TAGGING THE INITIAL-STATE GLUON IN THE Z+JETS PROCESS

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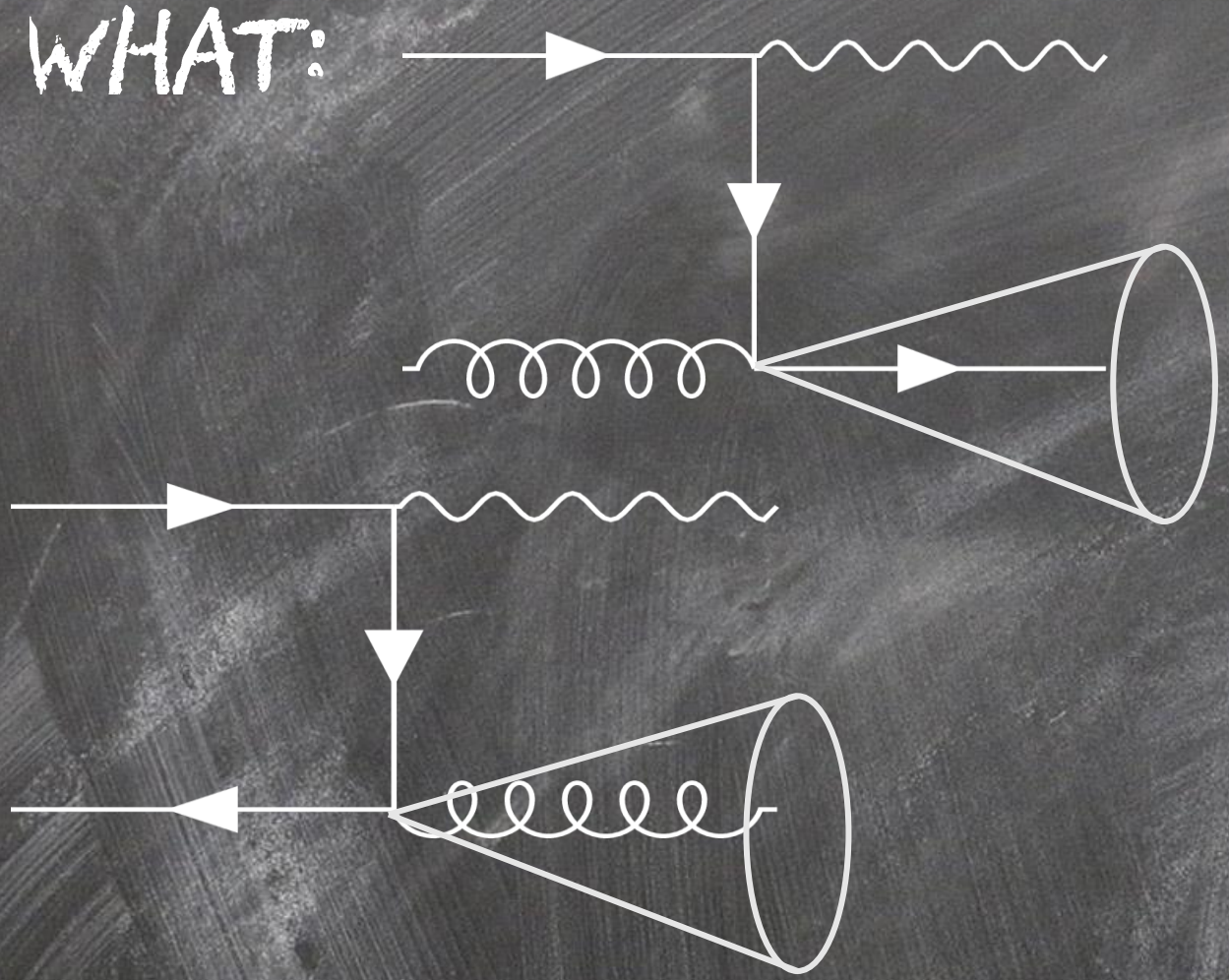
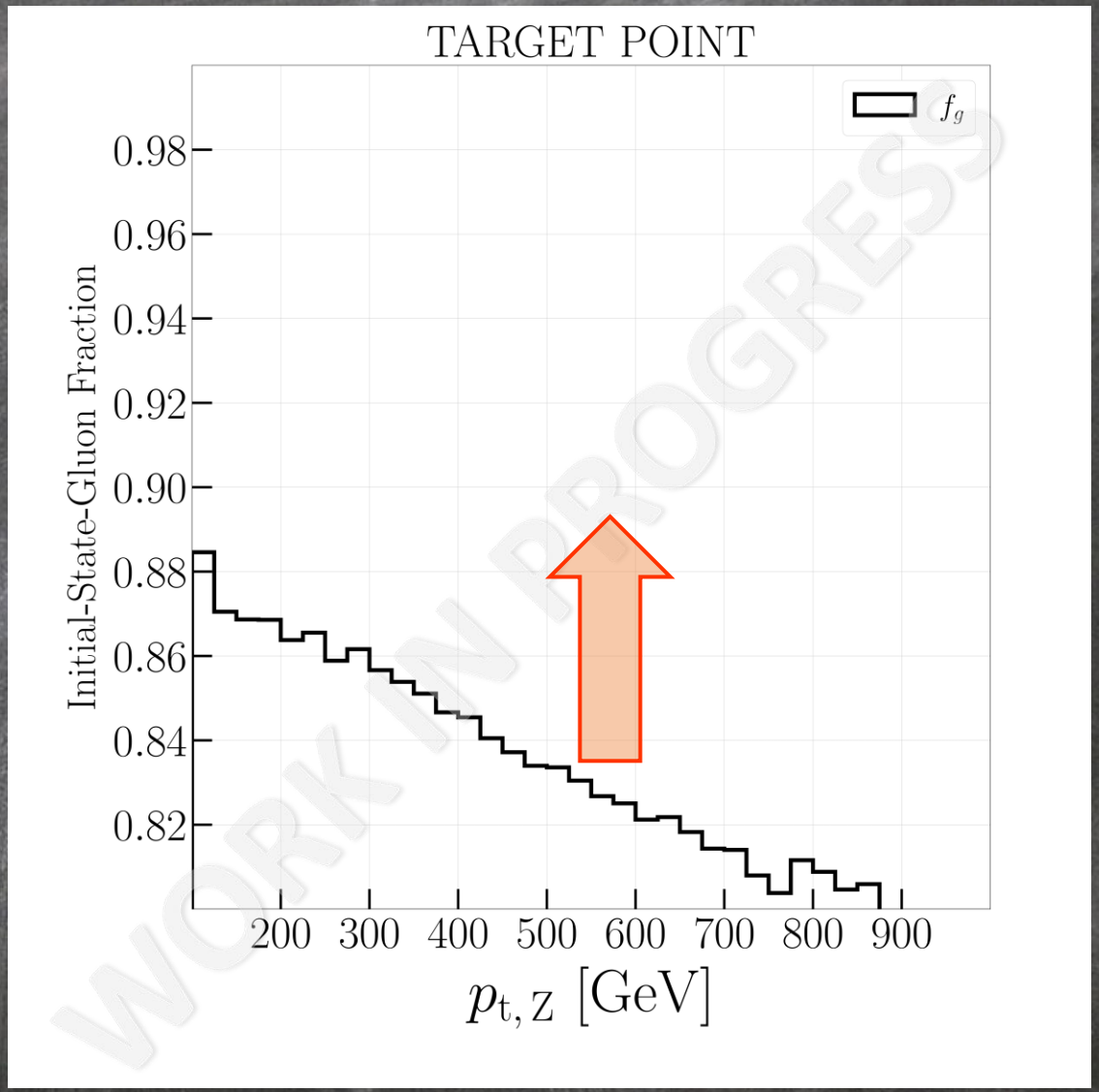
LHCP2021 Poster Session

WHAT:



$$f_g = \frac{\sigma_{qg}}{\sigma_{qq} + \sigma_{qg}} \approx 0.85$$



How:

From 1704.03878 (P. Gras, S. Höche, D. Kar, A. Larkoski, L. Lönnblad, S Plätzer, A. Siódmok, P. Skands, G. Soyez, J. Thaler)

$$\tilde{f}_g = \frac{\varepsilon_q \sigma_{qg}}{\varepsilon_g \sigma_{qq} + \varepsilon_q \sigma_{qg}} = \frac{\varepsilon_q f_g}{\varepsilon_g (1 - f_g) + \varepsilon f_g} = \left(1 + \frac{1 - f_g}{f_g} \frac{\varepsilon_g}{\varepsilon_q}\right)^{-1}$$

$$\varepsilon_g = \frac{f_q (1 - \tilde{f}_q)}{\tilde{f}_g (1 - f_g)} \varepsilon_q$$

Ill defined

What people sometimes think we mean

Quark as noun

Quark as adjective

Well defined

What we mean

- A quark parton
- A Born-level quark parton
- The initiating quark parton in a final state shower
- An eikonal line with baryon number 1/3 and carrying triplet color charge
- A quark operator appearing in a hard matrix element in the context of a factorization theorem
- A parton-level jet that has been quak-tagged using an IRC-safe flavored jet algorithm
- A phase space region (as defined by an unambiguous hadronic fiducial cross section measurement) that yields an enriched sample of quarks (as interpreted by some suitable, though fundamentally ambiguous, criterion)

How:

$$\lambda_\alpha^\kappa = \sum_{j \in \text{Jet}} \left(\frac{p_{T,j}}{\sum_{j \in \text{Jet}} p_{T,j}} \right)^\kappa \left(\frac{\Delta_j}{R} \right)^\alpha$$

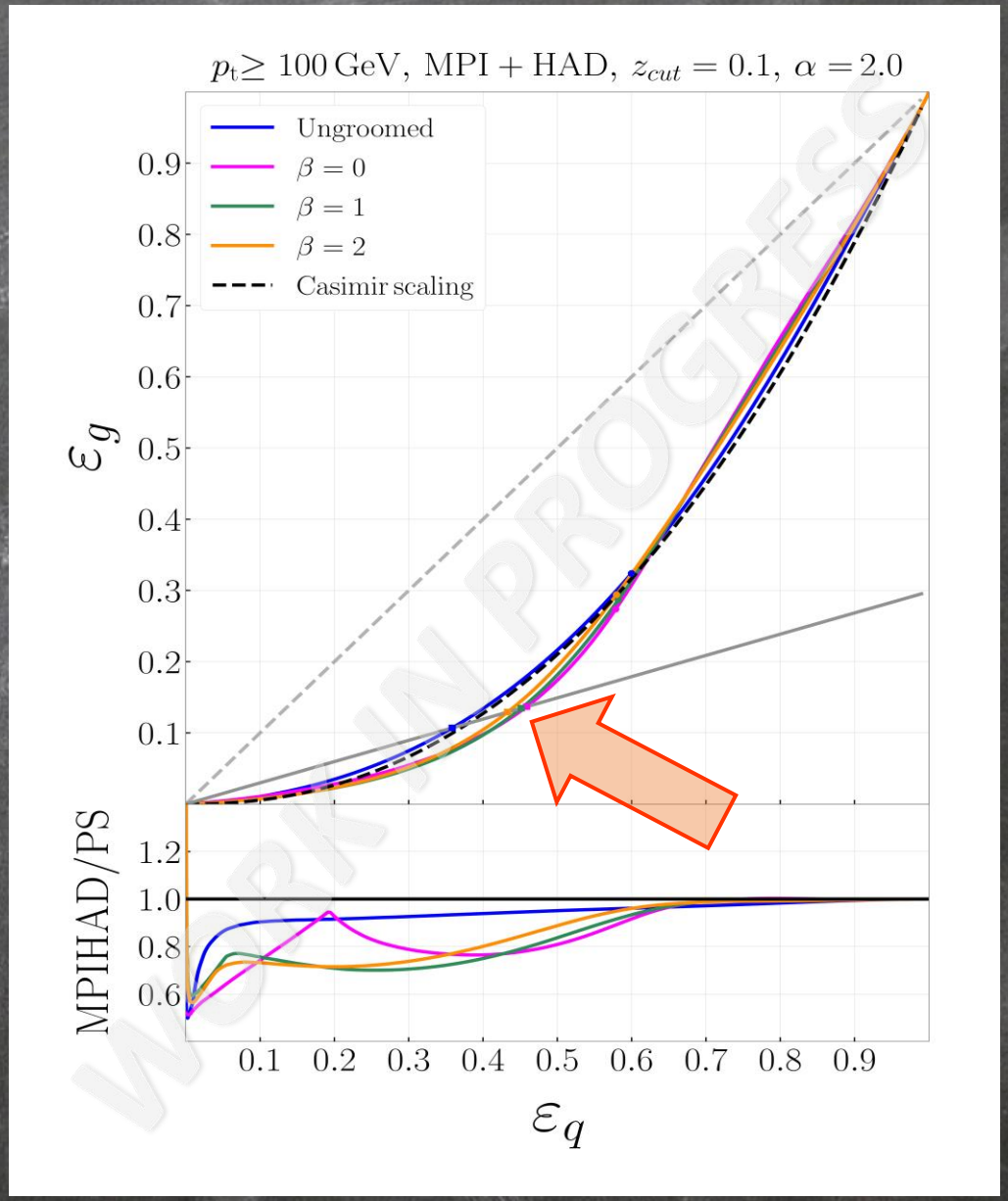
with $\Delta_j = \sqrt{(y_i - y_{\text{Jet}})^2 + (\phi_i - \phi_{\text{Jet}})^2}$

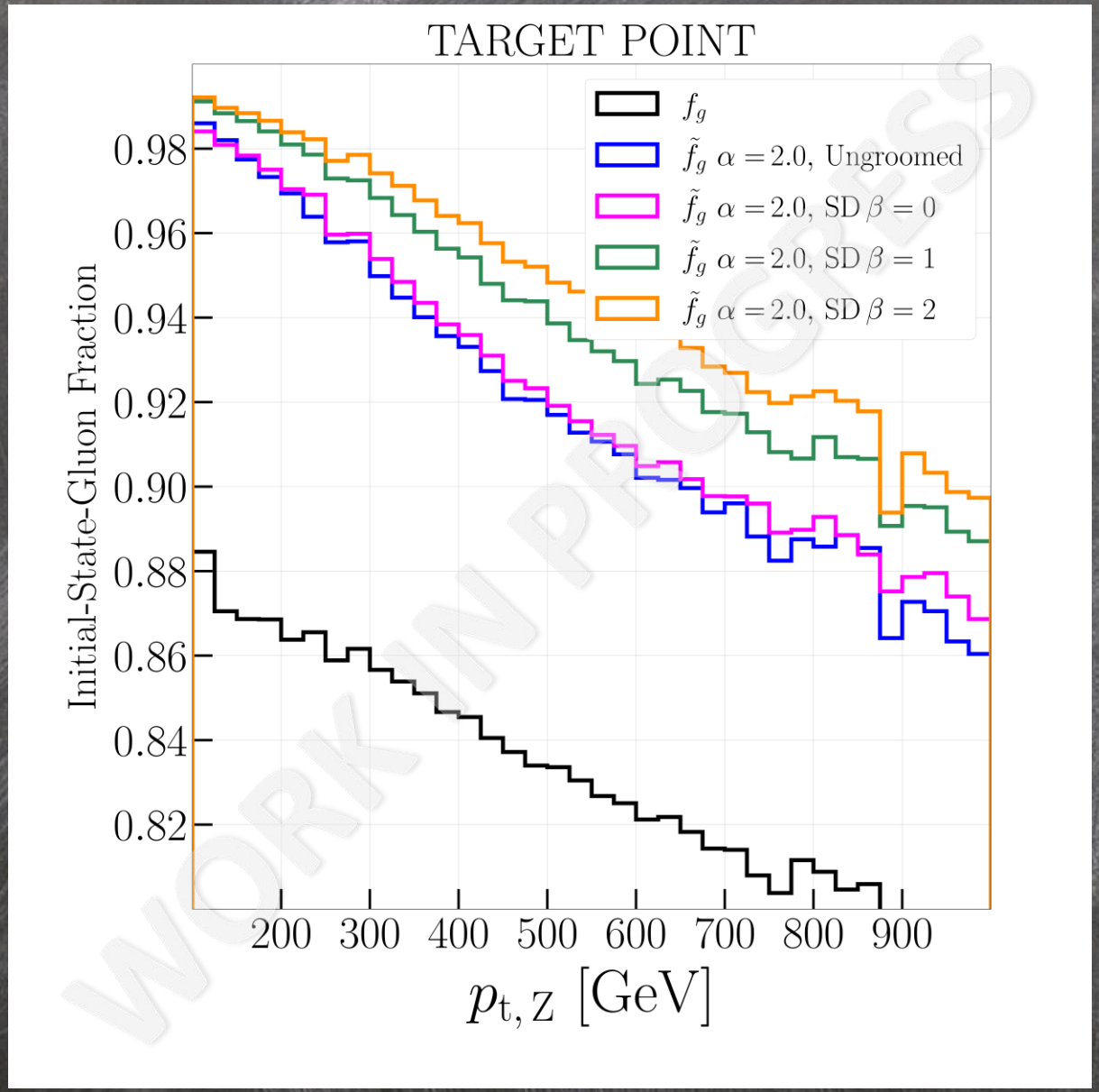
$$\varepsilon_k = \frac{\Sigma_{ij}(\lambda_{\text{cut}})}{\Sigma_{ij}(1)} = \frac{1}{\sigma_{ij}} \int_0^{\lambda_{\text{cut}}} \frac{\mathrm{d}\sigma_{ij}}{\mathrm{d}\lambda} \mathrm{d}\lambda$$

with $i\,j \to Z\,k$

$$f_g \approx 0.85 \Rightarrow \tilde{f}_g \approx 0.95$$

	Ungroomed	SD $\beta = 2$	SD $\beta = 1$	SD $\beta = 0$
λ_{cut}	0.04614	0.02113	0.01429	0.00519





CONCLUSIONS:

- We are able to enhance initial-state-gluon fraction by a 10 %
- Since angularities are IRC safe this is a well-defined tagging procedure from theo viewpoint.
- Can we use this result to provide a new handle on the determination of gluon PDF ?