KEK-SLAC Collaboration on SuperKEKB

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With material from M. Sullivan, S. Metcalfe, J. Wang, S. Novokhatski, J. Seeman

U.S. DEPARTMENT OF ENERGY
Office of Science

SLAC NATIONAL ACCELERATOR LABORATORY

SLAC Experience:

- Established electron/positron accelerator laboratory
- Experience from PEP-II design and construction
- Experience from nearly 10 years of running PEP-II
  - Exceeding design peak luminosiy by a factor 4
  - Exceeding design annual integral luminosity by a factor of 7
- Strong history of collaboration with KEK
  - NLC/JLC/ILC
  - Feedback and beam-diagnostics work
  - Beam dynamics, beam-beam, electron-cloud, CSR, *etc.*
- Strong team of accelerator physicists and engineers.

- Specific applicable experience
  - Positron production
    - SLC e^+ source and its components (Flux Concentrator)
  - Luminosity feedback
    - Fast dither feedback @ PEP-II
  - Beam collimation
    - Fixed & moveable collimators, system simulation, top-up injection diagnostics
  - Bunch-by-bunch feedback
    - Established leader
  - Accelerator physics and beam commissioning
    - Strong accelerator physics group with experience on real machines

What is SLAC looking for?

- Maintain and contribute SLAC strengths in ring collider design
  - A number of projects on the horizon (besides SuperKEKB), some still far away:
    - LHC upgrades (through LARP)
    - Muon Collider (through MAP)
    - US contribution to ILC (in Japan?)
    - Ultimate storage ring as a light source (e.g. PEP-X).
    - Ring-collider Higgs Factory (? CERN)
- Leverage US contribution to BELLE-II.
  - There are several US institutions involved in BELLE II
  - Hopefully, SLAC can help make high luminosity faster.
- Enhance US-Japan R&D collaboration. Leverage the US-Japan funding by providing accelerator physics support.

Areas for collaboration (Oide)

SLAC

- Collaboration has been already going on
  - Bunch-by-bunch feedback
  - X-band deflector for beam diagnostics at Linac
  - X-band structure development
  - Beam dynamics for CSR, beam-beam, etc.

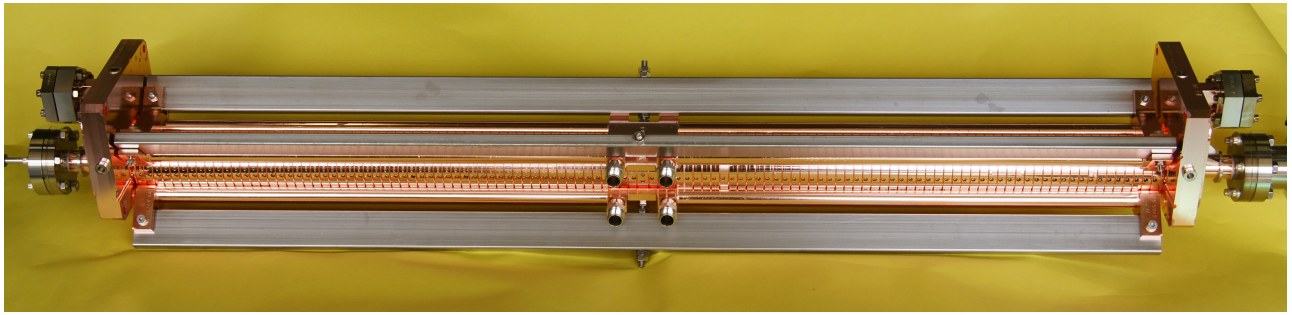
- Possible items for collaboration with SLAC for SuperKEKB:

  - Machine-detector interface, beam background at collision with top-up injection. Collimation schemes and hardware.
  - Low-emittance & high luminosity tuning with high-current collision. Beam-beam collision feedback, dithering, etc.
  - Low emittance & high current e+e- injector, from gun through Linac.
  - Commissioning of the e+ damping ring.
  - e+ source, flux concentrator, as well as beam commissioning of linac to DR.
  - Synchronization of 5 rings and the linac.
  - Alignments for Linac and/or rings.
  - and more....

Conveners

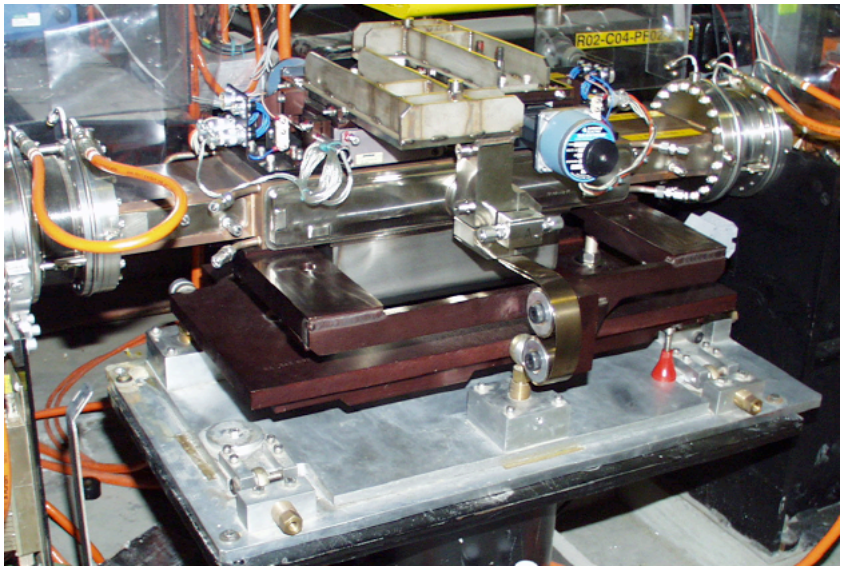
Subject	KEK Convener	SLAC Convener
IP feedback	Yoshihiro Funakoshi yoshihiro.funakoshi@kek.jp	Uli Wienands uli@slac.stanford.edu
Luminosity monitor	Sadaharu Uehara (*) uehara@post.kek.jp	tbd
Collimators	Yusuke Suetsugu yusuke.suetsugu@kek.jp	Uli Wienands (acting) uli@slac.stanford.edu
Beam background / MDI	Hiroyuki Nakayama (*) hiroyuki.nakayama@kek.jp	Michael Sullivan sullivan@slac.stanford.edu
Main ring commissioning	Yoshihiro Funakoshi yoshihiro.funakoshi@kek.jp	Yunhai Cai yunhai@slac.stanford.edu
Damping Ring	Mitsuo Kikuchi kikuchim@post.kek.jp	Yunhai Cai yunhai@slac.stanford.edu
Linac commissioning	Masanori Sato masanori.satoh@kek.jp	Yunhai Cai yunhai@slac.stanford.edu
Linac BPM	Tsuyoshi Suwada tsuyoshi.suwada@kek.jp	Steven Smith ssmith@slac.stanford.edu
X-band deflector	Mitsuhiro Yoshida mitsuhiro.yoshida@kek.jp	Juwen Wang jywap@SLAC.Stanford.EDU
Flux concentrator	Takuya Kamitani takuya.kamitani@kek.jp	John Sheppard jcs@slac.stanford.edu

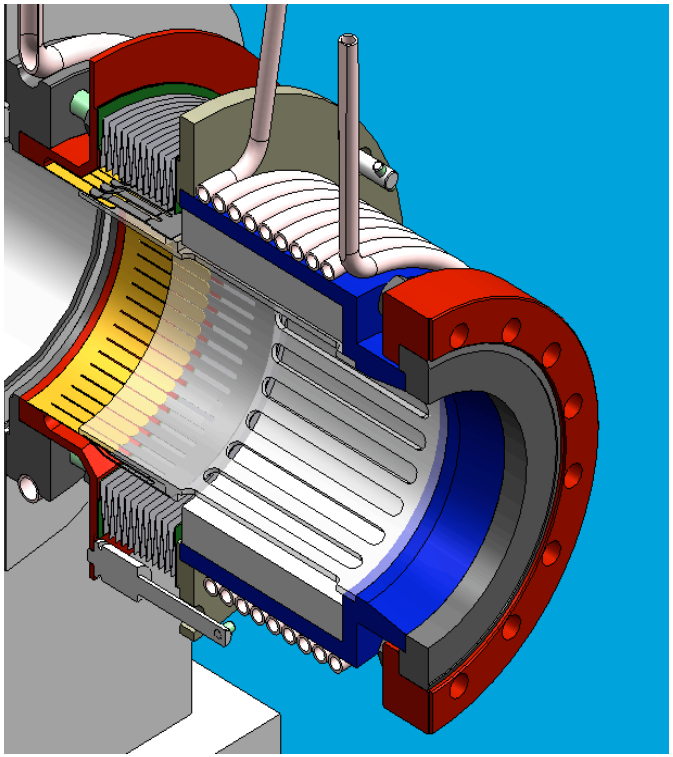
Example: Transverse Deflector Cavity for SuperKEKB



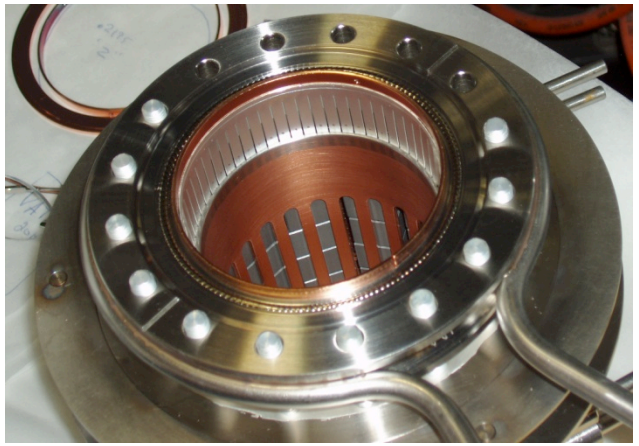
Example: Beam Collimators & HOM Absorbers

HER 27-m collimator

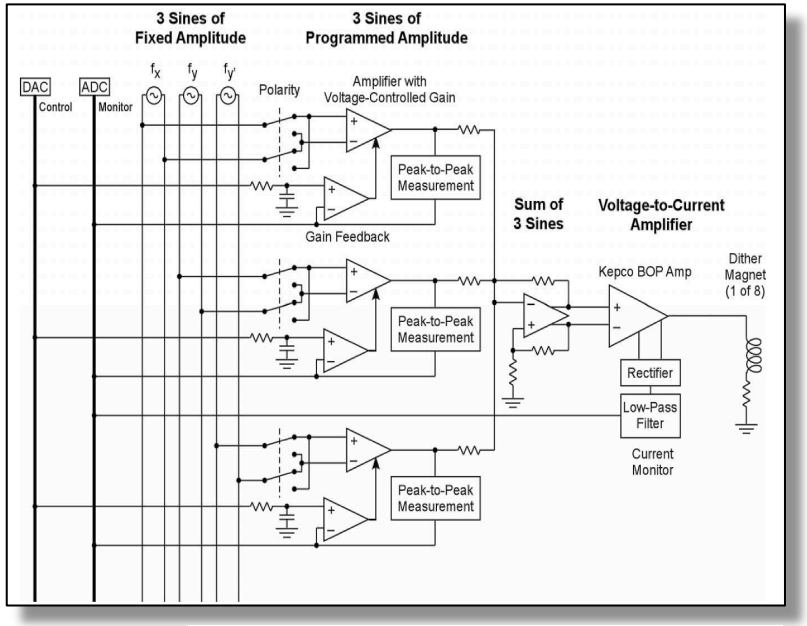




HOM-Absorber-Bellows

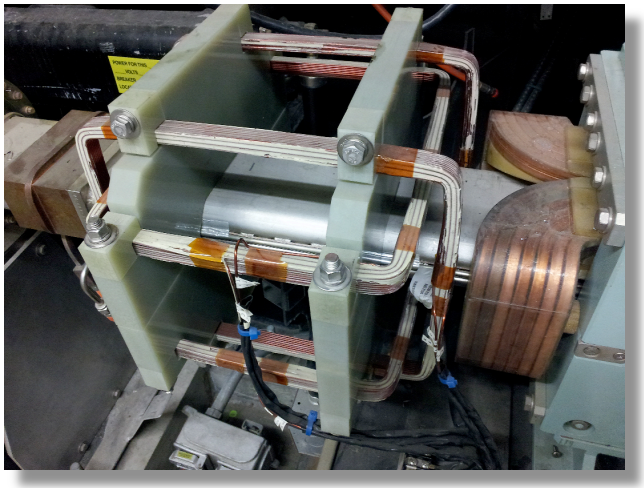


Example: Fast Dither Luminosity Feedback

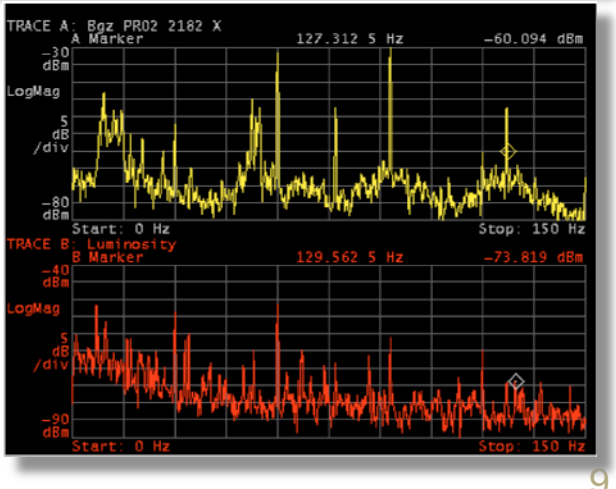


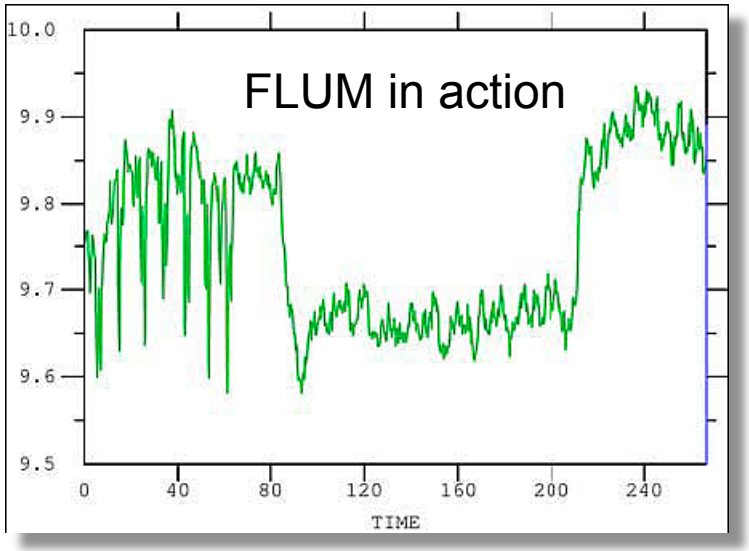
Drive ckt

Dither coil



Lumi
Signal
Spectrum





Funding Issues

- US-Japan funds can provide for hardware and manufacturing.
  - With KEK support a proposal has been submitted for JP-FY13.
- Accel. Physics to be funded by DOE OHEP.
  - SLAC has made the case to DOE and is seeking concurrence to to fund this opportunity in US-FY13 and US-FY14. A decision is pending.
  - SLAC has proposed to DOE a budget for US-FY15 and beyond to support increased effort.
    - This will be geared towards beam-commissioning and upgrades
    - Energy measurement by Compton scattering?
    - Polarization??

Status

- SLAC has asked J. Seeman & U. Wienands to be the central points of contact for SuperKEKB collaboration.
- We are meeting ≈ twice a month via SeeVogh.
- A list of “convenors” (POCs) on both sides has been established.
- Two groups of visitors from KEK have been at SLAC recently:
  - Linac and e^+ source issues
  - Beam collimation and HOM absorption
- Ongoing work to define scope and effort.

Potential SLAC-SuperKEKB Projects

Project	Scope of SLAC work (near term)	Coordinator	Start (pending funding)	Collaborators (tentative)
IP feedback	Revive and augment simulation code. Establish performance and requirements for feedback elements.	U. Wienands	soon	U. Wienands, M. Sullivan, S. Gierman, A. Fisher, J. Fox
Linac BPMs	Review designs. If SLAC design chosen; scope project	S. Smith, D. van Winkle	May 2013	pending scope definition
Beam Collimation	Simulate KEK system incl. injection. Review collimation hardware. Review HOM sitution.	U. Wienands (acting)	pending scope definition	U. Wienands, S. Novokhatski; E. Bong, S. Metcalfe (eng)
Flux Concentrator	Specify, design	J. Sheppard	pending scope definition	pending scope definition
Accelerator Physics	Beam dynamics Studies, Beam commissioning	Y. Cai	soon	G. Stupakov, L. Wang (CSR), tbd
Bunch-by-Bunch Feedback	Methods to characterize GHz power amps; clock synchronization tech. development	J. Fox	ongoing	J. Fox + students + post doctoral fellow.

Summary

- Mutual interest in collaboration on SuperKEKB
  - "Make high luminosity faster"
- We have defined the immediate needs of SuperKEKB, and the applicable resources at SLAC.
- Funding is being pursued on both sides (US-JPN; DOE)
  - Cast in form of "Projects" to facilitate discussion with OHEP
- We expect accelerator physics-related work to start fairly soon; hardware to come once the funding situation is clearer.