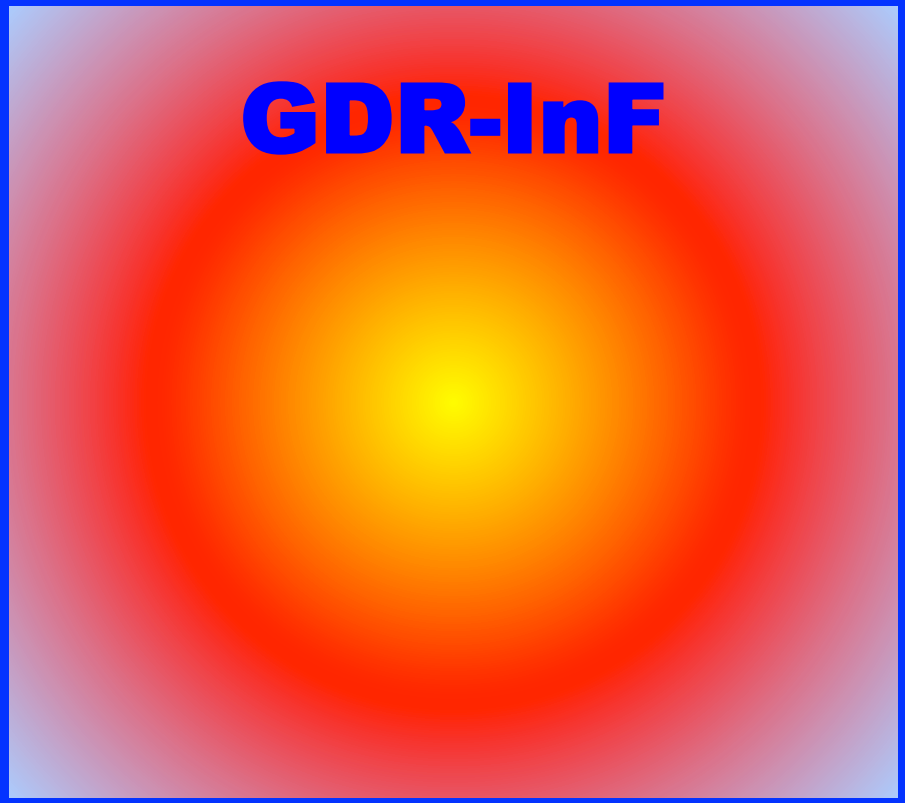


Groupement De Recherche
INTENSITY FRONTIER

Aoife Bharucha - Francesco Polci

THE INTENSITY FRONTIER

Probe NP pushing the experiment's luminosity rather than the energy scale.

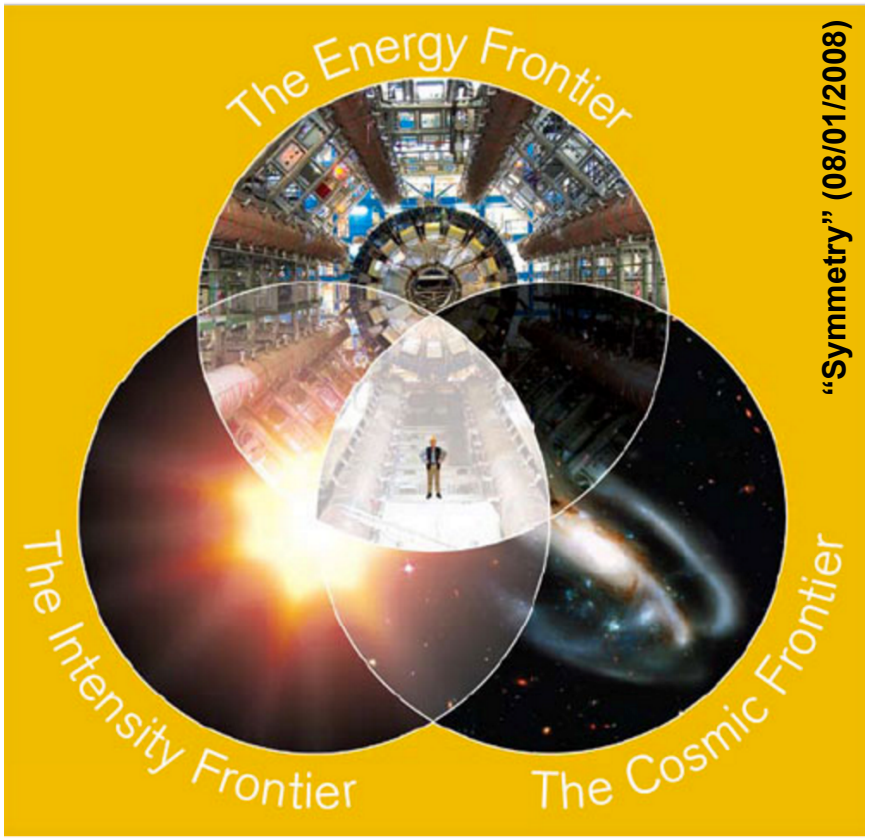
Strategies

1) **Measure SM processes having precise theory predictions**

2) **Search for hugely suppressed or forbidden processes in SM**

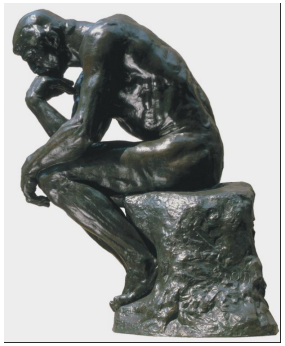
Both imply exploring rare processes
=> require high intensity

Proven to be successful already!



THE INTENSITY FRONTIER IN FRANCE

Lots of activities in the field in France



Theory:

- lattice QCD, EFT, sum rules calculations
- interpretation and predictions to phenomenology in the SM and beyond
- Fitting tools (CKMFitter, UTFit,…)

Experiments:

- Past: CPLEAR, NA48, BaBar… (certainly not exhaustive)
- Present: LHCb, nEDM@PSI, …
- Future: Belle2, COMET, SHIP… (at different levels)

Always keeping the eyes open on:

- the rest of the national and international community
- experiments running or getting planned in the world: NA62, MEG, FCC, ….

WHY A GDR?

Theory and experiment need to come together for interpret results, combine bounds from different searches

Goals:

- Reinforce relations between **theory and experiment**
- Facilitate **collaborations among labs**
- Favor the emergence of **common projects**
- Keep the **community bounded**, exchanging ideas and knowledge
- Provide **visibility** to the French intensity frontier community
- Promote the **young generation** of physicists working in the field
- Discuss about the **future of the intensity frontier**
- **Interact with the other French GDRs** (neutrino, Terascale, QCD)
- **Stay connected with the world** panorama in particle physics

THE GDR-InF COMMUNITY

- GDR-InF created on January 2017
- 61 senior physicists
- 14 laboratories of IN2P3, INP, CEA
- Many students and postdocs
- New members welcome!

Allocated budget: 15000 euros per year

One formal step missing: convention

Asmaa Abada[14], Ziad Ajaltouni[11], Yasmine Amhis[10], Sergey Barsuk[10], Nicole Bastid[11], Jerome Baudot[7], Damir Becirevic[14], Karim Benakli[15], Eli Ben-Haim[12], Véronique Bernard[4], Aoife Bharucha[2], Benoit Blossier[14], Philippe Boucaud[14], Jerome Charles[2], Matthew John Charles[12], Jacques Chauveau[12], Max Chefdeville[8], Julien Cogan[1], Eric Cogneras[11], Philippe Crochet[11], Wilfrid Da Silva[12], Sascha Davidson[5], Cedric Delaunay[9], Luigi Del Buono[12], Olivier Deschamps[11], Sebastien Descotes-Genon[14], Benjamin Fuks[15], Vladimir Gligorov[12], Mark Goodsell[15], Diego Guadagnoli[9], Frederic Kapusta[12], Marc Knecht[2], Emi Kou[10], Witek Krasny[12], Stephane Lavignac[6], Francois Le Diberder[10], Régis Lefèvre[11], Renaud Le Gac[1], Laurent Lellouch[2], Olivier Leroy[1], Frederic Machefert[10], Giampiero Mancinelli[1], Mariane Mangine Brinet[13], Nazila Farvah Mahmoudi[3], Jean Francois Marchand[8], Stephane Monteil[11], Vincent Morenas[11], Jean Orloff[11], Pascal Perret[11], Francesco Polci[12], Sarah Porteboeuf[11], Isabelle Ripp-Baudot[7], Patrick Robbe[10], Marie-Hélène Schune[10], Justine Serrano[1], Christopher Smith[13], Ana Teixeira[11], Vincent Tisserand[8], Stephane T'Jampens[8], Edwige Tournefier[8], Guy Wormser[10]

[1] *Centre de Physique des Particules de Marseille (CPPM), Marseille*
[2] *Centre de Physique Théorique (CPT), Marseille;*
[3] *Centre de Recherche Astrophysique de Lyon (CRAL), Lyon*
[4] *Institut de Physique Nucléaire (IPN), Orsay*
[5] *Institut de Physique Nucléaire de Lyon (IPNL), Lyon*
[6] *Institut de Physique Théorique (IPhT), CEA Saclay*
[7] *Institut Pluridisciplinaire Hubert Curien (IPHC), Strasbourg*
[8] *Laboratoire d'Annecy-Le-Vieux de Physique de Particules (LAPP), Annecy-Le-Vieux*
[9] *Laboratoire d'Annecy-Le-Vieux de Physique Théorique (LAPTh), Annecy-Le-Vieux*
[10] *Laboratoire de l'Accélérateur Lineaire (LAL), Orsay*
[11] *Laboratoire de Physique Corpuscolaire (LPC), Clermont-Ferrand*
[12] *Laboratoire de Physique Nucléaires et des Hautes Energies (LPNHE), Paris;*
[13] *Laboratoire de Physique Subatomique et Cosmologie (LPSC), Grenoble*
[14] *Laboratoire de Physique Théorique (LPT), Orsay*
[15] *Laboratoire de Physique Théorique et Hautes Energies (LPTHE), Paris*

Conseil de groupement

Following the proposal received, we have identified these members.
A meting per year, in coincidence with the general meeting.

Stephanie Roccia (CSNSM)
Olivier Leroy (CPPM)
Olivier Deschamps (LPC)
Nazila Mahmoudi (CRAL)
Stephane Lavignac (IPhT, CEA)
Isabelle Ripp-Baudot (IPHC)
Stephane T'Jampens (LAPP)
Diego Guadagnoli (LAPTh)
Marie-Helene Schune (LAL)
Christopher Smith (LPSC)
Sebastien Descotes-Genon (LPT)
Mark Goodsell (LPTHE)
Jerome Charles (CPT)

In role for 2,5 years

WORKING GROUPS

- CP violation
- Rare- radiative and semi-leptonic B decays
- Charm and Kaon physics
- Heavy flavour production and spectroscopy
- Interplay of quark and lepton flavour
- Future experiments

WORKING GROUPS

Following the proposal received, we have identified the conveners:

- **CP violation**
  Christopher Smith, Jean-Francois Marchand
- **Rare- radiative and semi-leptonic B decays**

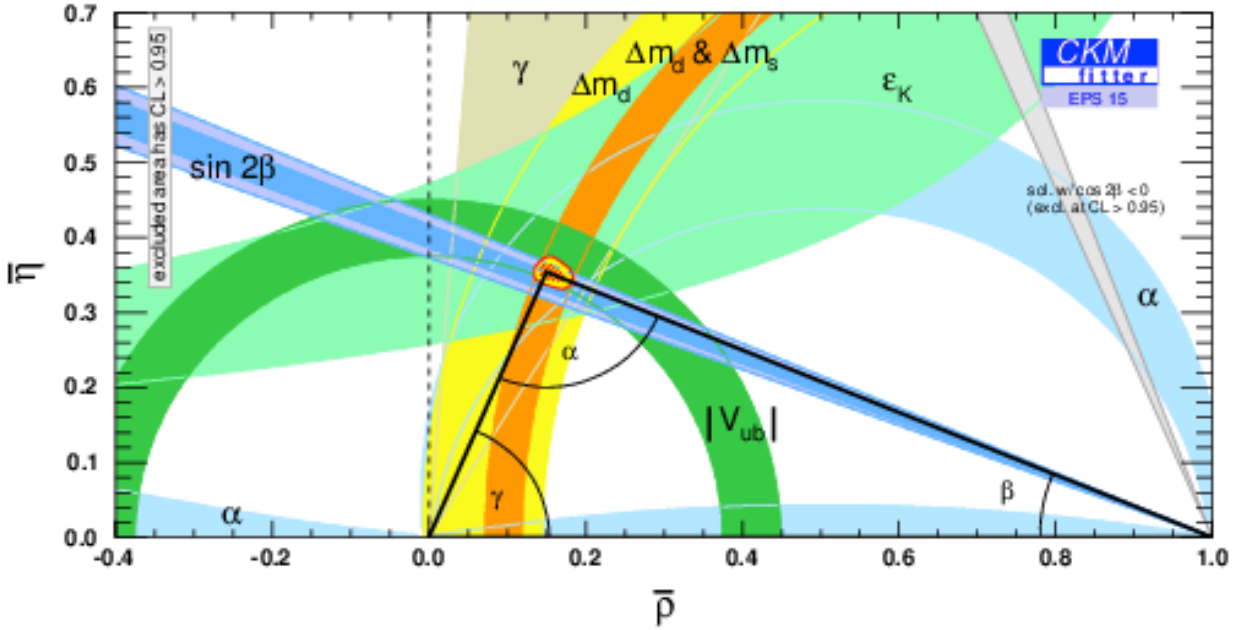
  +
- **Charm and Kaon physics**
  Damir Becirevic, Diego Guadagnoli, Justine Serrano, Yasmine Amhis
- **Heavy flavour production and spectroscopy**
  Emi Kou, Matthew Charles
- **Interplay of quark and lepton flavour**
  Ana Teixeira, Stephanie Roccia
- **Future experiments**
  Mark Goodsell, Stephane Monteil

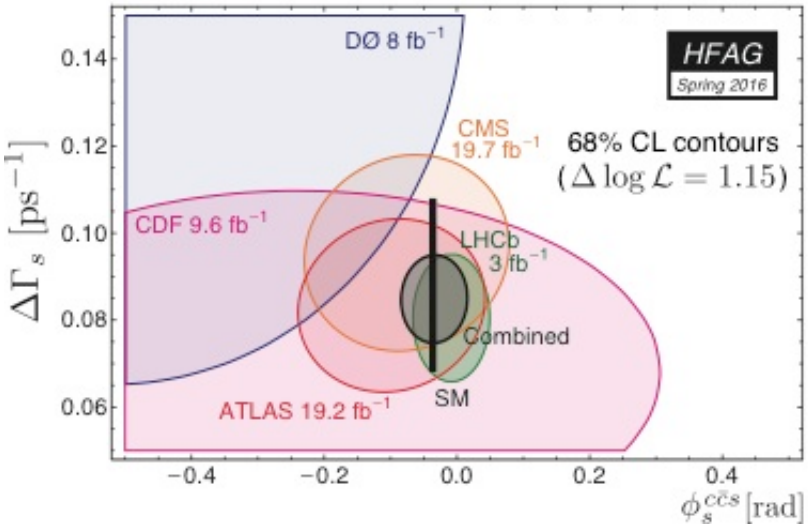
In role for 2,5 years

CP VIOLATION

Unitarity triangle: powerful test of the SM! (CKMFitter, UTfit)

B-factories and LHCb have a leading role





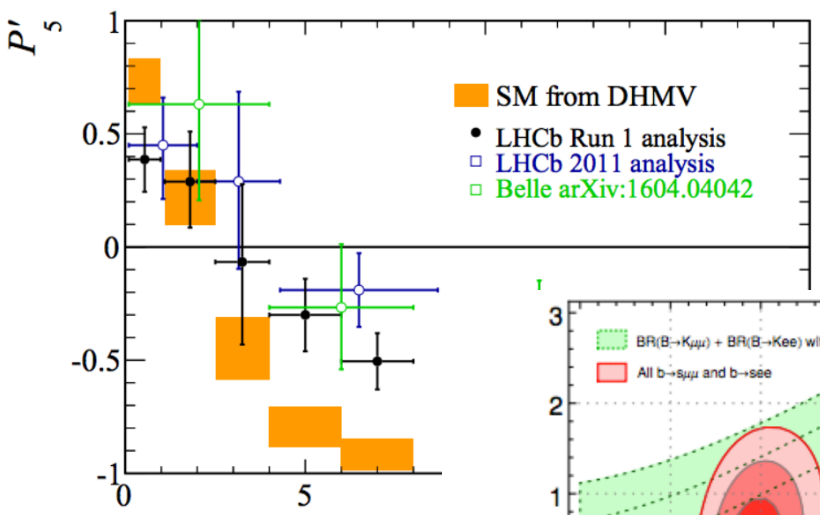
We are not yet done!

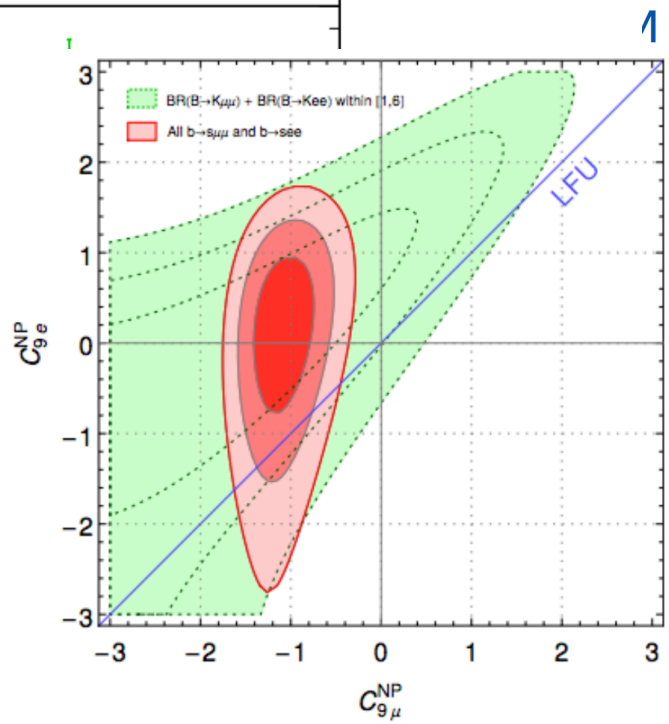
- measurement of γ to be improved
- B_s sector measurements (ϕ_s)
- Baryon sector
- CPV in strong interaction? (EDM experiments)

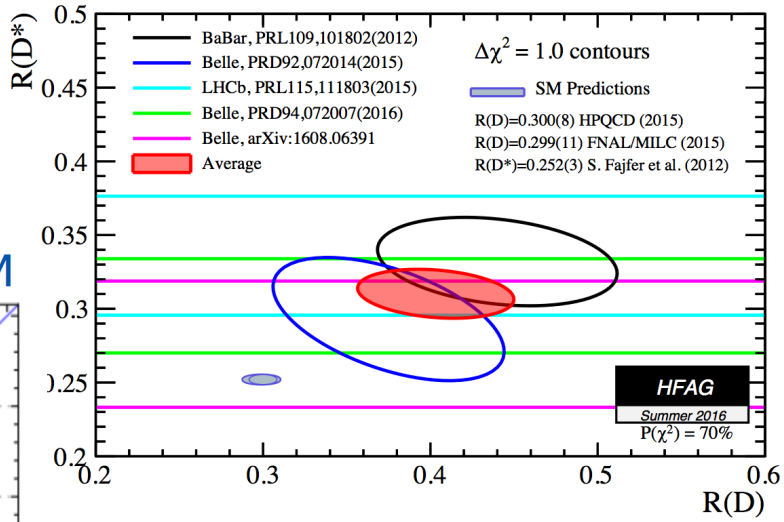
RARE, RADIATIVE AND SEMILEPTONIC B DECAYS

- **A plethora of results!** *BR*(B_s->$\mu\mu$), exciting tension in B->$K^*\mu\mu$ angular analysis, many *BRs*, LFU tests(R_K, R_{D^*}), constraints from B_s->$\phi\gamma$ and B->$K^*\gamma$

- Need to get all together for **understanding the overall picture!**

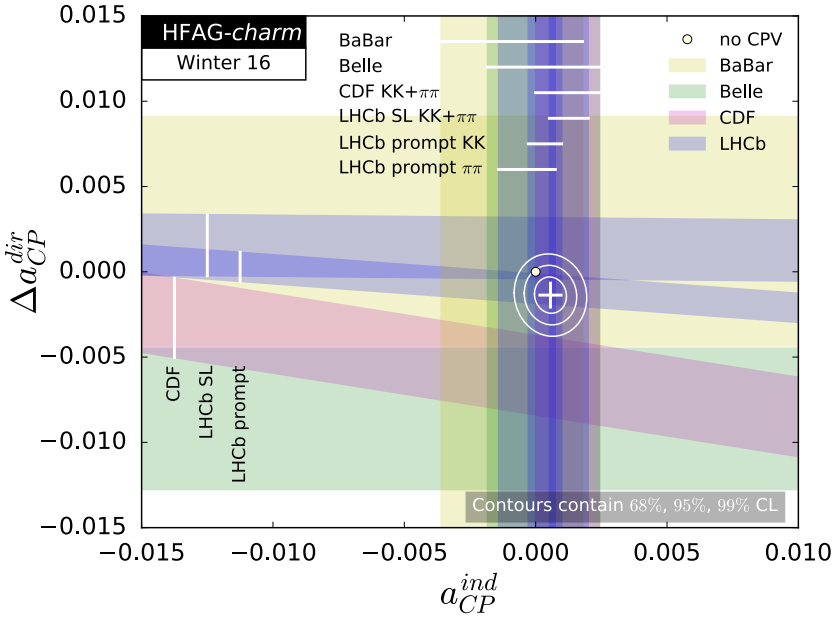




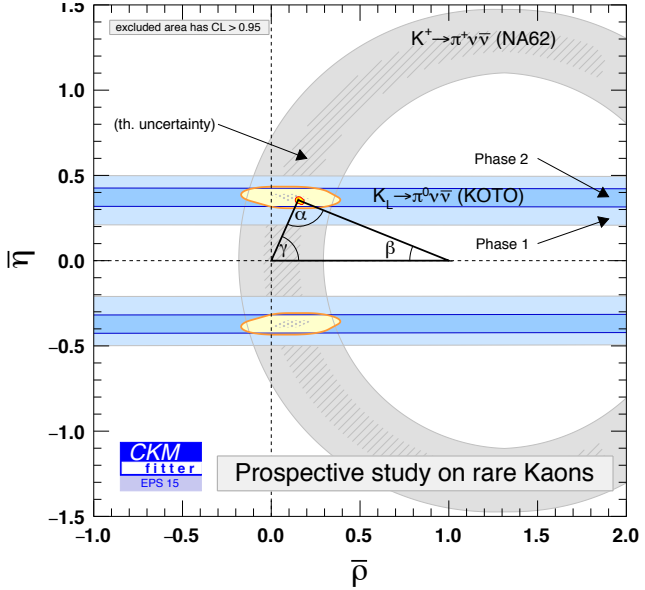


CHARM AND KAON PHYSICS

How to increase sensitivity to charm and kaon in current experiments?



- **Charm: difficult theoretical predictions** (long distance contributions dominating)
- **CP violation in charm:** a null test of NP (expected below ‰ level in SM)
- **Rare charm decays?**
  (ex: D^{+}->$\pi\mu\mu$ majorana neutrinos,
  D^{0}->$K\pi\mu\mu$ FCNC)

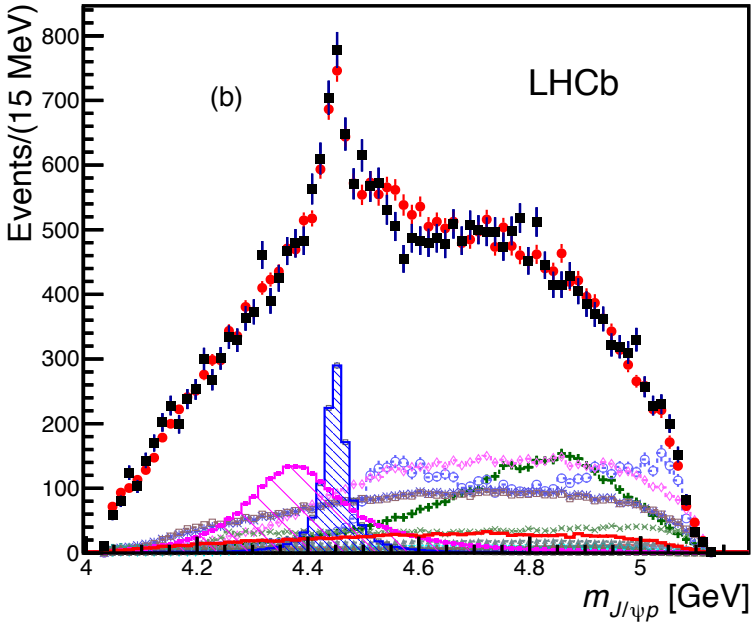


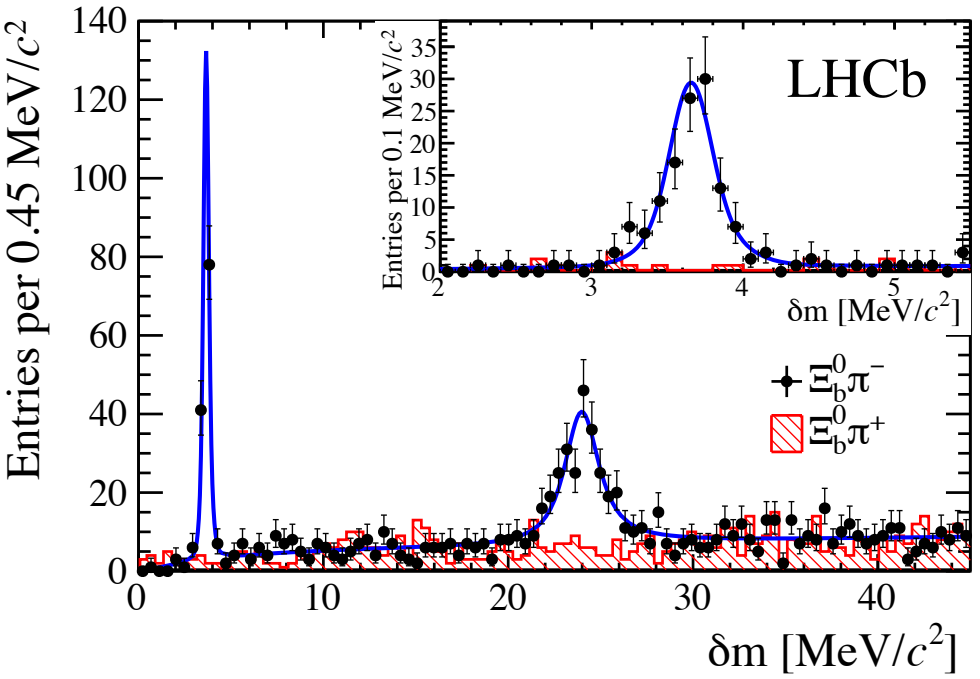
- **Kaon: birthplace of CPV!**
- Lattice QCD progressing on the evaluation of K->$\pi\pi$ => **precise calculation of $\varepsilon_{K'}/\varepsilon_K$**
- **Rare decays:**
  K->$\pi\nu\nu$ (NA62, Koto)
  LFV K->$(\pi)e\mu$

HEAVY FLAVOUR PRODUCTION AND SPECTROSCOPY

- **Probe QCD, crucial input for all measurements**
  (ex: - spectrum of charm resonances for R_{D^*};
  - $B->K^*\mu\mu$ form factors;
  - backgrounds description in simulation)

- **Interesting exotic states (pentaquarks, tetraquarks)** showing up: what do we learn?

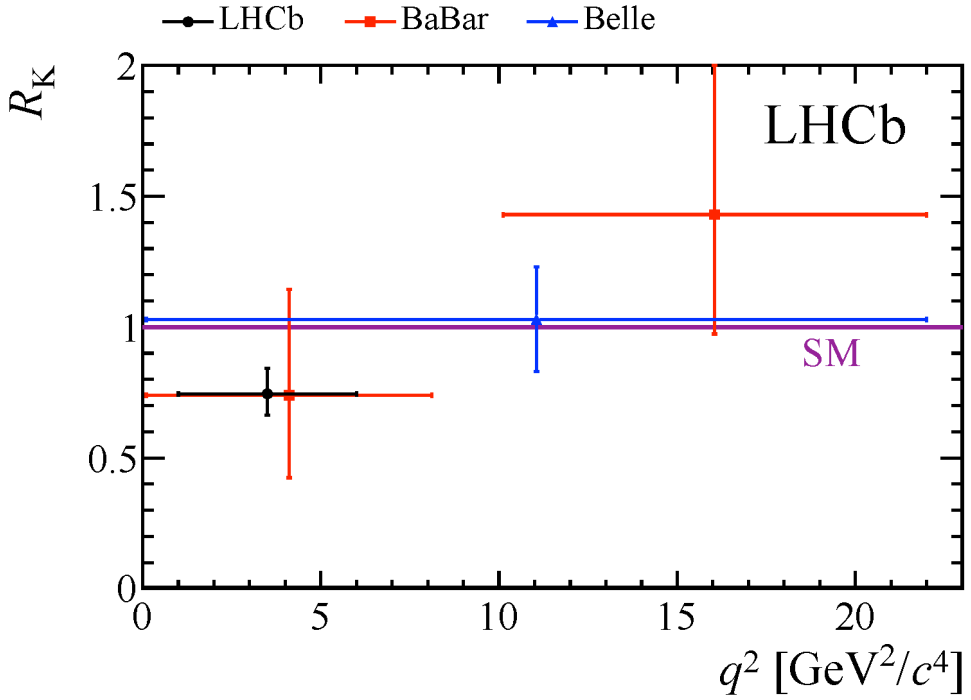


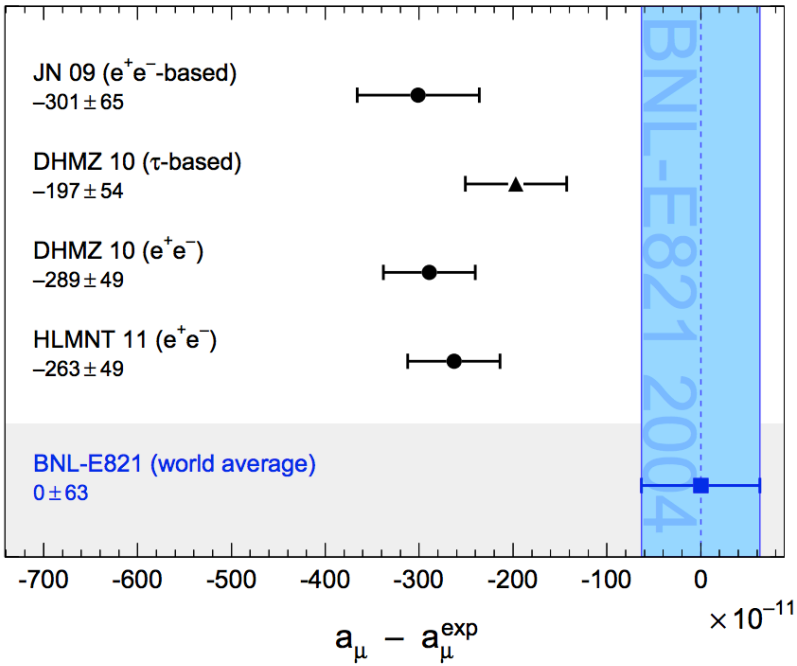


INTERPLAY OF QUARK AND LEPTON FLAVOUR

Tension in LFU test R_K, more R_H measurements coming

- **Connection with LFV dedicated experiments** (MEG, Mu2e, Mu3e, COMET, …)?
- Relation between the **NP alternatives in the quark sector and in the lepton sector** (extended Higgs sector, extended gauge sector, additional symmetries,…) ?
- **Implication on flavor conserving observables**, like *(g-2)*μ or di-electric dipole moments of leptons?

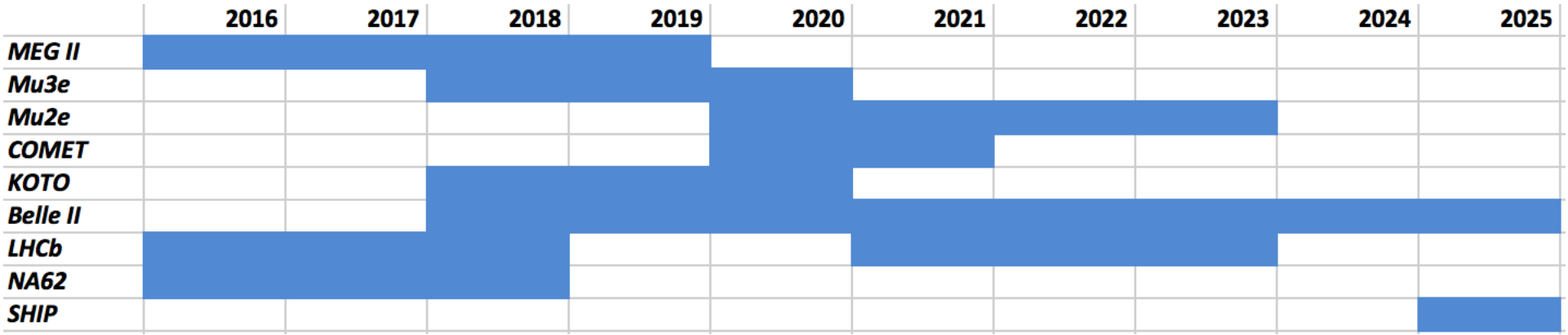




FUTURE EXPERIMENTS

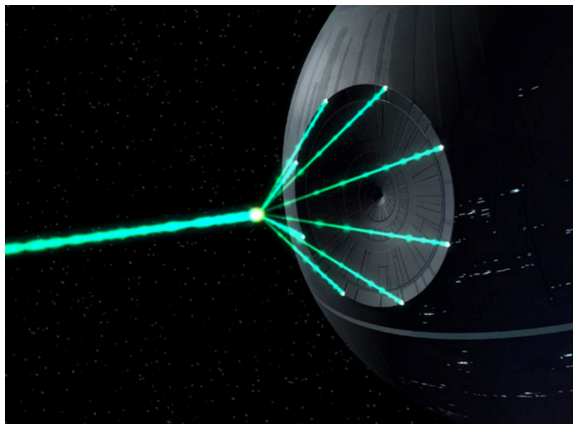
Many! Some ongoing, some starting soon, some foreseen.

Exciting time! Need to get informed and plan!



Beware: not precise timescale…

+ LHCb upgrade phase 2
+ FCC
+ dedicated WISP (weakly interacting new light particles) searches
+ ....



ACTIONS!

Meetings:

- A general workshop each year
- Smaller (cross-)working group meetings
- Purpose: brainstorming, knowledge exchange, concrete work together
- Format: any useful (talks, round table, bootcamps, hackathons, …)

Mailing list to diffuse any information concerning the field (news, conference and workshops, job opportunities,…): GDR-INTENSITYFRONTIER-L@LISTSERV.IN2P3.FR

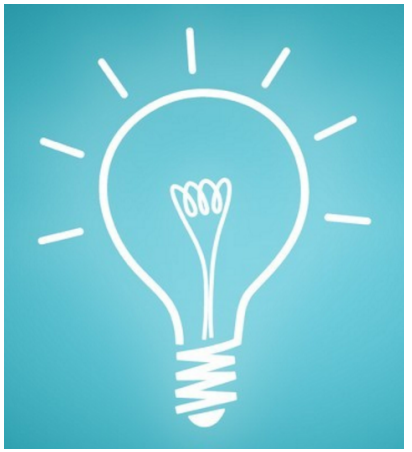
Please invite your students/postdocs to sign up!

Web site to collect the actions (work in progress): http://gdrintensityfrontier.in2p3.fr/

Question: How to make everyone aware of interests/activities of the others?

Other ideas?

Proposal of activities



Some proposals received:

- Workdays on charmless decays
- Workshop on future experiments in intensity frontiers
- LHCb upgrade phase 2: brainstorming on physics case
- Workshop on SHIP

Please send additional proposal by the end of April

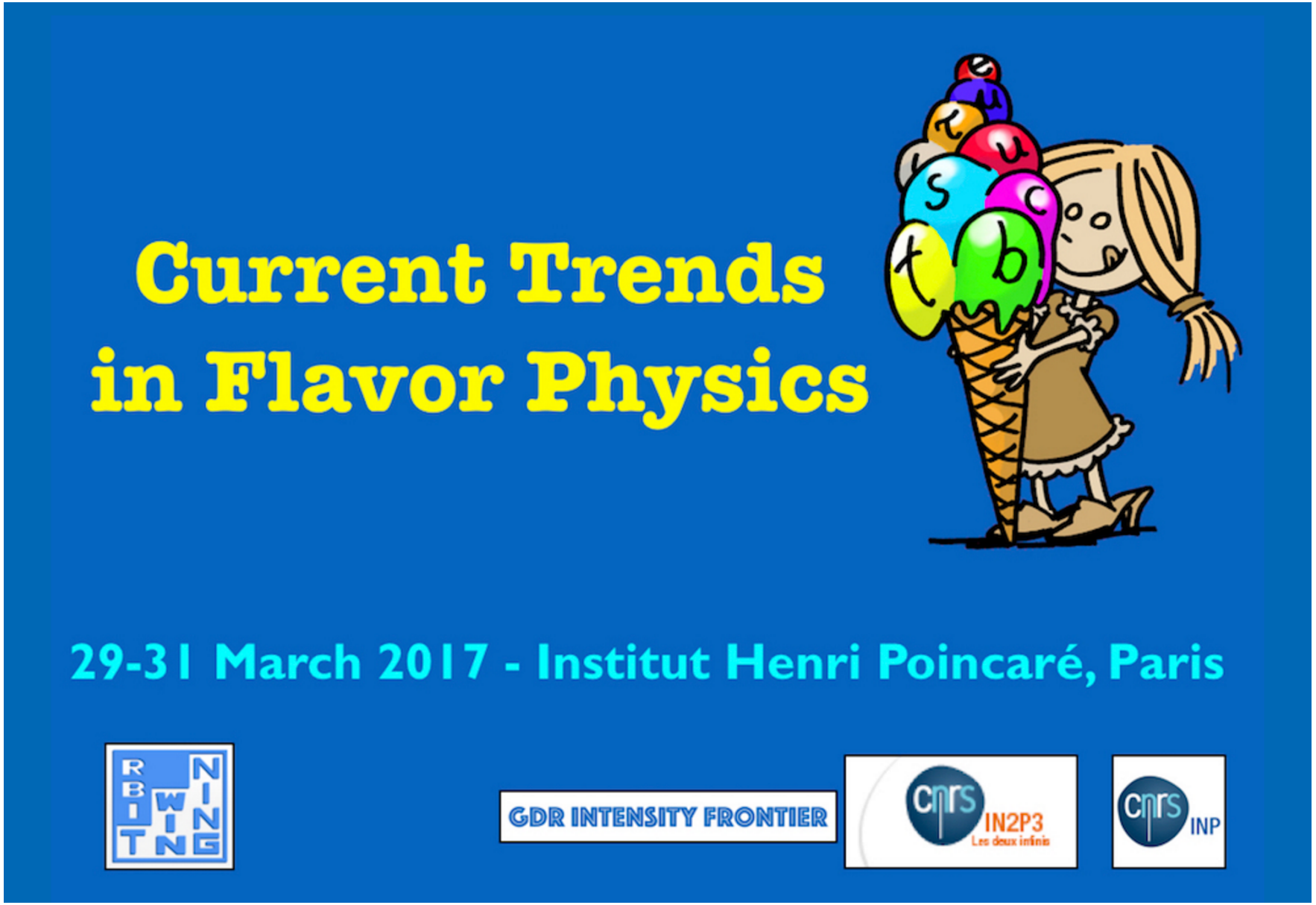
(with a couple of lines of explanation if possible)

They will be discussed with the conveners

The GDR-InF is willing to support all activities related to the intensity frontier.
Unfortunately we cannot fund all: **co-funding is very welcome!**

Feel free to always **advertise your events and positions on the mailing list!**

THE GDR-InF KICK-OFF MEETING!



https://indico.in2p3.fr/event/14159/