CSN 1

Riunione del 28 settembre - 2 ottobre

CdS

14/10/2020

Stefano Lacaprara

INFN Padova

Bilancio 2020: avanzi e tascona

- Avanzi missioni 2020 sigle: 4617kE (su 8000keu assegnati)
  - ½ a GE
  - ½ per anticipi di spese 2021: 2308.5 keu:
    - MOF-A CMS+ATLAS
    - Resto per anticipi SF
- Avanzi non missioni: 330.5 keu
  - Anticipi similfellow 2021
    - 533 keu
    - BES III - 60 keu RISE
    - +altro
      - Tra cui 10keu MuCol per computing a PD
        - Assegnati a Dtz gr1
        - Da capire se Tier2 o Cloud
- La ½ che rimane in CSN1 in “Tascona” per il 2021

Bilancio 2021

- Previsione di bilancio “come se fosse un anno normale”
  - Totale 8Meu (missioni) + 12Meu (resto) = 20 Meu
- Ma 2308.5keu in “Tascona” da tenere a parte
  - Sara’ assegnata (in tutto o in parte o nulla) dalla GE quando sara’ chiaro il FOE per il 2021
- Nella Tascona:
  - 730keu Spese CORE in bassa priorita’ per CMS e ATLAS fase2
  - 760keu ½ MOF-B CMS+ATLAS+LHCb
  - 343keu Sj per calcolo Tier2
  - 200keu per fondo ProjectAss al CERN per attivita’ ½ FCC/MuCol ½ altro esperimento
    - Idea da discutere con GE
  - 250keu indiviso per altre iniziative
  - + altre piccole cose
- Sperabilmente e’ una precauzione che non avra’ conseguenze e la tascona sara’ assegnata nel 2021.

Test di T e CPT con i K neutri

Processes under study:

$\Phi \to K_S K_L \to \pi^\mp e^\pm \nu, 3\pi^0$

$\Phi \to K_S K_L \to \pi^+\pi^-, \pi^\mp e^\pm \nu$

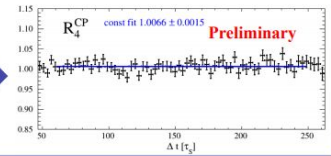
$\Delta t = t_2 - t_1$

- **L = 1.7 fb^{-1} analizzati**

$$R_4^{CP}(\Delta t) = \frac{I(\pi^+\pi^-, \pi^- e^+ \nu; \Delta t)}{I(\pi^+\pi^-, \pi^+ e^- \bar{\nu}; \Delta t)}$$

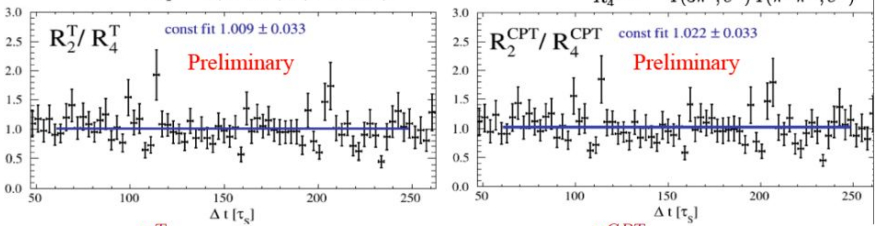
Expected:

$$R_4^{CP}(\Delta t \gg \tau_S) = 1 + 4\Re\epsilon \approx 1.0064$$



T asymmetric $\frac{R_2^T}{R_4^T} = \frac{I(3\pi^0, e^-)}{I(3\pi^0, e^+)} \frac{I(\pi^+\pi^-, e^-)}{I(\pi^+\pi^-, e^+)}$

CPT asymmetric $\frac{R_2^{CPT}}{R_4^{CPT}} = \frac{I(3\pi^0, e^-)}{I(3\pi^0, e^+)} \frac{I(\pi^+\pi^-, e^+)}{I(\pi^+\pi^-, e^-)}$



Aspettati: $\frac{R_2^T}{R_4^T} = 1 - 8\,\Re(\varepsilon)$ $\qquad \frac{R_2^{CPT}}{R_4^{CPT}} = 1 - 8\,\Re(\delta)$

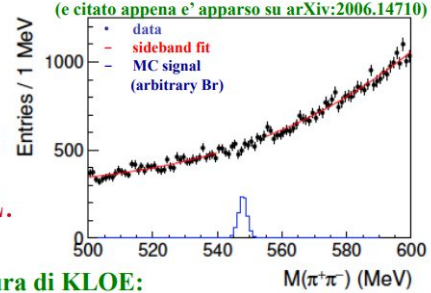
$\eta \to \pi^+\pi^-$

Accettato da JHEP

(e citato appena e' apparso su arXiv:2006.14710)

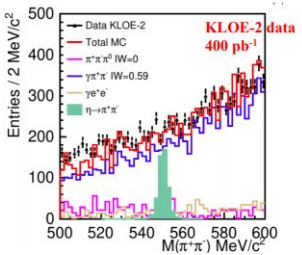
- **Nuovo limite superiore ottenuto dall'analisi di L = 1.6 fb^{-1}**
- **Principale background: $e^+e^- \to \pi^+\pi^-\gamma$**

$$Br(\eta \to \pi^+\pi^-) < 4.9 \times 10^{-6} \quad @\ 90\%\ \text{C.L.}$$



- **Limite combinato con la vecchia misura di KLOE:**

$$Br(\eta \to \pi^+\pi^-) < 4.4 \times 10^{-6} \ @\ 90\%\ \text{C.L.}$$



- **Limite aspettato usando tutta la statistica di KLOE + KLOE-2: ~ 2.5 × 10^{-6}**

P.Gauzzi CSN1 - Perugia

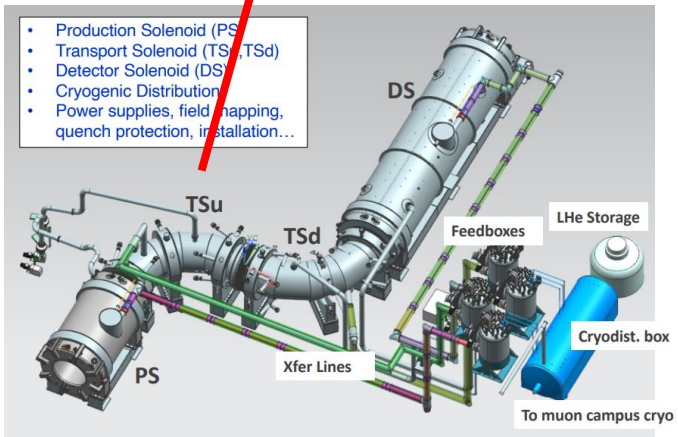
E' un processo che viola P e CP

Nello SM e' prodotto dalla fase della matrice CKM: Br ~ 3 × 10^{-29}

Mu2e S.Miscetti , LNF/INFN

- Transport Solenoid mechanically connected
- Tracker in problematic state

Diversi aspetti dell'assemblaggio dei piani e stazioni sono ancora da definire, e' stato richiesto un aiuto all'INFN.
Sono stati identificati 4 attività, anche tenendo conto delle limitazioni legate al COVID-19:
a) b) Design and production of fixturing for tracker panel testing **and** final assembly.
c) Design and assembly of the cooling ring for each tracker plane.
d) Design and production of fixturing for assembling tracker planes into the final tracker frame.



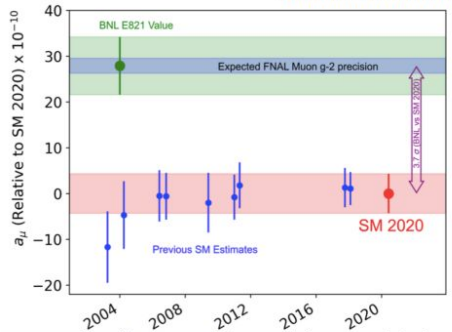
- Calo: All crystals received
  - Good progress on electronics and mechanics
- Major issue with access to FNAL for work
- Ritardo COVID stimato a 5 mesi
  - Detector installation end 2021
  - Commissioning w/ beams Q3/2023 (was Q1/2023)

G Minus2 Graziano Venanzoni

Novita' dalla teoria

T. Aoyama «The anomalous magnetic moment of the muon in the Standard Model», June 8, 2020, 194 pages, e-print: 2006.04822 [hep-ph] (~50 citations)

https://news.fnal.gov/2020/06/physicists-publish-worldwide-consensus-of-muon-magnetic-moment-calculation/



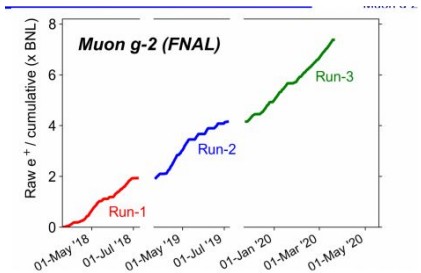
Contribution	Value $\times 10^{11}$
Experiment (E821)	116 592 089(63)
HVP LO (e^+e^-)	6931(40)
HVP NLO (e^+e^-)	−98.3(7)
HVP NNLO (e^+e^-)	12.4(1)
HVP LO (lattice, *udsc*)	7116(184)
HLbL (phenomenology)	92(19)
HLbL NLO (phenomenology)	2(1)
HLbL (lattice, *uds*)	79(35)
HLbL (phenomenology + lattice)	90(17)
QED	116 584 718.931(104)
Electroweak	153.6(1.0)
HVP (e^+e^-, LO + NLO + NNLO)	6845(40)
HLbL (phenomenology + lattice + NLO)	92(18)
Total SM Value	116 591 810(43)
Difference: $\Delta a_\mu := a_\mu^{\rm exp} - a_\mu^{\rm SM}$	279(76)

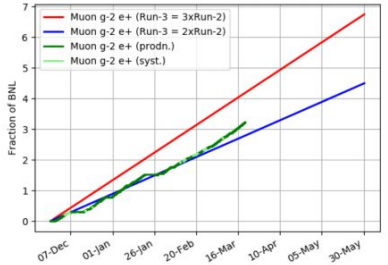
- Results of 4 years efforts of Theory Initiative (>170 people)
- No surprise (although one single number)
- HVP LO largest contribution (→MUoNE)

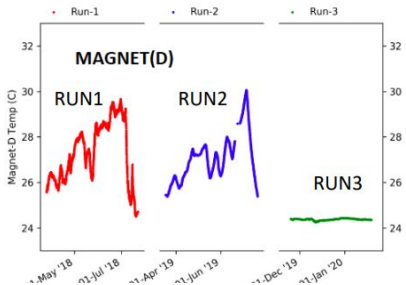
$\Delta a_\mu = (279 \pm 76) \times 10^{-11} = 3.7\sigma$

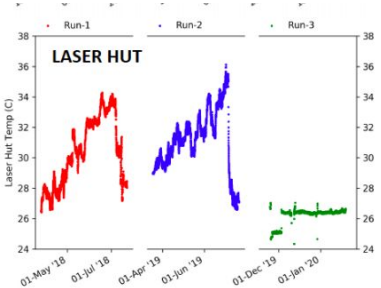
($\Delta a_\mu \sim 2300$ppb)

- Completato Run3 (in anticipo causa Covid)
- 7.4 x BNL









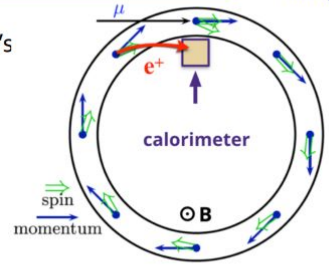
Notevole incremento della stabilità della temperatura del magnete e della Laser Hut nel Run3 rispetto Run 1&2.

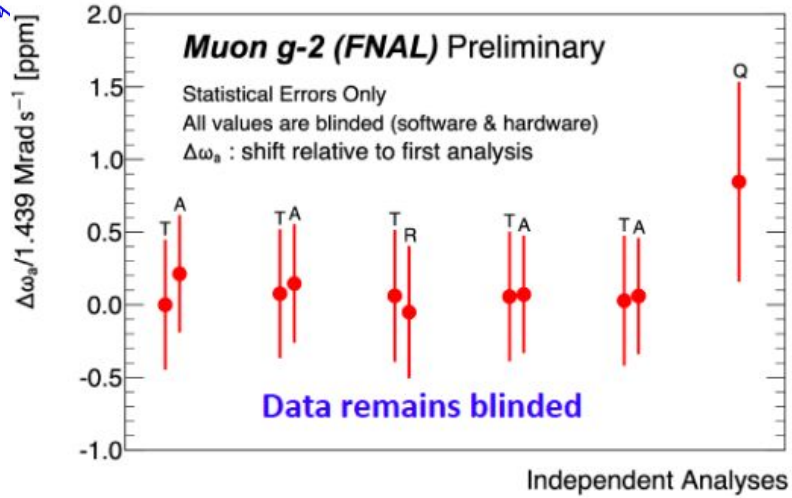
ω_a Measure

- Muon's spin is correlated to high energy positron's momentum
- The number of positrons is modulated by the anomalous precession frequency

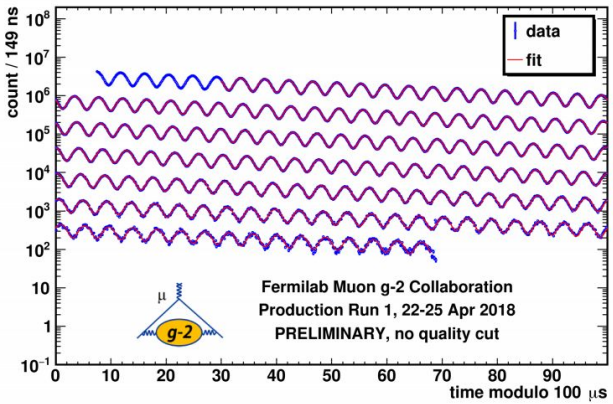
$$N_0 e^{-t/\tau}[1 - A\,cos(\omega_a t + \phi)]$$

- 4 different analysis methods:
  - T: integrate all positrons above 1.7 GeV





T-method Wiggle Plot



- expect **430 ppb** statistical uncertainty (compare to 460 ppb for BNL)
- Syst. error on ω_a expected to be O(100) ppb (inc. corrections for beam dynamics)
- Goal e989: 70 ppb

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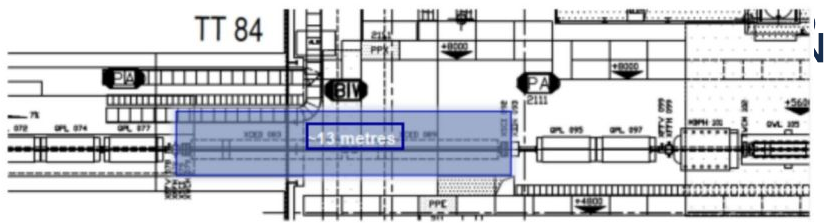
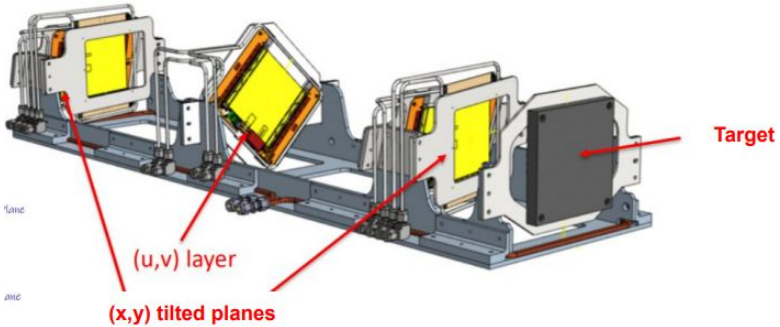
- Analisi RUN1 in corso. Risultato atteso per la fine dell'anno con errore totale ~ 0.5ppm.
- Nel frattempo analisi RUN2 e RUN3 (~5 xBNL) in progress.
- Partenza Run4 a novembre2020->luglio2021

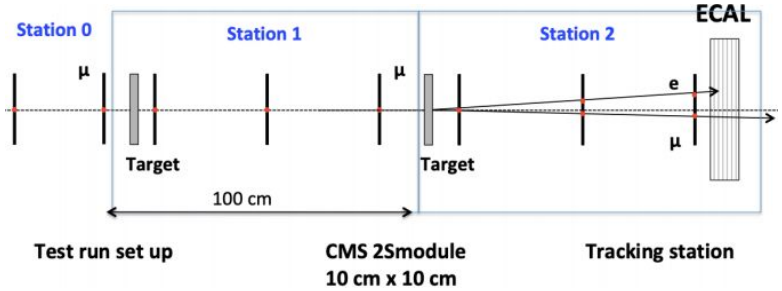
MuonE U. Marconi

- misura dello shift adronico di $\alpha(t)$ mediante scattering elastico μe
- con l'obiettivo di determinare il contributo a_μ^{HLO} al momento magnetico anomalo del muone con una incertezza statistica di 0.3% con 2 anni di presa dati



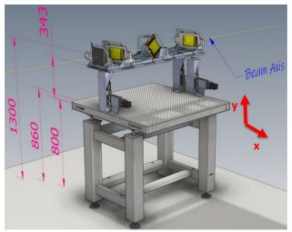
- Main activity: **test run in Q4 2021**
- rotating 2S sensors improves resolution: charge shared between two strips

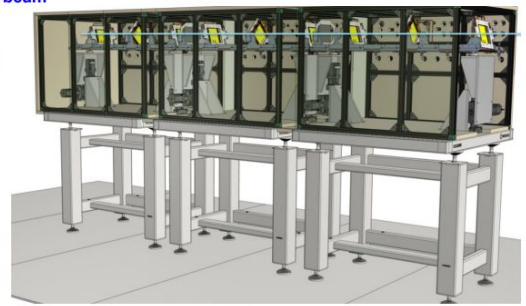




- ECAL: for TR2021 14x14 cm^2
  - 25 PWO crystals provided from CMS:
  - Mechanics and thermal stability Padova

Adjustable position with respect to the beam



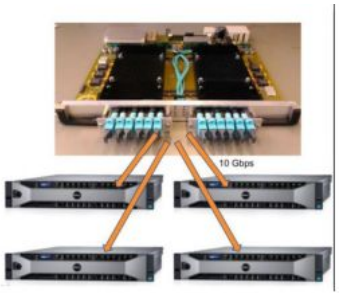


The enclosure thermally isolates the tracker, and provides connections to the services.

MuonE

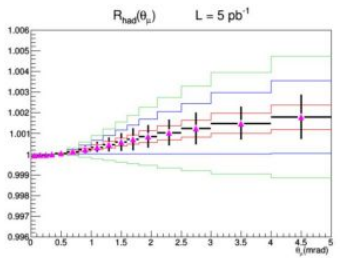
DAQ for the TR2021

- No trigger, direct data flow: 20 GB/s
  - Split on 4 servers
  - 2 TB/h/server
  - Server disk to provide 1 day of capacity



Analysis cont.d

- 10^9 elastic μe events expected from the TestRun 2021
- Marginal sensitivity to the hadronic running of $\alpha(q^2)$
- The leptonic running could be measured with <5% error
- Error statistically dominated
- Systematics: main focus of the analysis



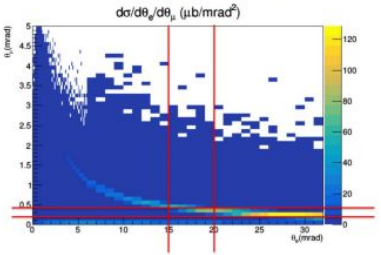
(θ_e < 30 mrad)

Initial sensitivity to the hadronic running of α.

Pure statistical level: 5.2σ
2D (θ_μ,θ_e) K=0.136 ± 0.026

Definitely we will have sensitivity to the leptonic running (ten times larger)

NLO convoluted with the detector resolution



Considerazioni dei referee

- l'esito del Pilot Run è decisivo per l'approvazione finale della misura proposta da MUonE
  - hardware e software devono essere pronti da qui ad un anno
  - per questo abbiamo chiesto a MUonE di indicare delle Milestone in modo da verificare lo stato di preparazione a step intermedi
  - importante ottimizzare nel Pilot Run l'angolo di tilt del moduli del Tracker
  - il Pilot Run dovrà essere utilizzato anche per testare l'utilizzo di strumenti software per misura della posizione dei moduli del Tracker
- un impatto maggiore in termini di FTE/persona

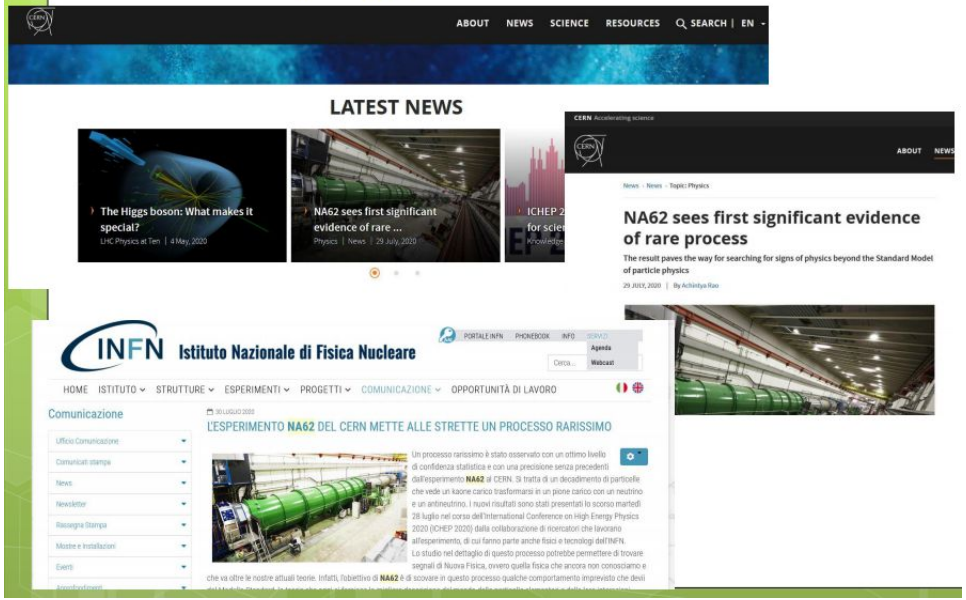
NA 62 Fabio Ambrosino (NA)

NA62 preliminary result (2016+2017+2018 data)

$$Br^{NA62}_{16+17+18}(K^+ \to \pi^+ \nu\bar{\nu}) = (1.10^{+0.40}_{-0.35 stat} \pm 0.03_{syst}) \cdot 10^{-10}$$

3.5σ significance, $P(only\ bkg) = 2 \cdot 10^{-4}$

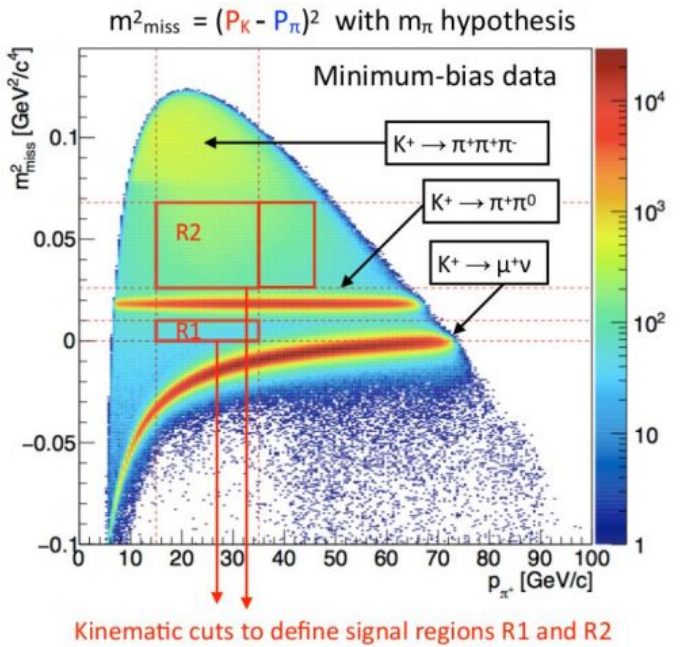
Homepages INFN/CERN



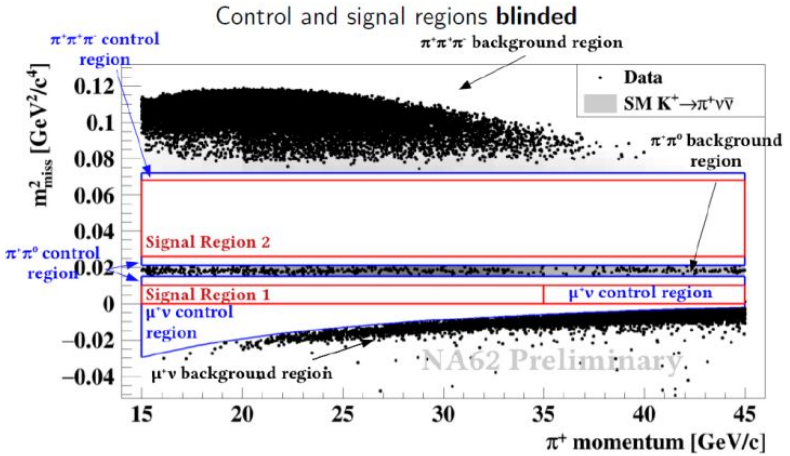
SIF, Science Times etc.

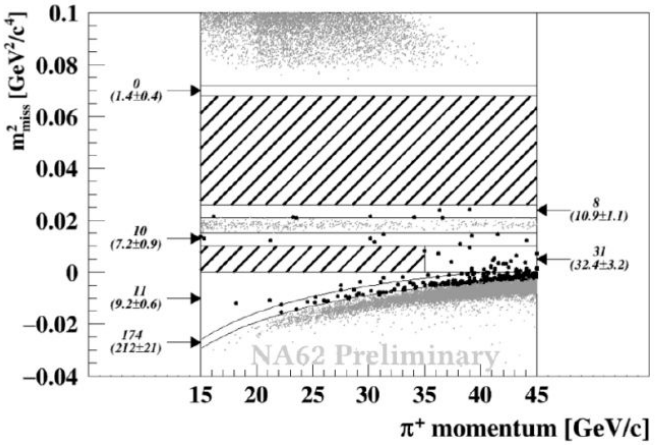
PNN: regioni di controllo

PNN: cinematica

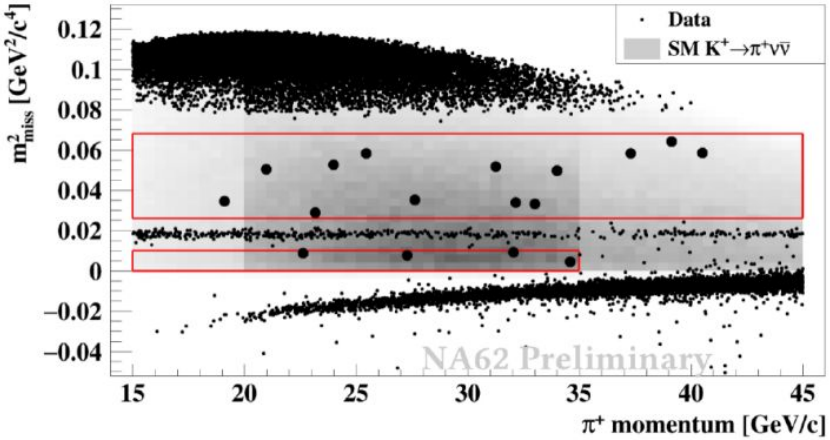


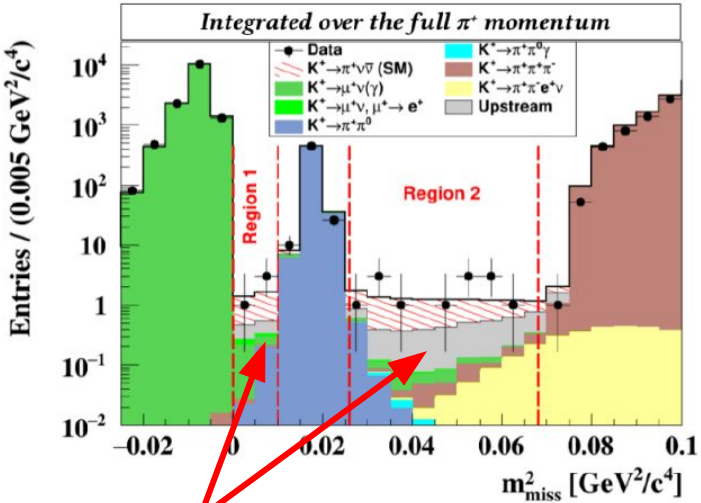
Kinematic cuts to define signal regions R1 and R2





PNN: opening the box





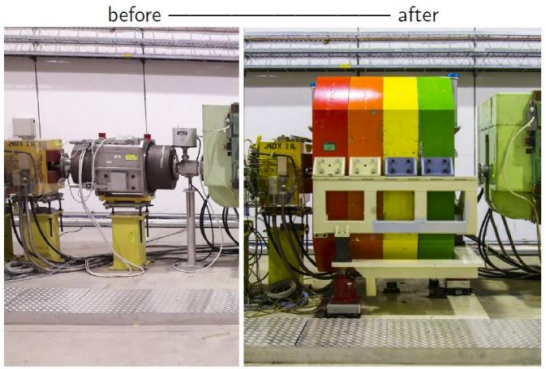
Expected SM signal events: $7.58 \pm 0.40_{syst} \pm 0.75_{ext}$,
expected background events: $5.28^{+0.99}_{-0.74}$,
observed events: 17

	2016 data	2017 data	2018 data
SES	$(3.15 \pm 0.24) \cdot 10^{-10}$	$(0.39 \pm 0.02) \cdot 10^{-10}$	$(0.111 \pm 0.007) \cdot 10^{-10}$
Expected SM signal	0.27 ± 0.04	2.16 ± 0.29	7.58 ± 0.85
Expected background	0.15 ± 0.09	1.50 ± 0.31	$5.28^{+0.99}_{-0.74}$
Observed events	1	2	17

- $Br^{NA62}_{16+17+18}(K^+ \to \pi^+\nu\bar{\nu}) = (1.10^{+0.40}_{-0.35 stat} \pm 0.03_{syst}) \cdot 10^{-10}$ (Preliminary)
- $Br^{SM}(K^+ \to \pi^+\nu\bar{\nu}) = (0.84 \pm 0.10) \cdot 10^{-10}$ *[Buras et al., JHEP11(2015)033]*

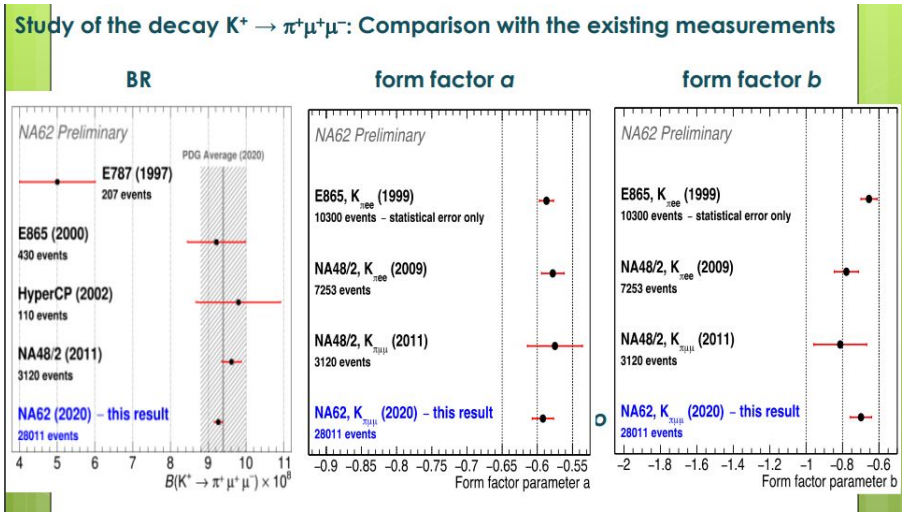
PNN: riduzione fondo upstream

Replacement of the final collimator against Upstream bkg
(June 2018)

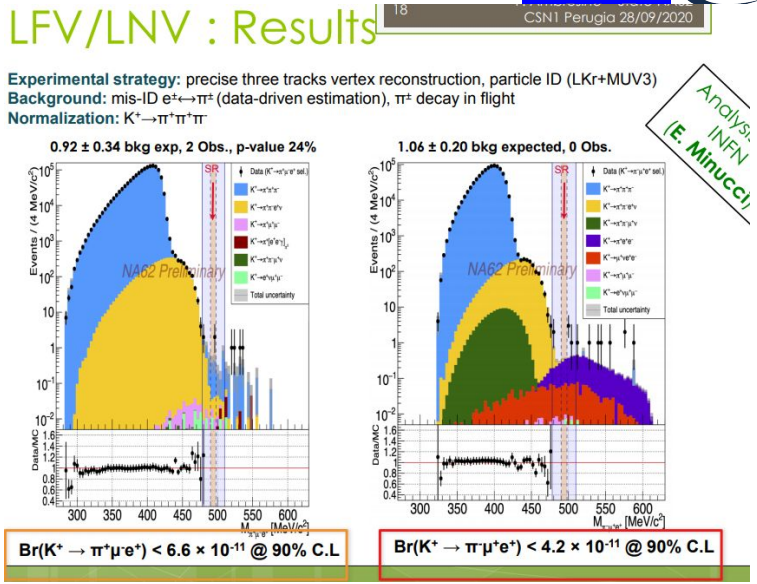


Altri risultati

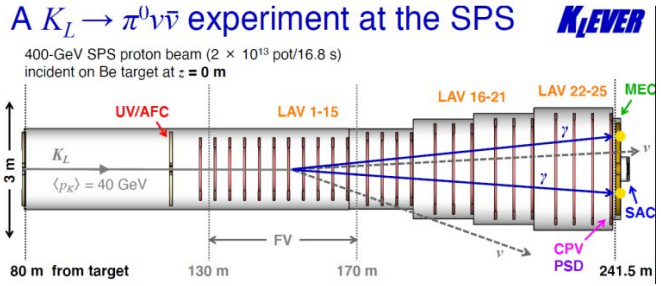
Miglioramento 10x



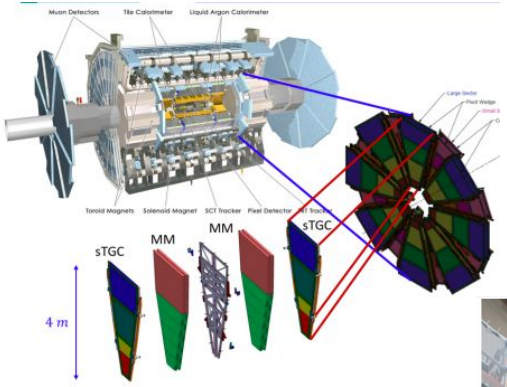
Misura al 1% di BR(10-7)

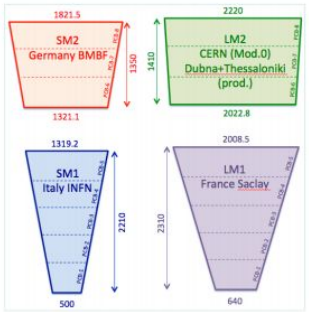


- Near future: 18 settimane di fascio da 17/7/2021
- Longer future: KLever misura KL->pi0 nu nu at SPS
  - Presentato a Snowmass

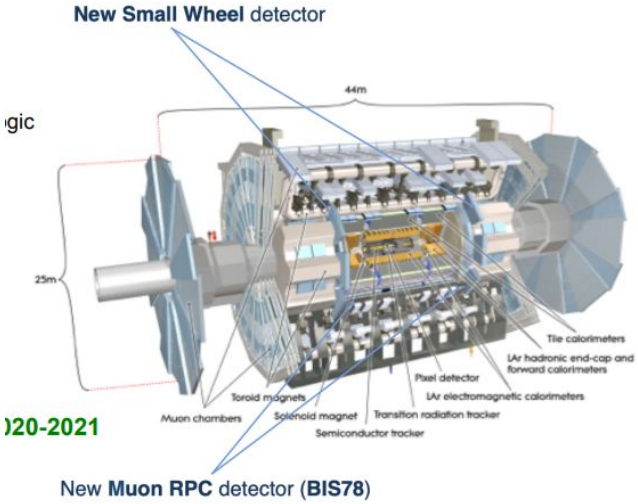


ATLAS LS2 Davide Boscherini



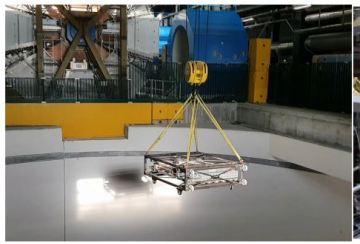


- Mu e trigger
- NSW-A pronta Ago 2021
- NSW-C ritardi sTGC (Cile e Canada) Oct 2021



Installazione in ATLAS

- L'installazione in ATLAS della prima stazione BIS78 (A04) è stata completata con successo il 18 Settembre;
- Questa settimana è prevista l'installazione della stazione A06;



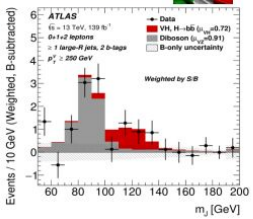
ATLAS Highlight fisica

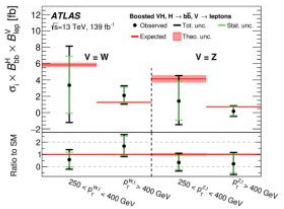
Higgs Physics: VH(→ bb)

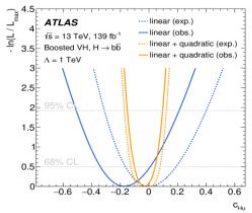
Gruppi italiani in Higgs e HH searches: BO, CS, LNF, GE, MI, PI, PV, RM1, RM3, TIFPA, UD

arXiv:2008.02508

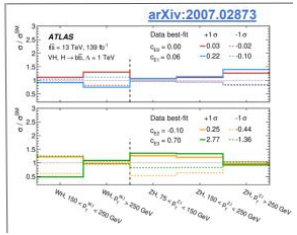
- H → bb in associated production with W and Z bosons in boosted regime
- Full Run 2 statistics (139 fb-1)
- PT(H) > 250 GeV
- Several signal regions: 0/1/2 leptons depending on W/Z decays
- Combined signal strength $\mu=0.72^{+0.39}_{-0.36}$
- Cross-section measurements
  - Two PT regions: [250-400] and > 400 GeV
- Limits on anomalous SM-EFT couplings
- Interpretation in the STXS framework
  - NP in the differential cross-sections
- In the global Higgs combination:
  - Global signal strength: μ=1.06±0.07







arXiv:2007.02873

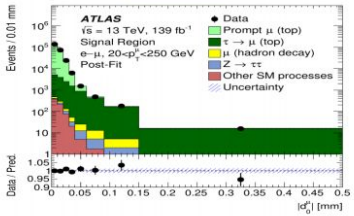


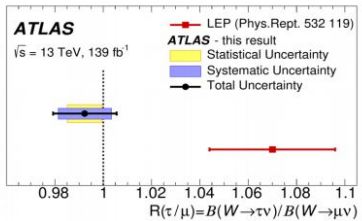
Standard Model Physics: Lepton Flavour Universality

arXiv:2007.14040 Submitted to Nature

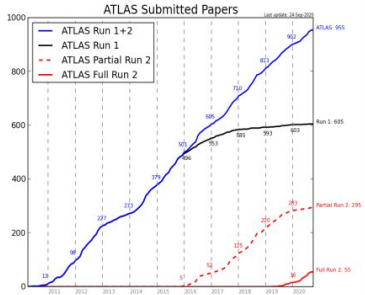
- Test of the W boson couplings with μ and τ in di-leptonic tt events
- Full Run 2 statistics: 139 fb-1
- Prompt muons from W
- Muons from τ are distinguished from prompt using:
  - Impact parameter d0, τ lifetime and kinematic properties
- Main backgrounds:
  - Z→ μμ + jets events
  - μ from non-W events

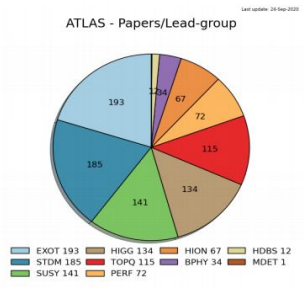
Gruppi italiani in Standard Model: BO, CS, GE, MI, NA, RM1,RM2





Pubblicazioni ATLAS



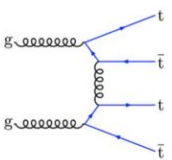


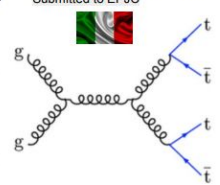
Gruppi italiani in Top physics: BO, CS, RM2, RM3, UD

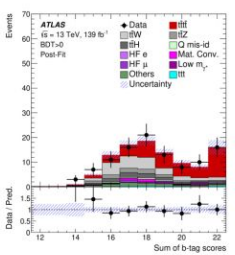
Top Physics: 4 tops evidence

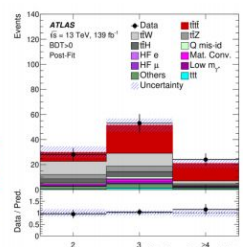
https://arxiv.org/abs/2007.14858 Submitted to EPJC

- First evidence of 4 top-quarks production!
- Full Run 2 statistics (139 fb-1)
- Same-sign and three lepton channels combined → Low background
- To further suppress the background, use of multivariate discriminants on:
  - Number of jets
  - Number of b-jets
  - Event kinematic
- $\sigma(4t) = 24^{+7}_{-6}$ fb
- Significance:
  - Expected 2.7σ
  - Observed 4.2σ



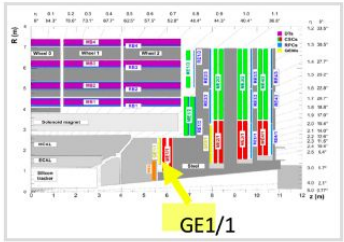






CMS LS2 G.M.Bilei

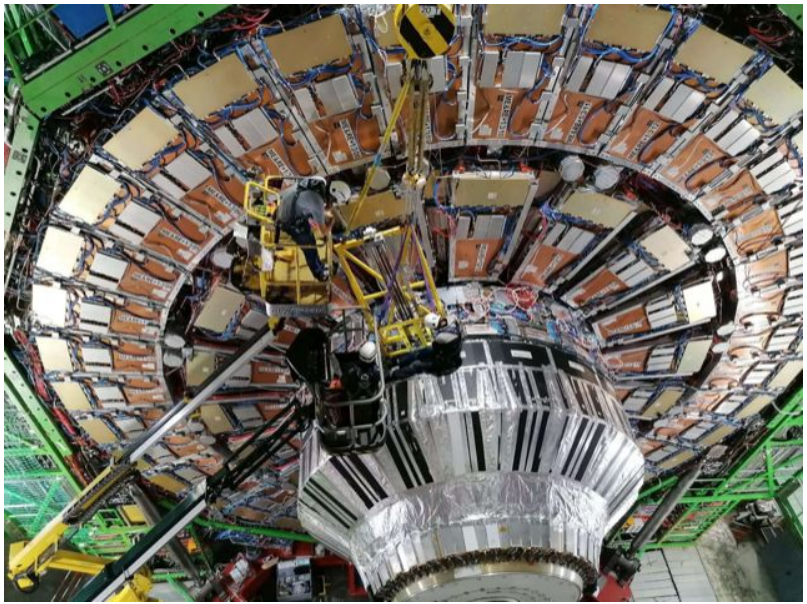
- GE1/1 installation completed last week
- first installed Phase-II detector!



Congratulations!

see also: CMS GEM's shine on

The GEM 1/1 project construction and installation was completed on Sep 14 on budget and on time.!!
Not trivial considered COVID.



Da Settembre L.Malgeri in place of R.Carlin as SP
A fine ottobre CMS-italia elegge nuovo RN

CMS highlight fisica

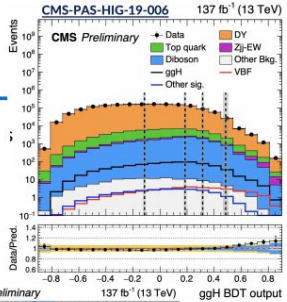
M.Pelliccioni

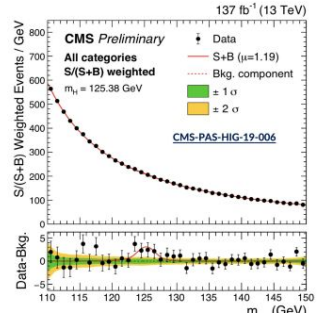
H → μμ : prima evidenza!

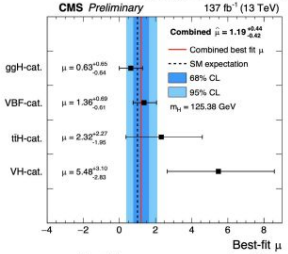
H → μμ

arXiv:2009.04363
sub. JHEP

- Test coupling seconda generazione
- In SM BR(H→μμ) ~ $2*10^{-4}$
- Richiesta di muoni isolati ad alto p_T
- Categorie di produzione
  - ggH, VBF, ttH, VH
  - VBF da fit DNN
- Separazione in categorie MVA score

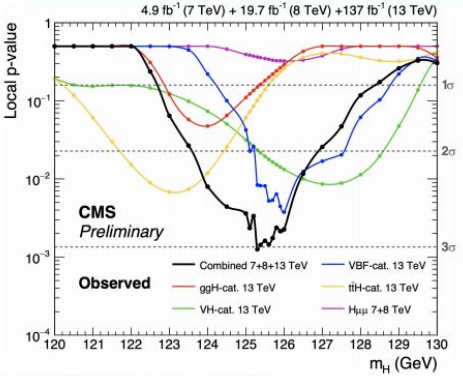






$$\mu = 1.19^{+0.41}_{-0.39}(stat)^{+0.17}_{-0.16}(syst)$$

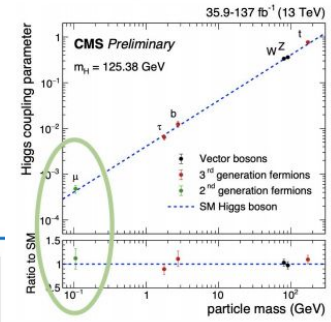
per m_H = 125.38 GeV



Ancora limitato da incertezza statistica
→ Run3 fondamentale

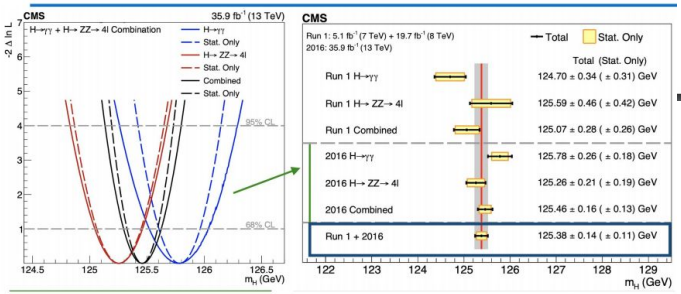
Eccesso a 3σ

Prod. Category	Obs. (exp.) significance (m_H = 125.38 GeV)
VBF	2.40 (1.77)
ggH	0.99 (1.56)
ttH	1.20 (0.54)
VH	2.02 (0.42)
Comb. 13 TeV	2.95 (2.46)
Comb Run 1+2	2.98 (2.48)



Massa H^0

Phys. Lett. B 805 (2020) 135425



Combinazione γγ e ZZ (Run1+2016)

m_H = 125.38 ± 0.14 miglioramento fattore 2 da Run1

Stessa incertezza di combinazione PDG attuale

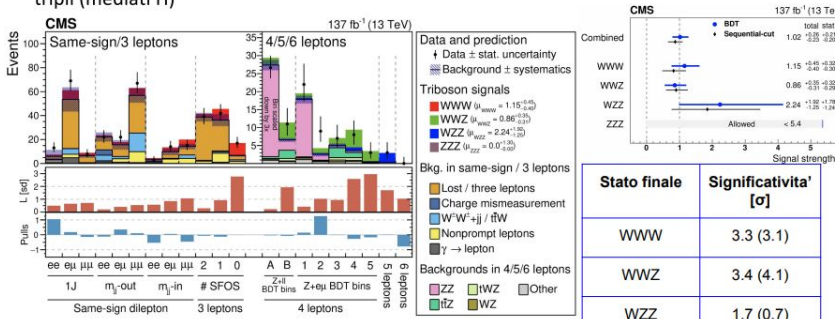
CMS highlight fisica M.Pelliccioni

Prima osservazione VVV

arXiv:2006.11191
Accettato da PRL
1000simo paper inviato!

- Test fondamentale non-abelianita' EWK
- Accoppiamenti quartici e tripli (mediati H)

	Same-sign	3 leptons	4 leptons	5 leptons	6 leptons
Targeted signal	$W^{\pm} \to l^{\pm}\nu$	$W \to l\nu$	$W \to l\nu$	$W \to l\nu$	$Z \to ll$
	$W^{\pm} \to l^{\pm}\nu$	$W \to l\nu$	$W \to l\nu$	$Z \to ll$	$Z \to ll$
	$W^{\pm} \to qq$	$W \to l\nu$	$Z \to ll$	$Z \to ll$	$Z \to ll$



Stato finale	Significativita' [σ]
WWW	3.3 (3.1)
WWZ	3.4 (4.1)
WZZ	1.7 (0.7)
ZZZ	0 (0.9)
Combinato	5.7 (5.9)

Evidenza WWW e WWZ e osservazione VVV
Tutti canali completamente dominati da incertezze statistiche

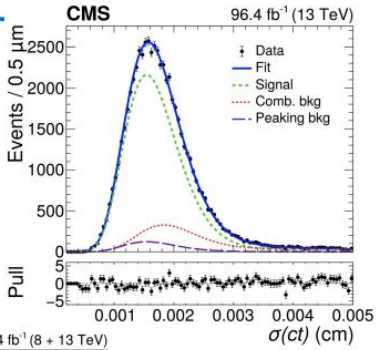
8

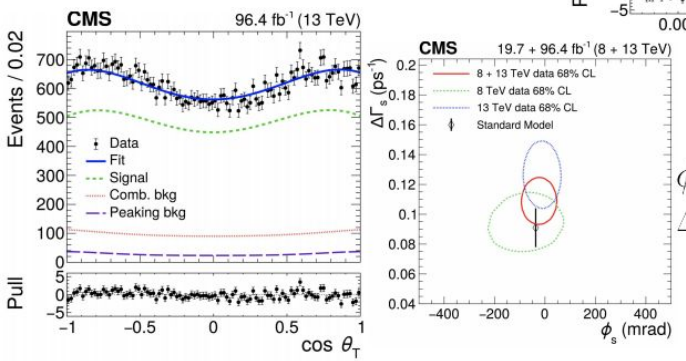
Grande contributo Padova:
A.Bragagnolo e E.Lusiani

CPV in $B_s \to J/\psi\,\phi(KK)$

CMS-BPH-20-001
sub PLB

Misura di ϕ_s e $\Delta\Gamma_s$
Analisi time-dep con trigger dedicato (17/18)
Flavor tagger su muone utilizza ML
Include prob. mistag per evento
Miglioramento significativo analisi 8 TeV





Combinazione 8+13 TeV

$$\phi_s = -21 \pm 45 mrad$$
$$\Delta\Gamma_s = 0.1073 \pm 0.0097 ps^{-1}$$

9

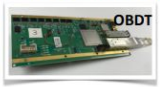
CMS Fase2 Livio Fano'

DT Phase 2

Milestone: EDR on June 25

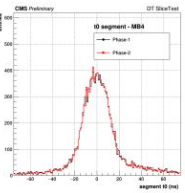
Outcome was very positive, allowing to proceed with core expenditures up to the ESR expected in April 2021.

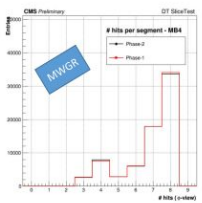
https://indico.cern.ch/event/921853/



OBDT pre-production design is ongoing (major change is the replacement of the GBTx with the the lpGBT). First prototypes expected by next year.

Slice test: One sector equipped with several OBDT prototypes





Time of cosmic muon computed by fitting the muon segment track in a DT chamber, using the **phase-1** and **phase-2** electronics

+ No difference observed

+ Succefully included in MWGR

Shilding - Resuming activity now to install some pending vertical sectors

Extraction of a MB2 for repairing LV in SL Theta

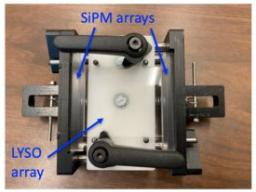
BTL sensors

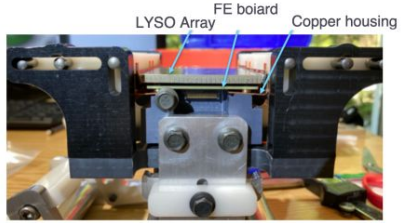
SiPM

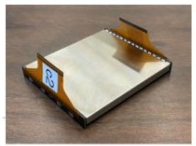
- **Final step of Market Survey**: two vendors
  - Plan to test ~200 pre-series arrays (April 2021) per vendor
  - Tender in Summer 2021
- **Substantial progress in SiPM irradiation and annealing studies**
  - Confirm earlier indications of larger radiation damage than anticipated
  - Studying mitigations (e.g. additional local cooling and in-situ annealing likely needed (thermoelectric coolers)

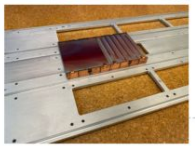
Tray prototype assembly verification ongoing (1-2 months delay):

- **mock-up components and tools in hands. Validating assembly process**
- **Functional prototype** with real modules, cooling plate and electronics aimed **for end of 2020**









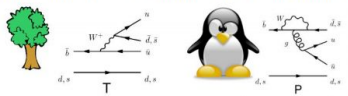
LHCb Highlight fisica Giulia Tuci

Violazione di CP in $B^0_{(s)} \to h^+h^-$

M.Calvi, D.Fazzini (MIB)
S.Perazzini, V.Vagnoni (BO)

LHCb-PAPER-2020-029

- Diversi processi fisici contribuiscono a decadimenti $B^0_{(s)} \to h^+h^-$ (h= K, π)
  - Presenza di diagrammi con loop → sensibilità a processi di fisica oltre il modello standard



- Misura asimmetria di CP dipendente dal tempo in $B^0 \to \pi^+\pi^-$ e $B^0_s \to K^+K^-$

$$A(t) = \frac{\Gamma_{\overline{B}^0_{(s)} \to f}(t) - \Gamma_{B^0_{(s)} \to f}(t)}{\Gamma_{\overline{B}^0_{(s)} \to f}(t) + \Gamma_{B^0_{(s)} \to f}(t)} = \frac{-C_f \cos(\Delta m_{d(s)} t) + S_f \sin(\Delta m_{d(s)} t)}{\cosh\left(\frac{\Delta\Gamma_{d(s)}}{2} t\right) + A_f^{\Delta\Gamma} \sinh\left(\frac{\Delta\Gamma_{d(s)}}{2} t\right)}$$

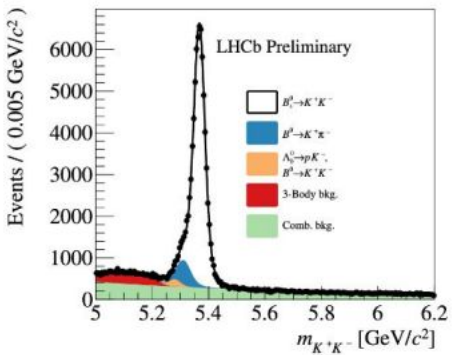
$$C_f \equiv \frac{1-|\lambda_f|^2}{1+|\lambda_f|^2}, \quad S_f \equiv \frac{2\mathrm{Im}\lambda_f}{1+|\lambda_f|^2}, \quad A_f^{\Delta\Gamma} \equiv -\frac{2\mathrm{Re}\lambda_f}{1+|\lambda_f|^2}, \quad \lambda_f \equiv \frac{q}{p}\frac{\bar{A}_f}{A_f}$$

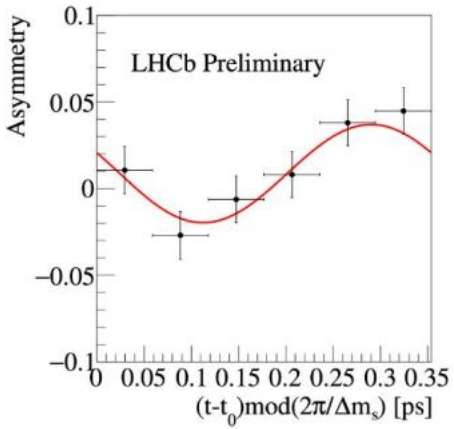
Violazione di CP nel decadimento

Violazione di CP nell'interferenza tra decadimento e mixing

- Misurata anche asimmetria di CP integrata nel tempo in $B^0 \to K^+\pi^-$ e $B^0_s \to \pi^+K^-$

LHCb-PAPER-2020-029





- Combinazione con misura Run1 PRD 98 (2018) 032004

$$\begin{aligned}
C_{\pi\pi} &= -0.320 \pm 0.038 \\
S_{\pi\pi} &= -0.672 \pm 0.034 \\
A_{CP}^{B^0} &= -0.0831 \pm 0.0034 \\
A_{CP}^{B^0_s} &= 0.225 \pm 0.012 \\
C_{KK} &= 0.172 \pm 0.031 \\
S_{KK} &= 0.139 \pm 0.032 \\
\mathcal{A}_{KK}^{\Delta\Gamma} &= -0.897 \pm 0.087
\end{aligned}$$

→ $(C_{KK}, S_{KK}, A^{\Delta\Gamma}{}_{KK}) \neq (0,0,-1)$ @ 6.5 σ

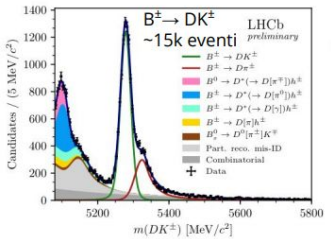
→ **Prima osservazione di violazione di CP dipendente dal tempo nei mesoni B^0_s**

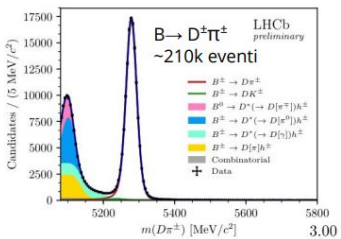
LHCb Highlight fisica

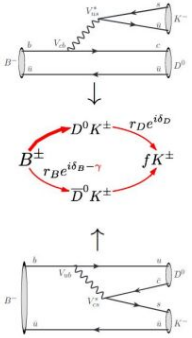
Misura angolo γ

LHCb-CONF-2020-001

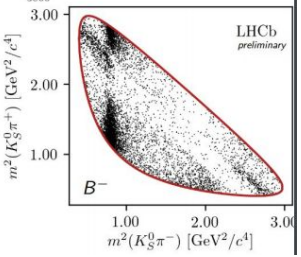
- Lo stato finale di $B^{\pm}\to(D^0\to K^0_S h^-h^+)K^{\pm}$ è accessibile sia con decadimenti D^0 e $\bar{D}^0$ → interferenza → misura angolo γ
  - ➢ $B^{\pm}\to D\pi^{\pm}$ come canale di controllo





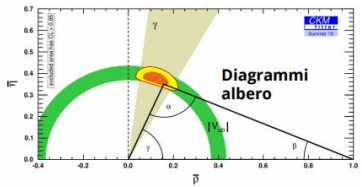


- Utilizzato dataset completo 2011-2018
- Dalitz plot diviso in bin e angolo γ estratto da un fit a $N_i^{\pm}$ → fondamentale input da BESIII per fase forte [PRL 124, 241802 (2020)]



γ= (69±5)°

Misura più precisa al mondo!



Da diagrammi ad albero

$$\gamma = (72.1^{+5.4}_{-5.7})^{\circ}$$

Primo test di transizioni $b \to s l^+ l^-$ nei barioni Λ^0_b

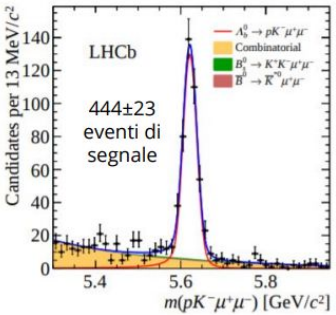
- ➢ Decadimenti $\Lambda^0_b \to pK^-e^+e^-$, $\Lambda^0_b \to pK^-\mu^+\mu^-$

$$R^{-1}_{pK} = \frac{\mathcal{B}(\Lambda_b^0 \to pK^- e^+ e^-)}{\mathcal{B}(\Lambda_b^0 \to pK^- J/\psi(\to e^+e^-))} \Big/ \frac{\mathcal{B}(\Lambda_b^0 \to pK^- \mu^+ \mu^-)}{\mathcal{B}(\Lambda_b^0 \to pK^- J/\psi(\to \mu^+\mu^-))}$$

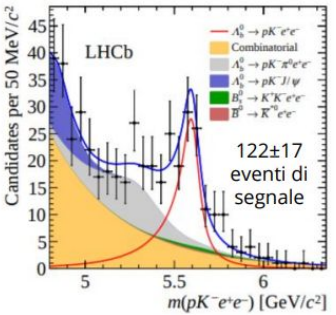
Test universalità leptonica: R_{pK}

JHEP 05 (2020) 040

Prima misura BR



Prima osservazione!



$$\mathcal{B}(\Lambda_b^0 \to pK^-\mu^+\mu^-)\big|_{0.1<q^2<6\,\mathrm{GeV}^2/c^4} = \left(2.65 \pm 0.14 \pm 0.12 \pm 0.29^{+0.38}_{-0.23}\right) \times 10^{-7}$$

$$R^{-1}_{pK}\big|_{0.1<q^2<6\,\mathrm{GeV}^2/c^4} = 1.17^{+0.18}_{-0.16} \pm 0.07$$

→ **R_{pK}^{-1} compatibile con l'unità entro 1σ** (test al 16% di precisione)

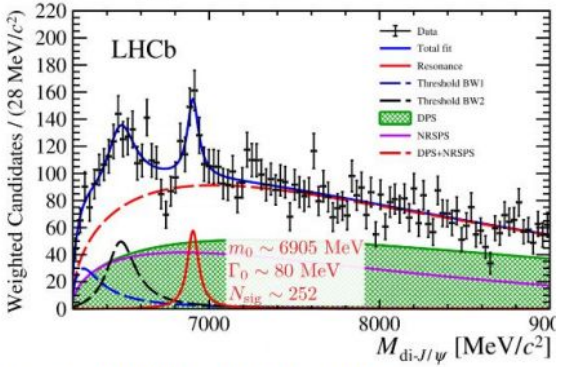
LHCb highlight fisica Giulia Tuci

Tetraquarks

L. An, L.Anderlini, G.Graziani (FI)

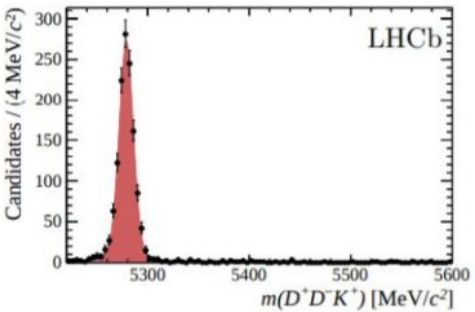
LHCb-PAPER-2020-011

- Osservato picco significativo a ~6905 MeV nello spettro della massa invariante m(J/ψ-J/ψ)
- Possibile interpretazione → $T_{c\bar{c}c\bar{c}}$

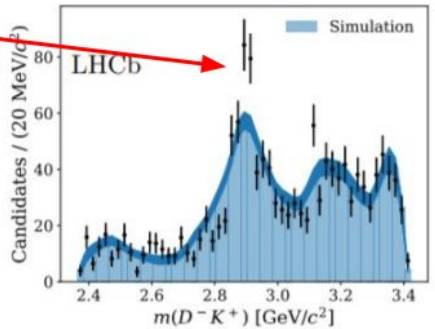


- Struttura compatibile con due $T_{cd\bar{s}u}$ osservata in $m(D^-K^+)$ studiando 1260 decadimenti $B^+ \to D^+D^-K^+$

LHCb-PAPER-2020-024

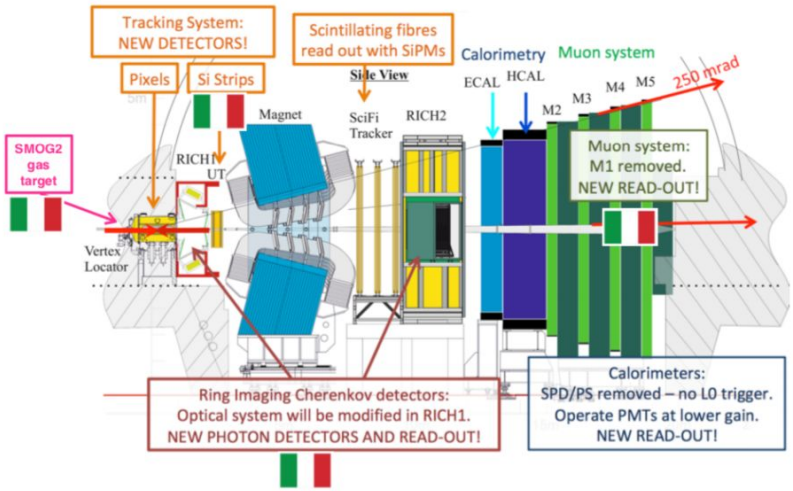


Struttura a $m(D^-K^+)$=2.9 GeV (4σ)



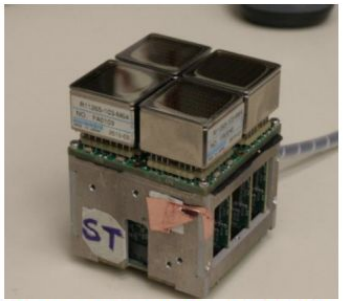
LHCb LS2 Vincenzo Maria Vagnoni

LHCb Upgrade I per l'INFN

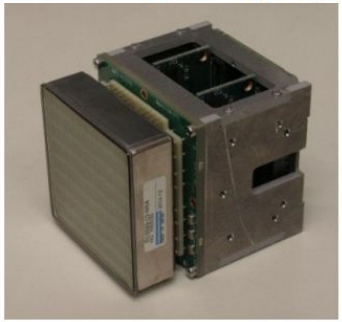


RICH

La componente INFN, inizialmente minoritaria, è ora maggioritaria nell'era dell'upgrade (FE, GE, MiB, PD, PG)



Elementary Cell (EC)



- Installazione colonne al CERN e inizio commissioning in questi giorni
- Schedula in tempo, nonostante il Covid

SHIP e SND@LHC Giovanni De Lellis (NA)

Deliberation Document
on the 2020 update of the European Strategy for Particle Physics

The European Strategy Group
(prepared by the Strategy Secretariat)

committees and the Research Board. Among the proposals for larger-scale new facilities investigated within the Physics Beyond Colliders study, the Beam Dump Facility at the SPS emerged as one of the frontrunners. However, such a project would be difficult to resource within the CERN budget, considering the other recommendations of this Strategy.

MEDIUM TERM PLAN 2021-2025

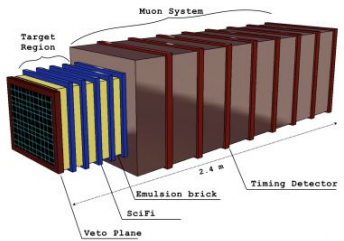
PBC activities are funded with an increased budget of 3 MCHF/year in this MTP (up from 1 MCHF/year). These resources will also be used to continue R&D and design studies (beam extraction and transfer, target system, radiation protection, etc.) for a beam dump facility at the SPS, so as to be ready to start construction before the end of the decade if a decision is taken on its implementation by the time of the next ESPP update.

- **BDF** facility strongly supported by CERN
- Priority will be given to aspects directly related to the facility (e.g. muon shield, magnets, decay vessel)
- The SHiP Collaboration will work on the preparation of an **R&D plan** for the facility

New satellite projects on a short timescale open to external contributions with independent Collaborations:

LINE1: SHiP technology applied to a different context → SND at LHC
LINE2: SHiP physics case on a smaller scale → mini-SHiP@PS

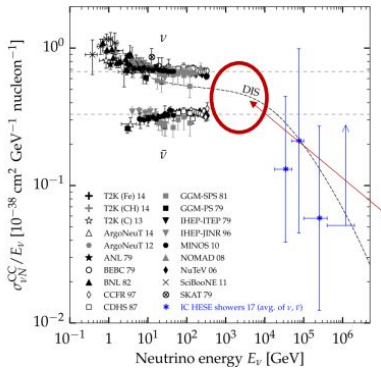
The Scattering and Neutrino Detector @LHC



SND@LHC motivazioni

- http://arxiv.org/abs/1804.04413

Bustamante and Connolly
PRL 122 (2019) 041101



OPEN ACCESS
IOP Publishing
Journal of Physics G: Nuclear and Particle Physics
J. Phys. G: Nucl. Part. Phys. **46** (2019) 115008 (19pp)
https://doi.org/10.1088/1361-6471/ab3f7c

Physics potential of an experiment using LHC neutrinos

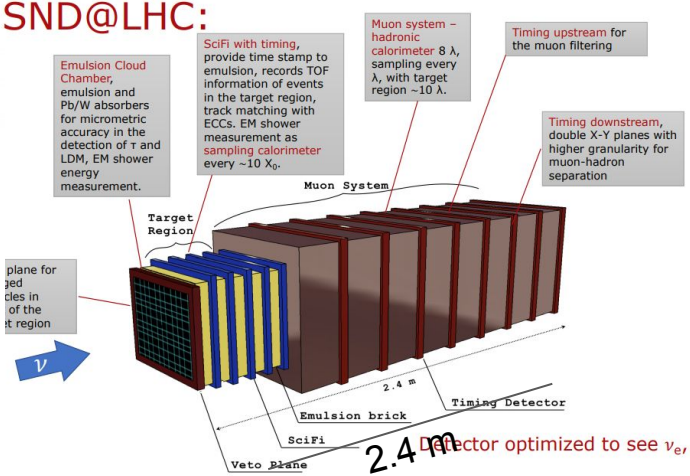
N Beni[1], M Brucoli[2], S Buontempo[5], V Cafaro[4], G M Dallavalle[4,8], S Danzeca[2], G De Lellis[2,3,5], A Di Crescenzo[3,5], V Giordano[4], C Guandalini[4], D Lazic[6], S Lo Meo[7], F L Navarria[4] and Z Szillasi[1,2]

CERN is unique in providing energetic **ν** (from LHC)
→ measure pp → **ν** X in an unexplored domain

See M. Dallavalle's talk, July 2019

8

The SND@LHC:



Detector optimized to see ν_e, ν_μ, ν_τ

13

PHYSICS PERSPECTIVE: NEUTRINOS AND QCD

- pp → **ν** X in the range 7.2< η < 8.7: neutrinos are mostly produced by charm decays
- Prediction for (beauty and) charm yield at such small angles are affected by large uncertainties and unconstrained by measurements
- None of the LHC detectors cover this range
- Neutrino detection as a tool to measure heavy flavour production at very small angles (large η)→ important QCD task

CERN Director of Research supports the physics case.

The following schedule was agreed with the LHCC (the Research Board took note of that)

- September 2020: LHCC review process initiated
- October 2020: questions provided by LHCC review panel to be answered in 1-2 weeks
- November 2020: focus session on the proposal at LHCC
- December 2020: submission of the Technical Proposal
- March 2021: final review with a presentation in the Open Session

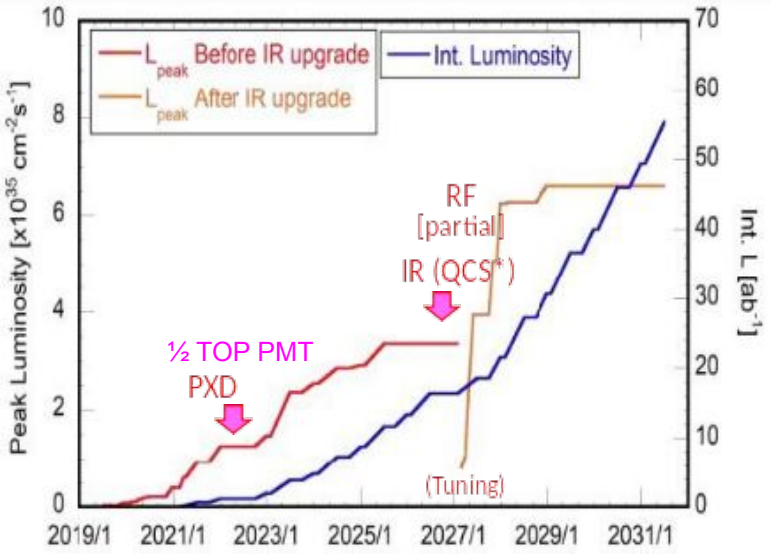
- Minimal infrastructure work will be done at the end of October. Remaining infrastructure work and detector installation from March 2021 until the end of 2021.

SND@LHC: Letter of Intent

LoI: CERN-LHCC-2020-013; LHCC-I-037
https://cds.cern.ch/record/2729015/files/LHCC-I-037.pdf

Belle II Paolo Branchini

SuperKEKB Roadmap2020



- Main reasons:

(1) Increase in the running cost (utility cost)

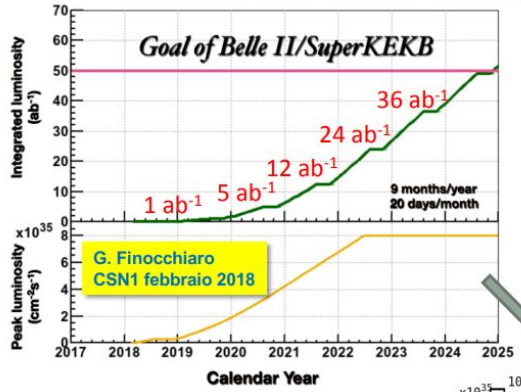
(2) Challenges found in the initial operations (~ 2019c) :

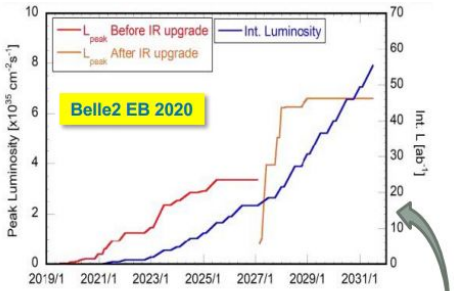
(a) Strong beam-beam effects at high bunch-current region

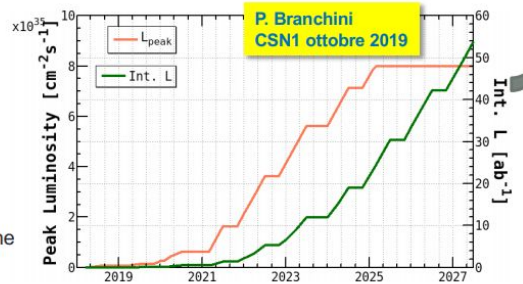
(b) Narrow physical aperture in QCS

(c) High background in Belle II

BELLE2: ROADMAP E UPGRADE



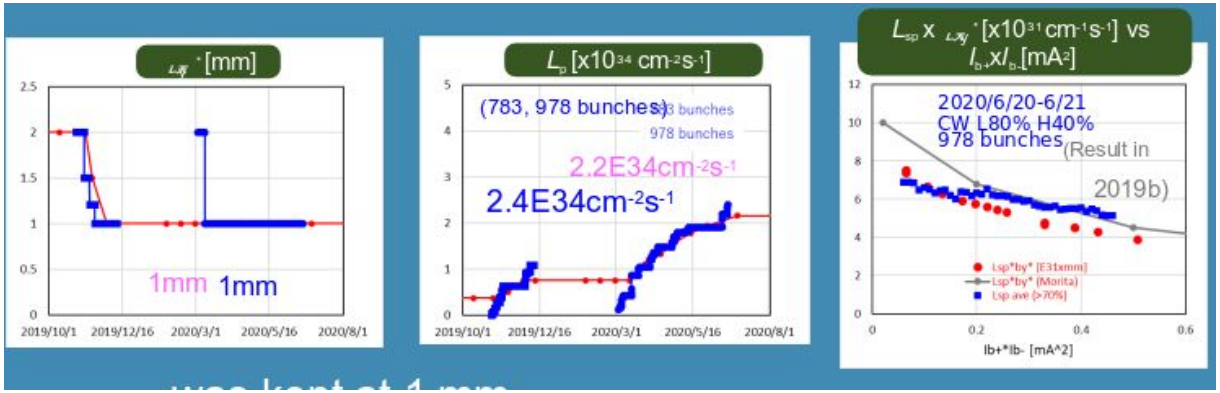


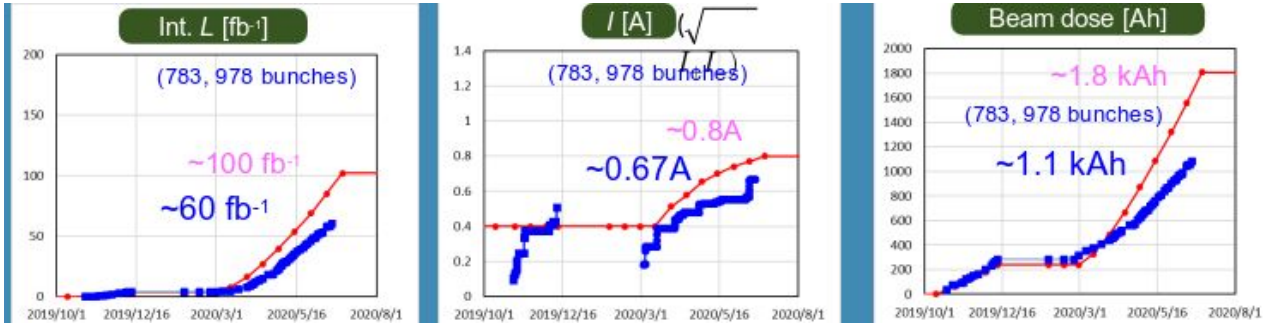


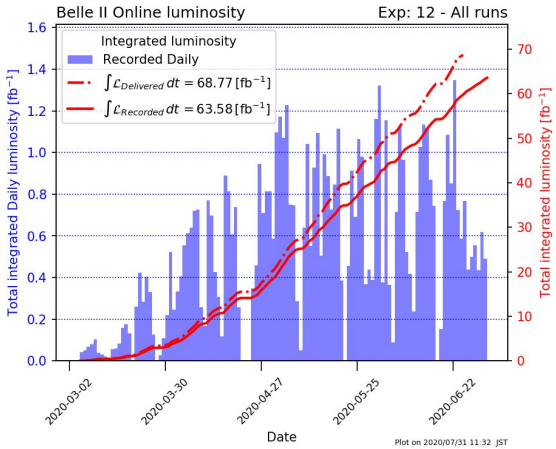
- La prospettiva temporale dell'esperimento è sostanzialmente cambiata rispetto all'inizio delle operazioni
- la macchina non è in grado di raggiungere la luminosità di design con il progetto originale
- KEK ha sottoposto un progetto di upgrade dell'acceleratore per superare alcune delle criticità osservate
- Ad esso si abbinerà un upgrade di BELLE2 che avrà un chiaro impatto sulla partecipazione INFN

F.Cossutti
Referee

Belle II Run2020a/b







★ L_{day}^{max} = 1.32fb⁻¹ (May 31)

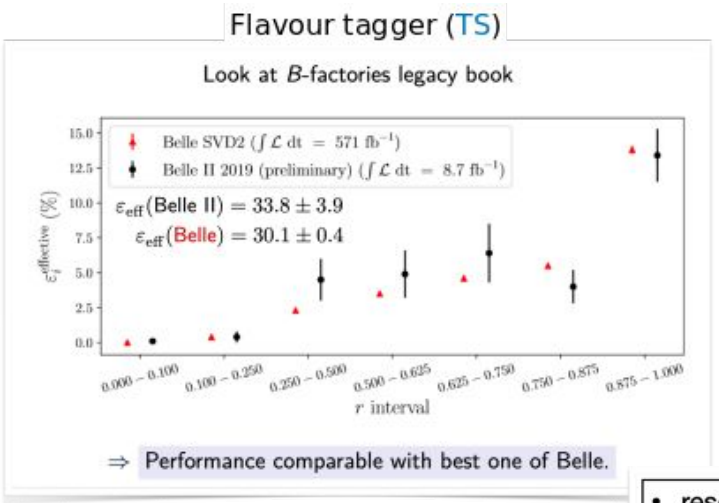
★ L_{peak} = 2.4 x 10³⁴cm⁻²s⁻¹ w/ Belle II ON

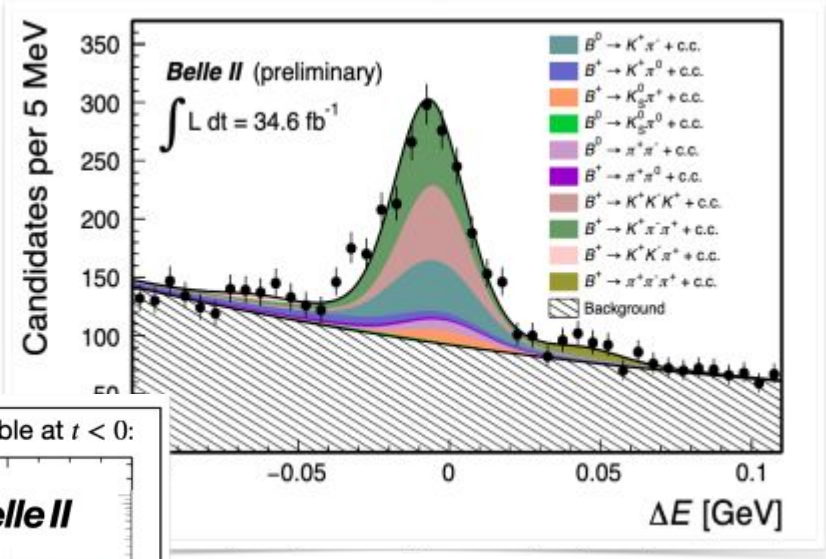
Luminosity world record !

Run 2020c started on monday - expected 60 /fb before X-mas

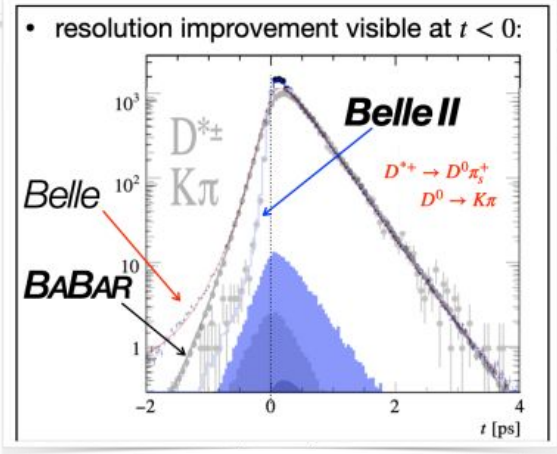
BelleII Highlight fisica

Branching ratio and CP asymmetry in charmless B decays (TS), first measurements presented at winter conferences and updated for ICHEP





D0 lifetime
Resolution better than BaBar and Belle



UPGRADE DI BELLE2: CONSIDERAZIONI GENERALI

F.Cossutti: Referee BelleII

- Il raggiungimento dei 50 ab^{-1} non è più un obiettivo del 2025, ma del 2031
  - L'orizzonte temporale del goal di fisica si sposta di ~6 anni nel futuro
- Per conseguirlo, è necessario un upgrade del rivelatore nel 2026 che permetta di estenderne la vita di altri 5-6 anni in ambiente ad alta luminosità
  - Tempi stretti per la definizione e realizzazione
- Ricevute varie proposte di contributo italiano su singoli sottorivelatori
  - Che si vanno a sommare al contributo già dato all'upgrade dei fotorivelatori del TOP, ed al cantiere sempre aperto dell'SVD beam monitoring
- Riteniamo opportuno che la Collaborazione italiana definisca per tempo il perimetro del futuro coinvolgimento in questo upgrade di concerto con la CSN1
  - E che sia chiaro il tetto di spesa che questo implica
  - Prima di discutere "goccia-a-goccia" uno stillicidio di proposte
  - Es. Possiamo/vogliamo essere simultaneamente coinvolti in upgrade di SVD, KLM, ECL e contribuire a vari nuovi sistemi di monitor di radiazione?

RD_FCC F.Bedeschi

Stato generale

FCC project milestones for the next 20 years

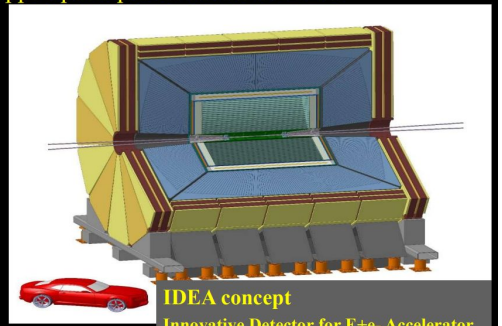
Infrastructure and Machine — Physics, Experiments, Detectors

(exact dates to be discussed in the coming months)

Milestone / activity	Target date	Possible timeline
First e^+e^- collisions in FCC-ee	2040	FCC-ee detector commissioning
Start machine installation	2037	Start FCC-ee detector installation
Tunnel completion	2035/36	
Start tunnel construction	2030	Start FCC-ee detector construction
Project approval	2028	FCC-ee Detector TDR's and approvals
Next ESPPU	2026/27	
Key prototypes (feasibility proof)	2025/26	FCC-ee Proto-collaborations and LoI's
CDR++/TDR (feasibility proof)	End 2025	CDR++ (Common work) Physics, Software, Technologies, R&D

- **FCC-IS – The Future Circular Collider Innovation Study.**
  - This INFRARED Research and Innovation Action project receives funding from the European Union's H2020 Framework Programme under grant agreement no. 951754
    - INFN partecipa con LNF – M. Boscolo responsabile scientifico
  - Kick-off workshop: CERN Nov. 9-13, 2020 →
    - 4th FCC Physics and Experiments Workshop → fisici INFN nell' IPAC
- Cresce lo sforzo sul software per FCCee
  - Sviluppo software comune per tutti i potenziali futuri colliders e+e- Key4HEP
    - Potenziato gruppo CERN
  - Riorganizzazione gruppi di fisica per affrontare lista di "case studies"
    - Coordinatori generali (Physics Performance Coordinators): Patrizia Azzi, Emmanuel Perez
- The 2020 International Workshop on the High Energy Circular Electron Positron Collider, Shanghai 26-28 Ottobre 2020
  - Fisici INFN nel Scientific Program Committee

Sviluppi e piani per rivelatori di IDEA

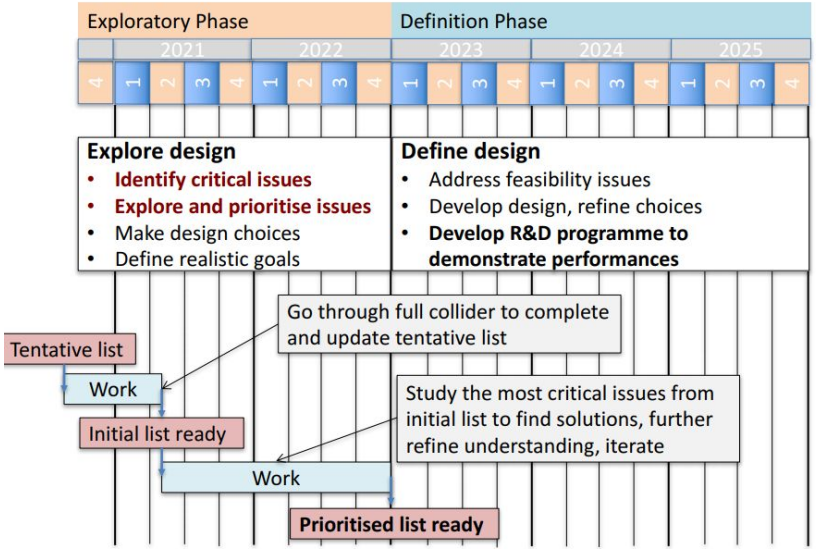


Silicio (TO/MI)
DC (BA/LE)
DualRO Calo (BO,CT,MI,PI,PV)
PreShower/Muon (BO,FE,LNF,TO)

- IDEA e' concetto di detector ormai "established"
  - Default nella simulazione DELPHES del CERN
  - Presentato ad ICHEP 2020 (anche ARCADIA, DC, µRwell, …)
- Contributi al disegno acceleratore su MDI (Boscolo/Bacchetta)
- Comincia un intenso lavoro di studi software stimolato dal CERN e noi ci siamo pienamente
- R&D sui rivelatori va completato nei prossimi 3-4 anni per potere essere competitivi alla presentazione delle LoI

RD_MuCol Nadia Pastrone

Tentative Timeline - September 2020



Deliverable:

Report assessing muon collider potential and describing R&D path to CDR

Scope:

- Focus on two energy ranges:
  - **3 TeV**, if possible with technology ready for construction in 10-20 years
  - **10+ TeV**, with more advanced technology

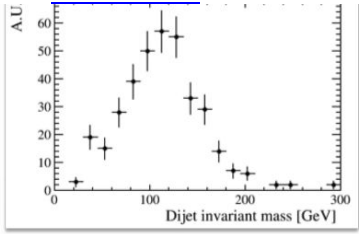
➔ **Physics benchmarks steer machine parameters and experiment design**

- Explore synergy with other options (neutrino/Higgs factory)
- Define R&D path

Hbb @ 1.5 TeV

D. Lucchesi et al.

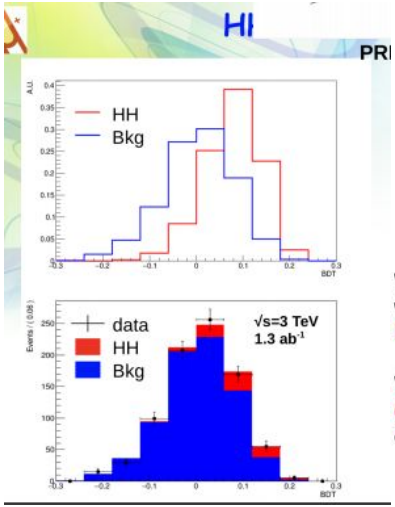
$\mu^+\mu^- \to H\nu\bar{\nu} \to b\bar{b}\nu\bar{\nu}$ + beam-induced background fully simulated



Higgs $b\bar{b}$ Couplings Results

The instantaneous luminosity, $\mathcal{L}$, at different $\sqrt{s}$ is taken from MAP.
The acceptance, A, the number of signal events, N, and background, B, are determined with simulation.

$\sqrt{s}$ [TeV]	A [%]	ϵ [%]	$\mathcal{L}$ [$cm^{-2}s^{-1}$]	$\mathcal{L}_{int}$ [ab^{-1}]	σ [fb]	N	B	$\frac{\Delta\sigma}{\sigma}$ [%]	$\frac{\Delta g_{Hbb}}{g_{Hbb}}$ [%]
1.5	35	15	$1.25 \cdot 10^{34}$	0.5	203	5500	6700	2.0	1.9
3.0	37	15	$4.4 \cdot 10^{34}$	1.3	324	33000	7700	0.60	1.0
10	39	16	$2 \cdot 10^{35}$	8.0	549	270000	4400	0.20	0.91



H(bb)H(bb) @ 3 TeV

Lorenzo Sestini @ ICHEP 2020

With 1.3 ab^{-1} (4 years of data taking) at 3 TeV we expect to select 67 HH events and 745 background events.

With a simple fit to the BDT → **An uncertainty of 33% on the cross section has been obtained.**

Studies

Demand for CPU and disk space
10 keu @ PD T2 if possible to be assigned in 2020

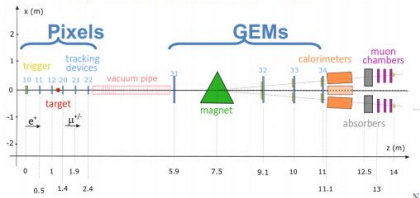
10k events μμ → νν**H**(→bb)
10k events μμ → νν**HH**(→bbbb)
10k events μμ → νν**HHH**(→bbbbbb)
10k events μμ → νν**H**(→WW*(ZZ*)→μμ+X)

10k events μμ → νν**H**(→γγ)
10k events μμ → νν**H**(→μμ)
10k events μμ → νν**H**(→ee)
10k events μμ → νν**H**(→cc)
10k events μμ → νν**H**(→ττ)
10k events μμ → νν**HH**(→WW*bb)

January 2021 | **July 2021 (Snowmass)** | **December 2021+2022**

Test Beam @ CERN

- Experimentally measure the key parameters of the LEMMA approach
  - **Emittance** of emerging μ beam
  - $\mu^+\mu^-$ production **cross-section at threshold**
  - properties of **spent e^+ beam** (transverse emittance and energy spectrum)
  - Effect of the **target material/thickness**
- Although these are theoretically known and can be obtained from simulations**, precise measurements do not exist at the $\mu^+\mu^-$ production threshold**
  - GEANT does not include e.g. near-threshold Coulomb enhancements, and has not been experimentally tested in this regime



Request for 3-weeks beam time in H4 submitted to SPSC
http://cds.cern.ch/record/2712394

CERN-SPSC-2020-004

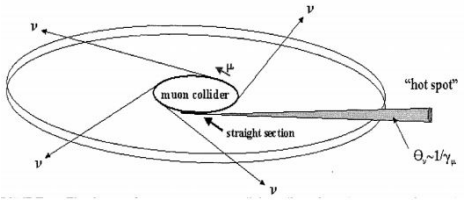
LEMMA-TB: an experiment to measure the production of a low emittance muon beam

N. Amapane[a,b], M. Antonelli[c], F. Anulli[d], N. Bacchetta[b], N. Bartosik[b], M. Bauce[d], A. Bertolin[b], M. Bianco[m], C. Biino[b], O. R. Blanco-Garcia[a], M. Boscolo[c], A. Braghieri[g], A. Cappati[a,b], F. Casaburo[1,d], M. Casarsa[i], G. Cavoto[1,d], N. Charitonidis[e,m], A. Colaleo[p], F. Collamati[d], G. Cotto[a,b], D.Creanza[p], C. Curatolo[b], N. Deelen[j], F. Gonella[b], S. Hoh[a,b], M. Iafrati[c], F. Iacoangeli[d], B. Kiani[a], D. Lucchesi[a,b], V. Mascagna[e,f], S. Mersi[m], A. Paccagnella[a,b], N. Pastrone[g], J. Pazzini[a,b], M. Pelliccioni[b], B. Ponzio[c], M. Prest[e,f], C. Riccardi[g,r], M. Ricci[c], R. Rossin[a,b], M. Rotondo[c], P. Salvini[g], O. Sans Planell[a,b], L. Sestini[b], L. Silvestris[p], A. Triossi[a], I. Vai[a,s], E. Vallazza[f], R.Venditti[p], S. Ventura[b], P. Verwilligen[p], P. Vitulo[q,t], and M. Zanetti[a,b]

Challenge: Neutrino Radiation Hazard

Neutrinos from decaying muons can produce showers just when they exit the earth

Particularly bad in direction of straights
But also an issue in the arcs



Potential mitigation by
- Site choice
- Owning the land in direction of experimental insertion
- Having a dynamic beam orbit so it points in different directions at each turn in the arcs
  - Or at least paint the beam in the the straights to dilute radiation

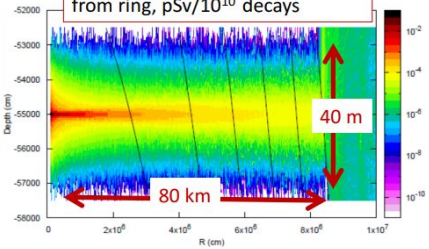
More important at higher energies (scaling E^3)

US study concluded: 6 TeV parameters are OK

Reasonable goal 0.1 mSv/ year, to be verified

On-going simulations and studies for mitigation with existing/future tunnels

Dose from 1 TeV $\mu^\pm$ vs distance from ring, pSv/10^{10} decays



- 10 keuro su PD da anticipare al 2020 (OK referee del calcolo)
- Abbiamo espresso perplessita' sull'uso massiccio della full simulation in questa fase del progetto e alla fine consigliato una riduzione del numero di eventi da simulare

Test beam LEMMA

Referee:

- PD
  - "Sistema avanzato DAQ a 40 MHz con link GBT": 20 k€ → OK
  - Missioni: Integrazione al CERN: 3 k€ → 1.5 k€ SJ a progetto definitivo

CSN1

- Prossima riunione a 19-20 Novembre a Frascati
  - in presenza se possibile