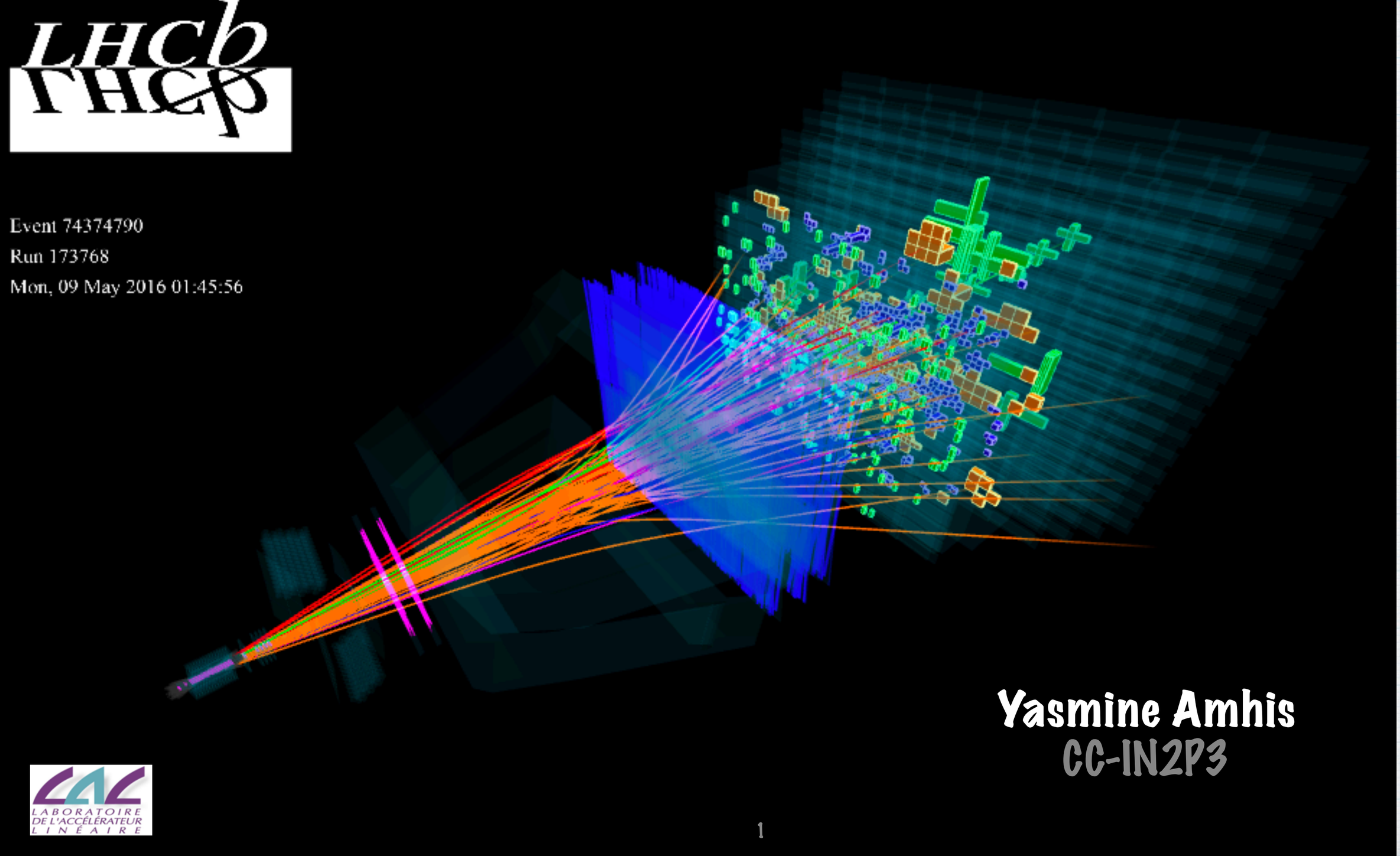


Yasmine Amhis
CC-IN2P3

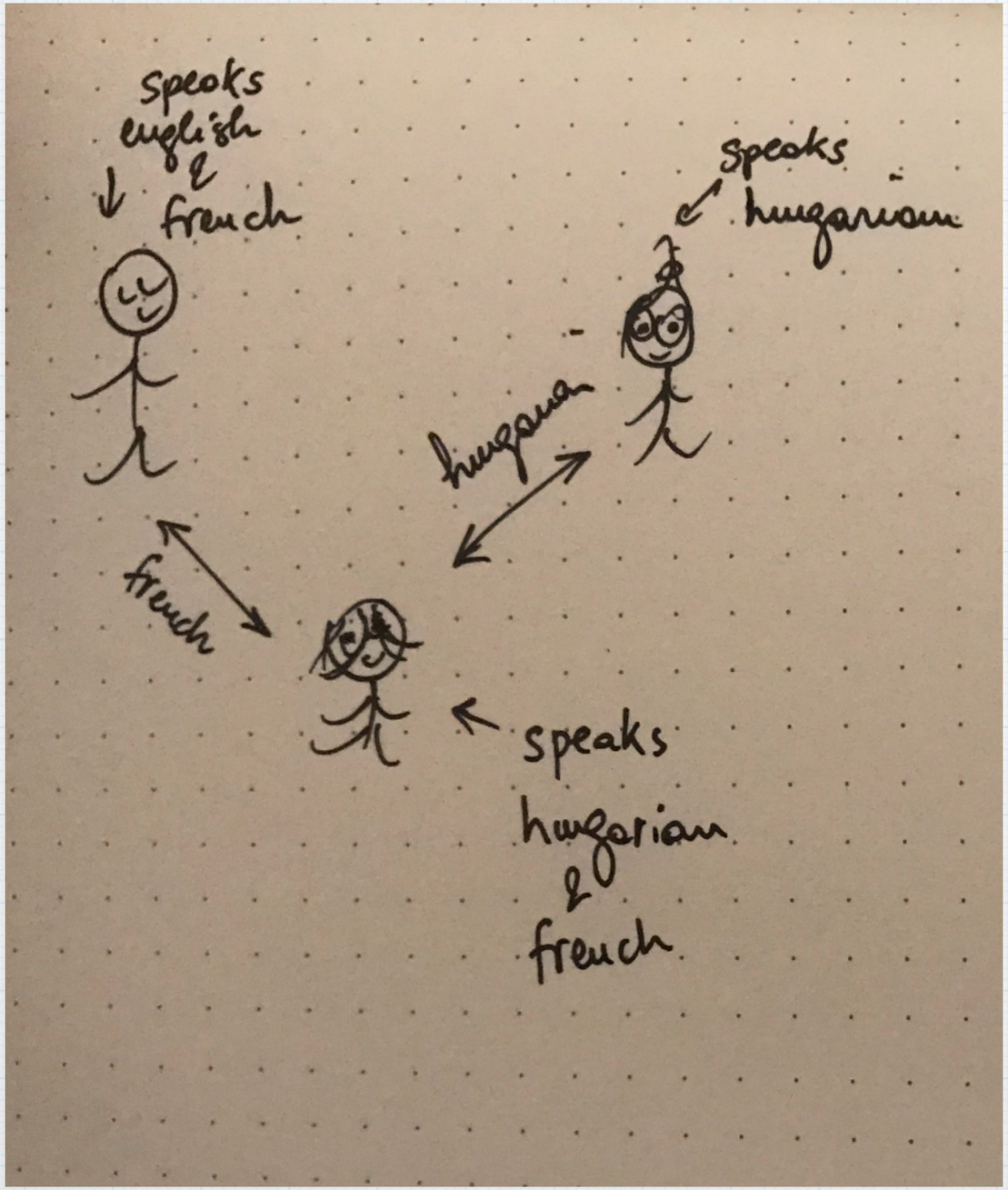
Let's start with some questions

1. What are the elementary constituents of matter?

2. What holds them together?

3. What is the correct mathematical framework to describe how the constituents are put together to form matter, how do they interact with each other and how can one predict its behavior under different conditions?

The Standard Model gives us
Almost a complete picture



Language : type of interaction

The knowledge of language :

Quantum numbers.

words that are exchanged :

Bosons.

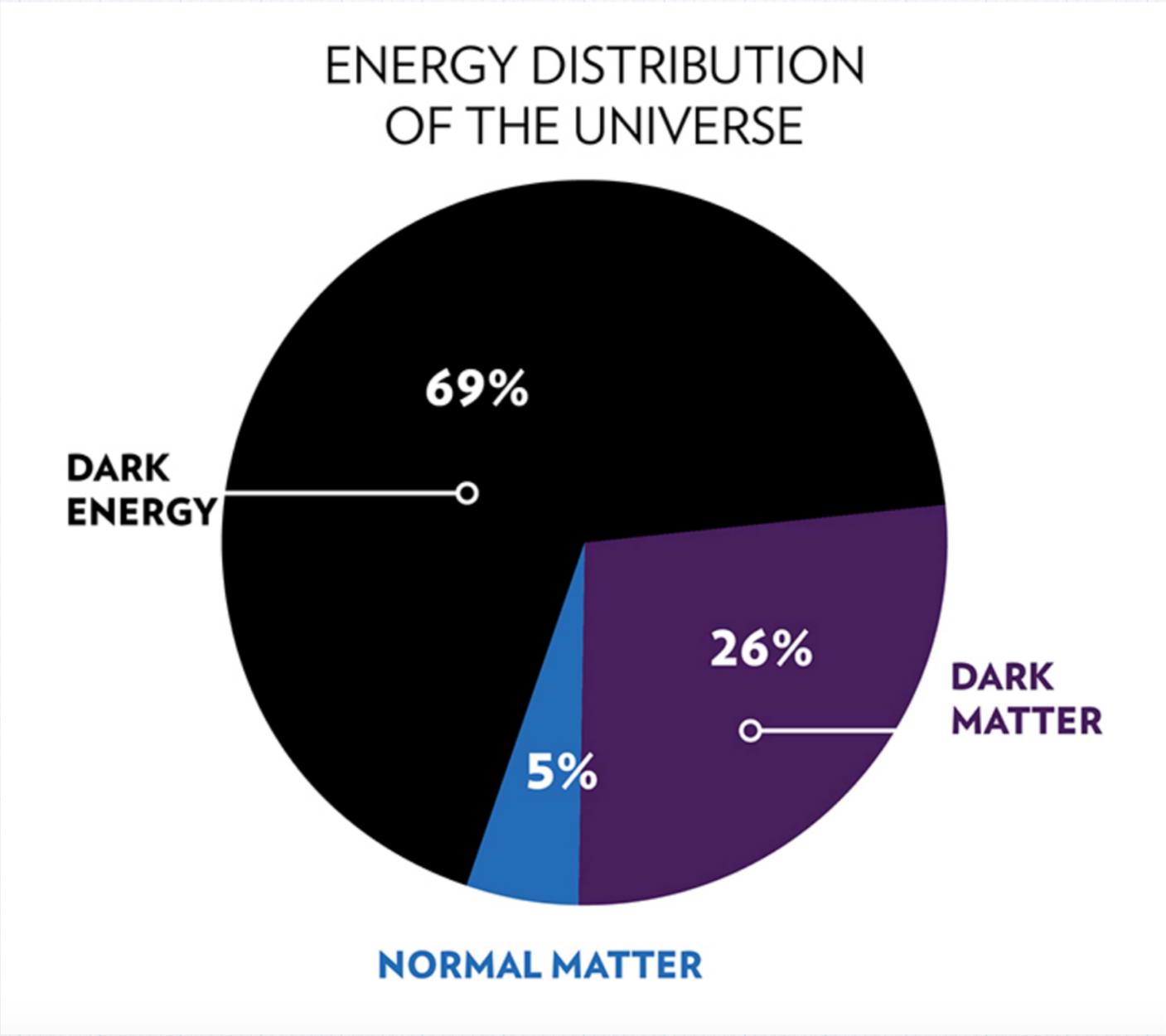
The Standard Model gives us
Almost a complete picture

LHCb... first plan

study of matter & antimatter

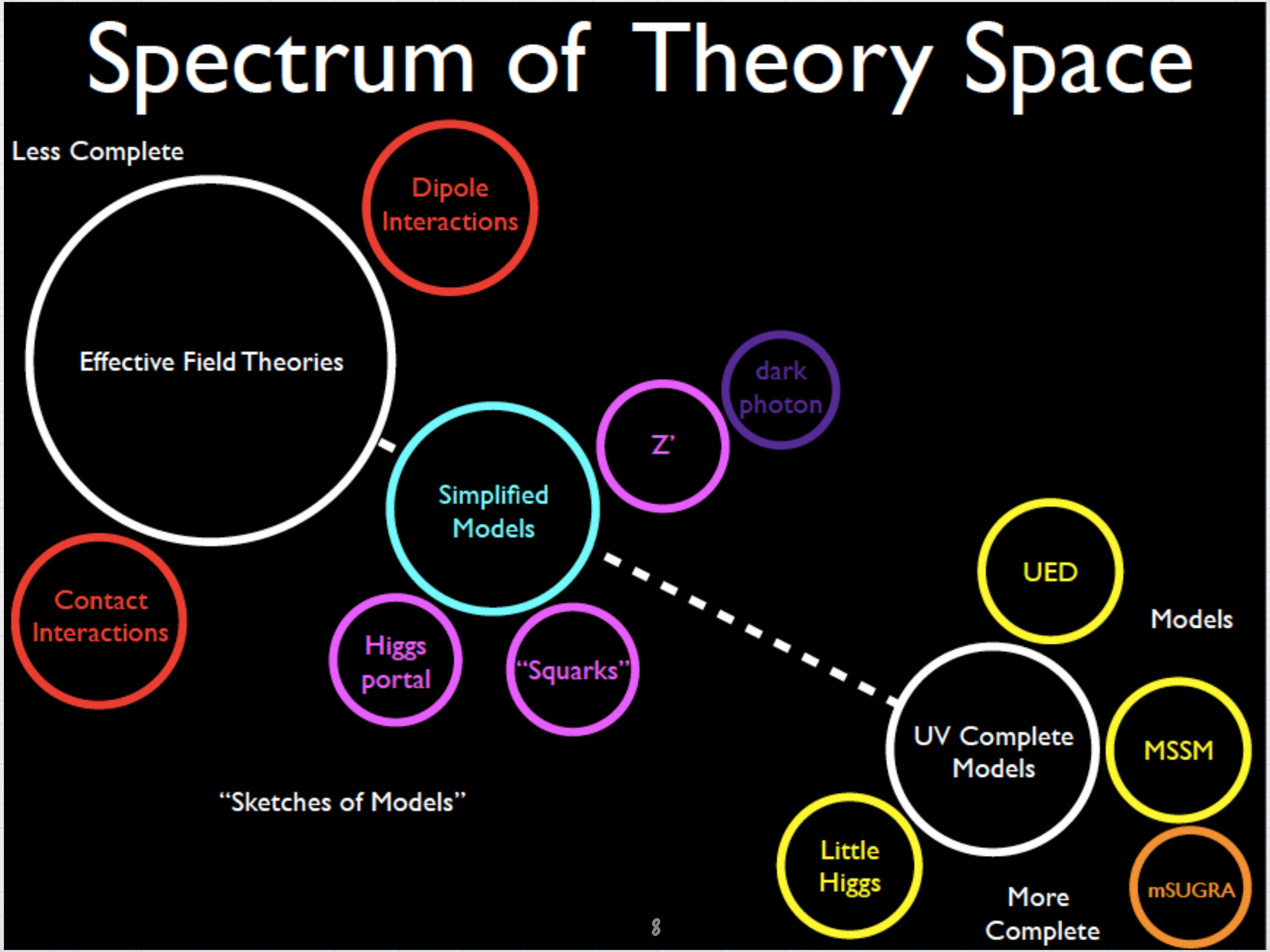
b-hadrons

Mais, mais, mais...

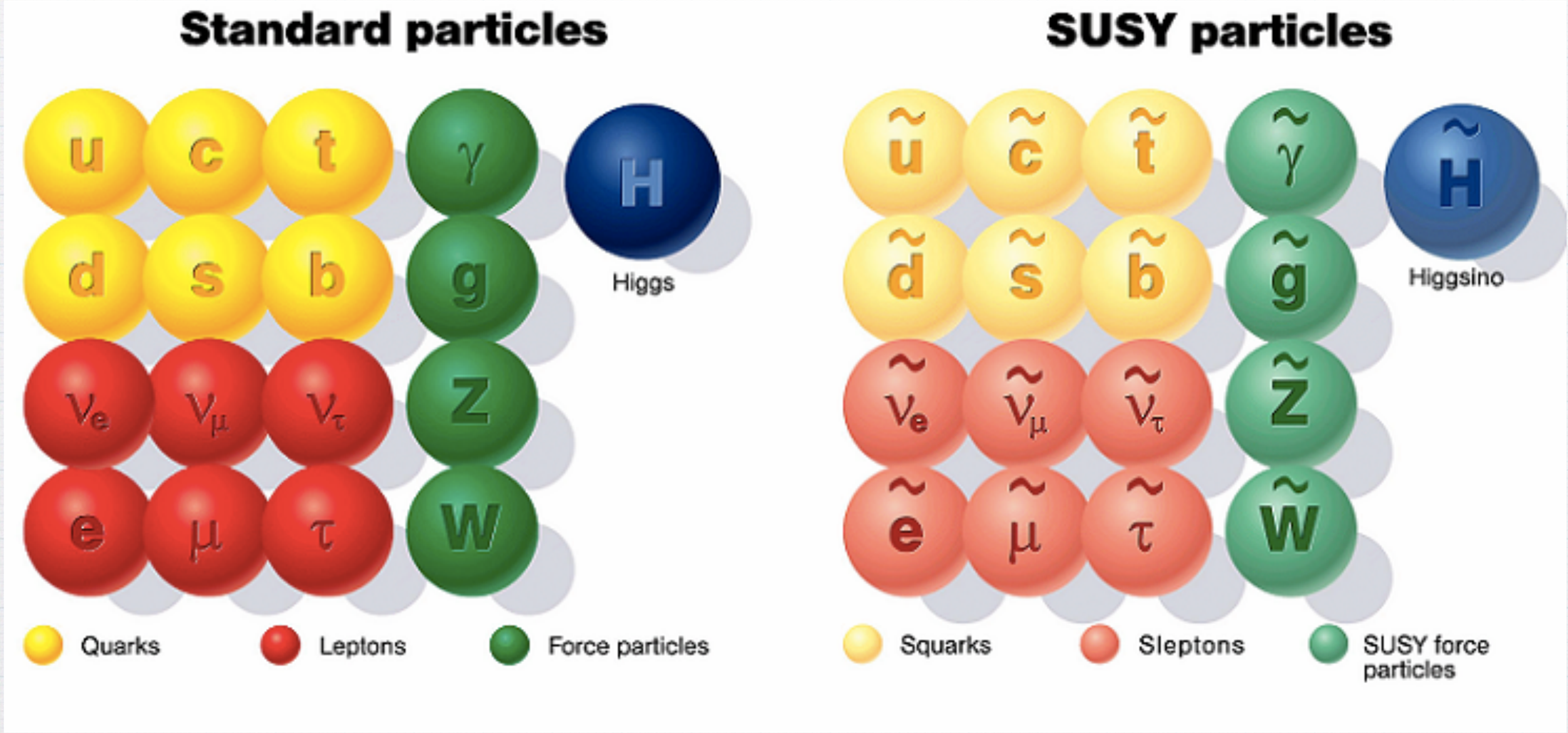



We need to search for New Physics

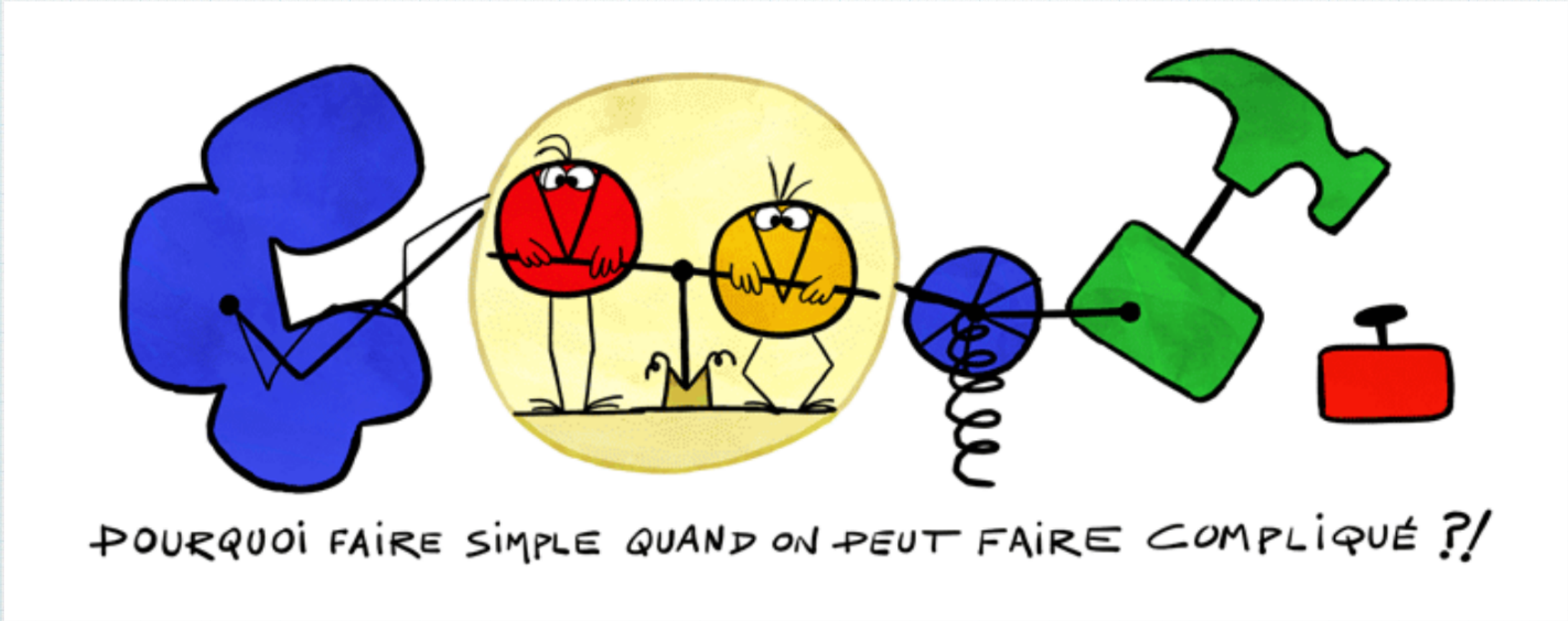
Spectrum of Theory Space



NP


Standard particles
u
c
t
γ
H
Higgs
d
s
b
g
ν_e
ν_μ
ν_τ
Z
e
μ
τ
W
Quarks
Leptons
Force particles
SUSY particles
$\tilde{u}$
$\tilde{c}$
$\tilde{t}$
$\tilde{\gamma}$
$\tilde{H}$
Higgsino
$\tilde{d}$
$\tilde{s}$
$\tilde{b}$
$\tilde{g}$
$\tilde{\nu}_e$
$\tilde{\nu}_\mu$
$\tilde{\nu}_\tau$
$\tilde{Z}$
$\tilde{e}$
$\tilde{\mu}$
$\tilde{\tau}$
$\tilde{W}$
Squarks
Sleptons
SUSY force particles

How to look for New Physics in an indirect way ?



Indirect Searches - Model Independent Searches

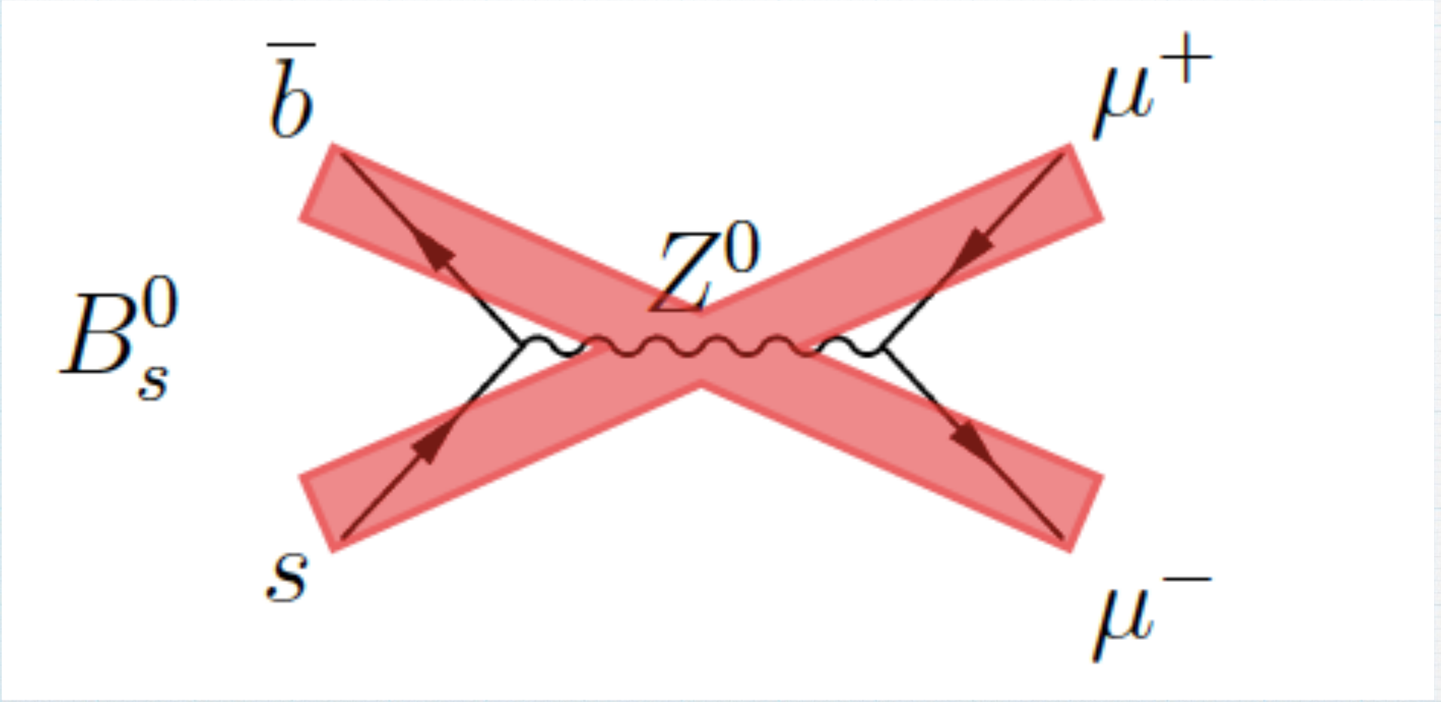
How can New Physics affect an oscillation ?

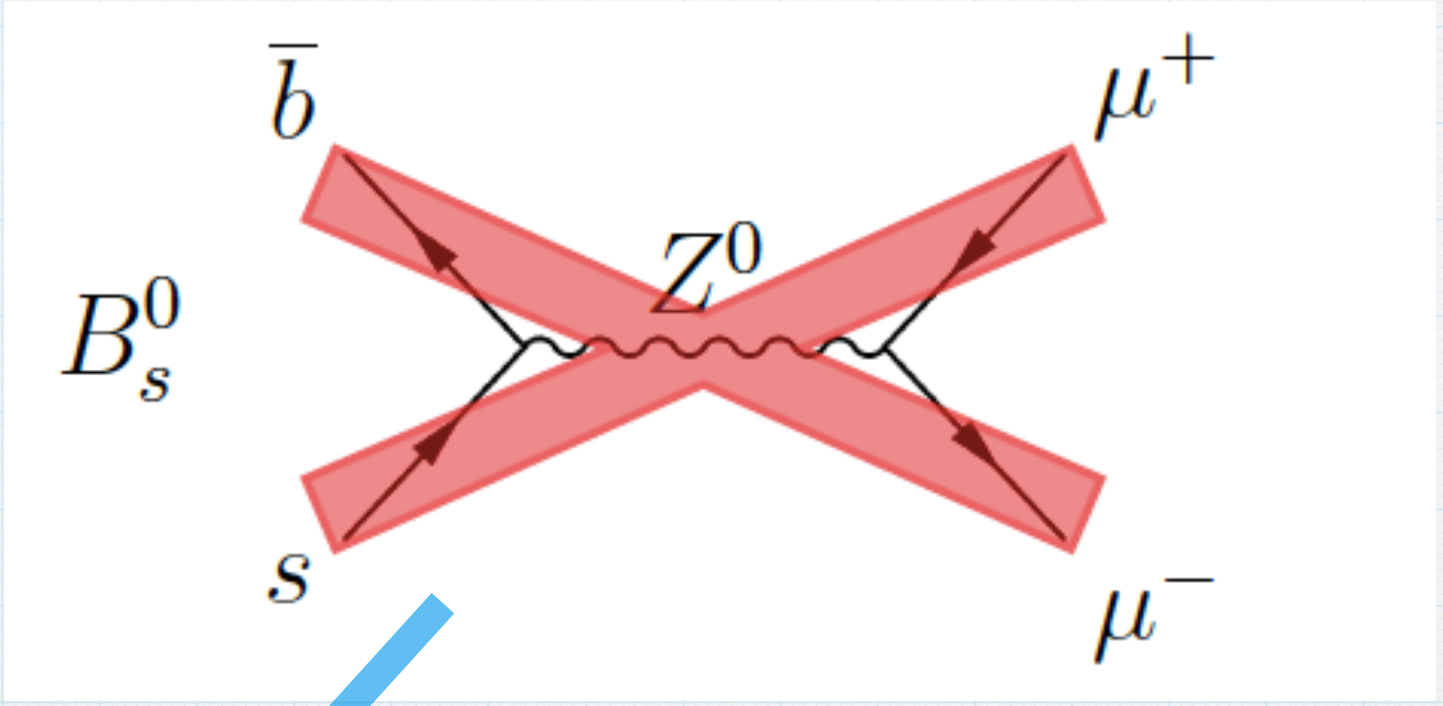
How can New Physics affect angular observables ?

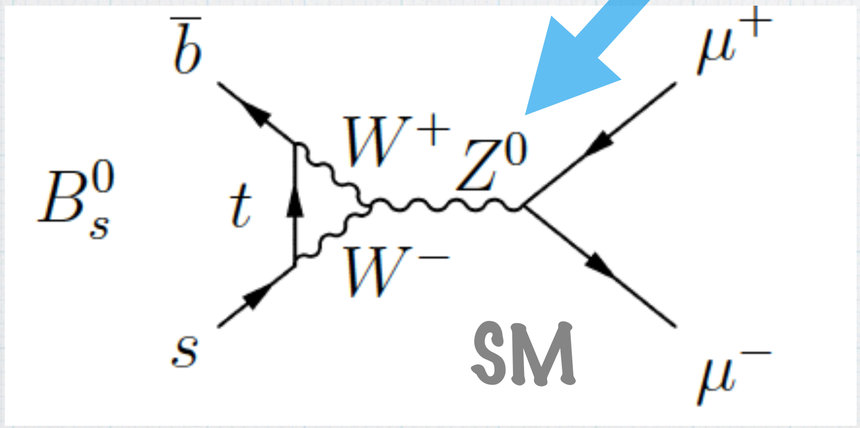
How can New Physics enhance a suppressed decay ?

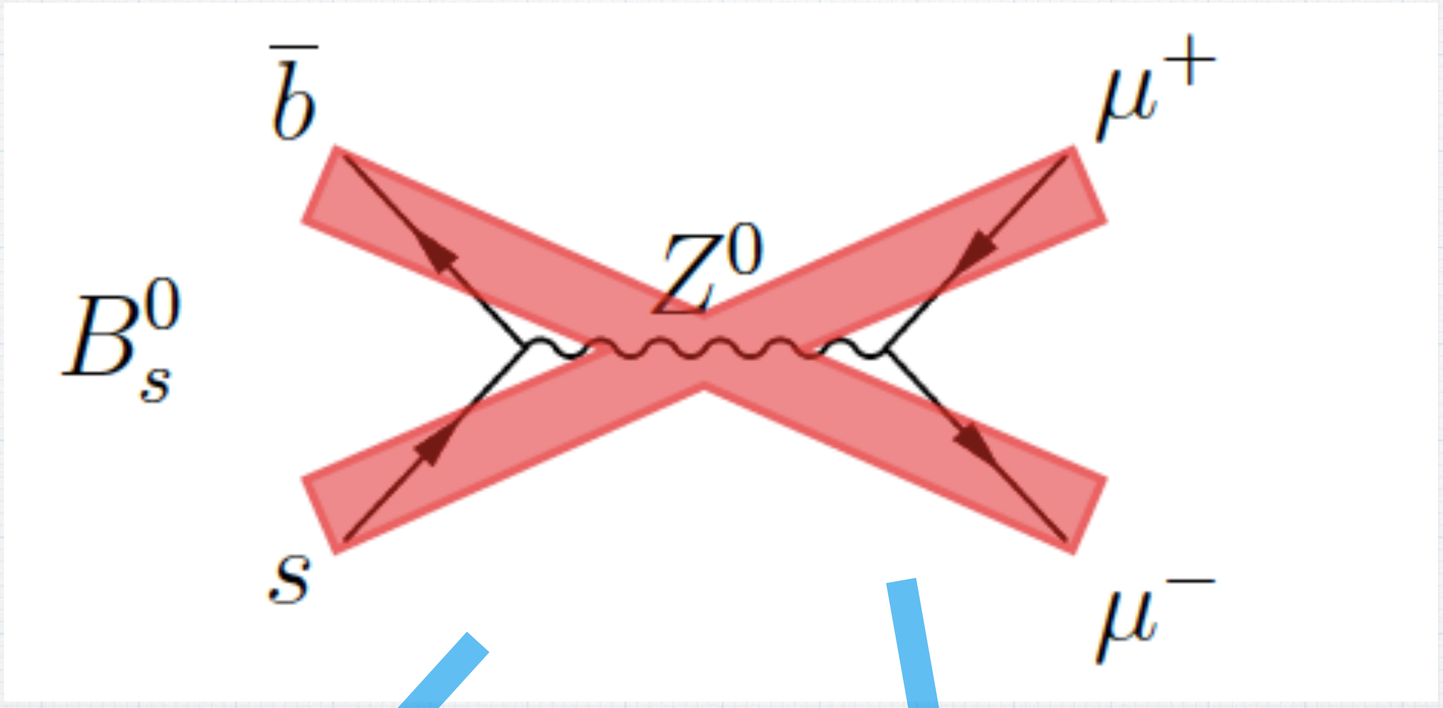
How can New Physics affect a phase ?

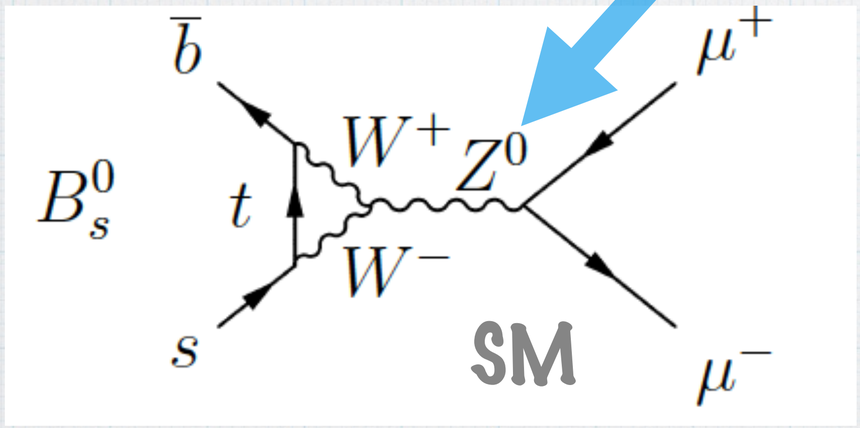
A very rare decay

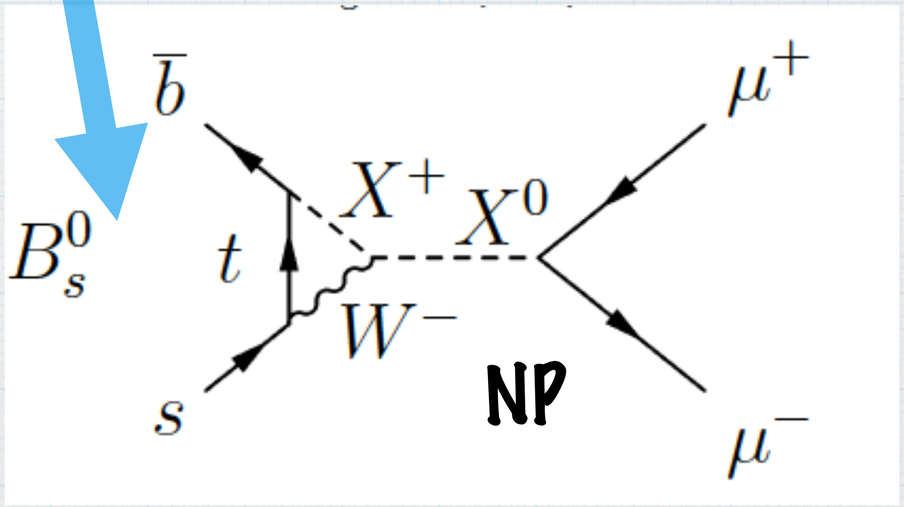

$\overline{b}$
μ^+
Z^0
B_s^0
s
μ^-

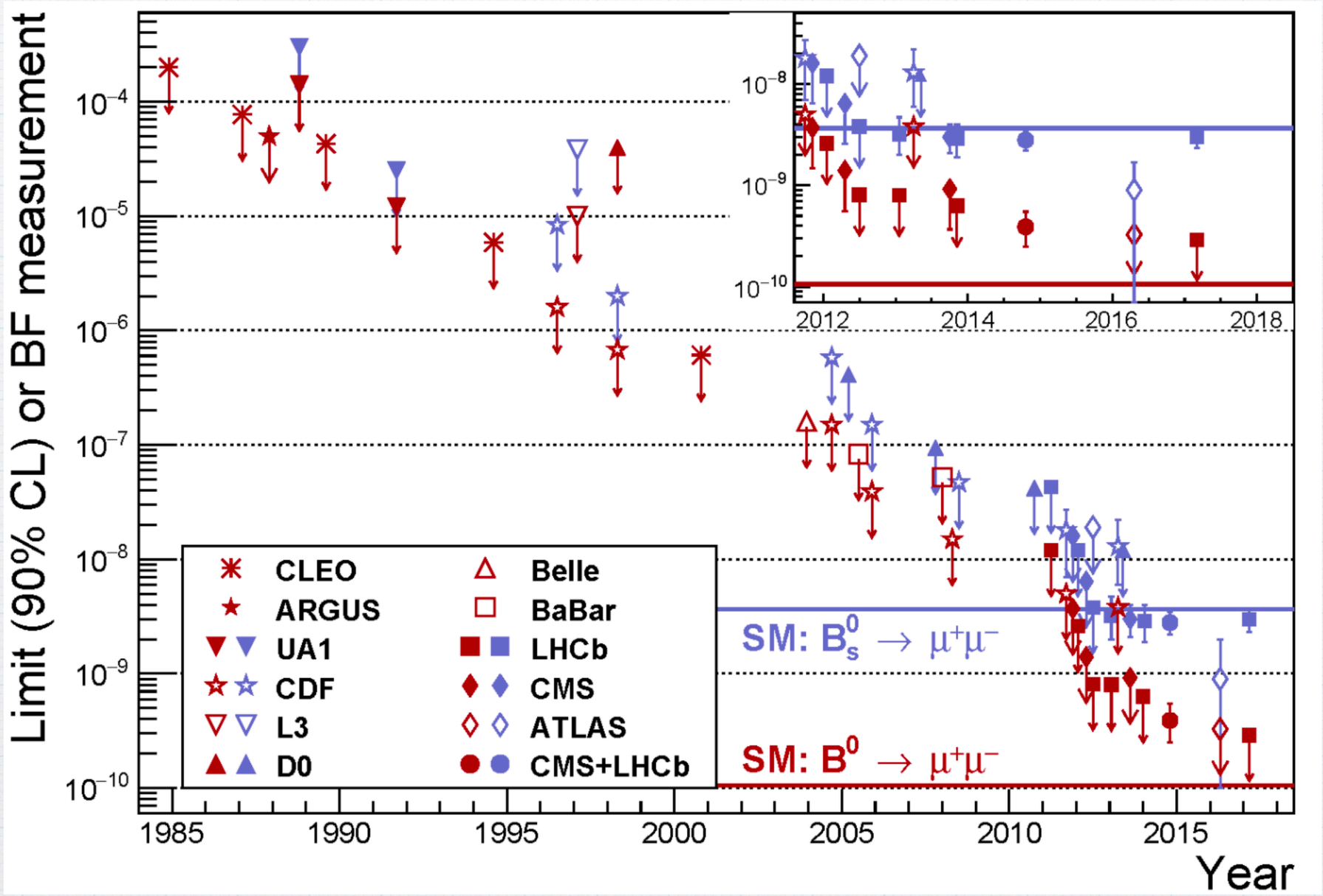

$\overline{b}$
μ^+
Z^0
B_s^0
s
μ^-


$\overline{b}$
μ^+
W^+
Z^0
B_s^0
t
W^-
s
SM
μ^-


$\overline{b}$
μ^+
Z^0
B_s^0
s
μ^-


$\overline{b}$
μ^+
W^+
Z^0
B_s^0
t
W^-
s
SM
μ^-


$\overline{b}$
μ^+
X^+
X^0
B_s^0
t
W^-
s
NP
μ^-

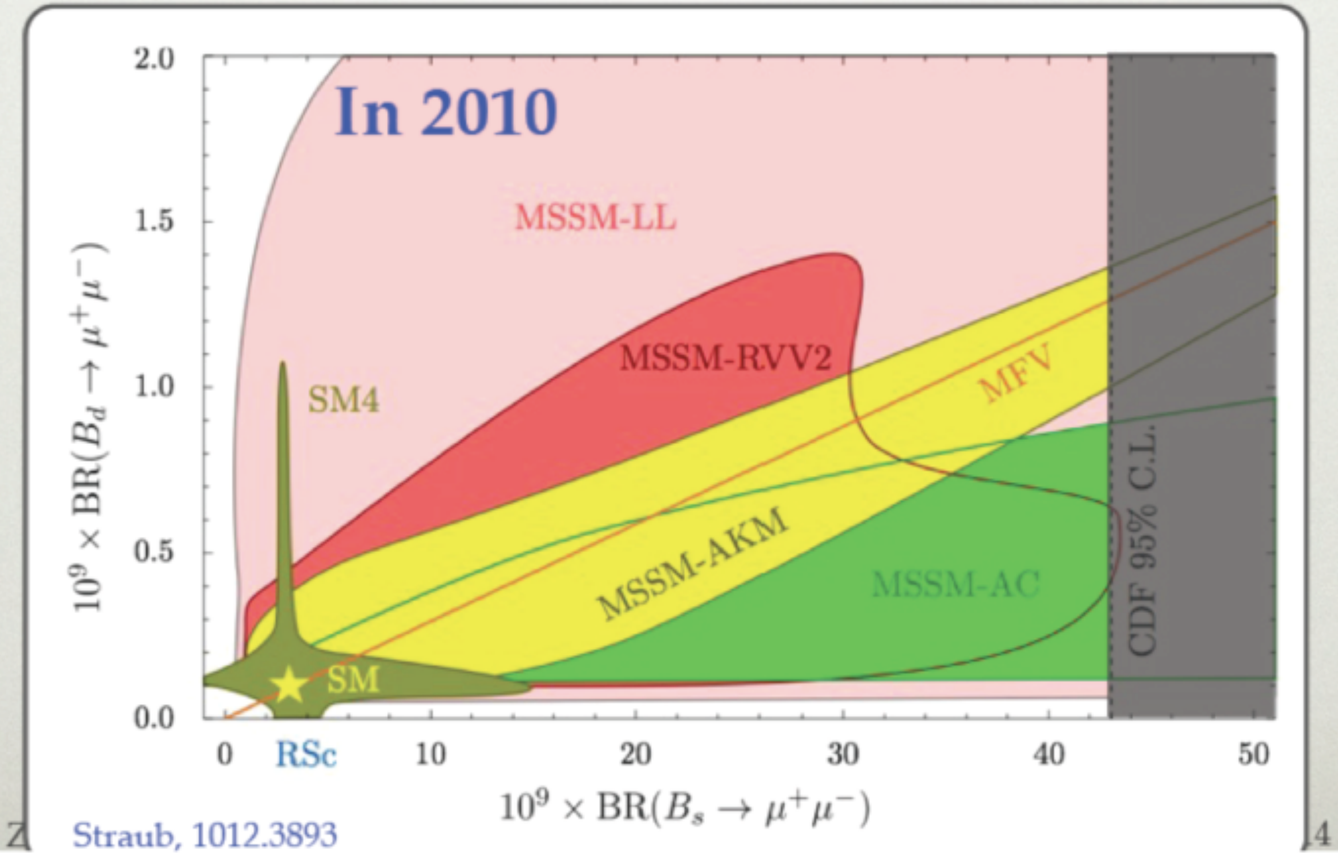


Phys. Rev. Lett. 118, 191801 (2017)

Zupan

IMPACT OF $B_s \to \mu\mu$

- flavor constraints for a long time a very important input in model building
- still true now, as an example: the impact of $B_s \to \mu\mu$



Straub, 1012.3893

Zupan

IMPACT OF $B_s \to \mu\mu$

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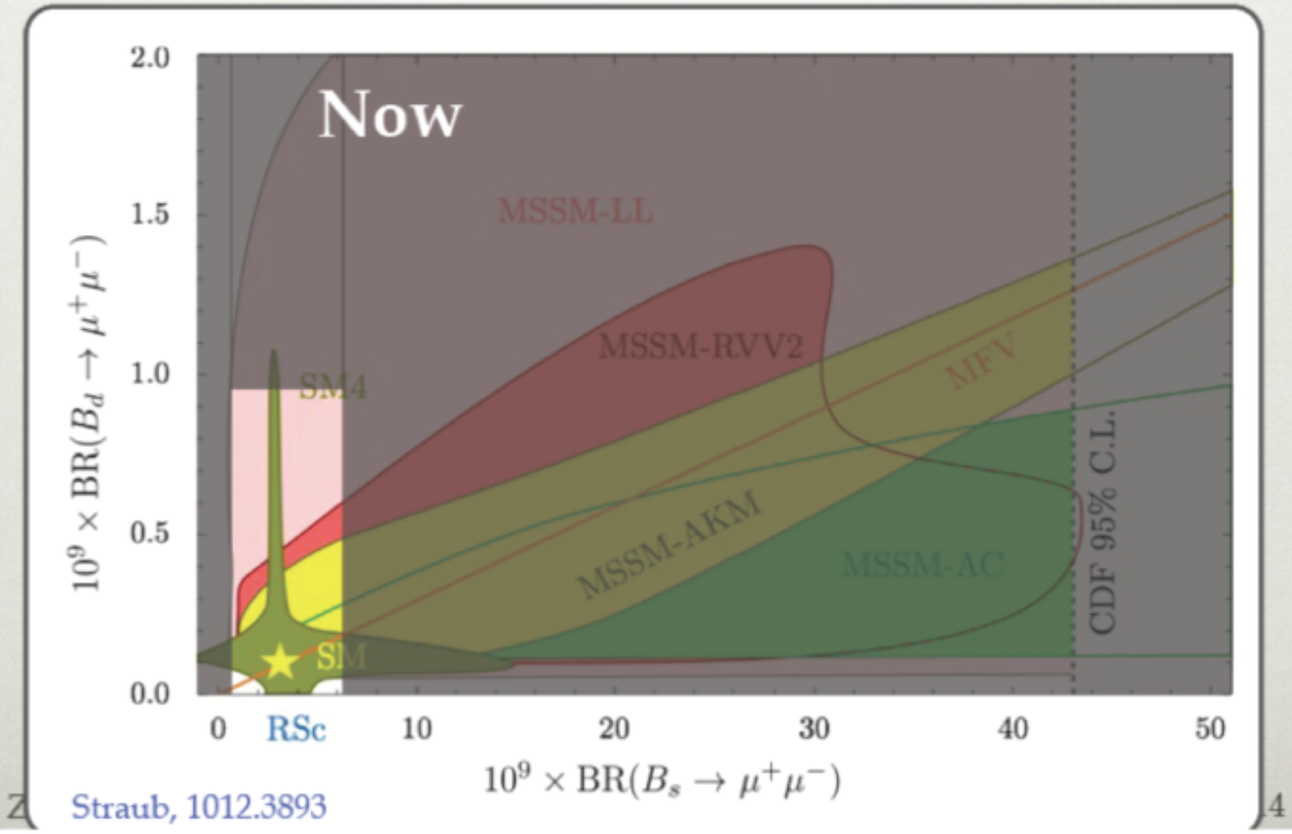
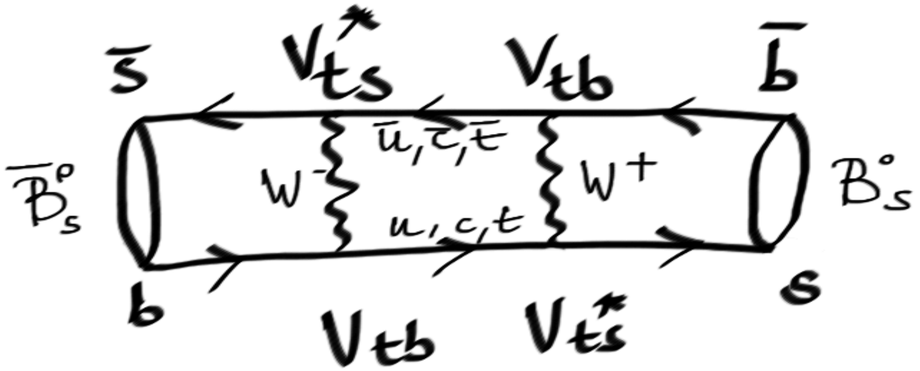
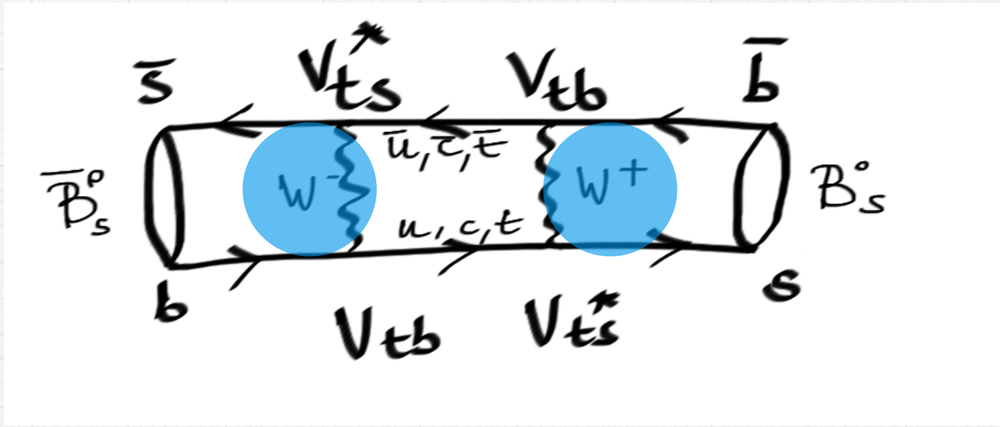


Straub, 1012.3893

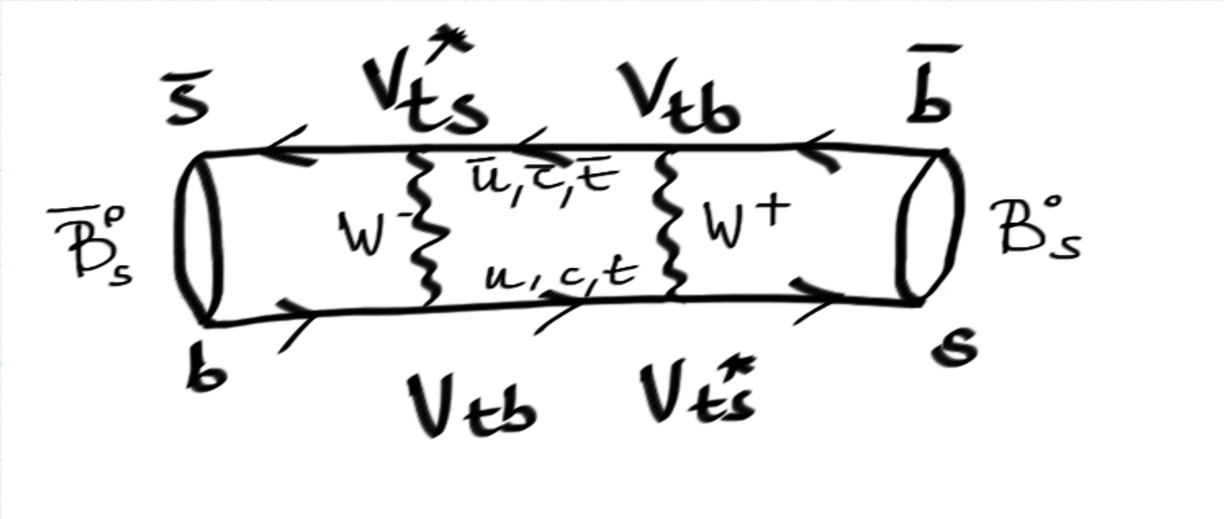
An oscillation

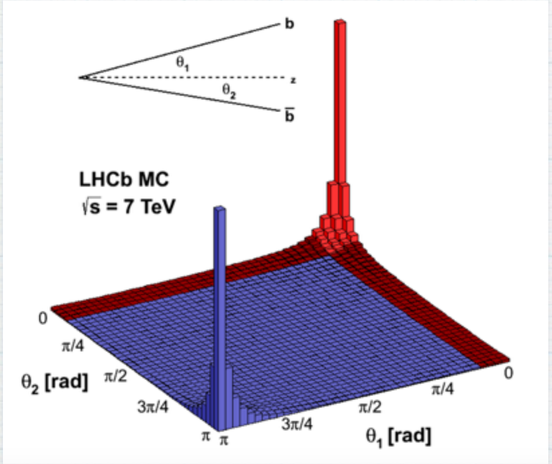
The Oscillation of the Bs meson



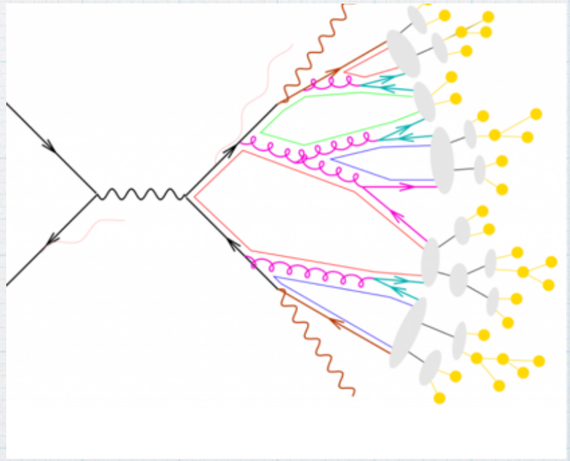


Can be a NP particle, this will modify the oscillation frequency

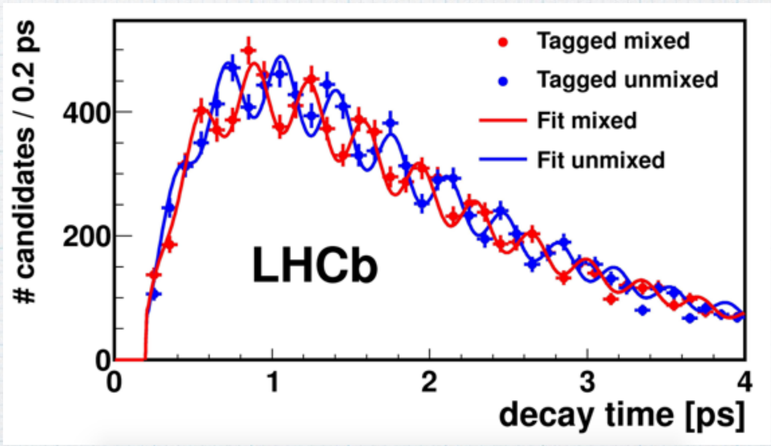




Production



Hadronisation



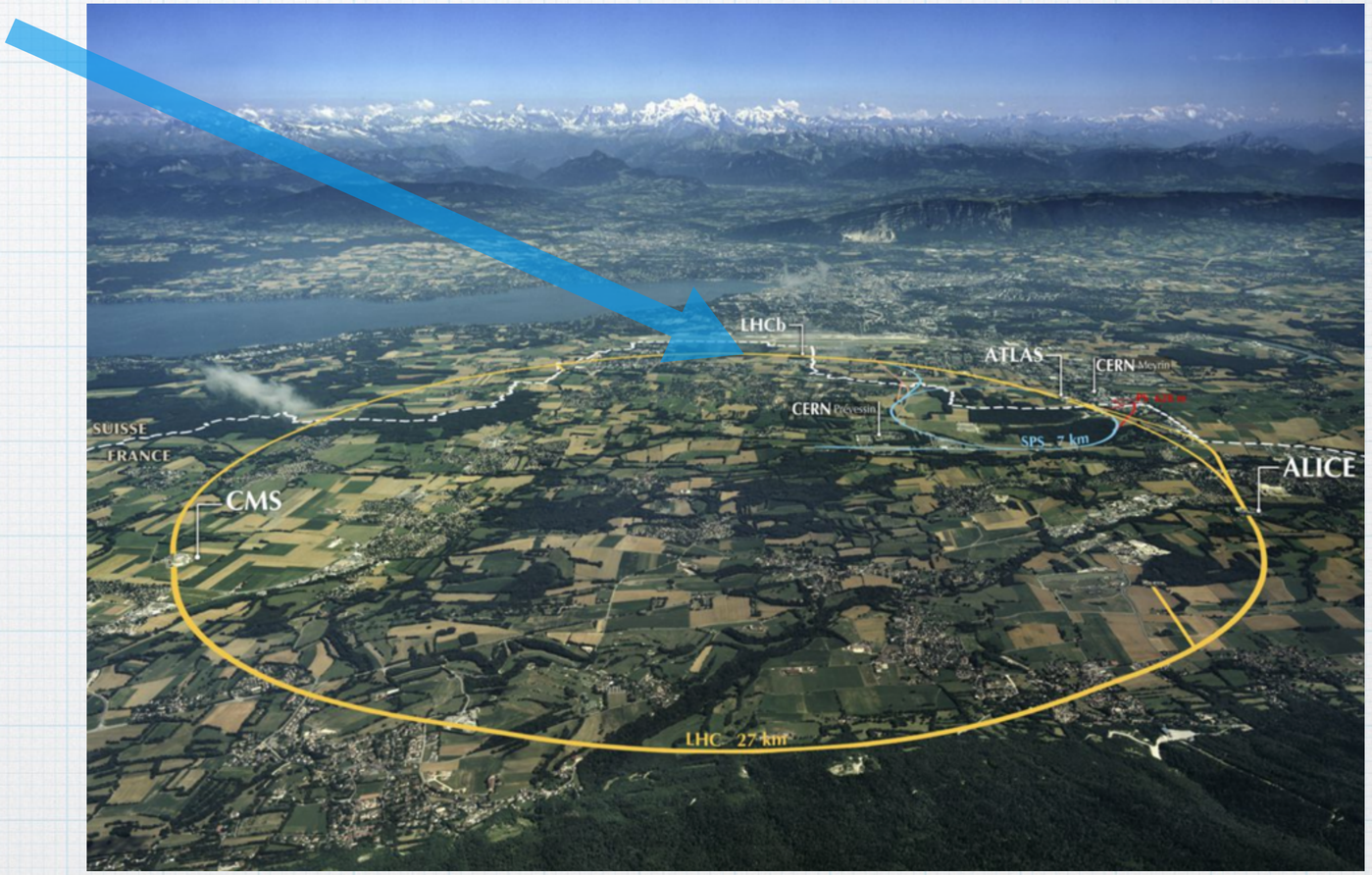
Oscillation

Who are we?

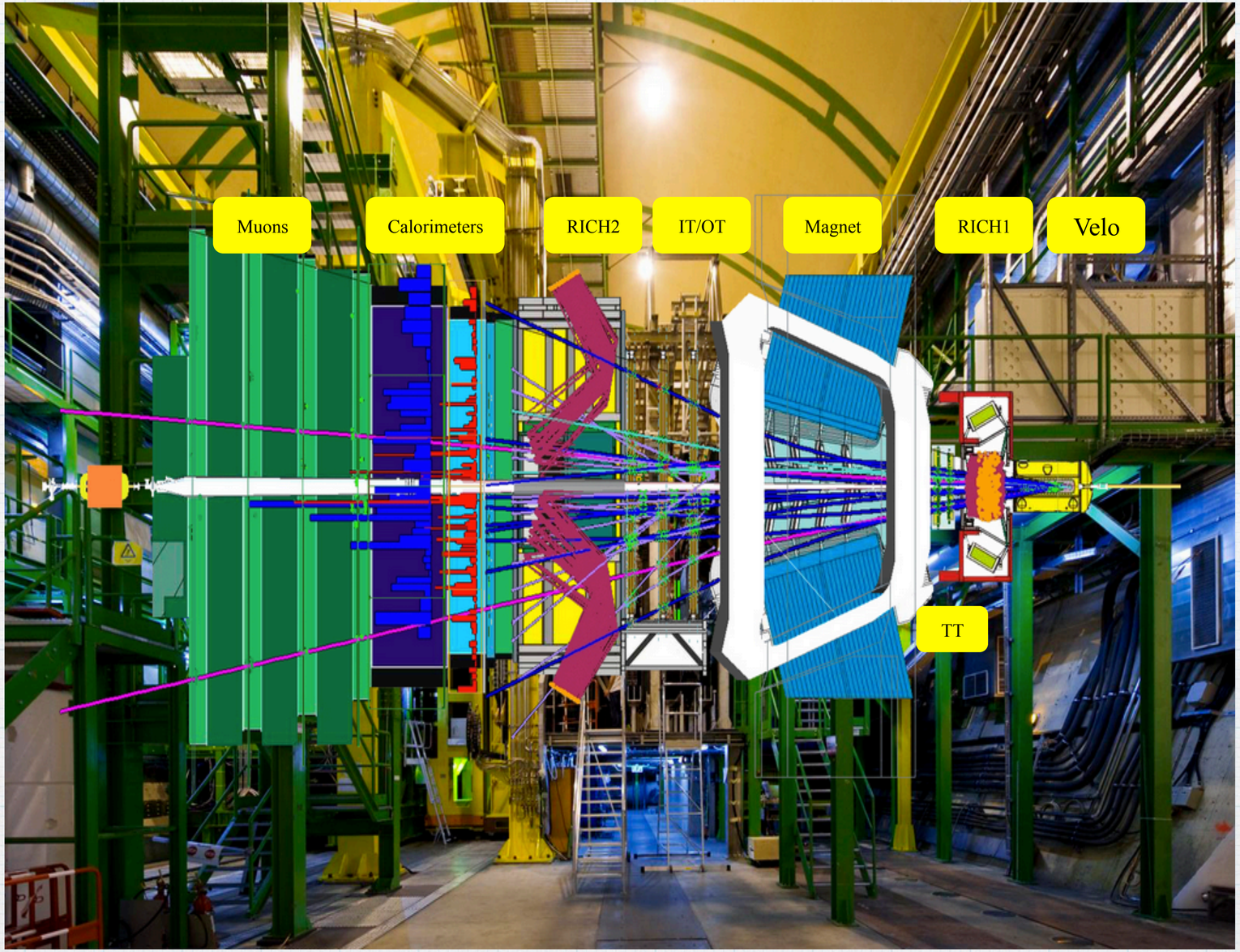
Located @ point 8

79 Institutes

18 Countries

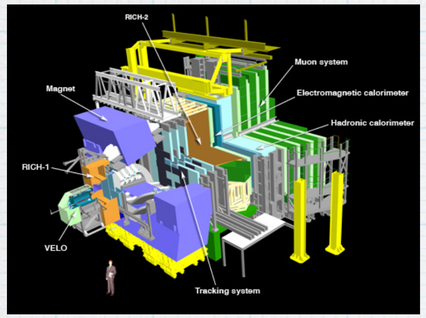


The LHCb detector



JINST 3 (2008) S08005 Int. J. Mod. Phys. A 30, 1530022 (2015)

A forward spectrometer located @ Interaction Point 8 of the LHC



Trigger

Simulation

Things I forgot

Monitoring

Reconstruction

Calibration

Reconstruction

Analysis

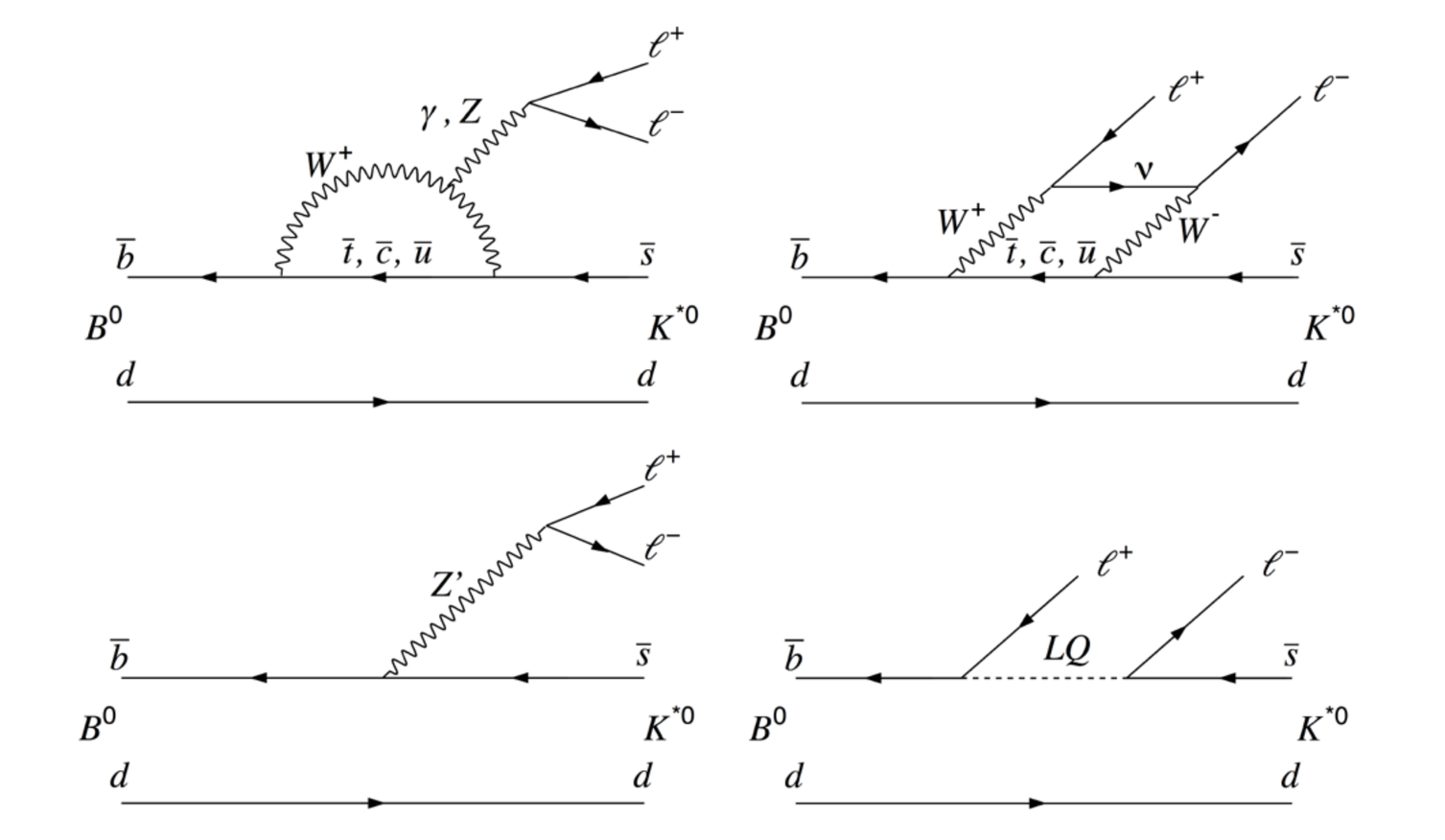
Buffering

Data Quality

Data !!

Lepton Universality

Lepton Universality

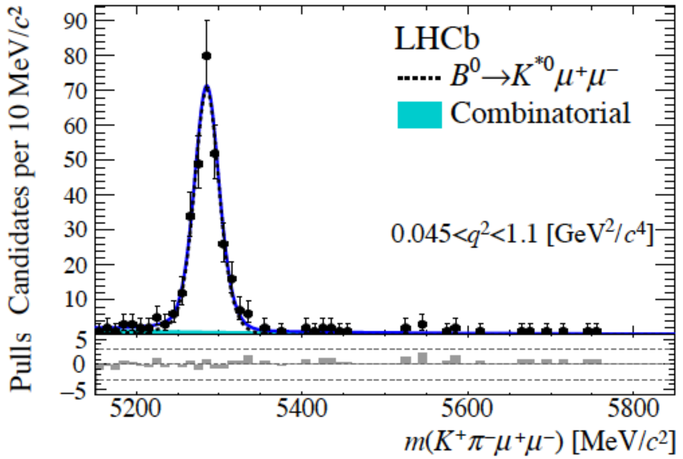


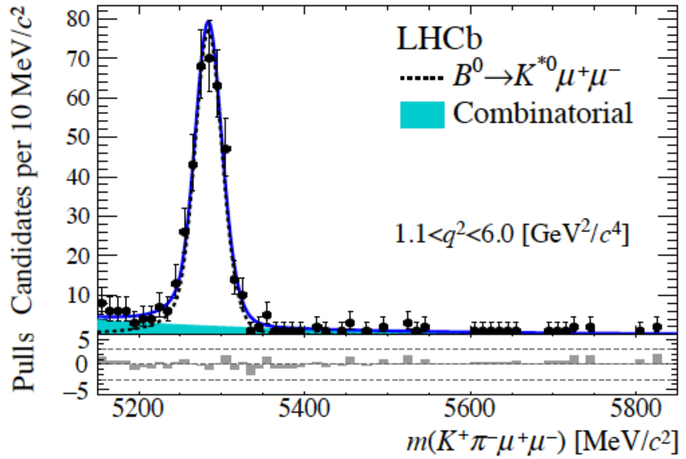
Do you know why these diagrams are called penguins

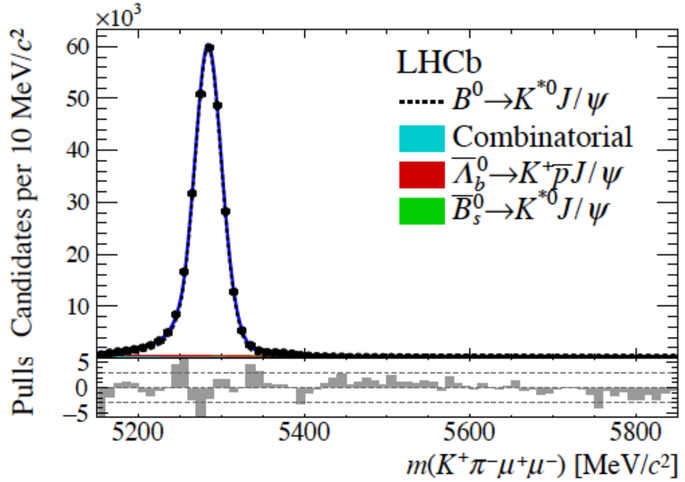
$$\mathcal{R}_{K^{*0}} = \frac{\mathcal{B}(B^0 \to K^{*0}\mu^+\mu^-)}{\mathcal{B}(B^0 \to K^{*0}J/\psi(\to \mu^+\mu^-))} \Big/ \frac{\mathcal{B}(B^0 \to K^{*0}e^+e^-)}{\mathcal{B}(B^0 \to K^{*0}J/\psi(\to e^+e^-))}$$

LOMuon
HLT
PID
MVA selection
Likelihood fit

muons

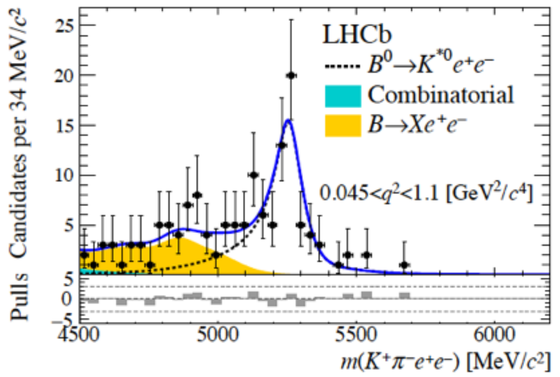


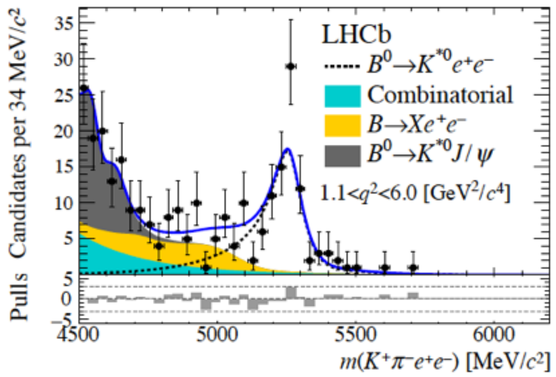




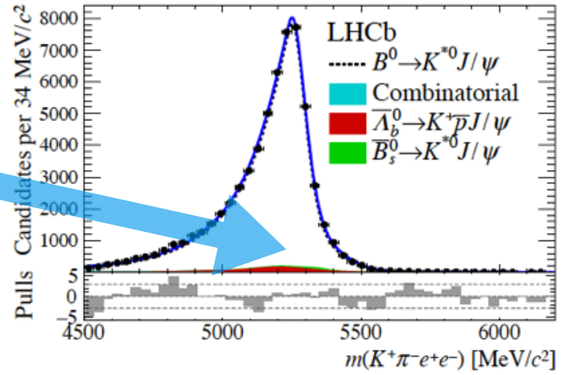
L0Electron
HLT
PID
MVA selection
Likelihood fit

+ Toys



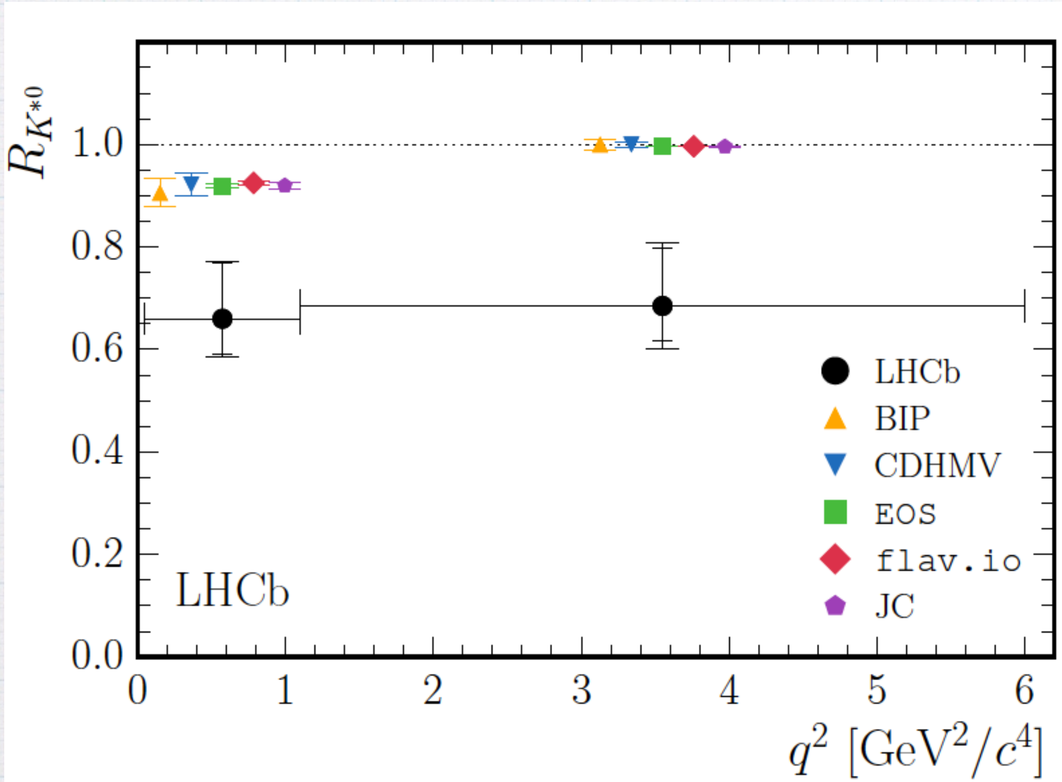


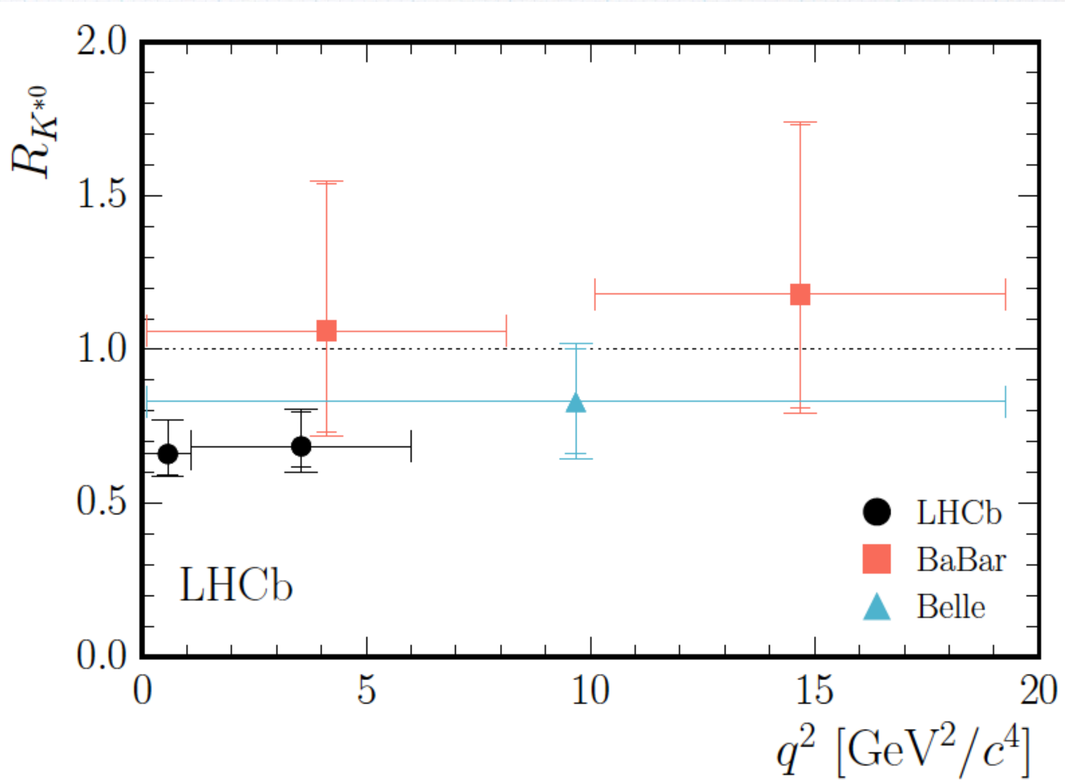
electrons



	$B^0 \to K^{*0}\ell^+\ell^-$		$B^0 \to K^{*0} J/\psi (\to \ell^+\ell^-)$
	low-q^2	central-q^2	
$\mu^+\mu^-$	$285 \pm {}^{18}_{18}$	$353 \pm {}^{21}_{21}$	$274416 \pm {}^{602}_{654}$
e^+e^-	$89 \pm {}^{11}_{10}$	$111 \pm {}^{13}_{12}$	$58361 \pm {}^{258}_{256}$

One of the coolest results so far....

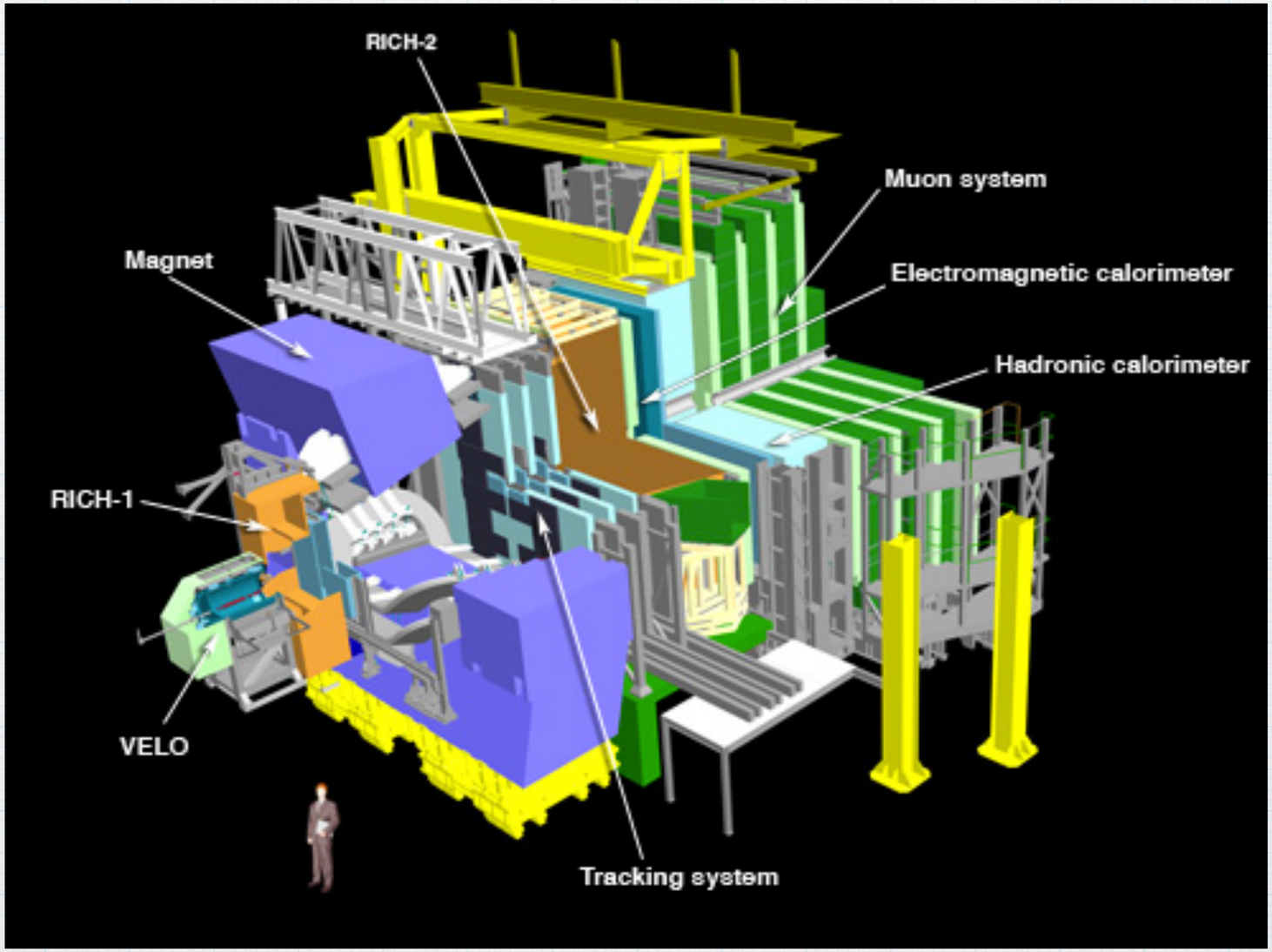




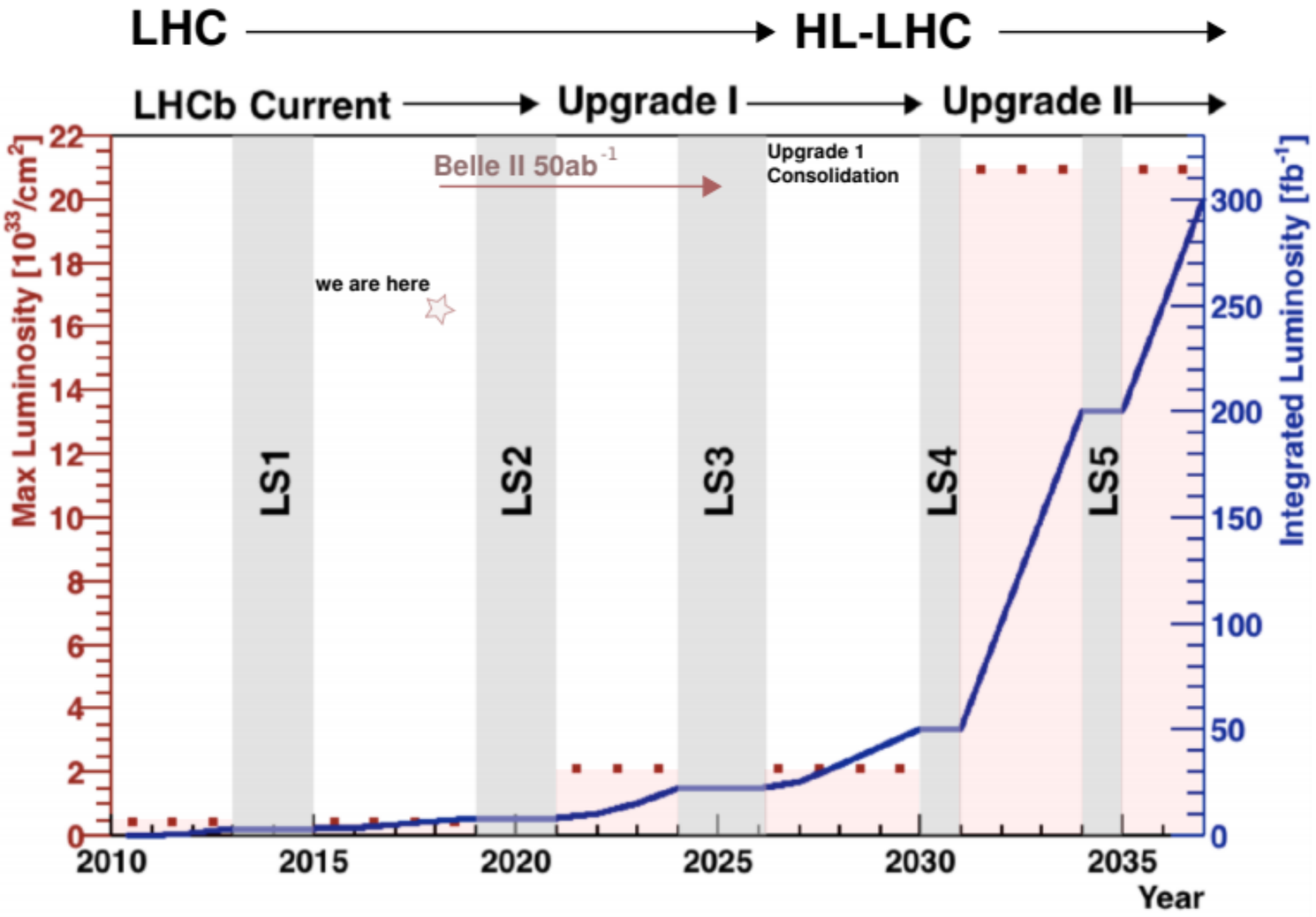
arXiv:1705.05802v2

One of the coolest results so far....

Our detector

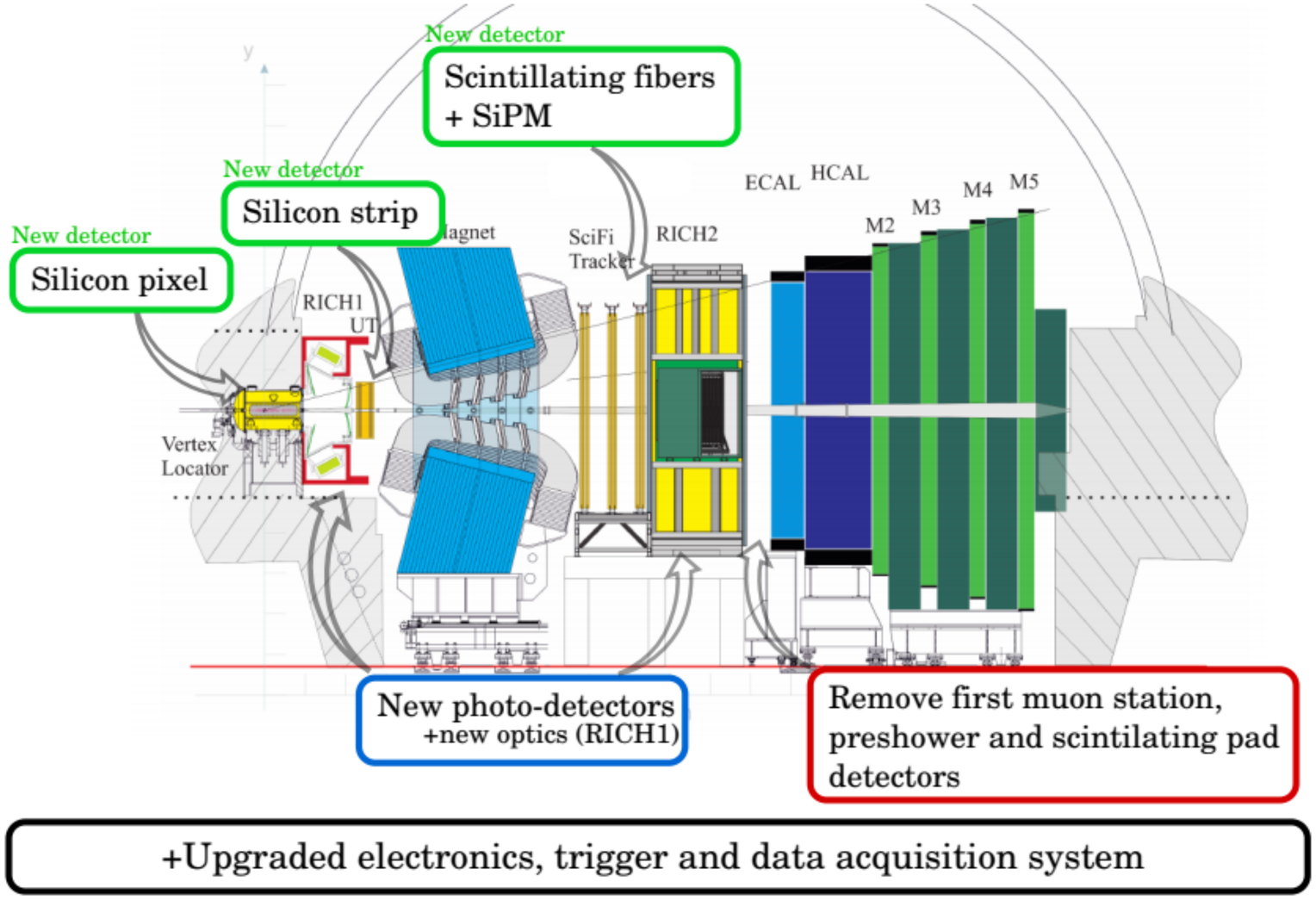


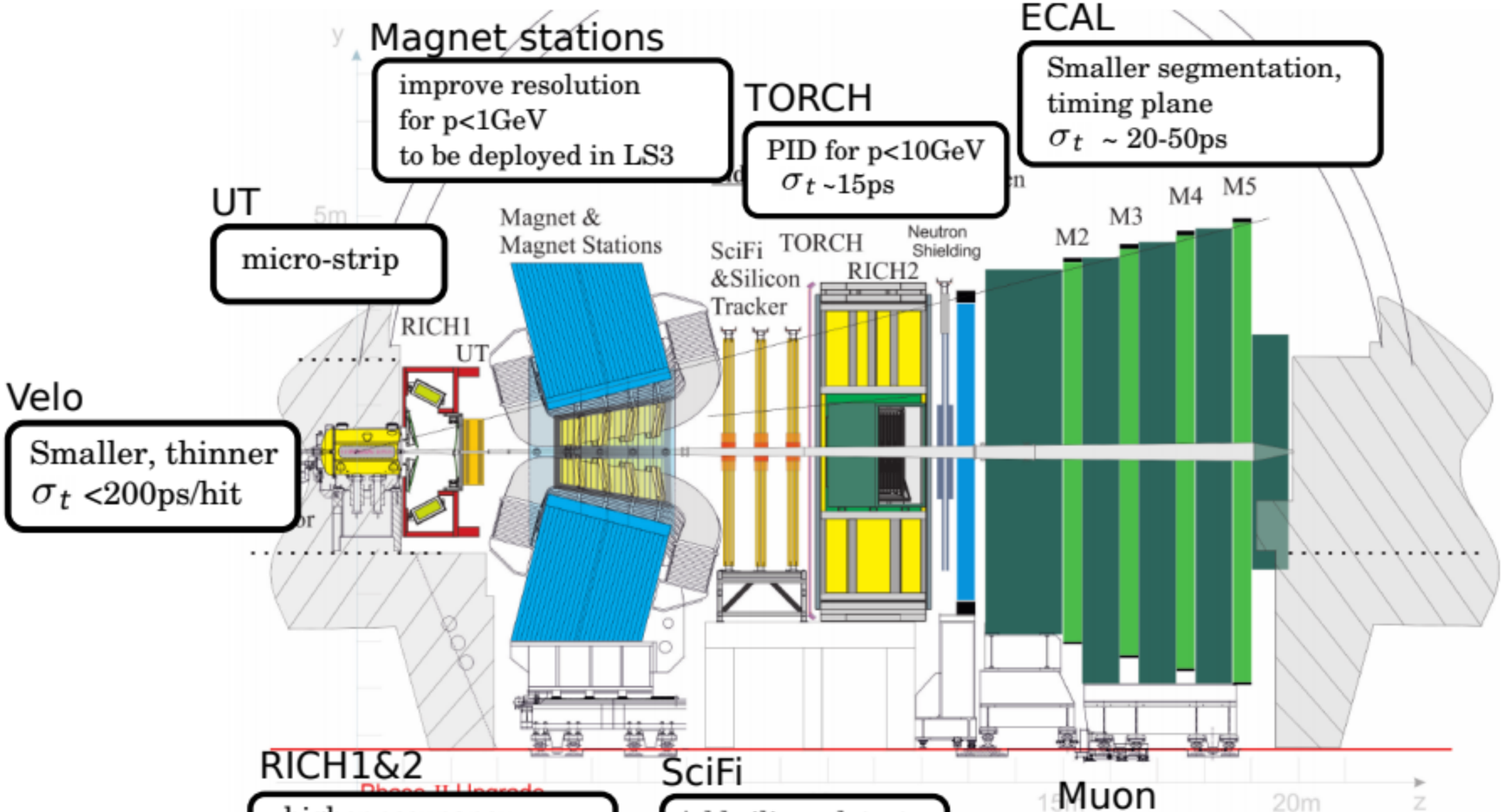
Planning



- During LHC era: $\mathcal{L} = 4 \times 10^{32} cm^{-2} s^{-1}$ to $2 \times 10^{33} cm^{-2} s^{-1}$.
- During HL-LHC era: $\mathcal{L} = 2 \times 10^{33} cm^{-2} s^{-1}$ to $2 \times 10^{34} cm^{-2} s^{-1}$.

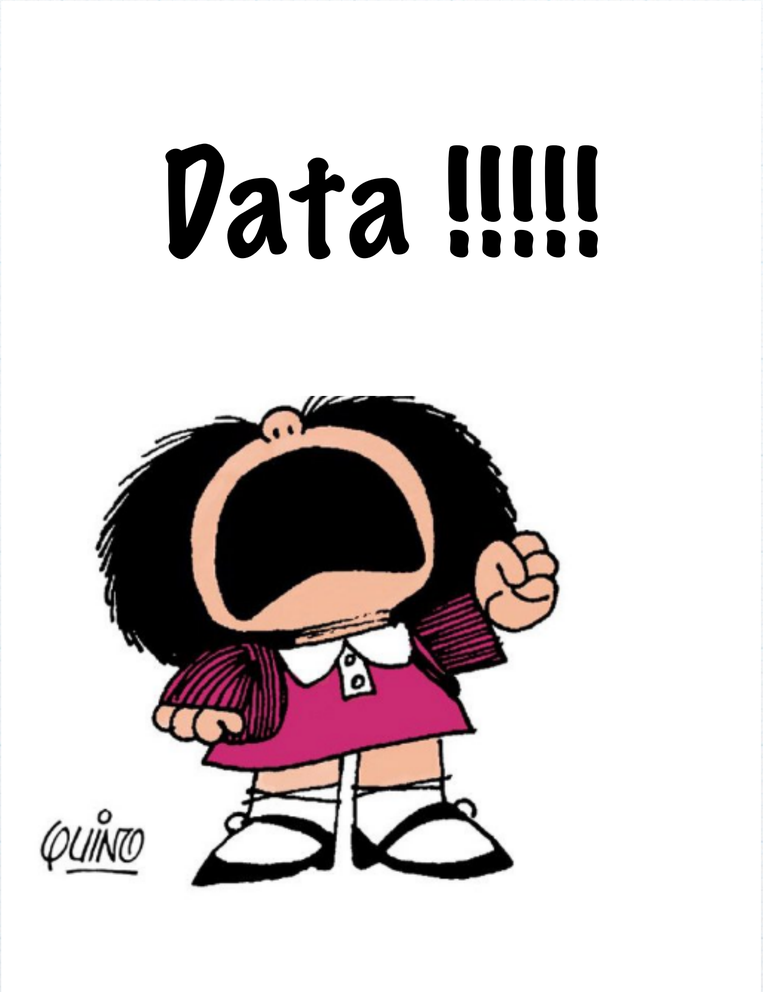
Upgrade I


New detector
Scintillating fibers
+ SiPM
New detector
Silicon strip
New detector
Silicon pixel
RICH1
UT
Vertex
Locator
SciFi
Tracker
RICH2
ECAL
HCAL
M2
M3
M4
M5
New photo-detectors
+new optics (RICH1)
Remove first muon station,
preshower and scintilating pad
detectors
+Upgraded electronics, trigger and data acquisition system


Magnet stations
improve resolution
for p<1GeV
to be deployed in LS3
TORCH
PID for p<10GeV
σ_t ~15ps
ECAL
Smaller segmentation,
timing plane
σ_t ~ 20-50ps
UT
micro-strip
Velo
Smaller, thinner
σ_t <200ps/hit
RICH1&2
higher occupancy
--> new photodetection
plane
SciFi
Add silicon detector
in the inner region
Muon
HCAL --> filter
inner chambers with
micro-resistive WELL
Magnet &
Magnet Stations
SciFi
&Silicon
Tracker
TORCH
RICH2
Neutron
Shielding
RICH1
UT
M2
M3
M4
M5
5m
20m
z

Upgrade II

What things look like from my perspective



- Real Data
- Monte Carlo
- Toys

```
taskname = ['MC electrons md']

data = ['/MC/2012/Beam4000GeV-2012-MagDown-Nu2.5-Pythia8/.../15154001/ALLSTREAMS.DST',
num=0

ds=BKQuery(path = data[num],dqflag = "All")
print ds.getDataset()
j = Job(
        name = taskname[num],
        backend = Dirac(),
            application = DaVinci(version =  'v36r6',optsfile = '/afs/cern.ch/user/y/yamhis/
            splitter = SplitByFiles(
            filesPerJob = 20,
            ignoremissing = True
            ),
                maxFiles = 100,
        outputfiles = [
                LocalFile('*.root'),
        ],
        inputdata = ds.getDataset()
        )


j.submit()
```

The script

yasmine — yamhis@lxplus016:~/LeptonU/ganga — ssh -Y yamhis@lxplus.cern.ch — 154×23

```
Generating proxy...
Enter Certificate password:
Added VOMS attribute /lhcb/Role=user
Uploading proxy for lhcb_user...
Uploading proxy for private_pilot...
Proxy generated:
subject      : /DC=ch/DC=cern/OU=Organic Units/OU=Users/CN=yamhis/CN=644299/CN=Yasmine Sara Amhis/CN=1492030566/CN=4253082879
issuer       : /DC=ch/DC=cern/OU=Organic Units/OU=Users/CN=yamhis/CN=644299/CN=Yasmine Sara Amhis/CN=1492030566
identity     : /DC=ch/DC=cern/OU=Organic Units/OU=Users/CN=yamhis/CN=644299/CN=Yasmine Sara Amhis
timeleft     : 23:53:58
DIRAC group  : lhcb_user
rfc          : True
path         : /tmp/x509up_u21157
username     : yamhis
properties   : NormalUser
VOMS         : True
VOMS fqan    : ['/lhcb/Role=user']

Proxies uploaded:
 DN                                                                    | Group         | Until (GMT)
 /DC=ch/DC=cern/OU=Organic Units/OU=Users/CN=yamhis/CN=644299/CN=Yasmine Sara Amhis | lhcb_user     | 2018/08/15 07:32
 /DC=ch/DC=cern/OU=Organic Units/OU=Users/CN=yamhis/CN=644299/CN=Yasmine Sara Amhis | private_pilot | 2018/08/15 07:32
[yamhis@lxplus016 ganga]$
```

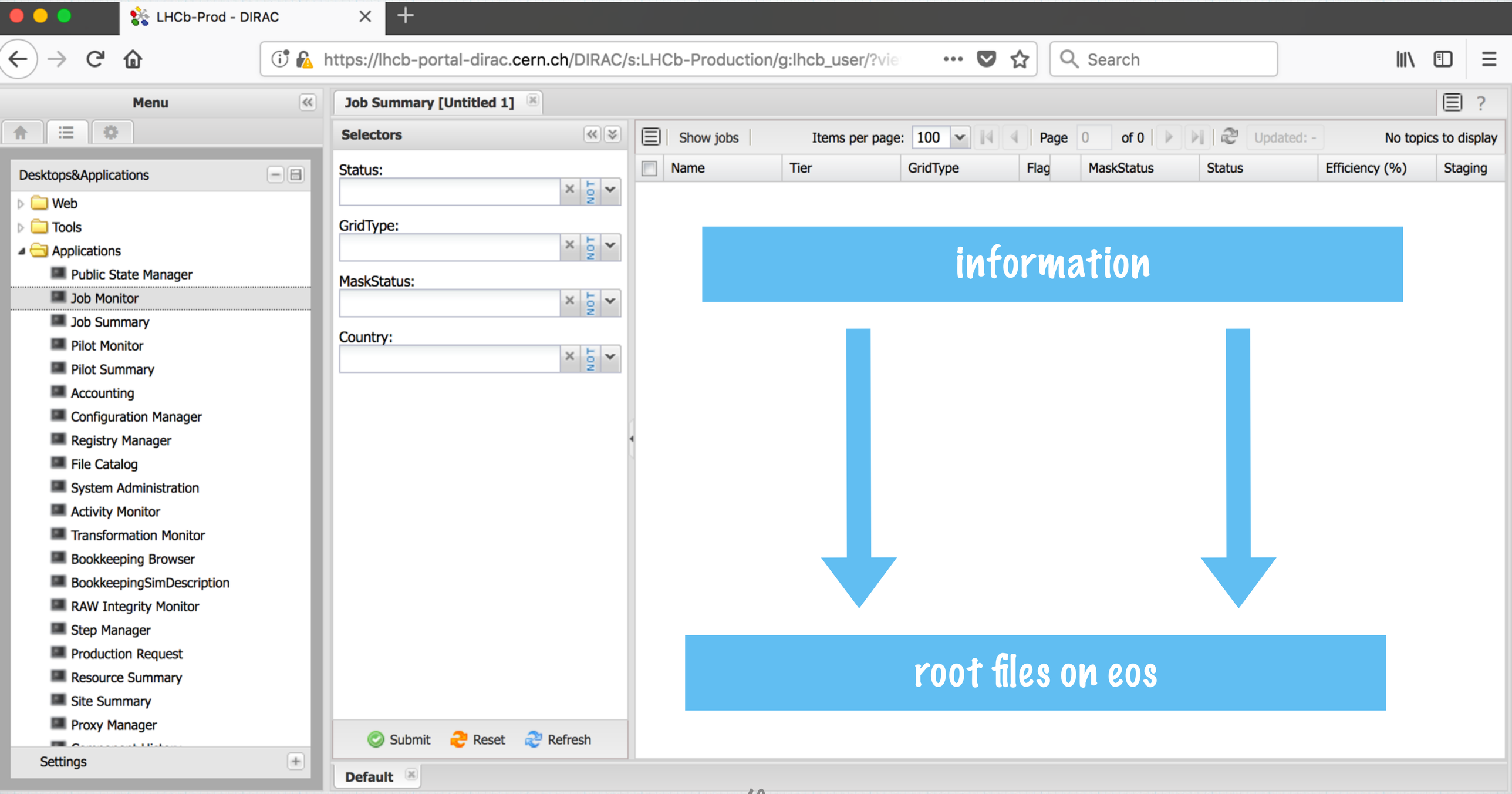
grid proxy

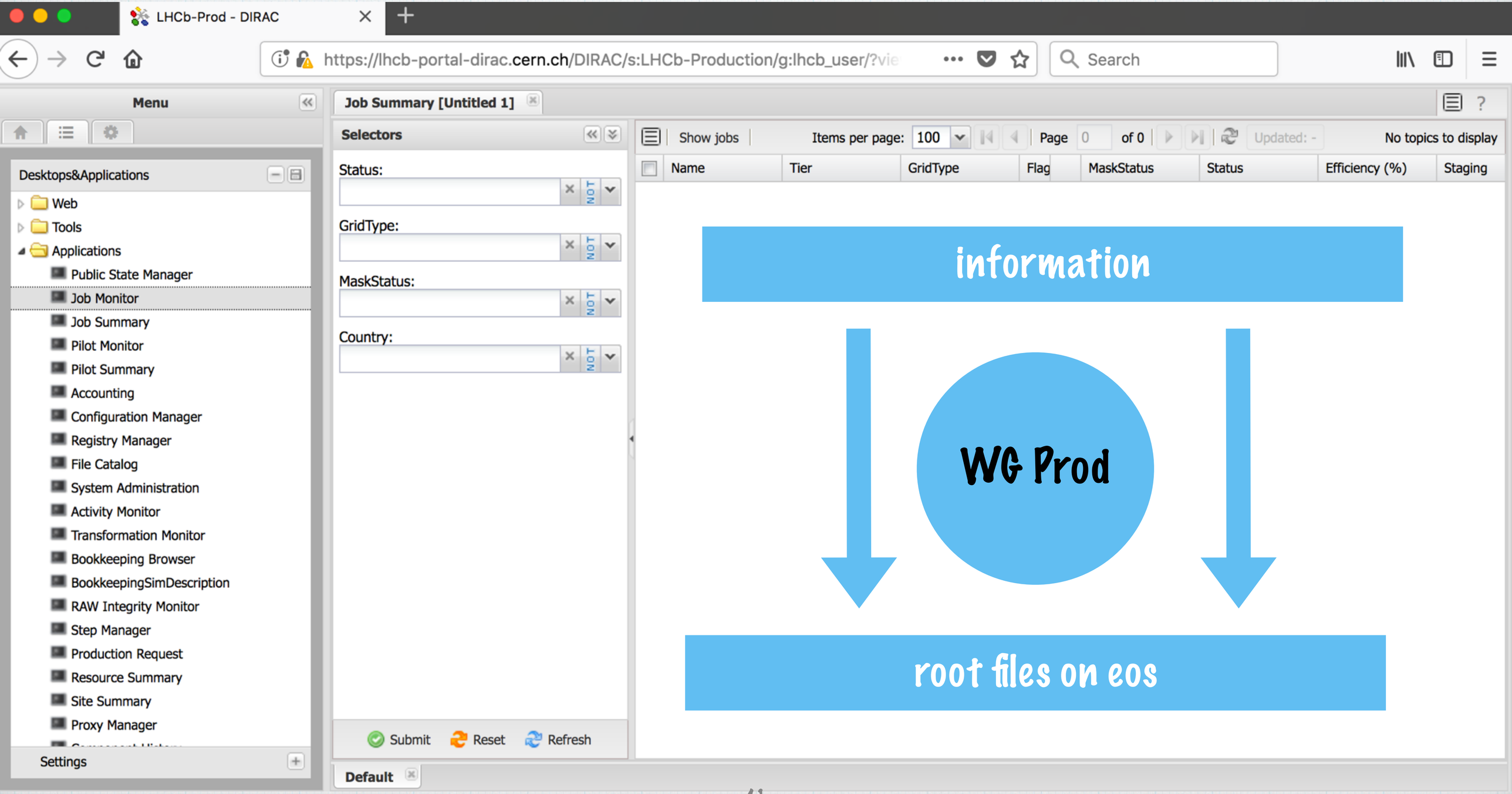
```
*** Welcome to Ganga ***
Version: 7.0.3
Documentation and support: http://cern.ch/ganga
Type help() or help('index') for online help.

This is free software (GPL), and you are welcome to redistribute it
under certain conditions; type license() for details.


INFO     reading config file /afs/cern.ch/user/y/yamhis/.gangarc
INFO     reading config file /cvmfs/ganga.cern.ch/Ganga/install/7.0.3/ganga/GangaLHCb/LHCb.ini
INFO     reading config file /cvmfs/lhcb.cern.ch/lib/GangaConfig/config/6-7-2/GangaLHCb.ini
INFO     Using LHCbDirac version v9r1p17
WARNING  WARNING: You're running low on disk space, Ganga may stall on launch or fail to download job output
WARNING  WARNING: Please free some disk space on: /afs/cern.ch/user/y/yamhis/gangadir/repository/yamhis/LocalXML
WARNING  WARNING: You're running low on disk space, Ganga may stall on launch or fail to download job output
WARNING  WARNING: Please free some disk space on: /afs/cern.ch/user/y/yamhis
 === Welcome to Ganga on CVMFS. In case of problems contact lhcb-distributed-analysis@cern.ch ===
INFO     Constructing LHCbDataset
 LHCbDataset (
   depth = 0,
   treat_as_inputfiles = False,
   persistency = None,
   files = [68 Entries of type 'DiracFile'] ,
   XMLCatalogueSlice =    LocalFile (
     namePattern = '',
     compressed = False,
     localDir = ''
   )
 )
INFO     Constructing LHCbDataset
WARNING  keyword argument in the Job constructor ignored: maxFiles=100 (not defined in the schema)
INFO     submitting job 0
INFO     job 0 status changed to "submitting"
INFO     Job 0: Preparing DaVinci application.
```

submitting the job

```
[21:10:10]
Ganga In [1]: jobs
Ganga Out [1]:
Registry Slice: jobs (1 objects)
--------------
    fqid |    status |      name | subjobs |    application |        backend |                          backend.actualCE |                       comment
-------------------------------------------------------------------------------------------------------------------------------------------------
       0 |       new |MC electro |         |        DaVinci |          Dirac |                                      None |

[21:10:12]
Ganga In [2]:
```

Monitoring


LHCb-Prod - DIRAC
https://lhcb-portal-dirac.cern.ch/DIRAC/s:LHCb-Production/g:lhcb_user/?vie
Search
Menu
Desktops&Applications
Web
Tools
Applications
Public State Manager
Job Monitor
Job Summary
Pilot Monitor
Pilot Summary
Accounting
Configuration Manager
Registry Manager
File Catalog
System Administration
Activity Monitor
Transformation Monitor
Bookkeeping Browser
BookkeepingSimDescription
RAW Integrity Monitor
Step Manager
Production Request
Resource Summary
Site Summary
Proxy Manager
Settings
Job Summary [Untitled 1]
Selectors
Status:
GridType:
MaskStatus:
Country:
NOT
Submit
Reset
Refresh
Default
Show jobs
Items per page:
100
Page
0
of 0
Updated: -
No topics to display
Name
Tier
GridType
Flag
MaskStatus
Status
Efficiency (%)
Staging
information
root files on eos


LHCb-Prod - DIRAC
https://lhcb-portal-dirac.cern.ch/DIRAC/s:LHCb-Production/g:lhcb_user/?vie
Search
Menu
Job Summary [Untitled 1]
Selectors
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Show jobs
Items per page:
100
Page
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of 0
Updated: -
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Name
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GridType
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Efficiency (%)
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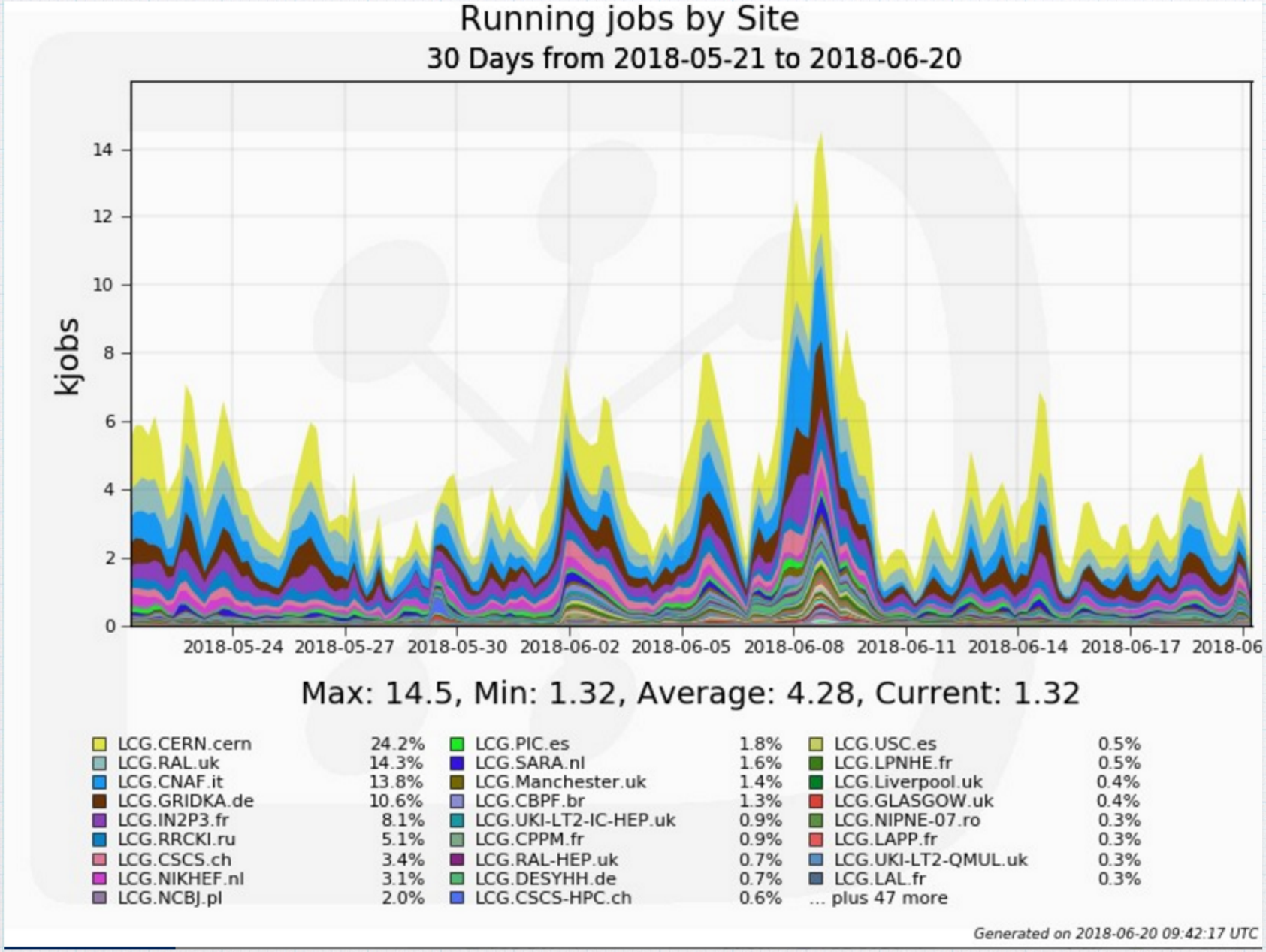
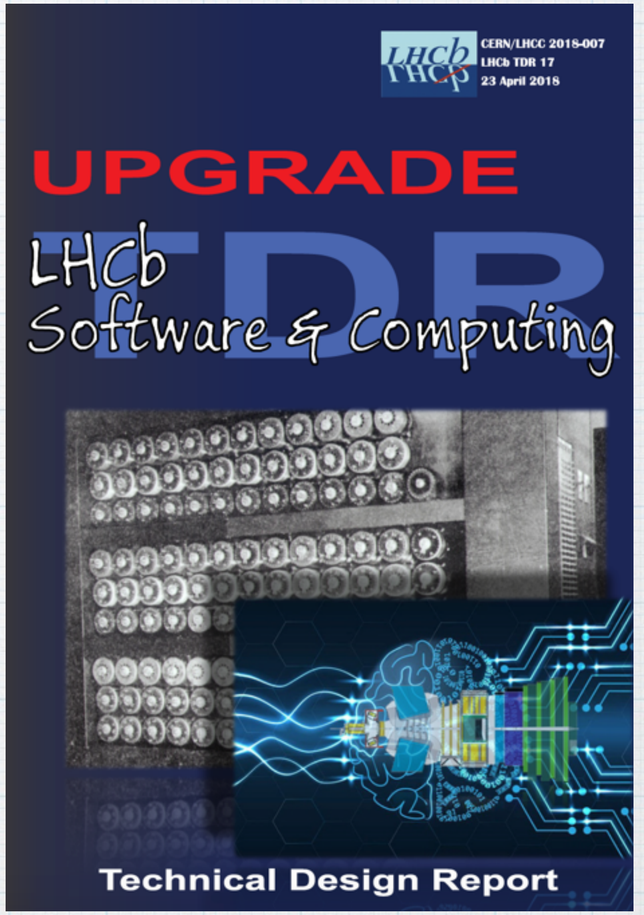
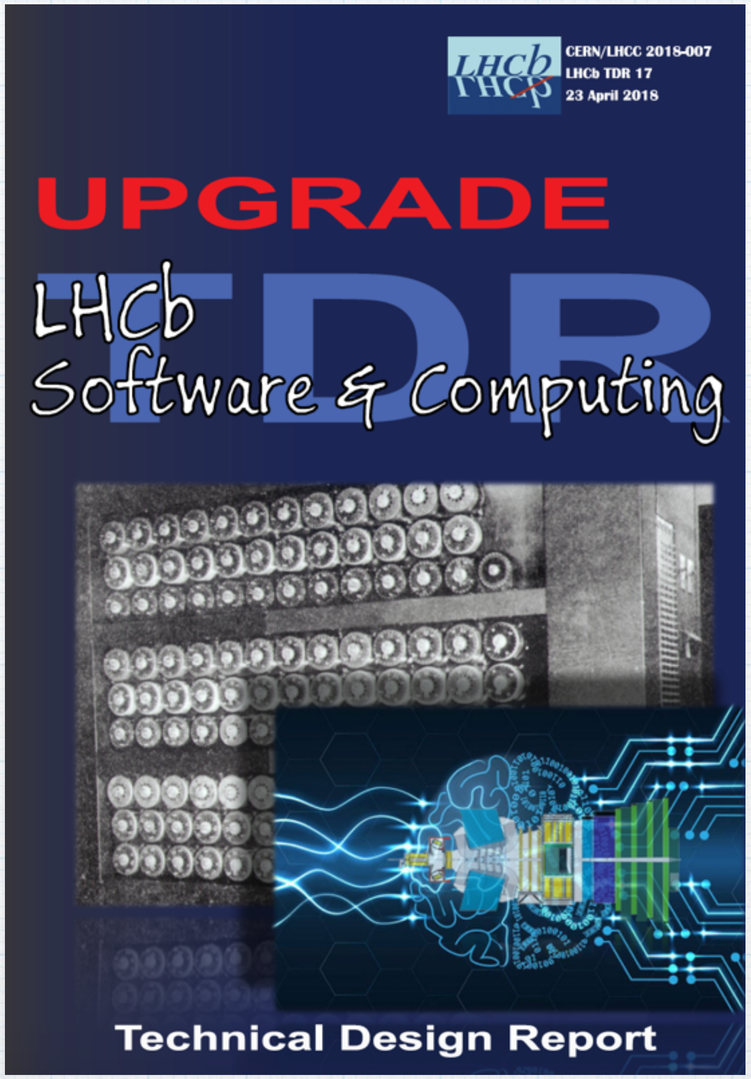
Bookkeeping Browser
BookkeepingSimDescription
RAW Integrity Monitor
Step Manager
Production Request
Resource Summary
Site Summary
Proxy Manager
Settings
Default
information
WG Prod
root files on eos


Running jobs by Site
30 Days from 2018-05-21 to 2018-06-20
kjobs
0
2
4
6
8
10
12
14
2018-05-24
2018-05-27
2018-05-30
2018-06-02
2018-06-05
2018-06-08
2018-06-11
2018-06-14
2018-06-17
2018-06
Max: 14.5, Min: 1.32, Average: 4.28, Current: 1.32
LCG.CERN.cern 24.2%
LCG.RAL.uk 14.3%
LCG.CNAF.it 13.8%
LCG.GRIDKA.de 10.6%
LCG.IN2P3.fr 8.1%
LCG.RRCKI.ru 5.1%
LCG.CSCS.ch 3.4%
LCG.NIKHEF.nl 3.1%
LCG.NCBJ.pl 2.0%
LCG.PIC.es 1.8%
LCG.SARA.nl 1.6%
LCG.Manchester.uk 1.4%
LCG.CBPF.br 1.3%
LCG.UKI-LT2-IC-HEP.uk 0.9%
LCG.CPPM.fr 0.9%
LCG.RAL-HEP.uk 0.7%
LCG.DESYHH.de 0.7%
LCG.CSCS-HPC.ch 0.6%
LCG.USC.es 0.5%
LCG.LPNHE.fr 0.5%
LCG.Liverpool.uk 0.4%
LCG.GLASGOW.uk 0.4%
LCG.NIPNE-07.ro 0.3%
LCG.LAPP.fr 0.3%
LCG.UKI-LT2-QMUL.uk 0.3%
LCG.LAL.fr 0.3%
... plus 47 more
Generated on 2018-06-20 09:42:17 UTC


LHCb
CERN/LHCC 2018-007
LHCb TDR 17
23 April 2018
UPGRADE
LHCb
Software & Computing
Technical Design Report

Un peu de lecture



Questionnaire de Proust

What is the observable ? A Br ? An angle ?

What is the process ? A penguin ? A tree ?

What are we testing/measuring ? NP ? SM ?

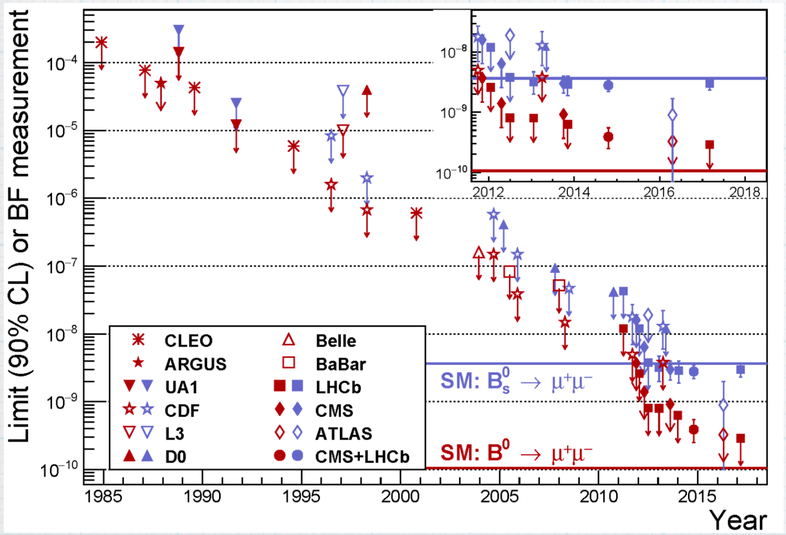
What is the stat ? Rare decay ?

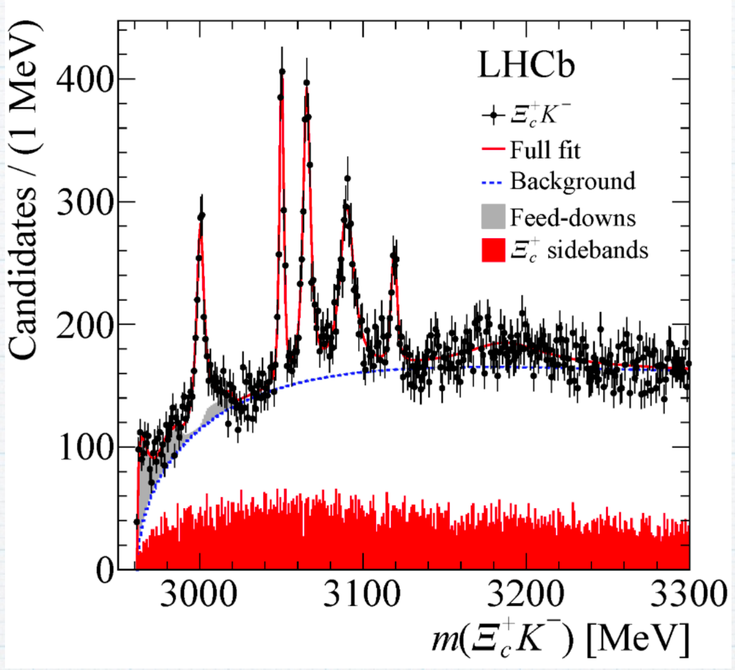
What is the topology of the decay ? Are we ever going to see it ?

What about the systematics ?

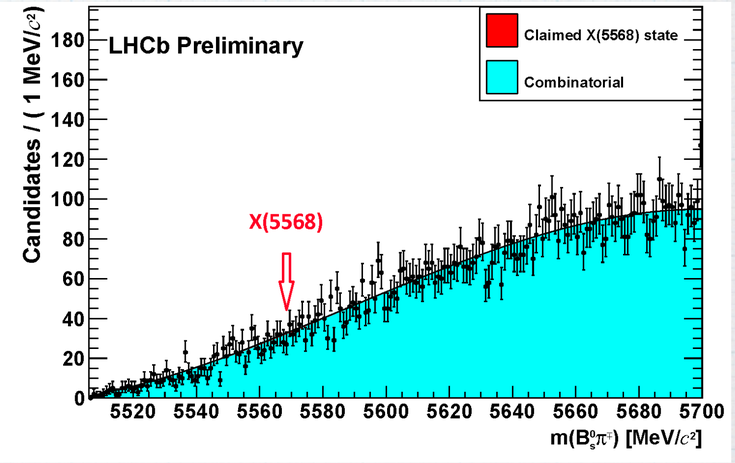
Do we really care about it ?

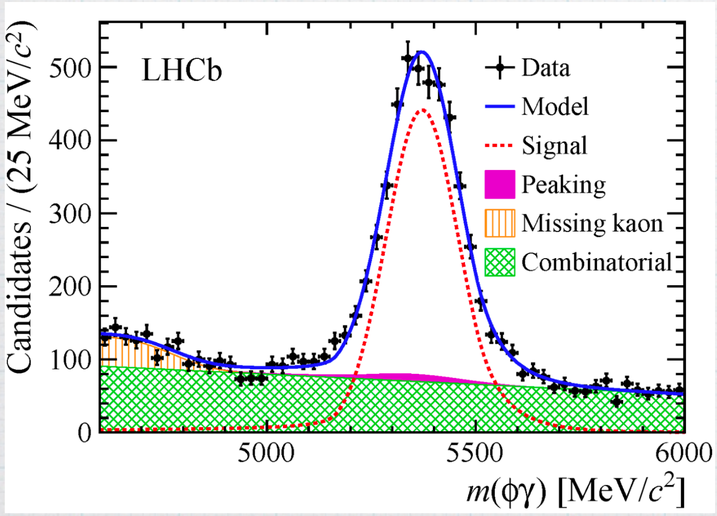
Merci !

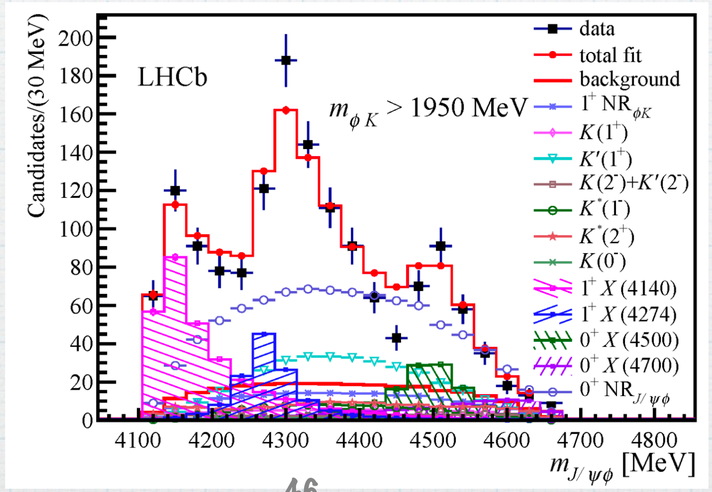


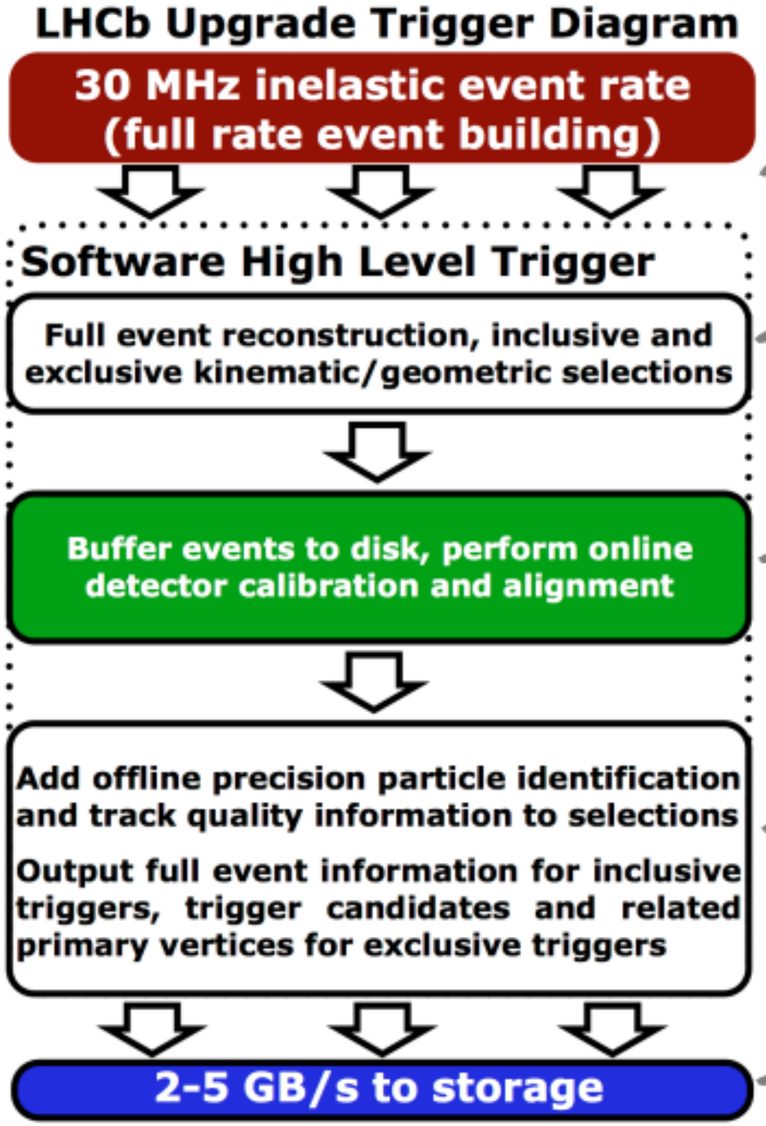


Lots of results









40 MHz readout. Aggregate 40 Tbit/s.

Tracking, followed by high efficiency
1-, 2-displaced tracks inclusive selections

→ reduce to 1 Tbit/s

Disk buffering and online calibration/alignement mechanisms demonstrated in Run 2.

Full reconstruction including particle identification + pure and efficient exclusive selections

[arXiv:1604.05596]

Turbo stream for high rate signals

→ Analysis on trigger object, only save what is necessary from the event