Interaction point simulations: Alternate MC

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LUXE Simulation and Analysis Task Force

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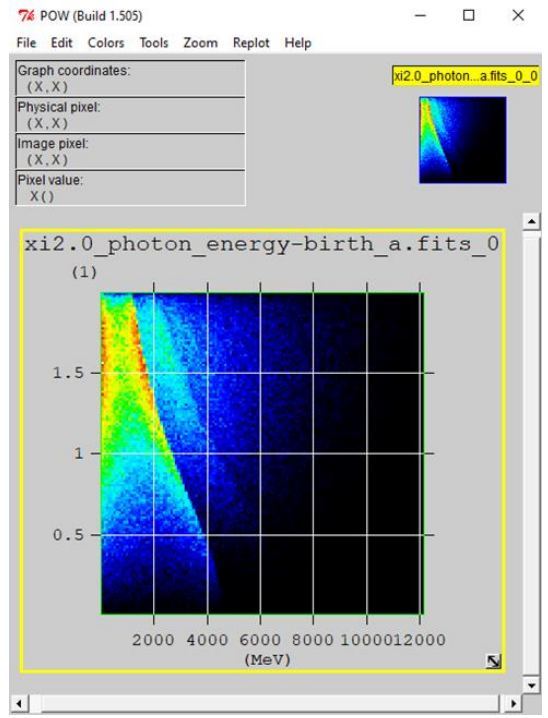
Alternate MC

Current status and future developments

- SFQED Monte-Carlo particle-tracking code, https://github.com/tgblackburn/ptarmigan, currently 0.4.0:
  - Nonlinear Compton (photon emission) in electron-laser collisions
  - Locally monochromatic and locally constant-field rates available (LMA requires reasonably long laser duration, but valid across the full range of ξ; LCFA requires $\xi > 5..10$)
  - Circularly polarized plane-wave/focused laser pulses, chirped or unchirped
  - Automated binning and output of particle distributions, statistics
- In progress for 0.5.x:
  - Mimic output format (plain-text)/coordinate system used by IPstrong
- On the roadmap for 1.x.y:
  - HepMC/stdhep output for event reconstruction
  - Nonlinear Breit-Wheeler ($\gamma \to e^+e^-$) for γ-laser collisions [May 2021]
  - Approximation to trident ($e^- \to e^-e^+e^-$) for electron-laser collisions [July 2021]
- And for 2.x.y:
  - Rates for polarized photons [EOY 2021] and LP backgrounds [2022]



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Current status and future developments

- A number of discrepancies remain, when comparing to pre-existing IPstrong simulation results:
  - Position of Compton edges (mass shift effects, determination of peak ξ)
  - Overall yield and spectral shape

- Results for phase I parameters (16.5 GeV electrons + JETI40 laser*) at $\xi = 0.15$, 0.3, 1.0 and 2.0
  - Available under `/afs/desy.de/user/t/tblackbu/public/e_laser_16.5GeV_JETI40/xi_scan`

```
-bash-4.2$ pwd
/afs/desy.de/user/t/tblackbu/public/e_laser_16.5GeV_JETI40/xi_scan
-bash-4.2$ ll
total 146862
-rw-r--r-- 1 tblackbu af-luxe      764 Dec 18 15:37 README
-rw-r----- 1 tblackbu af-luxe      796 Dec 18 15:28 xi0.15.yml
-rw-r----- 1 tblackbu af-luxe     5760 Dec 18 15:29 xi0.15_electron_energy.fits
-rw-r----- 1 tblackbu af-luxe 33402840 Dec 18 15:27 xi0.15_particles.out.gz
-rw-r----- 1 tblackbu af-luxe    11520 Dec 18 15:29 xi0.15_photon_energy-birth_a.fits
-rw-r----- 1 tblackbu af-luxe      794 Dec 18 15:28 xi0.3.yml
-rw-r----- 1 tblackbu af-luxe     5760 Dec 18 15:29 xi0.3_electron_energy.fits
-rw-r----- 1 tblackbu af-luxe 33915441 Dec 18 15:28 xi0.3_particles.out.gz
-rw-r----- 1 tblackbu af-luxe    23040 Dec 18 15:29 xi0.3_photon_energy-birth_a.fits
-rw-r----- 1 tblackbu af-luxe      794 Dec 18 15:28 xi1.0.yml
-rw-r----- 1 tblackbu af-luxe     5760 Dec 18 15:29 xi1.0_electron_energy.fits
-rw-r----- 1 tblackbu af-luxe 38279123 Dec 18 15:28 xi1.0_particles.out.gz
-rw-r----- 1 tblackbu af-luxe    83520 Dec 18 15:29 xi1.0_photon_energy-birth_a.fits
-rw-r----- 1 tblackbu af-luxe      794 Dec 18 15:28 xi2.0.yml
-rw-r----- 1 tblackbu af-luxe     5760 Dec 18 15:29 xi2.0_electron_energy.fits
-rw-r----- 1 tblackbu af-luxe 44497155 Dec 18 15:28 xi2.0_particles.out.gz
-rw-r----- 1 tblackbu af-luxe   141120 Dec 18 15:29 xi2.0_photon_energy-birth_a.fits
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```

*with reduced duration, for consistency with IPstrong

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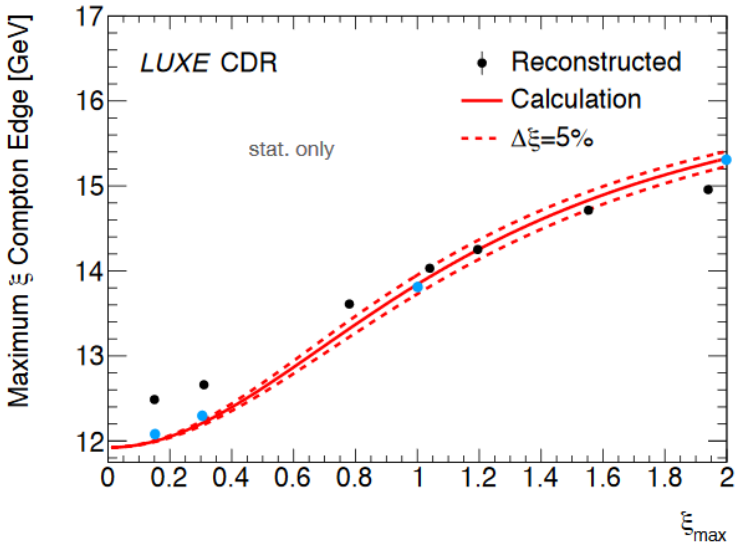

- Added points from Toms MC (blue points) by hand (truth information only, no detector binning!)

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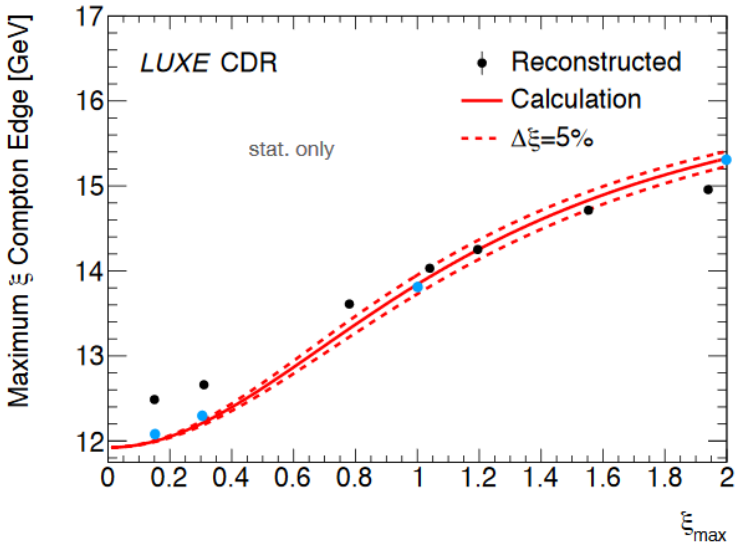
- In progress, test results for phase II parameters:
  - Range of focal spot sizes and pulse durations

- Crosschecking γ-ray angular profile

- Writing up the theory benchmarking work with Ben King



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