CSN1

LNF, 09/07/2019

Consiglio di Laboratorio preventivi 2020

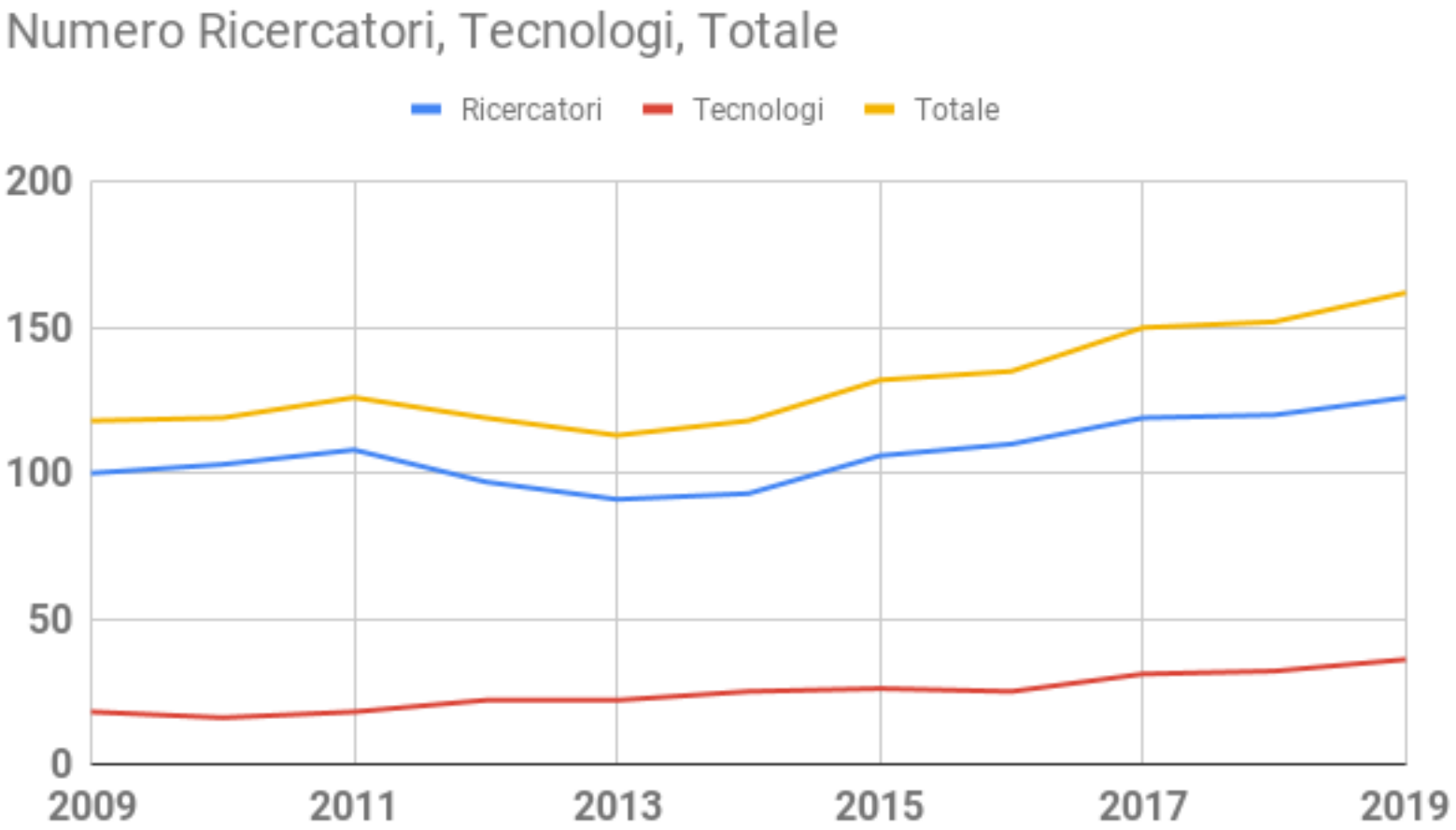
G. Finocchiaro

INFN - Laboratori Nazionali di Frascati

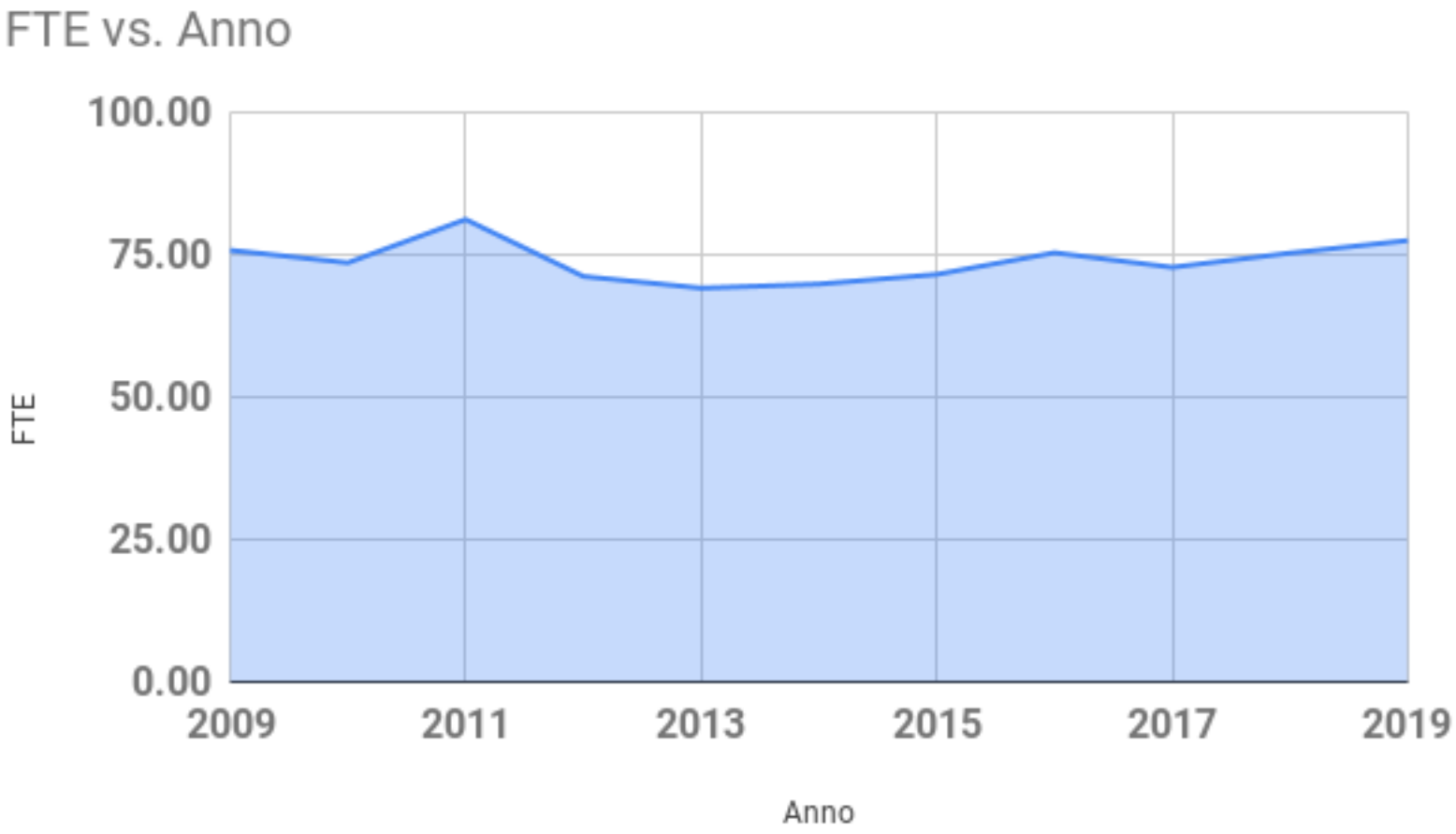
15 SIGLE DI CSN1

- In presa dati
  - ATLAS - BELLE2 - BESIII - CMS - KLOE - GMINUS2_DTZ - LHCb - NA62 - PADME
- In fase di costruzione
  - FASE2_ATLAS - FASE2_CMS - PMU2E
- Proposte / in fase di progettazione
  - RD_FA - SHiP_DTZ
- In evoluzione
  - UA9_DTZ
- Calcolo scientifico

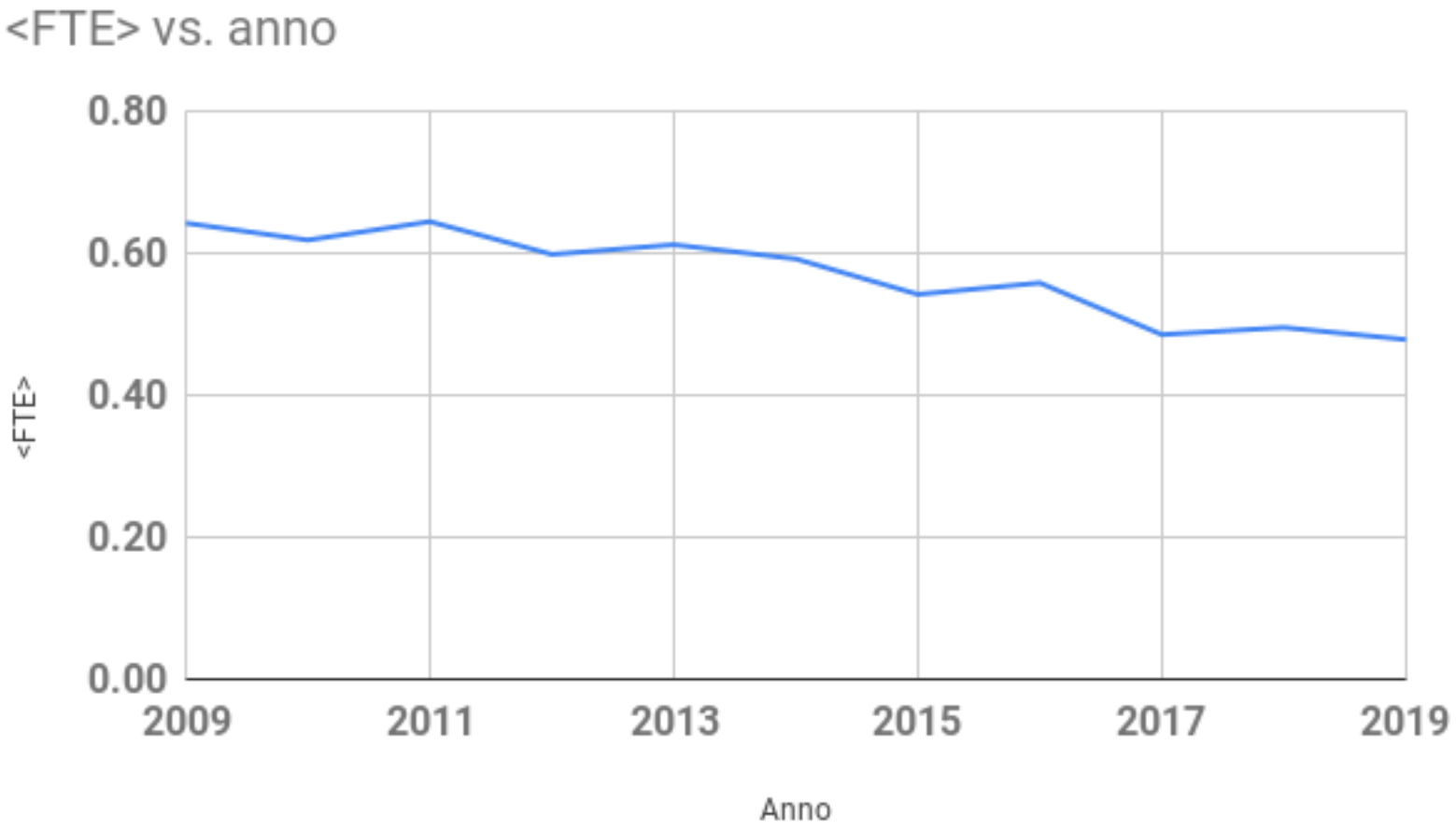
Quanti siamo



Quanti FTE


FTE vs. Anno
100.00
75.00
50.00
25.00
0.00
FTE
2009
2011
2013
2015
2017
2019
Anno

<FTE> LNF in CSN1



Mai così parcellizzati.

Una carrellata delle attività di CSN1

- BES III e ATLAS-ITK discussi in presentazioni dedicate
- Le richieste di servizi, già presentate, discusse e approvate dal CIF, sono mostrate in appendice.

Una carrellata delle attività di CSN1

- BES III e ATLAS-ITK discussi in presentazioni dedicate
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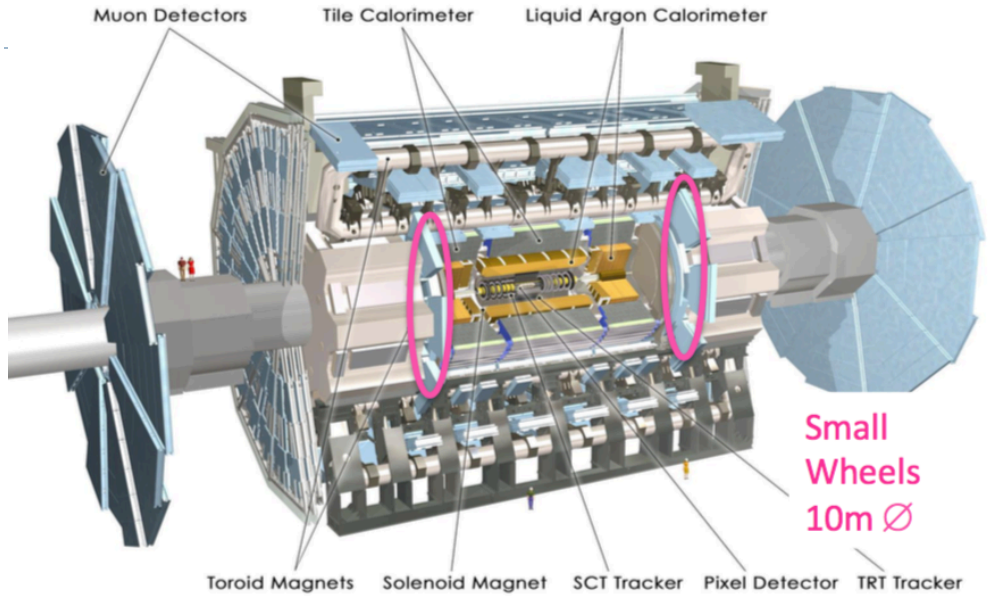
DISCLAIMER:

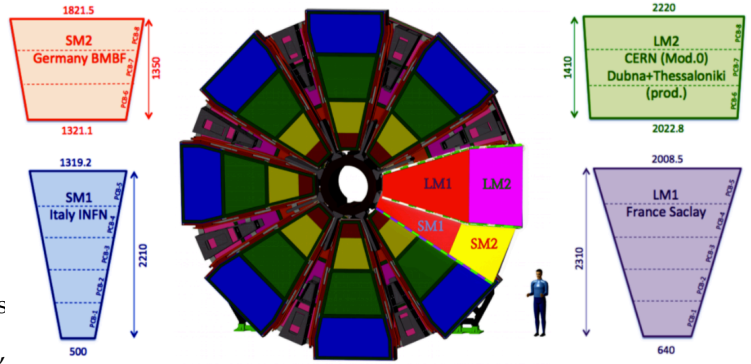
LE ATTIVITÀ SONO TANTE E INTERESSANTI, POTREI SFORARE DI QUALCHE MINUTO

ATLAS (FASE 2) - newSmallWheels



NSW, wheel structure:

- 8 large sectors (LM) and 8 small ones (SM) (2 MM modules per sector)
- MM aim: **precision tracking** (between 2 sTGC chambers for trigger)
- **p_T resolution ~15% at 1TeV**
- 4 type of chambers: LM 1-2, SM 1-2
- production shared between several institutes and industries: **Italy (SM1)**, Germany (SM2), France (LM1), Russia/Greece (LM2 – CERN for drawings and first prototypes)



ATLAS - nSW Status

Number of chambers produced and performances

	Sectors @ 570 V	Spark rate
M3	40	3 with 3 spark/min
M6	37	Ok
M7	40	1 with 7 spark/min on stereo
M8	36	Ok but 1 (26 spark/min)
M9	37	Ok
M10	35	Ok but 2 (5 spark/min) on stereo
M11	37	1 with 30, 2 with 12, 2 with 5 (all stereo but 1)
M12	38	1 with 11, 1 with 5 on stereo
M13	40	-
M14	39	3 with 5, 3 with 10, 1 with 20, 2 with 40

Well within the schedule

Performances and numbers from all sites

SM1	M3	93,8
	M6	90,34
	M7	93
	M8	91,23
	M9	88,12
	M10	89,67
	M11	90,71
	M12	90,48
	M13	93
	M14	92,45

LNF

LM1	M3	86,55
	M4	82,25
	M5	63,48

SACLAY

LM2	M3	88,89
	M4	93
	M5	92,54
	M6	91,75

DUBNA

SM2	M5	92,54
	M6	89,71
	M7	93

LMU

- INFN is now "de facto" leading the project — coordinator by LNF
- LNF is the main INFN site (assembly, tests and complete drift panels)
- **Far better than other sites in terms of performances and number of**
- **chamber produced**
- **LNF team appointed as production manager BIG THANKS TO ALL TEAM**
- **Already promising results on other chambers**

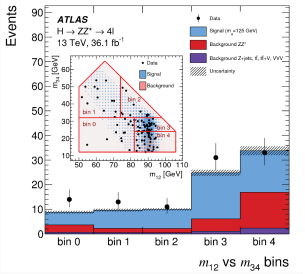
Gruppo 1 LNF, richieste 2020

Sigla	Ric	Tec	FTE	<FTE>	MISS	CON	APP	ALTRO	CAP
ATLAS	13	6	10	0.79	120	40	84	10	INV

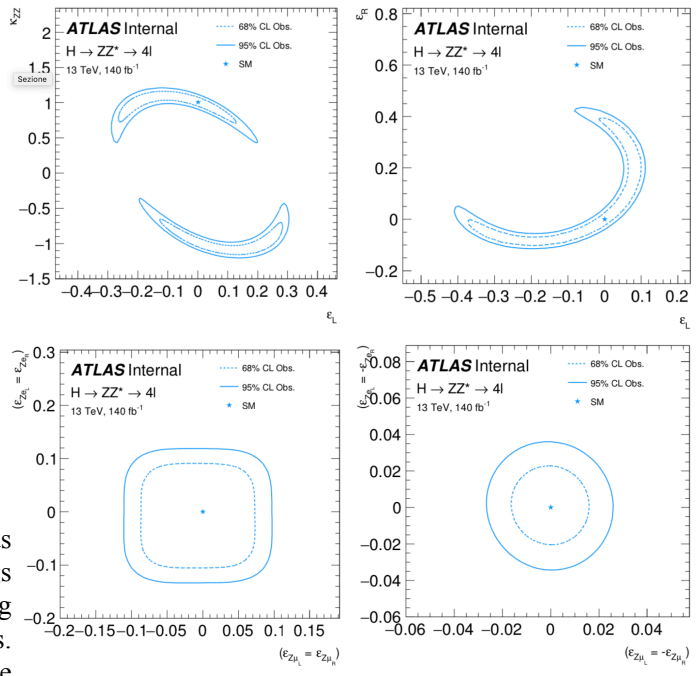
Measurement of the cross section in the H → ZZ* → 4l final state at 13 TeV with 2015-2018 data. Interpretation in the framework of Pseudo - Observables

C. Arcangeletti et al.

- The H→ZZ*→4l decay channel is referred to as the *Golden Chan*nel due to the high signal-background ratio (~2) and to a clear signature for the trigger due to the presence of leptons that comes from the Z bosons decays.
- Differential cross sections measurement can been performed with observables sensitive to the Higgs-boson production and decay modes and the results have been used to test the couplings of the Higgs boson with Standard Model particles and also to put constraints on anomalous Higgs-boson interactions with them using the Pseudo-Observable framework[1].
- Limits are set on modified Higgs boson interactions in this framework. The scenarios considered are:
  - **Linear EFT-inspired:** (κ_{ZZ} vs. $\varepsilon_{Zl(R)}$), where $\varepsilon_{Zl(R)} = 0.48\ \varepsilon_{Zl(R)}$, $\varepsilon_{Ze(L,R)} = \varepsilon_{Z\mu(L,R)}$.
  - **Flavor universal contact terms:** ($\varepsilon_{Z(R)}$vs. $\varepsilon_{Z(L)}$): where $\varepsilon_{Ze(L)} = \varepsilon_{Z\mu(L)}$, $\varepsilon_{Ze(R)} = \varepsilon_{Z\mu(R)}$, $\kappa ZZ = 1$.
  - **Flavor non-universal vector contact terms:** ($\varepsilon_{Ze(R)}$ vs. $\varepsilon_{Z\mu(R)}$), where $\varepsilon_{Zl(L)} = \varepsilon_{Zl(R)}$, $\kappa ZZ = 1$.
  - **Flavor non-universal axial contact terms:** ($\varepsilon_{Ze(R)}$ vs. $\varepsilon_{Z\mu(R)}$), where $\varepsilon_{Zl(L)} = -\varepsilon_{Zl(R)}$, $\kappa ZZ = 1$.
- The contact terms only affect the dilepton invariant mass spectra, then the $m12$ vs $m34$ distribution is used to put limits.

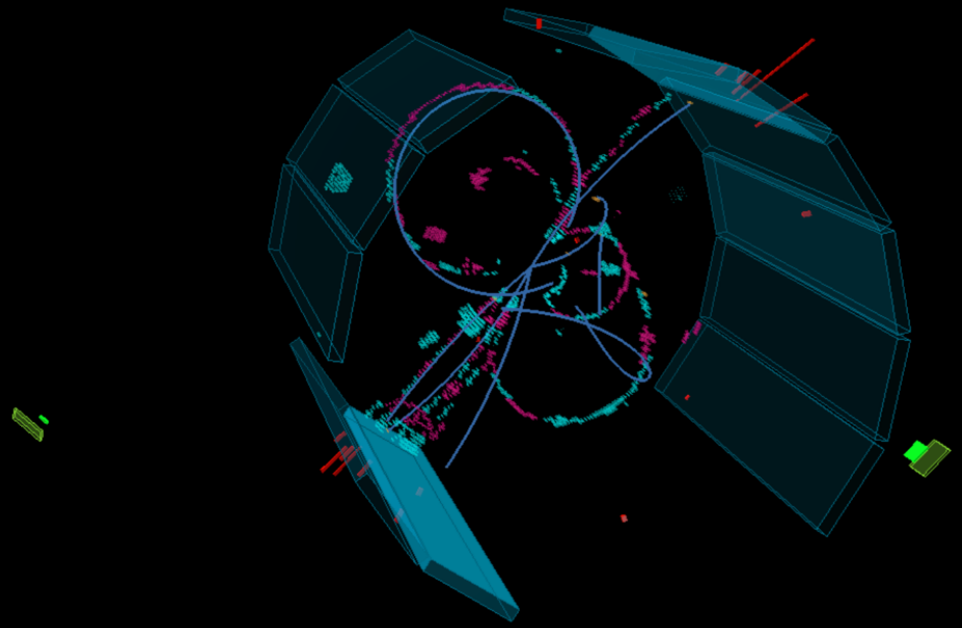


- The cross-section in each bin of $m12$ vs $m34$ has been computed by simulating a grid of couplings values for the given parameters and parametrizing the cross section with 2D quadratic functions. These fitted functions are incorporated into the likelihood and exclusions limits are derived.



[1] M. Gonzalez-Alonso, A. Greljo, G. Isidori and D. Marzocca, *Pseudo-observables in Higgs decays*, Eur. Phys. J. C75 (2015) 128

Belle II (at LNF)

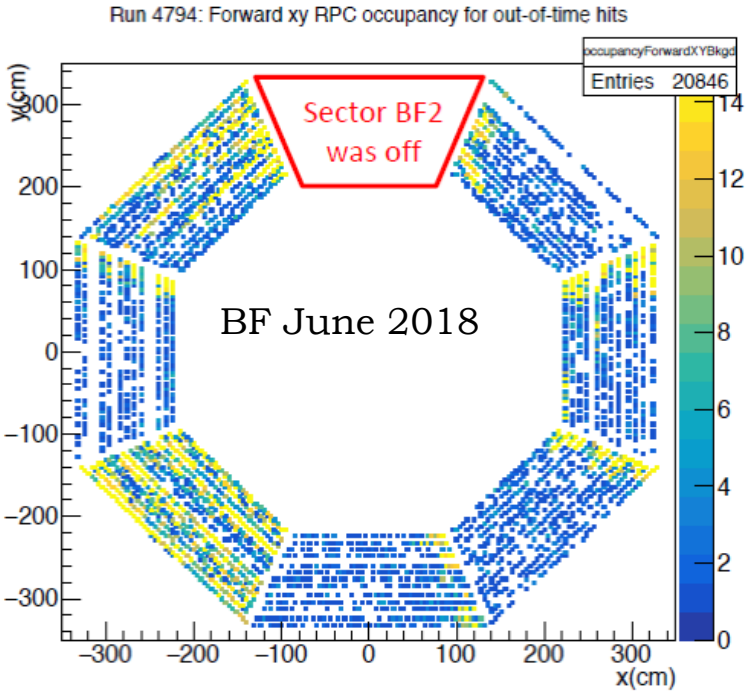


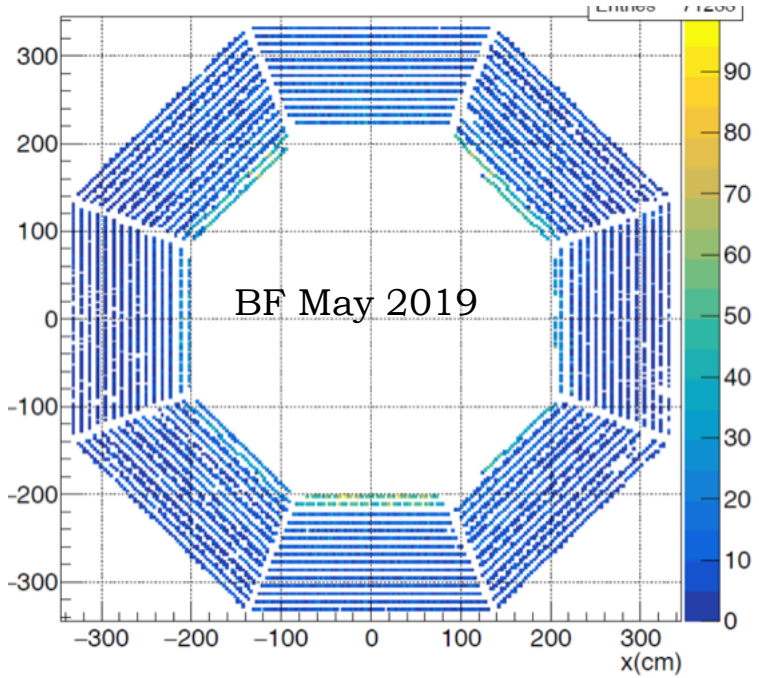
Belle II – Attività 2019

- Hardware
  - Sostituzione dei 16 crate VME contenenti l'elettronica di front end degli RPC del BKLM
  - Manutenzione schede di front end
    - Sostituzione e riparazione
  - Manutenzione apparato RPC
- Software
  - Ottimizzazione clustering KLM
- Fisica
  - Studio efficienza e risoluzione rivelazione di tracce cariche e K_L nel KLM utilizzando eventi $e^+e^- \to \mu^+\mu^-\gamma$ ed $e^+e^- \to \phi(K_S K_L)\gamma$ nei dati di Fase 2 e Fase 3
  - Analisi dati raccolti durante la «Fase 3»

Belle II – Manutenzione apparato

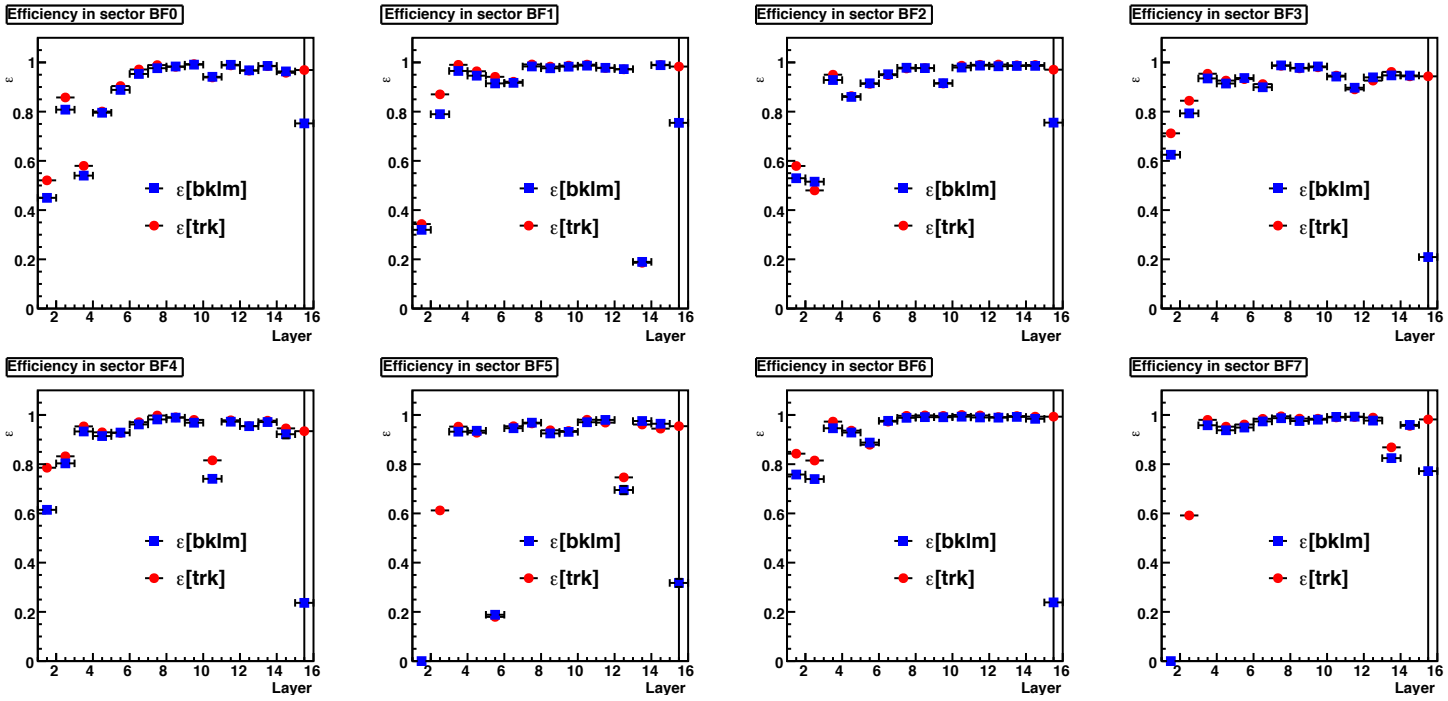
- Intervento a Gennaio per riparare tre crate nei settori BF1, BF2 e BF4
- Ripristinate le connessioni di cavi di segnale disconnessi e sostituiti con cavi di riserva quelli rotti
- Recuperati al 100% tutti i 16 settori barrel BWD e FWD, meno uno nel quale manca l'ultimo layer di RPC perché inaccessibile





Belle II – Studi efficienza tracce cariche

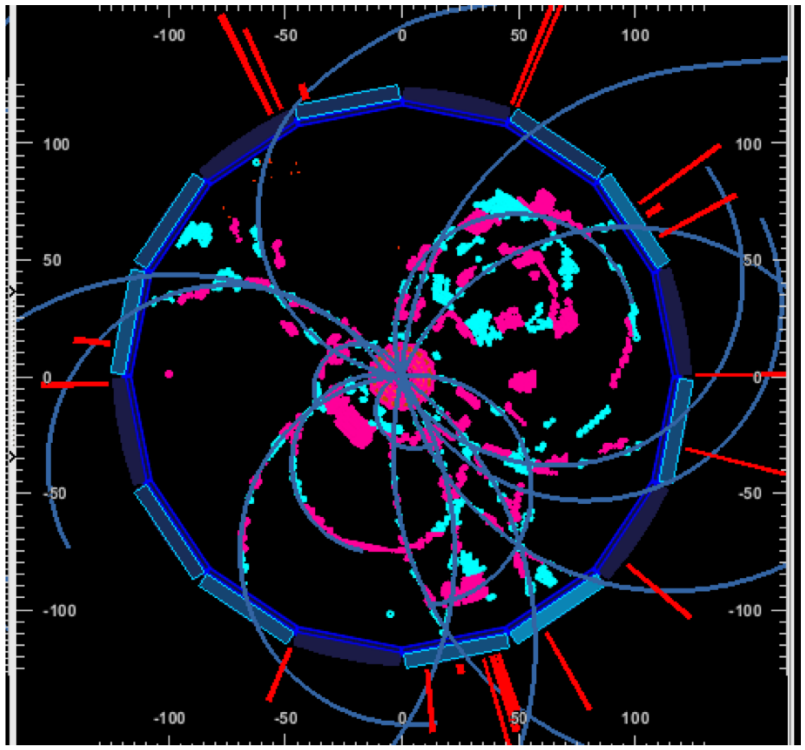
- Hit in corrispondenza di tracce di muoni in eventi $e^+e^- \rightarrow \mu\mu\gamma$ estrapolate nel KLM
- Mappe di efficienza, canali morti ecc. ottenute strip per strip sono inserite nel db e aggiornate nel tempo

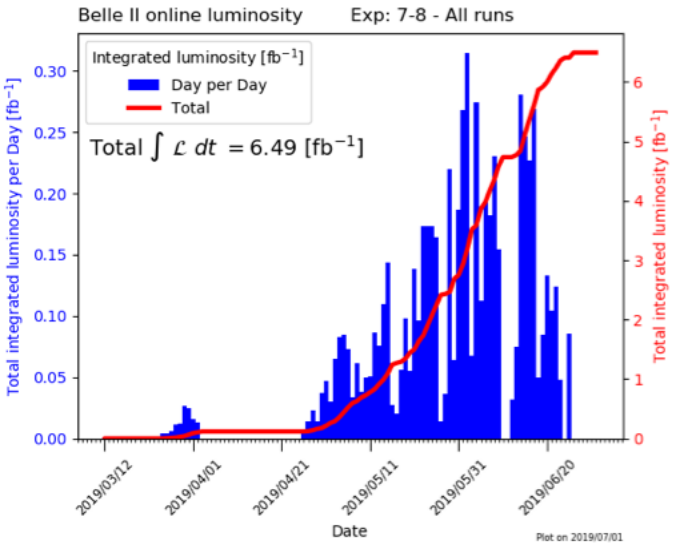


Belle II – «Phase 3» Primo run di Fisica

- Belle II ha iniziato la presa dati nella cosiddetta «Fase 3»
- Iniziata l'11 Marzo 2019, stop di 3 settimane dovuto ad un incendio che ha inondato di fuliggine parte del linac
- Attualmente la luminosità di picco raggiunta è di 1.2×10^{34} $cm^{-2} s^{-1}$ con Belle II spento, 6.1×10^{33} $cm^{-2} s^{-1}$ in presa dati, mentre quella integrata è stata di ~6.5 fb^{-1}
- Parametri raggiunti dalla macchina [goal finale]

β^*_y = 2 mm [0.3mm]
I_{beam} = 660 mA [2.6/3.6 A]
bunches = 1576 [2364]
L_{peak} = 6.1×10^{33} [8.0×10^{35}]





Belle II – Attività previste 2020

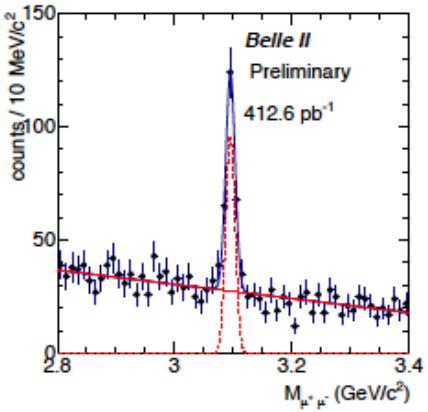
- Hardware
  - Manutenzione schede front end lettura degli RPC
- Software
  - Studio delle prestazioni del KLM come rivelatore di μ e K_L *(*efficienza, risoluzione spaziale, ecc.)
- Analisi
  - Studio del canale di decadimento $B \rightarrow J/\psi\ K_L$

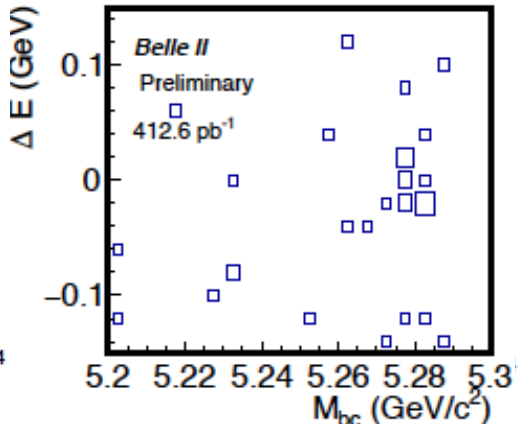
$B^0 \rightarrow J/\psi\, K_S$

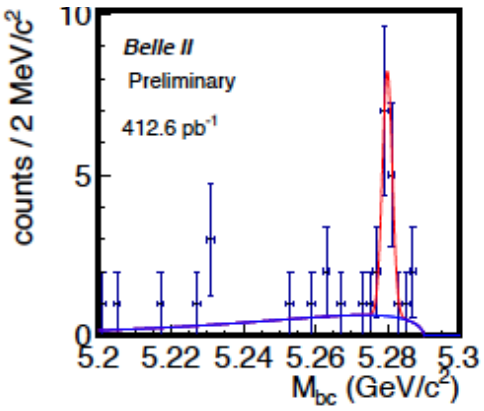
$M_{bc} = \sqrt{(E_{beam}^2 - p_B^2)}$

$\Delta E = E_{beam} - E_B$

$J/\psi \rightarrow \mu^+\mu^-$







Belle 2 LNF, richieste e composizione 2020

Sigla	Ric	Tec	FTE	<FTE>	MISS	CON	ALTRO CAP
Belle II	6	1	3	0.47	58.1	4.5	

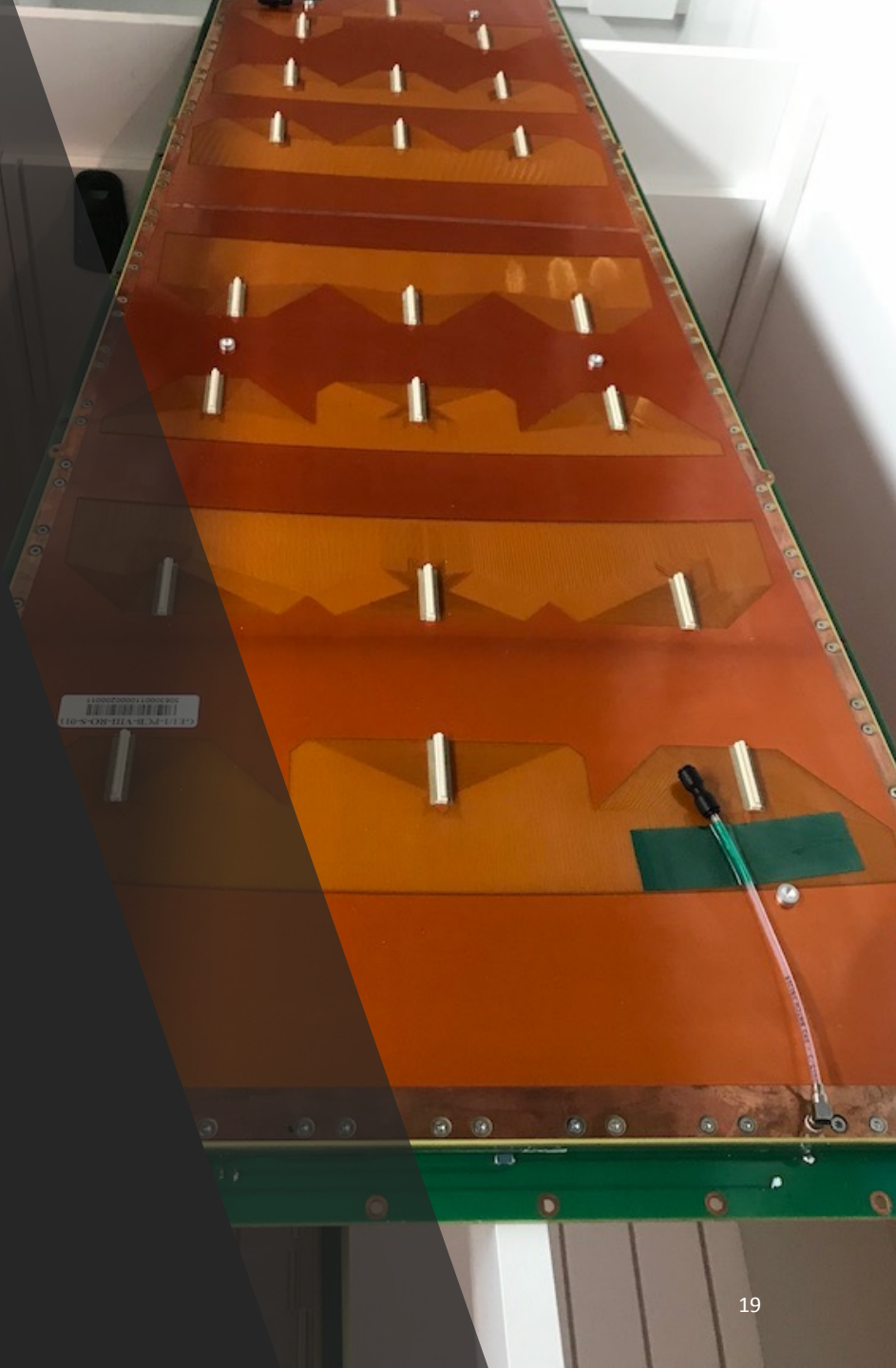
Componenti del gruppo 2020

- M. Beretta (0.2)
- R. de Sangro (Resp.) (0.8)
- G. Finocchiaro (0.8)
- B. Oberhof (AR) (1.0)
- P. Patteri (0.2)
- I. Peruzzi
- M. Piccolo

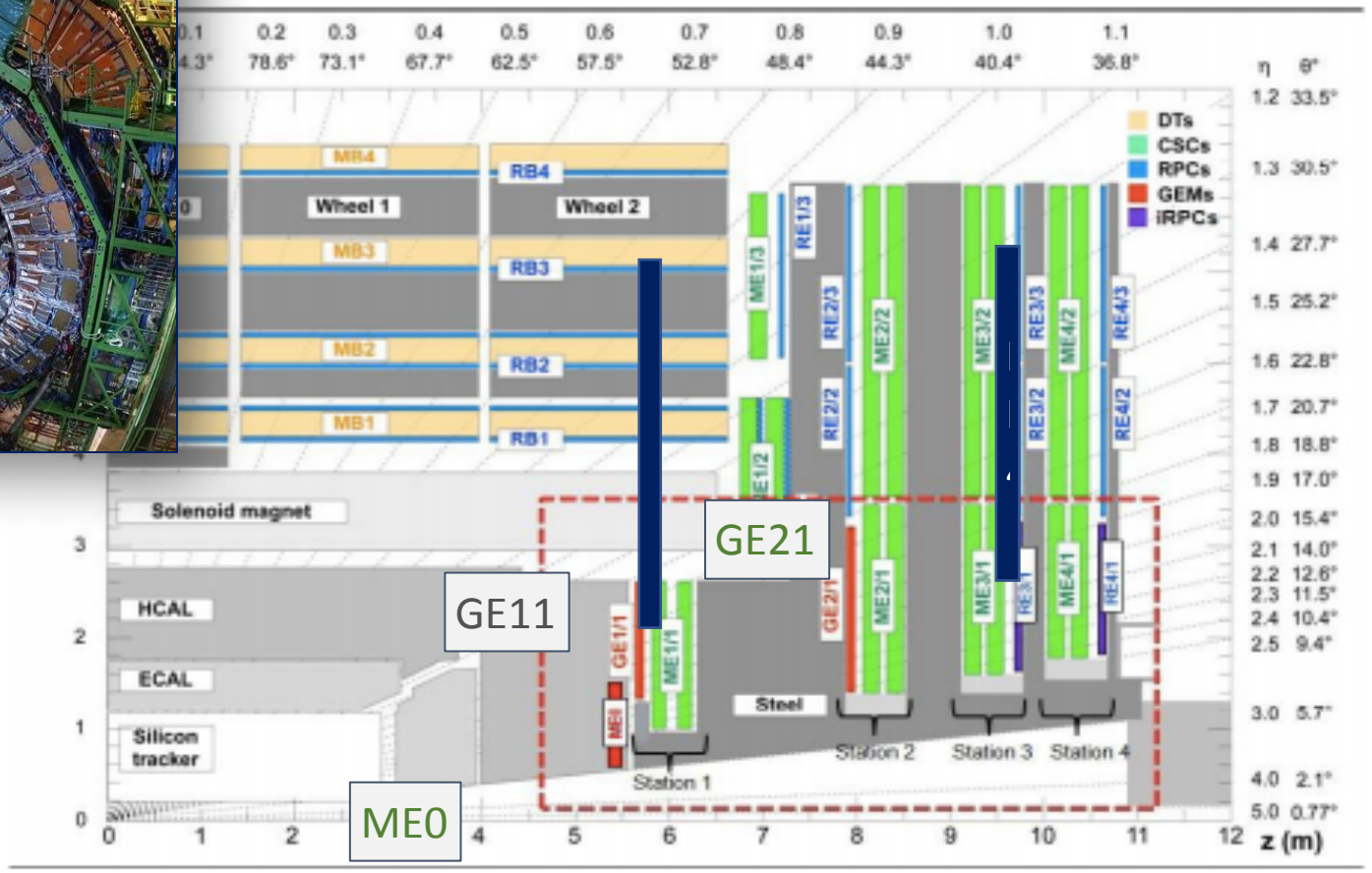
Responsabilità

- R. de Sangro - Resp KLM Italia, Belle II Shift Manager
- B. Oberhof - Contact KL reconstruction
- I. Peruzzi - Chair Sdello peakers Committee

CMS Frascati 2019-2020



CMS Forward Muon Upgrade: GEM



GE1/1: GEM Endcap Ring **1** Station 1

CMS FRASCATI Attività 2019-2020

- Assemblaggio SuperCamere GE1/1 (ongoing @CERN)
- Sito di produzione GE2/1 e ME0 (inizio produzione GE2/1 previsto prima metà 2020 – Soggetto a modifiche della schedula LS3)
- L'Installazione GE1/1 in CMS inizierà in autunno 2019
- R&D eco-gas e studio compatibilità materiali con nuove miscele
- Sviluppo sistema sensori FBG per monitoring temperatura delle camere GE1/1, GE2 (in P5).
  - Design, installazione, commissioning, analisi
- Upgrade del Sistema Gas Gain Monitoring degli RPC

CMS Frascati 2020

L.Benussi[a], S.Bianco[a], M.A.Caponero[b],
M. Ferrini[c], L.Passamonti[a], D.Piccolo[a]
D.Pierluigi[a], G.Raffone[a], M. Parvis[d], A.Russo[a], G.Saviano[c]
t.b.d. (assegno di ricerca)

[a]Laboratori Nazionali di Frascati dell'INFN, Italy
[b]Laboratori Nazionali di Frascati dell'INFN and ENEA Frascati, Italy
[c]Laboratori Nazionali di Frascati dell'INFN and Facolta' di Ingegneria Roma1, Italy
[d] Laboratori Nazionali di Frascati dell'INFN and Politecnico di Torino, Italy

PERCENTUALI 2019 (FTE)

L. Benussi	0.9
S. Bianco (resp)	0.8
M. Caponero	1.0
D. Piccolo	0.8
G. Raffone	0.5
G. Saviano	1.0
M. Parvis	0.3
M. Ferrini	1.0
TOTALE	6.3

PERCENTUALI 2020 (FTE)

L. Benussi	0.9
S. Bianco	0.8
M. Caponero	0.8
D. Piccolo (resp)	0.8
G. Raffone	0.5
G. Saviano	0.8
M. Parvis	0.3
M. Ferrini	1.0
Tbd (assegn.)	1.0
TOTALE	6.9

RESPONSABILITÀ 2019

L. Benussi	CMS_FASE2

RESPONSABILITÀ 2020

L.Benussi	Lev 2 GEM Detector HW coordinator
L. Benussi	CMS_FASE2
S.Bianco	Lev 3 Gas Gain Monitoring
D.Piccolo	Lev 3 Ecogas studies

RICHIESTE 2019 kEUR

Missioni	150.0
Consumi	19.5
TOTALE	169.5

RICHIESTE 2020 kEUR

Missioni	120.0
Consumi	12.5
Assegno Ric.	48.0
TOTALE	180.5

Attività 2019 e 2020

- Importante attività di montaggio SuperCamere al CERN (Al momento sono state assemblate 15 SC e attualmente sono in test presso un cosmic stand al 904).
- Nel 2020 le attività previste nei laboratori per le quale si richiedono strutture e personale sono:
  - **Costruzione SuperCamere al CERN** - 6 mesi uomo personale tecnico
  - **Installazione SC GE1/1** in P5 (inizio a fine 2019) – 6 mesi uomo personale tecnico
  - **Installazione dei sensori FOSxTemp nelle super-chamber** – 3 mesi uomo di personale tecnico
  - **Pre-produzione GE2/1** – Camera pulita ed. 27 e strutture attualmente utilizzate per produzione GE1/1 per caratterizzazione prototipo, 8 mesi uomo personale tecnico di supporto
  - **Studi eco-gas per rivelatori RPC** – utilizzo struttura ed. 27, 3 mesi uomo di personale tecnico di supporto

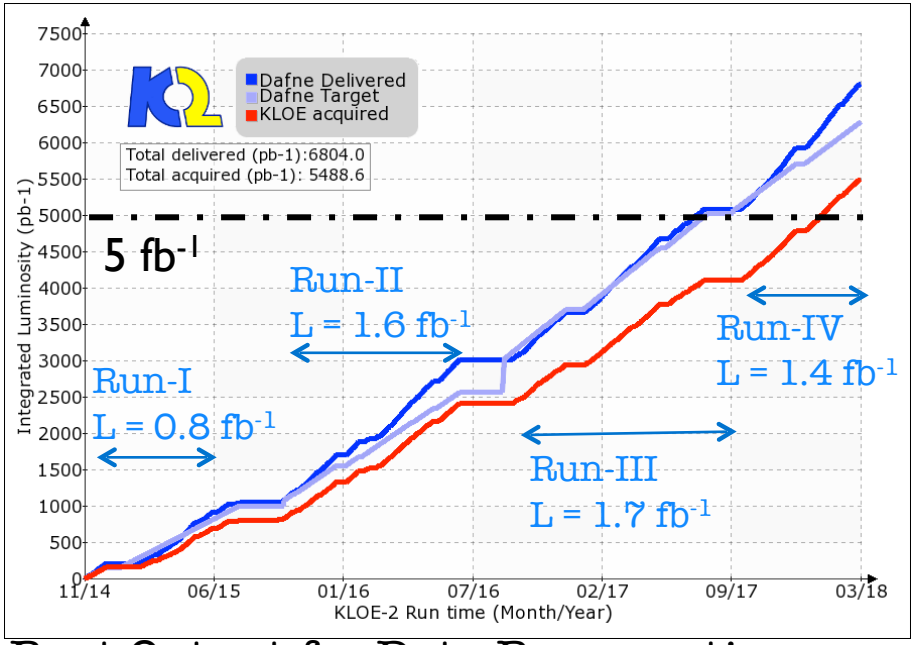
Lista pubblicazioni (esclusi articoli CMS)

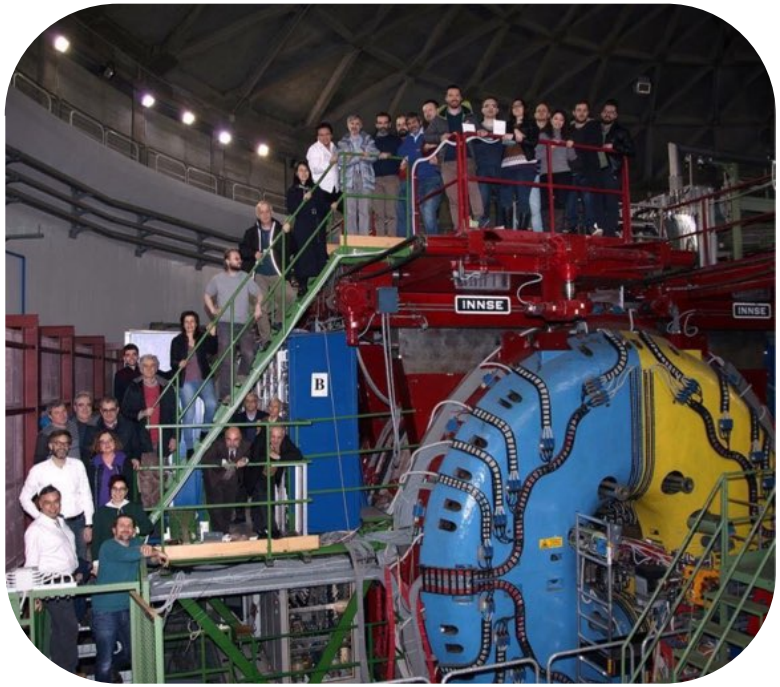
- **Articoli**
  1. Layout and Assembly Technique of the GEM Chambers for the Upgrade of the CMS First Muon Endcap Station By CMS Muon Collaboration (D. Abbaneo et al.). arXiv:1812.00411 [physics.ins-det]. 10.1016/j.nima.2018.11.061. Nucl.Instrum.Meth. A918 (2019) 67-75.
  2. Operational Experience With the GEM Detector Assembly Lines for the CMS Forward Muon Upgrade By D. Abbaneo et al.. 10.1109/TNS.2018.2871428. IEEE Trans.Nucl.Sci. 65 (2018) no.11, 2808-2816.
  3. Quality control for the first large areas of triple-GEM chambers for the CMS endcaps By CMS Collaboration (M. Tytgat et al.). 10.1051/epjconf/201817403003. EPJ Web Conf. 174 (2018) 03003.
  4. CMS GEM detector material study for the HL-LHC By S. Muhammad et al.. 10.22323/1.314.0799. PoS EPS-HEP2017 (2017) 799.
  5. Characterization of the water diffusion in GEM foil material By L. Benussi et al.. arXiv:1512.08621 [physics.ins-det]. 10.1051/epjconf/201817403005. EPJ Web Conf. 174 (2018) 03005.
  6. Candidate eco-friendly gas mixtures for MPGDs By L. Benussi et al.. arXiv:1512.08542 [physics.ins-det]. 10.1051/epjconf/201817405004. EPJ Web Conf. 174 (2018) 05004.
  7. A novel application of Fiber Bragg Grating (FBG) sensors in MPGD By D. Abbaneo et al.. arXiv:1512.08529 [physics.ins-det]. 10.1051/epjconf/201817403002. EPJ Web Conf. 174 (2018) 03002.
  8. Properties of potential eco-friendly gas replacements for particle detectors in high-energy physics By G. Saviano et al.. arXiv:1505.00701 [physics.ins-det]. 10.1088/1748-0221/13/03/P03012. JINST 13 (2018) no.03, P03012.
  9. Performance of GE1/1 Chambers for the CMS Muon Endcap Upgrade By CMS Muon Collaboration (D. Abbaneo et al.). arXiv:1903.02186 [physics.ins-det].
  10. Layout and Assembly Technique of the GEM Chambers for the Upgrade of the CMS First Muon Endcap Station By CMS Muon Collaboration (D. Abbaneo et al.). arXiv:1812.00411 [physics.ins-det]. 10.1016/j.nima.2018.11.061. Nucl.Instrum.Meth. A918 (2019) 67-75.
- **Conferenze**
  - S.Bianco, Convener's report, Spectroscopy Session, Heavy Quarks and Lepton 2019, Yamagata (Japan)

KLOE-2 Achievements 2019 (I)

D. Babusci, C. Bloise, F. Bossi, G. Capon, F. Curciarello, P.Ciambrone, E. De Lucia, A. De Santis, P. De Simone, A. Di Cicco, D. Domenici, S. Giovannella, X. Kang, M.Martini, S.Miscetti, D. Moricciani, E.Perez-DelRio, P. Santangelo, F. Sirghi and F. Fortugno, F. Sborzacchi

- KLOE-2 first round of Data Reconstruction completed with 20 pb-1/day average reconstruction rate
- MC running in parallel with 15 pb-1/day average reconstruction rate

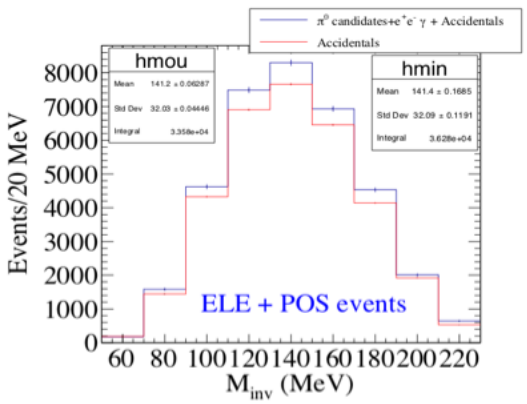


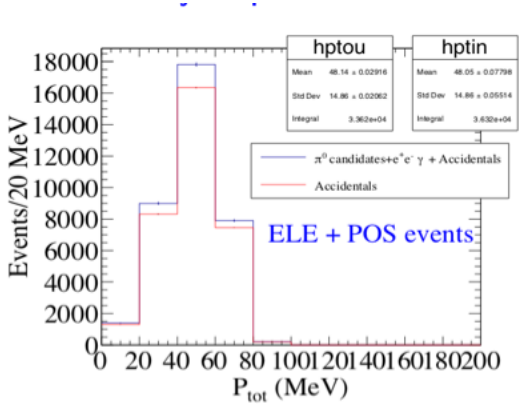


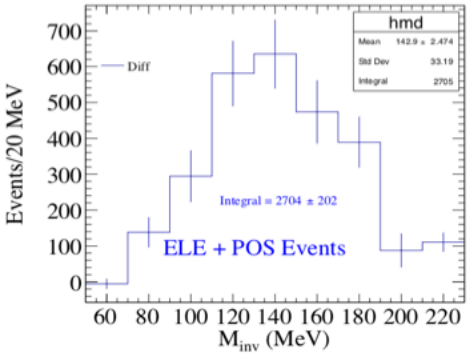
- Root Output for Data Preservation

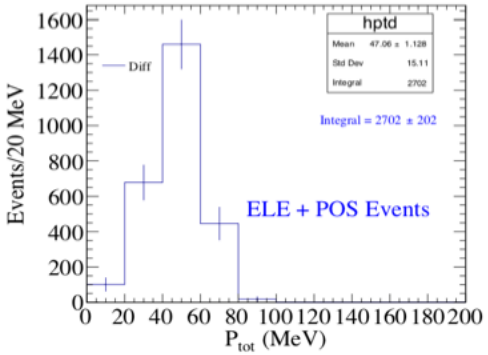
KLOE-2 Achievements 2019 (II)

HET π0 search: First statistical evidence of tagged sample	Preliminary @ PhiPsi 2019







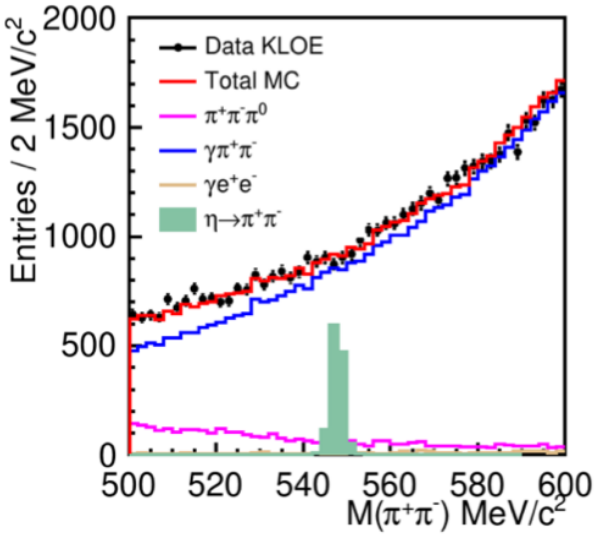


- MVA classifiers to separate radiative Bhabha scattering events from π0 from γγ scattering

KLOE-2 Achievements 2019 (III)

CP violation source in strong interaction : upper limit on $\eta \rightarrow \pi^+\pi^-$	Final Result Draft in preparation

- Best UL set by KLOE with 350 pb-1
  BR($\eta \rightarrow \pi^+\pi^-$) < 1.3x10^{-5} @ 90% CL
  [PLB 606 (2005) 276]
- Recent limit from LHCb with 3.3 fb-1
  BR($\eta \rightarrow \pi^+\pi^-$) < 1.6x10^{-5} @ 90% CL
  [PLB 764 (2017) 233]
- Updated with full statistics L = 1.6 fb-1
  BR($\eta \rightarrow \pi^+\pi^-$) < 5.8x10^{-6} @ 90% CL



KLOE-2 Achievements 2019 (III)

CP violation source in strong interaction : upper limit on $\eta \rightarrow \pi^+\pi^-$	Final Result Draft in preparation

- Best UL set by KLOE with 350 pb-1
  BR($\eta \rightarrow \pi^+\pi^-$) < 1.3×10^{-5} @ 90% CL
  [PLB 606 (2005) 276]
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  [PLB 764 (2017) 233]
- Updated with full statistics L = 1.6 fb-1
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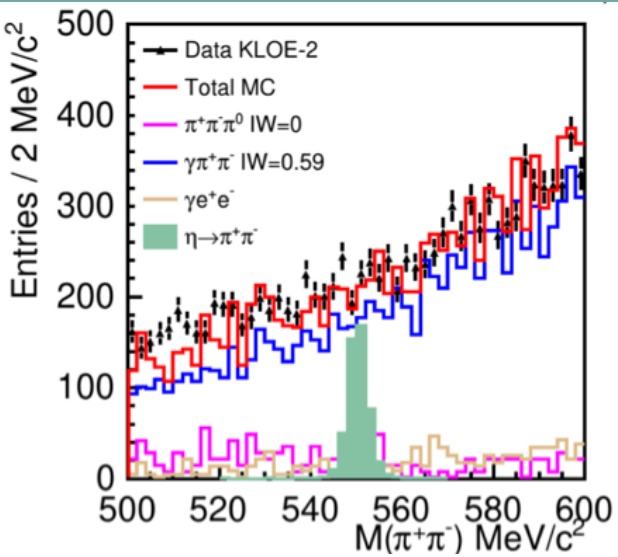
- Analysis with KLOE-2 data ongoing
  UL expected to reach 2.7×10^{-6} @ 90% CL



KLOE-2 Achievements 2019 (III)

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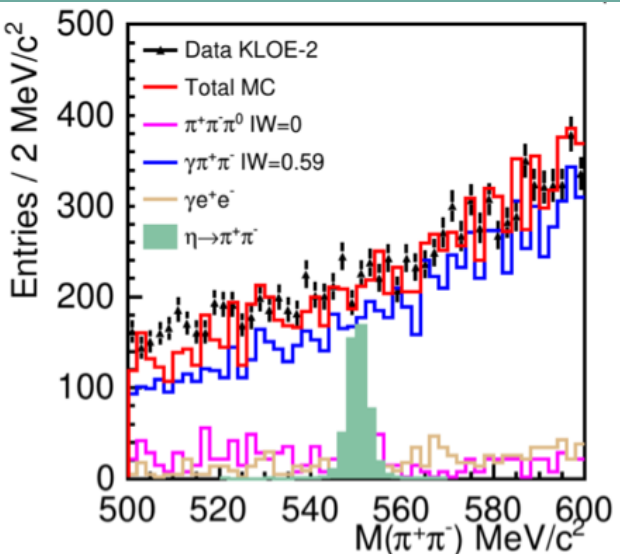
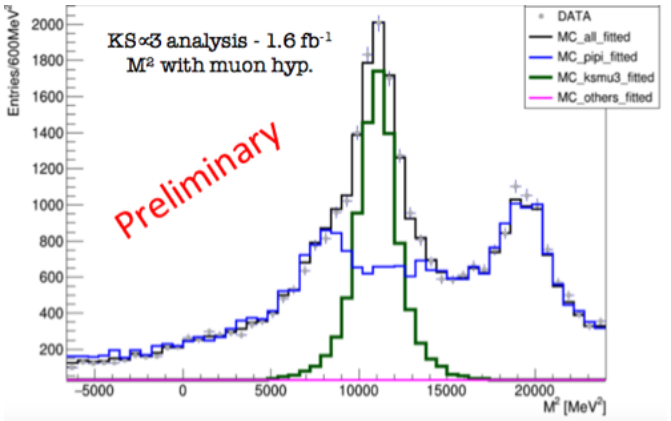


Measurement of $K_S \to \pi\mu\nu$ Branching Ratio	Finalizing systematics

- First measurement ever
- Vus & Lepton Universality test w KSe3
- 2.5% stat and O(3%) syst



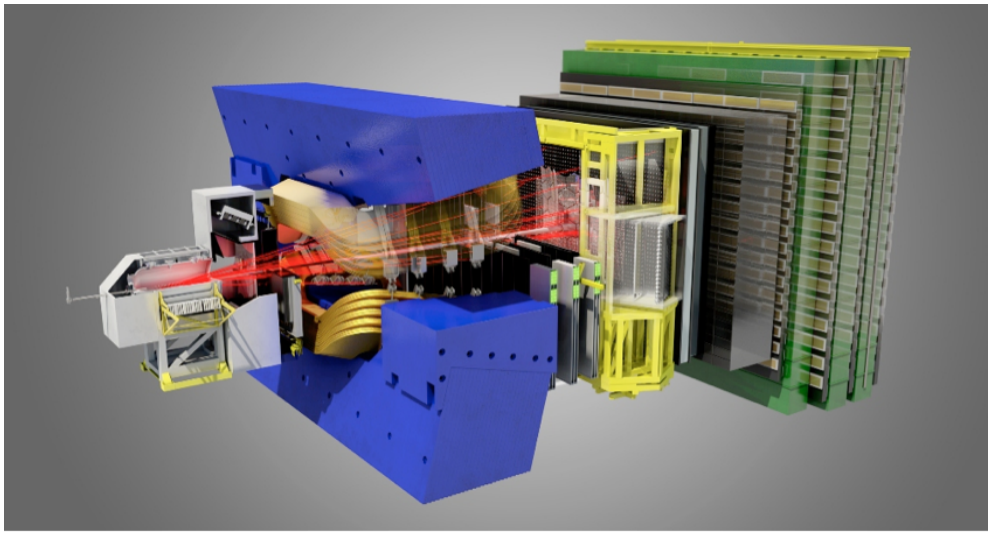
Gruppo 1 LNF, richieste nel 2020

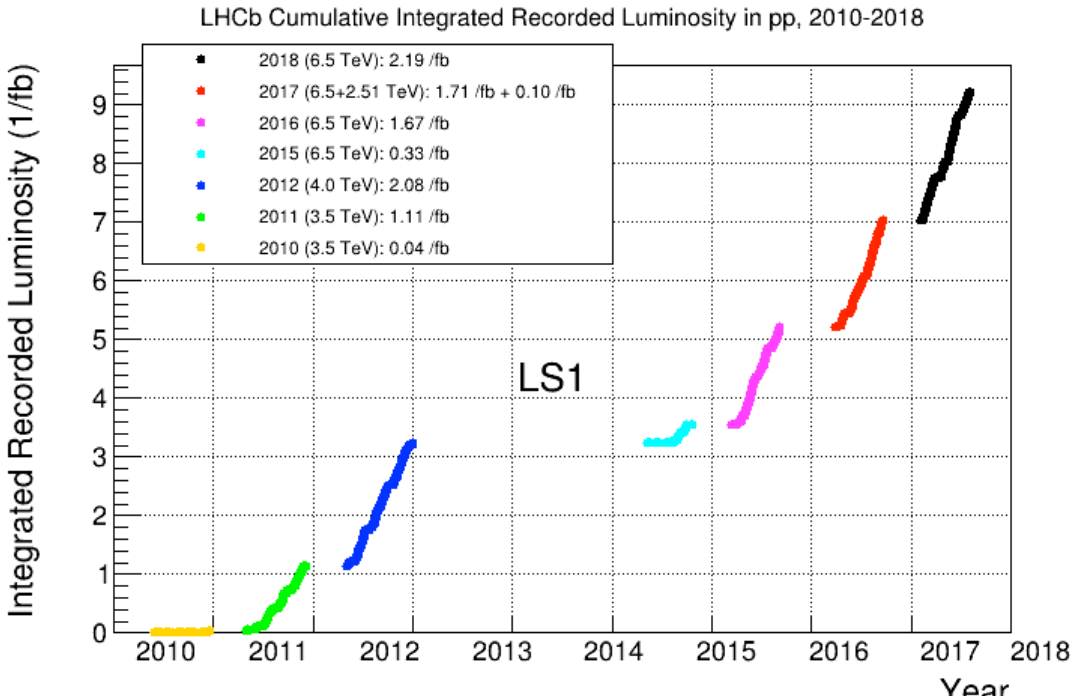
Preventivi di spesa preliminari (Keuro) (possibili aggiustamenti al ~10%):

Sigla	Ric	Tec	FTE	<FTE>	MISS	CON	APP	ALTRO CAP
KLOE-2	16	3	9.2	0.5	19.5	95.	5	26 MAN

D. Babusci, C. Bloise, F. Bossi, G. Capon, F. Curciarello, P.Ciambrone, E. De Lucia, A. De Santis, P. De Simone, A. Di Cicco, D. Domenici, S. Giovannella, X. Kang, M.Martini, S.Miscetti, D. Moricciani, E.Perez-DelRio, P. Santangelo, F. Sirghi and F. Fortugno, F. Sborzacchi

LHCb



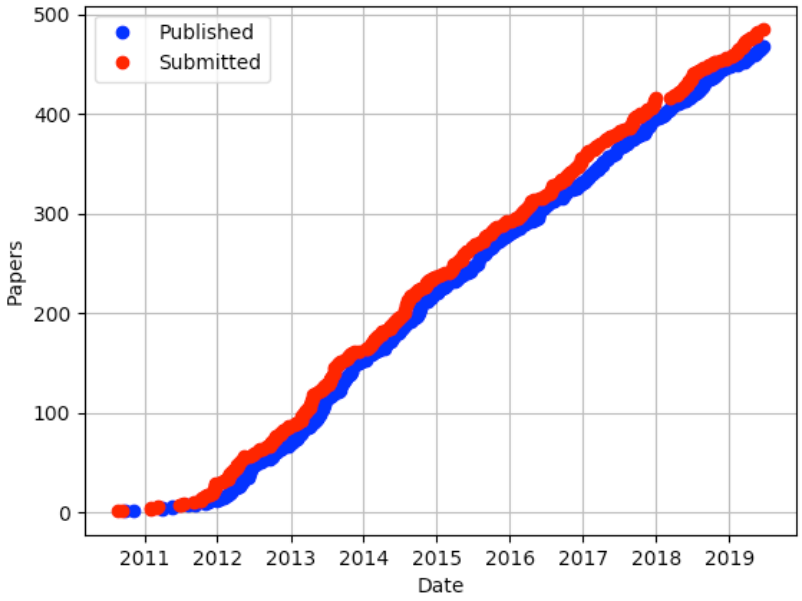


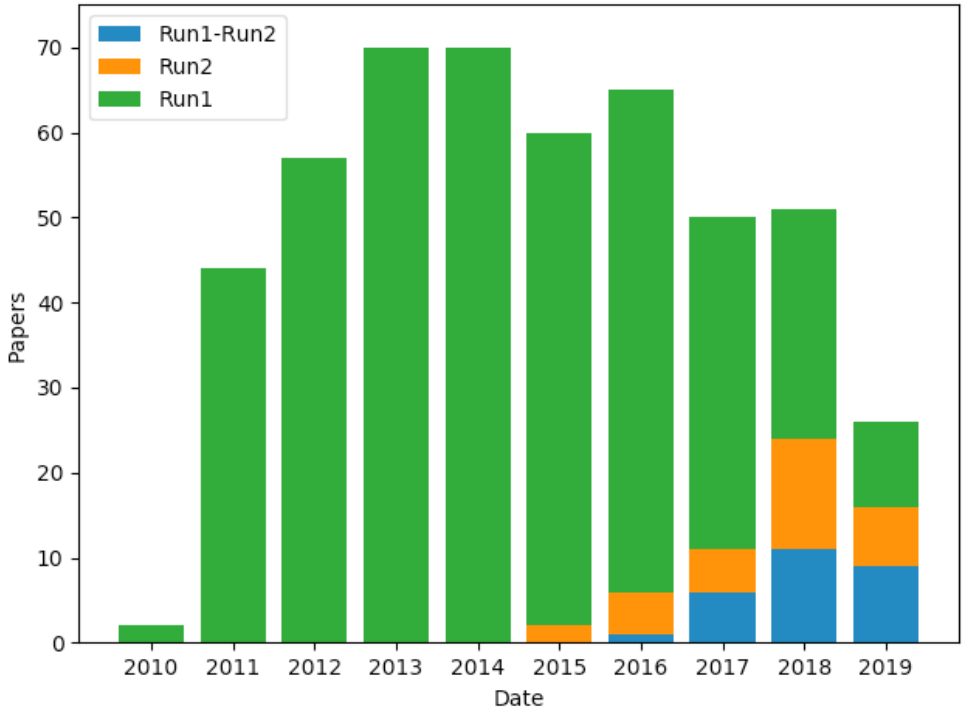
Fantastic 2018 data harvest. Total 9/fb collected by LHCb in Run 1 + Run 2

LHCb: broad physics program

- CKM mechanism and CP Violation: γ, sin2β, φ_s, amplitude and mixing in B,D decays,…
- Rare decays: $B^0_{s,d} \rightarrow \mu\mu$, b→sll, …
- SL decays: B→Dτν/B→Dμν,
- Spectroscopy: Xi^{++}_{cc}, tetraquark, pentaquark,…
- EW, QCD, direct searches: Z^0, $W^{\pm}$, top, dark-photons, Long Lived Particles...
- Heavy ion, fixed target: astroparticle measurements and hadronic effects in pA, AA

Approaching the 500 papers threshold





Most of the results from Run 1 data only. Full Run 1 + 2 data results coming soon

Ongoing data analyses (Frascati)

$B_{(s)}\mu\mu$ full Run 1 + Run 2:

[Fabio De Vellis (laureando), Palutan, Rotondo, Santimaria, Sarti, Sciascia]

- pubblicato [PRL 118, 191801 (2017)] con i dati di Run 1 + 1.6/fb di Run 2; prima osservazione (7.8 σ) di singolo exp. per il B_s. Ripetere per full Run 1 + Run 2

Misura del rapporto $R(D_s) = B_s \rightarrow D_s\mu\nu$ / $B_s \rightarrow D_s\tau\nu$; B → D form factors:

[Calì (PhD), de Simone, Klaver, Rotondo, Gianluigi Salerno (laureando)]

- the analogous R(D) e R(D*) show deviation (~4 σ) from SN.
- Form factors analysis: under collaboration review; expected for Beauty2019
- Specific study to seize impact of New Physics models on form factors measurements

Misura della polarizzazione della Λ_0 [on going]**:**

[Calero Diaz (PhD), Di Nezza, Liuti]

- importante per determinare la struttura di spin dei nucleoni

Misura del rapporto $\Lambda_b \rightarrow \Lambda_0 ee / \Lambda_b \rightarrow \Lambda_0 \mu\mu$ e ricerca del decadimento $\Lambda_b \rightarrow \Lambda_0 e\mu$:

[Jacopo Cerasoli (laureando), Santimaria, Sciascia]

- LFU test
- Publication expected for 2020 Winter conferences

* only Frascati names are indicated

LHCb: towards Run 3

* only Frascati names are indicated

Dismantling of all "old" detectors completed
- big contribution from Frascati for M1
(Arpaia, Capitolo, Santimaria, Saputi, Zossi)

Installation of the new ones ongoing full steam

90% of detector channels and 100% of read-out channels will be replaced.
New DAQ system and data centre

LHCb Real Time Analysis Project

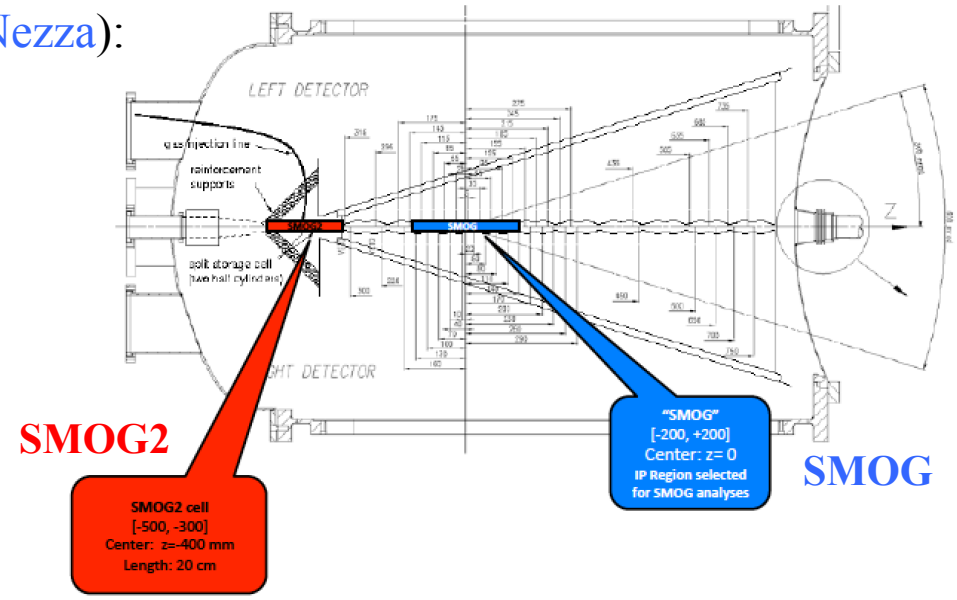
New project born in 2019 to coordinate software trigger and online reconstruction
High Frascati involvement: muon decoding (de Simone, Palutan), muon identification (de Simone, Kazeev (PhD), Palutan, Santimaria), monitoring (Sciascia), data challenges (Klaver), SMOG2 reconstruction and luminosity (Di Nezza)

LHCb: towards Run 3

* only Frascati names are indicated

System for MOnitoring Gas (SMOG) 2 (Di Nezza):

- Thanks to SMOG system, LHCb can run in fixed-target mode.
- beam-beam and beam-target data collected <u>in parallel</u>: successfully tested and used since 2017



New system (will be installed in November 2019)
- TDR ready since April 2019
- Excellent collaboration with LHC groups/experts
- order 10-100 increase of the useful target density for the same gas flow to the LHC than SMOG
- Injection of H_2, D_2, He, … all noble gasses up to Xe
- More precise target density (major systematic error so far)

Anagrafica 2020

Ricercatori [12.35 FTE, tbc]:

1) Gianni Bencivenni: 50 % 1 Ric.
2) Liliet Calero Diaz: 100 % PhD (Sapienza)
3) Stefano Calì: 100 % PhD (Tor Vergata)
4) Pierluigi Campana: 50 % Dir. Ric.
5) Patrizia de Simone: 90 % 1 Ric.
6) Pasquale di Nezza: 85 % 1 Ric.
7) Nikita Kazeev: 100 % PhD (Sapienza)
8) Suzanne Klaver: 100 % PosDoc straniero
9) Gaia Lanfranchi: 60 % 1 Ric.
10) Simonetta Liuti: 50 % Ric. Straniero Associato (Virginia University, US)
11) Gianfranco Morello: 70% Ric. TD
12) Matteo Palutan: 100 % 1 Ric.
13) Marcello Rotondo: 80 % Ric.
14) Marco Santimaria: 100 % AdR
15) Barbara Sciascia: 90 % Ric
16) Adalberto Sciubba: 10 % Prof. Associato (Sapienza)

Tecnologi [2.0 FTE]:

1) Pietro Albicocco: 30 % AdR
2) Paolo Ciambrone: 70 % 1 Tecnologo
3) Giulietto Felici: 20 % Dir Tecnologo
4) Marco Poli Lener: 60 % Tecnologo
5) Paolo Santangelo: 20 % 1 Tecnologo

Ruoli di coordinamento attivi:

- P. de Simone: Muon Software Coordinator [01/2017 - 01/2020]
- P. Di Nezza: Luminosity Coordinator [01/2019 - 03/2021]
- P. Di Nezza: SMOG2 Project Leader [04/2019 - 03/2021]
- S. Klaver: Convener of CPV, mixing and production SL subWG [01/2018 - 03/2020]
- S. Klaver: Convener of Data Challenger for Run 3 [03/2019 - 03/2021]
- M. Palutan: Responsabile nazionale [07/2018 - 06/2021]
- M. Rotondo: Editorial Board member [07/2018 - 06/2020]
- M. Santimaria: Convener of Very Rare Decays subWG [06/2019 - 06/2021]

Per tutto Run 2, ampia partecipazione ai "turni centrali" (sala controllo, piquet, run chief)

Gruppo 1 LNF, LHCb, richieste nel 2020

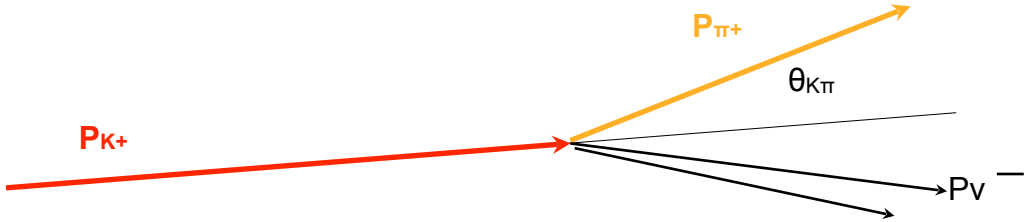
Sigla	Ric	Tec	FTE	<FTE>	MISS	CON	APP	ALTRO CAP
LHCb	16	5	14.35	0.68	146	31.5	-	75

Missioni: tot 146.44 kE
Estere: FTE*2MU*3.7kE = 106.2 kE
Interne: FTE*1kE = 14.35 kE
Responsabilità: 3MU*3.7kE [SMOG2 PL]+4*1MU*3.7kE[CPV + VRD + Muon soft. + Lumi] = 25.9 kE

Consumo:
Metabolismo: FTE*1.5 kE = 21.5 kE
SMOG2, costruzione gas feed system: 10 kE

Altri servizi diversi: tot 75 kE
MoF-B LHCb MUON (70% of 120 CHF, 1.11 CHF/EUR) 75 kE

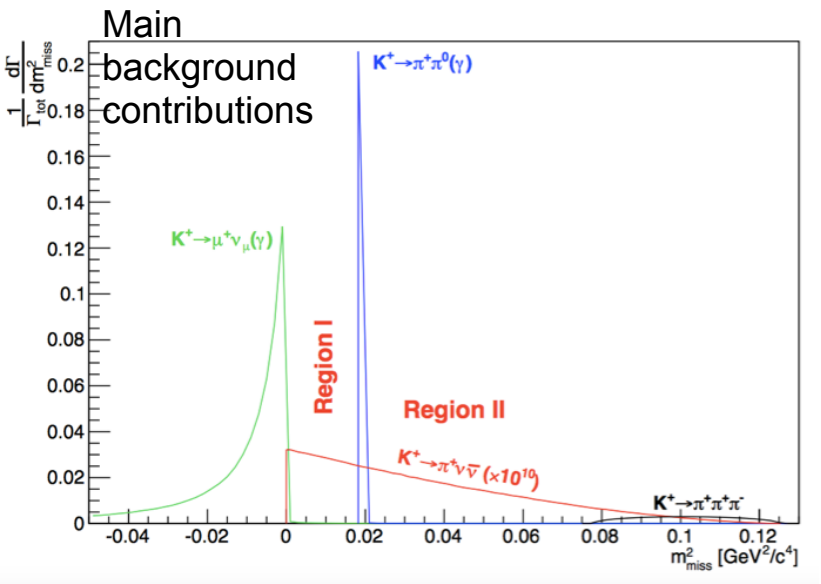
NA62 — Flagship: K→πνν decays

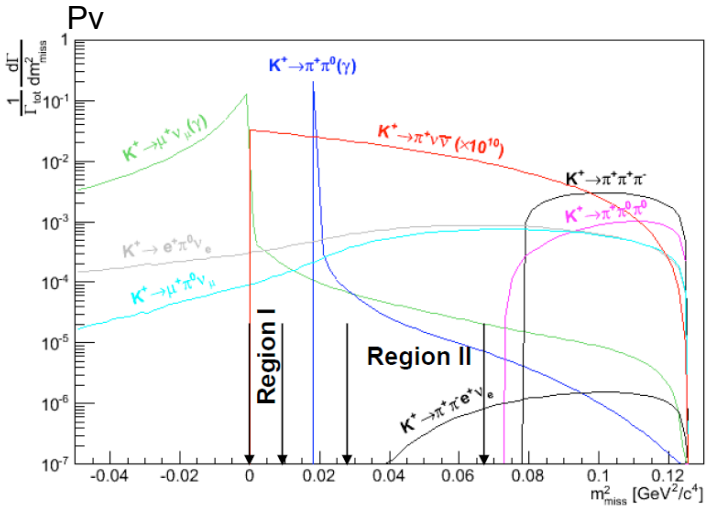


Most discriminating variable: $m^2_{miss} = (P_{K+} - P_{\pi+})^2$

Where the daughter charged particle is assumed to be a pion

Theoretical m^2_{miss} distribution for signal and backgrounds of the main K^+ decay modes: (signal is multiplied by a factor 10^{10}).





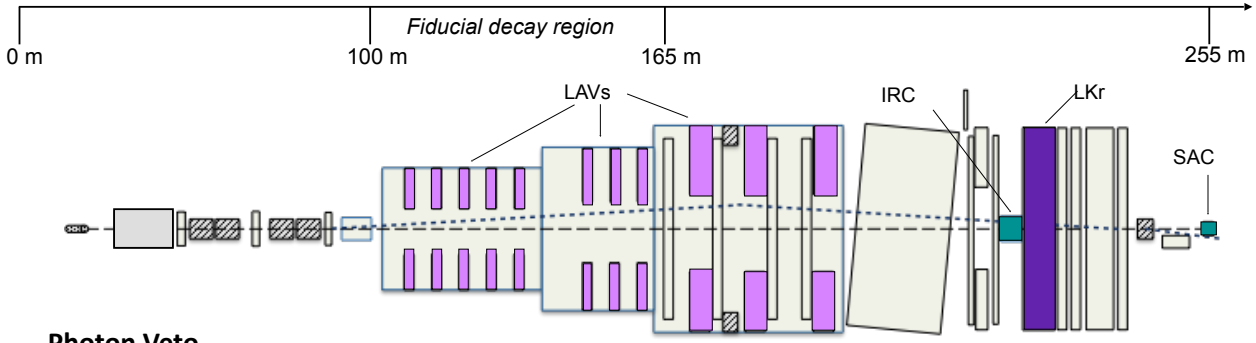
2 signal regions, on each side of the $K^+ \to \pi^+\pi^0$ peak (to eliminate 92% of the K^+ width)

Main background sources:

- $K^+ \to \pi^+\pi^0$, $K^+ \to \mu^+\nu$ non gaussian resolution and radiative tails
- $K^+ \to \pi^+\pi^+\pi^-$ non gaussian resolution tails
- decays with neutrino in final state

NA62

NA62: Photon Veto System LNF

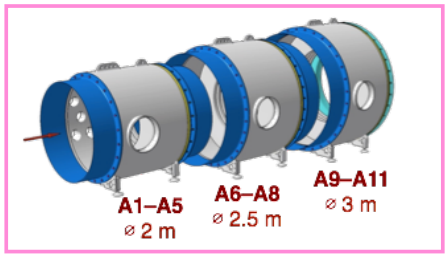


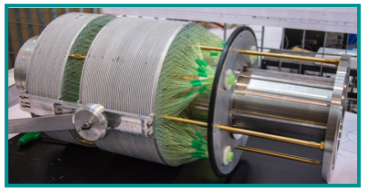
Photon Veto

LKr: NA48 LKr Calorimeter (1 <θγ<8.5 mrad) also for PID.
σ_t~500 ps (E > 3 GeV), σ_t~1 ns
(hadronic and MIP clusters), $\sigma_{dx,dy}$ ~1 mm

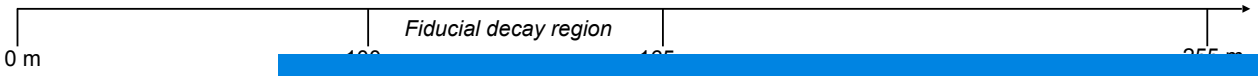
LAV: Large Angle Veto. 12 stations (8.5 <θγ <50 mrad).
4 or 5 rings of lead glass crystals read out by PMTs.
σ_t ~ 1 ns, 10^{-3} to 10^{-5} inefficiency (down to 150 MeV).

IRC/SAC: Inner Ring Calorimeter and Small Angle Calorimeter (θγ <1 mrad). Shashlik calorimeters. Lead and plastic scintillator plates. **σ_t < 1 ns, 10^{-4} inefficiency.**





NA62: Photon Veto System LNF



Photon rejection

Photon Veto

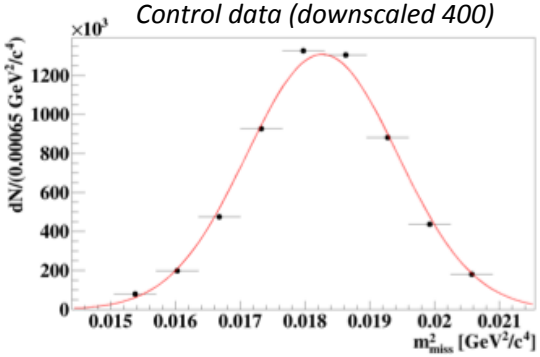
LKr: NA48 LKr
σ_t~500 ps
(hadronic

LAV: Large Ang
4 or 5 ring
σ_t ~ 1 ns,

IRC/SAC: Inner Ring
Calorimet
calorimet
plates. σ_t

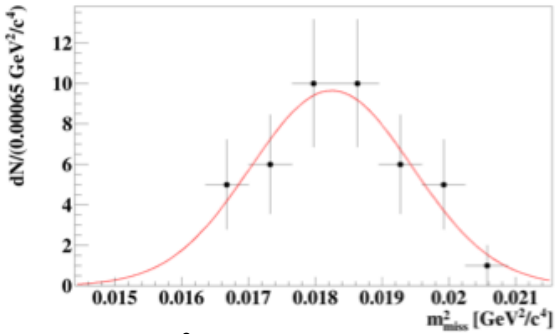
Events are rejected in case of coincidence between decay time and signals (±3-5 ns) in the LKr, LAV, SAC, IRC or hodoscope not associated to the π^+

Control data (downscaled 400)



$K^+ \to \pi^+\pi^0$ events before the γ rejection (minimum bias trigger)

PNN data



$K^+ \to \pi^+\pi^0$ events after γ rejection (PNN trigger):

The expected rejection is obtained with an estimate based on single-photon efficiencies

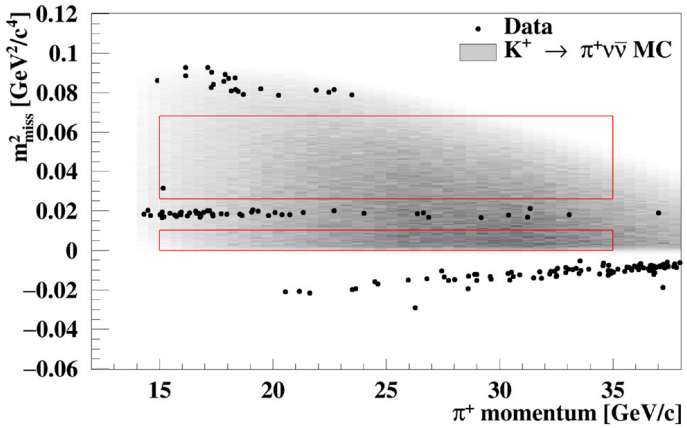
Fraction of surviving $K^+ \to \pi^+\pi^0$ (15 – 35 GeV momentum range) : ~$2.5 \cdot 10^{-8}$

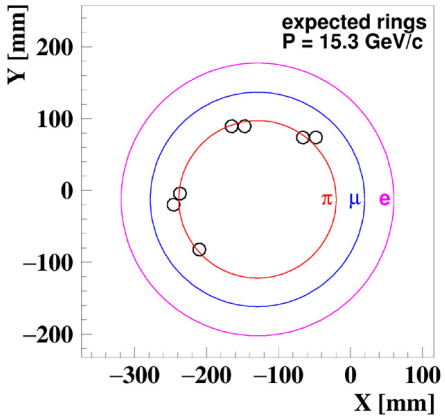
16

NA62 result for $K \longrightarrow \pi\nu\nu$

1.21×10^{11} K^+ decays in 2016 – 2% of collected data

The NA62 Collaboration / Physics Letters B 791 (2019) 156–166





Event Observed	1
SES	$(3.15 \pm 0.01_{stat} \pm 0.24_{syst} \cdot 10^{-10})$
Expected Background	$0.15 \pm 0.09_{stat} \pm 0.01_{syst}$
Expected SM $K^+ \to \pi^+\nu\bar{\nu}$	$0.267 \pm 0.001_{stat} \pm 0.020_{syst} \pm 0.032_{ext}$

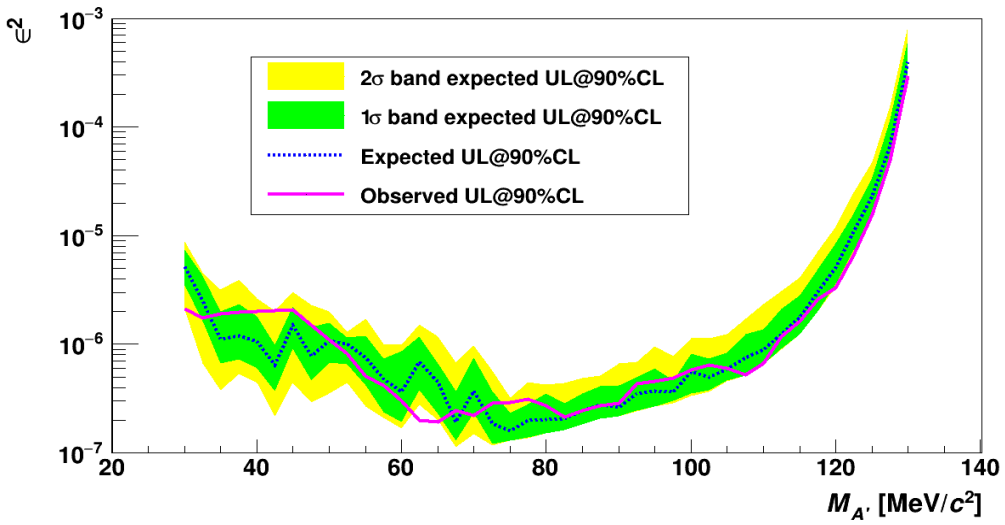
$$BR(K^+ \to \pi^+\nu\bar{\nu}) < 14 \times 10^{-10} \ @\,95\%CL$$

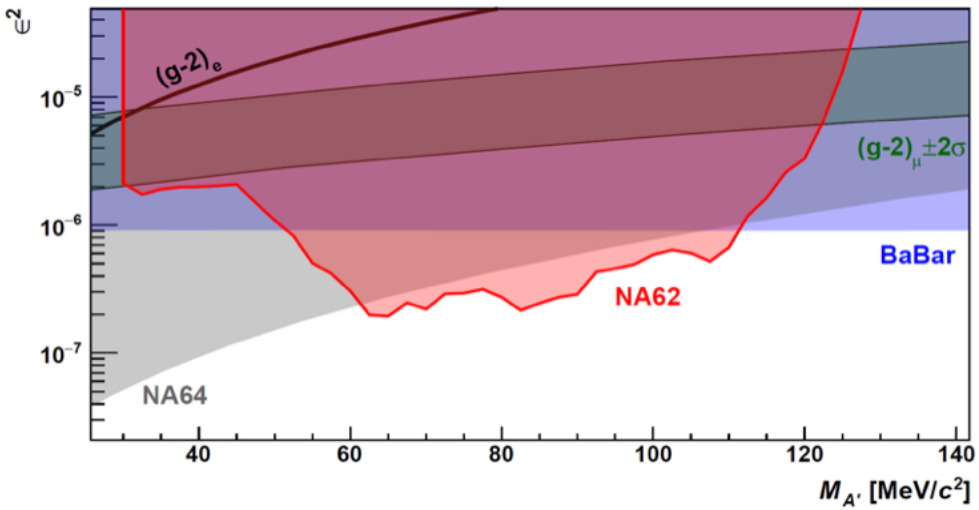
$$BR(K^+ \to \pi^+\nu\bar{\nu})_{SM} = (0.84 \pm 0.10) \times 10^{-10}$$
$$BR(K^+ \to \pi^+\nu\bar{\nu})_{exp} = (1.73^{+1.15}_{-1.05}) \times 10^{-10}$$

BNL E949/E787 Kaon Decay at Rest

- Present result is from cut based analysis
- Full probability based analysis is under development

Search for $\pi^0 \to \gamma A'$, $A' \to$ invisible





arXiv:1903.08767 (JHEP)

The analysis has been performed with a fraction of 2016 data, equivalent to ≈ 1% of the total kaon flux collected by NA62 through 2018.

- Search for excess of events in missing mass spectrum:

$$M^2_{miss} = (P_K - P_\pi - P_\gamma)^2$$

No significant statistical excess has been identified and upper limits on the coupling strength ε^2 in the mass range 30–130 MeV/c^2 have been set, improving on the previous limits over the mass range **60–110 MeV/c^2**

- Limit improved by more than three orders of magnitude:
  BR($\pi^0 \to \gamma\nu\nu$) < 1.9×10^{-7} at 90% CL
- Improvement on BR($\pi^0 \to$ invisible) over current limit of 2.7×10^{-7} is also possible

LNF responsibilities in NA62

Large Angle (LAV) and Small Angle (SAV) photon veto detectors

- Coordination of the photon veto system (fully constructed at LNF, calibrated and commissioned by Frascati group)
- Data quality monitoring and performance evaluation
- MC and Reconstruction framework upgrades
- Analysis of 2016 data and measurement of photon veto efficiency and random veto
- Experts support during data taking

L1 Trigger streams

- Development and optimization of algorithms; performance monitoring
- Experts support during data taking

Run coordination

Coordination of hidden sector analysis

Feasibility studies for the experimental program after the end of LHC Run 2

PHYSICISTS: Antonella Antonelli, Gaia Lanfranchi, Gianpaolo Mannocchi, Silvia Martellotti, Matteo Martini, Elisa Minucci,Matthew Moulson, Tommaso Spadaro.
Associates: Georgi Georgiev, Venelin Kozhuharov (Sofia).
TECHNICIANS: Rosario Lenci, Vincenzo Russo, Sauro Valeri, Tania Vassilieva, Giovanni Corradi, Diego Tagnani, Cesidio Capoccia, Emilio Capitolo.

CSN1 LNF*: Richieste 2020 molto indicative

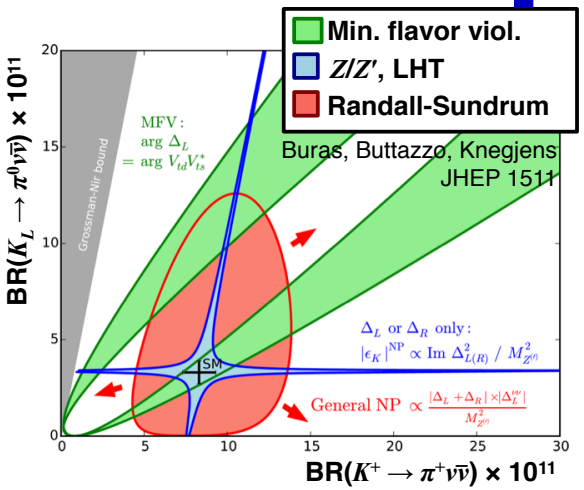
Sigla	Ric	Tec	FTE	<FTE>	MISS		CON	
NA62	9	0	6.3	0.70	91.5	66 +17.5	20	5.5

Anagrafica:	
Antonella Antonelli	100%
Gaia Lanfranchi	20%
Silvia Martellotti	100%
Matteo Martini	30%
Elisa Minucci	100%
Matthew Moulson	100%
Tommaso Spadaro	80%
Associates: Sofia	
Georgi Georgiev	50%
Venelin Kozhuharov	50%
TOTALE	**5.3 + 1.0 FTE**

Measurement of BR($K_L \to \pi^0\nu\nu$) at the SPS?

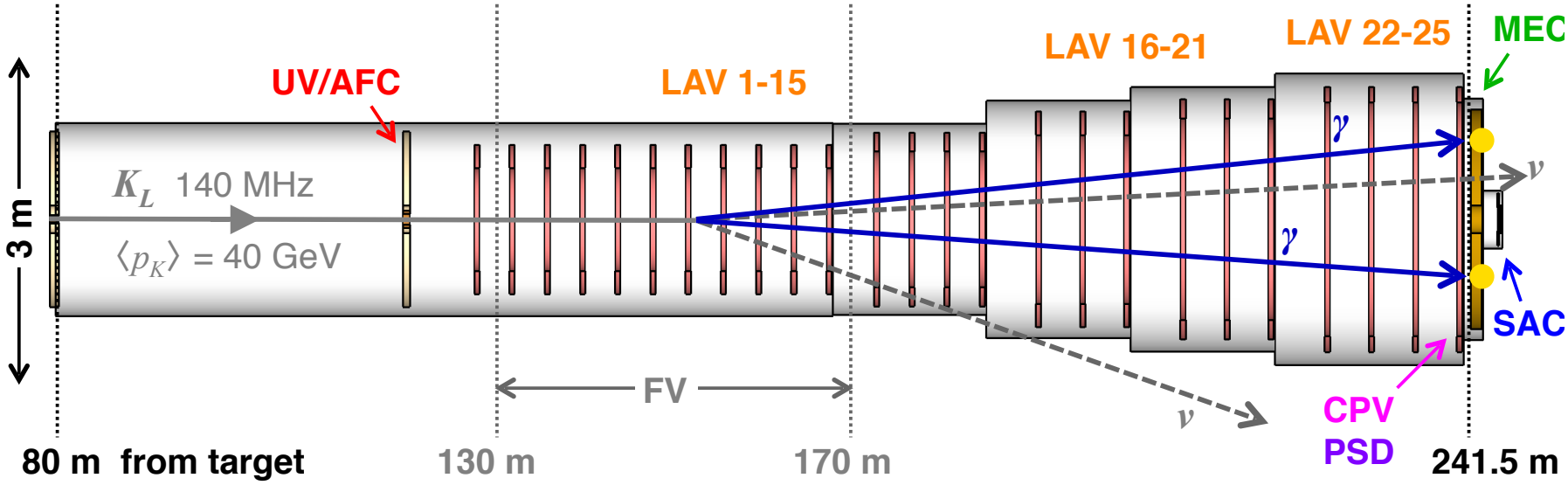
New physics affects K^+ and K_L differently

Measurements of both can discriminate among NP scenarios



KLEVER target sensitivity
5 years starting Run 4 (2026)
60 SM $K_L \to \pi^0\nu\nu$ events S/B ~ 1
δBR($K_L \to \pi^0\nu\nu$) ~ 20%

400-GeV SPS proton beam incident on Be target at z = **0 m**



Status and timeline

KLEVER

KLEVER is a subproject of NA62 to help define the future program in kaon physics at the SPS

Project timeline – target dates:

2018-2019 **Project consolidation**
- Participation in Physics Beyond Colliders
- Beam test of crystal pair enhancement
- Input to European Strategy for Particle Physics
- Expression of Interest to CERN SPSC in preparation

2019-2021 **Detector R&D**

2021-2025 **Detector construction**
- Possible K12 beam test if compatible with NA62

2024-2026 **Installation during LS3**

2026- **Data taking beginning Run 4**

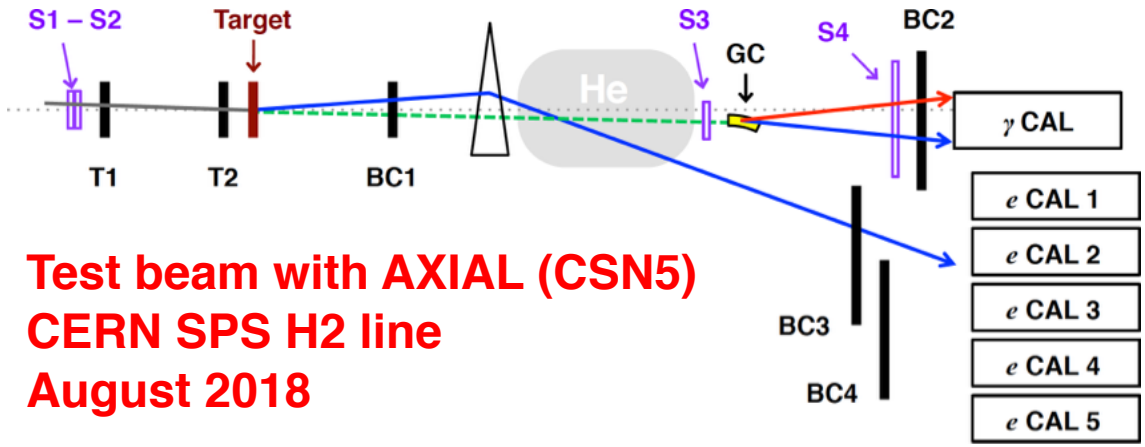
Most groups participating in NA62 have expressed interest in KLEVER

We are actively seeking new collaborators

Activity at Frascati in 2018-2019

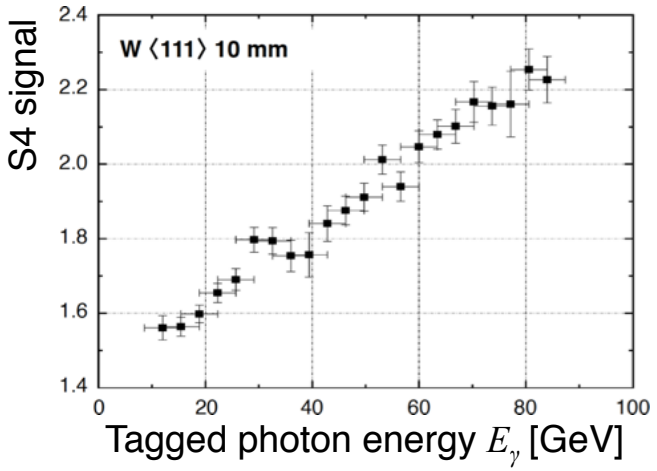
Current Frascati responsibilities (NA62 group):

- Overall project coordination: M. Moulson
- Monte Carlo development and sensitivity estimation
- Conceptual design of Active Final Collimator
- Study of coherent interactions of tagged photons in high-Z metal crystals



Test beam with AXIAL (CSN5)
CERN SPS H2 line
August 2018

Enhancement in charged particle production vs. photon energy



Exploitation of coherent interactions for KLEVER:

1. **Beam photon converter in dump collimator**
   Effective at converting beam γs while relatively transparent to K_L
2. **Absorber material for small-angle calorimeter (SAC)**
   Must be insensitive as possible to high flux of beam neutrons while efficiently vetoing high-energy γs from K_L decays

Planned future activity at Frascati

KLEVER

Photon efficiency measurements at BTF-2 will be key to KLEVER R&D

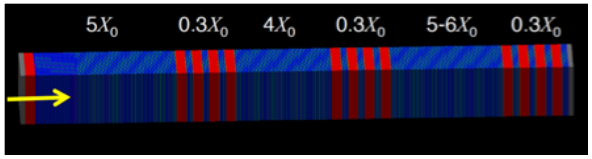
- Precision measurements of detection efficiency with single electrons
- Development of techniques for efficiency measurements with tagged photons

Beam test of shashlyk calorimeter with spy tiles (MEC)

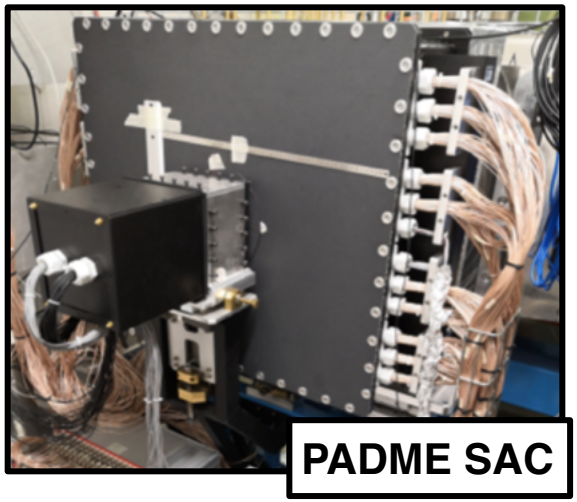
Fine-sampling: 0.275 mm Pb + 1.5 mm scintillator

Spy tiles measure longitudinal shower development:

- Identification of μ, π, n interactions
- Improved time resolution for EM showers



Development of ultra-fast calorimeter to intercept beam exit (SAC)



Synergy with PADME SAC upgrade for future running with continuous beam

Desired characteristics:

- > 100 MHz sustained rates
- σ_t < 100 ps; 2-pulse separation at ~ 1 ns
- Good radiation resistance

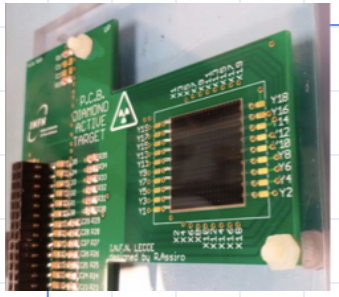
Could use PbF_2, but validation required for use at continuous high rates and high radiation doses

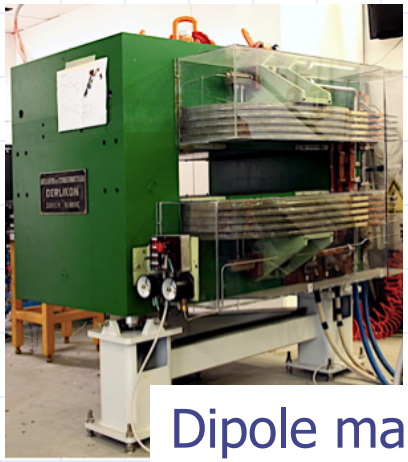
PADME LNF

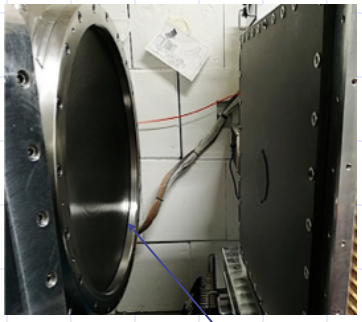
- Attività 2018
- Anagrafica
- Richieste finanziarie

The Complete Setup

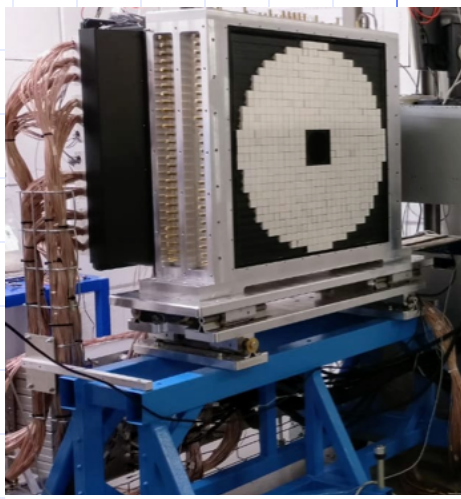
Active target
Lecce & University Salento







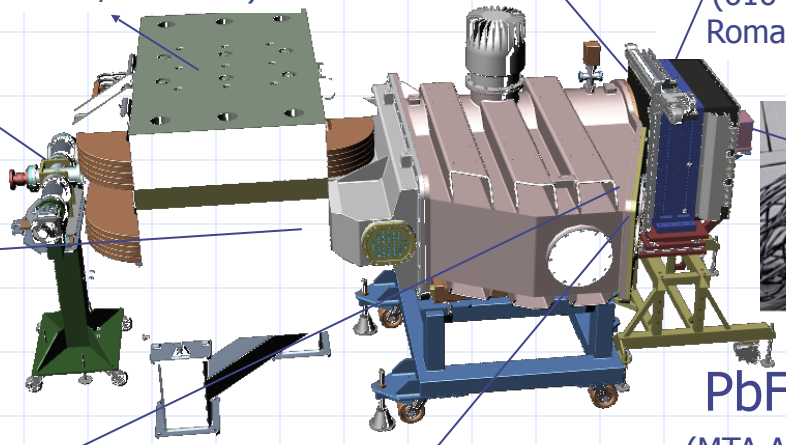
C-fiber window

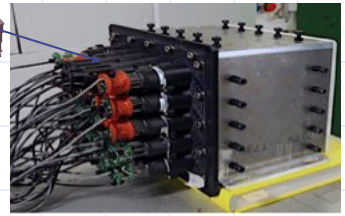


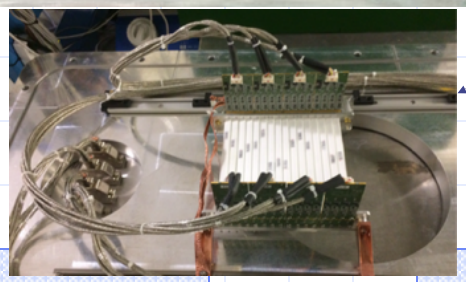
Dipole magnet
(CERN TE/NSC-MNC)

BGO calorimeter
(616 L3 endcap crystals:
Roma, Cornell U., LNF, LE)

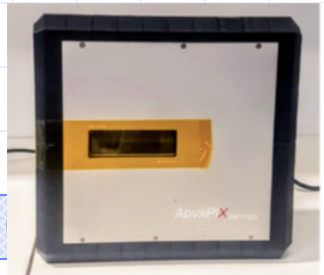
Veto scintillators
(University of Sofia, Roma)







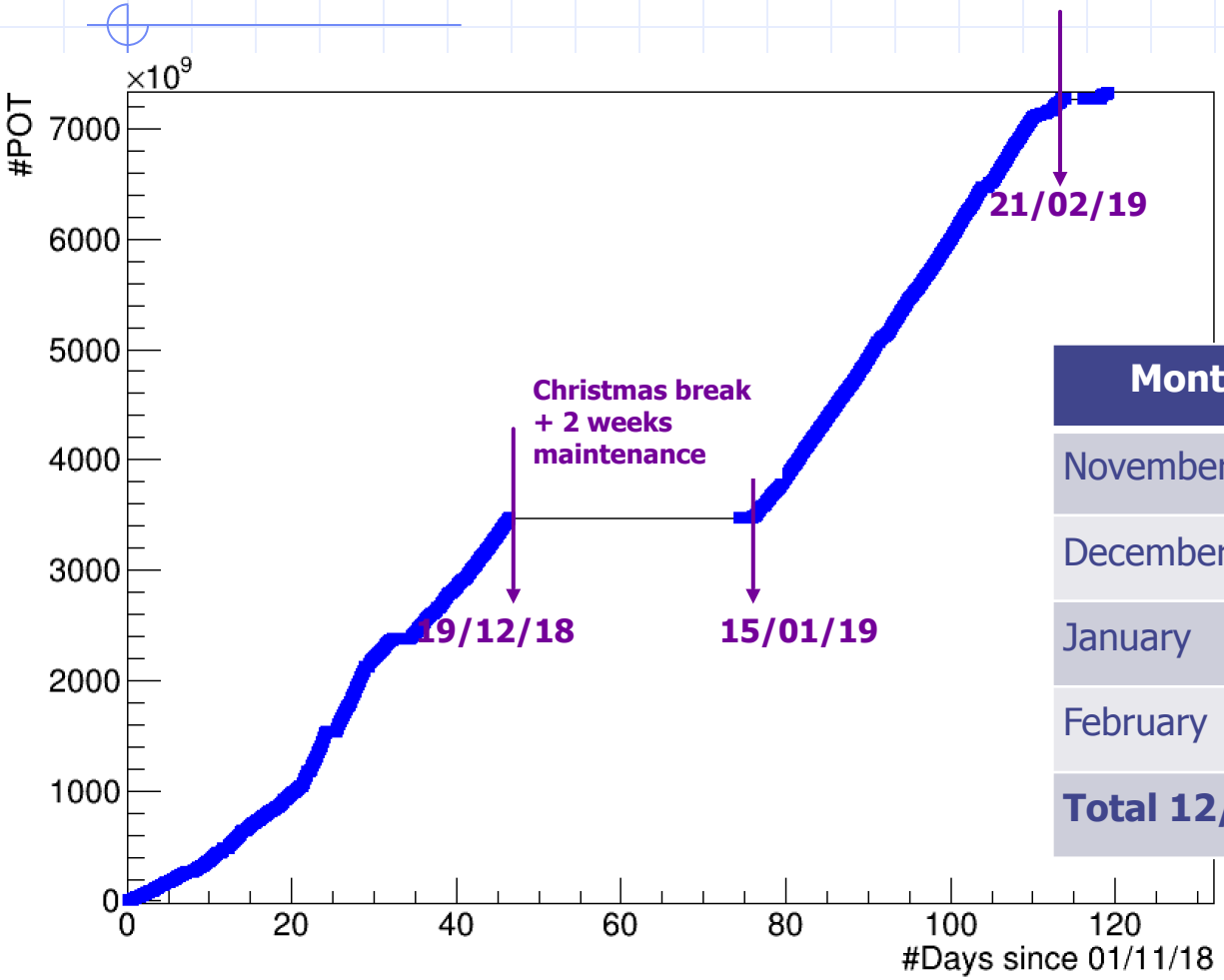
PbF_2 calorimeter
(MTA Atomki, Cornell U., LNF)



TimePIX3 array
(ADVACAM, LNF)

Data Taking Run I

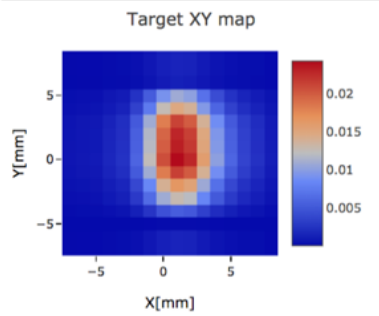
First PADME data taking took place from Nov. 2018 to Feb. 2019. Positron energy ~ 490 MeV

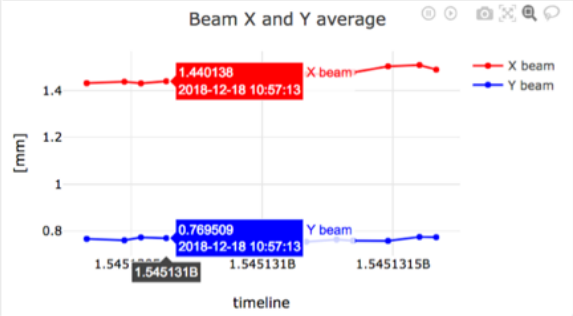


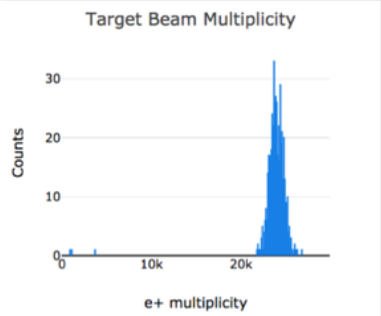
Month	#days	N_{POT}	N_{POT}/day
November	30	2.2E12	0.76E11
December	16	1.4E12	0.875E11
January	15	1.7E12	1.1E11
February	21	2.1E12	1.E11
Total 12/02	**82**	**7.4E12**	**0.9E11**

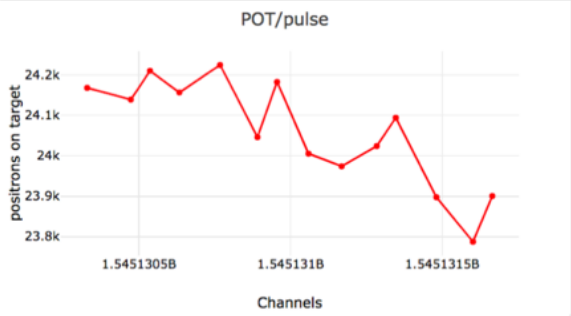
Online Monitor

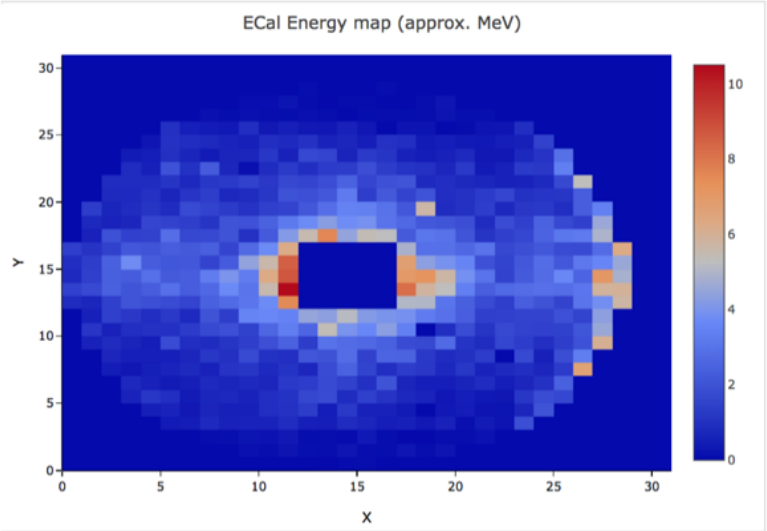
All detectors were up and running

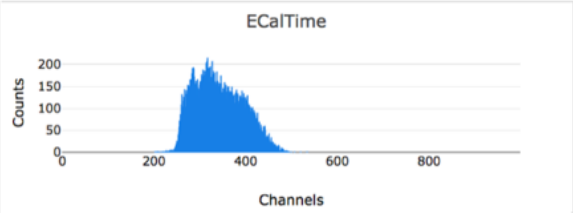


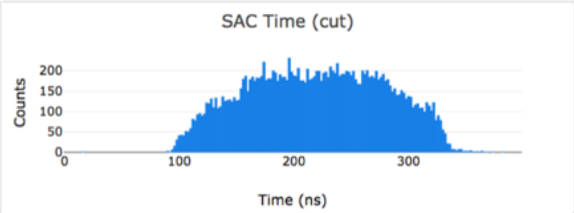


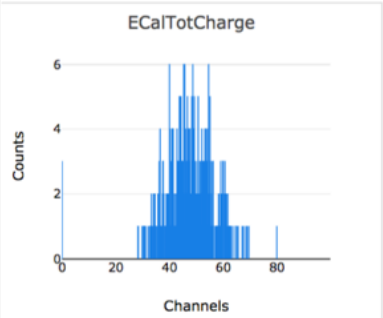


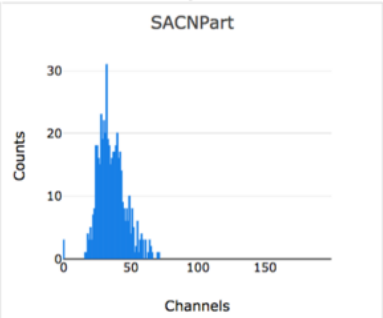


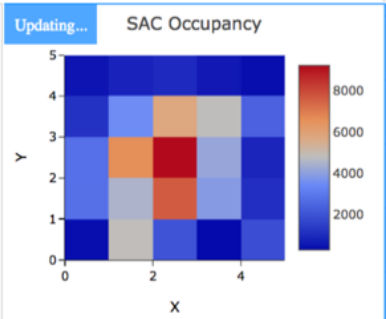


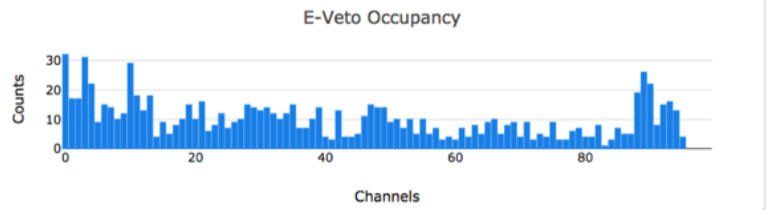


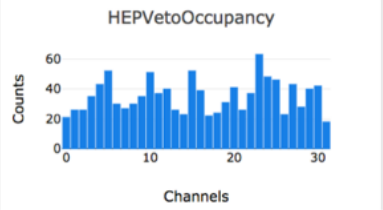


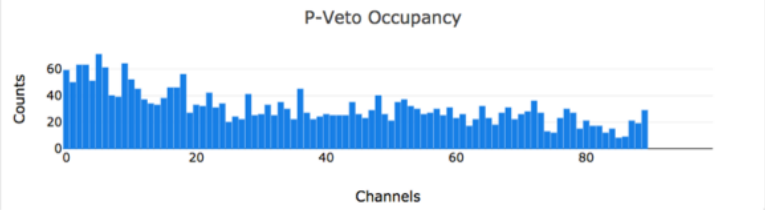












Anagrafica

Rispetto al 2019 la partecipazione rimane sostanzialmente invariata.

Nome	Percentuale
F. Bossi	50
B. Buonomo	20
R. De Sangro	20
D. Domenici	40
G. Finocchiaro	20
L. Foggetta	20
G. Georgiev	50
A. Ghigo	10
F. Giacchino	50
P. Gianotti	30
V. Kozhuharov	50
B. Liberti	20
M. Martini	20
I. Sarra	10
B. Sciascia	10
T. Spadaro	20
E. Spiriti	10
C. Taruggi	100
E. Vilucchi	10
TOT.	**5.6 FTE**

Richieste finanziarie

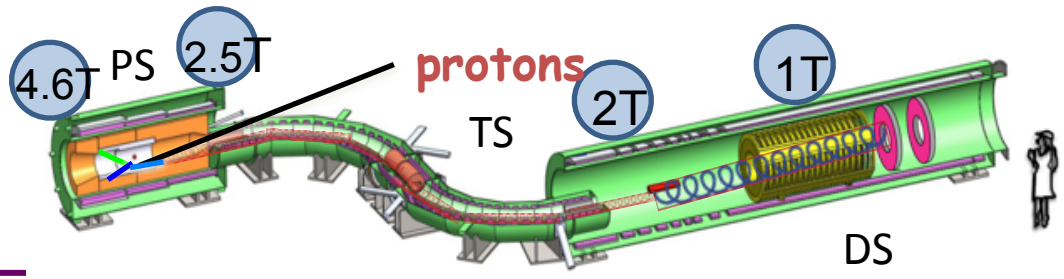
	Missioni	Consumo	Apparati	Inventario
LNF	10K(2K x 5FTE)	10K Metabolismo 10K PADME operation		24K Tape 84K CPU (Reco,MC) 20K Disk

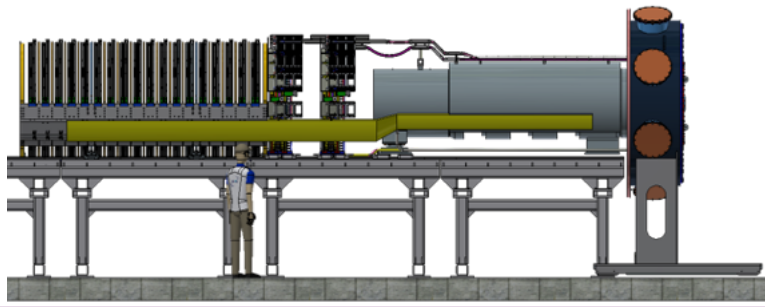
Sigla	Ric	Tec	FTE	<FTE>	MISS	CON	APP	INV
PADME	14	5	5.6	0.3	10	20		24 104

Calcolo Scientifico ai LNF nel Tier2 di Frascati

- Esperimenti con risorse pledged:
  - **ATLAS, PADME**
  - 2019: ~ 2PB disco, ~42 kHS06, ~4300 core,
  - ~20 disk server, ~20 macchine per servizi
- Altri esperimenti:
  - risorse opportunistiche del Tier2 e/o User Interface per accesso alla Grid e per uso interattivo:
    - ✓ Km3.net, Belle-II, LHCb, Muon Collider
- Altri progetti:
  - **PON IBISCO** (6/2019-2/2022): esperimento **CTA**
    - ✓ ~1PB disco netto, ~24 nodi di calcolo (~1300 core, ~20kHS06)
    - ✓ 10 server per servizi, core-switch con connessioni fino a 100Gbps
    - ✓ Partecipanti: INFN (Napoli, Bari, Catania), Università (Bari, Napoli), CNR, INAF, INGV
  - **IDDLS**: Italian Distributed Data Lake for Science
    - ✓ Partecipanti: GARR, INFN (CNAF, Bari, LNL, Napoli, Roma1, Pisa, Perugia)

MU2E status





- ❖ **CLFV: conversione di un muone in e- su targhetta di Al @ BR ~ $6x10^{-17}$**
- ❖ **CD3 June 2016 , costo DOE 274 M$**
- ❖ **Costruzione Civile completata. Acquisto cavi superconduttori completato.**
- ❖ **Costruzione magneti DS,PS e TS in corso. TS @ ASG (Genova)**
- ❖ **CSN1 ha approvato envelope finanziario Calorimetro a giugno 2015. (2.9 Meuro)**
  Statement of Work tra Mu2e ed INFN firmato Novembre 2016.
- ◆ **Produzione e test cristalli iniziata Feb 2018 → 1134/1450 shipped and tested**
- ◆ **Produzione e test SiPM Hamamatsu completata**
- ◆ **CRR per il calorimetro completata Maggio 2019 – Completate Gare costruzione componenti**
- ◆ **Module-0 completato e testato con elettroni e sotto vuoto**
- ◆ **Mockup ad LNF, costruzione al FNAL**

- ❑ INFN/GE Follow up per la costruzione del TS a ASG Genova + test cavi superconduttori
- ❑ INFN LNF/PI/LE responsabilita' calo elettromagnetico con Caltech(USA), JINR (RUS)

- ❑ LNF responsabilita' costruzione calorimetro elettromagnetico – S. Miscetti, L2 Manager
  - ❑ L3 Cristalli - S. Giovannella; L3 fotosensori – M.Martini; L3 Meccanica - F. Happacher
  - L3 FEE - G. Corradi; L3 assemblaggio – A.Saputi, I. Sarra

Mu2e group composition 2020

Ricercatori/Tecnologi LNF (6,5/9)

C. Bloise (0,7) Dir.Ric
F. Colao (Ass. Enea) (0,5)
M. Cordelli (Ass. senior) (1)
F. Fontana (0,5) (Ass.Marconi),
S. Giovannella (0,7) Ric,
F. Happacher (1,0) Ric, Res.Locale 2020
M. Martini (0,3) (Ass.Marconi),
S. Miscetti (0,8) Dir.Ric (Res.Nazionale)
D. Rinaldi (Ass. Ancona) (1,0)

Tot FTE (Ric+Tecnologi+PHD) => 12.5 / 15= 0,83

Non strutturati (5,7 FTE/6)

I. Sarra (0,7) RTDA Ass. Marconi
M. Ricci (1,0) Dott
R. Donghia (1,0) AR
E. Diociaiuti (1,0) Dott
D. Pasciuto (1,0) Dott
L. Montalto (Ass. Ancona) (1,0)

DR: G.Pileggi(0,2), A.Saputi(0,3) , A.Mengucci(0,5), M.Ventura(0,5), E.Capitolo (0,2)
SEA (6 MU) G.Corradi (0,5), S.Ceravolo(0,5), B.Ponzio(0,2)
SPCM: 6 MU

Calorimetro: Descrizione, attivita' 2019 + piani 2020

Attivita' 2019

+ Caratterizzazione cristalli e fotosensori prod
+ Irraggiamento con neutroni (FNG e PELBE-Dresda)
+ Irraggiamento con dose a Calliope
+ Misura MTTF sensori e pre-production FEE
+ Test cristalli, cavi e fibre (Outgassing) e test meccanici (SPCM)
+ produzione nuovi amplificatori SiPM (SEA)
+ Completamento analisi dati Module-0
+ Test Modulo-0 a bassa temperatura
+ produzione prototipo mezzanine board rad-hard
+ produzione prototipo board FEE rad-hard
+ studio sistemi LV, HV
+ studio cavi definitivi FEE-MB
+ distribuzione secondaria LASER system
+ Mockup meccanico
+ Integrazione Disegno nel Detector Solenoid
+ Completamento Construction Readiness Meccanica

PIANI 2020

→ Completare Produzione/QA cristalli
→ Produzione e QA Cavi
→ Produzione e QA FEE + Mezzanine Board
→ Completamento sistema LASER
→ Assemblaggio & cable routing
→ Costruzione parti Meccaniche
→ Assemblaggio e test dischi
  → Cristalli
  → FEE
  → Elettronica digitale
  → Cabling
  → Calibrazione

Ruolo LNF : Management, Meccanica, Test Cristalli, Sensori, FEE, Laser system

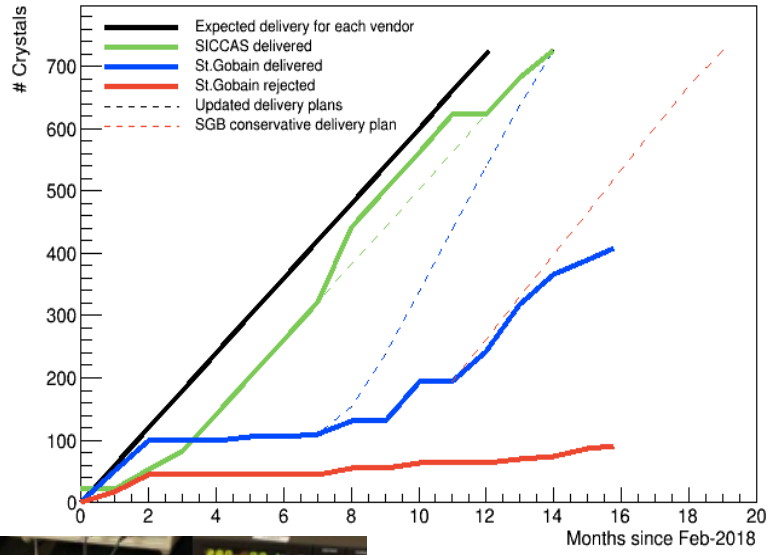
◇ **Piani**: Completamento Montaggio dischi
◇ **Obiettivi: Installazione in sala**

Attivita’ 2019

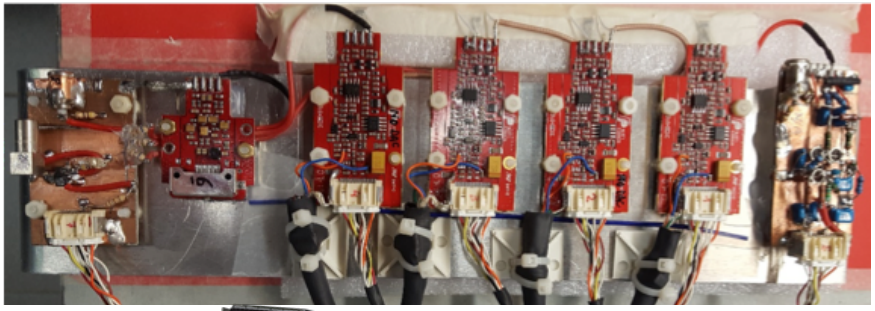
- QA Cristalli, incartaggio – 80%
- QA Sensori produzione completata
- Full size Mockup
- Sviluppo elettronica FEE e test dose
- Construction Readiness Review Meccanica - Calorimetro Integrato - Tender assegnati – Disegni esecutivi

crystals

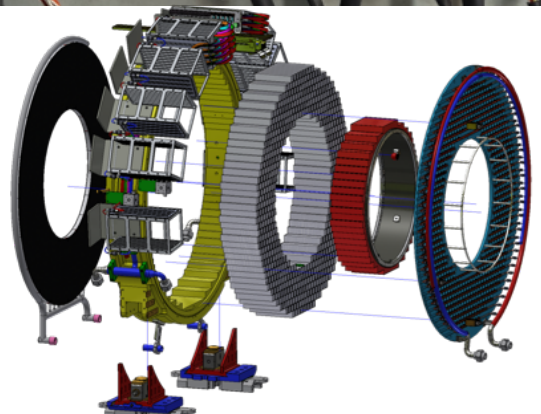
	SICCAS	St.Gobain	Total
Shipped	725/725	409/725	1134/1450
CMM + inspection	725	409	1134
Sent to Caltech	257	116	373
Out-of-specs	30	44+46	120
Irradiation at Caltech	9	3	12

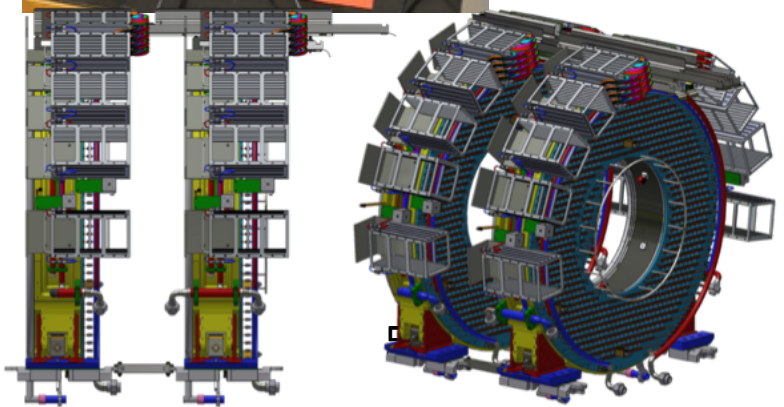


FEE+MB



Mechanics





PMU2E: Richieste 2020

MI	Metabolismo	8,5 kE	
	Gettone RN	3 kE	**18 KE**
	Missioni Marconi-LNF	6,5	
ME	Responsabilita` Project Leader+5 L3	71,5 kE	**174,5 kE+ 38,5 kE (sj)**
	Missioni QA + Assembly	46,5 kE	
	Missioni per personale tecnico (SJ)	16,5+16,5 (sj)kE	
	2 MU tecnici per supporto tracker activities	11 (sj)	
	Supporto addizionale assemblaggio e installazione In sala (F. Happacher – A. Saputi)	5,5+5,5 (sj) kE	
Trasporti	Trasporto	5 kE	
Consumi	Metabolismi	16 kE	**21 kE**
C.A	Cooling Station (SJ)	100	
	Shock absorber Lifting Transport fixture	3	
	Cables Trays and supports	7+5=11	209 kE
	G10 supports and inserts	5	
	Dist Boards+Patch panels	10+8	
	Flex pipes and Unions for cooling lines	8+5	
	LV/HV feed throughs	20	
	Laser crate+sync	20+10	

R&D sui Futuri Acceleratori:RD_FA @LNF

Attività suddivisa in WP, a Frascati siamo coinvolti in :

- **WP2:** Machine Detector Interface (MDI) per Futuri Acceleratori
  - M. Boscolo (convener WP), O. Blanco, L. Pellegrino
- **WP7: μ-RWELL R&D**
  - G. Bencivenni, M. Bertani, E. De Lucia, D. Domenici, G. Felici, M. Poli Lener, G. Morello
- **WP8**: Muon Collider
  - M. Antonelli (convener WP), M. Biagini, M. Boscolo, O. Blanco, A. Ciarma, S. Guiducci, L. Pellegrino, M. Rotondo

6.2 FTE totali:

WP2	
Boscolo Manuela	70
Blanco Oscar	20
Pellegrino Luigi	10

WP7	
Bencivenni Giovanni	40
Bertani Monica	10
De Lucia Erika	20
Domenici Danilo	30
Felici Giulietto	20
Morello Gianfranco	30
Poli Lener Marco	30

WP8	
Antonelli Mario	20
Biagini Maria Enrica	50
Blanco Oscar	80
Boscolo Manuela	30
Ciarma Andrea	100
Guiducci Susanna	30
Pellegrino Luigi	10
Rotondo Marcello	20

WP2: Machine Detector Interface FCC-ee

- 2018 was focused on completion of CDR

  https://fcc-cdr.web.cern.ch/ - FCCEE

- Refining in 2019 many aspects of the design:

Our goal is to have a feasible and engineered design of the Interaction Region that meets optics, beam dynamics and high current requirements, foresees tolerable radiation and meets as well the mechanical requirements in terms of integration, stability, assembly.

- MDI reports given on many on-going studies at the FCC-WEEK19 in Brussels (June 2019):
  - **Overview of MDI issues toward the TDR (M. Boscolo)**
  - Mechanical design of the interaction region (E. Levichev)
  - Final focus quadrupoles and solenoids (M. Koratzinos)
  - Beam-beam blow-up issues (D. El Khechen)
  - Impact of beam-beam effects on luminosity measurement (E. Perez)
  - Synchrotron radiation background studies (M. Luckhof)
  - Beam losses at IR (H. Burkhardt)
  - Improvement of detector performance with smaller central IP beam pipe (E. Leogrande)
  - HOM and heating with smaller central IP beam pipe (A. Novokhatski)
  - Synchrotron radiation with smaller central IP beam pipe (M. Sullivan)
  - Luminosity Measurement (Mogens Dam)

- M Boscolo et al, *Machine detector interface for the e+e- future circular collider*, 62th ICFA ABDW on high luminosity circular e+e- colliders, eeFACT18, Hong Kong (2019) link

WP2 FCC-ee: Machine Detector Interface

- Next steps (towards the TDR) will cover the following macro-areas:

  1. Beam physics (optics, beam dynamics, collective effects)
  2. Experimental environment & Luminosity measurement
  3. Simulation software
  4. Engineering (mechanical, magnets, diagnostics, vacuum, cooling, ...)

- Consolidate baseline of the MDI design for FCC-ee including now more mechanical details:
  - try to converge on a design of the IR with enough details to constitute a real engineering baseline
  - understand installation procedures, mechanical detector interfaces, detector and machine elements accessibility for maintenance/upgrades
  - mechanical stability and position precisions of some detector elements (i.e. Lumical) is a relevant element to consider in the design
  - define better the general strategy for services in and out of the detector

- Much work continues in order to complete a full simulation tool (MDIsim/GEANT) that allow us to have detailed background studies (Synch. Radiation)

WP2: MDI FCC-hh: Synchrotron Radiation in the Experiments

- This work was part of the Experimental Insertion Region (WP3) **EuroCirCol** design study ended on 31/05/19: M. Boscolo was leader of **Task 3.3 dedicated to the study of the impact of synchrotron radiation emitted by protons on detector and machine components in the interaction region.**
- Very successful design study, ended with FCC-hh CDR
- See also: CERN-ACC-2019-0018 http://cds.cern.ch/record/2655283
- Talk at FCC-WEEK19: M. Boscolo, SR backgrounds in the exp. insertion region of the FCC-hh

Outcome: the contribution of SR in the experimental area is found to be negligible, including last bends and final focus quads

- The fraction entering the TAS is ~47 W and ~13 W reach the Be chamber.
- The emitted photons are ~10^{10} but have a critical energy ~1keV, safely stopped by the Be pipe
- No full simulation into experiments is needed
- Also the non-collisions scheme, with a beam separation at the IP was studied and found to be at a safe limit at 100 W

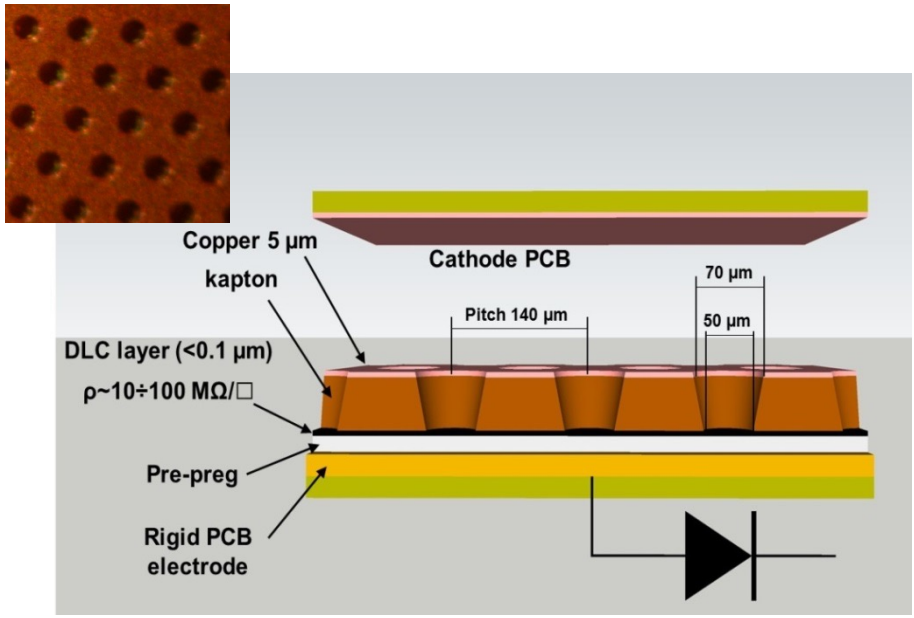
Lattice v9	half crossing angle	Power (TAS) [W]	Power(Be) [W]	Nγ(Be) [10^9]	Em(Be) [keV]
Nominal	yes, 100μrad	47	13	16	0.2

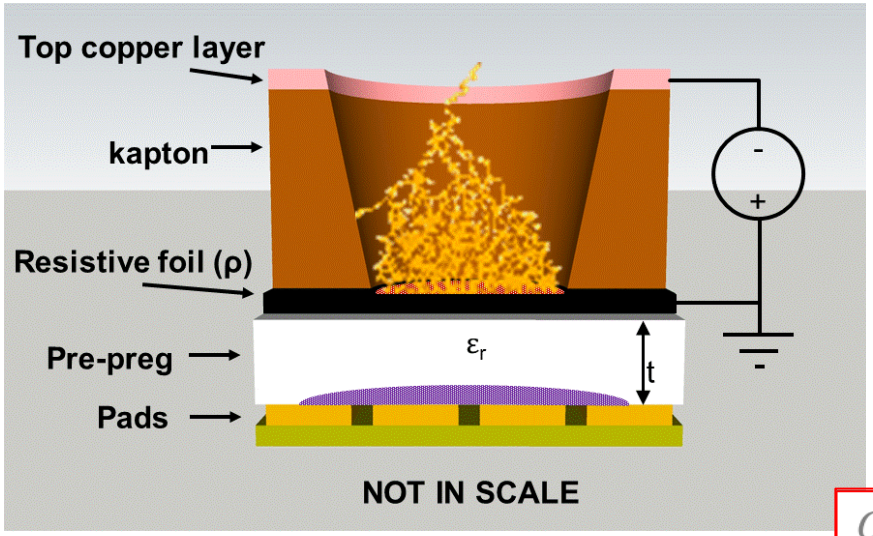
WP7: The μ-RWELL architecture

The μ-RWELL is a MPGD composed of only two elements:

- μ-RWELL_PCB
- drift/cathode PCB defining the gas gap

μ-RWELL_PCB = amplification-stage ⊕ resistive stage ⊕ readout PCB



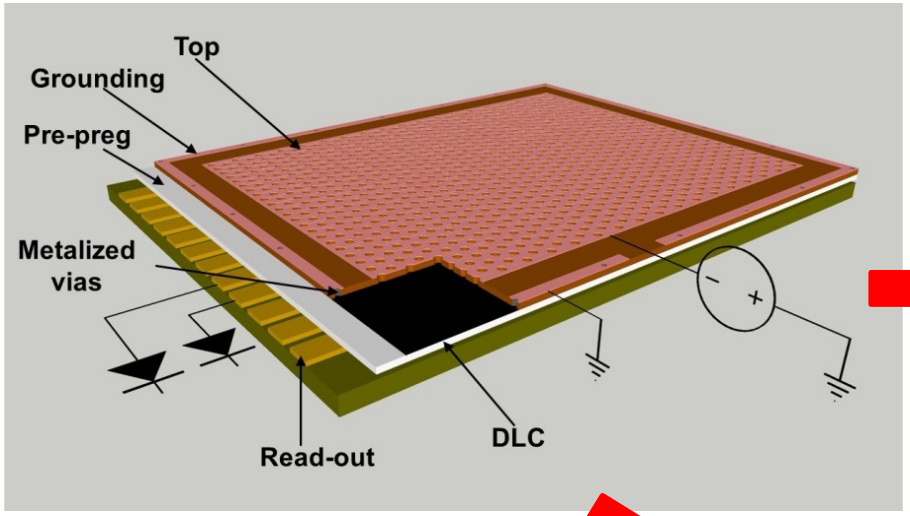


- The "WELL" acts as a multiplication channel for the ionization produced in the gas of the drift gap
- The charge induced on the resistive layer is spread with a time constant, τ ~ ρ×C

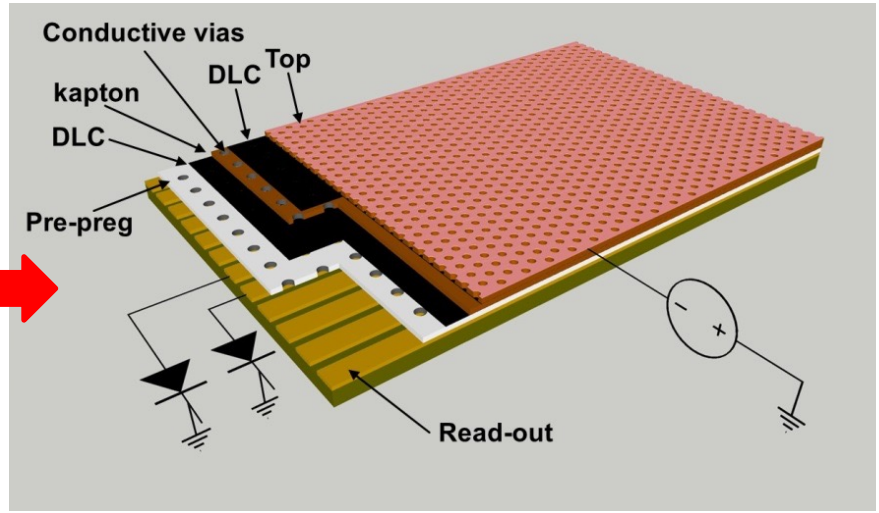
$$C = \varepsilon_0 \times \varepsilon_r \times \frac{S}{t} \cong 50\ pF/m \text{ (pitch/width 0,4 mm)}$$

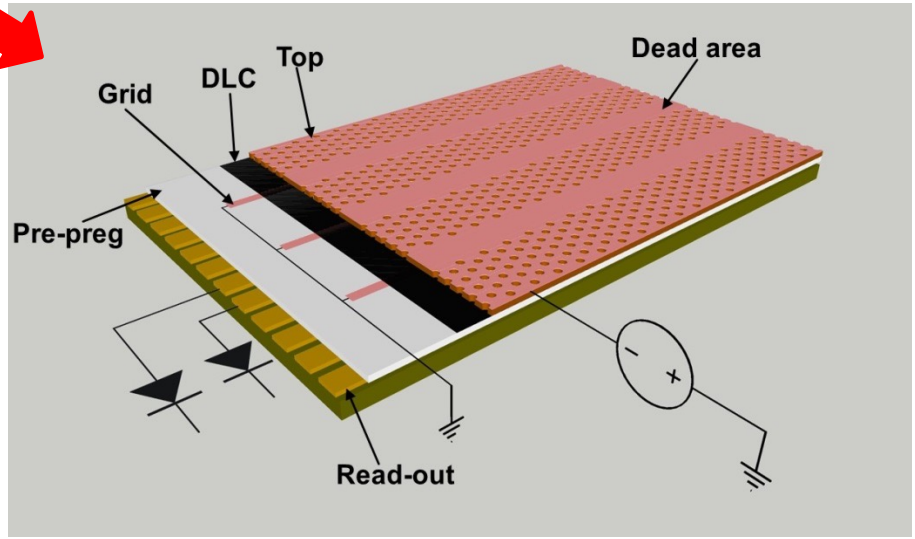
Detector Layouts

Single resistive layer – LOW RATE



Double resistive layer – HIGH RATE

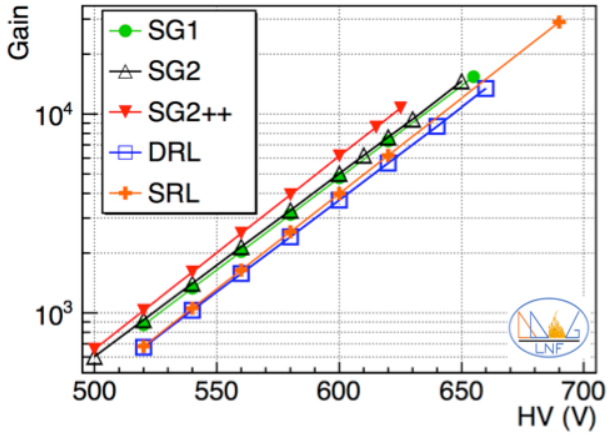




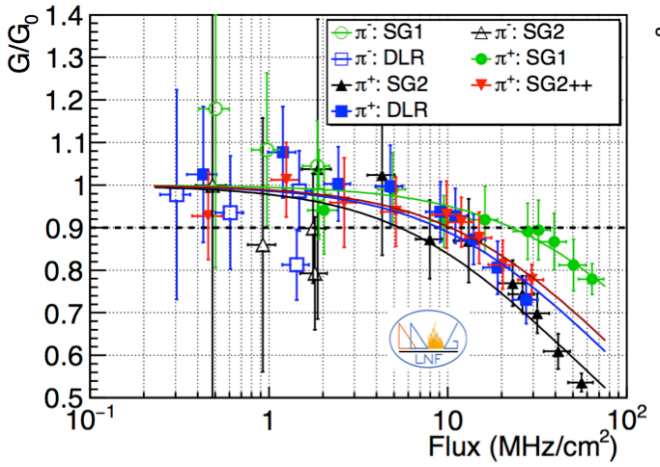
Single resistive layer with dense grid grounding – SIMPLIFIED HIGH RATE

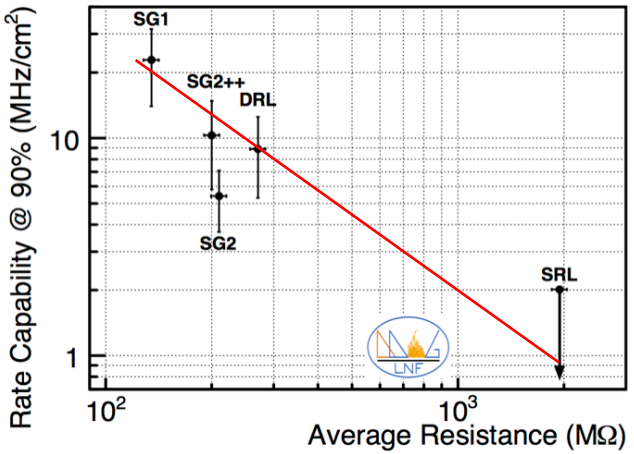
Detector performance

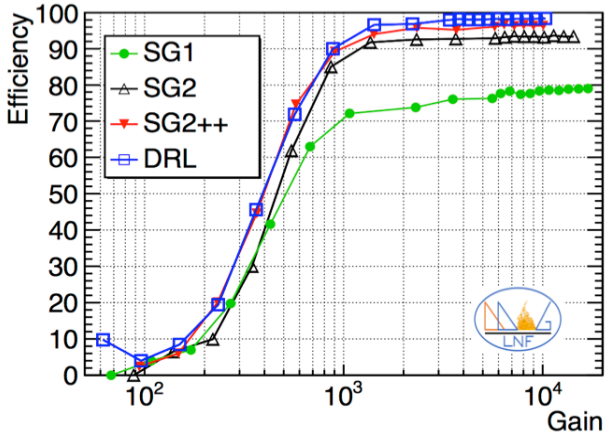
G ~ 10^4



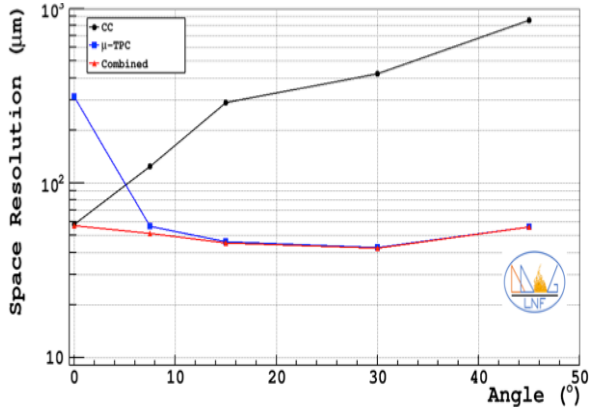
Rate capability ~ 10 MHz/cm^2



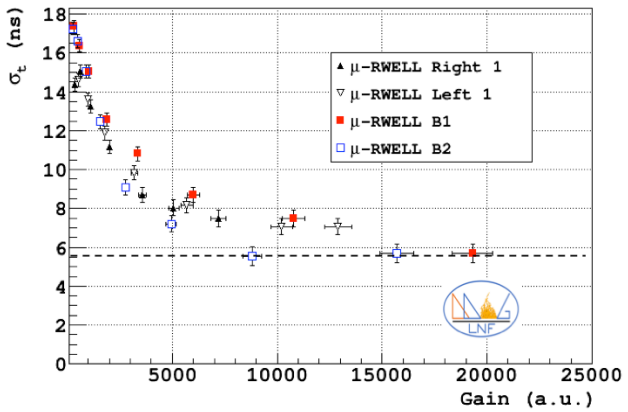




Efficiency ~ 98%



σ_x ~ 40 – 60 μm



σ_t ~ 5- 6 ns

Stato Programma 2019 (I)

WP7.1.0 - **Trasferimento Tecnologico (ELTOS+TECHTRA):** in corso, ottimi risultati nella realizzazione dei prototipi small area (**10x10 cm^2**). Entro luglio 2019 dovremmo, seppur con un ritardo consistente (problema INFN-CADENCE), realizzare in ELTOS I **primi prototipi low rate, 330x330 mm^2.**
Il lavoro proseguirà in autunno con la realizzazione dei **primi prototipi high rate** (**tipo SG2++), realizzati con DLC+Cu prodotto in Cina (pto successivo)**

WP7.1.1 - **R&D on improved DLC+Cu sputtering (Common Project RD51): collaborazione con USTC di HEFEI (PRC)** in corso, risultati ottimi. I primi rivelatori high rate tipo SG2++ costruiti e testati con successo ottenendo rate capability di 10 MHz/cm^2 con efficienza 97%. A luglio 2019 verrà consegnato un batch di fogli DLC+Cu sufficiente per la produzione dei **primi 16-20 prototipi di high rate in ELTOS**

WP7.2.1 - **Costruzione di u-RWELL 2D readout:** in consistente ritardo a causa del problema INFN-CADENCE. Puntiamo a disegnare il primo prototipo 2D entro l'autunno e completarne la costruzione entro fine 2019 (o almeno impegnare l'ordine)

Servizi 2ndo semestre 2019

SEA (4,5 mu): priorità A2

1. Progettazione circuiti resistivi per rivelatori MPGD
2. Progettazione readout PCB 2D (XY) della micro-RWELL
3. Supporto nello sviluppo di micro-RWELL in collaborazione con ditte italiane e straniere (ELTOS/TECHTRA/CERN)
4. Assemblaggio board di lettura basata su VTX per rivelatori MPGD

Programma preliminare 2020

preliminare

Il programma 2020 è focalizzato principalmente sulle seguenti attività:

1. realizzazione presso ELTOS/CERN/TECHTRA (**Technology Transfer**) di medium/large size High rate RWELLs (300x250 ÷ 600x250 mm^2)
2. progettazione, costruzione e caratterizzazione della RWELL cilindrica (**CREMLIN2**)
3. progettazione, costruzione e caratterizzazione delle RWELL per la rivelazione di neutroni termici (**ATTRACT – uRANIA**)

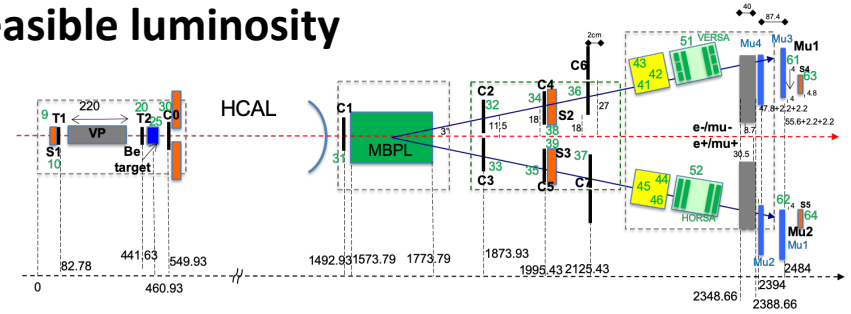
Richieste preliminari di finanziamento CSN1 per il 2020 (essenzialmente pto 1):

1.1 – Consumi per prototipi medium/large size …… ….. **25 k€**
1.2 – Co-funding **CP-RD51** (attività su DLC/DLC+Cu) …… **8 k€**
1.3 – Missioni contatti con Ditte/CERN per costruzione protos…… **5 k€**
1.4 – Missioni per TB prototipi …… **8 k€**

preliminare

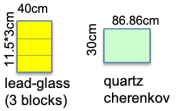
RDFA - WP8: Muon Collider

The LEMMA scheme is under study to assess a feasible luminosity



Test Beam at CERN done, financed by CSN1 experimental set-up:

not really a testbeam, but a small experiment, ask for 3 weeks of data taking in 2021



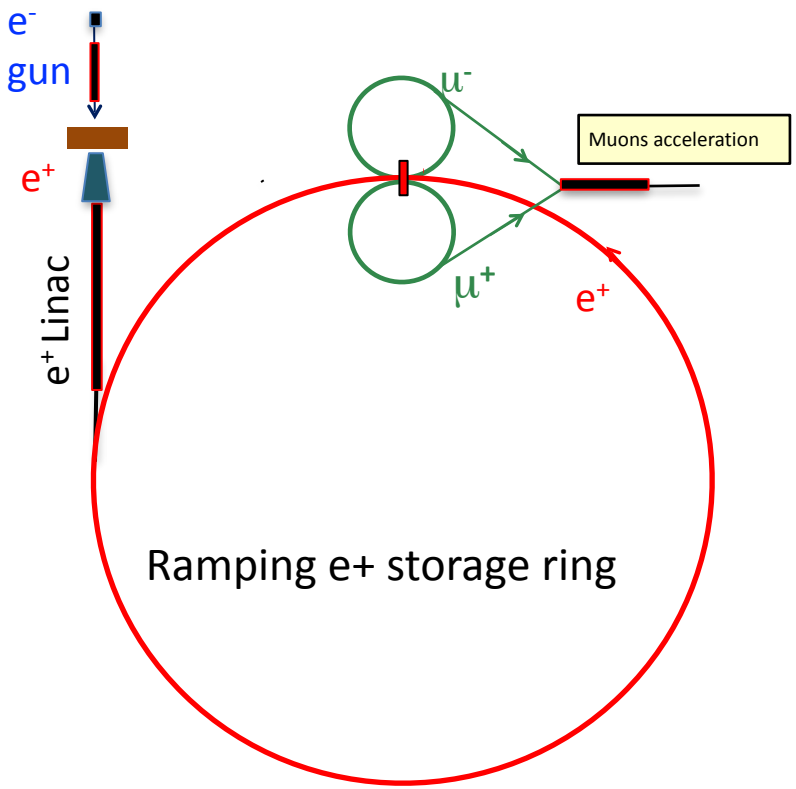
Some new Refs. (may be incomplete)

- CERN EP seminar: M. Antonelli, *Why and What MC*, CERN, 2 July 2019
- P. Raimondi, *Studies for a Low EMittance Muon Accelerator,* CERN, 2 July 2019
- *Positron driven muon source for a muon collider*, Lemma collab., arXiv:1905.05747 (2019)
- *The future prospects of muon colliders and neutrino factories*, M. Boscolo, JP. Delahaye and M. Palmer, arXiv: 1808.01858 (2018)
- ARIES Muon Collider workshop, Padova Luglio 2018
- IPAC19 contributed talk, M. Biagini et al., *Positron driven muon source for a muon collider: recent developments,* IPAC19 (2019)
- IPAC19 poster: O. Blanco et al. , Multi-target lattice for muon production from e+ beam annihilation on target
- Invited plenary talk: M. Boscolo, *Low emittance muon collider scheme*, NUFACT18 (2018)
- Invited talk: M. Boscolo, *The muon collider, 1st ARIES annual workshop, Riga (2018)*
- Invited talk: M. Boscolo, *New concepts for high energy colliders* , SIF2018
- At present : work to well define the possible R&D developments to propose to target 10^{34} Luminosity.

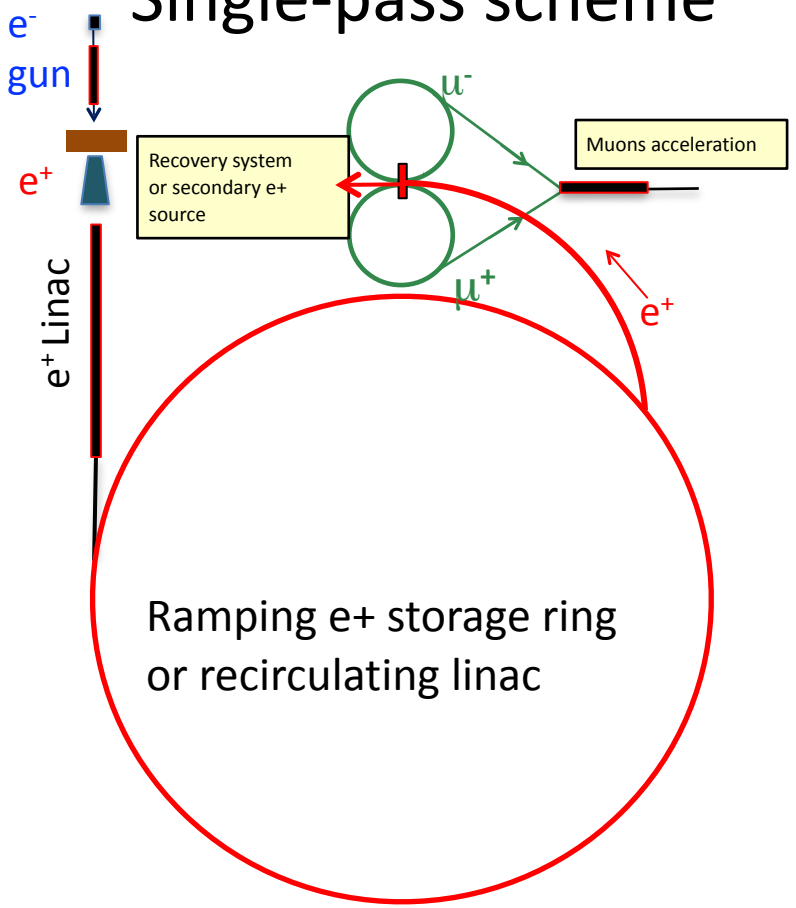
Possible schemes for muon production under investigation: goal is to maximize luminosity

Initial design on ring-with-target is evolving to relax the requirement on the e+ source and maximize the muons/ bunch

Multi-pass scheme



Single-pass scheme



Anagrafica RD_FA

Antonelli Mario	20	WP8			
Bencivenni Giovanni	40	WP7			
Bertani Monica	10	WP7			
Biagini Maria Enrica	50	WP8			
Blanco Oscar	80	WP8	20	WP2	→ INFN-Grant--CSN5 for LEMMA
Boscolo Manuela	70	WP2	30	WP8	
Ciarma Andrea	100	WP8	→ PhD acceleratori Sapienza per LEMMA, borsa INFN		
De Lucia Erika	20	WP7			
Domenici Danilo	30	WP7			
Felici Giulietto	20	WP7			
Guiducci Susanna	30	WP8			
Morello Gianfranco	30	WP7			
Pellegrino Luigi	10	WP2	10	WP8	
Poli Lener Marco	30	WP7			
Rotondo Marcello	20	WP8			

Gruppo 1 LNF, richieste 2020

Sigla	Ric	Tec	FTE	<FTE>	MISS	CON	APP	ALTRO CAP
RD_FA	10	5	6.2	0,42	30	33		INV

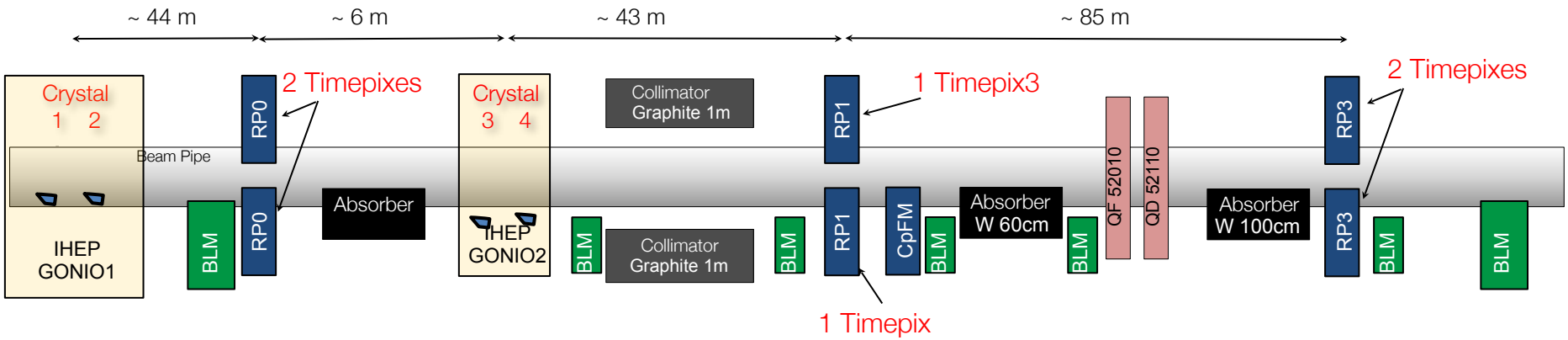
solo per WP7:

Consumi per prototipi medium/large size **25 k€**
Co-funding **CP-RD51** (attività su DLC/DLC+Cu)**8 k€**

WP2+WP7+WP8

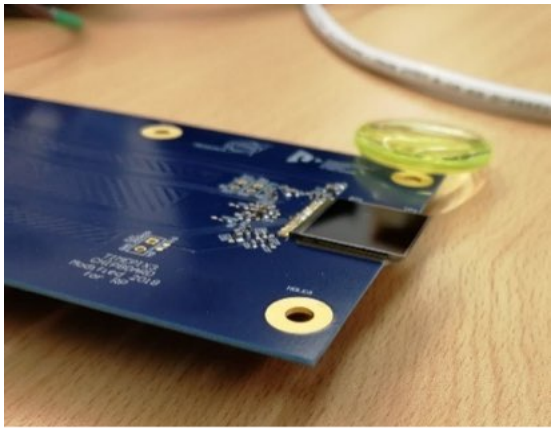
per **WP7**:
Missioni contatti con Ditte/CERN per costruzione protos..... 5 k€
Missioni per TB prototipi ..... 8 k€
il resto per meeting e workshop WP2 + WP8

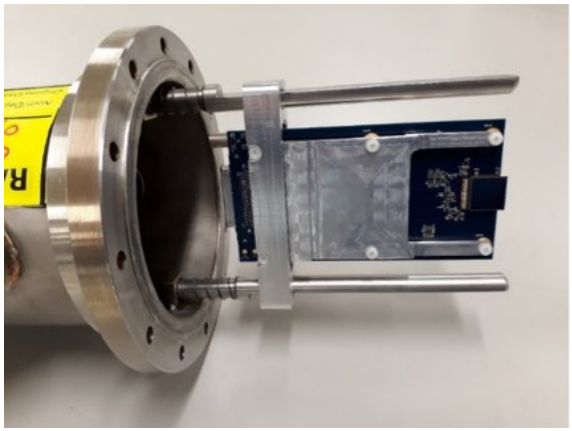
The UA9 SPS experimental setup 2018



Frascati contribution with
6 Timepix installed in SPS

A new Timepix3 has been installed in June 2018 on Roman Pot 1 external side with new readout system





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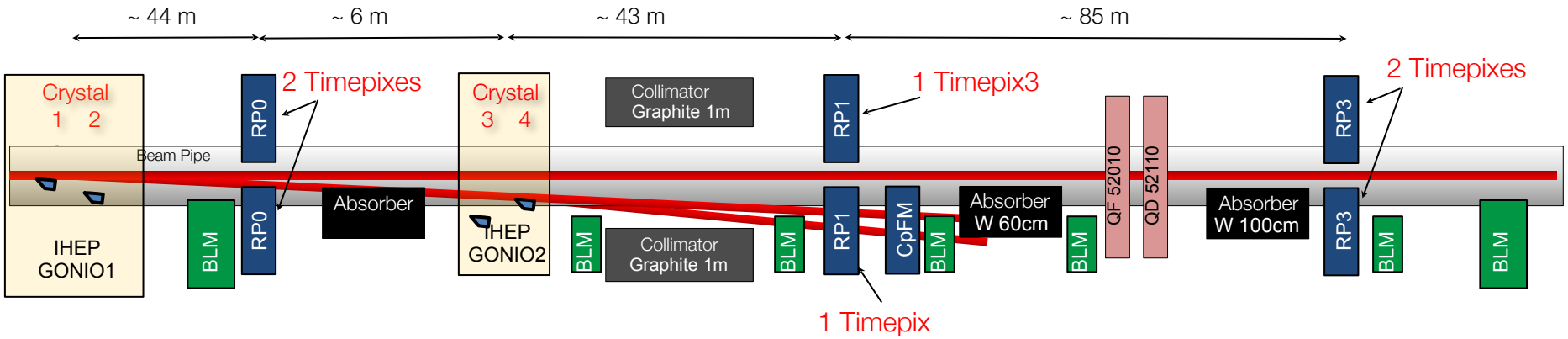

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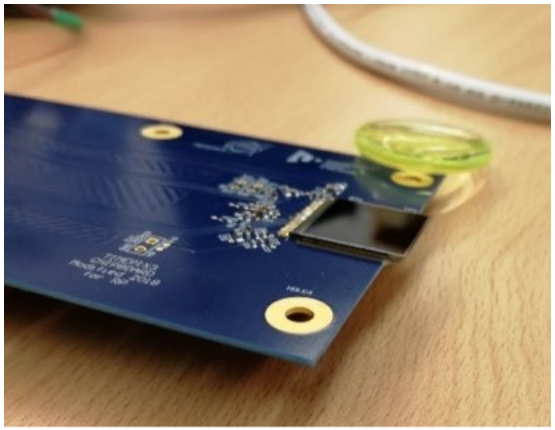
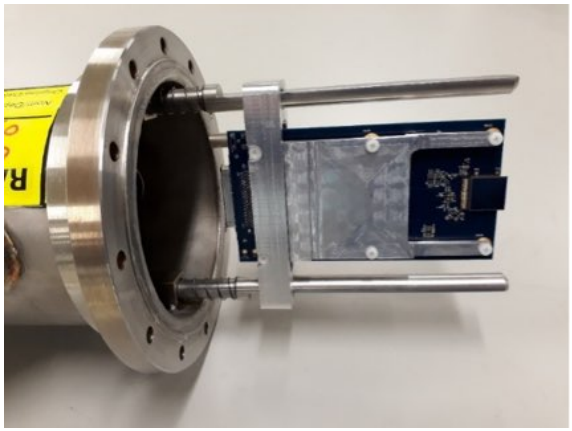
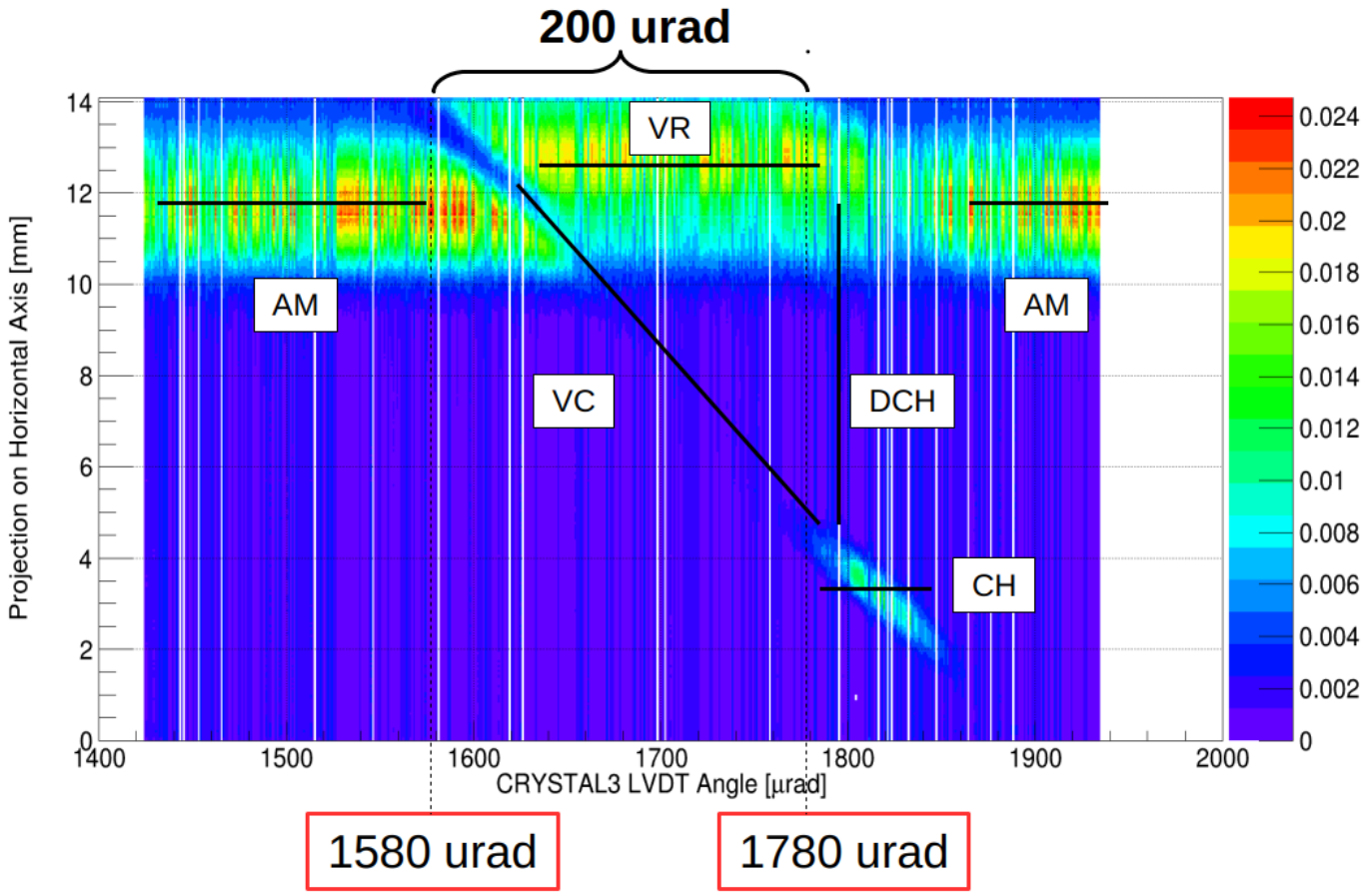




Double Channeling seen with Timepix in 2018 in SPS

10 minutes of crystal angular scan



UA9 summary

A. Variola and F. Murtas are organizing the new INFN contribution to UA9 collaboration for the next MoU.

Frascati is now involved in the Timepix based Beam Instrumentation in collaboration with Pilsen & Prague University, EN and BI division at CERN.

Some studies on new radiation tolerance sensor and readout devices are in progress.

Frascati will be involved in the improvement of Timepix firmware, data acquisition, offline analysis and radiation tolerance.

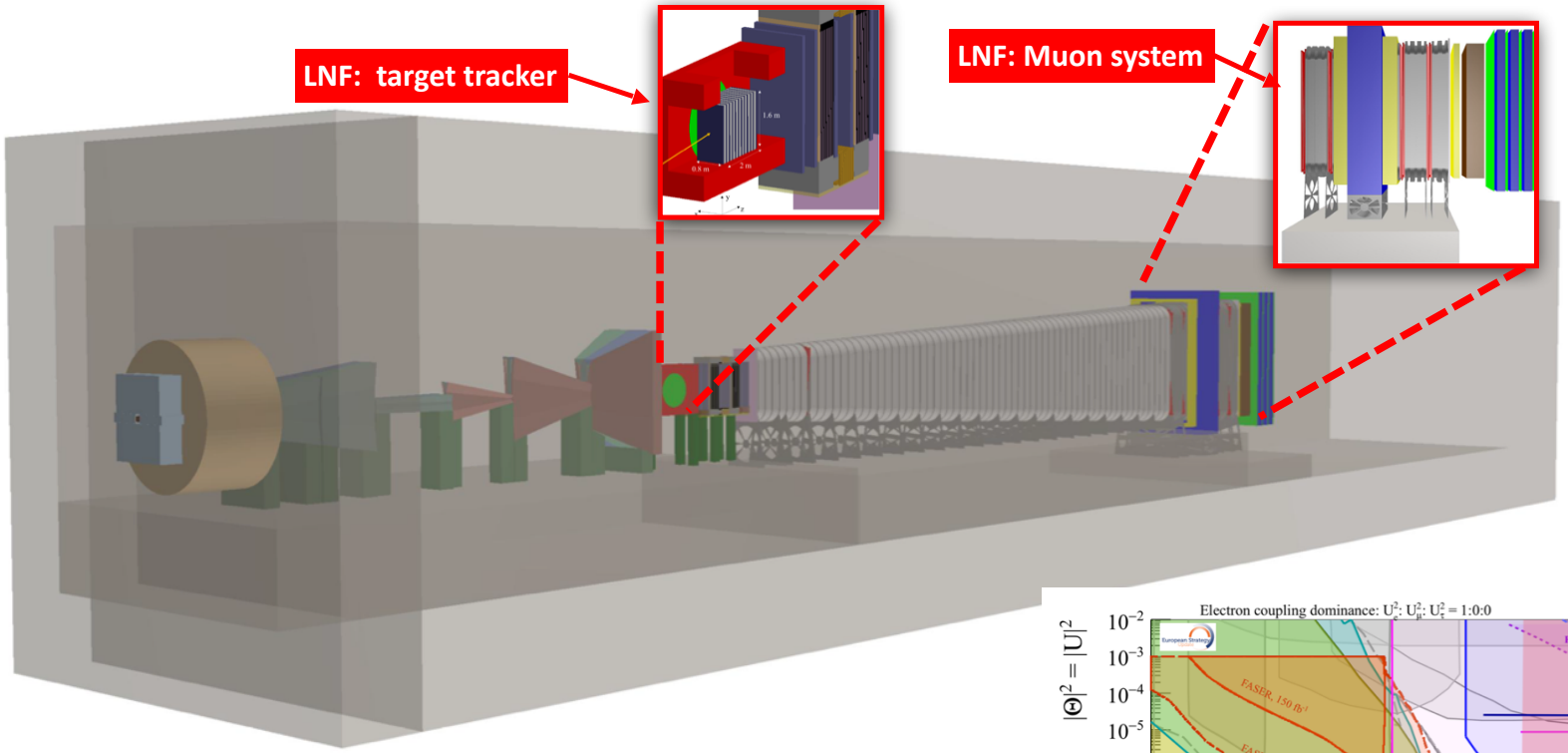
All these studies and constructions can be used in Dafne and BTF.

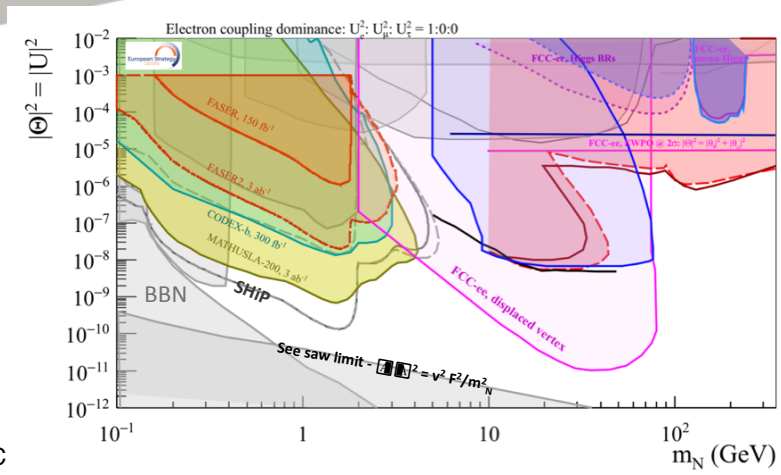
SHiP

LNF group: G. Bencivenni, M. Bertani, A. Calcaterra, P. Ciambrone, G. Felici, G. Lanfranchi, + aiuto esterno di Alessandro Paoloni per i test beams.

E il (preziosissimo) contributo di: F. Angeloni, A. Balla, G. Papalino, A. Saputi

Un grazie particolare ai servizi: SEA (Paolo Ciambrone) e SPCM (Tommaso Napolitano)





Sensitivity for Right Handed Neutrinos in the mass range 0.1-80 GeV: SHiP + FCC-ee at the Z pole can cover almost all the area compatible with lepto-genesis.

SHiP and the European Strategy for Particle Physics

1. SHiP-related deliverables submitted to the European Strategy Update:

- Physics Beyond Colliders summary report – arXiv: 1902.00260 – ESPP submission #42
- Physics Beyond Colliders BSM WG Report – arXiv: 1901.09966 (main Editor: G. Lanfranchi)
- The SHiP experiment at CERN – ESPP submission #12 (including cost-estimate)
- The SPS Beam Dump facility (BDF) – ESPP submission #129 (including cost-estimate)

(TDR being submitted to the Strategy in these weeks.)

2. SHiP and Beam Dump Facility mentioned in the Summaries of 5 (out of 7) Physics Working groups in Granada:

- ✓ Neutrinos (Marco Zito & Stan Bentvelsen)
- ✓ Flavor (Antonio Zoccoli & Belen Gavela)
- ✓ Dark Matter and Dark Sector (Marcela Carena & Shoji Asai)
- ✓ EW measurements (Beate Heinemann & Keith Ellis)
- ✓ BSM @ colliders (Gian Giudice & Paris Sphicas)
- ✓ QCD (J. D'Hondt, K. Redlich)
- ✓ Accelerators (Caterina Biscari, Lenny Rivkin)

3. European Strategy Group Chair: Report to CERN Council, June 21st:

https://indico.cern.ch/event/824273/contributions/3447355/attachments/1866788/3070019/CC-Report-from-Granada.pdf

Strategy Update, three main topics mentioned (beyond the big collider):

1. Physics Beyond Colliders (SHiP, LDMX, NA64++, proton EDM ring, etc);
2. Nuclear Physics & QCD;
3. Neutrinos & Astro-particles (includes Gravitational Waves).

4. New CERN Medium-Term-Plan (MTP) (approved by CERN Council, June 20th):

⟶ **7o MCHF to Physics Beyond Colliders in 2020-2029**

(will be revised next year after the Strategy Outcome and new timescale of HL-LHC).

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  (TDR being submitted to the Strategy in these weeks.)

2. SHiP and Beam Dump Facility mentioned in the Summaries of 5 (out of 7) Physics Working groups in Granada:

Next steps for SHiP:

- **December 2019:** SHiP Comprehensive Design Report to be submitted to the SPSC (with updated cost-estimates)
- **January 2020:** Outcome of the European Strategy.

3. European Strategy Group Chair: Report to CERN Council, June 21st:

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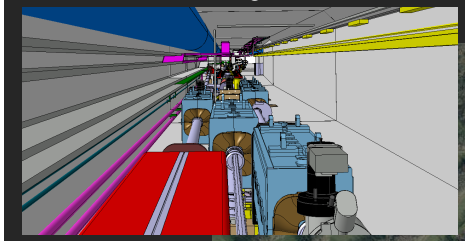
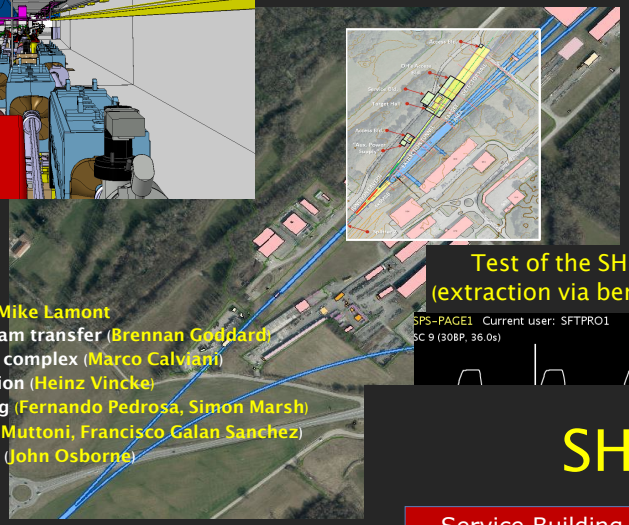
Beam Dump Facility: TDR completed

SHiP line branching off in TDC2





400 GeV proton beam
up to $4x10^{19}$ pot/year
$2x10^{20}$ pot/5 years

SHiP experimental hall

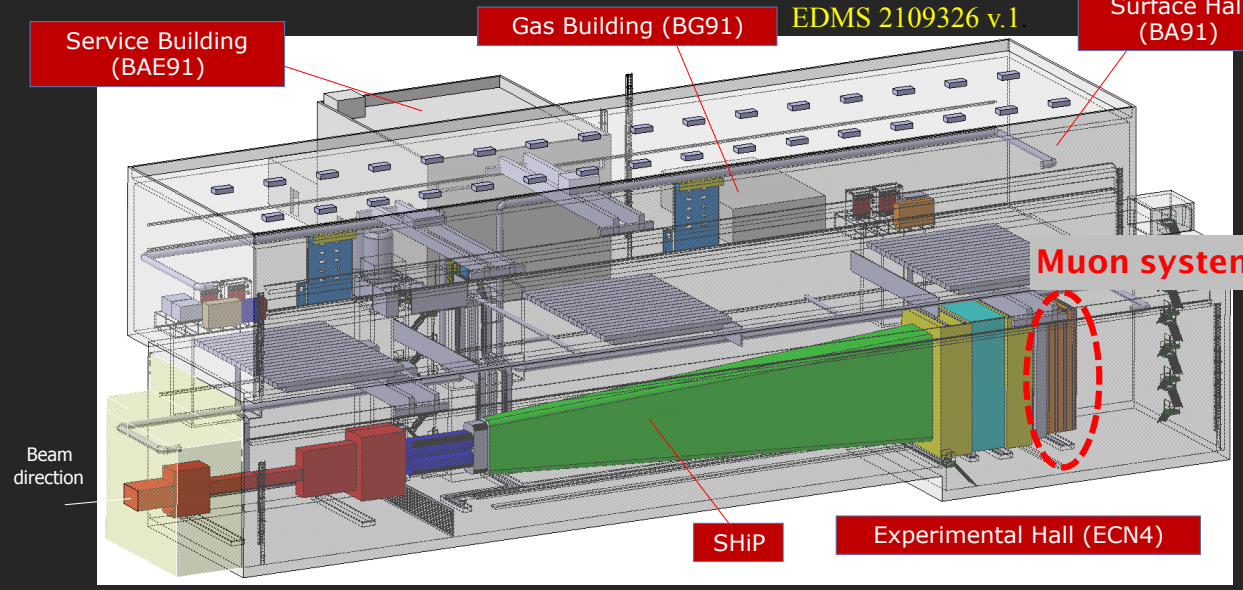
Test of the SHiP spill structure
(extraction via bent crystals, UA9-like

Responsibilities:

Overall coordination: Mike Lamont
WP1.Extraction and beam transfer (Brennan Goddard)
WP2.Target and target complex (Marco Calviani)
WP3.Radiation protection (Heinz Vincke)
WP4.Safety engineering (Fernando Pedrosa, Simon Marsh)
WP5.Integration (Yvon Muttoni, Francisco Galan Sanchez)
WP6. Civil engineering (John Osborne)

SHiP Experimental Hall - ECN4

EDMS 2109326 v.1



Experimental Hall being defined in all details:
service & gas buildings, surface hall, stairs, cranes, rails, storage areas, …

SHiP-LNF in 2020

Composizione Gruppo prevista nel 2020 (percentuali in via di definizione):

G. Bencivenni (10 %), M. Bertani (10 %), A. Calcaterra (40 %), P. Ciambrone (10 %),
G. Felici (10 %), G. Lanfranchi (30-50 %) , ….

Supporto tecnico previsto nel II semestre 2019 e nel 2020:

II - semestre 2019:

Richieste solo per i muoni:

- SPCM: 1.5 m.u. -
- SEA: servizio automazione, 2.0 m.u.;
- Tecnici Divisione Ricerca: A. Saputi (10%);

Necessario per:

⟶ Test Beam alla BTF: 23-29 settembre.

⟶ Internal Review del Muon System: 11 Ottobre;

Grosso sforzo per completare il Comprehensive Design Report entro Dicembre.

2020: Similar requests as in 2019 (sj Outcome of the European Strategy).

Gruppo 1 LNF, sommario richieste(*) 2020

(*) PRELIMINARI!

Sigla	Ric	Tec	FTE	<FTE>	MISS		CON		APP		ALTRO CAP	
ATLAS	13	6	10	0.79	120		40		84		10	INV
BELLE2	6	1	3	0.47	58		4.5					
BESIII	3	2	2.5	0.50	100		15		0		0	
CMS	9		6.9	0.77	120		12.5					
KLOE-2	16	3	9.2	0.5	19.5		95.		5		26	MAN
LHCb	16	5	14.4	0.68	146		31.5		-		75	
NA62	9	0	6.3	0.70	91.5	66 +17.5	20	5.5				
PADME	14	5	5.6	0.3	10		20				128	INV
PMU2E	15		12.5	0.83	193	38	16		109	100	5	TRA
RDFA	8	4	5	0,42	33		25				8	INV

Conclusioni (I)

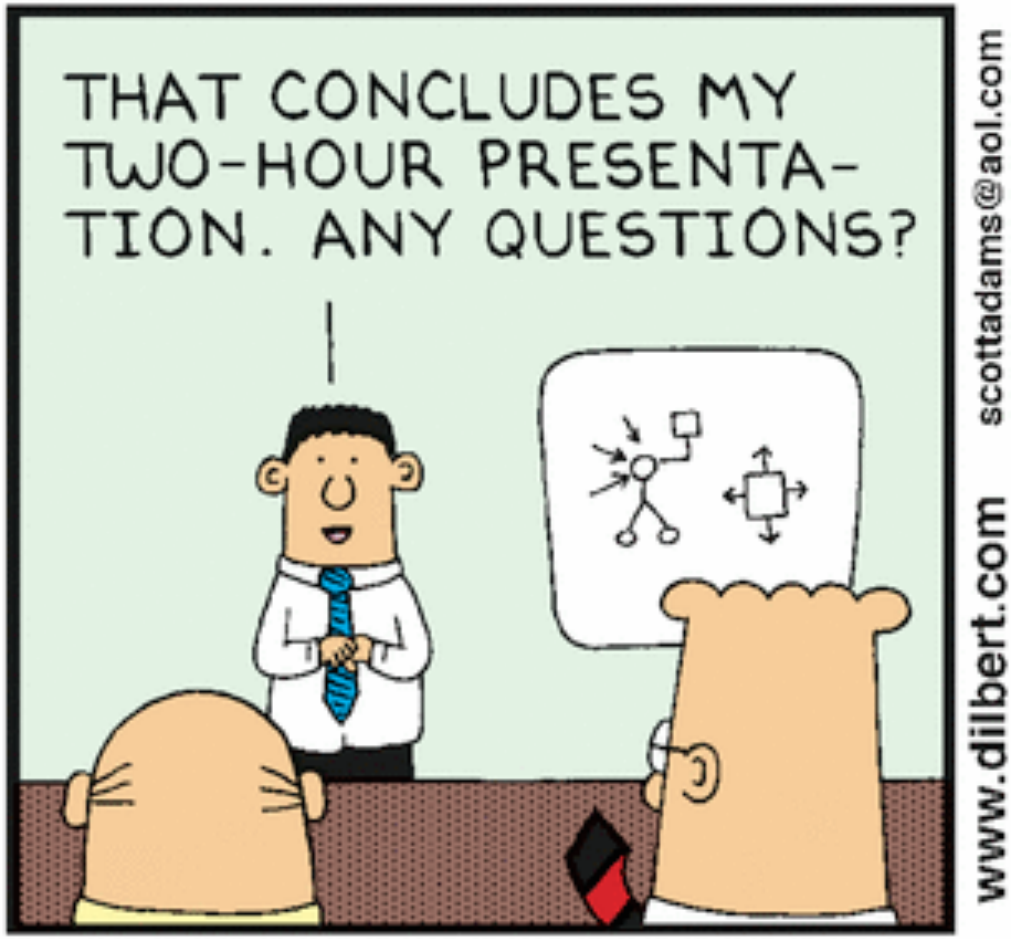
Attività di CSN1 molto variegate:

- 2 esperimenti locali importanti
  - KLOE-2 ha terminato la presa dati nel 2018. Ora deve analizzare 5.5fb^{-1} di dati. Risultati potenzialmente di estrema rilevanza.
  - PADME ha brillantemente iniziato la presa dati nel 2018, dimostrando che il rivelatore funziona a dovere. Ora deve analizzare i dati acquisiti. Buoni progressi nell'analisi (non mostrati oggi).
- NA62: "PNN" su dati 2017 attesi per KAON 2019, su dati 2018 per estate 2020 (F. Ambrosino @CSN1 08/07/2019).

Conclusioni (II)

- Iniziata la presa dati di Belle II a SuperKEKB. La strada verso l'altissima luminosità è ancora lunga (e perigliosa).
- Le attività di costruzione per gli upgrade di LHC (Atlas, CMS, LHCb) procedono a pieno ritmo.
- e anche di (P)MU2E.
- Nuove proposte
  - SHiP, RD_FA: attendiamo il verdetto dell'European Strategy
  - KLEVER: a quando la decisione se installare durante LS3?

Buon lavoro a tutti noi!



Backup slides

Riepilogo delle richieste e assegnazioni di servizi

ATLAS: richieste servizi II sem. 2019 e I sem. 2020

Richieste II semestre 2019			
SEA	staff	3 mu	3 mu
SPCM	completamento attrezzature NSW + taglio profilati	3 mu	3 mu
SPAS	Assemblaggio camere e tools per siti nSW	9.6 mu	9,6 mu
	Tecnici gruppo rivelatori	6 mu	6 mu

Richieste I semestre 2020			
SEA	staff	3 mu	3 mu
SPCM	completamento attrezzature NSW + taglio profilati	3 mu	3 mu
SPAS	Assemblaggio camere e tools per siti nSW	9.6 mu	9,6 mu
	Tecnici gruppo rivelatori	6 mu	6 mu

Belle II: richieste servizi I sem. 2020

	Richieste 2020	I Semestre	II Semestre
SSE	Tecnici gruppo esperti di elettronica	2 mu	2 mu

Utilizzo servizi II sem. 2019 gruppo KLOE

Personale tecnico		
	Computing (Fortugno 100% - Sborzacchi 50%)	

Utilizzo servizi I sem. 2020 gruppo KLOE

Personale tecnico		
	Computing (Fortugno 100% - Sborzacchi 50%)	

PADME: Richieste servizi II sem. 2019

Richieste II semestre 2019			
SEA	Prog.Elettronica	2 mu	5 mu
	CAD	0.5 mu	
	Collaudo e produzione	1 mu	
	Contingenza	1 mu	
SPCM	Progettazione/stampe 3D	0.5 mu	3.5 mu
	Meccanica: supporti SAC	3 mu	
	Metrologia		
SEM	Progettazione camera da vuoto, tooling assemblaggio	6	6mu
SSE	Tecnici gruppo esperti di meccanica	6 mu	6 mu
	Tecnici gruppo esperti di elettronica		

Richieste servizi PADME per il 2020

Richieste I e II semestre 2019			
SEA			
SPCM	Reparto carpenteria: tooling vari	0.5 mu	1 mu
	Reparto meccanica:		
	Metrologia	0.5 mu	
SEM	Piccoli interventi per supporti meccanici	1 mu	1 mu
SSE	Tecnici gruppo esperti di meccanica	1 mu	1 mu
	Tecnici gruppo esperti di elettronica		

Richieste servizi LHCb per il 2019 e 2020

Richieste II semestre 2019			
SEA	CAD	1.0 mu	11.5 mu
	Contingenza	2.0 mu	
	Staff	8.5 mu	
SPCM	Tecnici officina	0.5 mu	0.5 mu
DR	Progettazione meccanica	2.0 mu	2.0 mu
DR	Informatico	3.0 mu	3.0 mu

Richieste I e II semestre 2020			
SEA	Produzione e test ODE	TBD	TBD
	Sviluppo firmware e software ECS	12 mu	
	Supporto esperimento	TBD	
DR	Muon + SciFi	4 mu	4 mu
DR	Informatico	6 mu	6 mu

LNF, 04-06-2019 **PROGRAMMAZIONE SPCM GEN-GIU 2019** **MESI: 6**

PREVISIONE **CONSUNTIVO**

Priorità	**PROGETTAZIONE**	**M.U.**	mesi = 6 personale = 1 **M.U. disponibili*= 5,0**	**M.U.**
-	GESTIONE UFF. TEC.	1		0
4	ANET	0,75	progetto e stampa 3D struttura meccanica per setti in carburo di boro	0
4	ATLAS PP1 (ITK)	1	stampa 3D componenti per prototipo PP1 (ITK)	0
2	BESIII	0,5	progetto e stampa 3D connettori HV e particolari vari (spare)	0
4	CYGNO (LIME / MANGO)	0,25	costruzione particolari per prototipo LIME / MANGO	0
4	GENESIS (Ad. ERC CNRS)	0,75	progettazione spettrometro neutronico pulsato	0
2	PADME	0,25	stampa 3D componenti per supporto telescopio	0
2	SCF_LAB	0,5	stampa 3D componenti vari	0
4	SHiP	0,75	progetto e stampa 3D supporti tiles per test con raggi cosmici e BTF	0
	PICCOLI LAVORI		piccole richieste di disegni/progetti/prototipaz. non programmati (<15 ore-uomo)	0
	totale M.U. =	**5,75**	**impegno prog. = 115 %** **impegno eff.= 0 %**	**0**

Priorità	**MECCANICA**	**M.U.**	mesi = 6 personale = 4 **M.U. disponibili*= 20,0**	**M.U.**
-	GESTIONE OFF.	2		0
4	ANET	0,75	costruzione struttura meccanica per setti in carburo di boro	0
4	ATLAS NSW	3	completamento attrezzature NSW + taglio profilati	0
4	ATLAS PP1 (ITK)	2	costruzione prototipo PP1 (ITK)	0
2	BESIII	2,5	lavorazione supporti per cilindri L1 e L3 + varie	0
4	CYGNO (LIME / MANGO)	1	costruzione particolari per prototipo LIME / MANGO	0
4	GENESIS	0,75	costruzione spettrometro neutronico pulsato	0
4	LHCb	0,5	installazione del beam-plug del Muon System (CERN)	0
3	MU2E	3	4 zampe con regolazione X-Y integrata simili ai prototipi 2016	0
2	PADME	1,25	sistema di calibrazione per calorimetro elettromagentico + Supporto per Monitor	0
4	RD_FA	1	realizzazione di n.1 “tendi-GEM” (Micro-RWELL, active area 100x100 mm2)	0
2	SCF_LAB	6	supp. MPAc x M100 + calotte CORA-micro/n4/p7 + Anelli Kel-F MoonLIGHT75	0
4	SHiP	0,75	costruzione supporti tiles per test con raggi cosmici e BTF	0
1	SIDDARTHA-2	3	supporti/frame meccanici per shielding e luminometro	0
1	VIP2	0,5	piccoli aggiustamenti setup (Veto e Shielding)	0
	PICCOLI LAVORI		piccole richieste di lavorazioni meccaniche non programmate (<15 ore-uomo)	0
	totale M.U. =	**28,00**	**impegno prog. = 140 %** **impegno eff.= 0 %**	**0**

* Ferie: 1,5/12 M.U. Malattia/Permessi: 0,25/12 M.U. Aggiornamento/Manutenzione: 0,25/12 M.U.
Totale indisponibilità annuale: 2/12 M.U. fattore di disponibilità: 1 - (2/12) = 0,83

SEA II sem 2019

ESPERIMENTO	Prog. Elettronica	CAD	Automazione	Staff	Contingenza	PRIORITA' CIF
ALICE		0,5	0,5		0,5	A1
ATLAS		3,5	2,5	2,0	8,0	A1
Belle 2		0,5	1,0		0,5	A2
BESIII		0,5	0,5		0,5	A1
CYGNUS-RD		3,0			1,0	A3
FOOT	3,0				1,5	A1
JUNO		1,0	0,5		0,5	A2
KAONNIS/SIDDHARTA-2					2,0	A3
LHCb		1,0		8,5	2,0	A1
MPGD_NEXT	3,0		0,5		1,5	A2
PADME		1,0				A3
PMU2E	1 ,5	1,0			4,0	A1
QUAX, SIMP (Laboratorio COLD)			0,5		0,5	A1
SCF_LAB		0,5			1,0	A2
Servizio FISMEL		0,5			1,5	A1
Servizio SiDS		1,0			0,5	A3
SHIP	0,5		0,5		0,5	A1
VIP2					0,5	A3
Attività LNF - Monitor fascio	0,5	0,5	0,5		0,5	A3
Attività LNF - sistema sicurezze			2,0		2,0	A2
Varie SEA	3,5	3,5	2,0	1,5	7,0	
contingenza		2,0	2,0			
Tot	21,0	2,0	13,0	12,0	36,0	

Impegni personale tecnico 2019

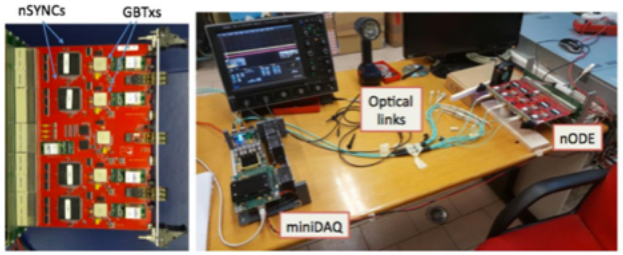
	Nome	Competenza	Richieste II semestre 2019	Assegnazioni II semestre 2019
1	Baldini Roberto	Rivelatori		
2	Capitolo Emilio	Rivelatori progettista meccanico	60% ATLAS 30% PADME 20% XLAB 20% Mu2e	60% ATLAS 20% PADME 10% XLAB 10% Mu2e
3	Capoccia Cesidio	progettista meccanico	50% SIDDHARTA-VIP 100% MEGANTE 30% CYGNO	30% SIDDHARTA-VIP 50% MEGANTE 20% CYGNO
4	Cerioni Stefano	progettista meccanico	50% BESIII 30% RWELL 60%ATLAS	50% BESIII 50%ATLAS
5	Fortugno Fabio	Informatico	100% KLOE	100% KLOE
6	Lobello Marco	Progettista meccanico	30% ATLAS ITK 25% PADME	30% ATLAS ITK 25% PADME 45% RWELL
7	Mengucci Alessandro	Rivelatori e meccanico	70% SIDDHARTA-VIP 50% Mu2e 50% JUNO	40% SIDDHARTA-VIP 30% Mu2e 30% JUNO
8	Orecchini Dario	Progettista meccanico	60% ATLAS 50% JLAB12	50% ATLAS 50% JLAB12
9	Orlandi Aldo	Rivelatori e meccanico	30% BESIII 50% ALICE 20% CYGNO	30% BESIII 50% ALICE 20% CYGNO
10	Ortenzi Bruno	progettista Meccanico	100% FOOT	100% FOOT
11	Paoletti Emiliano	Rivelatori	50% ALICE 70% BESIII 50% ATLAS 50% CYGNO	40% ALICE 40% BESIII 20% CYGNO

	Nome	Competenza	Richieste II semestre 2019	Assegnazioni II semestre 2019
12	Pasquali Luigi	Rivelatori	Mobilità	
13	Passamonti Luciano	Rivelatori	50% ALICE 30% CYGNO 50% CMS	40% ALICE 20% CYGNO 40% CMS
14	Pierluigi Daniele	Rivelatori	50% ALICE 30% CYGNO 50% CMS	40% ALICE 20% CYGNO 40% CMS
15	Pileggi Giuseppe	Meccanico	25% Mu2e 50% ATLAS 30% QUAX	20% Mu2e 50% ATLAS 30% QUAX
16	Rosatelli Filippo	Progetista meccanico	50% ATLAS 50% CYGNO	50% ATLAS 50% CYGNO
17	Russo Alessandro	Rivelatori	50% ALICE 30% BELLE2 50% CMS	40% ALICE 20% BELLE2 40% CMS
18	Saputi Alessandro	Progettista meccanico	30% LHCb 30% PADME 15% ATLAS 50% Mu2e 20%SHiP	30% LHCb 20% PADME 10% ATLAS 30% Mu2e 10%SHiP
19	Sborzacchi Francesco	Informatico	50% KLOE 50% LHCb	50% KLOE 50% LHCb
20	Tibuzzi Mattia	Rivelatori	100% MOONLIGHT	100% MOONLIGHT
21	Vassileva Tatiana	Rivelatori	100% ATLAS	100% ATLAS
22	Ventura Maurizio	Rivelatori	50% SIDDHARTA 25% Mu2e 50% JUNO	25% SIDDHARTA 25% Mu2e 50% JUNO

LHCb: towards Run 3

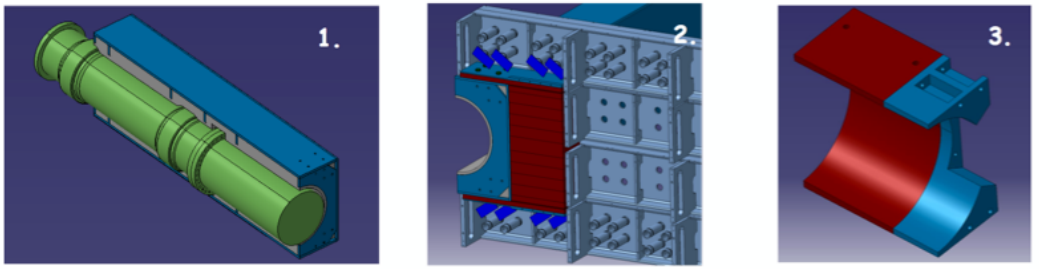
* only Frascati names are indicated

Muon Read Out
(Albicocco, Balla, Carletti, Ciambrone, Gatta):
- New On Detector Electronics (nODE) boards + nSYNC chip
- New Control boards (nPDM and nSB)
- Installation and full commissioning at CERN
- Completely new Electronic Control System ECS

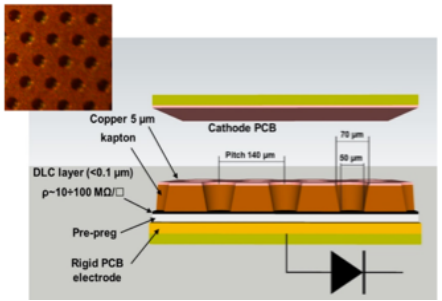


Muon System in the simulation (Palutan, Sarti)
- Improved description of Muon system in Monte Carlo
- Low background simulation (crucial for study background rejection at the Upgrade)

Muon beam plugs: (Palutan, Saputi)
Installation of a significantly improved shielding in front on M2: ~60% bkg reduction in the hottest regions.

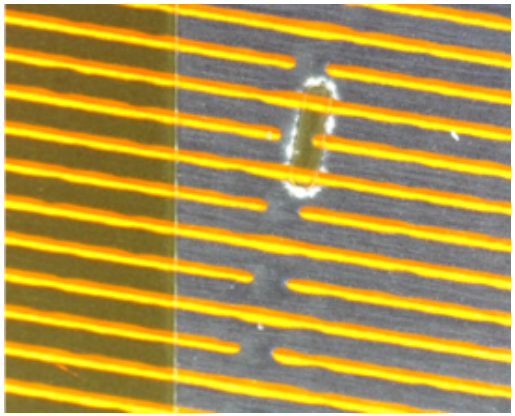


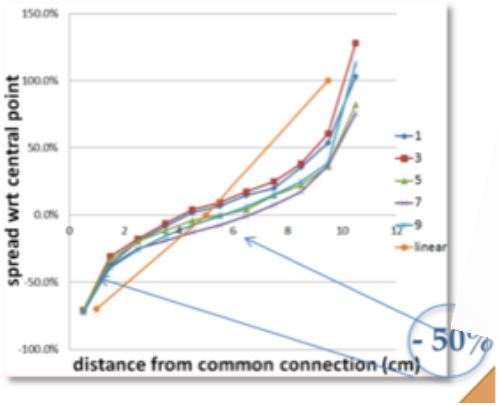
Development for future detectors:
(Bencivenni, Felici, Matteo Giovannetti (laureando), Morello, Poli Lener)
- High rate muRwell
- working on technology transfer to industries

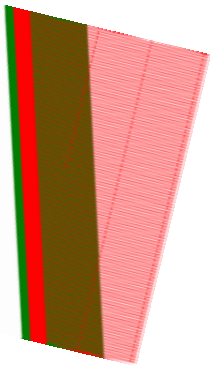


HV issues: Resistance and Layout

Layout issues now solved by us (was identified by B. Ponzio already in 2012 RD51 technical note)







Problem with low resistivity circuits (some %)

Not able to increase with uniform sanding

Form rui:

Our observations are similar to yours , sanding is not changing a lot the value. We have also performed test to change the value with the press , but this will not help for glued panels .

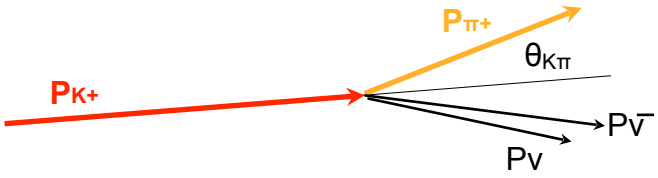
We have tried also Sulphuric acid etching , we can observe a factor of 2 increase in less than 20 sec, but this chemistry is really problematic for safety.

The only simple possibility I see is to increase the value by hiding a part , like you want to do.

NA62 Goal

Design criteria: **kaon intensity, signal acceptance, background suppression**

Kaons with high momentum.
Decay in flight technique.
Signal signature: **K^+ track** + **π^+ track**



Backgrounds

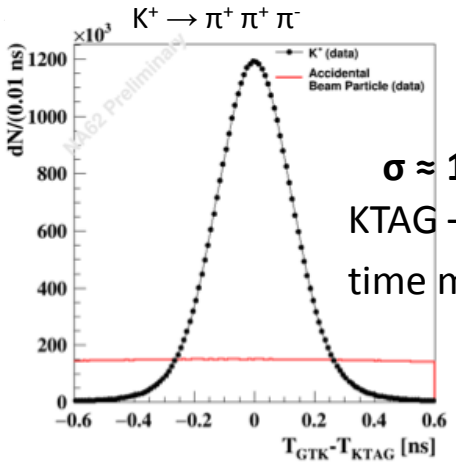
Decay	BR	Main Rejection Tools
$K^+ \to \mu^+\nu_\mu(\gamma)$	63%	μ-ID + kinematics
$K^+ \to \pi^+\pi^0(\gamma)$	21%	γ-veto + kinematics
$K^+ \to \pi^+\pi^+\pi^-$	6%	multi-track + kinematics
$K^+ \to \pi^+\pi^0\pi^0$	2%	γ-veto + kinematics
$K^+ \to \pi^0 e^+\nu_e$	5%	e-ID + γ-veto
$K^+ \to \pi^0\mu^+\nu_\mu$	3%	μ-ID + γ-veto

Key features

- O(100 ps) Timing between sub-detectors
- O(10^4) Background suppression from kinematics
- O(10^7) μ-suppression ($K^+ \to \mu^+\nu$)
- O(10^7) γ-suppression (from $K^+ \to \pi^+\pi^0$, $\pi^0 \to \gamma\gamma$)

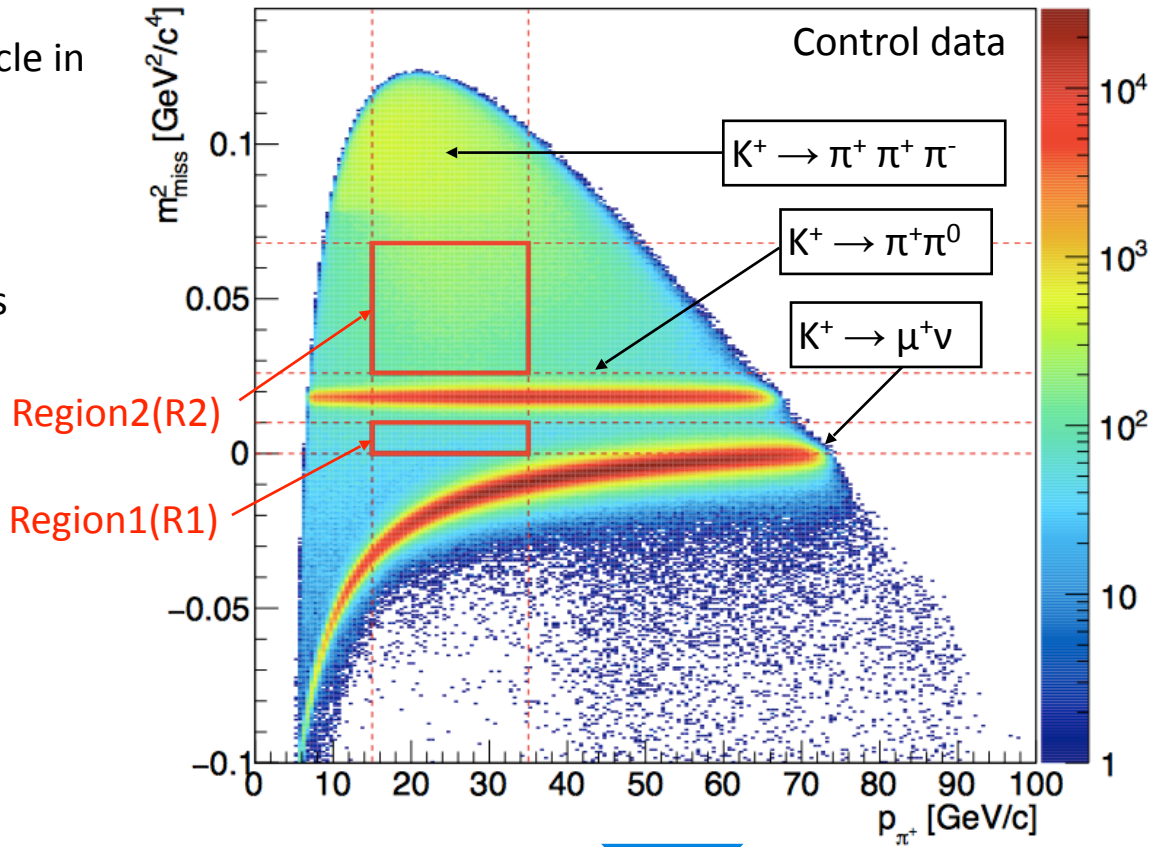
Kinematic selection of signal regions

- K^+ decays with a single charged particle in final state
- Particle ID: π^+
- Multiple charged particle rejection
- Kinematic Selection of Signal Regions



σ ≈ 110 ps
KTAG –GTK –RICH time matching

- 110 < Z_{vertex} < 165 m
- 15 < $P_{\pi+}$ < 35 GeV/c
(to leave at least 40 GeV of E_{mis})



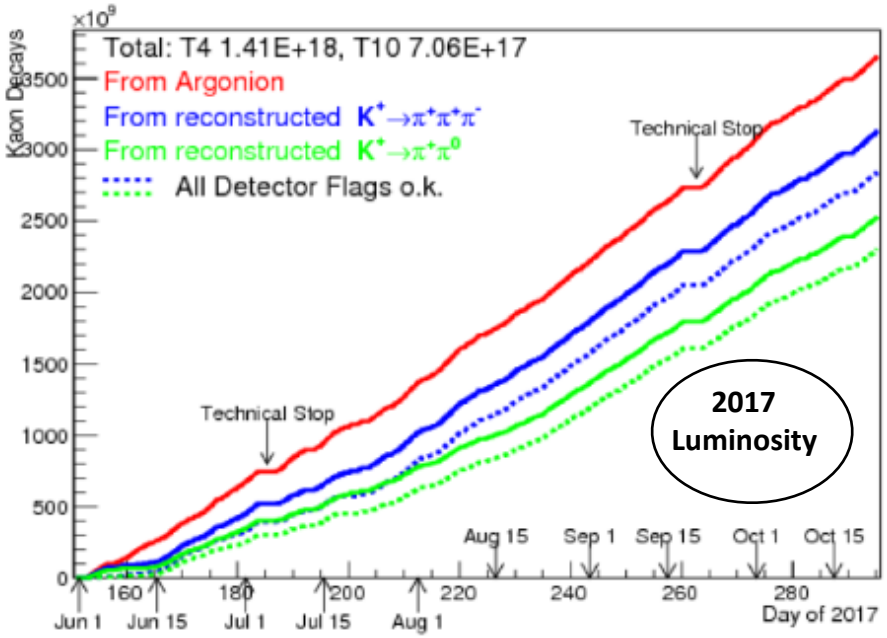
$m^2_{miss} \equiv m^2_{miss}(GTK, STRAW) = (P_K - P_\pi)^2$
with m_π hypothesis

NA62 Timescale

2014	2015	2016	2017	2018	2019-2020
Pilot Run	Commissioning	Commissioning + Physics Run	Physics Run	Physics Run	LS2 Long shutdown 2

2016: 40% of nominal intensity: 13 x 10^{11} proton on target ~ **1 x 10^{11} K^+ decays useful for πνν**

2017: 60% of nominal intensity: 20 x 10^{11} proton on target **> 3 x 10^{12} K^+ decays collected**



beam fluctuations reduced

In **2018** we had 217 days of data taking,
with optimized data quality monitoring.

Conference talks

1. Matthew Moulson. GdR-InF Workshop: The Future of the Kaon Physics. Plenary, CERN
2. Matthew Moulson. First Forum on Rare Kaon Decays: KLEVER: An experiment to measure BR(KL -> p0 nu nu-bar) at the CERN SPS. Plenary, Edinburgh.
3. Silvia Martellotti. La Thuile 2018, Les Rencontres de Physique de la Vallée d'Aoste: K+→π+νν decay and NP searches at NA62 Februa...
4. Spadaro Tommaso: La Thuile 2018, Les Rencontres de Physique de la Vallée d'Aoste Exotic Decays at NA62
5. Lanfranchi Gaia : ALPS 2018, Search for exotics decays with NA62.
6. Moulson Matthew: Exotic Hadrons and Flavor Physics Kaon experiments: Status and outlook Stony Brook University NY, US.
7. Moulson Matthew: ICHEP 2018 Searches for exotic particles at NA62
8. Antonelli Antonella LISHEP 2018 NA62 Ultra-rare decay, results and perspects

9. Moulson Matthew. KLEVER: An experiment to measure BR(KL -> p0 nu nu-bar) at the CERN SPS
10. Kozhuharov Venelin (M) NuPhys2018 Search for heavy neutrinos @ CERN SPS

NA62 potential for A' visible decays(PBC)

Expected sensitivity to dark photons di-lepton decays from the sole contribution of the Be-target: **$A' \to e^+e^-$, $A' \to \mu^+\mu^-$** in NA62 fiducial volume

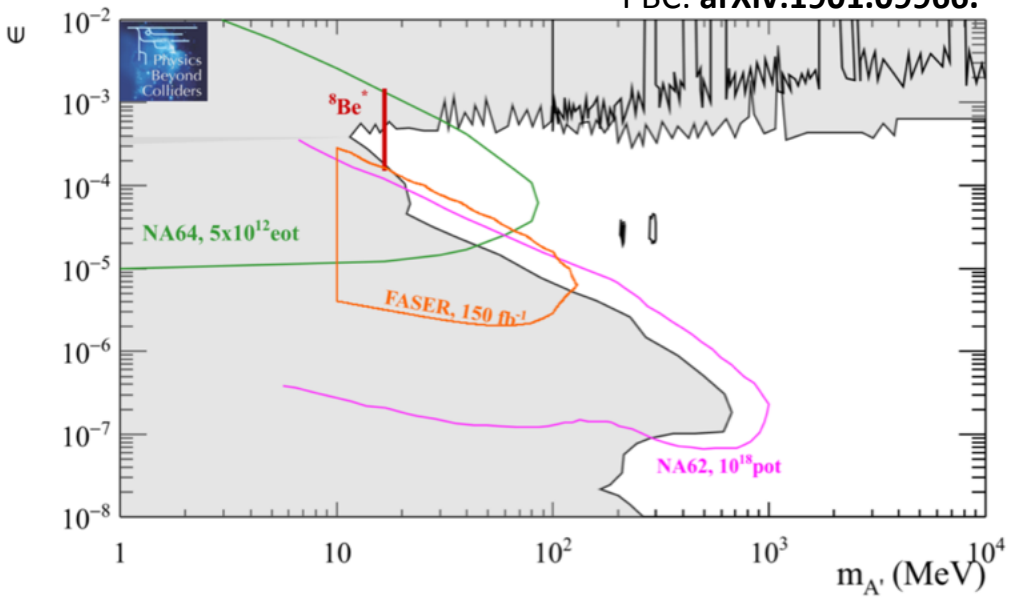
Expectation plot:

- account for acceptance/trigger/ selection efficiency
- assumption of complete background rejection
- Evaluate 90% CL exclusion plot

Sensitivity expected to be higher than shown:

- including direct QCD production of A'
- Including A' production in the collimator (here, only target)

PBC: **arXiv:1901.09966.**



PBC projects on ~ 5 year timescale: upper limits at 90 % CL for Dark Photon in visible decays in the plane mixing strength with SM photon versus mass $m_{A.}$

Acquired in 2016-2018: ~ 10^{18} POT with μμ-parasitic trigger, ~5 10^{16} POT with *ee*-parasitic trigger

Background rejection has been proven with 4 × 10^{15} POT statistic for the $\mu^+\mu^-$ final state, polluted by background due to accidental pairing of two muons from the beam halo

NA62 potential for Axion Like Particles

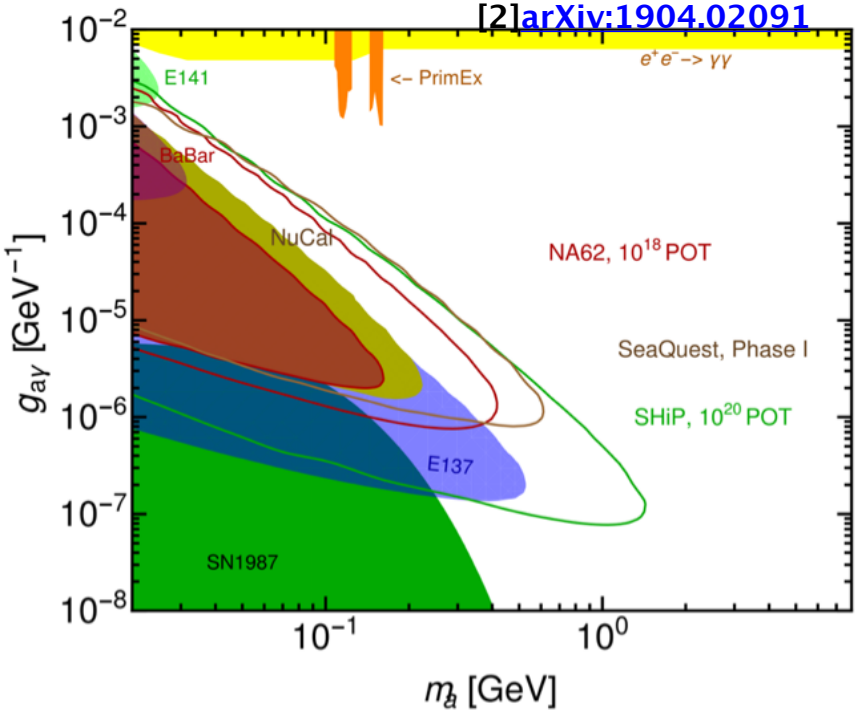
Axion Like Particle (ALP) production via Primakoff effect[1] from interaction onto collimator, assuming a single ALP state "a", and the predominant coupling to photons
⇒ search can be performed only in **beam-dump** mode

Production mechanism

- ALP created by the charged proton itself
- Protons interact with the target nucleus and produce neutral mesons. The mesons (mostly π^0) decay into $\gamma\gamma$ which subsequently can interact with another nucleus to produce an ALP. Recently found to be very relevant[2]:

The decay $a \rightarrow \gamma\gamma$ may occur in NA62 fiducial volume

[2]arXiv:1904.02091

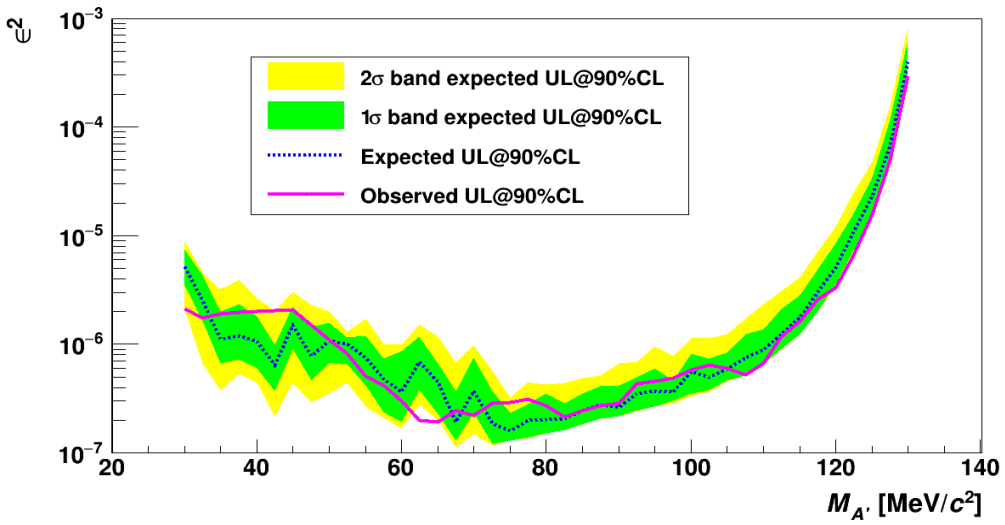


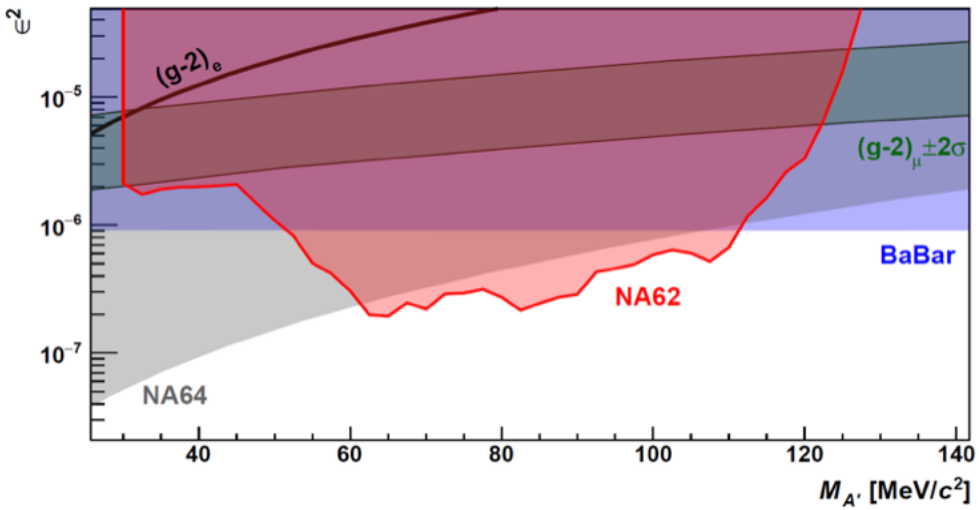
ALPs with photon coupling. Current bounds -90% CL (filled areas) and prospects on 5 years timescale (solid lines) in the plane coupling $g_{a\gamma\gamma}$ versus mass m_{ALP}. Geometrical acceptance considered with zero background assumption

Analysis of 3x10^{16} POT collected in dump mode in 2016-2018 in progress (1 day of run in real beam-dump mode :~ 1.3 10^{16} POT's, enough statistic to put a new upper limit).

[1]JHEP 1602 (2016) 018

Search for $\pi^0 \to \gamma A'$, $A' \to$ invisible





arXiv:1903.08767 (JHEP)

The analysis has been performed with a fraction of 2016 data, equivalent to ≈ 1% of the total kaon flux collected by NA62 through 2018.

- Search for excess of events in missing mass spectrum:

$$M^2_{miss} = (P_K - P_\pi - P_\gamma)^2$$

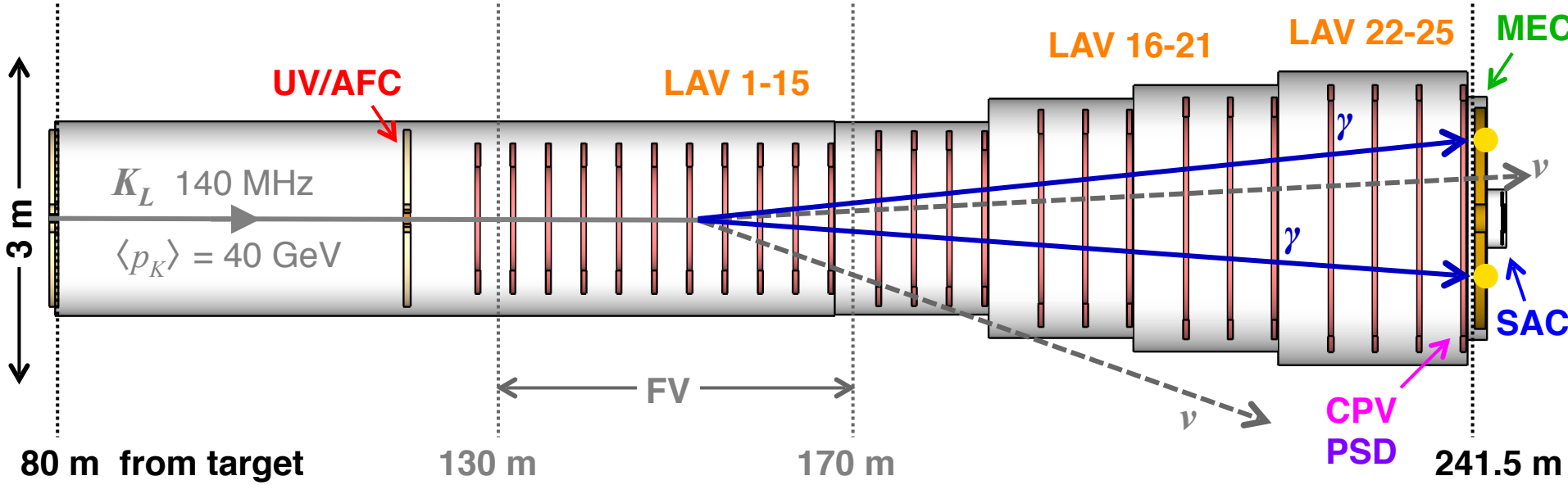
No significant statistical excess has been identified and upper limits on the coupling strength ε^2 in the mass range 30–130 MeV/c^2 have been set, improving on the previous limits over the mass range **60–110 MeV/c^2**

- Limit improved by more than three orders of magnitude:
  BR($\pi^0 \to \gamma\nu\nu$) < 1.9×10^{-7} at 90% CL
- Improvement on BR($\pi^0 \to$ invisible) over current limit of 2.7×10^{-7} is also possible

A $K_L \to \pi^0 \nu\bar{\nu}$ experiment at the SPS

KLEVER

400-GeV SPS proton beam incident on Be target at z = 0 m



For 60 SM events, need:

5×10^{19} pot

e.g. 2×10^{13} ppp/16.8 s × 5 yrs

$\langle p_K \rangle$ = 40 GeV

Photons from $K_L \to \pi^0\pi^0$ boosted in energy for easier vetoing

Higher energy than KOTO: Complementary approach

Main detector/veto systems:

UV/AFC Upstream veto/Active final collimator

LAV1-25 Large-angle vetoes (25 stations)

MEC Main electromagnetic calorimeter

SAC Small-angle vetoes

CPV Charged particle veto

PSD Pre-shower detector

CSN1 LNF: Richieste 2018, assegnato e SJ 2019

Sigla	Ric	Tec	FTE	<FTE>	MISS			CON (^)			APP(#)		ALTRO CAP(*)		
LHCb	15	4	13.4	0.71	161	76	-	53	33	11	160	160	72	40	32

^ Consumo: 53 kE
- 11 kE [SJ]: SMOG2

Apparati: 160 kE
- 55 kE: Tell40 [PCIe40 per Muon System] 2nd tranche.
- 40 kE: Fibre ottiche per Muon System.
- 20 kE: Meccanica nODE boards
- 20 kE: Tell40 [PCIe40 per Muon System]: richiesta aggiuntiva per coprire l'anticipo fatto (luglio 2018) a Milano per istruire una gara necessaria per l'elettronica UT (ibridi)

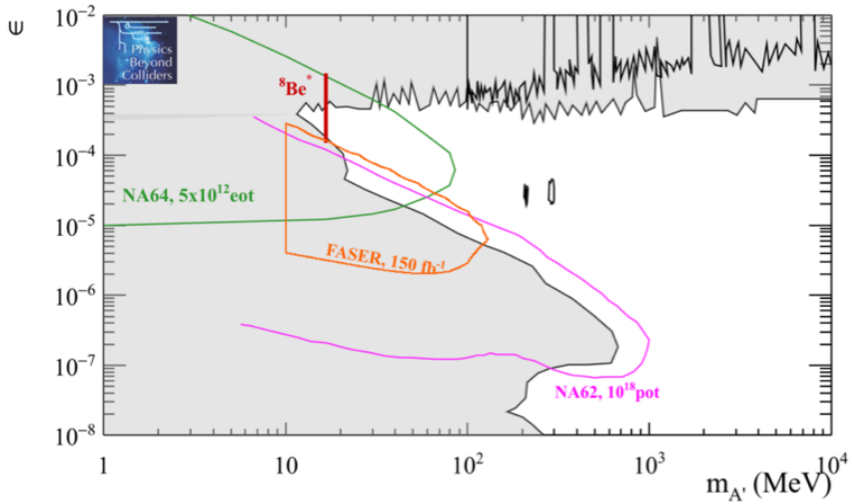
* Altri servizi (MOFb LHCb muon): 72 kE
MOF-B Muon System: da CERN-RRB-2019-044, tabella 7, 120kCHF di cui l'Italia paga 70%, cioé 84 kCHF = 72 kE (for ~0.86 eur/CHF)

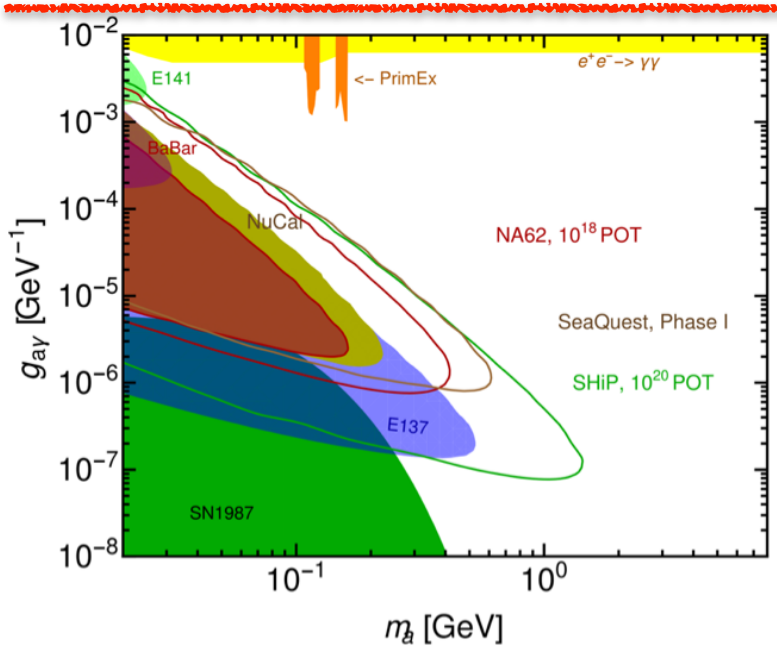
NA62 potential in exotic searches

PBC: **arXiv:1901.09966.**

A'→e⁺e⁻, A'→μ⁺μ⁻ visible decays
Expected sensitivity to dark photons di-lepton decays in NA62 FV

In 2016-2018 acquired w/ parasitic trigger:
~ 10^{18} POT (μμ), ~5 10^{16} POT with (*ee*)





ALP to visible decays
Expected sensitivity to dark photons di-lepton decays in NA62 FV

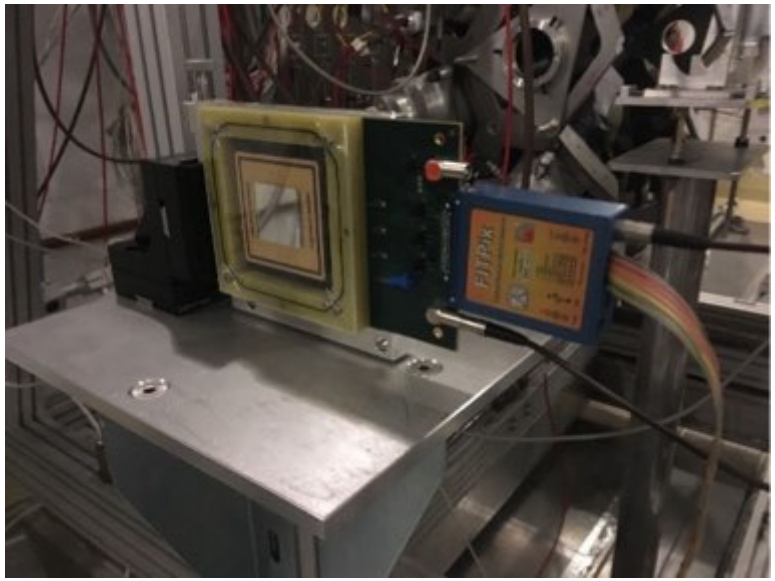
Analysis of 3x10^{16} POT collected in dump mode in 2016-2018 in progress (1 day of run in real beam-dump mode :~ 1.3 10^{16} POT's, enough statistic to put a new upper limit).

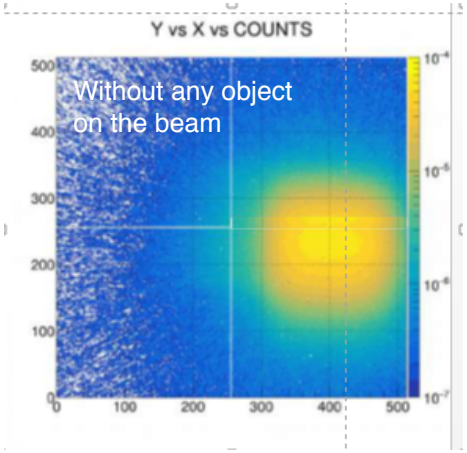
[2]arXiv:1904.02091

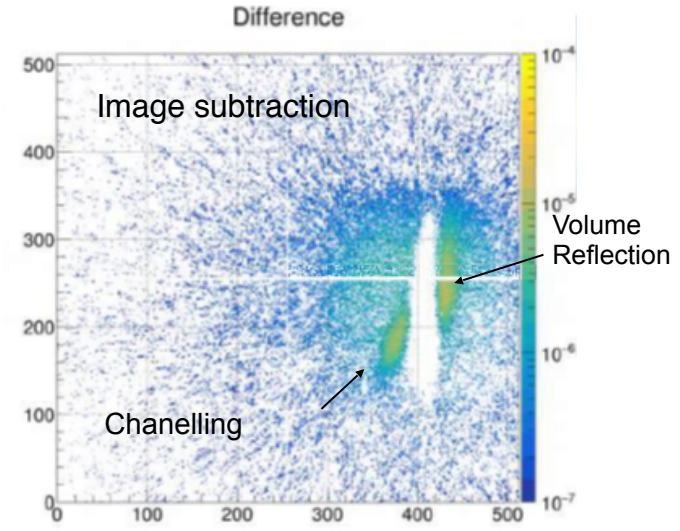
CSN1 LNF*: Richieste 2018, assegnato e SJ '19

Sigla	Ric	Tec	FTE	<FTE>	MISS		CON		APP		INV	
PADME	14	6	5.2	0.3	10	10	20	13.5	25	0	100.5	70 11.5

TimepixQuad detector for test on beam extraction





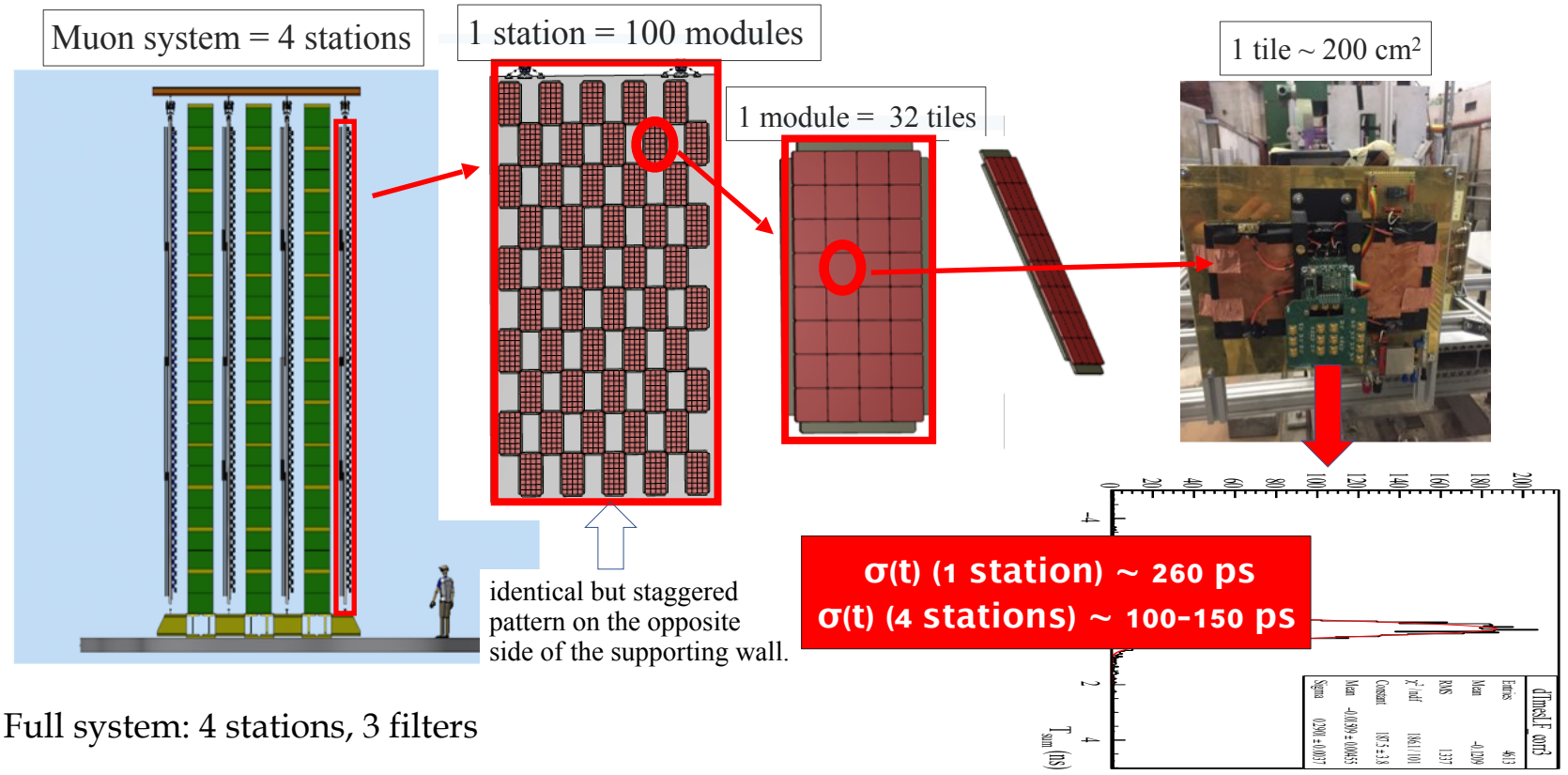


We have used two Timepix quads with 3x3 cm^2 active area as beam monitor near the crystals for studies on beam extraction

The effect of crystal on the extracted beam is easily visible in few minutes of acquisition

F.Murtas, A. Natochi, W.Scandale

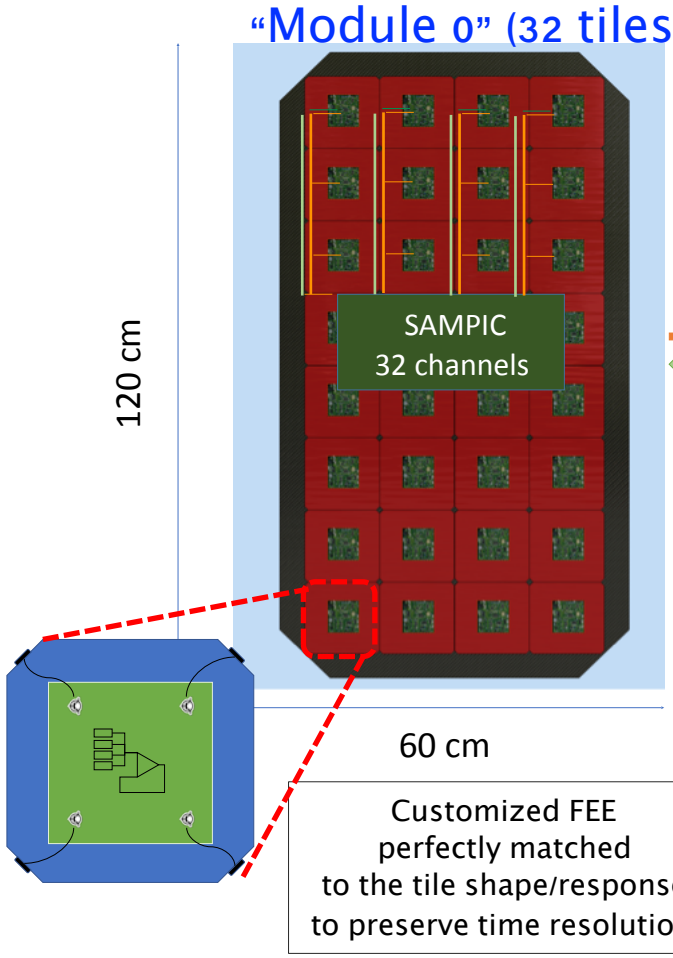
SHiP Muon System: Conceptual Design



Full system: 4 stations, 3 filters

Goal: build a large area (288 m²) muon detector with ~O(100-150) ps time resolution

Muon system: Module 0 & Readout Architecture



Analog Signal,
Power to Analog FE

Digitized Signal,

Clock, fast commands,
slow control

DAQ Concentrator
~32 Links from
SAMPIC
1 Link to DAQ

Submitted an EoI to AIDA++

Parties: INFN-Frascati, INFN-Bologna and FBK
EU funding request: 100 kEuro over 3 years
Deliverable: one fully equipped module 0.