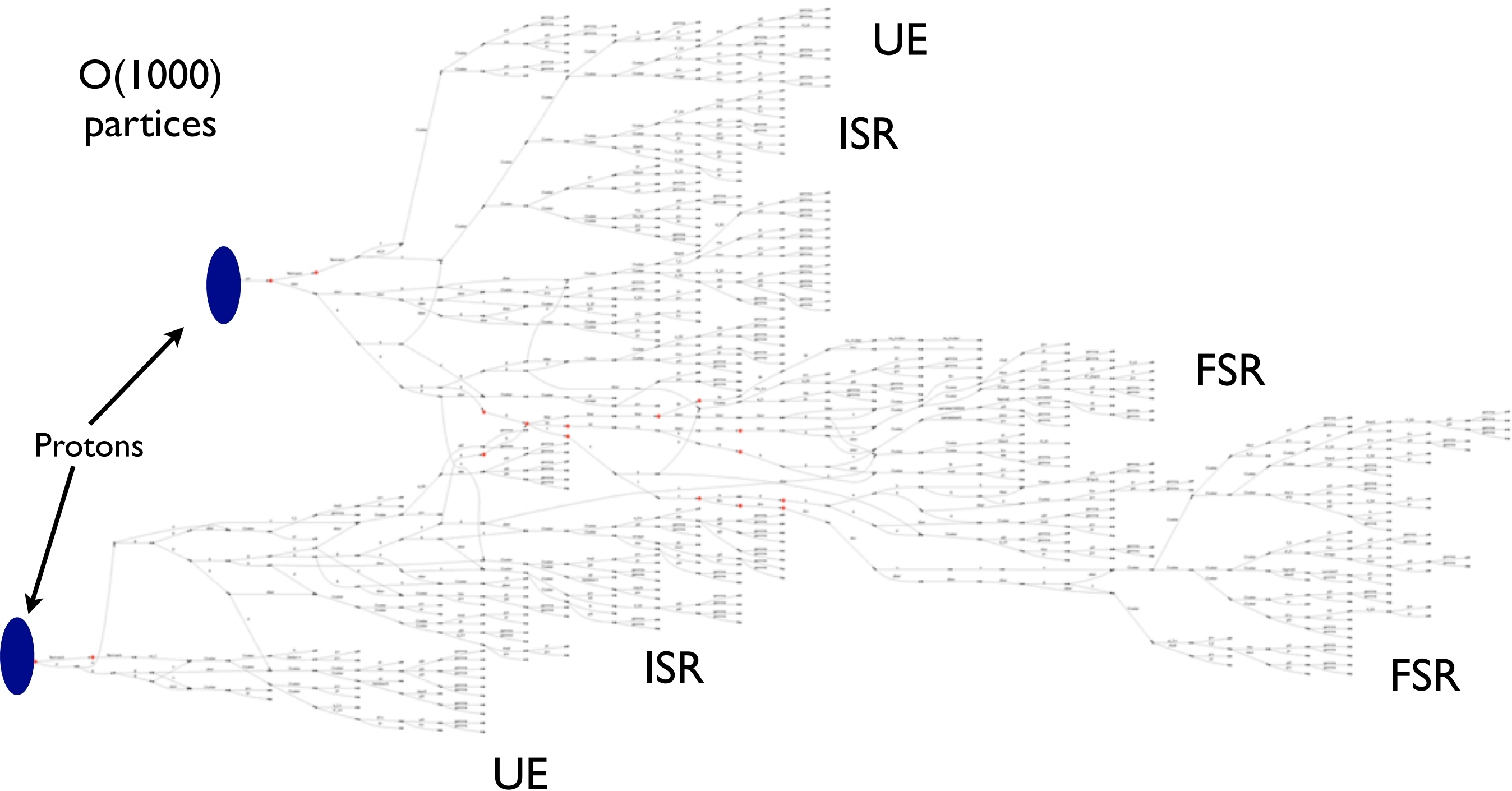


Event reconstruction with shower deconstruction

Michael Spannowsky
University of Oregon

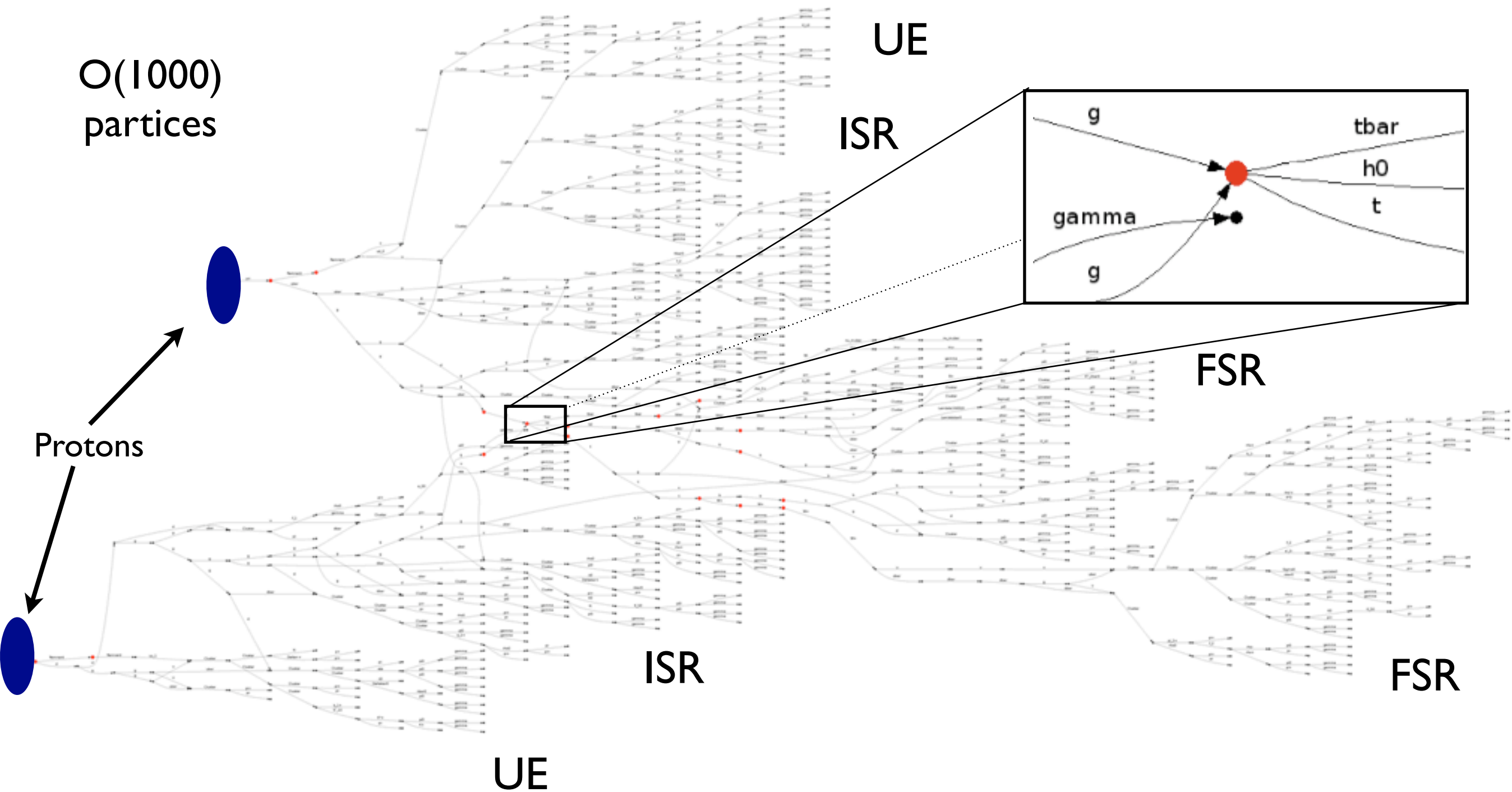
In collaboration with Davison Soper (UO)

LHC yields complex environment!

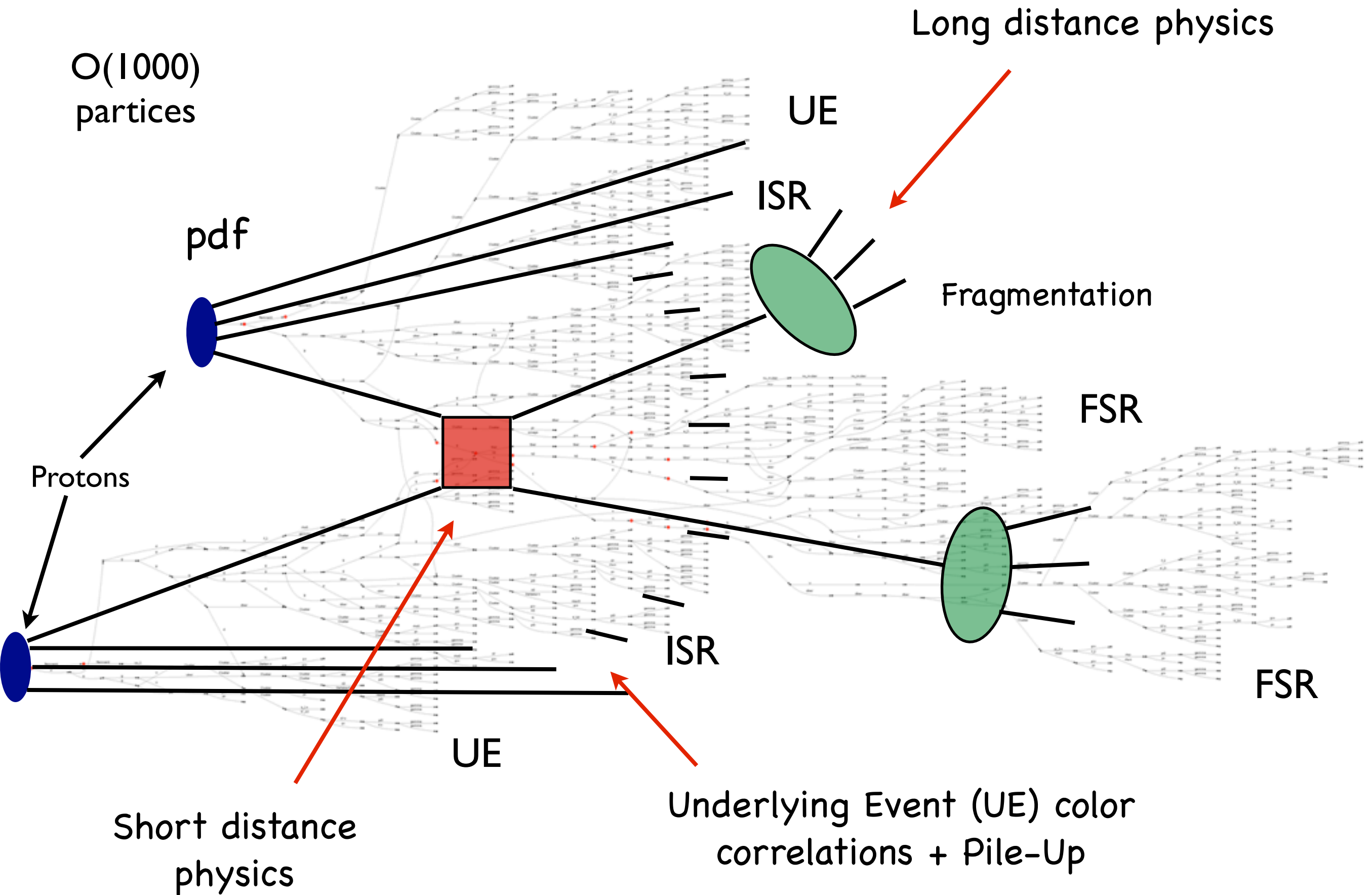


Tedious for theorists and experimentalists

LHC yields complex environment!



Tedious for theorists and experimentalists



Shower deconstruction

- a new method to search New Physics -

- Maximal information approach to discriminate signal from backgrounds
→ UE, ISR, FSR, hard proces
- We want one discriminating analytic function
- Have to respect limitations by experiment

Event deconstruction time consuming
for simplicity
choose boosted scenario, eg. $HZ \rightarrow b\bar{b}l\bar{l}$

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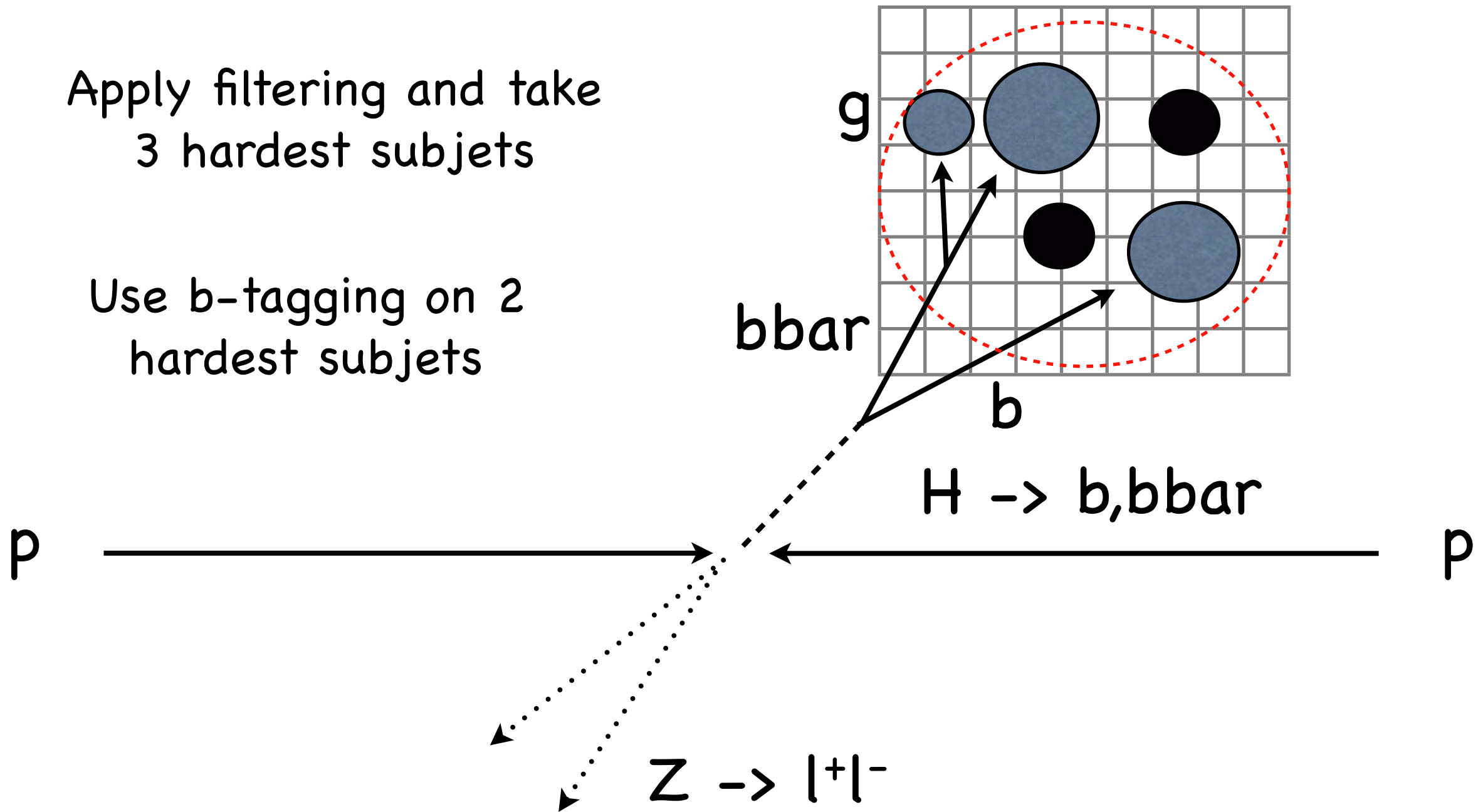
Butterworth, Davison, Rubin, Salam PRL 100 (2008)

HV - Higgs discovery channel

[Butterworth, Davison, Rubin, Salam PRL 100 (2008)]

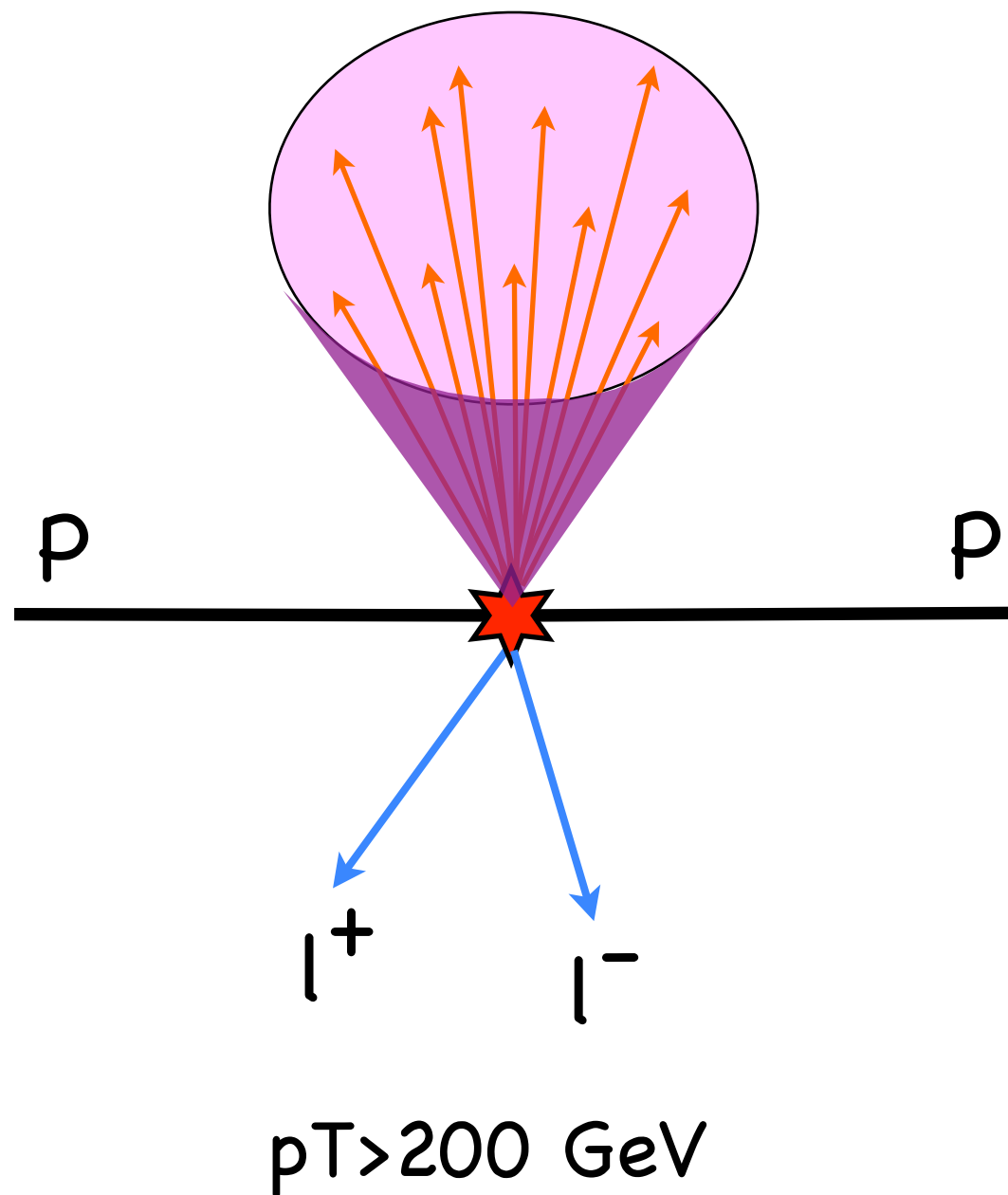
Apply filtering and take
3 hardest subjets

Use b-tagging on 2
hardest subjets

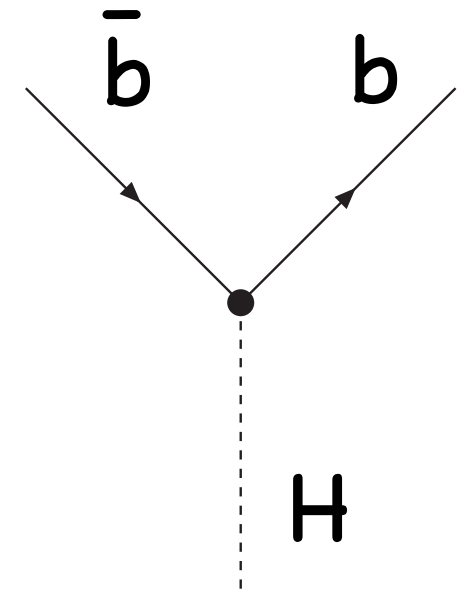


Shower deconstruction

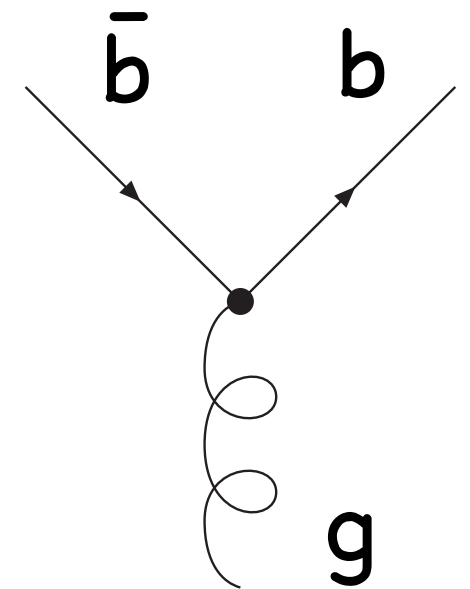
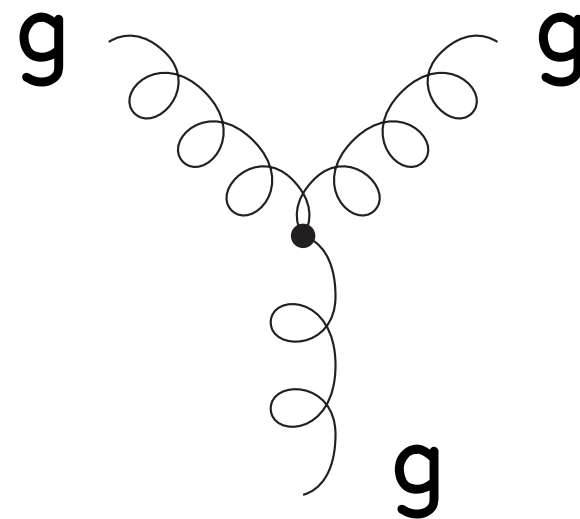
- a new method to search New Physics -



signal



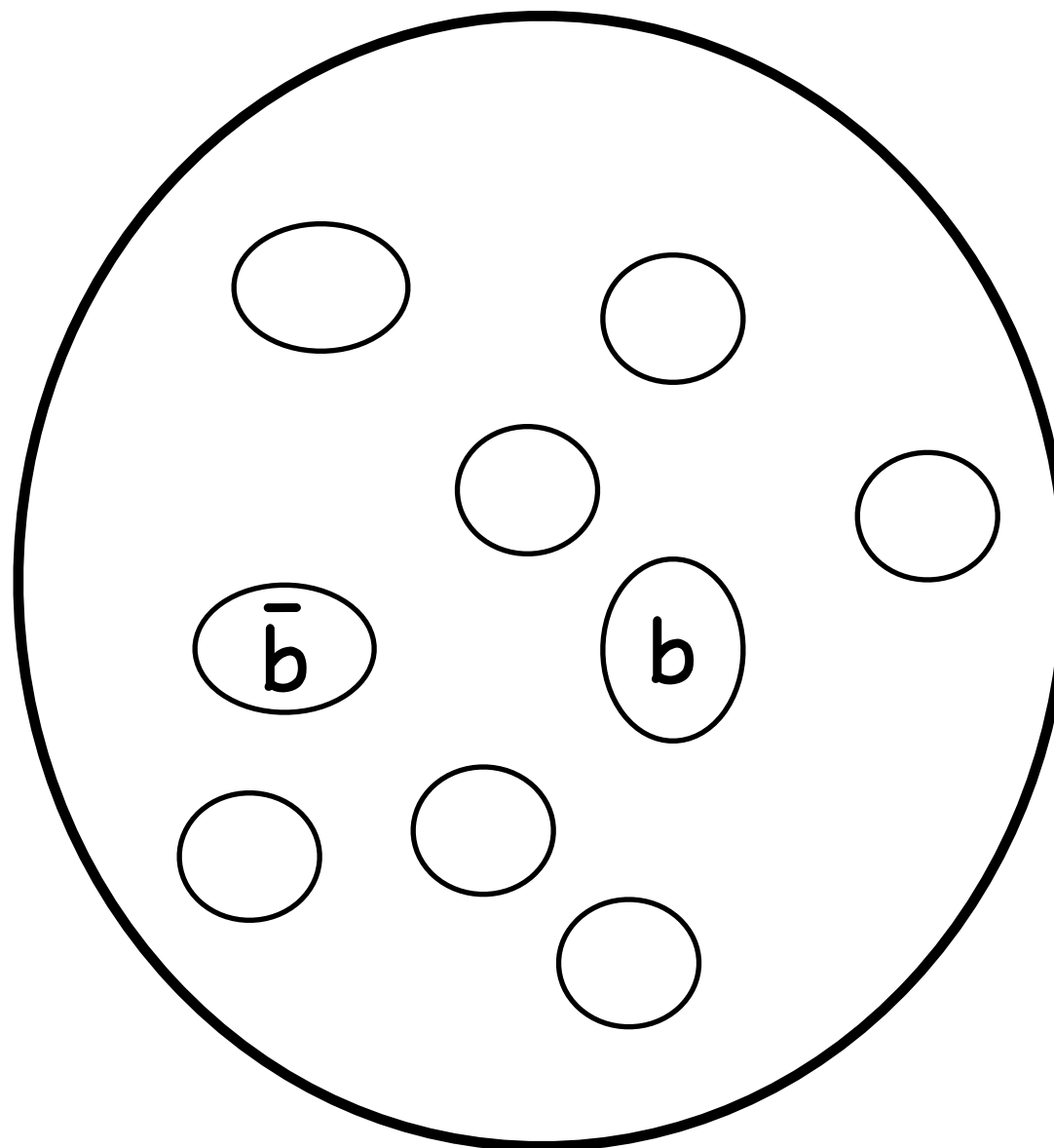
background



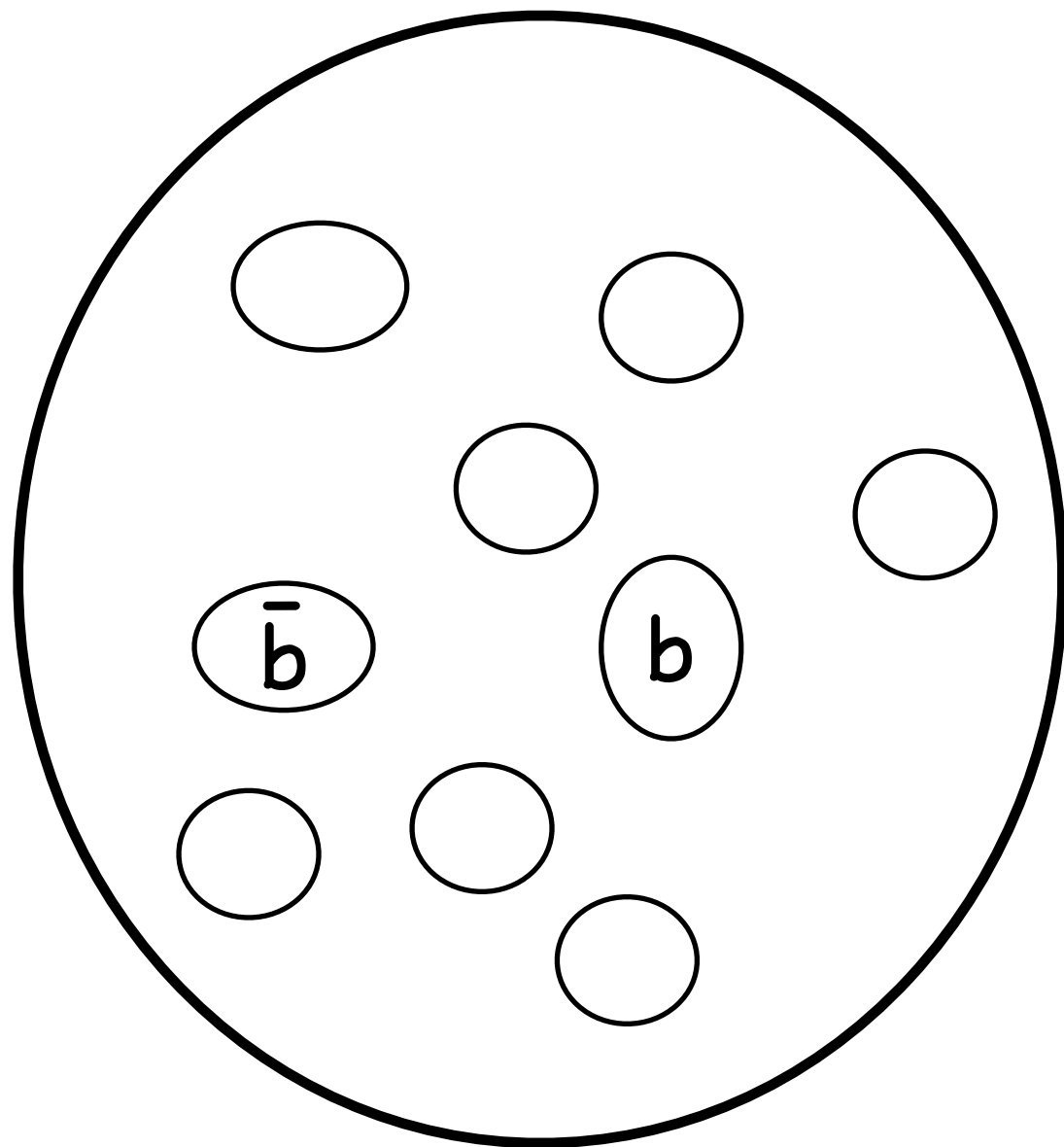
Recombine fat jet's constituents to microjets

(k_T , $R=0.15$, $p_T > 1$ GeV)

microjets are basic elements of event/fat jet

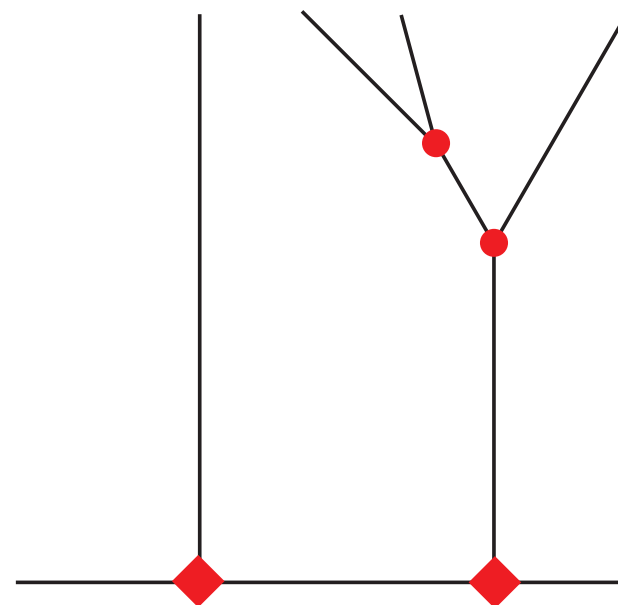


Fat jet: $R=1.2$, anti- k_T

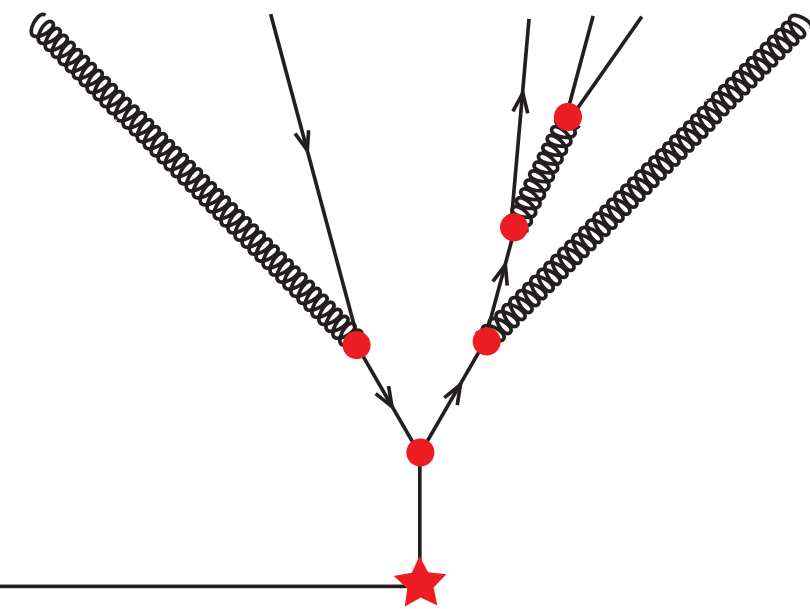


microjets
 $R=0.15$, k_T

ISR/UE



hard interaction

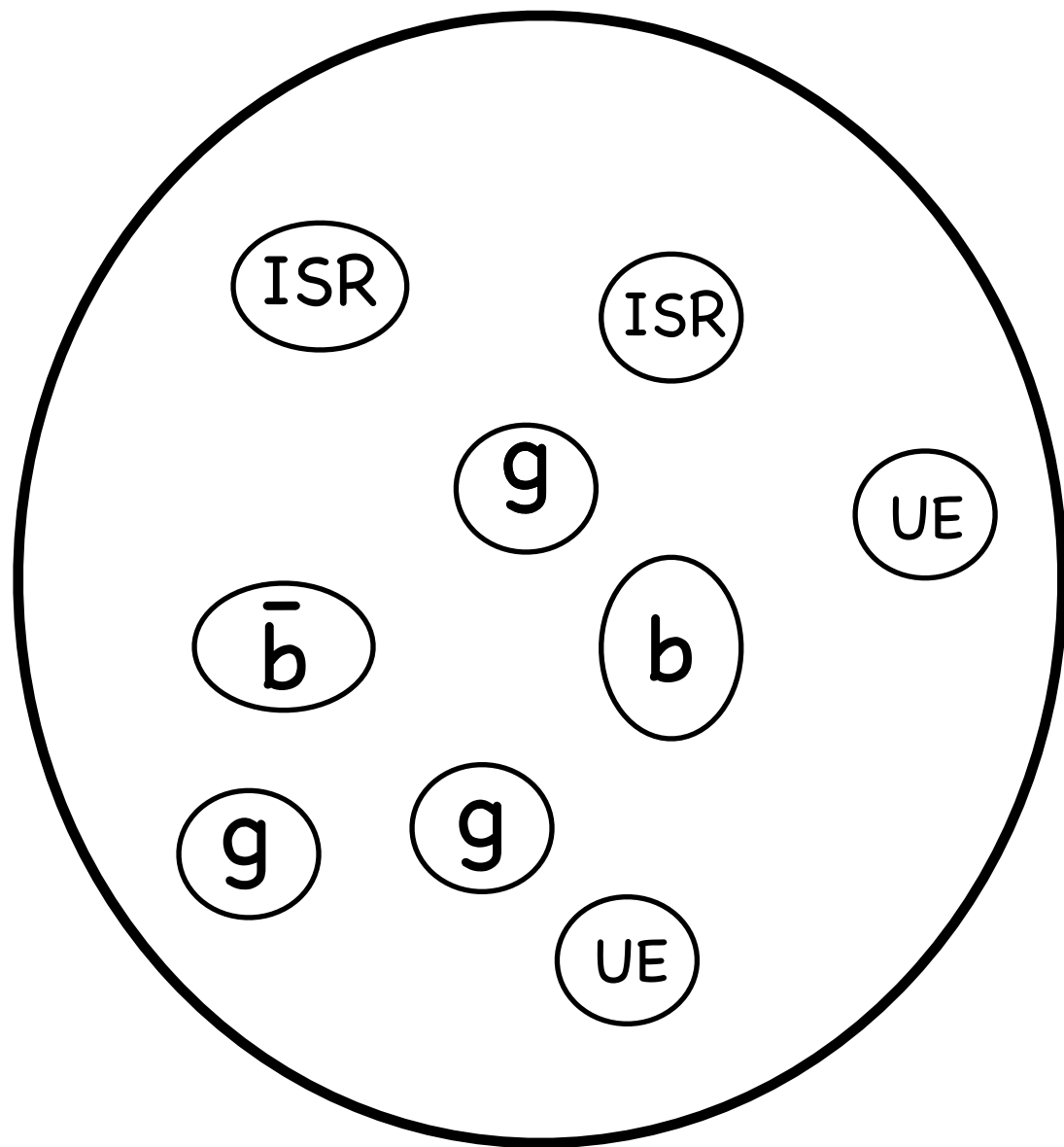


Build all possible shower histories

signal vs background hypothesis
based on:

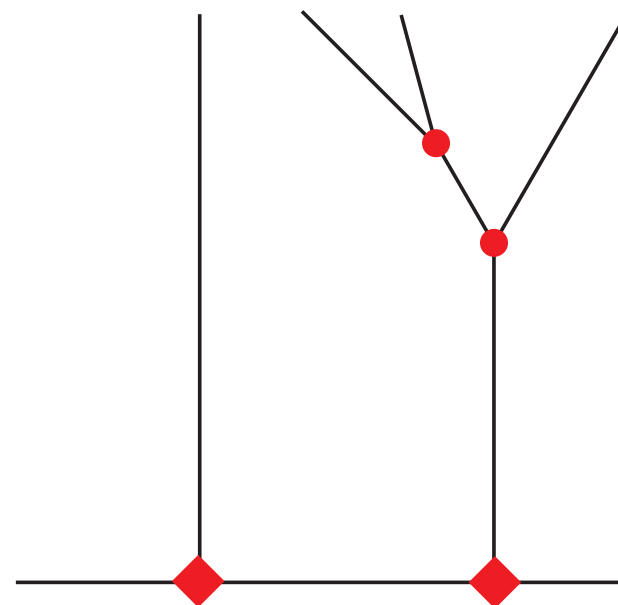
- ▶ Emission probabilities
- ▶ Color connection
- ▶ Kinematic requirements
- ▶ b-tag information

Fat jet: $R=1.2$, anti- k_T

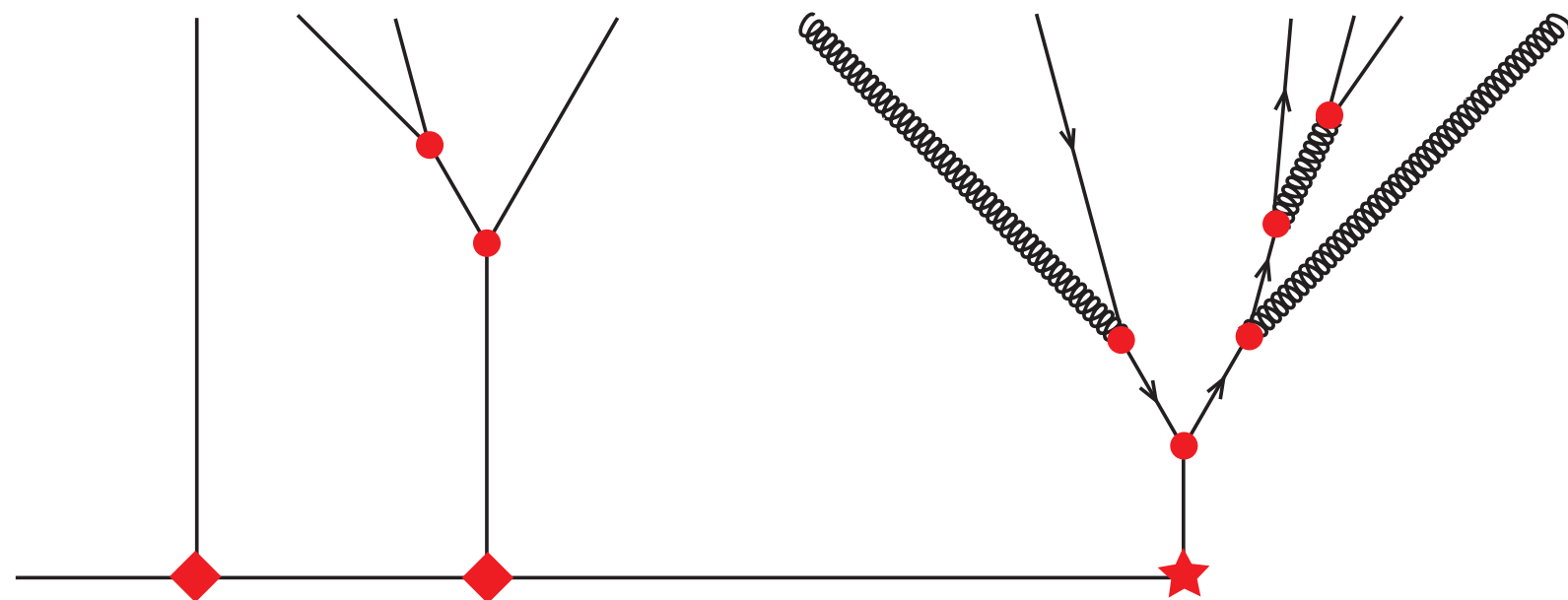


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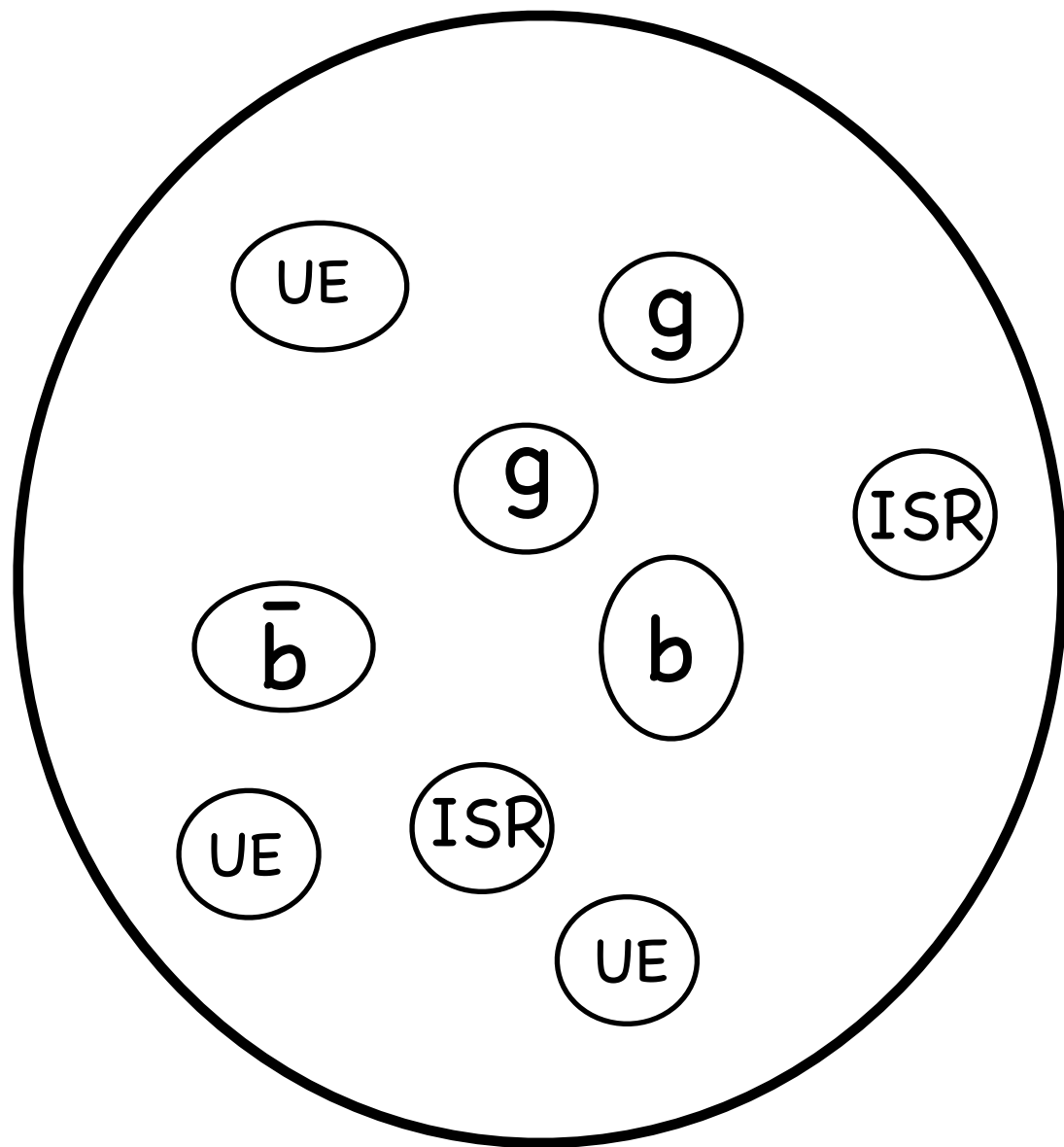


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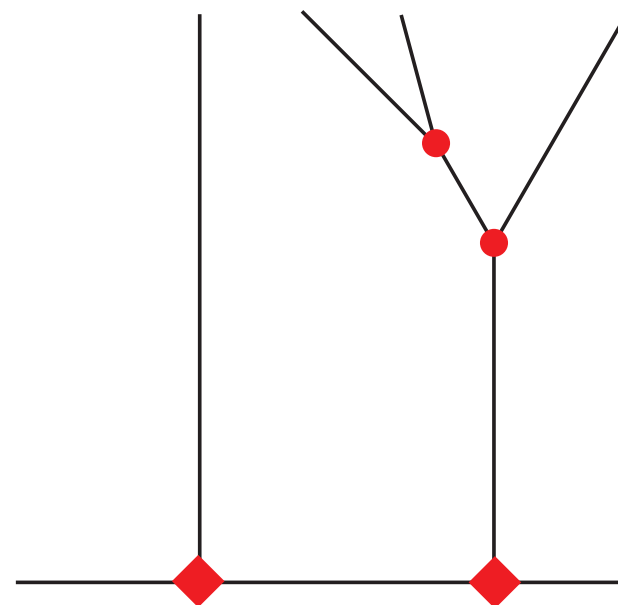
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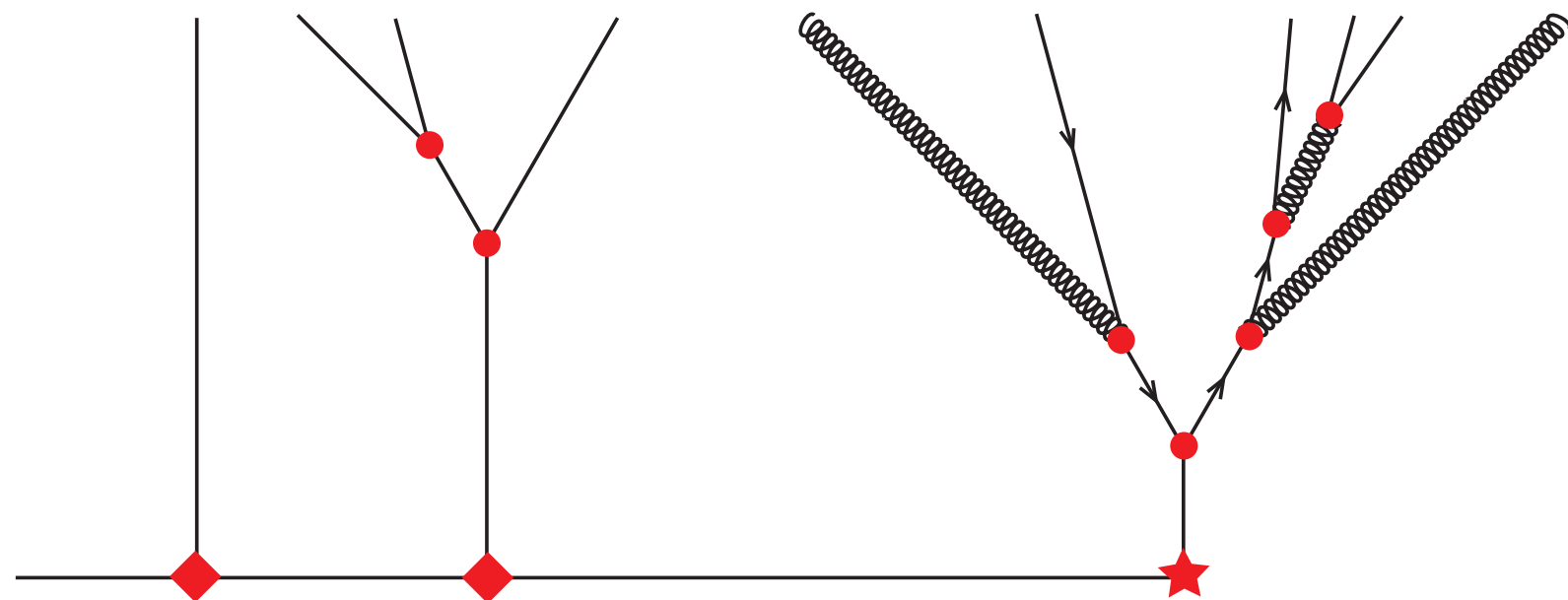


microjets
 $R=0.15$, k_T

ISR/UE



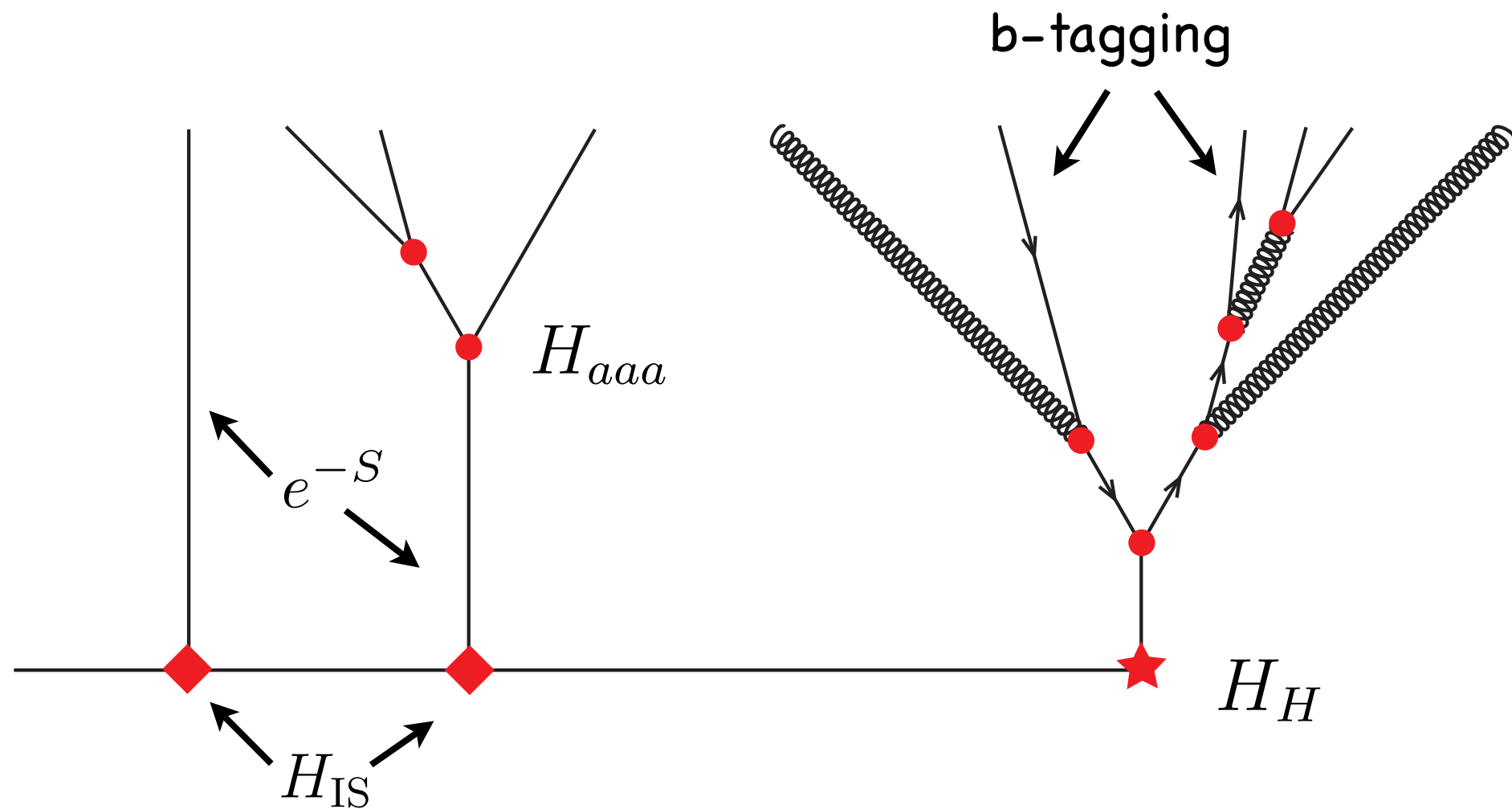
hard interaction



Build all possible shower histories

signal vs background hypothesis
based on:

- ▶ Emission probabilities
- ▶ Color connection
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- ▶ b -tag information



Propagator corresponds to Sudakov factor

Red symbols corresponds to splitting/decay function

$$\chi(\{p, t\}_N) = \frac{P(\{p, t\}_N | S)}{P(\{p, t\}_N | B)} = \frac{\sum_{\text{histories}} H_{ISR} e^{-S_{I1}} \dots H_H e^{-S_{s1}} H_{bg}^s e^{-S_{s2}} \dots}{\sum_{\text{histories}} H_{ISR} e^{-S_{I1}} \dots H_{gbb} e^{-S_{b1}} H_{bg}^b e^{-S_{b2}} \dots}$$

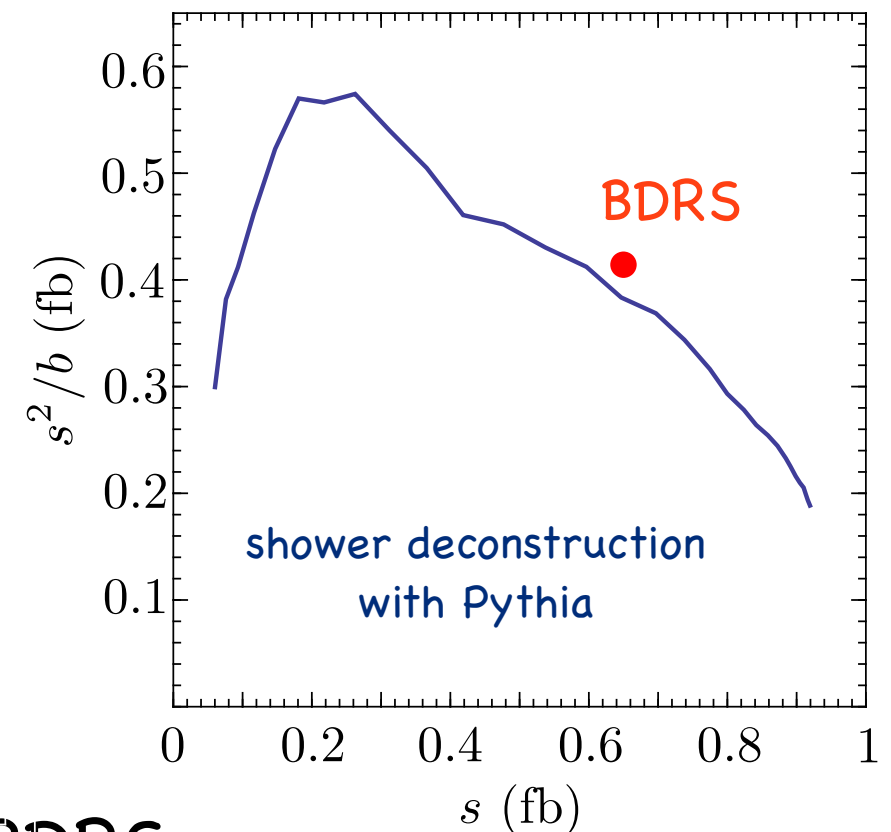
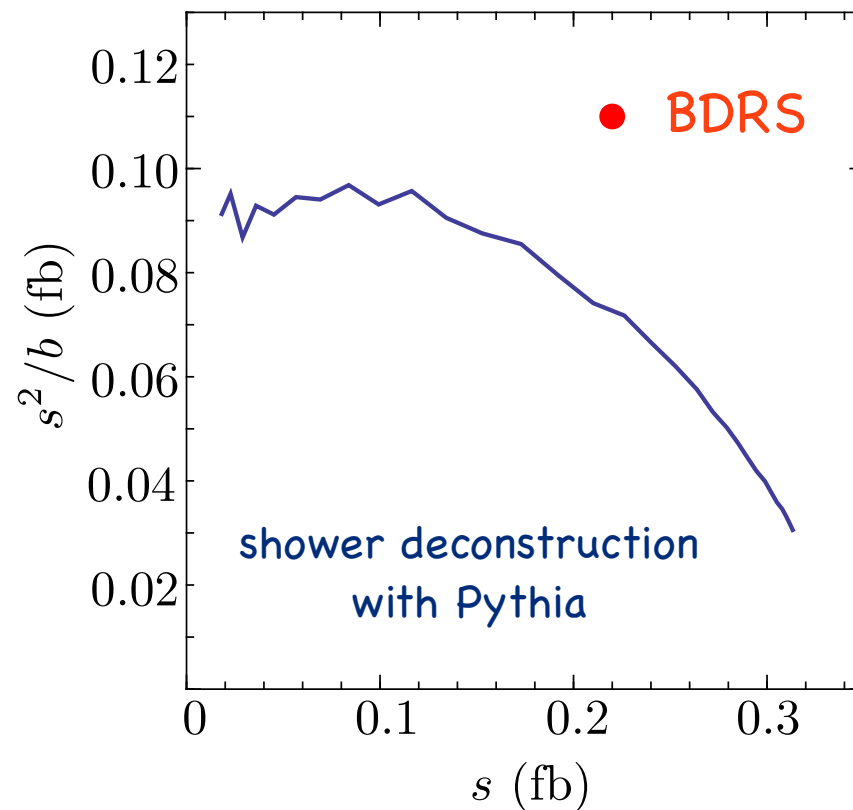
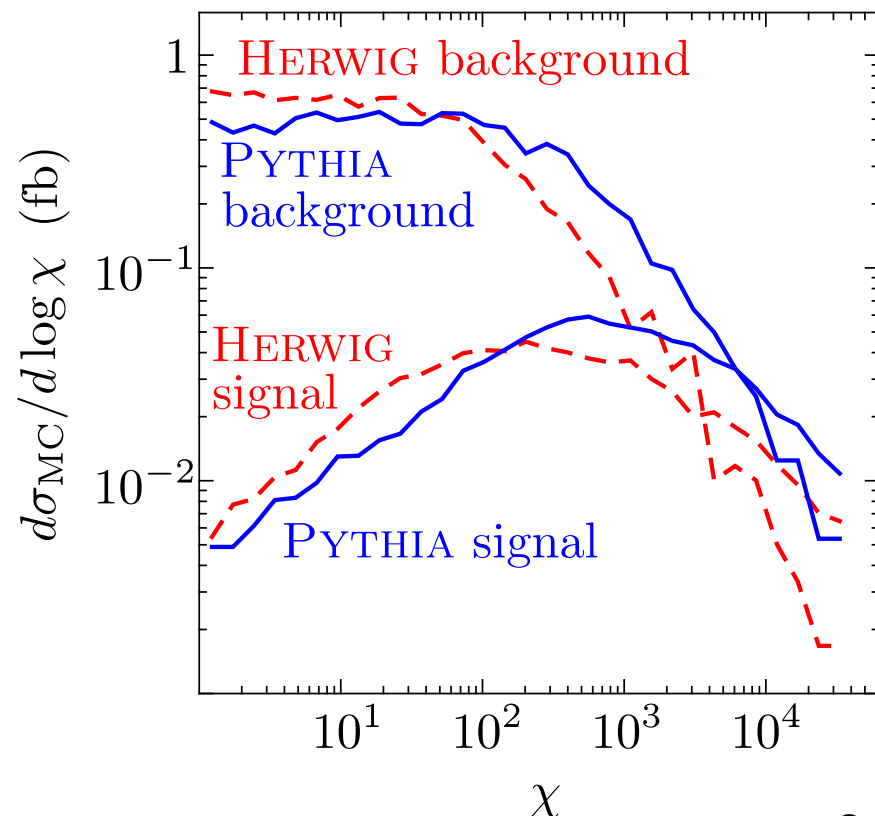
For more details see: [Soper, Spannowsky 1102.3480]

Results of shower deconstruction (SD)

NLO CS: $\sigma_{\text{MC}}(\text{S}) = 1.48 \text{ fb}$ $\sigma_{\text{MC}}(\text{B}) = 2610 \text{ fb}$

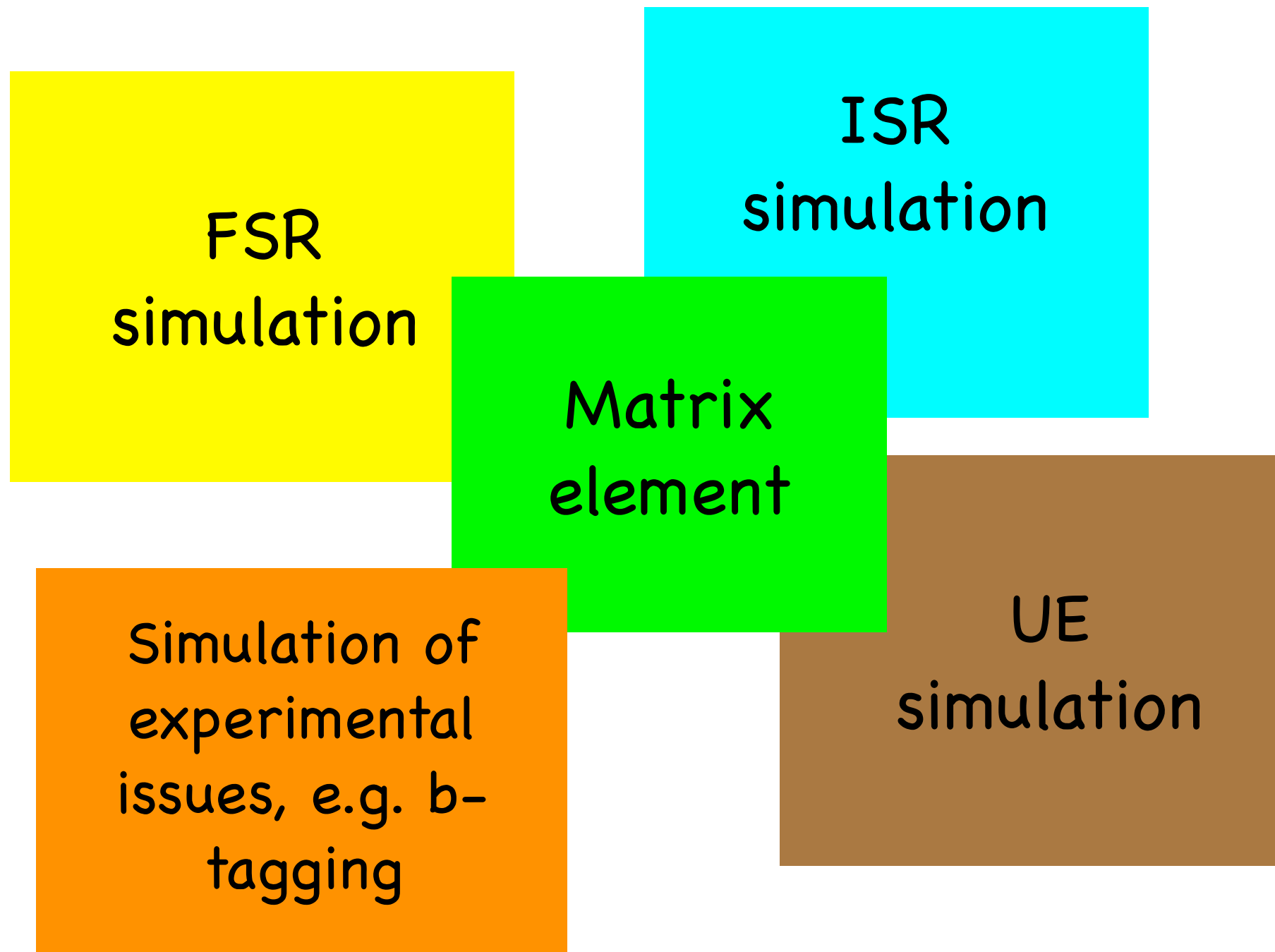
imperfect b-tagging

perfect b-tagging



- ▶ In simple HZ final state not as good as BDRS
- ▶ SD performs comparable for Herwig++ and Pythia
- ▶ Profits more from information than BDRS, e.g. b-tagging

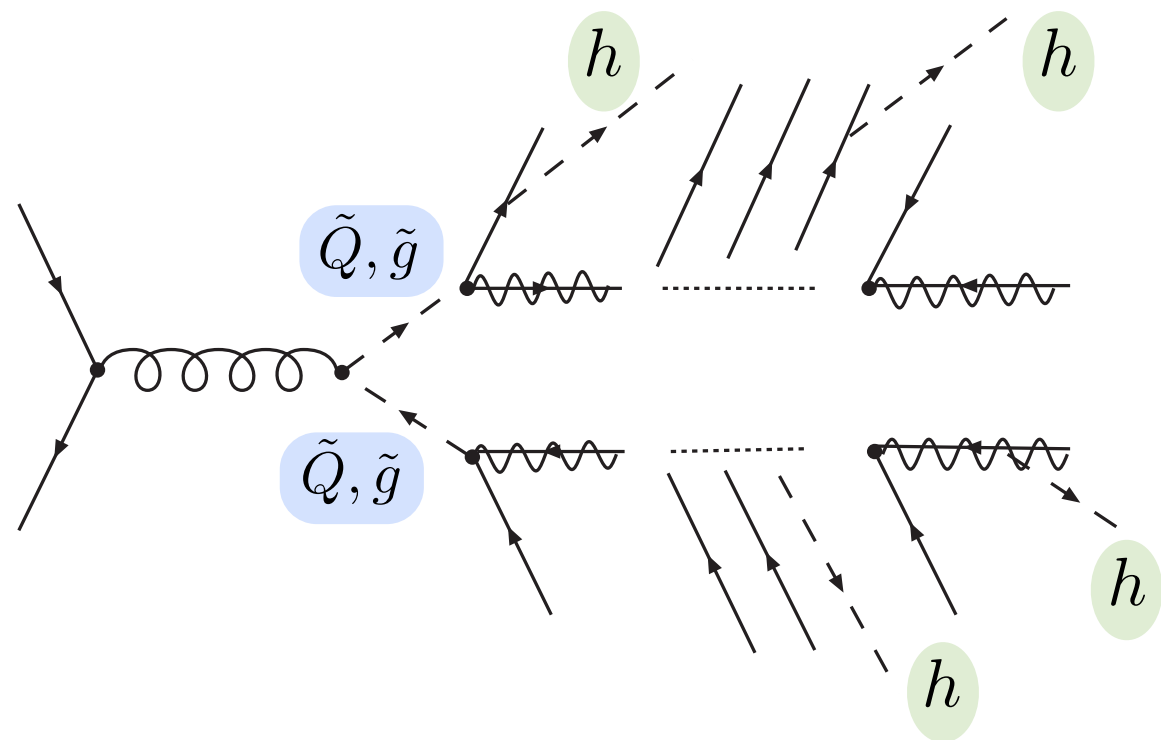
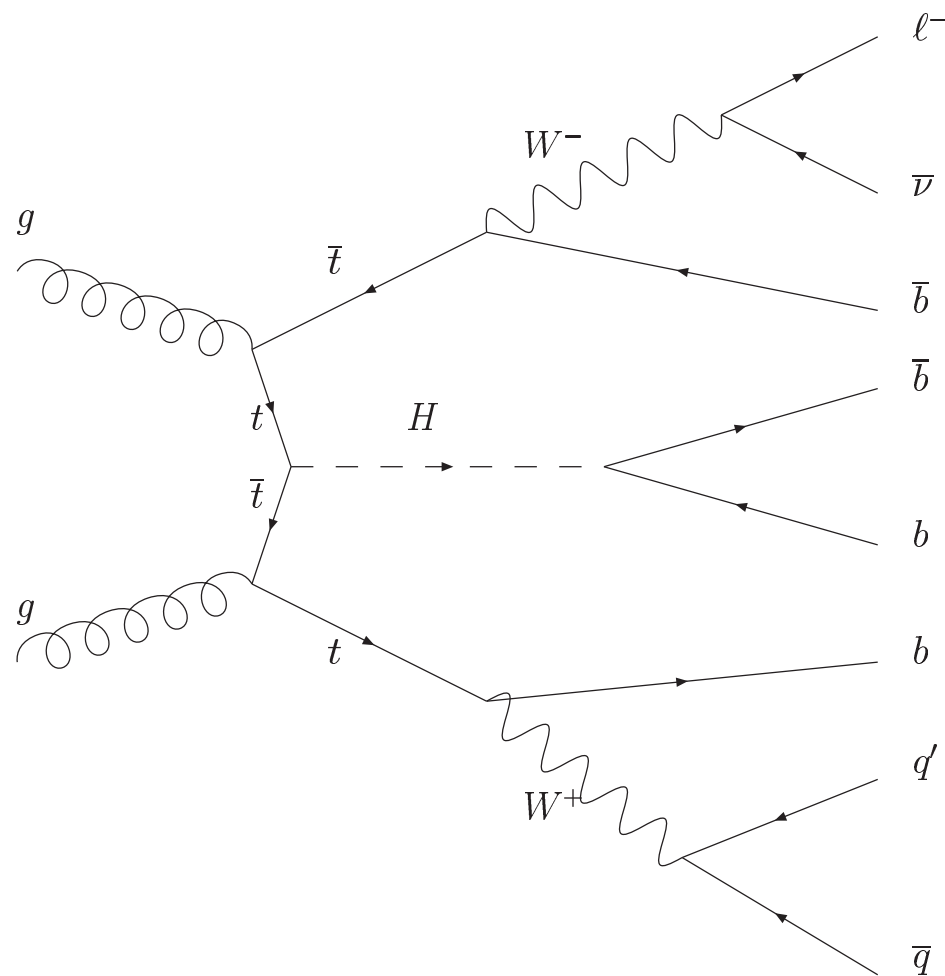
Lots of room for improvement:



Modular build -> improvements are additive

Targeted scenarios:

- ▶ Busy final states -- e.g. $t\bar{t}h$, susy cascades



- ▶ Difficult processes with low stat. significance

Conclusions

- ▶ SD realization of 'maximal information approach'
- ▶ In simple HZ final state not as good as BDRS
- ▶ Theoretical Systematic uncertainty similar to BDRS
- ▶ Profits more from information than BDRS, e.g. b-tagging
- ▶ Might be useful for busy final states
- ▶ Modular set-up -> parts can be improved independently