

# Emiliano Furfaro

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## Informazioni Personali

### Anagrafica

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### Parametri bibliometrici

Pubblicazioni 359

Citazioni 21710

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## Formazione

A.A. **Dottorato di Ricerca**, *Università degli Studi di Roma "Tor Vergata"*.  
2015-2016 Titolo della tesi: "Precise measurement of the charged *B* meson mass at the LHCb experiment".

A.A. **Laurea in Fisica con votazione 105/110**, *"Sapienza" Università di Roma*.  
2008-2009 Titolo della tesi: "Studio ed ottimizzazione delle prestazioni delle camere a multifilo dell'esperimento LHCb".

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## Esperienza Lavorativa

da apr. 2019 "Sapienza" Università di Roma.

### **Tecnico.**

Supporto alle attività del Laboratorio didattico di Ottica del Dipartimento di Fisica.

Responsabile Unico del Procedimento per procedure di acquisto di beni e servizi relativi ad attrezzature tecnico-scientifiche di importo superiore e inferiore la soglia comunitaria

2015-2019 Neat s.r.l., Roma (Italia).

### **Responsabile attività di verifica e validazione del software.**

Sviluppo in codice C delle funzionalità di sistemi integrati real time.

Programmazione secondo le linee guida MISRA C per sistemi elettronici ferroviari in sicurezza con livello SIL4.

Bug fixing e test.

Attività di laboratorio.

- 2012-2016 Università degli Studi di Roma “Tor Vergata”.  
**Dottorato di Ricerca in Fisica.**  
Analisi statistica dei dati prodotti dall’esperimento LHCb.  
Utilizzo di tecniche di “machine learning” (alberi decisionali) per l’estrazione del campione di segnale dai dati analizzati.  
Definizione delle funzioni per i fit delle distribuzioni. Misura della massa del mesone  $B$  carico.  
Esperto del monitoring delle camere a muoni dell’esperimento LHCb.
- 2010-2012 INFN, Sezione “Roma1”.  
**Borsa Tecnologo per attività di ricerca in Fisica delle Alte Energie nell’ambito dell’esperimento LHCb.**  
Programmazione embedded attraverso il linguaggio C.  
Sviluppo di applicativi in ambiente WinCC/PVSS SCADA per la gestione dell’elettronica di front-end del rivelatore di muoni.
- ott. 2010 Alia-Space srl.  
**Programmatore.**  
Stage in programmazione C# e SQLServer volto alla gestione dei database attraverso windows forms.
- mag.-lug. 2007 CERN – European Organization for Nuclear Research.  
**Ricerca nell’ambito della collaborazione LHCb.**  
Test su banco e installazione delle camere a muoni sull’apparato sperimentale.  
Test e hardware fixing delle camere in esercizio sull’apparato.
- 2005-2019 C.F Audio Systems.  
**Co-fondatore.**  
Progettazione elettronica e disegno dei telai in ambiente CAD.  
Costruzione prototipi e prodotti finiti.

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## Corsi professionali

- 2005-2006 **Qualifica professionale in programmazione Java e C++.** *Centro Provinciale di Formazione Professionale “ADRIATICO” di Roma.*
- Luglio 2010 **Corso base Web developer ASP.NET,** tirocinio formativo della durata di 160 ore presso *Key To Business s.r.l.*  
Principali materie: Object Oriented Programming, sintassi e semantica del linguaggio C#, introduzione alla Base Dati Sql Server, programmazione Web Asp.Net, accesso attraverso ADO.NET.

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## Attività Scientifica

### Associazioni

- 2007-2017 CERN User  
2010-2017 Associato INFN

## Esperimento LHCb

### Misura di precisione della Massa del Mesone $B$ carico

Lo studio è stato condotto con il gruppo LHCb di Roma2 all'Università "Tor Vergata". È stato scelto un canale di decadimento del  $B$  carico soppresso ma particolarmente favorevole che garantisce una bassa sistematica dovuta alla scala dei momenti, basso  $Q$ -value. Grazie all'alta luminosità di LHCb è stato possibile raggiungere l'alta statistica richiesta per questo tipo di misura con i dati acquisiti nel 2011 e nel 2012. Ho studiato tale canale,  $B^+ \rightarrow J/\psi\phi K^+$  con  $J/\psi \rightarrow \mu^+\mu^-$ ,  $\phi \rightarrow K^+K^-$ , selezionando gli eventi di segnale rispetto a quelli di fondo attraverso l'uso di tecniche di machine learning, alberi decisionali  $BDT$  (*Boosted Decision Tree*). Ho così effettuato uno studio tramite simulazione e dati reali del segnale e del fondo per l'addestramento di tale  $BDT$  al fine di ottenere il miglior rapporto  $S/N$ . Ho quindi definito la migliore funzione che descrive la distribuzione di massa invariante attraverso lo studio di dati simulati per il fondo e il picco di risonanza. Grazie a questa analisi ho potuto migliorare la precisione della misura della massa del mesone  $B$  carico rispetto all'ultima migliore misura riportata in letteratura. In questo periodo ho continuato a seguire la manutenzione del sistema di controllo e monitoring del *Muon System* di LHCb iniziata nel corso del 2011 e in occasione dell'inizio del "Run2" di LHCb sono stato inserito nella lista degli esperti del *Muon System* con il ruolo di "Chamber Monitor Expert" delle camere a muoni.

### Studio del *Branching Fraction* del canale $\psi(2S) \rightarrow \mu^+\mu^-$

Con il gruppo LHCb di Roma2 e il gruppo dell'analisi dati di LHCb ho effettuato lo studio del decadimento della particella  $\psi(2S)$  nel canale  $\psi(2S) \rightarrow \mu^+\mu^-$  attraverso il decadimento del mesone  $B^+$  nel canale  $B^+ \rightarrow \psi(2S)K^+$ . In particolare ho eseguito la misura del *Branching Fraction* di tale canale che dalla precedente misura di LHCb, con i dati del solo anno 2010, mostrava una discrepanza con i valori riportati in letteratura. Ho effettuato la misura sfruttando il rapporto  $\mathcal{B}(\psi(2S) \rightarrow \mu^+\mu^-)/\mathcal{B}(\psi(2S) \rightarrow J/\psi\pi^+\pi^-(J/\psi \rightarrow \mu^+\mu^-))$ : la presenza in un canale di due tracce cariche in più rispetto all'altro ha comportato che l'efficienza di tracciamento fosse un importante aspetto di questa analisi. Ho così principalmente condotto lo studio analizzando, sia con dati reali che con dati simulati, l'efficienza di ricostruzione delle tracce dei due pioni carichi nello spazio  $\eta - p$  e analizzando la molteplicità delle tracce rivelate per i due canali di decadimento al fine di effettuare le correzioni alla misura che tenessero conto delle caratteristiche di rivelazione dell'apparato sperimentale.

### Ricerca di risonanze esotiche nel decadimento del mesone $B_s$

Nell'ambito della ricerca di risonanze esotiche nel decadimento inclusivo  $b \rightarrow J/\psi\phi\dots$ , condotta dal gruppo LHCb della sezione di Roma2 in collaborazione con il gruppo dell'analisi dati di LHCb, mi sono occupato dell'analisi dello spettro di massa invariante  $M(J/\psi\phi) - M(J/\psi)$  nella regione  $1000 \div 2060 \text{ MeV}/c^2$  attraverso i dati raccolti dall'esperimento nel 2011 e nel 2012. La mia attività ha riguardato l'analisi e il confronto dello spettro ottenuto dai dati e dalla simulazione dei canali di decadimento al fine di studiare le strutture visibili per  $M(J/\psi\phi) - M(J/\psi) \simeq 1200 \text{ MeV}/c^2$  e  $M(J/\psi\phi) - M(J/\psi) \simeq 1400 \text{ MeV}/c^2$ . In particolare per queste strutture non sono stati individuati meccanismi di riflessione, mancata ricostruzione di tutte le particelle prodotte nei decadimenti, che ne potessero spiegare la natura. È così stato ipotizzato che questi picchi siano dovuti al decadimento di una nuova particella chiamata  $X(4300)$  e da una possibile struttura a bassa massa  $X(4140)$ . La mia analisi ha confermato l'esistenza delle due strutture evidenziando la necessità di raccogliere ulteriori dati e di incrementare i dati simulati al fine di poter interpretare come "nuove particelle" tali risonanze.

## Sviluppo del Sistema di Controllo e Monitoring del Muon System

Nell'ambito della collaborazione LHCb, nel gruppo dei muoni di Roma1, ho collaborato alla gestione del sistema di controllo e monitoring del *Muon System* studiando il firmware scritto in linguaggio C delle schede ELMB (progettate e disegnate al CERN) che gestiscono la comunicazione con l'hardware di front-end basata sul bus I2C e sul protocollo CANOpen. Ho sviluppato durante il "Run1" un applicativo per il monitoring delle camere del rivelatore di muoni basato sul sistema SCADA PVSS con interfaccia a pannelli nel linguaggio C. Tale software permette la gestione *real time* dei 120.000 canali di elettronica di front-end, 250 schede di controllo (*Service boards*). In questo periodo di lavoro ho rilasciato diverse versioni di tale software che è usato per monitorare lo stato delle camere grazie a quattro possibili analisi effettuabili sia durante la presa dati che in fase di ottimizzazione. La versione attualmente usata si basa su un protocollo client-server da me sviluppato che permette l'apertura di più pannelli di controllo senza possibilità di sovrapporre le richieste all'hardware di front end. In parallelo allo sviluppo ho apportato dei miglioramenti a diversi pannelli preesistenti nel sistema di monitoraggio rendendoli più veloci da usare e aggiungendo funzionalità mancanti, nonché sistemandone alcuni non ben funzionanti. Questa attività ha richiesto la mia presenza nel sito dell'esperimento per cui ho effettuato diverse missioni al CERN lavorando quasi esclusivamente nella sala controllo di LHCb. Durante questi periodi ho avuto l'occasione di effettuare diversi turni come *piquet*, esperto reperibile, del sistema dei muoni.

## Studio delle prestazioni delle camere proporzionali a multi-filo

Durante il periodo di tesi di laurea mi sono occupato dello studio e dell'ottimizzazione delle prestazioni delle camere a multifilo (MWPC) del rivelatore di muoni dell'esperimento LHCb attraverso i raggi cosmici. Per tale scopo ho partecipato alla realizzazione di una stazione di test che permette di acquisire fino a 600 canali di elettronica. Grazie a tale stazione è stato possibile studiare nel dettaglio le prestazioni dei diversi tipi di camere. In particolare mi sono occupato della ottimizzazione del sistema di test e dello sviluppo di un sistema di tracciamento dei raggi cosmici che consentisse di ricostruire la traiettoria delle particelle e di individuare le zone colpite di ciascuna camera in esame. I dati acquisiti sono stati successivamente analizzati da un software, che ho realizzato in ambiente ROOT nel linguaggio C++, in grado di ricostruire la traccia di una singola particella attraverso una selezione degli eventi e un fit.

## Test e installazione delle camere proporzionali a multi-filo

Durante il periodo di installazione dell'esperimento ho collaborato all'attività di test di funzionamento delle camere a multifilo del rivelatore di muoni di LHCb, sia in laboratorio che direttamente nel sito dell'esperimento. Mi sono occupato dei test su banco delle camere e dell'installazione delle camere sull'apparato sperimentale. Ho inoltre lavorato ai test e all'*hardware fixing* delle camere per prepararle all'esercizio in apparato.

## Test di cristalli per lo sviluppo di un calorimetro per l'esperimento SuperB

Ho iniziato a lavorare nel gruppo impegnato alla progettazione del calorimetro elettromagnetico dell'esperimento SuperB partecipando ai test eseguiti all'impianto di irraggiamento "Calliope" (presso il Centro Ricerche ENEA, Casaccia) per lo studio dell'invecchiamento di prototipi basati su cristalli di LYSO e BGO nell'ambito della ricerca della migliore tecnologia per il calorimetro.

## Pubblicazioni

### Articoli su rivista

1. A. Ciardiello, S. Altieri, F. Ballarini, V. Bocci, S. Bortolussi, L. Cansolino, D. Carlotti, M. Ciocca, A. Cruciani, R. Faccini, A. Facoetti, C. Ferrari, L. Ficcardenti, E. Furfaro, S. Giagu, F. Iacoangeli, G. Macioce, C. Mancini-Terracciano, A. Messina, L. Milazzo, S. Pacifico, S. Piccolella, I. Postuma, D. Rotili, V. Vercesi, C. Voena, F. Vulcano, and S. Capuani. “Multimodal evaluation of  $^{19}\text{F}$ -BPA internalization in pancreatic cancer cells for boron capture and proton therapy potential applications”. *Physica Medica, European Journal of Medical Physics*, 2022.  
10.1016/j.ejmp.2021.12.011.
2. R. Aaij *et al.* [LHCb Collaboration]. “Search for  $CP$  Violation in  $D_S^+ \rightarrow K_S^0 \pi^+$ ,  $D_S^+ \rightarrow K_S^0 K^+$  and  $D^+ \rightarrow \phi \pi^+$  Decays”. *European Physical Journal C*, 2019.  
10.1140/epjc/s10052-019-7218-1.
3. R. Aaij *et al.* [LHCb Collaboration]. “Measurements of  $CP$  asymmetries in charmless four-body  $\Lambda_b^0$  and  $\Xi_b^0$  decays”. *European Physical Journal C*, 2019.  
10.1140/epjc/s10052-019-7218-1.
4. R. Aaij *et al.* [LHCb Collaboration]. “Measurement of the ratio of branching fractions of the decays  $\Lambda_b^0 \rightarrow \Psi(2S)\Lambda$  and  $\Lambda_b^0 \rightarrow J/\Psi\Lambda$ ”. *Journal of High Energy Physics*, 2019.  
10.1007/JHEP03(2019)126.
5. R. Aaij *et al.* [LHCb Collaboration]. “Erratum to: Differential branching fraction and angular analysis of  $\Lambda_b^0 \rightarrow \Lambda \mu^+ \mu^-$  decays”. *Journal of High Energy Physics*, 2018.  
10.1007/JHEP09(2018)145.
6. R. Aaij *et al.* [LHCb Collaboration]. “Measurement of forward top pair production in the dilepton channel in pp collisions at  $\sqrt{s} = 13$  TeV”. *Journal of High Energy Physics*, 2018.  
10.1007/JHEP08(2018)174.
7. R. Aaij *et al.* [LHCb Collaboration]. “Search for  $CP$  violation using triple product asymmetries in  $\Lambda_b^0 \rightarrow p K^- \pi^+ \pi^-$ ,  $\Lambda_b^0 \rightarrow p K^- K^+ K^-$  and  $\Xi_b^0 \rightarrow p K^- K^- \pi^+$  decays”. *Journal of High Energy Physics*, 2018.  
10.1007/JHEP08(2018)039.
8. R. Aaij *et al.* [LHCb Collaboration]. “Amplitude Analysis of the Decay  $\bar{B}^0 \rightarrow K_S^0 \pi^+ \pi^-$  and First Observation of the  $CP$  Asymmetry in  $\bar{B}^0 \rightarrow K^*(892)^- \pi^+$ ”. *Physical Review Letters*, 2018.  
10.1103/PhysRevLett.120.261801.
9. R. Aaij *et al.* [LHCb Collaboration]. “Studies of the resonance structure in  $D^0 \rightarrow K^\mp \pi^\pm \pi^\pm \pi^\mp$  decays”. *European Physical Journal C*, 2018.  
10.1140/epjc/s10052-018-5758-4.

10. R. Aaij *et al.* [LHCb Collaboration]. “Evidence for the Rare Decay  $\Sigma^+ \rightarrow p\mu^+\mu^-$ ”. *Physical Review Letters*, 2018.  
10.1103/PhysRevLett.120.221803.
11. R. Aaij *et al.* [LHCb Collaboration]. “Erratum to: Measurement of  $CP$  observables in  $B^\pm \rightarrow DK^{*\pm}$  decays using two- and four-body  $D$  final states”. *Journal of High Energy Physics*, 2018.  
10.1007/JHEP05(2018)067.
12. R. Aaij *et al.* [LHCb Collaboration]. “Search for the rare decay  $\Lambda_c^+ \rightarrow p\mu^+\mu^-$ ”. *Physical Review D*, 2018.  
10.1103/PhysRevD.97.091101.
13. R. Aaij *et al.* [LHCb Collaboration]. “Search for  $B_c^+$  decays to two charm mesons”. *Nuclear Physics B*, 2018.  
10.1016/j.nuclphysb.2018.03.015.
14. R. Aaij *et al.* [LHCb Collaboration]. “Measurement of the Ratio of the  $B^0 \rightarrow D^{*-}\tau^+\nu_\tau$  and  $B^0 \rightarrow D^{*-}\tau^+\nu_\mu$  Branching Fractions Using Three-Prong  $\tau$ -Lepton Decays”. *Physical Review Letters*, 2018.  
10.1103/PhysRevLett.120.171802.
15. R. Aaij *et al.* [LHCb Collaboration]. “Test of lepton flavor universality by the measurement of the  $B^0 \rightarrow D^{*-}\tau^+\nu_\tau$  branching fraction using three-prong  $\tau$  decays”. *Physical Review D*, 2018.  
10.1103/PhysRevD.97.072013.
16. R. Aaij *et al.* [LHCb Collaboration]. “Measurement of the Ratio of Branching Fractions  $B(B_c^+ \rightarrow J/\psi\tau^+\nu_\tau)$ ”. *Physical Review Letters*, 2018.  
10.1103/PhysRevLett.120.121801.
17. R. Aaij *et al.* [LHCb Collaboration]. “A measurement of the  $CP$  asymmetry difference between  $\Lambda_c^+ \rightarrow pK^-K^+$  and  $p\pi^+\pi^-$  decays”. *Journal of High Energy Physics*, 2018.  
10.1007/JHEP03(2018)182.
18. R. Aaij *et al.* [LHCb Collaboration]. “First measurement of the  $CP$ -violating phase  $\phi_s^{d\bar{d}}$  in  $B_s^0 \rightarrow (K^+\pi^-)(K^-\pi^+)$  decays”. *Journal of High Energy Physics*, 2018.  
10.1007/JHEP03(2018)140.
19. R. Aaij *et al.* [LHCb Collaboration]. “Measurement of  $CP$  asymmetry in  $B_s^0 \rightarrow D_s^\mp K^\pm$  decays”. *Journal of High Energy Physics*, 2018.  
10.1007/JHEP03(2018)059.
20. R. Aaij *et al.* [LHCb Collaboration]. “Measurements of the branching fractions of  $\Lambda_c^+ \rightarrow p\pi^-\pi^+$ ,  $\Lambda_c^+ \rightarrow pK^-K^+$ , and  $\Lambda_c^+ \rightarrow p\pi^-K^+$ ”. *Journal of High Energy Physics*, 2018.  
10.1007/JHEP03(2018)043.

21. R. Aaij *et al.* [LHCb Collaboration]. “Search for the lepton-flavour violating decays  $B_s^0 \rightarrow e^\pm \mu^\mp$ ”. *Journal of High Energy Physics*, 2018.  
10.1007/JHEP03(2018)078.
22. R. Aaij *et al.* [LHCb Collaboration]. “Measurement of  $CP$  observables in  $B^\pm \rightarrow D^{(*)}K^{pm}$  and  $B^{pm} \rightarrow D^{(*)}\pi^{pm}$  decays”. *Physics Letters, Section B: Nuclear, Elementary Particle and High-Energy Physics*, 2018.  
10.1016/j.physletb.2017.11.070.
23. R. Aaij *et al.* [LHCb Collaboration]. “Search for Dark Photons Produced in 13 TeV pp Collisions”. *Physical Review Letters*, 2018.  
10.1103/PhysRevLett.120.061801.
24. R. Aaij *et al.* [LHCb Collaboration]. “Measurement of branching fractions of charmless four-body  $\Lambda_b^0$  and  $\Xi_b^0$  decays”. *Journal of High Energy Physics*, 2018.  
10.1007/JHEP02(2018)098.
25. R. Aaij *et al.* [LHCb Collaboration]. “First observation of forward  $Z \rightarrow b\bar{b}$  production in  $pp$  collisions at  $s = 8$  TeV”. *Physics Letters, Section B: Nuclear, Elementary Particle and High-Energy Physics*, 2018.  
10.1016/j.physletb.2017.11.066.
26. R. Aaij *et al.* [LHCb Collaboration]. “Search for weakly decaying  $b$ -flavored pentaquarks”. *Physical Review D*, 2018.  
10.1103/PhysRevD.97.032010.
27. R. Aaij *et al.* [LHCb Collaboration]. “Updated determination of  $D^0 - \bar{D}^0$  mixing and  $CP$  violation parameters with  $D^0 \rightarrow K^+\pi^-$ ”. *Physical Review D*, 2018.  
10.1103/PhysRevD.97.031101.
28. R. Aaij *et al.* [LHCb Collaboration]. “Search for excited  $B_c^+$  states”. *Journal of High Energy Physics*, 2018.  
10.1007/JHEP01(2018)138.
29. R. Aaij *et al.* [LHCb Collaboration]. “First observation of  $B^+ \rightarrow D_s^+ K^+ K^-$  decays and a search for  $B^+ \rightarrow D_s^+ \phi$  decays”. *Journal of High Energy Physics*, 2018.  
10.1007/JHEP01(2018)131.
30. R. Aaij *et al.* [LHCb Collaboration]. “First Observation of the Rare Purely Baryonic Decay  $B^0 \rightarrow p\bar{p}$ ”. *Physical Review Letters*, 2017.  
10.1103/PhysRevLett.119.232001.
31. R. Aaij *et al.* [LHCb Collaboration]. “Updated search for long-lived particles decaying to jet pairs”. *European Physical Journal C*, 2017.  
10.1140/epjc/s10052-017-5178-x.
32. R. Aaij *et al.* [LHCb Collaboration]. “Measurement of the shape of the  $\Lambda_b^0 \rightarrow \Lambda_c^+ \mu^- \nu_\mu$  differential decay rate”. *Physical Review D*, 2017.  
10.1103/PhysRevD.96.112005.

33. R. Aaij *et al.* [LHCb Collaboration]. “Measurement of the  $\Upsilon(nS)$  polarizations in  $pp$  collisions at  $\sqrt{s} = 7$  and 8 TeV”. *Journal of High Energy Physics*, 2017. 10.1007/JHEP12(2017)110.
34. R. Aaij *et al.* [LHCb Collaboration]. “Measurement of the  $B_{\pm}$  production cross-section in  $pp$  collisions at 10.1016/j.physletb.2017.11.066 and 13 TeV”. *Journal of High Energy Physics*, 2017. 10.1007/JHEP12(2017)026.
35. R. Aaij *et al.* [LHCb Collaboration]. “Bose-Einstein correlations of same-sign charged pions in the forward region in  $pp$  collisions at  $\sqrt{s} = 7$  TeV”. *Journal of High Energy Physics*, 2017. 10.1007/JHEP12(2017)025.
36. R. Aaij *et al.* [LHCb Collaboration]. “ $\chi_{c1}$  and  $\chi_{c2}$  Resonance Parameters with the Decays  $\chi_{c1,c2} \rightarrow J/\psi\mu+\mu-$ ”. *Physical Review Letters*, 2017. 10.1103/PhysRevLett.119.221801.
37. R. Aaij *et al.* [LHCb Collaboration]. “Measurement of  $B^0$ ,  $B_s^0$ ,  $B^+$  and  $\Lambda_b^0$  production asymmetries in 7 and 8 TeV proton–proton collisions”. *Physics Letters, Section B: Nuclear, Elementary Particle and High-Energy Physics*, 2017. 10.1016/j.physletb.2017.09.023.
38. R. Aaij *et al.* [LHCb Collaboration]. “Prompt and nonprompt  $J/\psi$  production and nuclear modification in  $pPb$  collisions at  $sNN = 8.16$  TeV”. *Physics Letters, Section B: Nuclear, Elementary Particle and High-Energy Physics*, 2017. 10.1016/j.physletb.2017.09.058.
39. R. Aaij *et al.* [LHCb Collaboration]. “Search for Baryon-Number Violating  $\Xi_b^0$  Oscillations”. *Physical Review Letters*, 2017. 10.1103/PhysRevLett.119.181807.
40. R. Aaij *et al.* [LHCb Collaboration]. “Updated branching fraction measurements of  $B_{(s)}^0 \rightarrow K_S^0 h^+ h^-$  decays”. *Journal of High Energy Physics*, 2017. 10.1007/JHEP11(2017)027.
41. R. Aaij *et al.* [LHCb Collaboration]. “LHCb Collaboration”. *Nuclear Physics A*, 2017. 10.1016/S0375-9474(17)30380-9.
42. R. Aaij *et al.* [LHCb Collaboration]. “Measurement of  $CP$  violation in  $B^0 \rightarrow J/\psi K_S^0$  and  $B^0 \rightarrow \psi(2S) K_S^0$  decays”. *Journal of High Energy Physics*, 2017. 10.1007/JHEP11(2017)170.
43. R. Aaij *et al.* [LHCb Collaboration]. “Measurement of  $CP$  observables in  $B^{\pm} \rightarrow DK^{*\pm}$  decays using two- and four-body  $D$  final states”. *Journal of High Energy Physics*, 2017. 10.1007/JHEP11(2017)156.



44. R. Aaij *et al.* [LHCb Collaboration]. “Study of  $b\bar{b}$  correlations in high energy proton-proton collisions”. *Journal of High Energy Physics*, 2017.  
10.1007/JHEP11(2017)030.
45. R. Aaij *et al.* [LHCb Collaboration]. “Observation of  $D^0$  Meson Decays to  $\pi^+\pi^-\mu^+\mu^-$  and  $K^+K^-\mu^+\mu^-$  Final States”. *Physical Review Letters*, 2017.  
10.1103/PhysRevLett.119.181805.
46. R. Aaij *et al.* [LHCb Collaboration]. “Improved limit on the branching fraction of the rare decay  $K_S^0 \rightarrow \mu^+\mu^-$ ”. *European Physical Journal C*, 2017.  
10.1140/epjc/s10052-017-5230-x.
47. R. Aaij *et al.* [LHCb Collaboration]. “Erratum to: Measurement of the  $J/\psi$  pair production cross-section in  $pp$  collisions at  $\sqrt{s} = 13$  TeV”. *Journal of High Energy Physics*, 2017.  
10.1007/JHEP10(2017)068.
48. R. Aaij *et al.* [LHCb Collaboration]. “Study of prompt  $D^0$  meson production in  $pPb$  collisions at  $\sqrt{sNN} = 5$  TeV”. *Journal of High Energy Physics*, 2017.  
10.1007/JHEP10(2017)090.
49. R. Aaij *et al.* [LHCb Collaboration]. “Observation of the Doubly Charmed Baryon  $\Xi_{cc}^{++}$ ”. *Physical Review Letters*, 2017.  
10.1103/PhysRevLett.119.112001.
50. R. Aaij *et al.* [LHCb Collaboration]. “Measurement of  $B_s^0$  and  $D_s^-$  Meson Lifetimes”. *Physical Review Letters*, 2017.  
10.1103/PhysRevLett.119.101801.
51. R. Aaij *et al.* [LHCb Collaboration]. “Study of charmonium production in  $b$ -hadron decays and first evidence for the decay  $B_s^0$ ”. *European Physical Journal C*, 2017.  
10.1140/epjc/s10052-017-5151-8.
52. R. Aaij *et al.* [LHCb Collaboration]. “Observation of the Decays  $\Lambda_b^0 \rightarrow \chi_{c1}pK^-$  and  $\Lambda_b^0 \rightarrow \chi_{c1}pK^-$ ”. *Physical Review Letters*, 2017.  
10.1103/PhysRevLett.119.062001.
53. R. Aaij *et al.* [LHCb Collaboration]. “Test of lepton universality with  $B^0 \rightarrow K^{*0}l^+l^-$  decays”. *Journal of High Energy Physics*, 2017.  
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