Possible contribution to Belle II at IPHC

Situation in Strasbourg

- PICSEL group = Physics with Integrated Cmos Sensors and ELectron machines
  - Particular interest in data analysis at e^+e^- colliders: Super Flavour Factory and ILC.

- Ambition of performing data analysis in the PICSEL group:
  - Long period of detector development motivated by ILC.
  - All physicists in this group had an activity of data analysis in the past (DELPHI, OPAL, DØ, CMS, STAR, ...).
  - Has to be done in synergy with the group activities:
    - Expertise in CMOS detectors design and test.
    - Knowledge in tracking.

- Former contribution to the SuperB project until its cancellation.
  - Existence of a strong commitment in the SuperB project in France, mainly at LAL- Orsay, since the beginning.

Situation in France

- Endorsement by IN2P3 of:
  - Try to build a French community contributing to Belle II.
  - Lead informal discussions with the Belle II collaboration.

  But:
  - Motivated by physics analysis.
  - Critical mass to enable impact.
  - Acceptation by IN2P3 scientific council.

- First contacts with the Belle II spokesperson (Peter Križan): February 2013.

  No discussion yet with Tom Browder ➛ at November collaboration week.

- Actions undertaken:
  - Discussions with all French particle physics laboratories.
  - Seminaries on Belle II in 7 labs.

- Conclusion after > half a year:
  - French contribution to SuperB was important (mainly from LAL Orsay), but mainly on accelerator and detector in the last period ➛ no obvious pool to join Belle II.
  - Two labs (immediately) interested: LAL Orsay and IPHC Strasbourg.
  - Synergy between ILC and Belle II activities appears as an interesting possibility.

Financial support

- IN2P3: support asked for 2014. No answer yet (no DAS).
- LIA FJPPL: International Associated Laboratory - France-Japan Particle Physics Laboratory
  - 2013:
    1) Investigation of a contribution to the inner tracker and to the physics analysis in the Belle-II experiment
       Partners: I. Ripp-Baudot / Y. Ushiroda *et al.*
       6000 € from IN2P3 (6600 asked) + 350 kJ¥ from KEK (350 asked).
    2) Collaboration on fast luminosity measurements and MDI questions for super B meson factories
       Partners: Ph. Bambade / S. Uehara *et al.*
       2000 € from IN2P3 (5000 asked) + 500 kJ¥ from KEK (500 asked).
    3) Increasing sensitivities to physics beyond the SM in B physics
       Partners: LHCb LAL and LPNHE, Belle II KEK/ theory KEK, LPT and LAL (Emi Kou)
       2000 € from IN2P3 (3500 asked) + 600 kJ¥ from KEK (900 asked).
  - 2014: new request(s) will be submitted on Belle II with LAL and IPHC.
- ANR: National Agency for Research.
  Applications 2014: deadline submission was October, 23th (was too short)
  ➛ target the next one (grants would arrive early 2016).
- JSPS: Japan Society for the Promotion of Science.
  - Out of 10 oversea offices, 1 is in Strasbourg: http://jsps.unistra.fr/
    ➛ ask for a support for a PLUME detector expert at KEK during BEAST II ??
  - La maison du Japon: "House of Japan"
    Academic institution. http://mufrancejapon.u-strasbg.fr/

IPHC contributions to Belle II under discussion

- BEAST II: commissioning of the SuperKEKB collider
  - First discussion with Y. Ushiroda and S. Tanaka ➛ agree that we investigate how to participate to BEAST II (period ~ Jan. - June 2016) together with the DEPFET group.
  - Working discussions with S. Vahsen (convener) and C. Marinas (vxd)
    ➛ small paragraph added to the BEAST II TDR with a description of the PLUME double-sided ladder equipped with CMOS pixel sensors, presented as a possible device to do hit rate counting in the inner tracking volume.

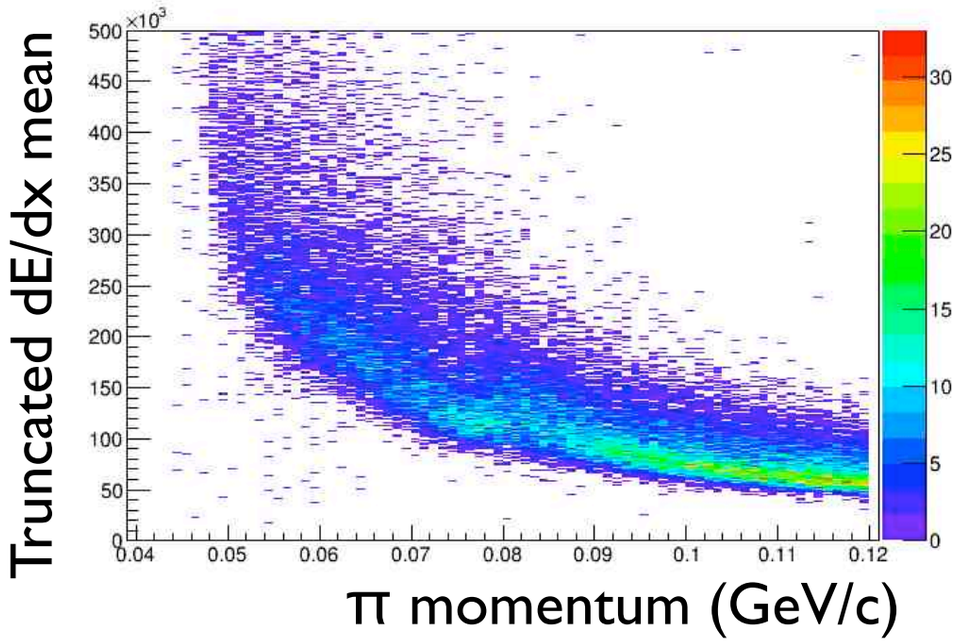
    Details in the next presentation by J. Baudot.

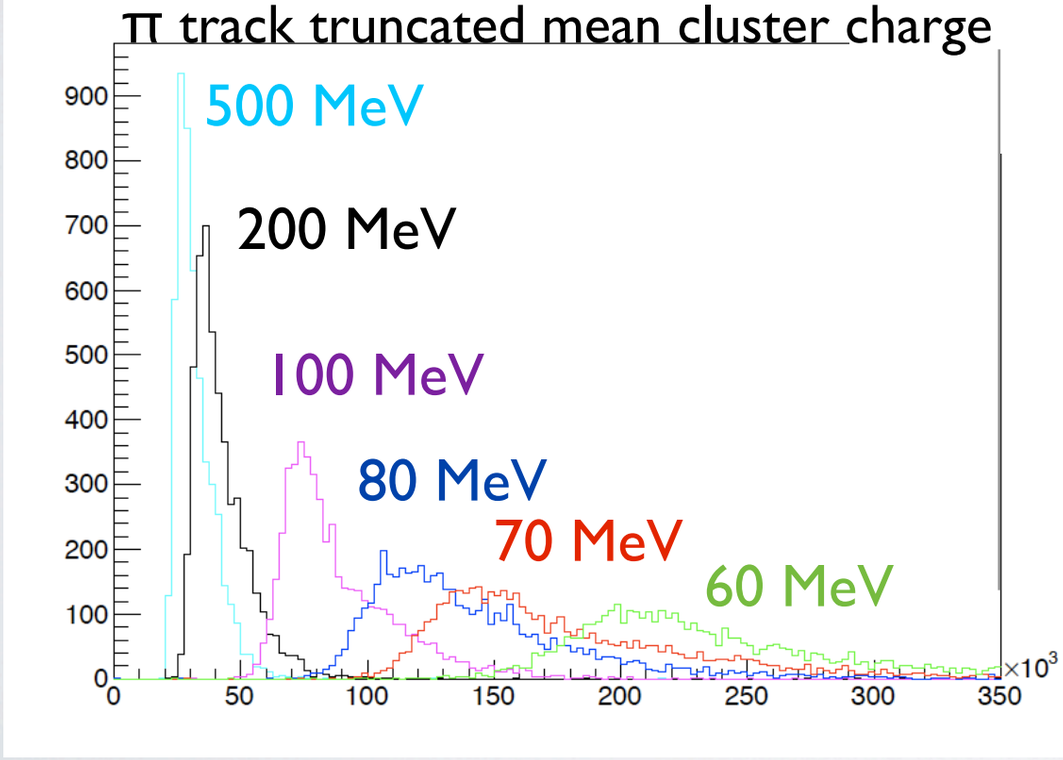
- Algorithm: track and vertex reconstruction
  - Discussion with M. Heck (tracking conv.) and Th. Kuhr (software conv.)
    ➛ Belle II computing account obtained by IRB (as a "visitor physicist").
  - Particular interest in: low momentum tracking efficiency and resolution, and vertexing efficiency and resolution (cf. CMOS technology assets).

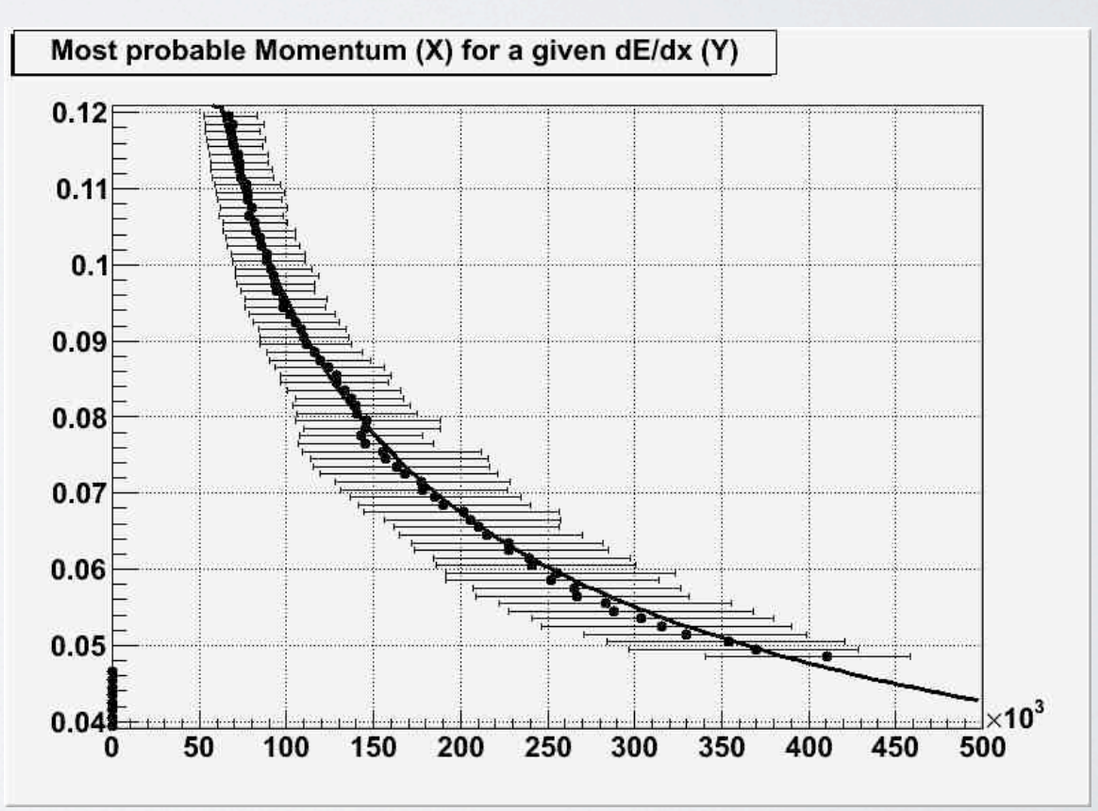
- Physics analysis: time dependent measurements
  - Channel will be investigated with LAL-Orsay.
- PhD Students:
  - 1 undergoing (2^{ond} year) PhD thesis: time dependent asymmetry in D^0 decays - PLUME - tracking in Belle II.
  - 1 proposed PhD thesis: Tag side vertexing (sin2β) - BEAST II with PLUME.

Tracking in Belle II

- Low momentum tracks:
  - Compare momentum estimation from helix fit and from dE/dx (SVD, PXD) in the $1/\beta^2$ region.
  - Based on method described in the frame of ALICE (cf. S. D. Paganis *et al.*, arXiv:hep-ex/0104006).
  - Ongoing study performed by IRB in the Belle II framework.
  - Outlooks: use dE/dx information to reduce accidental hit association from low momentum tracks?



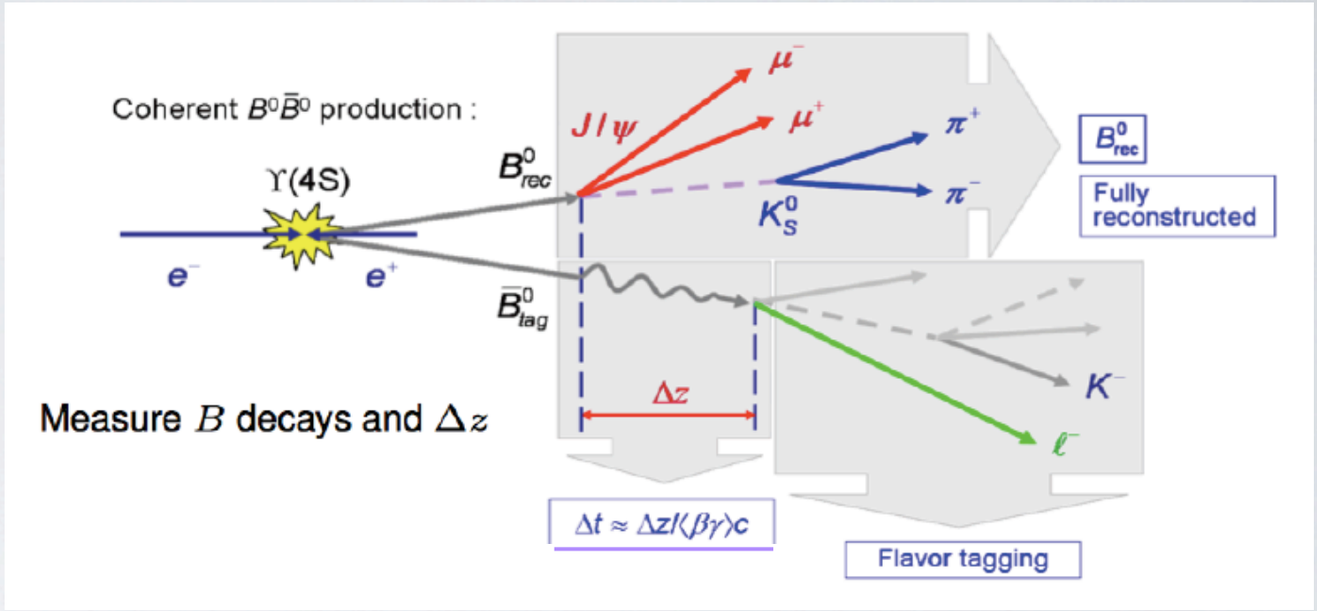


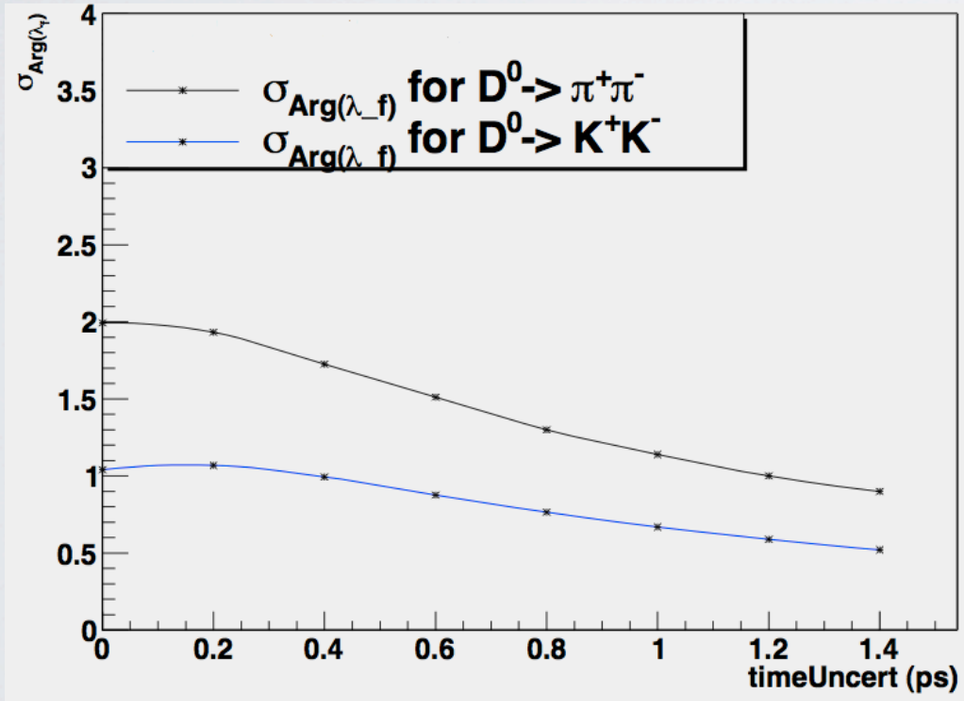


Physics analysis

- Measurement of sin2β from the unitarity triangle: focus on the resolution of the tag side B decay vertex.

➛ possible synergy with $t\bar{t}$ analysis at ILC (LAL), currently limited by the measurement of the vertex charge, due to missed low momentum tracks at secondary vertex. ???





- Time dependent asymmetry measurement in D^0 decays:

$$D^{*+} \to D^0 (\to \pi^+\pi^-, K^+K^-)\ \pi^+$$

  - Sensitivity to sin2β from the charm unitarity triangle.
  - Part of a (2ond year) PhD student: R. Maria.
  - Charm physics is a good benchmark to study limits of the inner tracker performances: particular sensitivity to spatial resolution and to multiple scattering (low momentum and D^0 short lifetime).

Only toy-MC study up to now. No continuum D production possible yet in Belle II ➛ time resolution not translated into spatial resolution.

Conclusion and outlooks

- LAL and IPHC wish to propose a relevant contribution to Belle II:
  - Motivation driven by participating to a physics analysis (channel not decided yet).
  - IPHC interested by contributing to vertexing and/or tracking studies.
  - Issue of critical mass to enable impact.
  - Synergy with ILC activities?

- Possible contributions to BEAST II have been identified:
  - IPHC: hit rate measurement in the inner tracker volume, with a PLUME double-sided pixellated ladder.
    - ➛ undergoing work at IPHC and with BEAST II conveners.
    - ➛ manpower and financial support are investigated.
  - LAL: fast luminosity and radiative bhabha background hit rate measurements with diamond sensors.
    - ➛ undergoing work with Belle II and SuperKEKB physicists.
    - ➛ PhD thesis began on October 2013 on this subject.
    - ➛ Aim: beam monitoring.

➛ further discussions at LAL tomorrow.