Mitigate for final installation

- *Bari Expertise on electronics indispensable*: **G. De Robertis & F. Licciulli**
- **F. Simone +** students **(F. Ivone, C. Aruta)** **(all** *giving crucial contribution)*

F. Simone, C. Aruta & F. Ivone



R&D campaign (GEM «Sustained Operation») lauched this summer to

- **understand the origin of the channel loss**
- study the effect of discharges on **VFAT3 -->** spark-resistant version of hybrid designed under coordination of Bari electronics team

  (after intense test campaign **v3** VFAT3 hybrid was selected for GE1/1)
- **reduce sparks in future Triple-GEM detectors:**
  - Double-segmented foils for GE2/1 & ME0

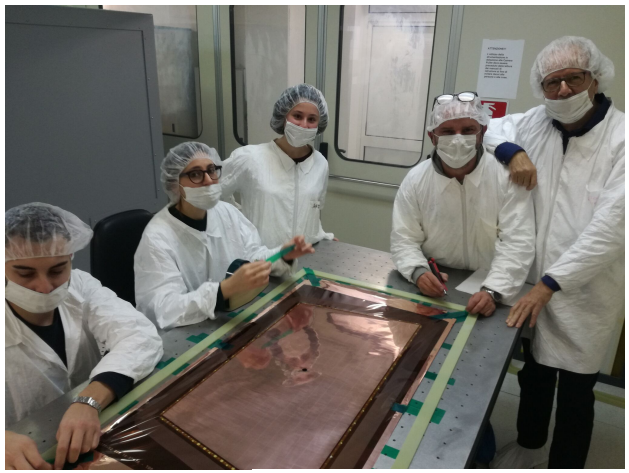
A. Colaleo, M. Maggi, J.Merlin, P.Verwilligen, F. Licciulli, G. De Robertis

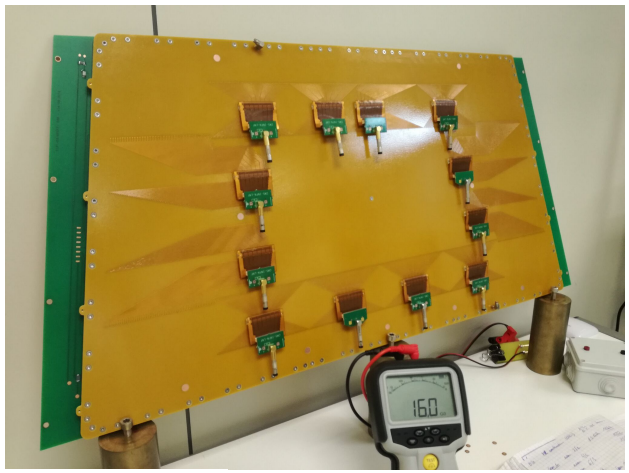
GEM aging studies (V. Mastrapasqua)

GEM Phase-2 activities 2

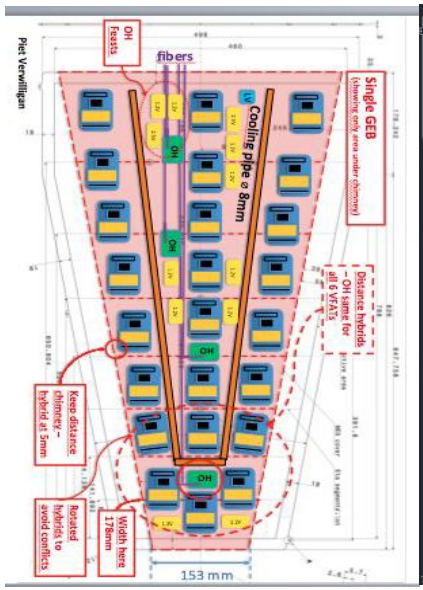
CMS-Bari also involved in GEM Phase-2 activities:

- Construction & Test of GE2/1 Prototypes — **A.Ranieri, R.Venditti, J.Merlin** (GE2/1 prod. manager) **& P.Verwilligen**
- Design of ME0 Readout Board (complex interplay between services, readout, daq & detector) — **P. Verwilligen**
- Stand-Alone & CMSSW integrated simulation of GEM Detectors — **Simulation coordinated by P. Verwilligen**
- Preparation of Phase-2 Electronics: packaged VFAT3: **design** & **tender** — **GEM Electronics coordinated by F. Licciulli**
- Preparation for Neutron Beam Test (Discharges) in October 2019 – in collaboration with INFN Pavia





Construction & Test GE2/1



Design of ME0 readout

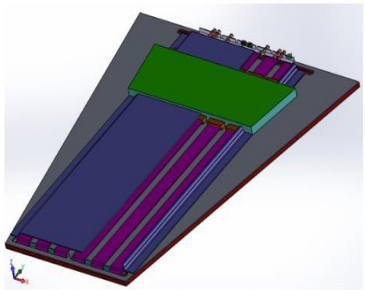
iRPC Design for RE3/1 & RE4/1 : 2D readout 3

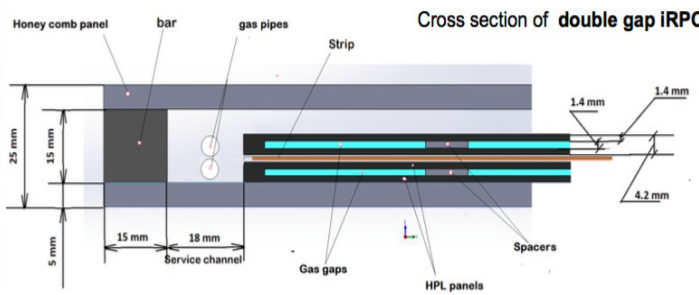
The design of the improved RPC has been defined

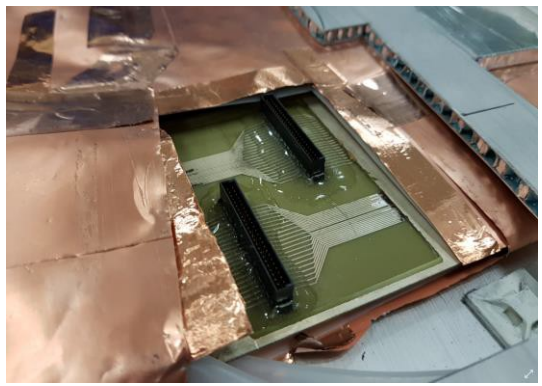
	iRPC	RPC
High Pressure Laminate thickness	1.4 mm	2 mm
Num. of Gas Gap	2	2
Gas Gap width	1.4 mm	2 mm
Resistivity (□cm)	0.9 - 3 x 10^{10}	1 - 6 x 10^{10}
Charge threshold	50 fC	150 fC
h segmentation	2D readout	3 h partitions

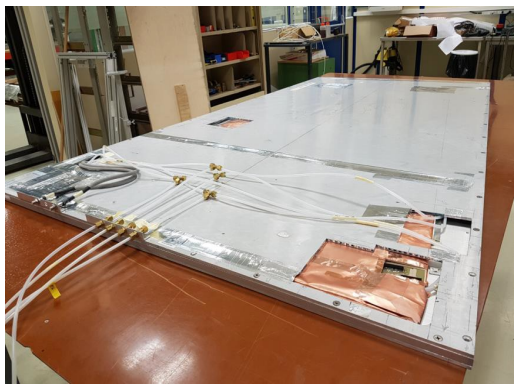
2D readout design:

Readout Strips (with a pitch ≈*0.6÷1.0* cm) are readout from both-ends and connected to a new Front-End Boards equipped with a TDC





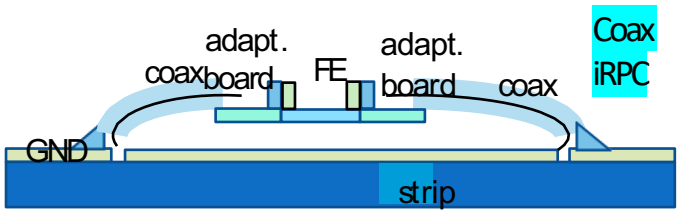


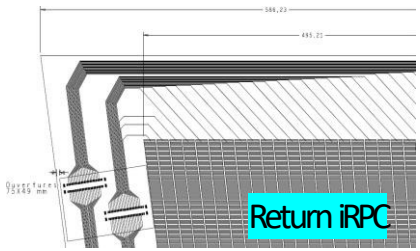


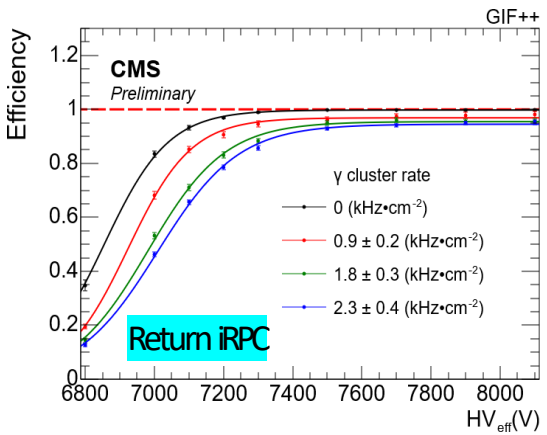
Two full size-RPCs with new FEBs have been tested at GIF++:
- Coaxial design: strips connected to FEB through coaxial cables
- Return design: return lines embedded on PCB

Return design adopted for ease of constr & impedance match

Validation of new FEB_V1 (PETIROC) ongoing @ 2kHz/cm^2 γ





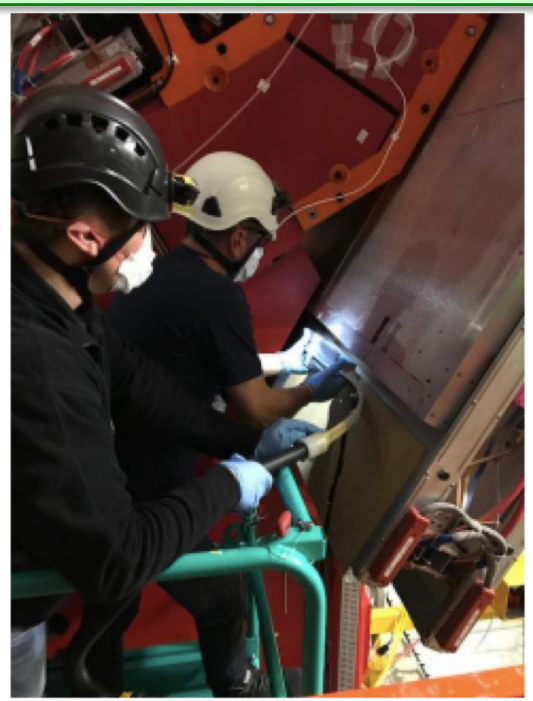


Prototypes tested at GIF++
by **A. Gelmi, R. Aly**

RE3/1 & 4/1 Services
installation by **N. Lacalamita**

R&D upgrade
W.Elmetenawee, I.Margjeka

RPC Gas Leak reparation 4



In 2018, the RPC gas system was operated with:

- **Total flow** ~8800 l/h
- **Leak rate:** ~900 l/h (constant)

Leaky chambers are located:

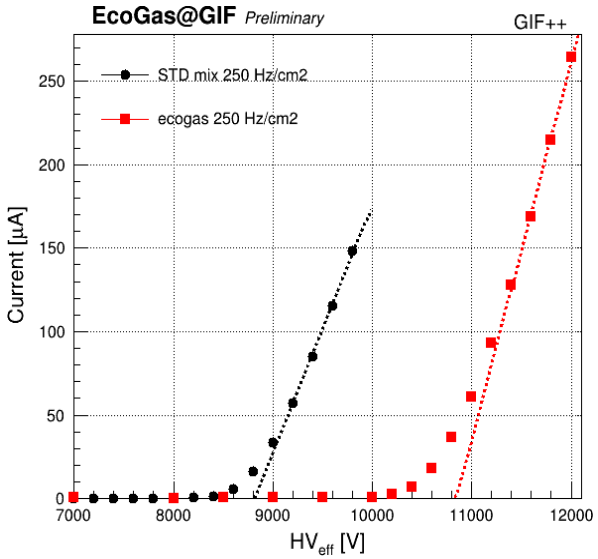
- 63 in the Barrel → 800-850 l/h
- 8 in the Endcap → 50-100 l/h

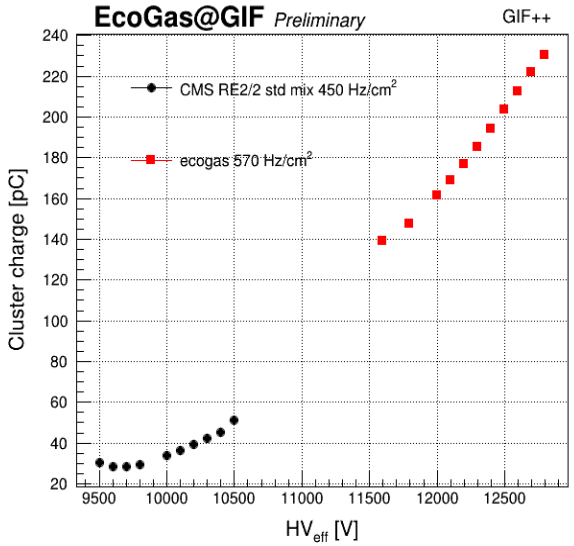
- In the framework of CMS strategy for GHG emission reduction, a massive leak repair campaign started in March 2019.
  - carried out by **G. Pugliese, M. Franco**
  - **Encap region:** five leaky chambers have been replaced with spare chambers, leading to a **leak reduction of ~ 35 l/h.**
  - **Barrel region:**
    - Access to the positive side from April to June 2019. All leaky chambers have been first inspected to localize the source of leak.
    - A new procedure to repair the leaky RPCs was also successfully implemented allowing access to the broken gas component by a partially extraction of the station (RPC & DT). **Strong contribution of Bari Technicians in all phases !**
    - **27% of leaky chambers have been repaired. Leak reduction of ~ 90 l/h.**

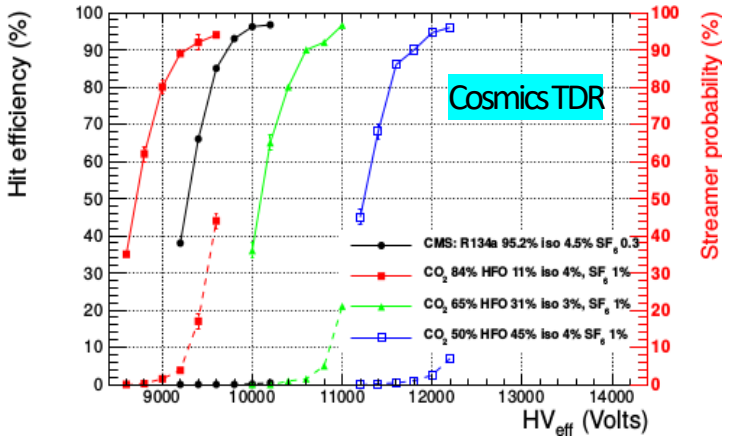
RPC & iRPC Longevity studies @ GIF++ 5

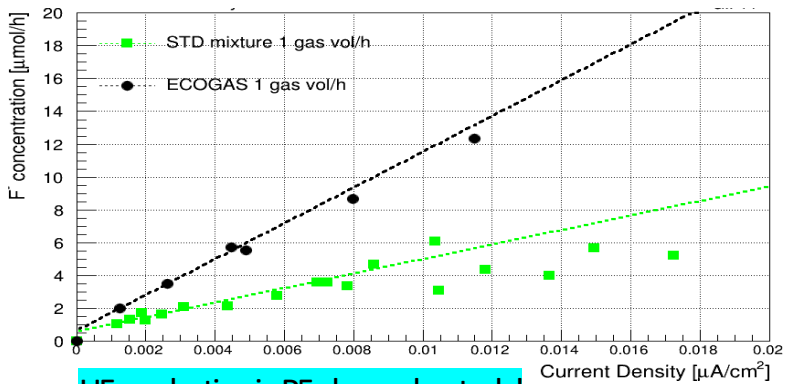
- **Main goal: validate existing RPCs & iRPC for HL-LHC (1C/cm²); test iRPC prototypes rate-capability**
- **GIF++ is interesting place to study RPC detector performance & investigate new GWP-neutral gas mixtures**
  - 5 RPCs (2 CMS, 1 ATLAS, 1 Alice, 1 EP-DT) under test in common project; 1 RPC with CMS electronics
  - Ecogas mix based on HFO1234ze ($C_3H_2F_4$) under study: 45% HFO, 50% CO_2, 4% iC_4H_{10}
  - 2kV shift of HV Working Point @ 250Hz/cm² – in agreement with TDR (Cosmics only)
  - Study of HF production (2.5 x higher) & Study of Cluster Size & Cluster Charge ongoing

carried out by **G. Pugliese, A. Gelmi**









HF production in P5 also under study!

RPC & GEM personpower requests for 2020

Servizio	GEM	Task	At CERN	Access
Progettazione Mecchanica	2	Progettazione Costruzione GE2/1	-	-
Officina Meccanica	8	GE2/1 (2) + SC (2) + Inst & Serv (2.5) + Serv (1.5)	6	-
Camera Pulita	-	Modules Construction GE2/1	-	6
Progettazione Elettronica	-		-	-
Servizio Elettronico	3	Test Setup GE2/1 + Test packaged VFAT3	-	-

Servizio	RPC	Task	At CERN	Access
Progettazione Mecchanica	-		-	-
Officina Meccanica	6	Services (1.5) + Leak (4) + GIF++ (0.5)	6	-
Camera Pulita	-		-	-
Progettazione Elettronica	-		-	-
Servizio Elettronico	-		-	-

GEM Activities 2020:

- [at CERN] Installation 2nd endcap GE1/1; Services GE1/1 & GE2/ [Technicians]
- [at CERN] Data taking & Analysis @ Cosmic Stand; Commissioning @ P5; Global Runs [Phycisists]
- [in Sezione] Construction & Test GE2/1 (40 modules) [Tech & Phys]

RPC Activities 2020:

- [at CERN] Leak Repair Campaign (expertise Bari) + Services RE3/1 & RE4/1 [Technicians]
- [at CERN] Commissionning @ P5 (RE4); GIF++ (ecogas); Global Runs. [Phycisists]

Miscellanea

In 2019 we have done a *CMS-Masterclass* & *participated to the ERN (CMS virtual visit)*

We will host *CMS-Italia annual meeting* (2019 november 13th-15th)

Final numbers/names/responsibilities/requests

Anagrafica for CMS-Bari 2020 – in preparation

- Some colleagues left (F. Errico, R. Radogna, C. Calabria, A. Sharma)

- Some colleagues arrived (J. Merlin - starting; M. Gul - will start soon;
  new PhD students + new master students)

- EXCEL file for *Anagrafica 2020* available (in GOOGLE DRIVE; link circulated among staff)

  https://drive.google.com/file/d/1u0jjYD35y43sdbDMTnUaRnpfV1UzWmnZ/view?usp=sharing

CMS overall request for INFN-Bari services in 2020 - Recap

- Overall requests evaluated in "*mesi persona*" :

SERVICE	TRK	GEM	RPC	
Progettazione Meccanica	**6**	**2**	-	→ **8**
Officina meccanica	**3**	**8 (2+6@Cern)**	**6(@Cern)**	→ **5+12(@CERN)**
Camera Pulita	**12**	(6 access only)	-	→ **12**
Servizio Elettronico	**-**	**3**	-	→ **3**

Current/future Contributions/Responsibilities within CMS

2019 → 2020

BARI				
Responsabilita` subdetectors	**Cognome**	**Nome**	**Livello**	**descrizione responsabilita**
TK	Silvestris	Lucia	L1	Run coordination
MUO	Colaleo	Anna	L1	Muon System manager → ends august 2019
RPC	Pugliese	Gabriella	L1	RPC System manager
FIS	Pompili	Alexis	L2	BPAG convener → starts september 2019
GEM	Venditti	Rosamaria	L2	GEM Upgrade Physics coordinator
TK	Loddo	Flavio	L2	RD53 Project Leader Engineer/TK-Ph2 IT-ASIC Coordinator
GEM	Maggi	Marcello	L2	GEM Run coordinator
GEM	Licciulli	Francesco	L2	GEM Electronics coordinator
CALC	Maggi	Giorgio	L2	T2 site manager
GEM	Merlin	Jeremie	L2	GEM production manager
FIS	De Filippis	Nicola	L3	Future Higgs WG convener
GEM	Llcciulli	Francesco	L3	ASIC-DAQ Integration
GEM	Merlin	Jeremie	L3	GEM GE2/1 Production Manager
GEM	Verwiligen	Piet	L3	GEM Detector Response Modeling Coordinator
GEM	Verwilligen	Piet	L3	GEM Phase-2 Simulation Coordinator
GEM	Verwilligen	Piet	L3	GEM Production Site Manager

Other involvements in Committees : M. de Palma (Career committee)

N. De Filippis (Schools & PhD Thesis awards commitees)

Team responsibilities :

A. Pompili (Team Leader)

S. My (deputy Team Leader / Tracker IB representative)

P. Verwilligen (deputy Team Leader / Muon IB representative)

Trimestral support for young students @ CERN

- **In the period 2016-2019 CMS-Bari benefitted from six 3-month scolarships funded by INFN ("similfellow junior") to support activities of our young students @ CERN, provided through a public call on a merit basis [related to their academic path (marks reported, final degree evaluation)].**
  This number is well beyond the average over the all INFN CMS groups!

Name	Current position
A. Di Florio	INFN post-doc
F. Simone	Phd student
A. Taliercio	Phd student (@Louvain)
F. Ivone	Master student
V. Mastrapasqua	Graduate student
A. Zaza	Master student

Wide support to conference/workshop participation

- **In 2018 CMS-Bari supported a rather wide participation to Conferences & Workshops, (a large part for the non-staff members of the group); this table is the comparison with other INFN CMS groups (not normalized to the number of group members). Our involvement is higher than the average over the all INFN CMS groups.**

	Num. Talks con proceedings	Num. talks senza proceedings
Bari	22	12
Bologna	13	1
Catania	0	0
Firenze	4	3
Genova	3	1
LNF	0	1
LNL	0	0
Milano	7	10
Napoli	7	5
Padova	8	4
Perugia	6	5
Pisa	7	4
Pavia	14	0
Roma 1	6	5
Torino	21	11
Trieste	1	2
TOT	119	64