Holmganga: Lund strings vs CGC

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- And possibly make a better hybrid.

The initial state energy density (2010.07595)

- Key difference between CGC/strings: Energy density right after collision.
- Both: Boost invariant plateau ie. longitudinal E and B fields.
- PbPb collision at 2.76 GeV numbers:
  - IP-Glasma 1206.6805: $\frac{dE}{d^3x} \approx 500$ GeV/fm^3
  - String: $\frac{dE}{d^3x} \approx 5$ GeV/fm^3
- Strings: Vaccum condensate enough to keep strings together.
- Questions:
  1. These must be different, right?
  2. How is it reasonable to fragment CGC fluxtubes with Pythia or Herwig?

- Several partons taken from the PDF.
- Hard subcollisions with $2 \rightarrow 2$ ME:

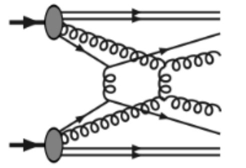

Figure T. Sjöstrand

$$\frac{d\sigma_{2\rightarrow 2}}{dp_{\perp}^2} \propto \frac{\alpha_s^2(p_{\perp}^2)}{p_{\perp}^4} \rightarrow \frac{\alpha_s^2(p_{\perp}^2 + p_{\perp 0}^2)}{(p_{\perp}^2 + p_{\perp 0}^2)^2}.$$

- Momentum conservation and PDF scaling.
- Ordered emissions: $p_{\perp 1} > p_{\perp 2} > p_{\perp 4} > ...$ from:

$$\mathcal{P}(p_{\perp} = p_{\perp i}) = \frac{1}{\sigma_{nd}} \frac{d\sigma_{2\rightarrow 2}}{dp_{\perp}} \exp\left[-\int_{p_{\perp}}^{p_{\perp i-1}} \frac{1}{\sigma_{nd}} \frac{d\sigma}{dp'_{\perp}} dp'_{\perp}\right]$$

- The $p_{\perp,0}$ parameter $\approx 1/$colour screening length.

Color reconnections

- Many partonic subcollisions $\Rightarrow$ Many hadronizing strings.
- But! $N_c = 3$, not $N_c = \infty$ gives interactions.
- Easy to merge low-$p_\perp$ systems, hard to merge two hard-$p_\perp$.

$$\mathcal{P}_{merge} = \frac{(\gamma p_{\perp 0})^2}{(\gamma p_{\perp 0})^2 + p_\perp^2}$$

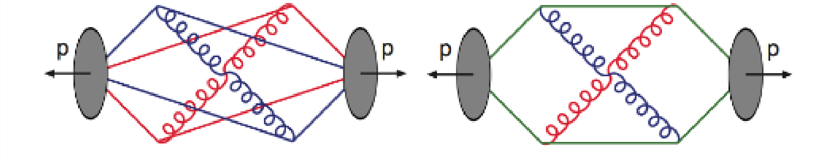

Figure T. Sjöstrand

- Actual merging decided by minimization of:

$$\lambda = \sum_{dipoles} \log(1 + \sqrt{2}E/m_0)$$

Fighting words

1. Saturation in a cascade or CGC and CR are just two ways of saying the same things. You can not tell the difference.
2. Unless you can give a satisfactory description of what the remnant looks like, which agrees with data, it does not make sense to have a proton where I have extracted 20 gluons? Not just a Pythia question.
3. Seems like PDFs are really not neccesary? Or maybe only for high $p_\perp$ precision stuff?

A CGC enhanced MPI framework?

- My understanding: $2 \to 1$ gluon emissions from classical fields around and under Q_s.
- This is exactly the region where:
  - MPI cross section completely dominated by parametrization.
  - ISR and FSR play a role, but cut-off very low! Could be raised.
- Replace such emissions with single gluon emissions from background field, generated with IP-Glasma/other?
- All the way to 0, get intrinsic $k_\perp$ for free? "Min bias" pp not the best discriminator, $Z^0 p_\perp$ in Drell-Yan better.
- Colour tracking painful. Add soft CGC gluons to existing MPI systems.

Those high multiplicity events really bugs me