

Research Area 2: Updates

Decays of bottom, charm, and strange quarks

13.07.2026, Siegen
CmF General Assembly

Sally Stefkova
Thomas Mannel



List of RA2 projects

We received 18 different funding project applications:

- RA2-1: B Decays with multi-hadron final states (Hanhart, Kubis, Mannel)
- RA2-2: Excited Lambda spectrum in rare B decays (Albrecht, Thoma)
- RA2-3: Unraveling the D^{**} (Hanhart, Kubis, Neubert, Prim)
- RA2-4: QED Corrections in Bottom decays (Albrecht, Mannel)
- RA2-5: Charming Darwin (Albrecht, Bernlochner, Lenz)
- RA2-6: Combined BelleII and LHCb Wilson Coefficient analysis (for CC semileptonics) (Albrecht, Bernlochner, Prim)
- RA2-7: Phenomenology of Bs to 4 leptons (Albrecht, Stamou)
- RA2-8: Vxb (Bernlochner, Dingfelder)
- RA2-9: Light Cone distribution amplitudes of B hadrons (Feldmann, Gubernari)
- RA2-10: Analytic Properties of the charm contribution in b to s II (Gubernari, Kubis)
- RA2-11: Semi-inclusive semileptonic B decays (Mannel, Prim)
- RA2-12: CPV in hadronic D decays (Feldmann, Hiller, Lenz, Mitzel)
- RA2-13: Constraining NP in rare semileptonic charm decays (Hiller, Mitzel)
- RA2-14: $R(D^*)$ with semileptonic tagging (Prim)
- RA2-15: Charm decays with invisibles (Hiller, Stefkova)
- RA2-16: Inclusive Semileptonic decay rates of B and Bs mesons (Garofalo, Gross, Ubrach)
- RA2-17: Flavor Structure in Axion models and generic extension with light NP (Feldmann, Stamou, Stefkova)
- RA2-18: Beyond the Standard Model effects in tree-level B decays (Albrecht, Lenz)

RA2 Working Model

6 cross-functional teams

1. FCNC SL(charm loops; connection with RA1)

- **Mulder, Gubernari**
- **Projects:** RA2-2, RA2-10, RA2-7

2. Charm physics (hadronic + SL)

- **Hiller, Mitzel**
- **Projects:** RA2-5, RA-12, RA2-13, RA2-15

3. CC SL decays ($V_{ub} V_{cb}$, $R(D^{(*)})$)

- **Mannel, Prim**
- **Projects:** RA2-3, RA2-8, RA2-11, RA2-14, RA2-16, RA2-9, RA2-4

4. Hadronic Multi-body

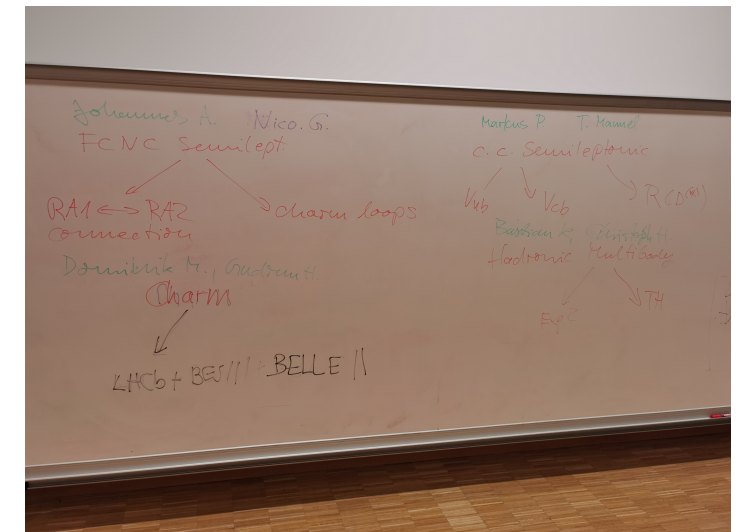
- **Kubis, Hanhart**
- **Project:** RA2-1

5. Light NP (connection with RA4)

- **Stamou, Stefkova**
- **Project:** RA2-17 (Merge with RA4 or 6)

6. WET EFT Fits

- **Kroninger, Hiller, Feldmann, Bechtle**
- **RA2-6 (Merge?)**



RA2 hybrid meeting @ Bonn

Hybrid meeting with (most) cross-functional project leads took place on 28.4.2026:

- [Physics discussions](#) across the 6 cross-functional teams
- Different approach on running the CFTs:
 - CFT1 Nico would like to initiate spontanar
 - CFT2 Dominik & Gurdrun have already Charm-in-dor and they would likely continue in that format
 - CFT3 Markus & Thomas would only like to meet at the RA2 level and do not consider adding additional meetings

RA2 meeting: CFT kick-off			
Úterý 28. 4. 2026 12:30 → 17:00 Europe/Berlin			
Käthe-Kümmel-Str. 1/2.052 (ROT) - Seminar Room (ROT)			
Popis Zoom link: https://uni-bonn.zoom-x.de/j/61081187196?pwd=BBJY3rx8tK0W4f50G0wb6a8opli5dy.1			
12:30	→ 12:45	Introduction	⌚ 15min
Introduction_CFT...			
12:45	→ 13:30	CFT1	⌚ 45min
Přednášející: Mick Mulder (TU Dortmund), Nico Gubernari			
CRF1.pdf			
13:30	→ 14:15	CFT2	⌚ 45min
Přednášející: Dominik Mittel, Gurdrun Hiller			
14:15	→ 15:00	CFT3	⌚ 45min
Přednášející: Markus Prim, Thomas Mannel			
15:00	→ 15:15	Break	⌚ 15min
15:15	→ 16:00	CFT4, CFT5, CFT6	⌚ 45min
Přednášející: Bastian Kubis (HISK, Bonn University), Christoph Hanhart, Christoph Hanhart (uni-bonn), Emmanuel Stamou (TU Dortmund), Gurdrun Hiller, Slavomira Stefkova (PI)			
CFT5KickOffMeet... hanhart_merged... Kubis_RA2-28042...			
16:00	→ 17:00	Discussion + Next Steps	⌚ 1h

In the next slides news since 1.1.2026, so including the discussions from hybrid meeting!

CFT1 FCNC SL Decay News

Topic	Experiment /Theory	Project Connection	Status	New personpower	Paper
Search for $b \rightarrow s/d$ ν $\bar{\nu}$ decays (Stefkova)	Belle II	$b \rightarrow s \ell \ell$	WIP; frequent reports at experimental working group		-
Excited Lambda spectrum in rare B decays (Albrecht, Thoma)	LHCb	RA2-2	WIP; Presented in Amplitude Analysis forum (April 10) on $L^* \rightarrow pK$ resonances + application at LHCb to $Lb \rightarrow pK$ (J/ψ , γ , $\mu\mu$) decays	Will start hiring for $Lb \rightarrow pK\mu\mu$ Run 3 analysis, second half of this year	-
Light Cone distribution amplitudes of B hadrons (Feldmann, Gubernari)	Theory	RA2-9	Progress documented in paper	-	https://arxiv.org/abs/2606.20267
Analytic Properties of the charm contribution in b to $s \ell \ell$ (Gubernari, Kubis)	Theory	RA2-10	Progress documented in paper	-	https://arxiv.org/abs/2604.01284
Dispersive analysis of D- and B-meson form factors with chiral and heavy-quark constraints (Kubis)	Theory		Progress documented in paper		https://link.springer.com/article/10.1140/epjc/s10052-026-15758-1

CFT2 Charm Decay News

Topic	Experiment /Theory	Project Connection	Status	New personpower	Paper
CPV in hadronic decays: (D. Mitzel): $A_{CP}(D \rightarrow KK)$	LHCb	RA2-12	WIP	-	-
Rare SL charm decays: (D. Mitzel): Null tests and Hadronic Spectra in $D \rightarrow hll$, $L_c \rightarrow pll$	LHCb	RA2-13	WIP; CmF partner Jüttner shows interest in rare charm on the lattice: 2603.15487	-	-
Charm decays with invisibles : Probing baryon number with missing energy: $\Lambda_c \rightarrow \pi, K + \text{inv}$ (G. Hiller)	Theory	RA2-15	Progress documented in paper; presented by A.Mohamed (Siegen) with a talk at the Flavorful FCC-ee workshop , June 26, CERN	-	https://arxiv.org/abs/2602.15936

Other meetings with many CmF participants: charmindor, flavor at FCC-ee workshop

CFT3 CC SL Decays News

Topic	Experiment /Theory	Project Connection	Status	New personpower	Paper
Semi inclusive B to DX l nu (Prim)	Belle II	RA2-11	Starting	New master student starting October, new postdoc will be hired	
New SL R(D*) (Prim)	Belle II	RA2-14	Starting		
B to mu nu (Bernlochner, Prim, Dingfelder)	Belle II	Leptonic decays	Published		PRD 113, 112012
Hadronic R(D*) and Ptau (Bernlochner, Prim, Dingfelder)	Belle II	R(D*)	To be presented at ICHEP 2026		

Meetings:

First LHCb-Belle II-Theory meeting scheduled for 24.7 on SL B to D l nu**

Workshop Challenges in SL decays, PBH Bad Honnef, 13.-15.4.2026

CFT4 Hadronic MultiBody Decays News

Topic	Experiment /Theory	Project Connection	Status	New personpower	Paper
Understanding Large Localized CP Violation in $B^\pm \rightarrow K^\pm \pi^+ \pi^-$ Using Dispersive Methods (Kubis, Hanhart)	Theory	RA2-1	Progress Reported in paper		PRL 136, 111901

CFT5 Light NP News

Topic	Experiment /Theory	Project Connection	Status	New personpower	Paper
Constraints on $B \rightarrow K$ invisible from $B \rightarrow K \nu \bar{\nu}$ measurement (Stefkova)	Belle II	RA2-17	Progress Reported in paper		https://arxiv.org/abs/2602.09666
Optimised search for $B \rightarrow K$ invisible (Stefkova)	Belle II	RA2-17	Starting	Will hire PhD student in September	
Charm decays with invisibles : Probing baryon number with missing energy: $\Lambda_c \rightarrow \pi, K + \text{inv}$ (G. Hiller)	Theory	RA2-15	Progress documented in paper; presented by A.Mohamed (Siegen) with a talk at the Flavorful FCC-ee workshop , June 26, CERN	-	https://arxiv.org/abs/2602.15936

CFT6 Global Fits News

Topic	Experiment /Theory	Project Connection	Status	New personpower	Paper
Combined Belle II-LHCb b to c tau nu study published (Prim, Bernlochner, Albrecht)	Belle II/LHCb	RA2-6	Progress Reported in paper		https://arxiv.org/abs/2604.00735

Some selected Highlights

Joint LHCb–Belle II Prospects to Constrain New Physics in $B \rightarrow D^{(*)}\tau\nu$

Johannes Albrecht¹, Florian Bernlochner², Marco Colonna¹, Lorenz Gärtner³, Abhijit Mathad⁴, Biljana Mitreska⁵, Markus Prim², Ilias Tsaklidis²

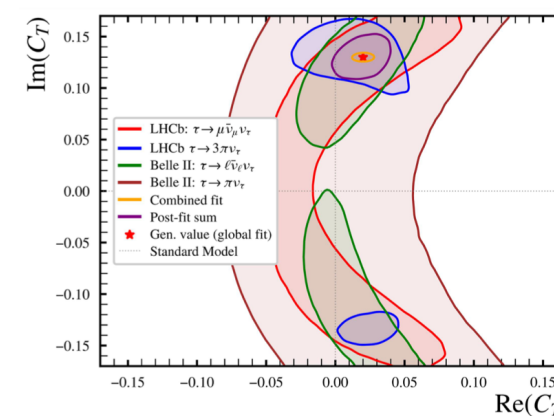
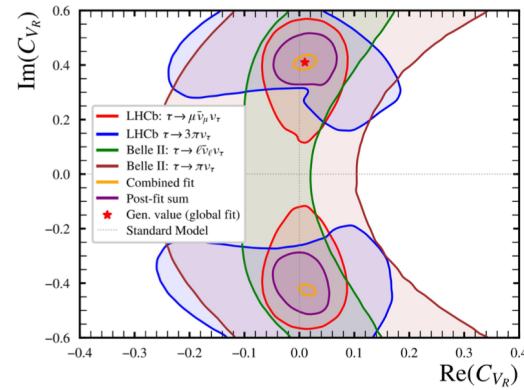
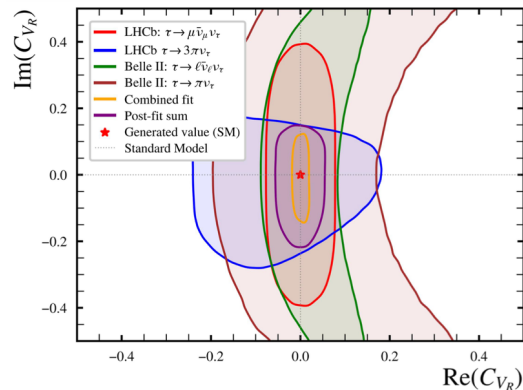
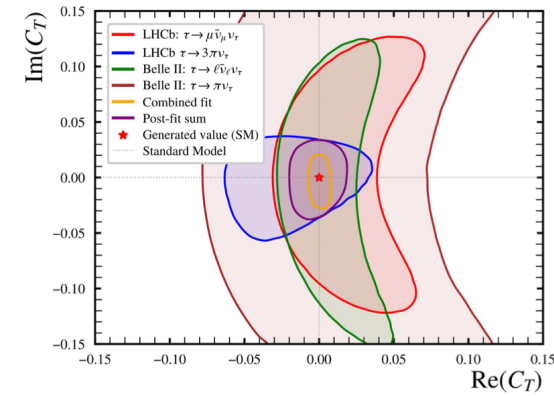
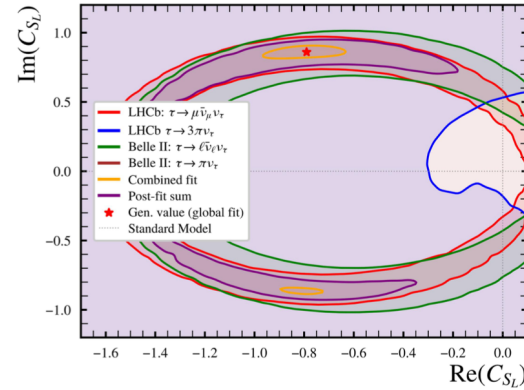
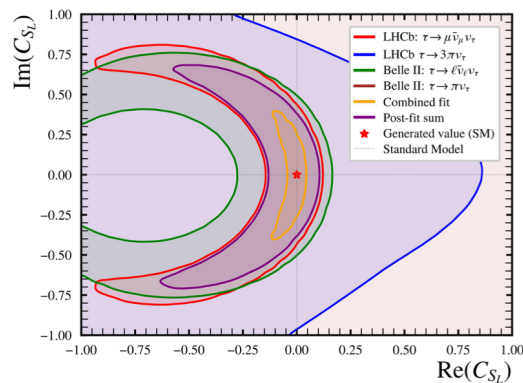
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³LMU Munich, Munich, Germany

⁴CERN, Geneva, Switzerland

⁵Department of Physics and Astronomy, University of Manchester, Manchester, United Kingdom



Some selected Highlights

Understanding large localized CP violation in $B^\pm \rightarrow K^\pm \pi^+ \pi^-$ using dispersive methods

L. A. Heuser^{a,1,*}, A. Reyes-Torrecilla^{a,2,†}, C. Hanhart^{a,3}

B. Kubis^{a,1}, P. C. Magalhães^{a,4}, T. Mannel^{a,5}, and J. R. Peláez^{a,2,1}

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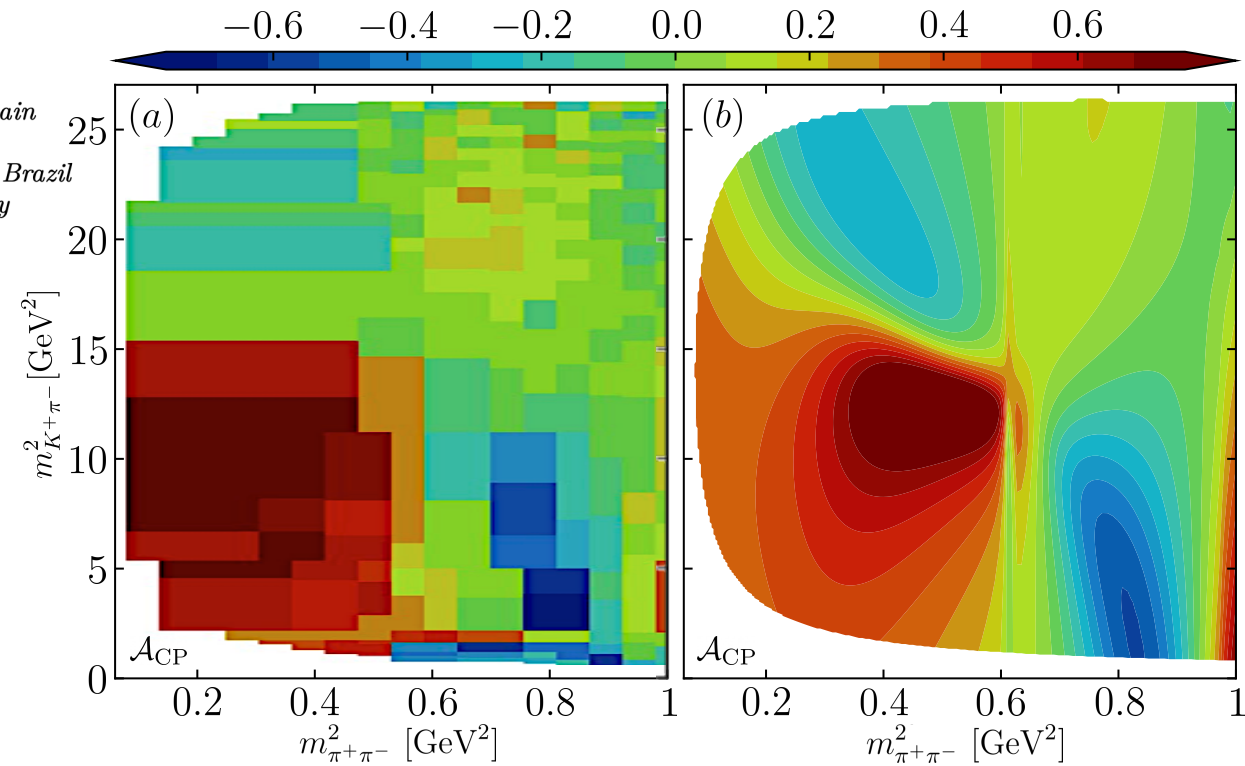
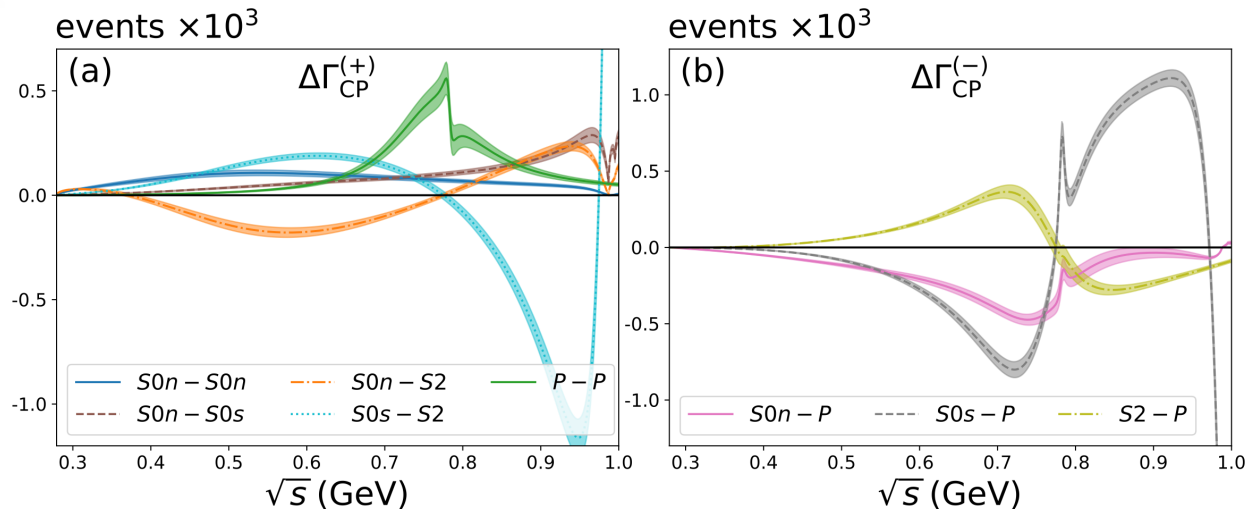
²Departamento de Física Teórica and IPARCOS, Universidad Complutense de Madrid, 28040 Madrid, Spain

³Institute for Advanced Simulation (IAS-4), Forschungszentrum Jülich, 52425 Jülich, Germany

⁴Departamento de Raios Cósmicos e Cronologia, Universidade Estadual de Campinas 13083-860, Campinas, Brazil

⁵Center of Particle Physics (CPPS), Theoretische Physik 1, Universität Siegen, 57068 Siegen, Germany

We utilize the universality of pion-pion ($\pi\pi$) final-state interactions at small invariant masses to understand the enhanced localized CP violation in $B^\pm \rightarrow K^\pm \pi^+ \pi^-$, using a dispersive approach. From a fit to the integrated CP-asymmetry data, we successfully predict the Dalitz-plot kinematic distribution of the asymmetry in the low-energy $\pi\pi$ region, including the large localized CP violation recently observed by LHCb. An essential role is played by the contributions of isospin 2. This formalism, whose parameters have a physical meaning, can be adapted straightforwardly to other systems with CP violation enhanced by final-state interactions.



Some selected Highlights

Three-particle di-light-cone distribution amplitudes of the B -meson in heavy-quark effective theory

Riccardo Bartocci^{a,b}, Philipp Böer^c, Thorsten Feldmann^d,
Max Ferré^e, Nico Gubernari^f, Daniel Vladimirov^d

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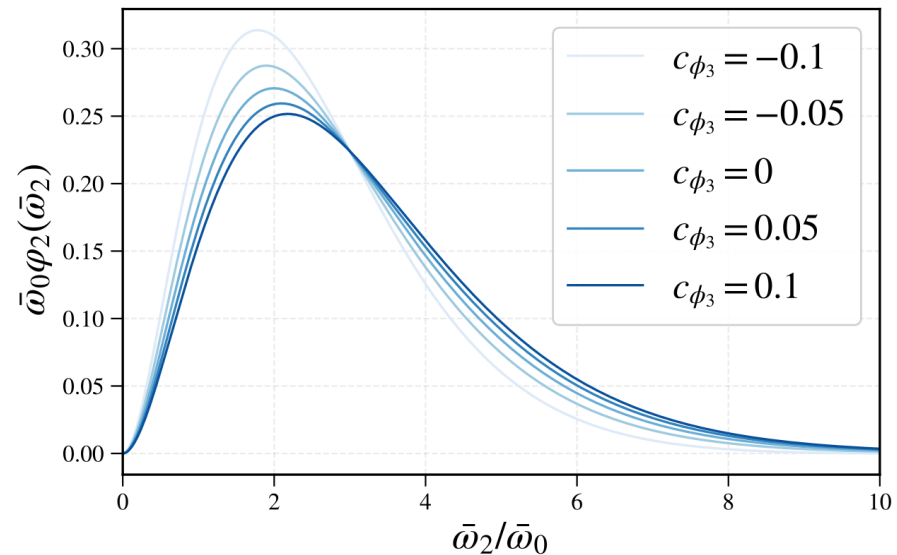
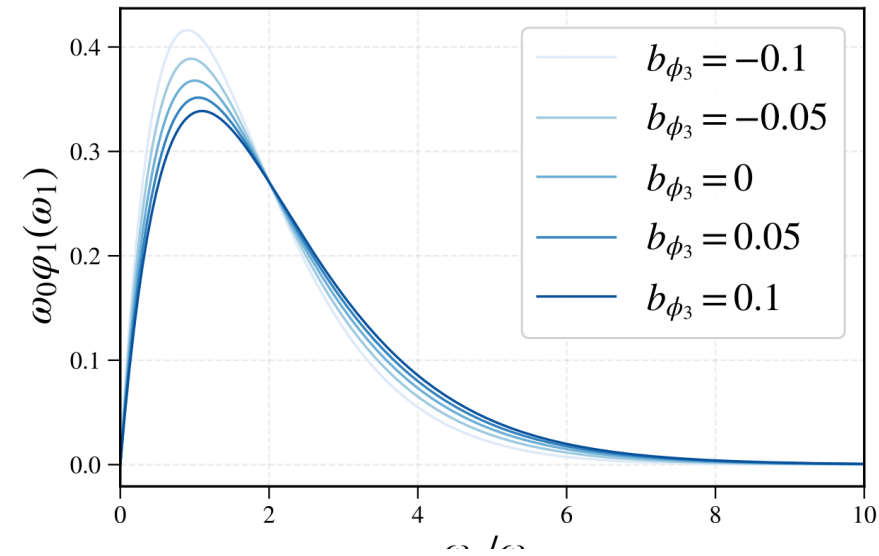
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Outlook

- Work has started in most of the CFTs
- CFT5 (Light NP) and CFT6 (WET Fits) have links to other RAs:
To be established
- CFT4 needs an experimental connection:
To be established

Back-up

Selected Projects and Funds Allocation

Research Area 2

	PI	Short Title	Personnel (FTE)	Recommended Duration (month)	Total FTE	Comments
RA2-2	Albrecht, Thoma	Excited Lambda spectrum in rare B decays	0,67	36	2,00	Albrecht 100%
RA2-6	Albrecht, Prim, Bernlochner	Combined Belle II and LHCb Wilson Coefficient analysis (for CC semileptonics)	1,00	6	0,50	Bernlochner 100%
RA2-7	Albrecht, Stamou	Phenomenology of Bs to 4 leptons	0,67	36	2,00	Stamou 100%
RA2-8	Bernlochner, Dingfelder	Precision Measurements of $ V_{ub} $ and $ V_{cb} $ with Exclusive and Inclusive Semileptonic decays	1,00	36	3,00	Bernlochner 50%, Dingfelder 50%
RA2-12	Feldmann, Hiller, Mitzel, Lenz	CPV in hadronic D decays	1,00	24	2,00	Lenz 75%, Feldmann 25%
RA2-13	Hiller, Mitzel	Constraining NP in rare semileptonic charm decays	0,67	36	2,00	Mitzel 100%
RA2-16	Garofolo, Gross, Urbach	Inclusive Semileptonic decay rates of B and Bs mesons	0,67	36	2,00	Urbach 100%
RA2-17	Feldmann, Stamou, Stefkova	Flavor Structure in Axion models and generic extension with light NP	0,67	36	2,00	Stefkova 100%

+RA2-1 will be funded via different sources

RA2 Working Model

(Online) meetings for CFTs and RA2:

- **CFTs:** Depending on the project stage / theory- experiment interplay the CFT leads should decide on the intensity. We plan to create an RA2 Indico category where CFTs within RA2 will be listed as subcategories.
- **RA2 bi-monthly meeting:** Discuss general progress (conveners+CFT leads) to understand/monitor progress of different CFTs.

In-person meetings for RA2:

- We would like to have once-a-year F2F meeting for RA2 ideally coupled to the official CmF meeting. Options include booking a half-day either before or after the CmF meetings to review project status if the general CmF meetings already do not have this on agenda.

Mailing lists:

- **RA2 mailing list:** If you wish to receive news about RA2, please subscribe to the mailing list (cmf-ra2@listen.uni-bonn.de). If you see your colleagues missing just share the link with him/her/them.
- **CFTs mailing lists:** CFT leads will be responsible for creating these and kick-starting the meetings