

Towards the Chiral Belle Conceptual Design Report

5 June 2023

B2GM Nagoya

Discussion:

Considering Chiral Belle Project Staging Options

One option:

Stage 1: implement transversely polarized e- beams

- Confirm large transverse polarization is transferred to HER
- Measure spin lifetime with transverse Compton polarimeter and validate calculations of long spin lifetime
- Consider possible physics measurements
 - Energy calibration of HER e- beam with resonant depolarization - perform at Y(1S) where CM is precisely known to also calibrate LER e+ energy; would provide precision CM energies above the Y(4S)
 - Unmeasurably small azimuthal dependence ($O(10^{-7})$ in SM, when e+ is not polarized (studies by A. Aleksejevs), but may have beyond SM possibilities – to be investigated

Stage 2: implement spin rotators and longitudinal Compton polarimeters

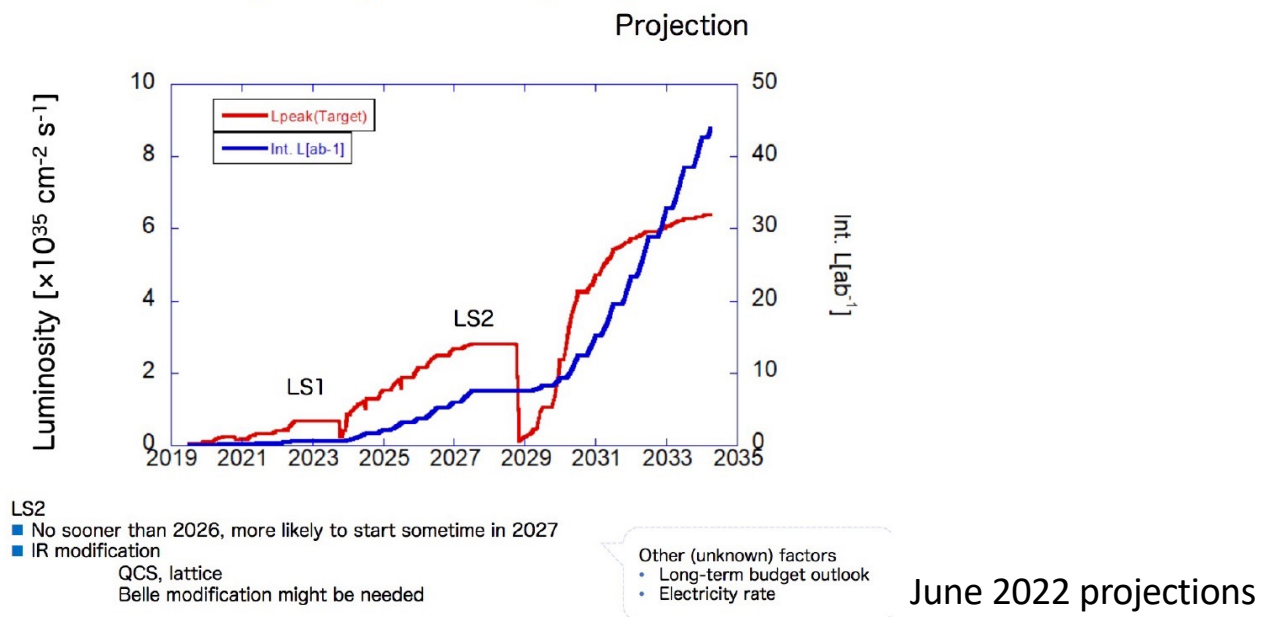
- Initially with dedicated polarization runs and start Chiral Belle electroweak physics program

Stage 3: Collect High integrated luminosity polarization data set

- Full Chiral Belle physics program – including highest precision EW physics and high precision tau g-2 approaching 10^{-6} .

SuperKEKB polarization upgrade

- Would aim to install longitudinal polarization in Long Shutdown 2 (LS2) for new final focus ~2027, or later
- Polarization upgrade R&D in MEXT KEK Roadmap 2021-26



Workpackages for CDR

- Physics – documented in Snowmass Whitepaper
 - Electroweak measurements - use Snowmass text as basis for most
 - Electron-pair- published Belle II luminosity paper
 - Muon-pair – documented selection
 - Tau-pair selection – discussed, additional studies possible
 - b-bbar selector – MC estimates, additional work required
 - c-cbar selector – MC estimates, additional work required
 - s-sbar separated from ud – not considered yet
 - uds selector – not considered yet
 - Tau g-2 – use Snowmass text as basis
 - Tau EDM – use Snowmass text as basis
 - Tau LFV – use Snowmass text as basis

Workpackages for CDR

- Polarized Source
 - Beam generation – cathode production and testing, update with additional information EIC developments?
 - Wien filter conceptual design is required
 - Linac Transport
- Spin Rotator
 - Compact Spin rotator: Long Term Tracking studies to be completed with radiation damping and fluctuations as well as studies with tolerances in rotator elements
 - Conceptual design of compact spin rotator magnet
 - BINP Spin rotator conceptual design
- Longitudinal Compton Polarimeter
 - Location – discussion of locations in a BINP and Compact Spin rotator scenarios
 - Conceptual design
- Transverse Polarization study as Stage 1
- Tau polarimetry – analysis with BaBar data to be used, almost complete

Rough draft of Schedule

- “The Belle II Detector Upgrades
Conceptual Design Report”
has a section on “Polarization Beam Option”

a few pages to introduce the physics motivation and
technical workpackages of the project

-> propose it mainly as brief summary of
Snowmass Whitepaper

Complete the polarization section that will reference
the Chiral Belle CDR

Rough draft of Schedule

- Conceptual Design of Spin Rotators- BNL, feedback field maps into Bmad
- Compton polarimeter conceptual design
- CDR target of Upgrade Working Group is ~first half of 2023
- Produce a 1st draft of the Chiral Belle Polarization Upgrade CDR on similar time scale

CDR 0th Version in Overleaf

<https://www.overleaf.com/7121516199rtkyjbcnhcqr>

basically the text from the Snowmass Whitepaper, which is to be converted into the CDR text.

The Chiral Belle Conceptual Design Report: Upgrading SuperKEKB with a Polarized Electron Beam

Belle II Collaboration

Publishing date