Starterkit 2019

Physics at LHCb

Mat Charles (Sorbonne Université / LPNHE, CERN)

Somehow, all of this in 15-20 min:

- LHCb's structure and organisation
- Tools and processes -- stuff you need to know
- The physics we do (er, if time for physics)

Physics working groups

- Analysis work happens in physics analysis working groups
- Most have subgroups
  - Example: Charm has a subgroup for rare charm decays
- After your home institute, the WG/subgroup is your first point of contact for help and advice.
- You should present your analysis to the WG/subgroup from time to time for advice and feedback.
- When your analysis is nearly ready, the WG will be the first to review it.

QCD, Electroweak and Exotica

B hadrons and Quarkonia

Charm physics

Rare decays

B decays to Charmonia

B decays to Open Charm

Charmless b-hadron decays

Semileptonic decays

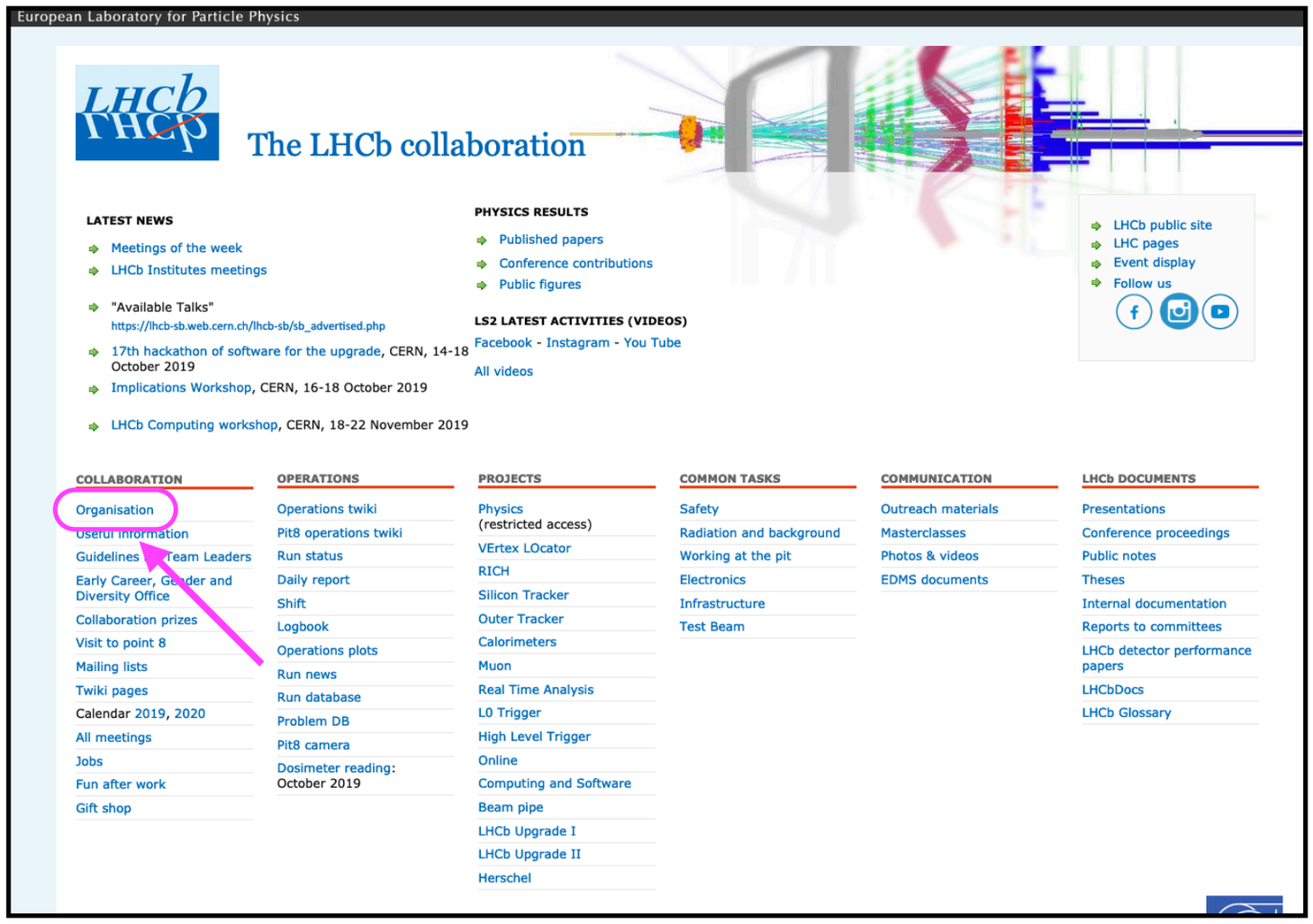
Ions and Fixed Target

Physics working groups

- As well as physics analysis working groups, there are also physics performance working groups:
  - Run 1-2 performance
  - Flavour tagging
  - Luminosity
  - Simulation
- ... plus other groups:
  - Stripping (offline data filtering)
  - Statistics
  - Amplitude analysis
  - Early measurements task force
- They have expertise in particular areas.
- Analysis WGs have liaisons with most of these who can help you.
  - e.g. the Charm WG has simulation liaisons to help you prepare MC requests

Physics working groups

- The WGs and subgroups are organised by their convenors.
- To find who the convenor of a group is, go to:



LHCb homepage > Organisation

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LHCb homepage > Organisation > Structure

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Physics Planning Group		
Physics Coordinator	Matt Charles	
Deputy Physics Coordinator	Johannes Albrecht	
Spokesperson	Giovanni Passaleva	
Deputy Spokesperson	Chris Parkes	
CB Chair	Val Gibson	
RTA	Vladimir Gligorov	
Computing PL	Concezio Bozzi	
Operations Coordinator	Silvia Borghi	
EB Chair	Patrick Koppenburg	
Physics analysis working group conveners		
For LHCb Physics History & Sub-structure see here		
QCD, Electroweak & Exotica	Olli Lupton Stephen Farry	
Rare Decays	Flavio Archilli Simone Bifani	
B Decays to	Seyda Esen	

LHCb homepage > Organisation > Structure > Substructure

Physics working groups

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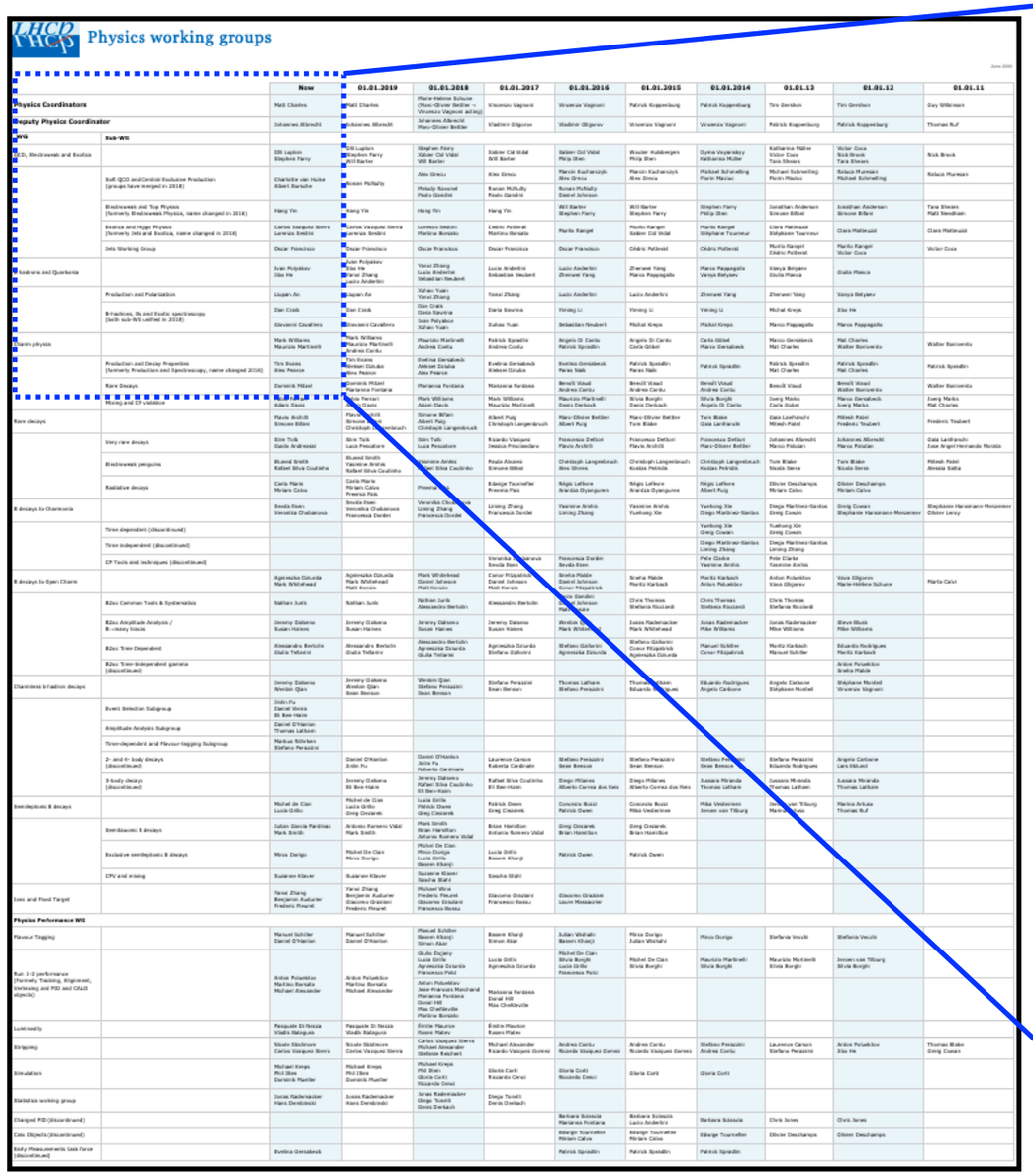
Physics working groups

		Now	01.01.2019	01.01.2018	01.01.2017	01.01.2016	01.01.2015	01.01.2014	01.01.13	01.01.12	01.01.11
Physics Coordinators		Matt Charles	Matt Charles	Pierre-Hélène Schune (Marc-Olivier Bettler → Vincenzo Vagnoni acting)	Vincenzo Vagnoni	Vincenzo Vagnoni	Patrick Koppenburg	Patrick Koppenburg	Tim Gershon	Tim Gershon	Guy Wilkinson
Deputy Physics Coordinator		Johannes Albrecht	Johannes Albrecht	Johannes Albrecht Marc-Olivier Bettler	Vladimir Gligorov	Vladimir Gligorov	Vincenzo Vagnoni	Vincenzo Vagnoni	Patrick Koppenburg	Patrick Koppenburg	Thomas Ruf
WG	Sub-WG										
QCD, Electroweak and Exotica		Olli Lupton Stephen Farry	Olli Lupton Stephen Farry	Stephen Farry Xabier Cid Vidal Will Barter	Xabier Cid Vidal Will Barter	Xabier Cid Vidal Philip Ilten	Wouter Hulsbergen Philip Ilten	Dyma Veybitskiy Katharina Müller	Katharina Müller Victor Coco Tara Shears	Victor Coco Nick Brook Tara Shears	Nick Brook
	Soft QCD and Central Exclusive Production (groups have merged in 2018)	Charlotte van Hulse Albert Bursche	Charlotte van Hulse Albert Bursche	Alex Grecu Philip Ilten	Alex Grecu	Marcin Kucharczyk Alex Grecu	Marcin Kucharczyk Pierre Marage	Michael Schmelling Pierre Marage	Michael Schmelling Marcin Misiura	Rebeca Gonzalez Suarez Michael Schmelling	Rebeca Gonzalez Suarez
	Electroweak and Top Physics (formerly Electroweak Physics, name changed in 2016)	Hang Yin	Hang Yin	Hang Yin	Hang Yin	Will Barter Stephen Farry	Will Barter Stephen Farry	Stephen Farry Philip Ilten	Jonathan Anderson Simone Bifani	Jonathan Anderson Simone Bifani	Tara Shears Matt Needham
	Exotica and Higgs Physics (formerly Jets and Exotica, name changed in 2016)	Carlos Vazquez Sierra Lorenzo Sestini	Carlos Vazquez Sierra Lorenzo Sestini	Lorenzo Sestini Martina Borsato	Cedric Potterat Martina Borsato	Mario Rangel Xabier Cid Vidal	Mario Rangel Stephane Tourneur	Clara Matteuzzi Stéphane Tourneur	Clara Matteuzzi	Clara Matteuzzi	Clara Matteuzzi
	Jets Working Group	Oscar Francisco	Oscar Francisco	Oscar Francisco	Oscar Francisco	Oscar Francisco	Cédric Potterat	Cédric Potterat	Mario Rangel Cédric Potterat	Mario Rangel Victor Coco	Victor Coco
B hadrons and Quarkonia		Ivan Polyakov Jibo He	Ivan Polyakov Jibo He Yanxi Zhang Lucio Anderlini Sebastian Neubert	Yanxi Zhang Lucio Anderlini Sebastian Neubert	Lucio Anderlini Sebastian Neubert	Lucio Anderlini Zhenwei Yang Marco Pappagallo	Zhenwei Yang Marco Pappagallo	Marco Pappagallo Vanya Belyaev	Vanya Belyaev Giulia Manca	Giulia Manca	
	Production and Polarization	Liupan An	Liupan An	Xuhao Yuan Yanxi Zhang	Yanxi Zhang	Lucio Anderlini	Lucio Anderlini	Zhenwei Yang	Zhenwei Yang	Vanya Belyaev	
	B-hadrons, Bc and Exotic spectroscopy (both sub-WG unified in 2018)	Dan Craik Giovanni Cavallero	Dan Craik Giovanni Cavallero	Dan Craik Gioia Saverina	Daria Savrina	Yiming Li	Yiming Li	Yiming Li	Michal Kreps	Jibo He	
				Xuhao Yuan	Xuhao Yuan	Sebastian Neubert	Michal Kreps	Michal Kreps	Marco Pappagallo	Marco Pappagallo	
Charm physics		Mark Williams Maurizio Martinelli	Mark Williams Maurizio Martinelli Andrea Contu	Maurizio Martinelli Andrea Contu	Patrick Spradlin Andrea Contu	Angelo Di Canto Patrick Spradlin	Angelo Di Canto Carla Gobel	Carla Gobel Marco Gersabeck	Marco Gersabeck Mat Charles	Mat Charles Walter Bonivento	Walter Bonivento
	Production and Decay Properties (formerly Production and Spectroscopy, name changed 2016)	Tim Evans Alex Pearce	Tim Evans Alex Pearce	Evelina Gersabeck Aleksei Dzialas Alex Pearce	Evelina Gersabeck Aleksei Dzialas	Evelina Gersabeck Ferran Nath	Patrick Spradlin Ferran Nath	Patrick Spradlin	Patrick Spradlin Mat Charles	Patrick Spradlin Mat Charles	Patrick Spradlin
	Rare Decays	Dominik Mitzel	Dominik Mitzel	Marianna Fontana	Marianna Fontana	Benoit Viaud Andrea Contu	Benoit Viaud Andrea Contu	Benoit Viaud	Benoit Viaud Walter Bonivento	Walter Bonivento	
Rare decays		Adam Davis	Adam Davis	Mark Williams Adam Davis	Mark Williams Maurizio Martinelli	Maurizio Martinelli Denis Derkach	Silvia Borghi Denis Derkach	Silvia Borghi Angelo Di Canto	Joerg Marks Carla Gobel	Marco Gersabeck Joerg Marks	Joerg Marks Mat Charles
	Very rare decays	Elvio Tolk Dario Andreotti	Elvio Tolk Luca Pescatore	Simone Bifani Albert Puig Christoph Langenbruch	Albert Puig Christoph Langenbruch	Albert Puig	Christoph Langenbruch	Christoph Langenbruch Kostas Petridis	Tom Blake Gaia Lanfranchi	Mitesh Patel Frederic Teubert	Frederic Teubert
	Radiative decays	Carla Marin Miriam Calvo Francesca Fiore	Carla Marin Miriam Calvo Francesca Fiore	Francesca Dordei	Albert Puig Francesca Dordei	Albert Puig Arantza Oyanguren	Albert Puig	Albert Puig	Miriam Calvo	Olivier Deschamps Miriam Calvo	Olivier Deschamps Miriam Calvo
B decays to Charmonia		Sneha Nair Veronika Chobanova	Sneha Nair Veronika Chobanova Francesca Dordei	Veronika Chobanova Liming Zhang Francesca Dordei	Liming Zhang Francesca Dordei	Yasmine Amhis Liming Zhang	Yasmine Amhis Yuehong Xie	Yuehong Xie Diego Martinez Santos	Diego Martinez Santos Greig Cowan	Greig Cowan Stephanie Hansmann-Menzemer	Stephanie Hansmann-Menzemer Olivier Leroy
	Time dependent (discontinued)							Yuehong Xie Greig Cowan	Yuehong Xie Greig Cowan		
	Time independent (discontinued)							Diego Martinez Santos Liming Zhang	Diego Martinez Santos Liming Zhang		
	CP Tools and techniques (discontinued)				Veronika Chobanova Sneha Nair	Francesca Dordei Sneha Nair		Pete Clarke Yasmine Amhis	Pete Clarke Yasmine Amhis		
B decays to Open Charm		Agnieszka Dziurda Mark Whitehead Matt Kenzie	Agnieszka Dziurda Mark Whitehead Matt Kenzie	Mark Whitehead Daniel Johnson Matt Kenzie	Conor Fitzpatrick Daniel Johnson Matt Kenzie	Sneha Malde Daniel Johnson Conor Fitzpatrick	Sneha Malde Moritz Karbach	Moritz Karbach Anton Poluektov	Anton Poluektov Vava Gligorov	Vava Gligorov Marie-Hélène Schune	Marta Calvi
	B2cc Common Tools & Systematics	Nathan Jurik	Nathan Jurik	Nathan Jurik Alessandro Bertolin	Alessandro Bertolin	Marco Gersabeck Matthew Kenzie	Chris Thomas Stefania Vecchi	Chris Thomas Stefania Vecchi	Chris Thomas Stefania Vecchi		
	B2cc Amplitude Analysis / B→Hhhh Modes	Jeremy Dalseno Susan Haines	Jeremy Dalseno Susan Haines	Jeremy Dalseno Susan Haines	Jeremy Dalseno Susan Haines	Wenbin Qian Mark Whitehead	Jonas Rademacker Mark Whitehead	Jonas Rademacker Mike Williams	Jonas Rademacker Mike Williams	Steve Blusk Mike Williams	
	B2cc Time Dependent	Alessandro Bertolin Giulia Tellarini	Alessandro Bertolin Giulia Tellarini	Alessandro Bertolin Agnieszka Dziurda Giulia Tellarini	Agnieszka Dziurda Stefano Gallorini	Stefano Gallorini Agnieszka Dziurda	Stefano Gallorini Conor Fitzpatrick Agnieszka Dziurda	Manuel Schiller Conor Fitzpatrick	Manuel Schiller Moritz Karbach	Eduardo Rodrigues Moritz Karbach	
	B2cc Time-Independent gamma (discontinued)									Anton Poluektov Sneha Malde	
Charmless b-hadron decays		Jeremy Dalseno Wenbin Qian Sean Benson	Jeremy Dalseno Wenbin Qian Sean Benson	Wenbin Qian Stefano Perazzini Sean Benson	Stefano Perazzini Sean Benson	Thomas Latham Stefano Perazzini	Thomas Latham Eduardo Rodrigues	Eduardo Rodrigues Angelo Carbone	Angelo Carbone Stéphane Monteil	Stéphane Monteil Vincenzo Vagnoni	
	Event Selection Subgroup	Jixin Fu Daniel Vieira El Bay-Haris									
	Amplitude Analysis Subgroup	Daniel O'Hanlon Thomas Latham									
	Time-dependent and Flavour-tagging Subgroup	Markus Röhrken Stefano Perazzini									
	2- and 4- body decays (discontinued)		Daniel O'Hanlon Jixin Fu	Daniel O'Hanlon Jixin Fu Roberta Cardinale	Laurence Carson Roberta Cardinale	Stefano Perazzini Sean Benson	Stefano Perazzini Sean Benson	Stefano Perazzini Sean Benson	Stefania Perazzini Eduardo Rodrigues	Angelo Carbone Lars Eklund	
	3-body decays (discontinued)		Jeremy Dalseno El Bay-Haris	Jeremy Dalseno Rafael Silva Coutinho El Bay-Haris	Rafael Silva Coutinho El Bay-Haris	Diego Milanes Alberto Correa dos Reis	Diego Milanes Alberto Correa dos Reis	Jussara Miranda Thomas Latham	Jussara Miranda Thomas Latham	Jussara Miranda Thomas Latham	
Semileptonic B decays		Michel de Cian Lucia Grillo Greig Cowan	Michel de Cian Lucia Grillo Greig Cowan	Lucia Grillo Patrick Owen Greig Cowan	Patrick Owen Greig Cowan	Conor Fitzpatrick Patrick Owen	Conor Fitzpatrick Mika Vesterinen	Mika Vesterinen Jeroen van Tilburg	Jeroen van Tilburg Marco Pappagallo	Marina Artuso Thomas Ruf	
	Semileptonic B decays	Julien Garcia Pardinas Mark Smith	Antonio Romero Vidal Mark Smith	Mark Smith Brian Hamilton Antonio Romero Vidal	Brian Hamilton Antonio Romero Vidal	Greig Cowan Brian Hamilton	Greig Cowan Brian Hamilton	Greig Cowan			
	Exclusive semileptonic B decays	Mirco Dorigo	Michel De Cian Mirco Dorigo	Michel De Cian Mirco Dorigo Lucia Grillo Basem Khanji	Lucia Grillo Basem Khanji	Patrick Owen	Patrick Owen				
	CPV and mixing	Suzanne Klaver	Suzanne Klaver	Suzanne Klaver Sascha Stahl	Sascha Stahl						
Loss and Fixed Target		Yanxi Zhang Benjamin Audurier Frederic Fleuret	Yanxi Zhang Benjamin Audurier Giacomo Graziani Frederic Fleuret	Michael Wing Frederic Fleuret Giacomo Graziani Francesco Bossu	Giacomo Graziani Francesco Bossu	Giacomo Graziani Laure Massacrier					
Physics Performance WG											
Flavour Tagging		Manuel Schiller Daniel O'Hanlon	Manuel Schiller Daniel O'Hanlon	Manuel Schiller Basem Khanji Simon Akar	Basem Khanji Simon Akar	Julian Wishahi Basem Khanji	Mirco Dorigo Julian Wishahi	Mirco Dorigo	Stefania Vecchi	Stefania Vecchi	
Run 1-2 performance (formerly Tracking, Alignment, Vertexing and PID and CALO aspects)		Anton Poluektov Martino Borsato Michael Alexander	Anton Poluektov Martino Borsato Michael Alexander	Giulia Dujany Lucia Grillo Agnieszka Dziurda Francesco Polci Anton Poluektov Jean-François Marchand Marianna Fontana Alex Pearce Max Chefdeville Martino Borsato	Marianna Fontana Daniel Hill Max Chefdeville	Lucia Grillo Agnieszka Dziurda Francesco Polci	Michel De Cian Silvia Borghi Lucia Grillo Francesco Polci	Michel De Cian Silvia Borghi	Maurizio Martinelli Silvia Borghi	Maurizio Martinelli Silvia Borghi	Jeroen van Tilburg Silvia Borghi		
Luminosity		Pasquale Di Nezza Khalil Bahgoura	Pasquale Di Nezza Khalil Bahgoura	Emilie Maurice Xuan Mates	Emilie Maurice Xuan Mates	Andrea Contu Ricardo Vazquez Gomez	Andrea Contu Ricardo Vazquez Gomez	Andrea Contu	Andrea Contu	Andrea Contu	Thomas Blake Greig Cowan
Simulation		Michael Kreps Phil Ilten Dominik Mueller	Michael Kreps Phil Ilten Dominik Mueller	Michael Kreps Phil Ilten Gloria Corti Riccardo Cenci	Gloria Corti Riccardo Cenci	Gloria Corti Riccardo Cenci	Gloria Corti	Gloria Corti			
Statistics working group		Jonas Rademacker Hans Dembinski	Jonas Rademacker Hans Dembinski	Jonas Rademacker Diego Tuzelli Denis Derkach	Diego Tuzelli Denis Derkach						
Charged PID (discontinued)						Barbara Sciascia Marianna Fontana	Barbara Sciascia Lucio Anderlini	Barbara Sciascia	Chris Jones	Chris Jones	
Calo Objects (discontinued)						Edwige Tournefier Miriam Calvo	Edwige Tournefier Miriam Calvo	Edwige Tournefier	Olivier Deschamps	Olivier Deschamps	
Early Measurements task force (discontinued)		Bettina Gerstenlenk				Patrick Spradlin	Patrick Spradlin	Patrick Spradlin			

		Now
Physics Coordinators		Matt Charles
Deputy Physics Coordinator		Johannes Albrecht
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	Rare Decays	Dominik Mitzel

LHCb homepage > Organisation > Structure > Substructure

WG and subgroup convenors

- If you're not sure who to ask or how to get started with something, the WG or subgroup convenors are always a good place to start.
- They might not know the answer -- but they probably know who the right person to ask is.
- They can also help with admin questions, like:
  - How and when can I present my analysis to the WG?
  - How do I get some more simulated events generated?
  - How do analysis reviews work? What do I need to do?
  - How do I get a talk at a conference?
  - Is it okay to show this plot in a conference?
  - I've written some conference proceedings -- are they okay?
- If you have procedural worries about your analysis, talk to your WG convenor (and supervisor)
  - Example: if another group is working on something similar and you're worried about overlaps/collisions.

The bigger structure

In LHCb, the WG convenors report to the physics coordinator (PC) team:


Mat Charles (PC)
Johannes Albrecht (Deputy PC)

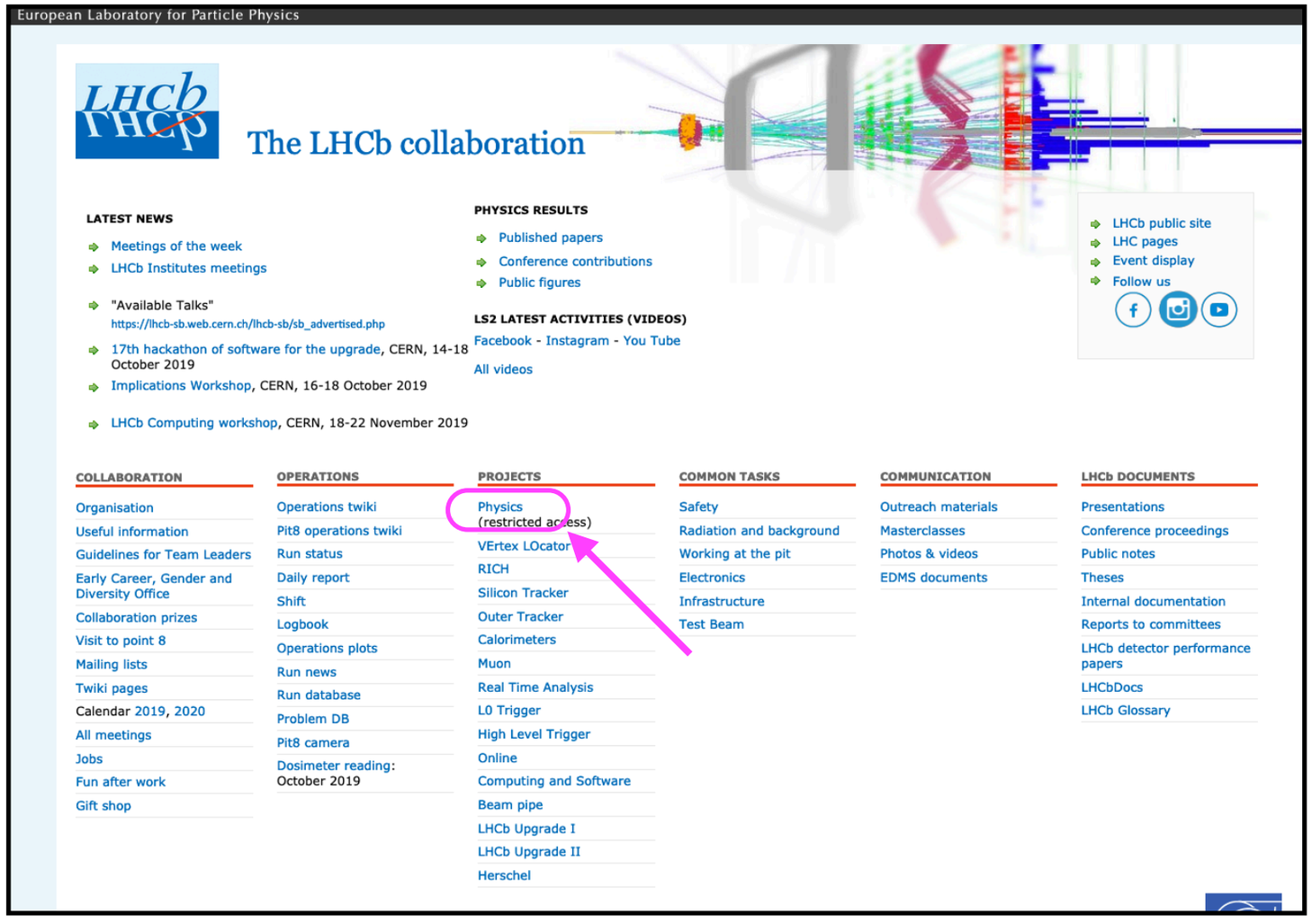
You'll see/hear us at the weekly Tuesday meetings, and at collaboration weeks. We report to the Spokesperson (SP) team:


Giovanni Passaleva (SP)
Chris Parkes (Deputy SP)

You'll also need to interact with the Editorial Board (EB) and the Speakers' Bureau (SB):


Patrick Koppenburg (EB chair)
Stefania Ricciardi (SB chair)

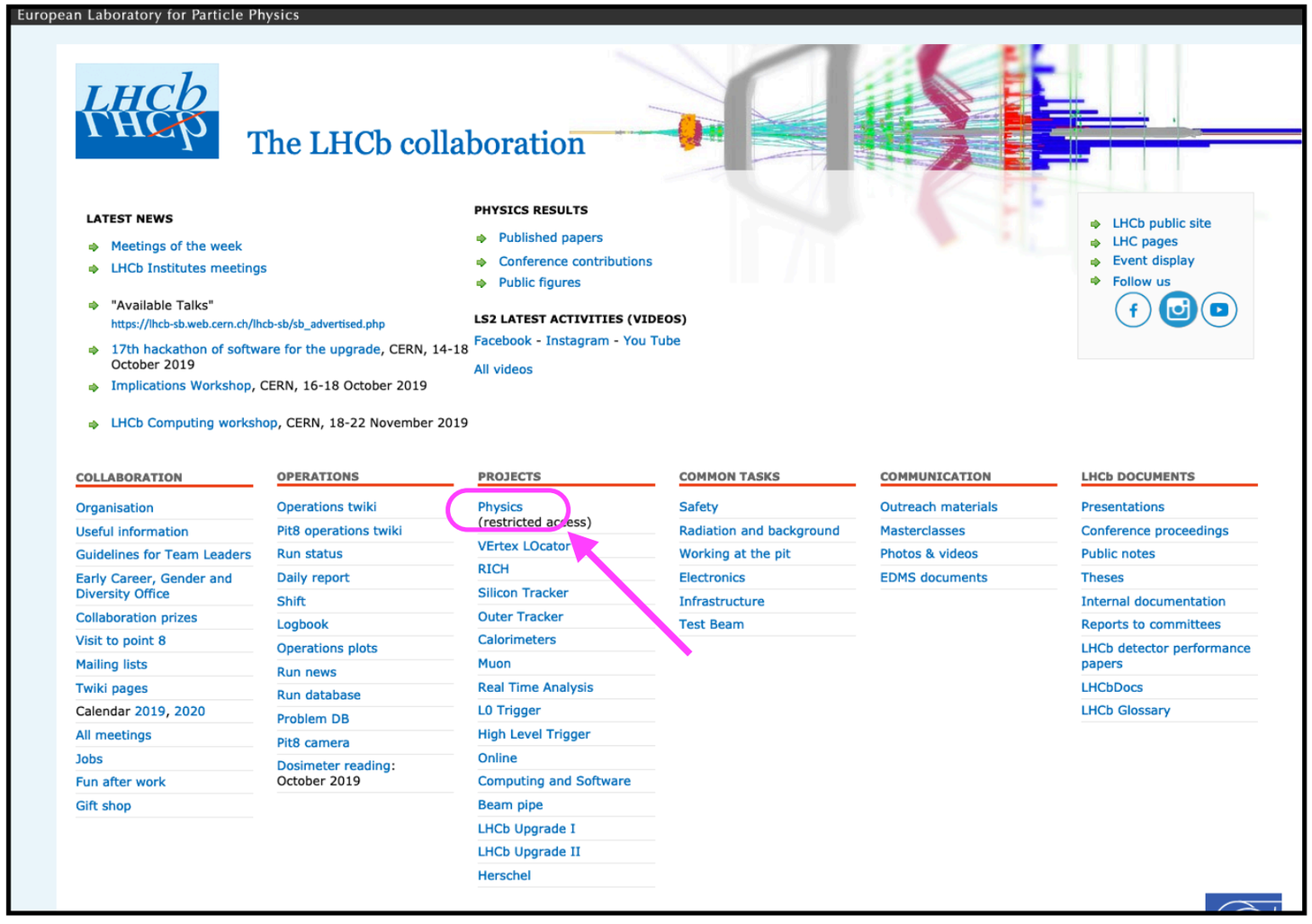
Some useful resources



- The Physics twiki is a hub page and has links to each of the WGs plus other resources.
- There's a lot of information here.
- Some of that information is out of date...

LHCb homepage > Physics

Some useful resources



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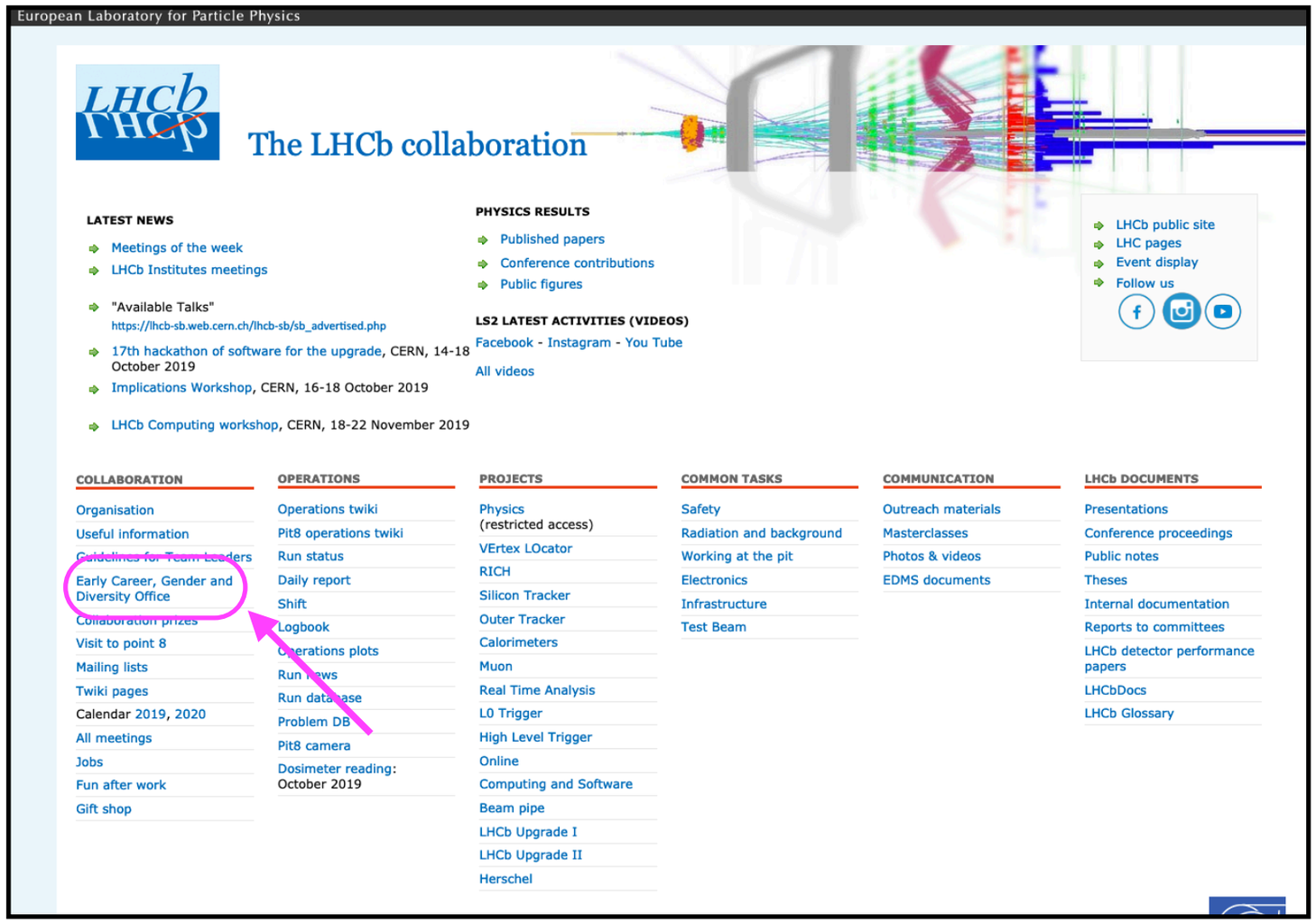
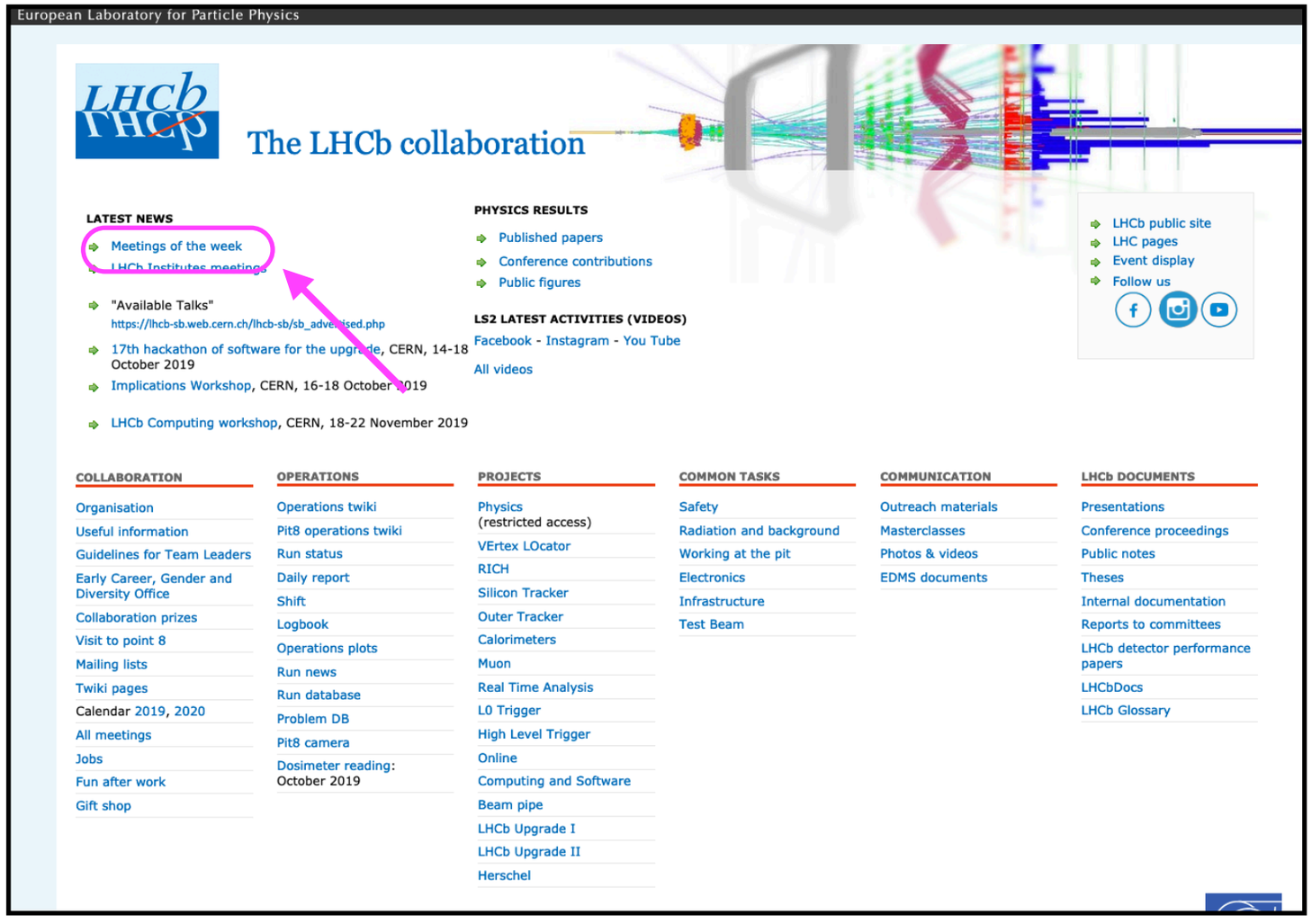


- ECGD page -- see next talk!

LHCb homepage > Early Career, Gender and Diversity Office

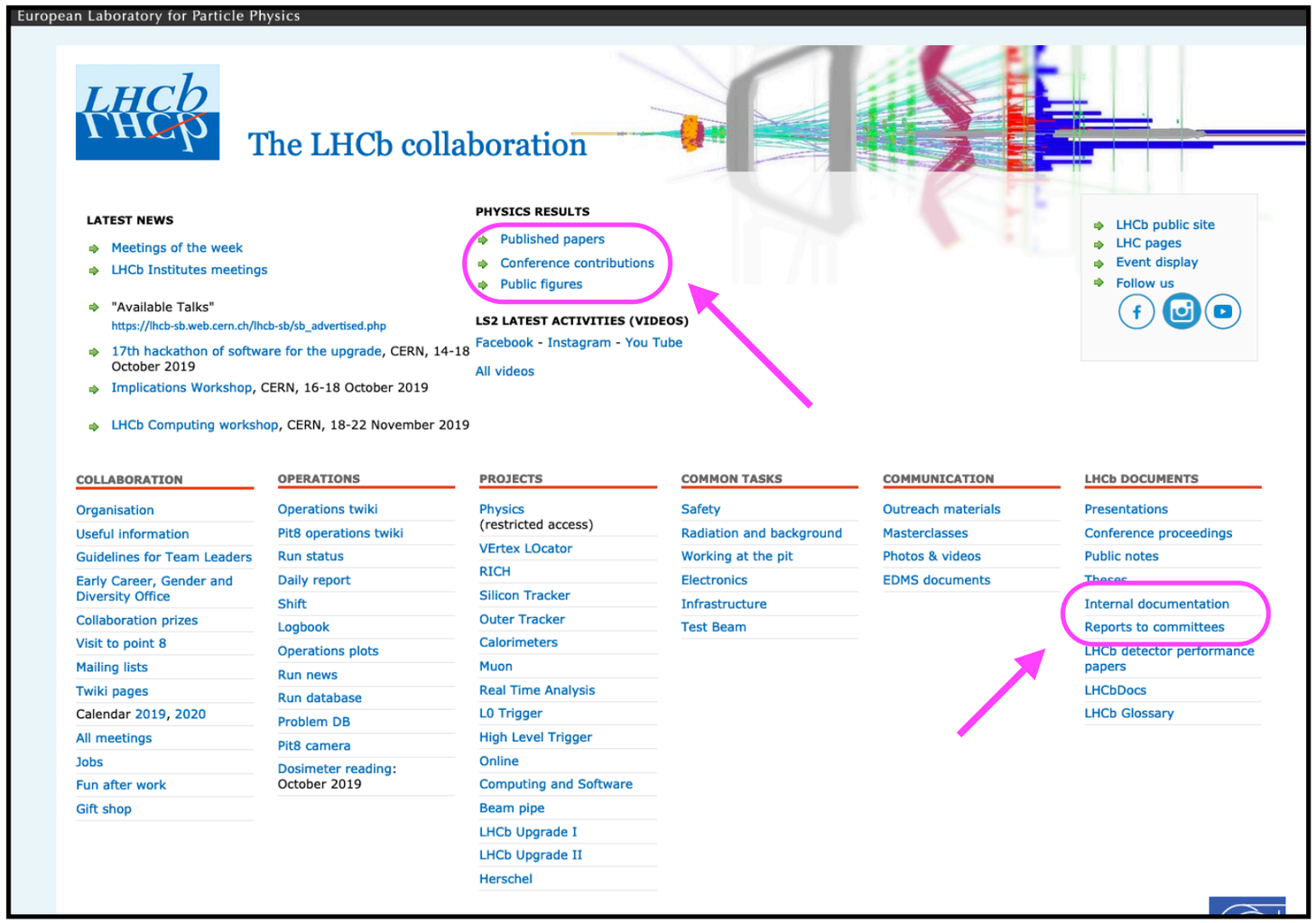
Some useful resources



- Meetings of the week: a quick way to check what's going on.
- Lets you see (e.g.) where and when your WG is meeting.
- There are many meetings; don't try to go to them all.
- But do please go to the Tuesday meeting, to keep up with news from the collaboration.

LHCb homepage > Meetings of the week

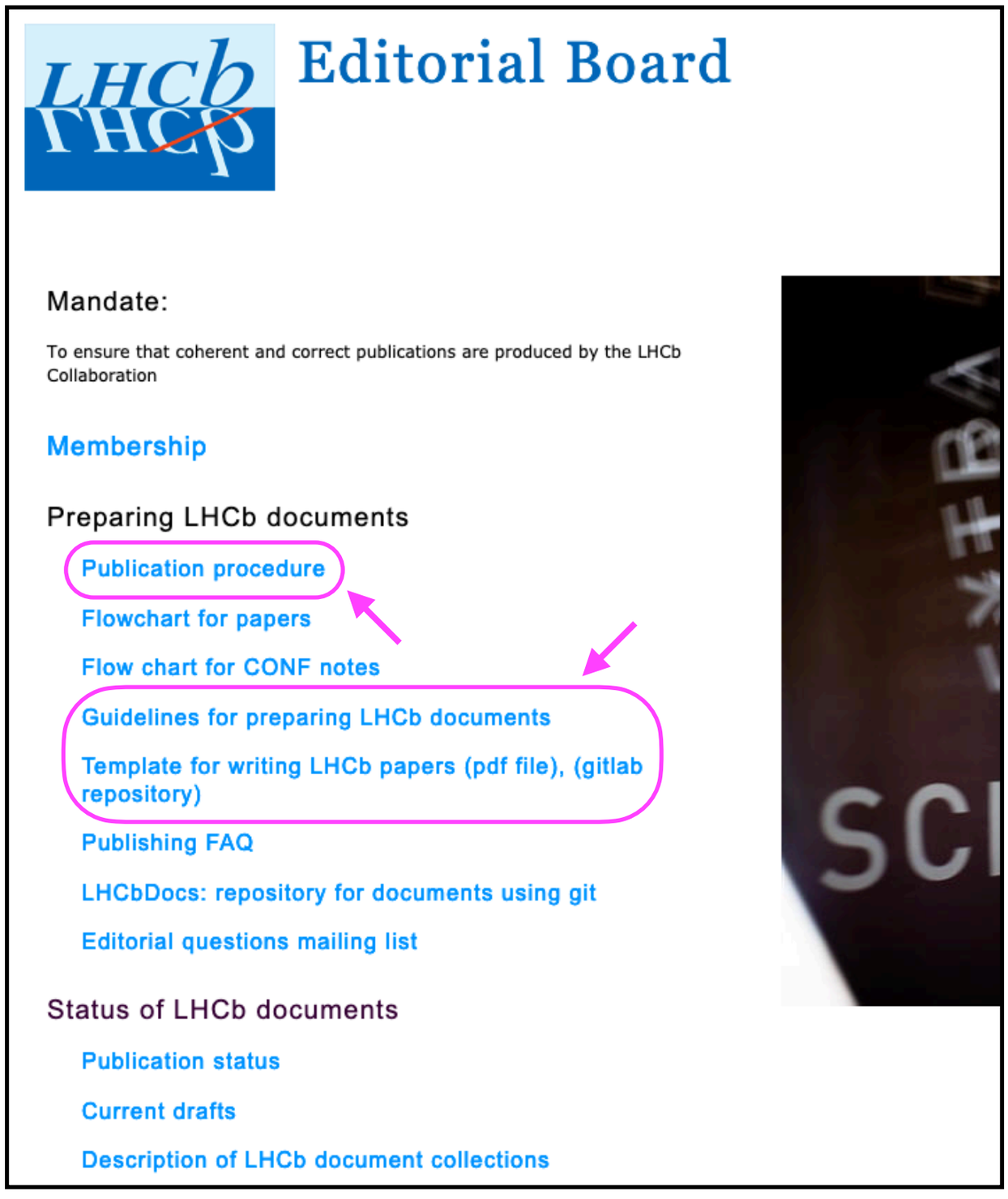
Some useful resources



[LHCb homepage]

- The public lists of PAPER, CONF, FIGURE* documents show all analysis results we've published.
- The "Reports to committees" link (then "Documents produced for the LHCC") has all the Technical Design Reports that document our detector.
- The "Internal Documentation" has all finished analysis notes.

Some useful resources



- The EB page explains how to turn your analysis into a paper and get it published.
- Lots of useful resources there for when it's time to start writing.
- Also templates for your analysis note etc.
- The "Publication status" link will let you see a list of analyses under review.
- Speaking of which...

LHCb homepage > Organisation > Editorial Board

Analysis review

There are quite a few steps, but basically:

1. You work on your analysis, presenting regularly to the working group and listening to feedback.
2. You document it in an analysis note (ANA). To get an ANA number, just ask the Secretariat.
3. When it's ready, you talk to the WG convenors and they will explain how to go through a WG review.
4. When the WG is happy with the analysis, they sign off. The PC team appoints a Review Committee of two people.
5. The RC reviews the analysis.
6. As the RC review converges, you write it up as a paper (PAPER) or conference note (CONF). An EB reviewer will be assigned to help with the editing.
7. After they sign off, you do an approval to go to PAPER (or CONF) presentation to the collaboration.
8. The draft is circulated to the collaboration for 1-2 weeks.
9. Further iterations with the EB. Eventually: you submit it!

How long does it take?

- It varies a lot, depending on what you need, how complex the analysis is, etc.
  - If you need a fresh stripping or a huge amount of simulated events, that can add a long delay.
- To do the analysis and write a complete ANA may take 6-12 months. Longer for a complex analysis, maybe less if you're fast.
- The WG review may take a month or two
- The RC review may take 3-6 months (to approval-to-go-to-PAPER)
- Then about another 2 months of collaboration-wide circulations and editing before it's ready to submit.
- ... that's a long time!
- But you can work on analysis #2 while #1 is in review.

Some bits of advice

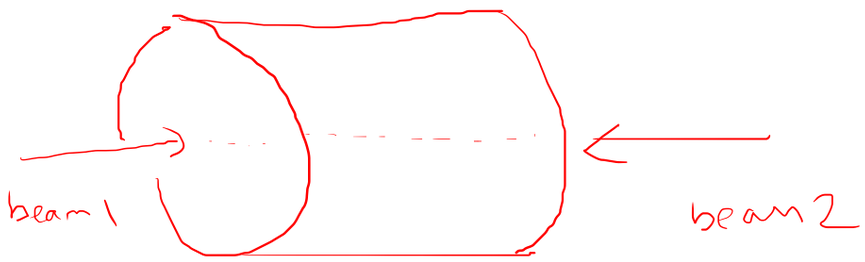
- Be critical of your own work. Test things even if they should obviously be true. If something looks odd, try to understand it (for sure before asking for a review).
- If you spot a problem in the data, talk the relevant WG liaison and (if need be) PPWG. If it's something new, help them understand and fix it.
- Within LHCb, everything is open. But only approved results can be shown outside LHCb. If in any doubt which is which, talk to your WG convenor.
  - Especially for analyses in progress, and especially especially hot ones.
  - This applies on Twitter and WhatsApp just as much as at Moriond.
- Follow some reviews so you'll understand how it works when it's your turn
- Request simulation ahead of time, and plan for stripping/trigger lines waaay ahead of time.

Some bits of advice

- Play nice. Nobody "owns" an analysis -- but if you want to work on something that another group is working, or plans to, talk to them (and to the WG convenors).
  - Corollary: it's good to talk to the convenors before starting a new analysis in case someone is working on it that you're not aware of.
- Be considerate with resources and with other people's time.
  - But don't be afraid to ask for something you truly need.
- Try to code in a clear, easy-to-understand, hard-to-mess-up way. Future you will thank you for it.
  - Use toy simulation to check it's doing what you think it is.
  - Unit tests can be useful too.
  - For many analyses, CPU time is cheaper than physicist time.
- Systematics will take a lot of work and some pain. Try to think through the full analysis chain and see how you can test each assumption. Don't sweat the small stuff: if it's way subdominant, you don't need to compute the uncertainty precisely.

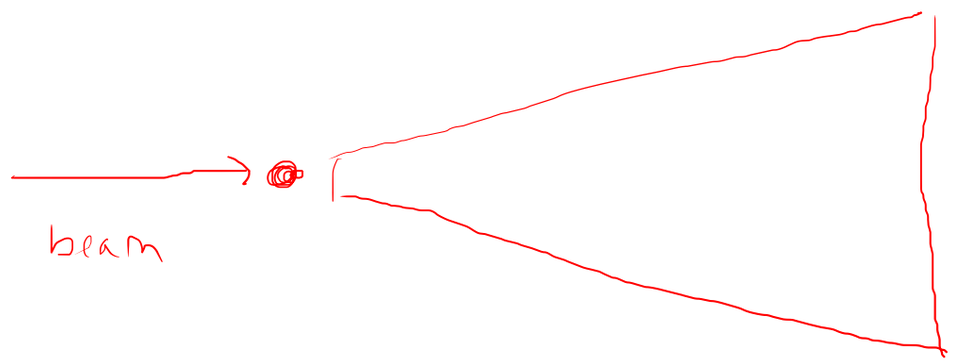
Why LHCb looks the way it does

Classic GPD, Belle/BaBar etc:



Fixed target experiment

(e.g. FOCUS, SELEX)



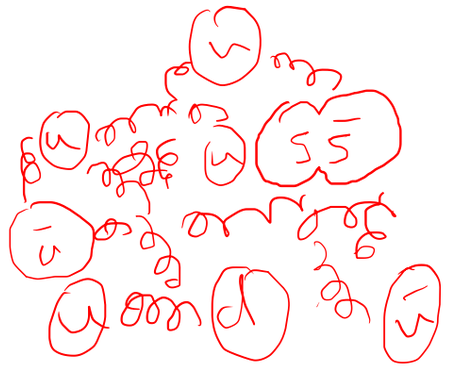
Q) Why are most people working on collider experiments rather than fixed target?

Q) Why does LHCb look like a fixed-target experiment?

Inside the proton

Model: 

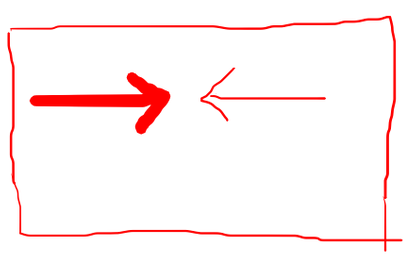
(works surprisingly well!)

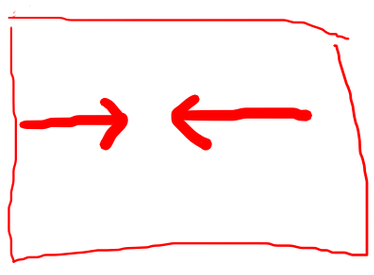
Reality (HERA, ...) : 

- Jolly gluons, $q\bar{q}$ pairs (mostly carrying a small fraction of proton's mom.)

Parton Distribution Functions

$\Rightarrow$ many more soft partons, a few hard ones

Common: 
lower $\sqrt{s}$, forward boost
LHCb

Rare: 
higher $\sqrt{s}$, central events
CMS, ATLAS