Isabelle Ripp-Baudot, IPHC Strasbourg
Joint workshop of the FJ- and FK-PPL
Seoul, 18-20 May, 2016

project: FLAV_01

(3rd year of project in JFY-2016)

Characterisation of the SuperKEKB induced background during the BEAST II commissioning of the Belle II experiment

Outline:

- **SuperKEKB collider, Belle II and BEAST II experiments**
- **Status report on JFY-2015 activity**
- **Spending of JFY-2016 funding and request for JFY-2016**
- **Conclusion and outlook**

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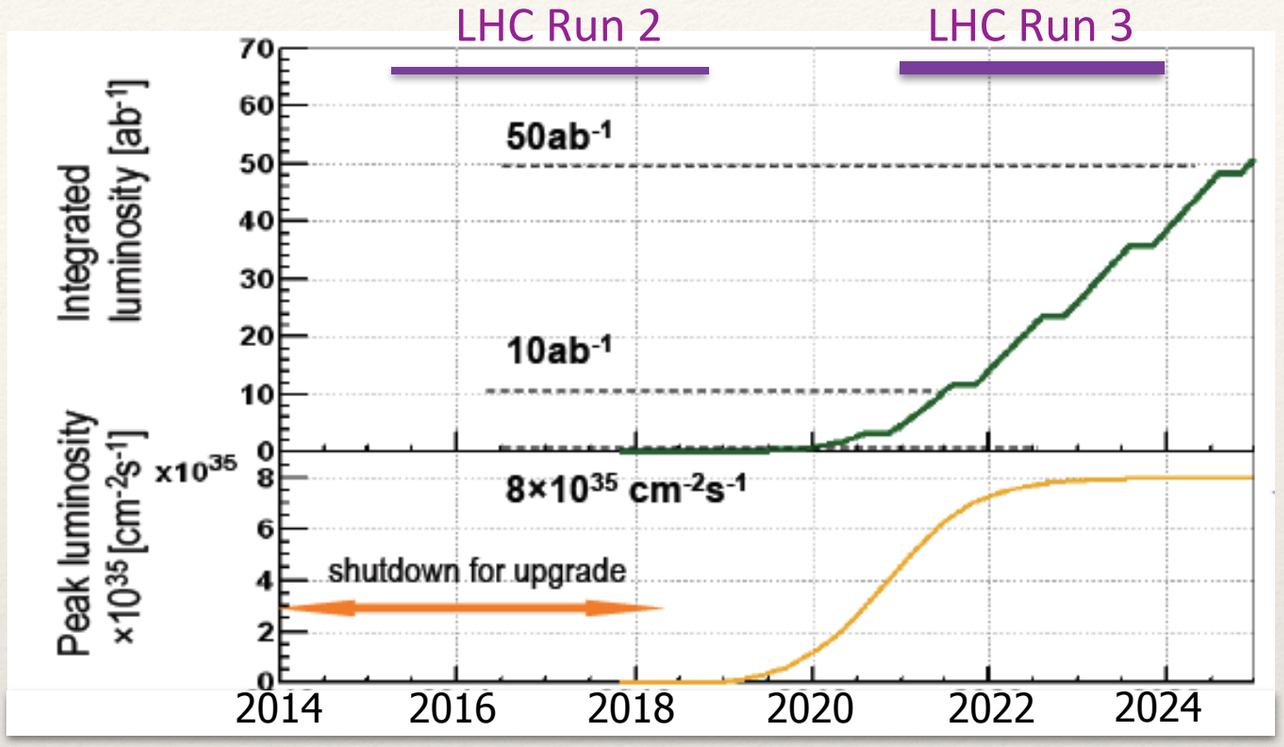
Belle II and SuperKEKB

- Belle II experiment at SuperKEKB:
  - International collaboration: 570 members from 23 countries.
  - Physics program complementary to LHC: quantum path to discover and understand BSM physics.

- SuperKEKB e^+e^- collider at Y(4S):
  - Based on a new nano-beam scheme.
  - Goal: instantaneous luminosity world record (from KEKB) ×40 to reach **$L = 0.8\times10^{36}\ cm^{-2}\ s^{-1}$**.



October 2018: start of physics run

End 2024: 50 ab^{-1} on tape

Early 2016: BEAST II collider commissioning until $10^{34}\ cm^{-2}\ s^{-1}$ reached.

End of 2021: 10 ab^{-1} on tape

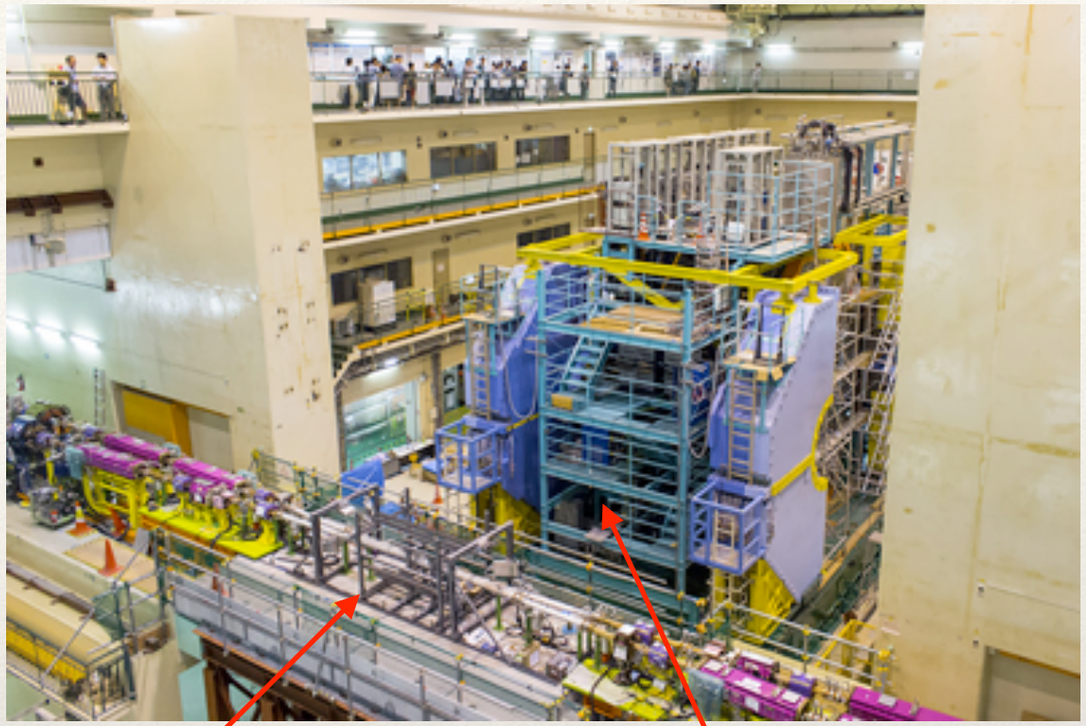
The BEAST II experiment

Beam **E**xorcism for **A** **ST**able BELLE **II** experiment.

IPHC and LAL joined the KEK project "MDI R&D for SuperKEKB" in July 2014.

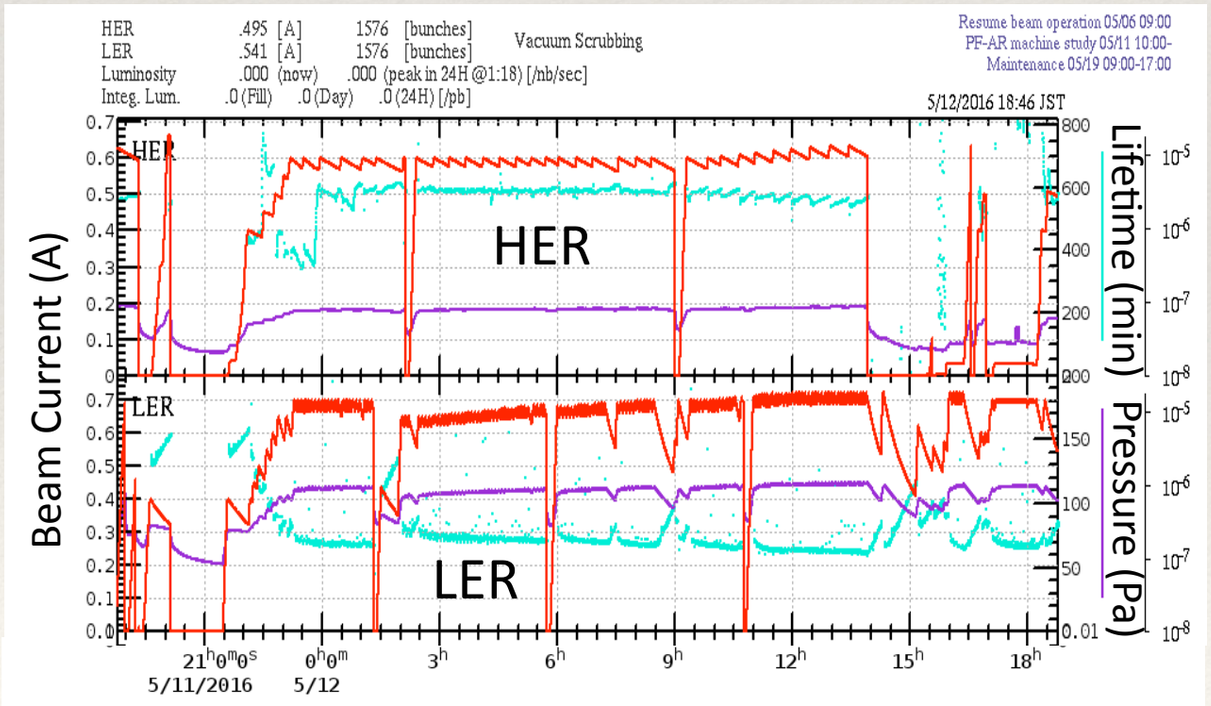
BEAST II Phase 1

- Fine tuning of single beams.
- Study of Single Beam background.
- Belle II detector is rolled out, dedicated BEAST Phase 1 detectors equip the Interaction Region.
- Data taking campaign: Feb. 2016 - June 2016.



BEAST **BEAUTY**

SuperKEKB is on!



http://www-linac.kek.jp/skekb/snapshot/dailysnap.html

- Press releases:

KEK: http://www.kek.jp/en/NewsRoom/Release/20160302163000/

interaction.org: http://www.interactions.org/cms/?pid=1035541

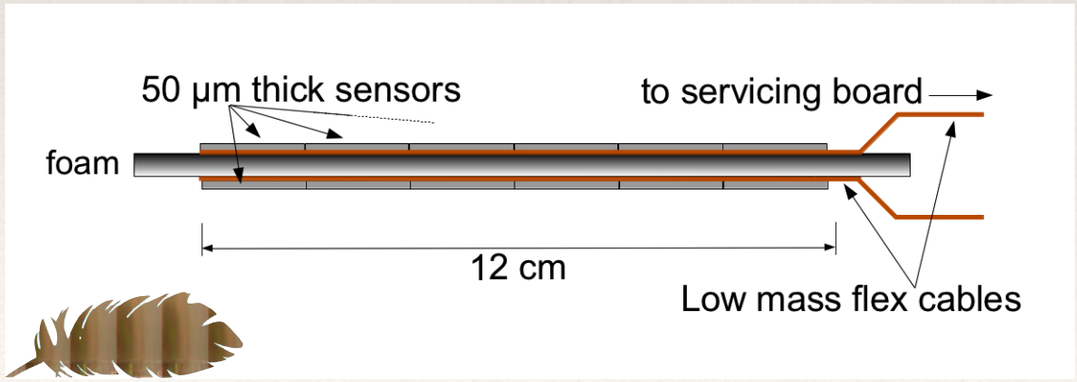
IN2P3: http://www.in2p3.fr/recherche/actualites/2016/nouvelle_super_KEKB.html

French newspaper: http://www.lefigaro.fr/sciences/2016/04/27/01008-20160427ARTFIG00366-superkekb-un-accelerateur-de-particules-va-explorer-des-pans-inconnus-de-la-physique.php

BEAST II Phase 2

- Commissioning of Belle II and SuperKEKB in colliding mode.
- Data taking campaign: Nov. 2017 - March 2018.
- Belle II detector (w/o inner tracker) at interaction point, solenoid and final focus magnet on.
- Inner tracker equipped with dedicated BEAST Phase 2 detectors + 1 VXD module.
- Purpose:
  - Fine tuning of beam parameters to reach 10^{34} cm^{-2} s^{-1}.
  - Commissioning of the Belle II detector and DAQ.
  - Insure safe operation of the Belle II detector.
  - Study of single beam and beam beam background.
  - Validation of the background simulation.
  - Positioning of shields to screen the background.

➢ Proposal: use unique feature of the double-sided pixelated PLUME ladder to characterise the background induced within the inner tracker volume of Belle II.



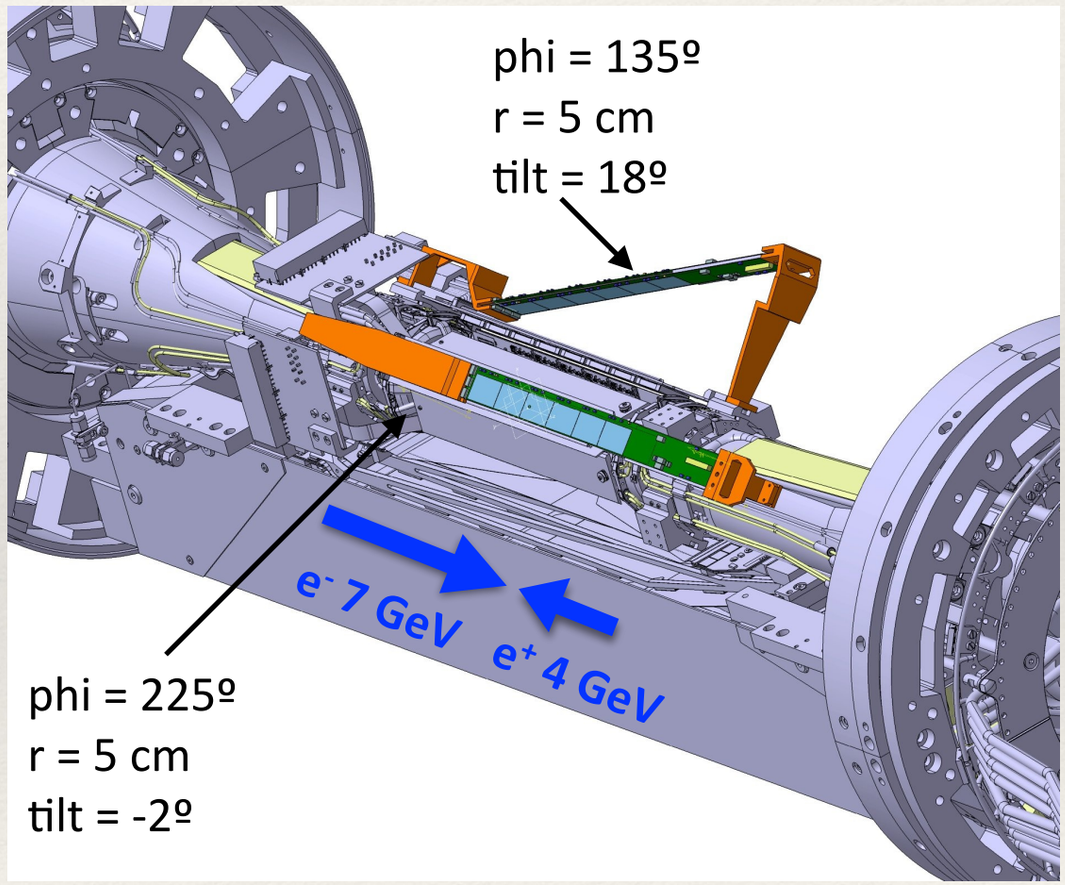
- R&D pursued for the ILC vertex detector.
- Double-sided pixel layer.
- Self-stiffened.
- Very light: record material budget 0.4 % X_0.
- 8×10^6 pixels, pitch 18.4×18.4 μm^2.

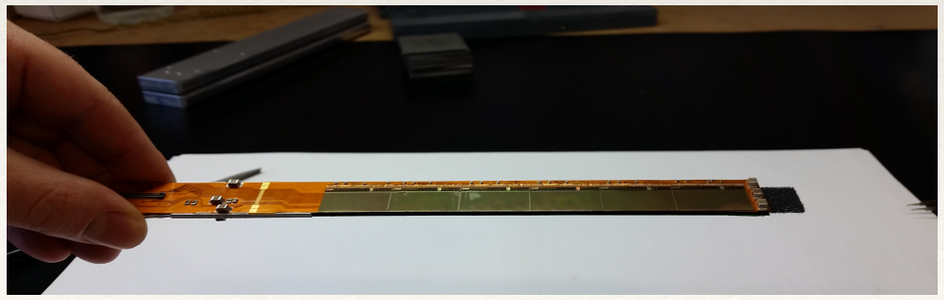
Status report on JFY-2015 activity: detector construction

- BEAST Phase 2 detector list presented by Belle II to the BPAC in October 2015:
  PLUME device geometry consists of 2 inclined ladders.
  - one large tilt of 18º: to scan secondaries produced in showers in surrounding material.
  - one very small tilt of -2º: to intercept helix tracks at different radii.

- Detector construction:
  - MIMOSA-26 sensors provided by the PICSEL group (cf. EUDET Beam Telescope, STAR PXL).

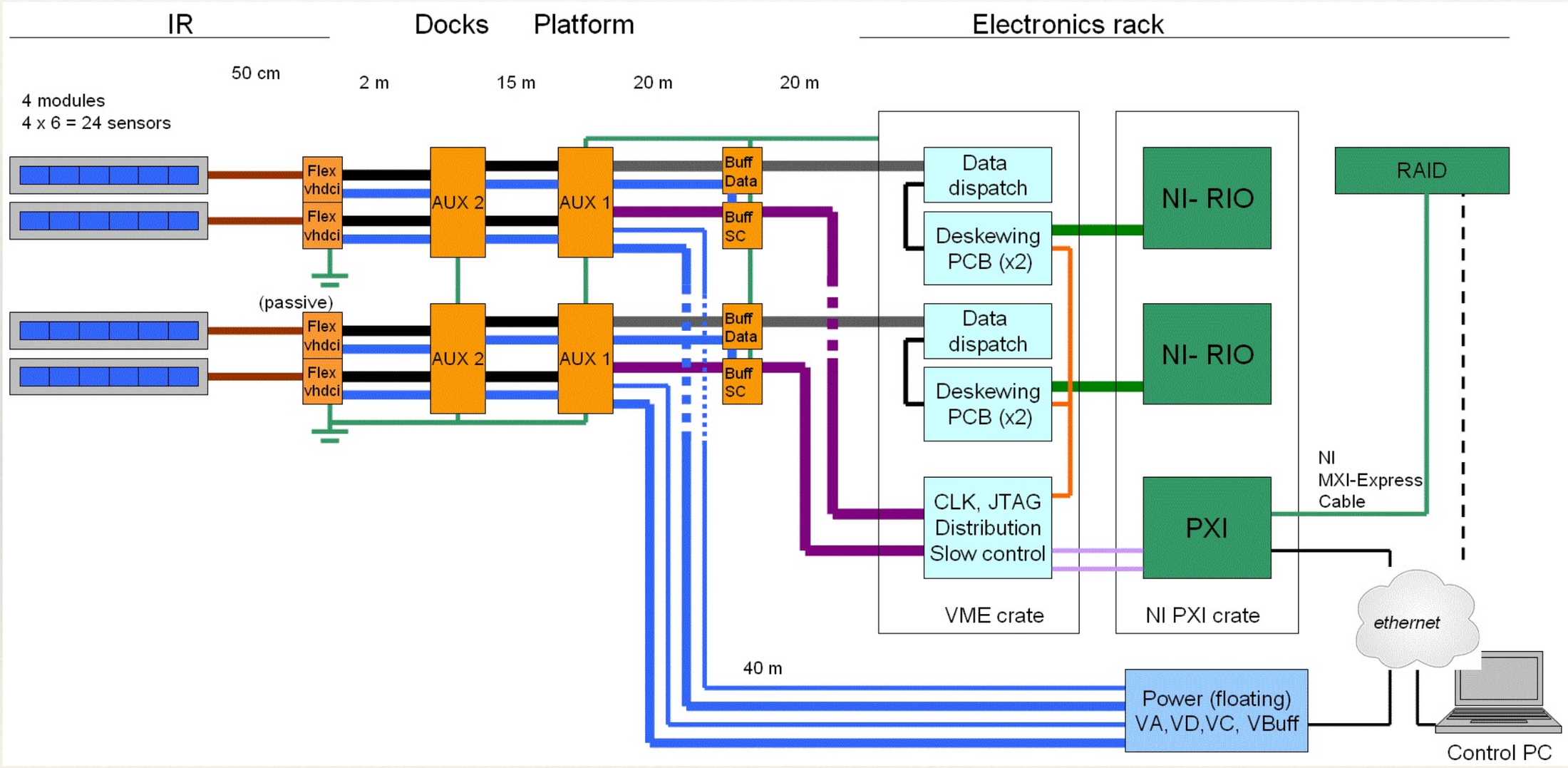
  - Ladders mounted by the PLUME collaboration (Bristol, DESY, IPHC).
    2 ladders will be operated + 2 spares.
  - Construction is on-going, delivery expected in Summer 2016.



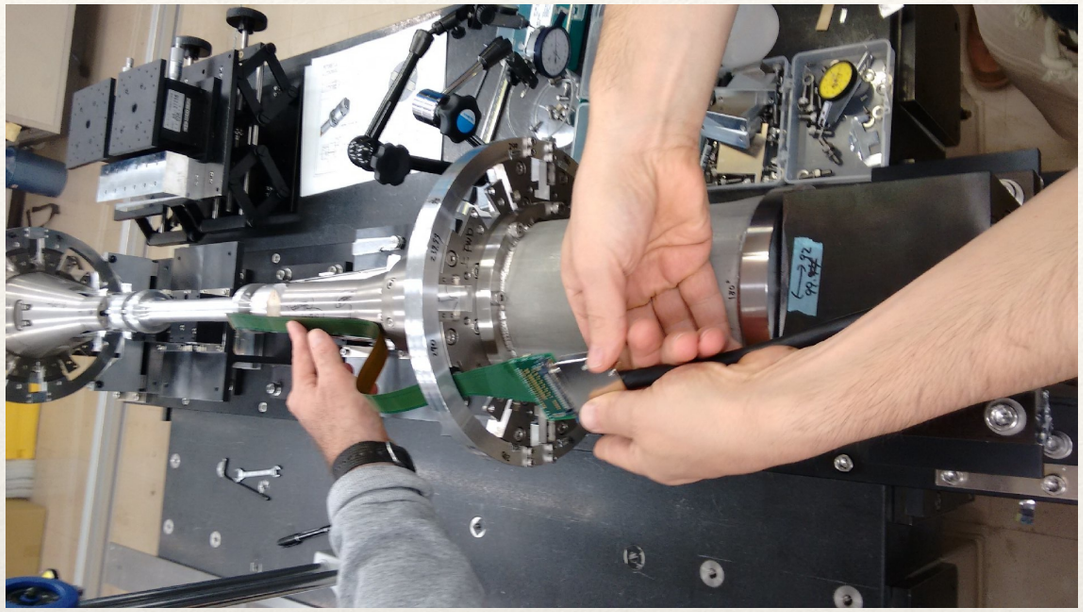


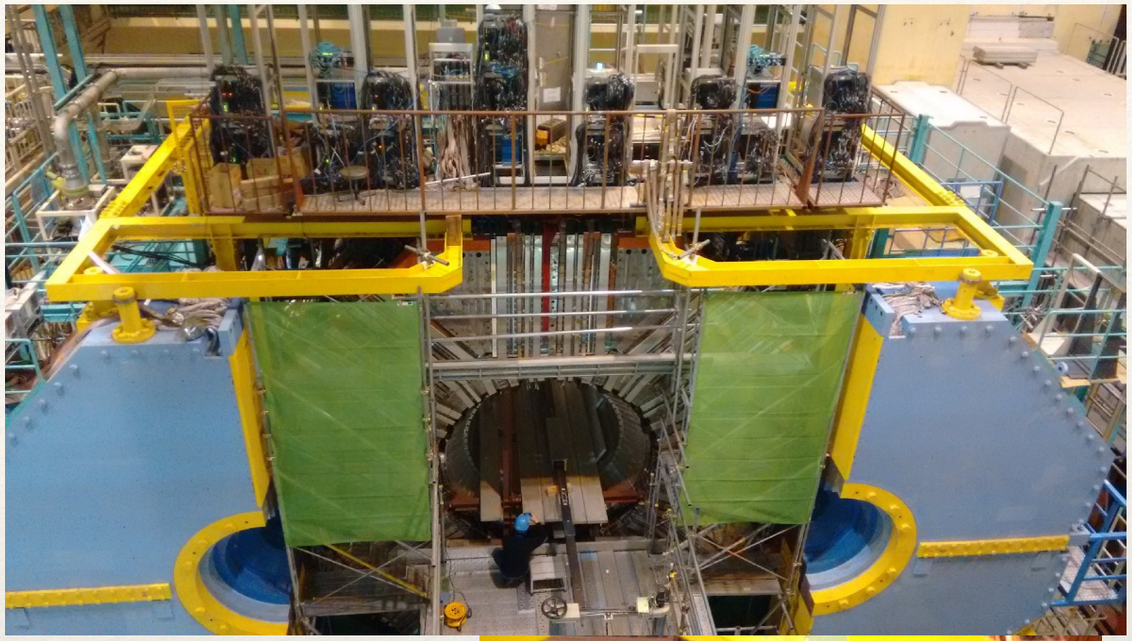
Status report on JFY-2015 activity: DAQ integration

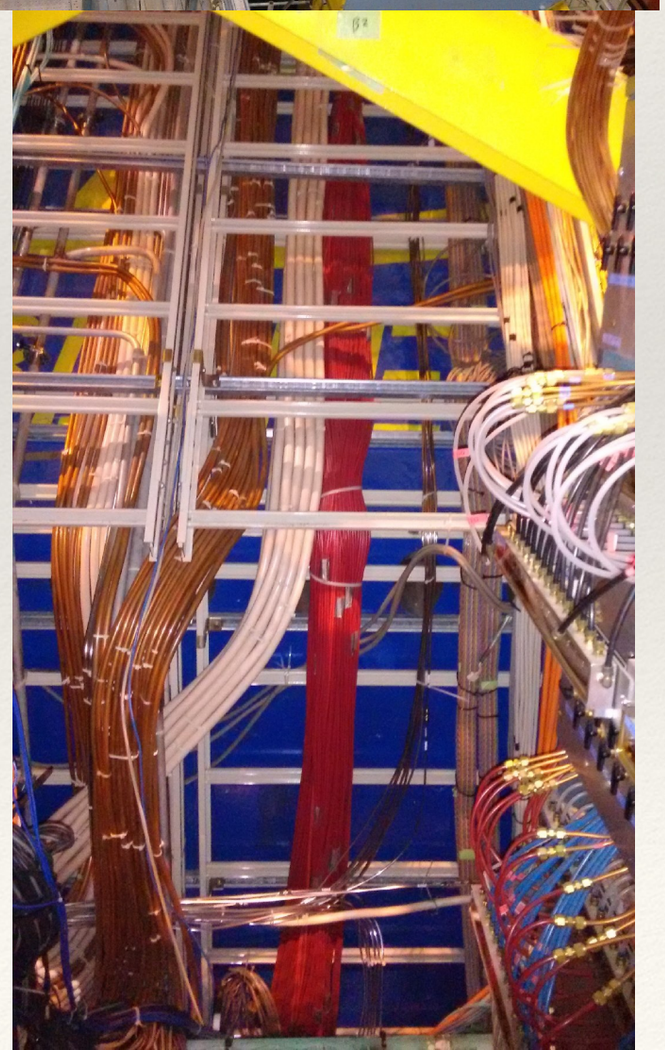
- DAQ integration: read out 16×10^6 channels and transmit signal over 40 m.
  Various cards have to be designed and produced: work is on-going (5 Engineers).



Status report on JFY-2015 activity: detector integration







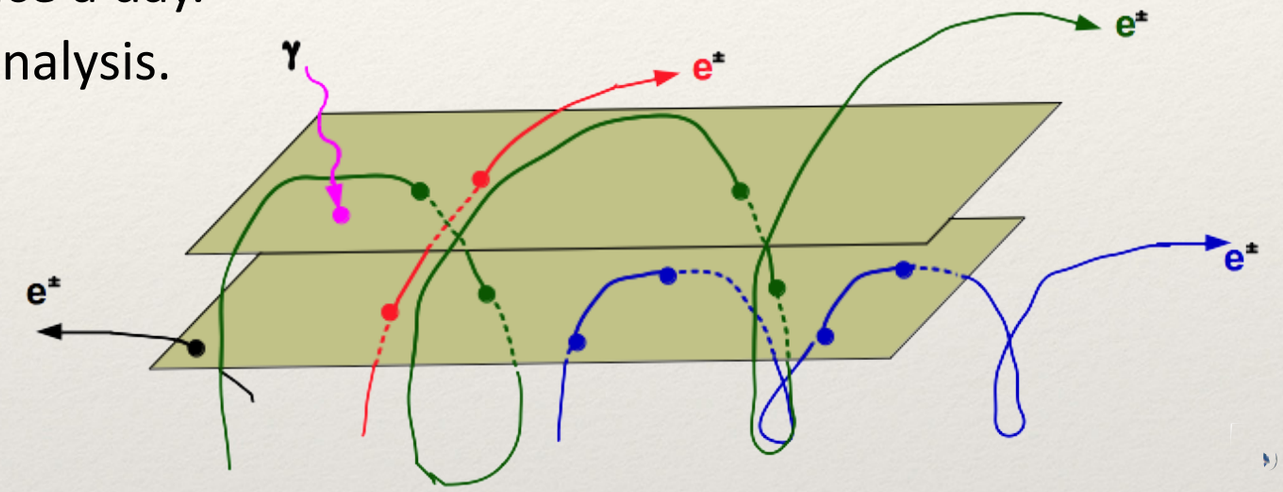
Cable routing and integration tests at KEK:
strong constraints on mechanical integration.

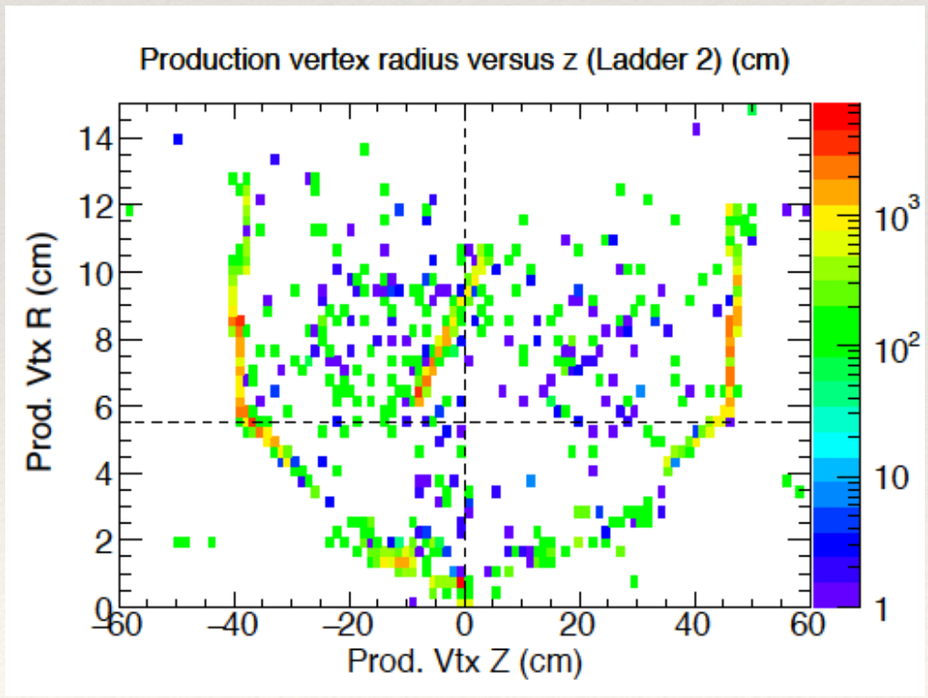
Status report on JFY-2015 activity: background study

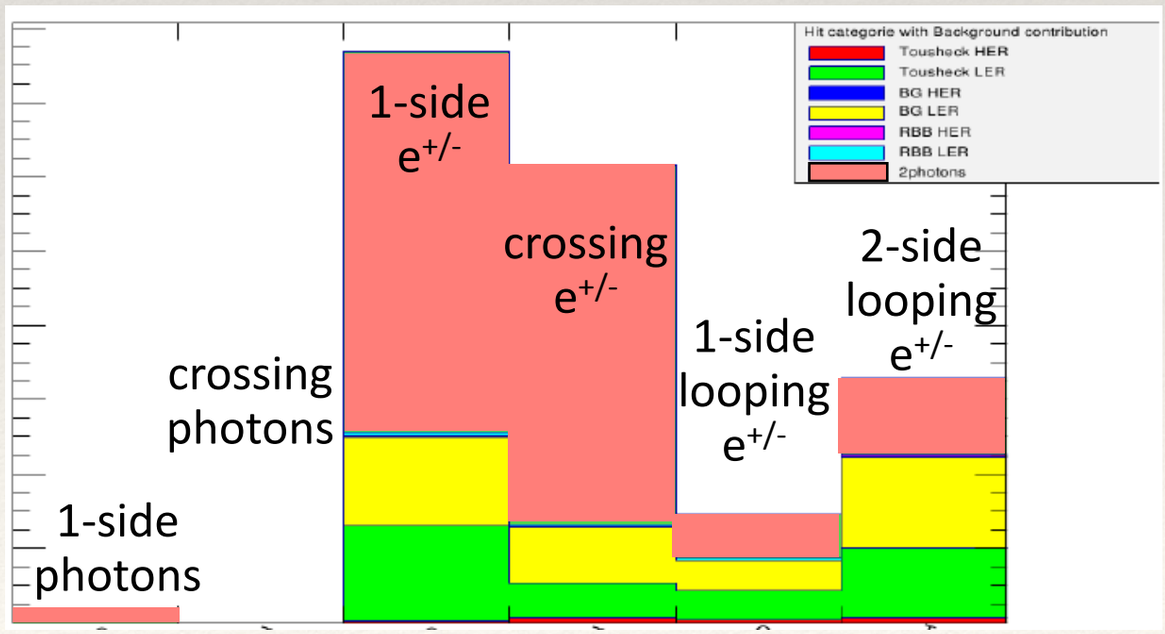
- On-line analysis: fast analysis, background level estimators (e.g.: hit rates as a function of z axis) provided ~ on-line (e.g. every 10 sec.) to SuperKEKB people.
  Completed at the same date as the data taking.

- Off-line analysis: sophisticated study, to disentangle the various background sources as a function of collider parameters. Results released e.g. twice a day.
  After the data taking: still 6 months of off-line analysis.

➔ both analyses under development with help of 2 Master student on-going internships.







TYL JFY-2015 spending and JFY-2016 request

- **Spending of JFY-2015:**
  - IN2P3 funding: 5 k€ totally used for 3 travels to KEK
    (out of 9 travels made to KEK + 1 to Okinawa).
  - KEK funding: 86 k¥ used to attend Okinawa TYL workshop 2015.

  Attempt to organise a KEK-IN2P3 Background at LAL but too many duties on BEAST Phase 1.

- **Requests for JFY-2016:**
  - To IN2P3: 8.4 k€
    - 3 travels France→Japan (5.4 k€).
      9 travels to KEK already scheduled,
      + TYL meeting to Seoul,
      + full scale integration test + beam test at DESY
      in Nov. - Dec. 2016 (6 weeks).
    - Shipping of equipment to KEK (3 k€).
      Cost estimate under work with Ulisse CNRS.
  - To KEK: 1 050 k¥
    - 3 travels Japan→France: to participate to a TYL
      Background meeting, joint with A_RD_08 TYL project
      and/or to the TYL workshop.

Status report on JFY-2015 activity: search for additional supports

- IdEx de l'Université de Strasbourg, call for proposal 2015: Exploratory projects.

➔ success. Funding for equipment and travels (22.6 k€)

- ANR call for proposal 2016: MIBEL [already submitted in 2015]
  - Partners: IPHC, LAL, KEK.
  - Subject: BEAST Phase 2 measurements and preparation for the future physics analysis.
  - Request: 2×2.5 years of post-doct. salary and 38 k€ for travels.
  - Directly based on two TYL projects: A_RD_08 and FLAV_01.

➔ result end of June 2016. Pre-proposition selected, final selection on-going.

- IdEx de l'Université de Strasbourg, call for proposal 2016: PhD grant for foreign students.

➔ failed.

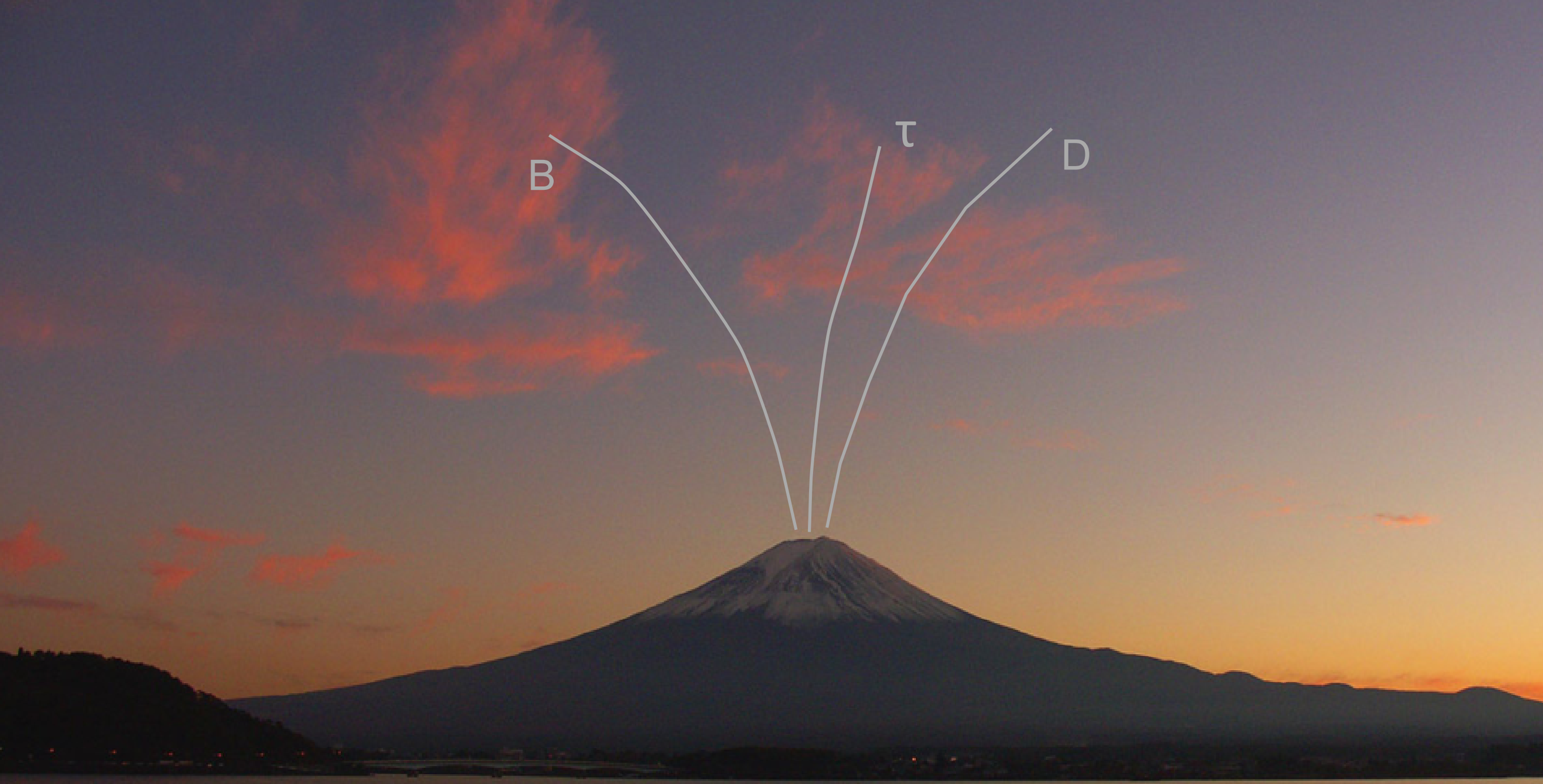
- Ecole Doctorale de l'Université de Strasbourg, call for proposal 2016:
  - PhD grant, starting in Oct. 2016.
  - Subject: BEAST Phase 2 (FLAV_01) and preparation for the future physics analysis.

➔ result end of June 2016.

Conclusion and outlook

- SuperKEKB will deliver collisions with the highest instantaneous luminosity in the world.
- SuperKEKB commissioning started in 2016 and physics run will start in Fall 2018.
- Belle II will play a crucial role in the search and the understanding of beyond SM physics, with a physics program complementary to energy frontier experiments, but also to LHCb and other intensity frontier experiments.
- This project is on the commissioning of the Belle II experiment and will provide unique skill for future e^+e^- collider experiments.
- Expected scientific production:
  - Belle II technical note in preparation on BEAST Phase 2 plans.
  - Two reports from Master internships.
  - Article on background study end of 2018.
  - Article on PLUME operation end of 2018.

➢ we hope that this project will lead to a future French contribution to the Belle II program.



thank you for your attention.