LUXE SAS Meeting

Forward Gamma-ray Spectrometer 17/04/2023

Previous work

- Most recent simulation studies of interest shown in the spectrometer technical note/TDR
- Spectrometer was used in a LWFA experiment at Apollon last spring
- A lot of work has been done on the analysis of this data
 - Extracting electron/positron spectra from LANEX screen with proper background corrections
 - Correctly applying energy resolution constraints when 'discretising' signal
 - Improvements to deconvolution algorithm particularly statistical robustness and uncertainty estimation

TDR simulation work



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Apollon experiment



Apollon results – simulating source spectra



Spectral intensity of LWFA electrons as measured by other diagnostics

Energy spectra of the bremsstrahlung beam after conversion and after propagation to the spectrometer

Apollon results – measuring electron positron pairs



Apollon results – reconstruction of photon spectrum . Reconstruction algo



- Reconstruction algorithm applied to experimentally measured electron and positron spectra, the 'true' positron spectrum taken from simulation and compared to the photon spectrum predicted by simulation
- Uncertainty bands are the 95% confidence interval
- Reconstruction from positrons is better overall as they suffer from less noise
- Reconstruction from electrons gives correct general trend but has fluctuations
- On a whole, analysis and reconstruction gives reasonable results compared to simulation predictions

What to do next?

- Simulation work
 - Run upgraded algorithm on latest LUXE simulations -> new signal/background estimates, reconstruction errors...
- Further improvements for utility
 - Since spectrometer can operate on single-shot basis, implement a live application of analysis and reconstruction algorithm
 - Requires: background correct method per shot, code optimisation, data storage...
 - Further improvements to deconvolution algorithm such as ML techniques?
- Expanding applications
 - Inferred polarimetry of the photon beam?
 - Can additional information be extracted from the non-dispersed axis?