Analytical modeling of CLIC energy distributions

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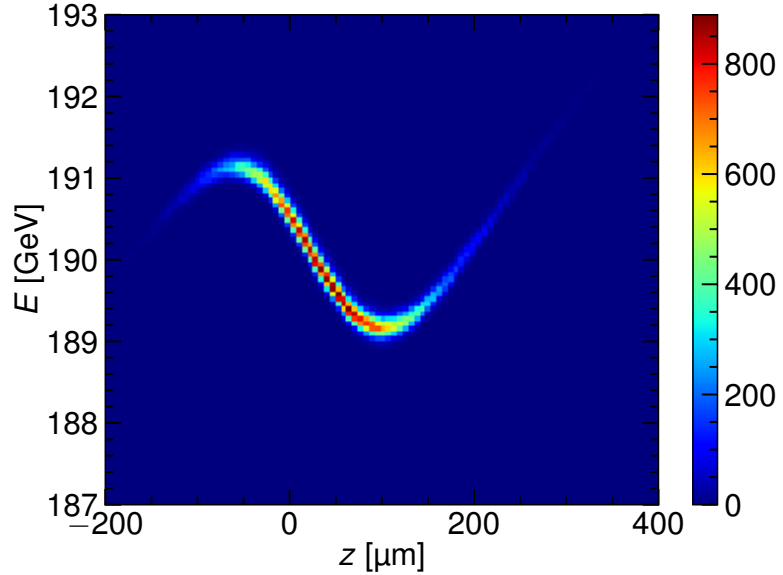
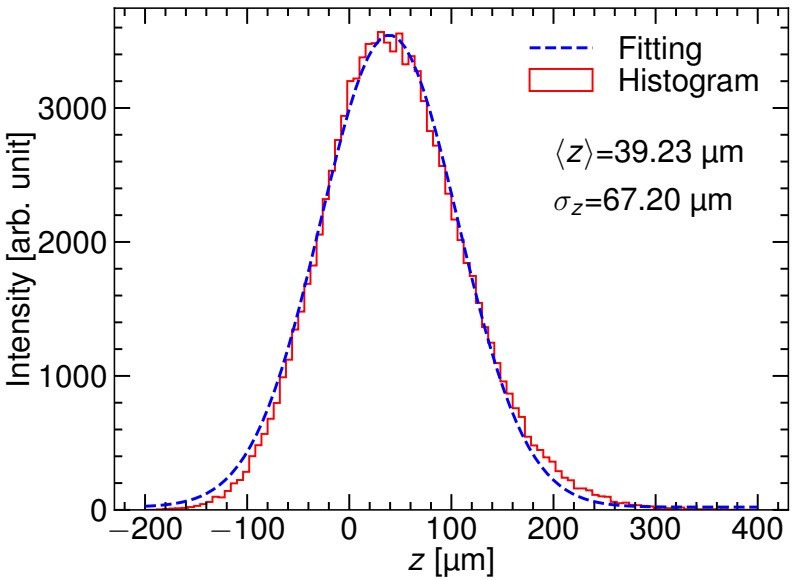
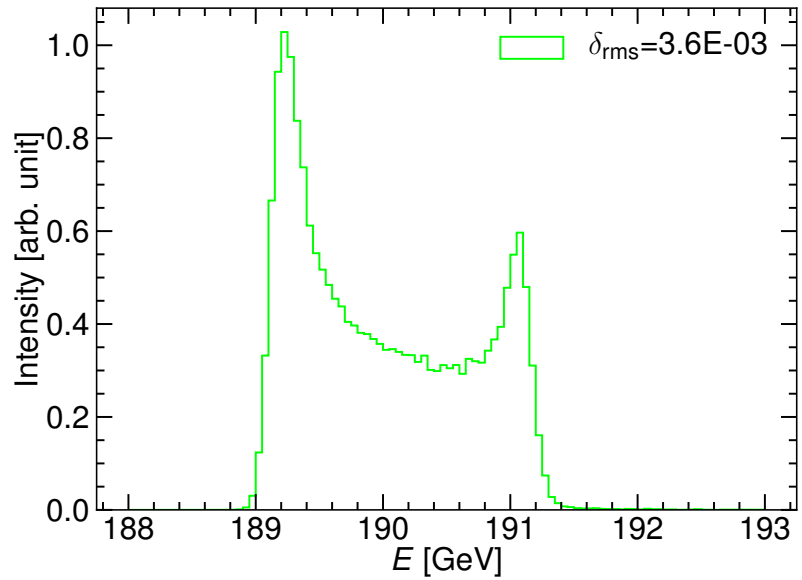
Input – longitudinal – realistic

- Output from ML tracking; 10^5
- $E_0 = 190$ GeV
- $\varepsilon_{x,\text{norm}} = 920$ nm, $\varepsilon_{y,\text{norm}} = 20$ nm
- $\delta_{\text{rms}} = 0.361\%$







[1] data from Chetan Gohil

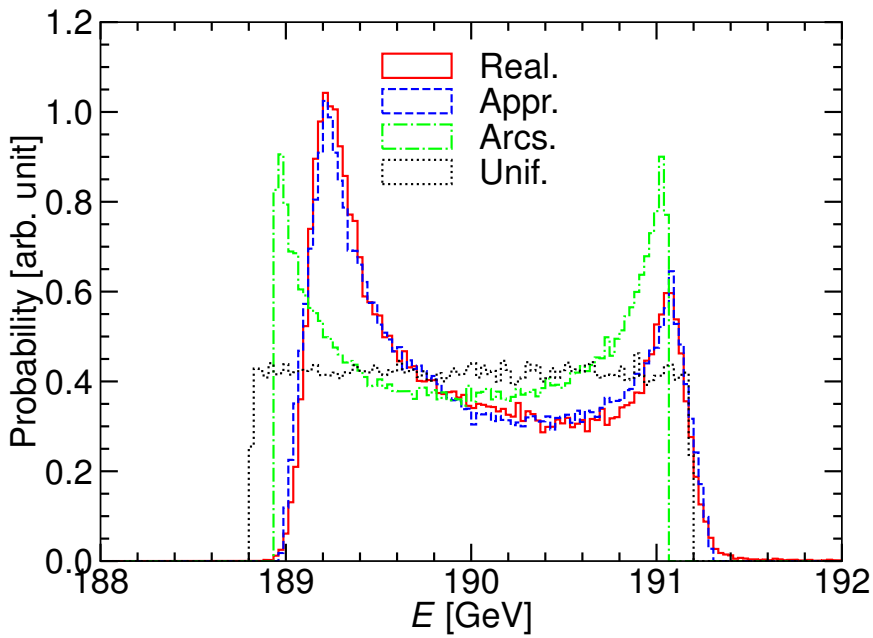
Analytic models

- Uniform distribution: bandwidth$\approx 1.25\%$ and $\sigma_\delta = 0.361\%$
- Arcsine distribution ($\sigma_\delta = 0.361\%$, cuts at $3P_{\text{min}}$)

$$f(\delta) = \frac{1}{\pi\sqrt{(x-a)(b-x)}}$$

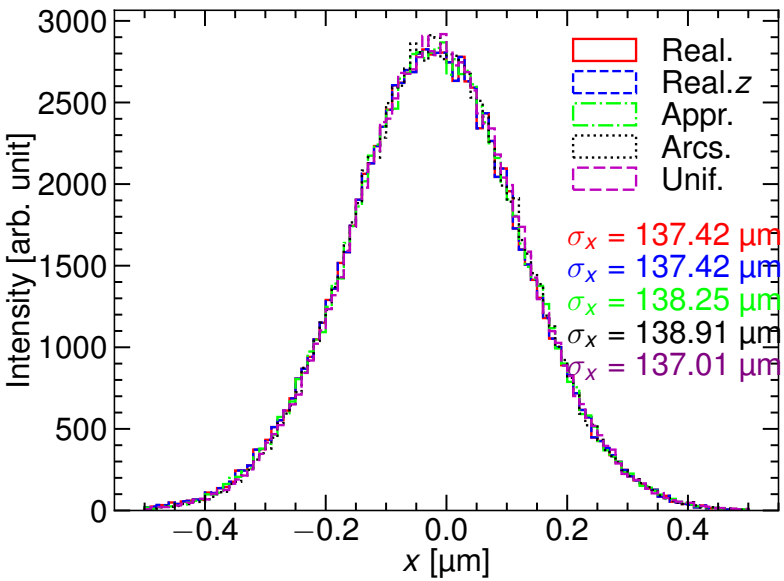
- Approximation w/ a piecewise function ($\sigma_\delta = 0.361\%$)

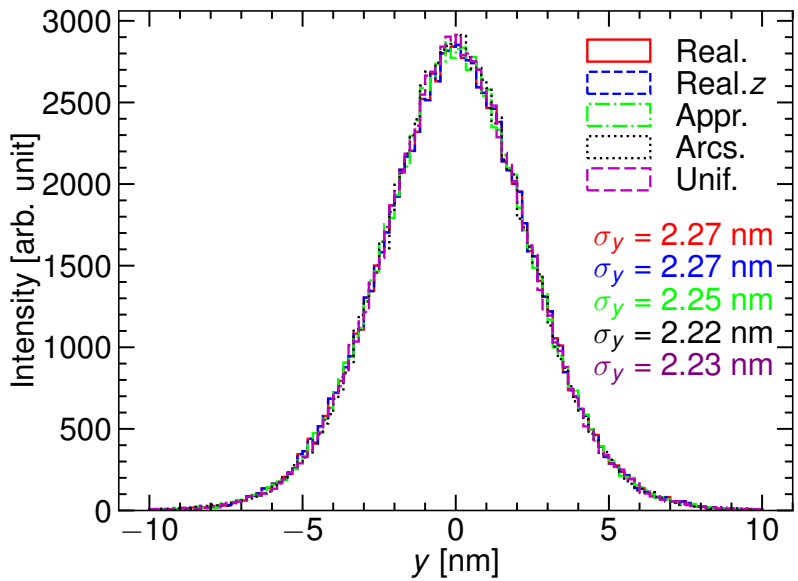
$$f(\delta) = \begin{cases} k_1 x + b_1 & a < x \leqslant x_1 \\ \frac{1}{B}(x-a)^{1-\alpha}(b-x)^{1-\beta} & x_1 < x < x_2 \\ k_2 x + b_2 & x_2 \leqslant x < b \end{cases}$$



Tracking results

	Realistic	Real. uncor.	Approximated	Arcsine	Uniform
σ_x [µm]	144.33	144.38	142.43	140.86	141.69
σ_y [nm]	2.66	2.66	2.54	2.50	2.52
$\sigma_{x,\mathrm{fit}}$ [µm]	137.42	137.42	138.25	138.91	137.01
$\sigma_{y,\mathrm{fit}}$ [nm]	2.27	2.27	2.25	2.22	2.23
$\mathcal{L}^*$ [$10^{34}\mathrm{cm}^{-2}\mathrm{s}^{-1}$]	2.11	2.08	2.13	2.19	2.16
$\mathcal{L}^*_{1\%}$ [$10^{34}\mathrm{cm}^{-2}\mathrm{s}^{-1}$]	1.17	1.17	1.19	1.21	1.20





[1] w/o SR at bends and quads

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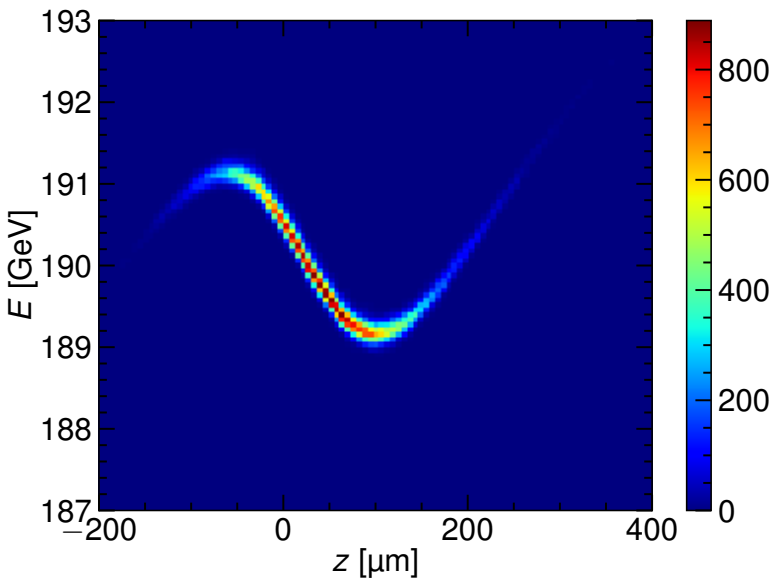

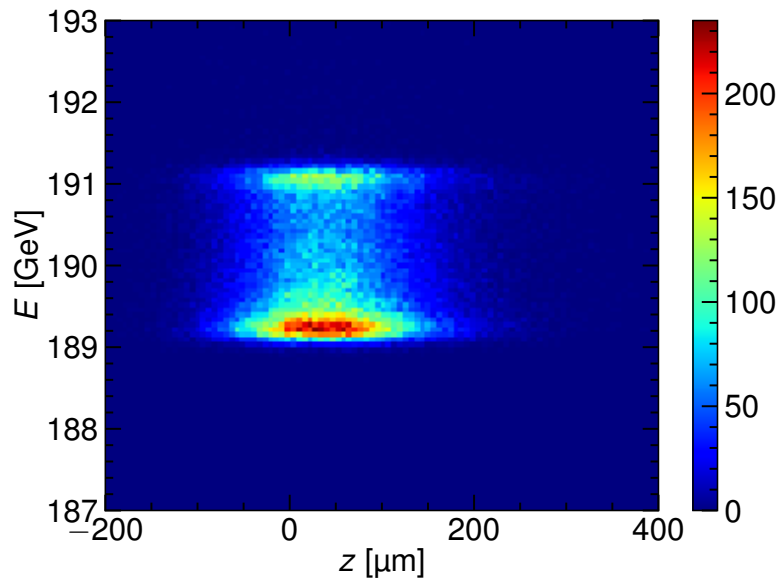

[1] w/o SR at bends and quads

Conclusion and prospects

- Many questions need to be understood, e.g., unsymmetrical E-profile, luminosity difference and ...

$\Rightarrow$ Satisfactory analytical model(s) to approach the realistic beam from ML

Thank you for your attention!

Tracking results (2018-10-22)

- Approximated $E-$profile by a piecewise function gives the best approach
- Arcsine distribution also acceptable?

	Realistic	Approximated	Arcsine	Uniform
σ_x [m]	137.42	138.43	139.07	138.93
σ_y [nm]	2.27	2.24	2.22	2.20
$\mathcal{L}^*$ [10^{34}cm^{-2}s^{-1}]	1.201	1.201	1.221	1.227
$\mathcal{L}^*_{1\%}$ [10^{33}cm^{-2}s^{-1}]	6.633	6.798	6.807	6.872

* Energy spread were not set to the same value 0.361%
* A factor 1.76 should be considered for luminosity values

[1] w/o SR at bends and quads