CDet Performance and Analysis in GEp-V

25-Minute Talk Structure (40 min total incl. questions)

1. Motivation & Role in GEp-V (3–4 min)

- Slide 1: Title slide – CDet Performance and Analysis in GEp-V (Name, Institution, SBS Collaboration)
- Slide 2: GEp-V Context – Physics goal, high luminosity environment, need for precise time correlation with ECal and BigBite tracking; CDet role in coincidence trigger and background suppression.
- Slide 3: CDet Design Overview – Two layers, scintillator paddles, multi-anode PMTs, NINO front-end, TDC digitization; emphasis on fast timing and high-rate capability.

2. Detector & Readout Architecture (7–8 min)

- Slide 4: Full Signal Chain – Detector $\rightarrow$ NINO $\rightarrow$ Repeaters $\rightarrow$ vfTDC/VETROC $\rightarrow$ CODA; cable lengths, LVDS standard, need for repeaters, trigger logic integration.
- Slide 5: NINO Front-End – Leading-edge discriminator, time-over-threshold encoding charge, threshold control via low voltage supply, impact on efficiency and timing walk.
- Slide 6: Low Voltage Supply & Threshold Control – Voltage rails, stability during running, monitoring during GEp-V, channel-to-channel variation, noise behavior.
- Slide 7: Multi-Anode PMT HV Optimization – Gain matching strategy, pixel-to-pixel variation, HV compromise setting, stability during Kin-1 vs Kin-3, rate dependence.

3. Timing Optimization During Running (6–7 min)

- Slide 8: Trigger Configuration – Coincidence logic, BigBite + ECal + CDet, role of CDet in trigger latency determination, use of low current Kin-1 running.
- Slide 9: Kin-1 Low Current Timing Scan – Time difference histograms, window scan, latency adjustment, final window width, background rejection, FWHM/σ values.
- Slide 10: Kin-3 Timing – Differences vs Kin-1, rate dependence, geometry considerations, ongoing analysis or preliminary low-current timing plot.

4. Post-Run Analysis Progress (6–7 min)

- Slide 11: vfTDC Fine Timing Calibration – Per-channel offset calibration, reference channel method, before/after calibration plots, slewing correction status.
- Slide 12: Raw Leading/Trailing Edge Distributions – No cuts; leading edge spectrum, trailing edge spectrum, time-over-threshold distribution, timing walk considerations.
- Slide 13: Per Paddle Rates (Layer 1 & 2) – Heat map or bar plots, pixel-to-pixel variation, identification of pathological channels, geometry and solid angle effects.
- Slide 14: Event Selection Strategy – (i) ECal position correlation, (ii) ECal timing correlation, (iii) Layer 1 vs Layer 2 correlation, (iv) Time-over-threshold selection cuts.
- Slide 15: Example Clean Event Selection – Before/after cuts, emergence of signal peak, efficiency and background reduction factor.

5. Summary & Next Steps (2–3 min)

- Slide 16: Performance Summary – Timing resolution achieved, operational stability, rate capability, trigger contribution.
- Slide 17: Ongoing Work – Slewing corrections, efficiency maps, cross-calibration with ECal, potential improvements for future SBS running.