Suggestion for Controlling the Coherent Edge

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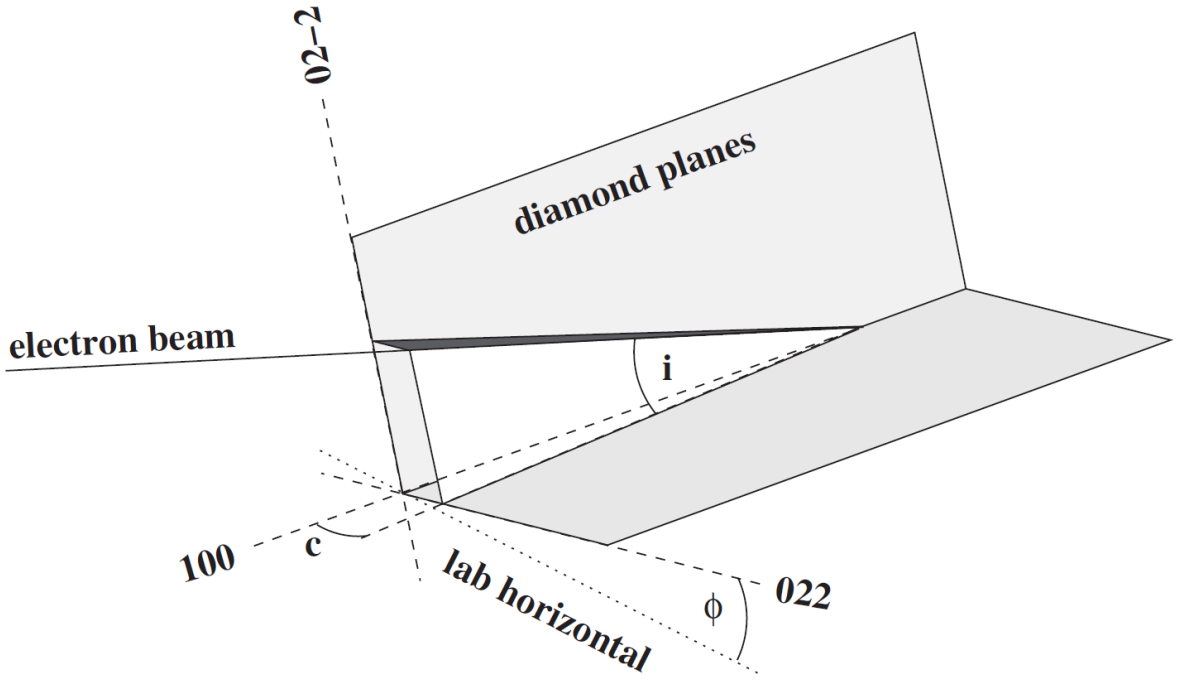
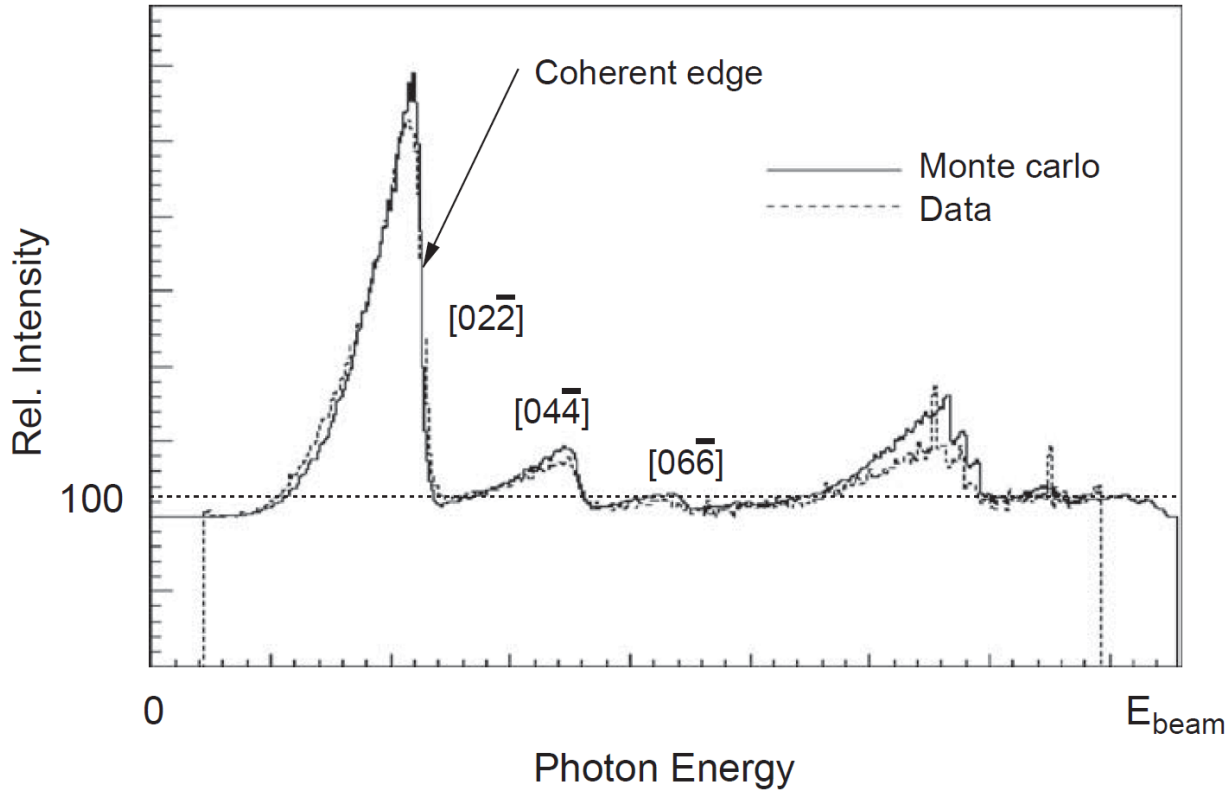
Coherent Bremsstrahlung Angles and Energy





From K. Livingston, Nuclear Instruments and Methods in Physics Research A603 (2009) 205–213

Introduction

- Position of coherent edge is controlled by changing one angle of the diamond.
- Coherent edge position is periodically calculated by a ROOT macro running in the background and is made available in EPICS.
  - This may need to be made more reliable.
- Only one angle of the diamond lattice controls the position of the coherent edge:
  - $E_c \approx \frac{g\ \theta\ E_0^2}{k+g\ \theta\ E_0}$, g is an even integer, k=26.5601 MeV
- This angular change may be implemented as a combination of movements of the two rotational stages of Hall D goniometer : goniometer yaw and pitch.
- The "orthogonal" angle of the diamond lattice does not need to be changed.
  - The coherent edge position is not sensitive to it.
  - Changing the "orthogonal" angle without control will lead to undesirable consequences.

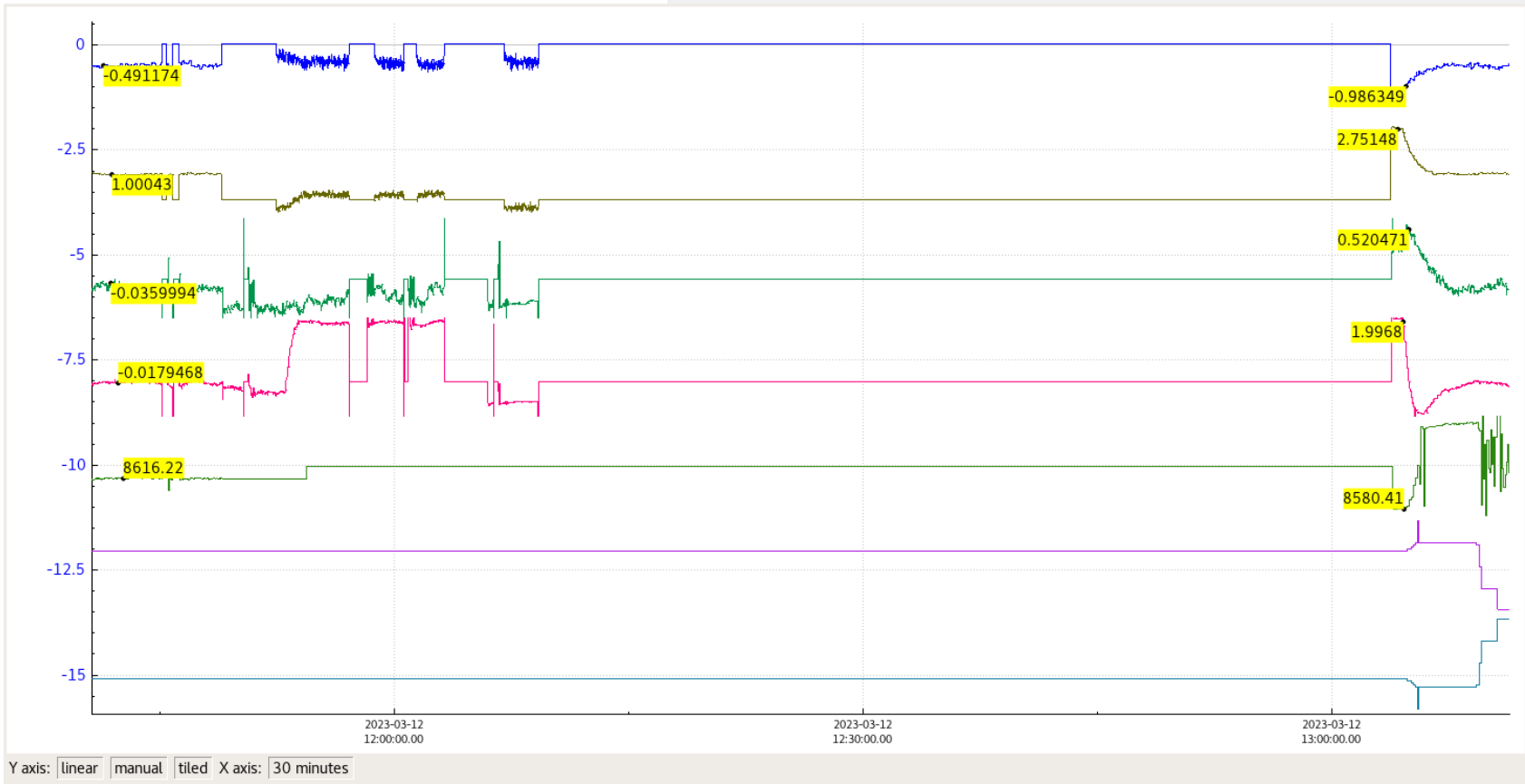
Corrections to the main angle

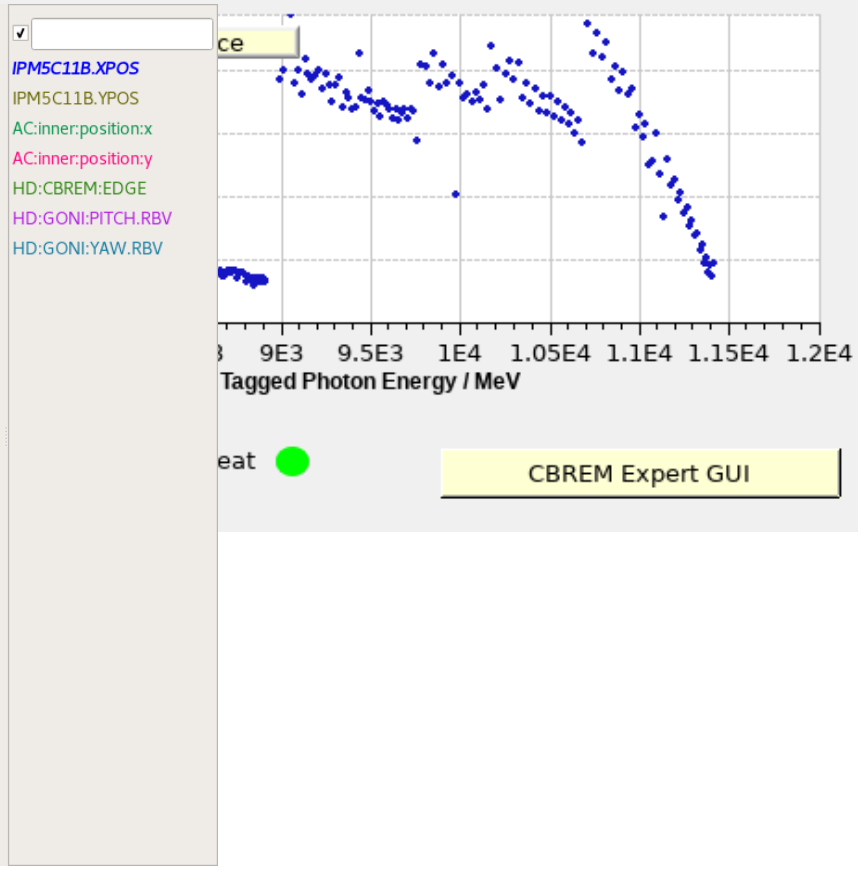
- One of the ways to determine the correction to the θ angle is to use the formula:
  - $\Delta\theta \approx \frac{k}{g\,(E_0 - E_c)^2}\Delta E_c$ (From K. Livingston, NIM A603 (2009) 205–213)

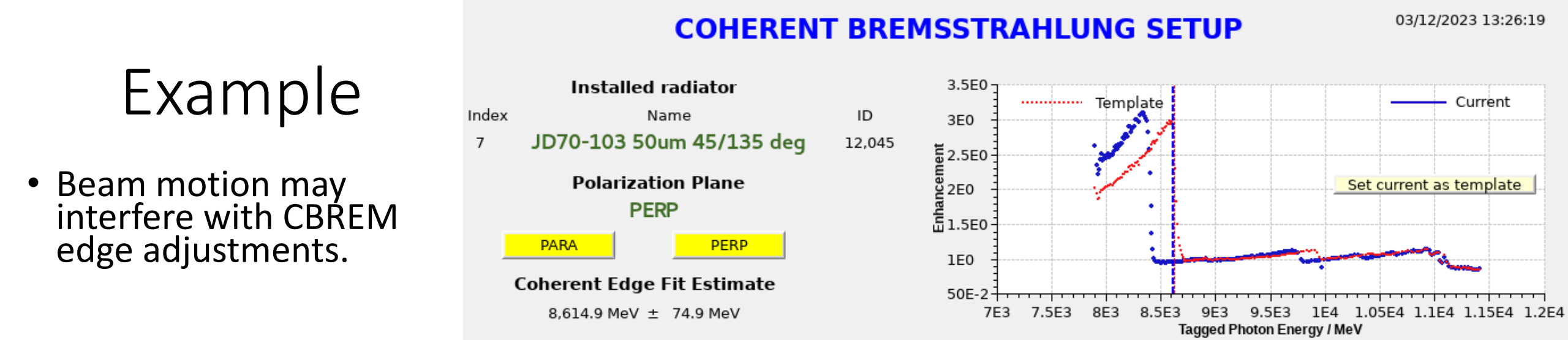
- Due to the delays in controlling the goniometer and scaler readbacks, calculating the exact angular shift may cause confusing behavior.
- One can set a PID-type of control loop to adjust the angle.
  - Does not use the knowledge of energy vs angle dependence.
- Use the data in the MYA archiver to optimize the change in the angle using some ML algorithm.
  - Calculate the change according to the formula
  - Determine the correction to the required change using AI and MYA data.
  - The translation into goniometer motion would be done in EPICS.

Example

- Beam motion may interfere with CBREM edge adjustments.







Suggested strategy

- Periodically calculate a correction (1st order) to the main angle θ based on the formula and the latest value for the coherent edge $\Delta\theta \approx \frac{k}{g\,(E_0 - E_c)^2}\,\Delta E_c$.
  - This correction most likely will work for much of the time.
- Use MYA data and an AI function to calculate a smaller angular correction (2nd order) to the previous 1st order correction value to account for beam availability and beam related variations to avoid overcorrections.
- Put the corrected angle correction into EPICS.
  - Thus, AI will prevent confusion and failures by the correction calculator.