ALEPH Future Analyses

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Miniworkshop on CMS + ALEPH Analyses
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Outline

① Future jet measurements

② Future EEC measurements

③ Discussion: What is the priority?

Note: These slides are just some prompts based on previous discussions, not at all a limiting list! We should discuss more ideas here ☺️
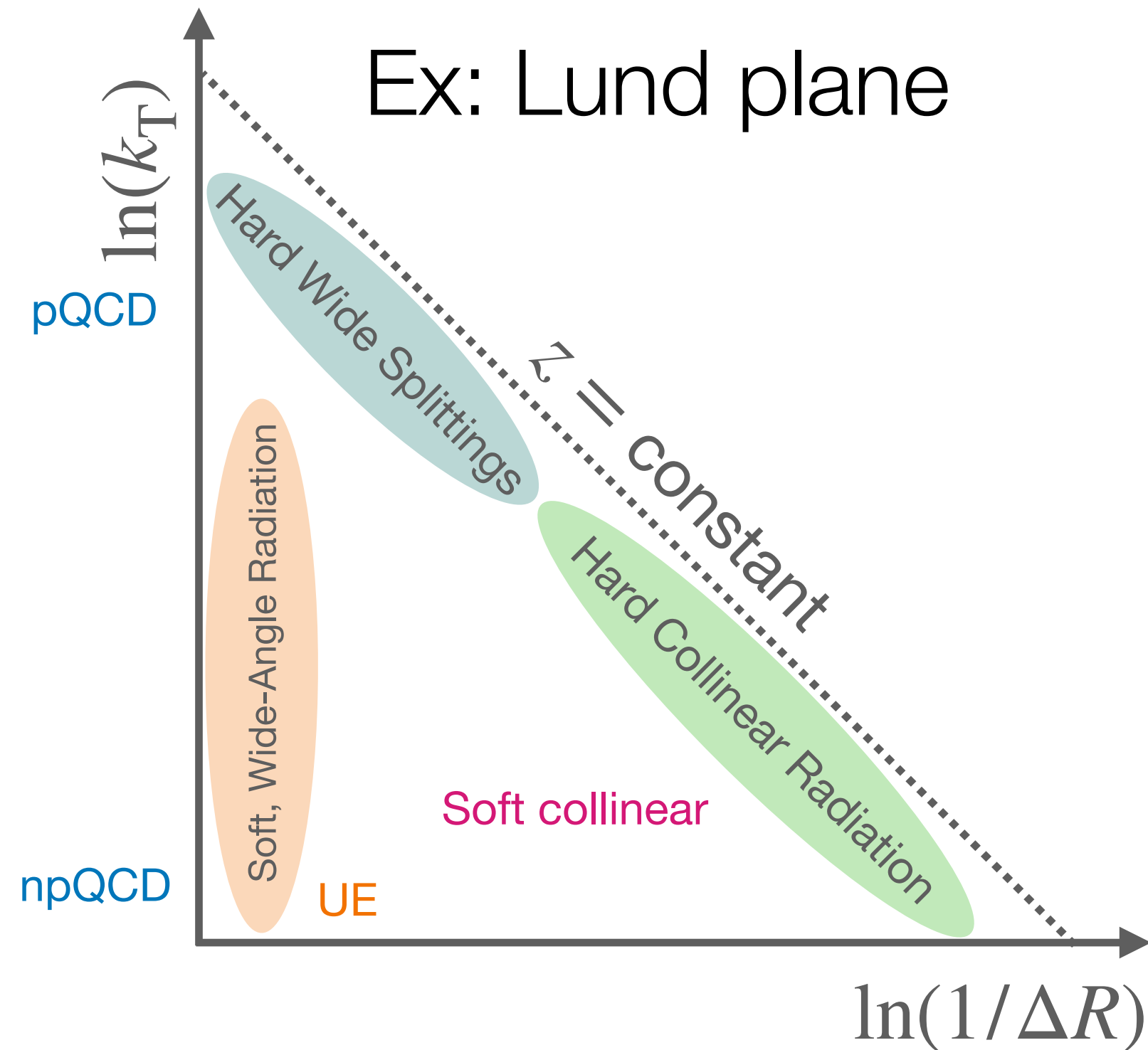
Future Jet Measurements

Jet substructure measurements

For currently available jet measurements, <u>see talk by Yi</u>!

❋ Some jet substructure measurements already explored in [<u>JHEP 06 (2022) 008</u>]

❋ Future: comprehensive look at multidimensional measurements of jet substructure

Ex: Lund plane

Can make use of multidimensional correction methods like Omnifold (or Multifold) in clean environment to do detailed comparisons!
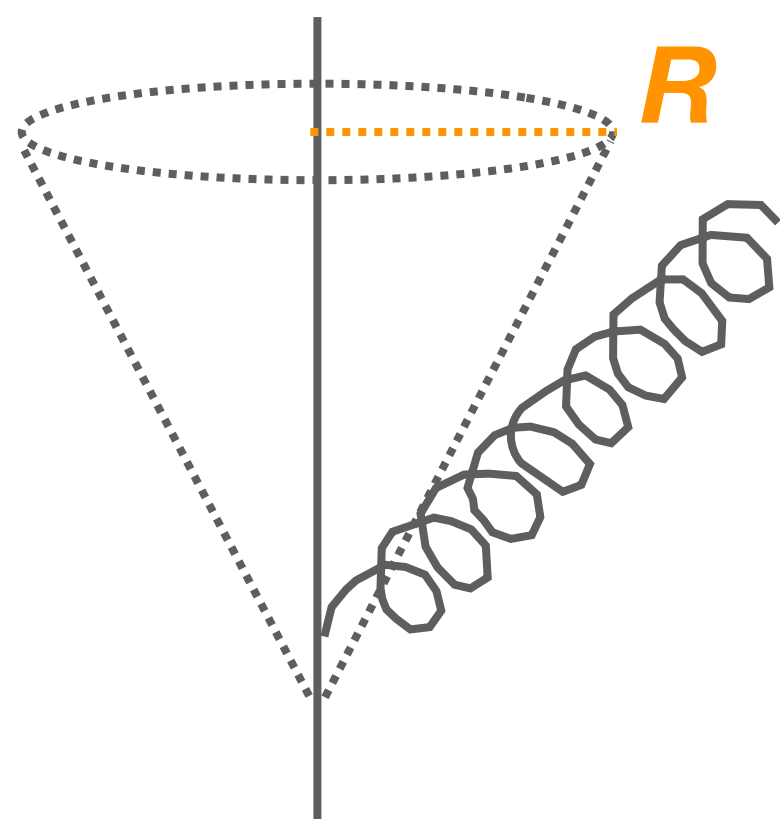
See, [<u>PRL 124 (2020) 18 182001</u>] for more details
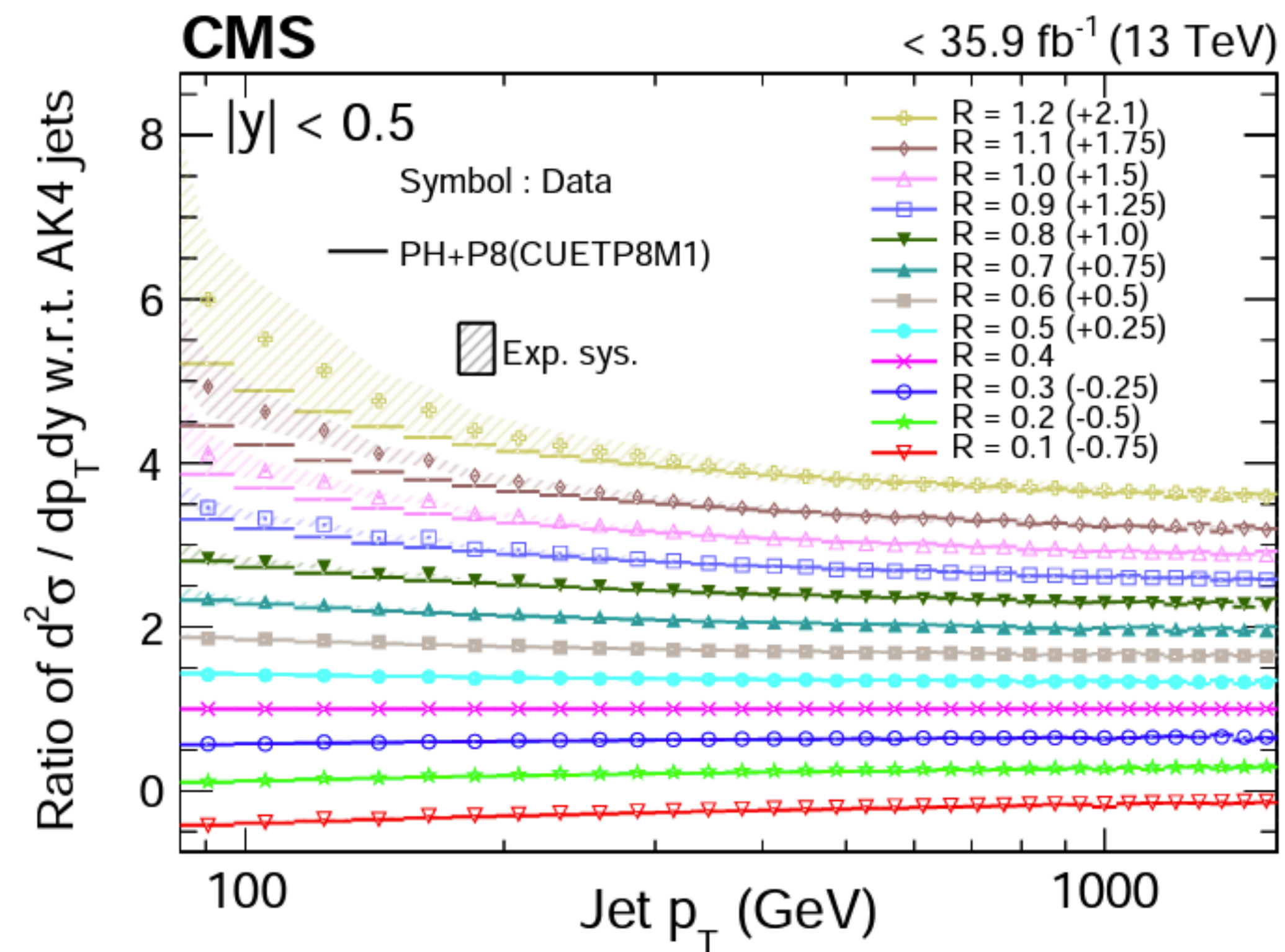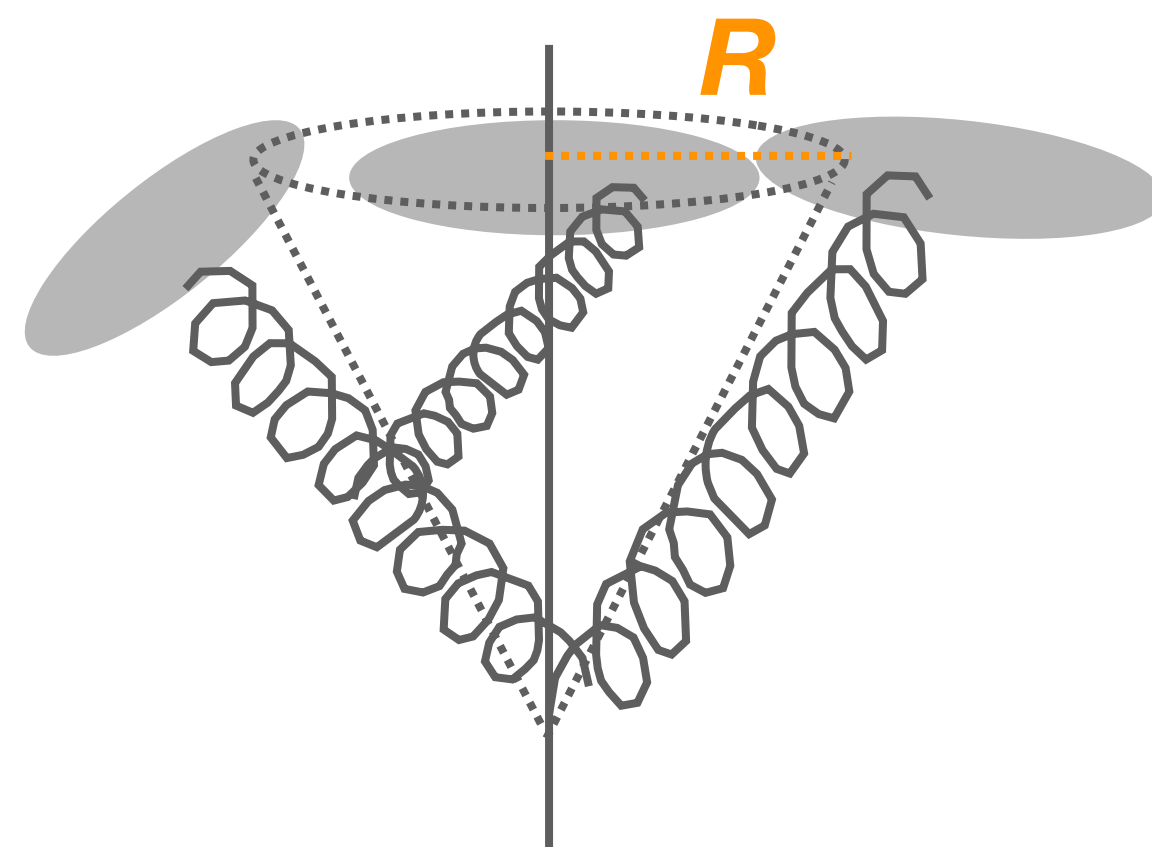
R-dependence measurements

✳ Effects like the parton shower and hadronization can cause energy to fall outside of reconstructed jet cone w/ resolution parameter *R*.

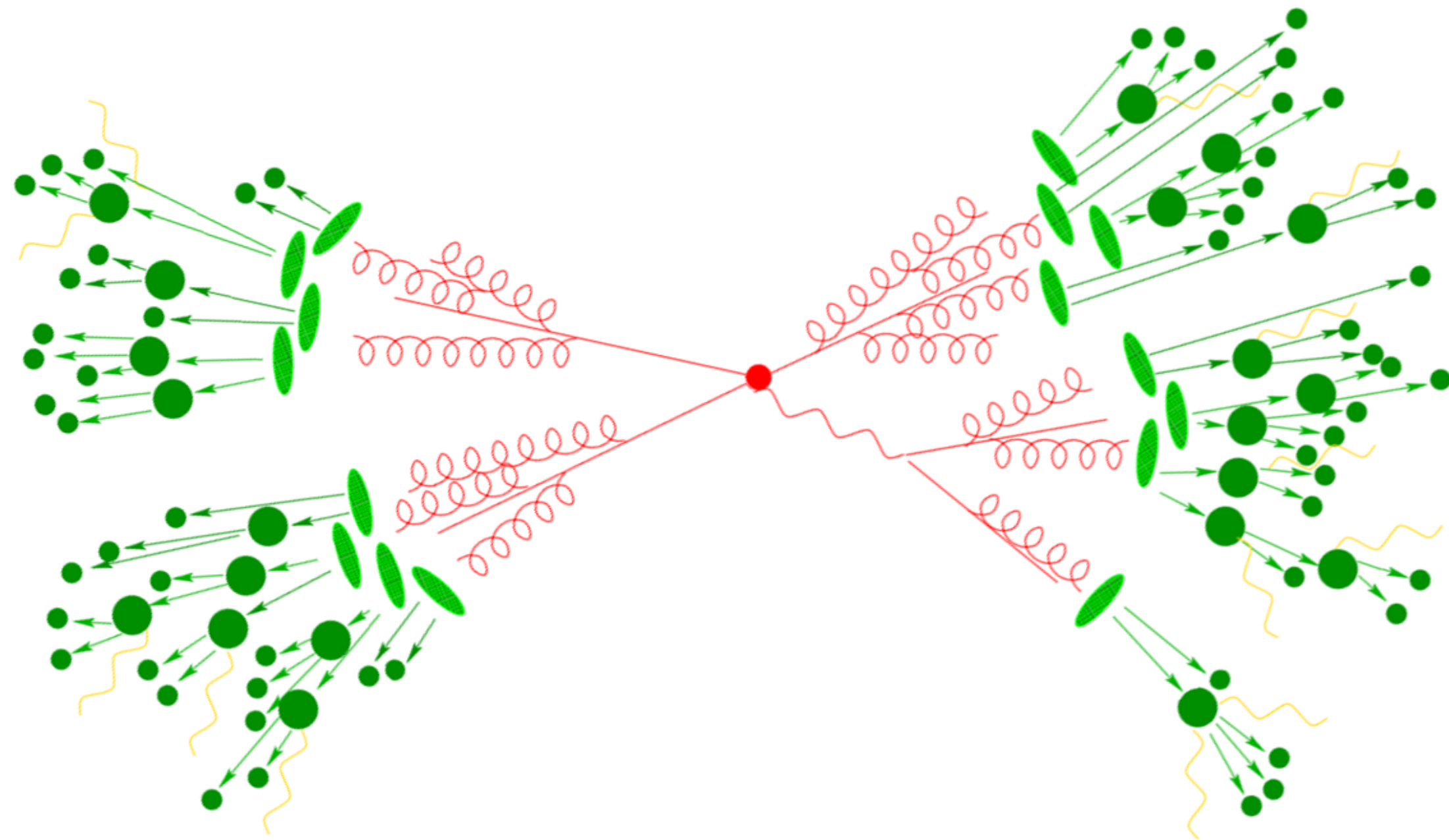[JHEP 12 (2020) 082]

Parton Shower   **Hadronization**

✳ *R*-dependence measurements are sensitive to these details and therefore can be used to study these processes!
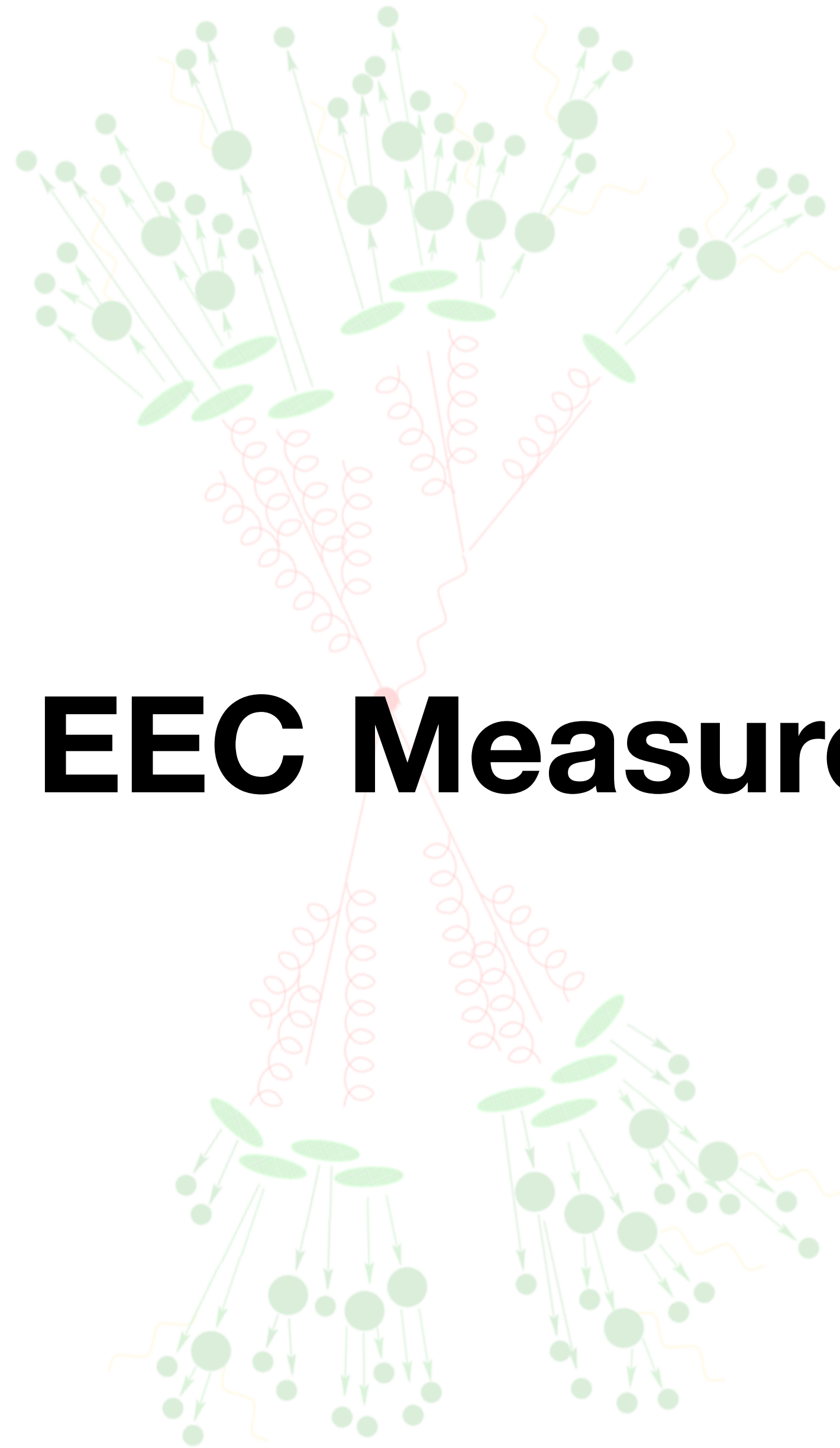
Further MC tuning

❋ e^+e^- collisions are very useful for tuning MC

   ❋ PYTHIA, HERWIG, SHERPA all tuned with hadron-level LEP observables

❋ For future measurements of jets, can focus on measurements most useful for this tuning, i.e. things like leading vs. sub-leading hadron
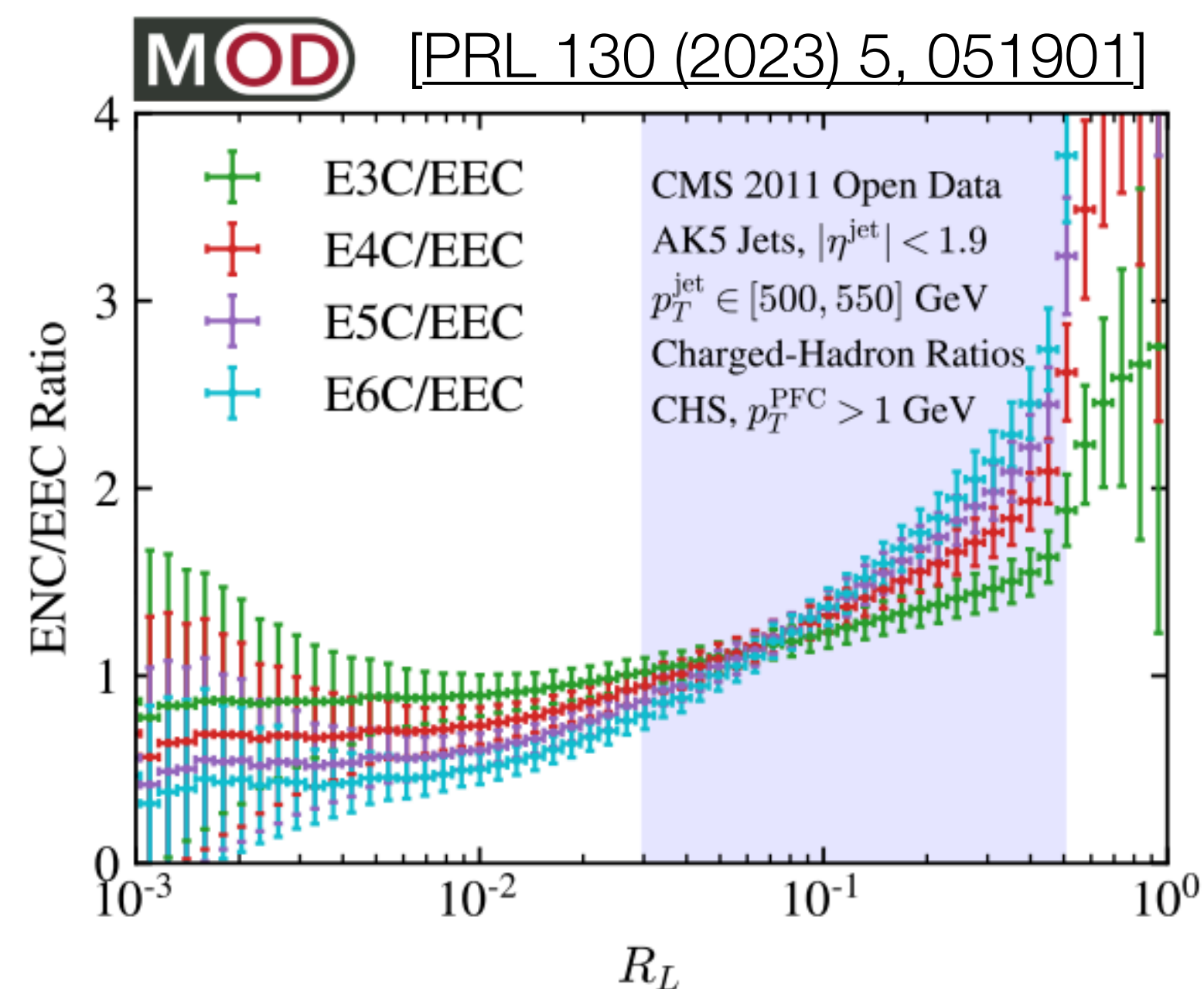
Future EEC Measurements

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CMS + ALEPH Miniworkshop

Higher point correlators

❀ Work in progress to measure the E3C/E2C in ALEPH (collinear → back-to-back region).

ALEPH e⁺e⁻, √s = 91.2 GeV, Work-in-progress
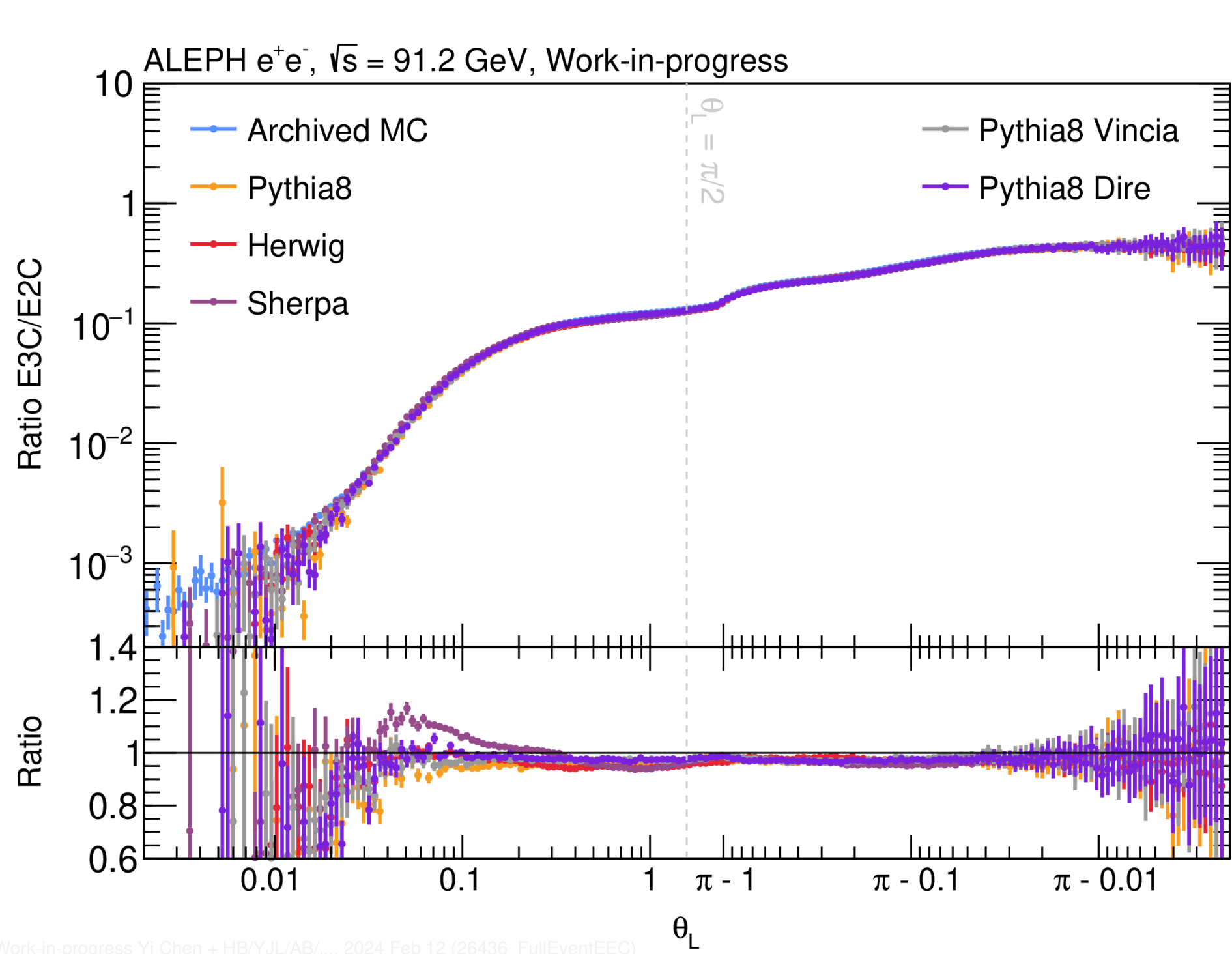
See talk by Yen-Jie for current status

❀ In the clean environment of $e^+ e^-$ could potentially go much higher!

❀ Useful for the extraction of α_s from perturbative regime

[PRL 130 (2023) 5, 051901]

CMS 2011 Open Data
AK5 Jets, $|\eta^{jet}| < 1.9$
$p_T^{jet} \in [500, 550]$ GeV
Charged-Hadron Ratios
CHS, $p_T^{PFC} > 1$ GeV

❀ How high could we go? Size of the corrections is the real limit here.

Charge correlators

❈ Measurement of the plus/minus $\langle \varepsilon_+ \varepsilon_- \rangle$ correlation in back-to-back and collinear region

Complimentary to other charge correlation measurement, for example see [Phys. Rev. D 105, L051502]

See also [H1prelim-22-032]

❈ Useful for the study hadronization mechanisms, correlations between charges, and changes to scaling behavior
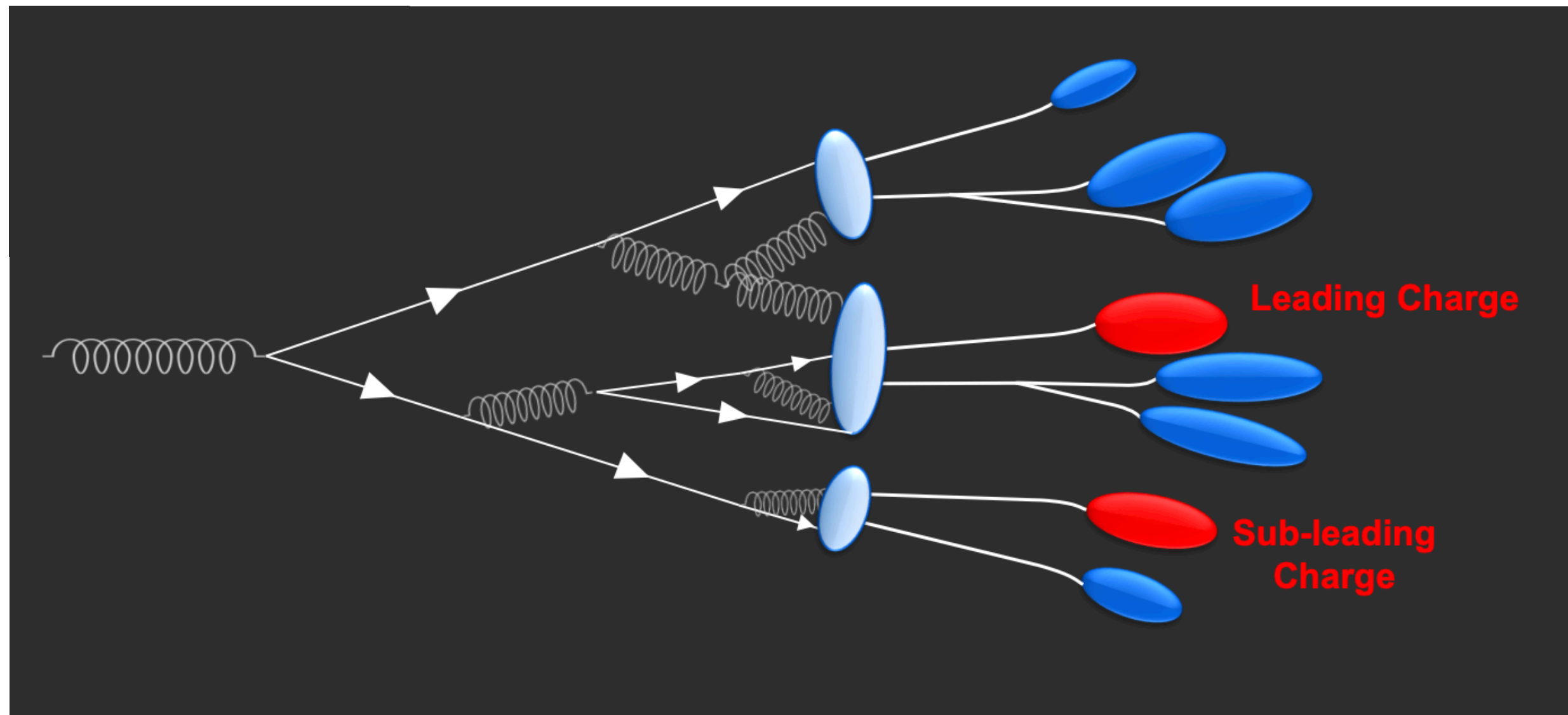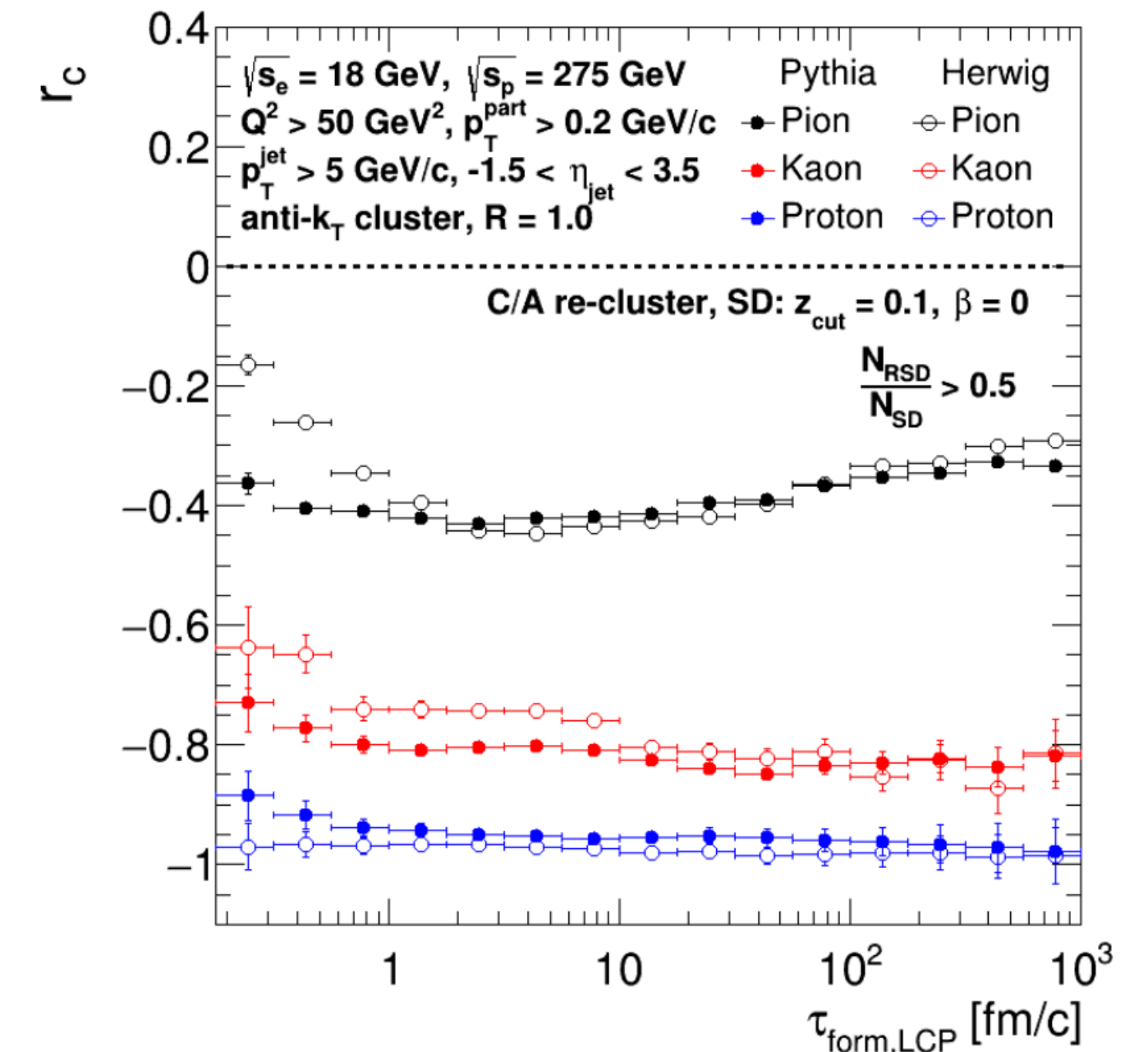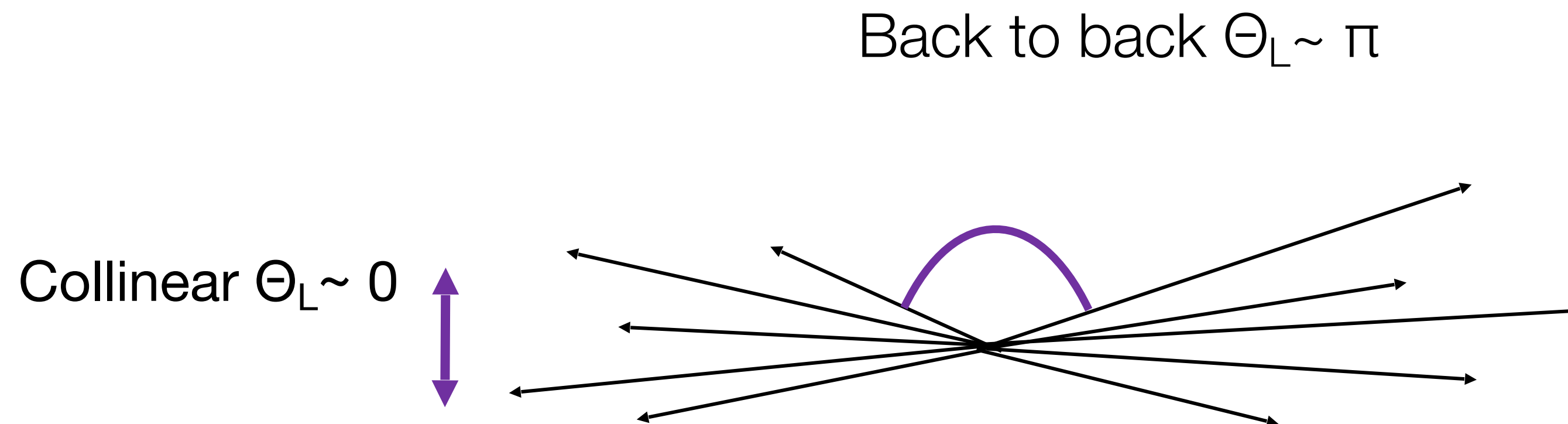

Image credit: [talk at ECT* workshop]

See also [talk at ECT* workshop]

$E^n E^m$ **Correlators**

❋ Can be used to selectively enhance/suppress soft radiation

   ❋ Convenient for experiment

   ❋ Studying different values of n, m useful for studying the perturbative/non-perturbative transition

   ❋ Particularly interesting in the back-to-back (Sudakov) limit
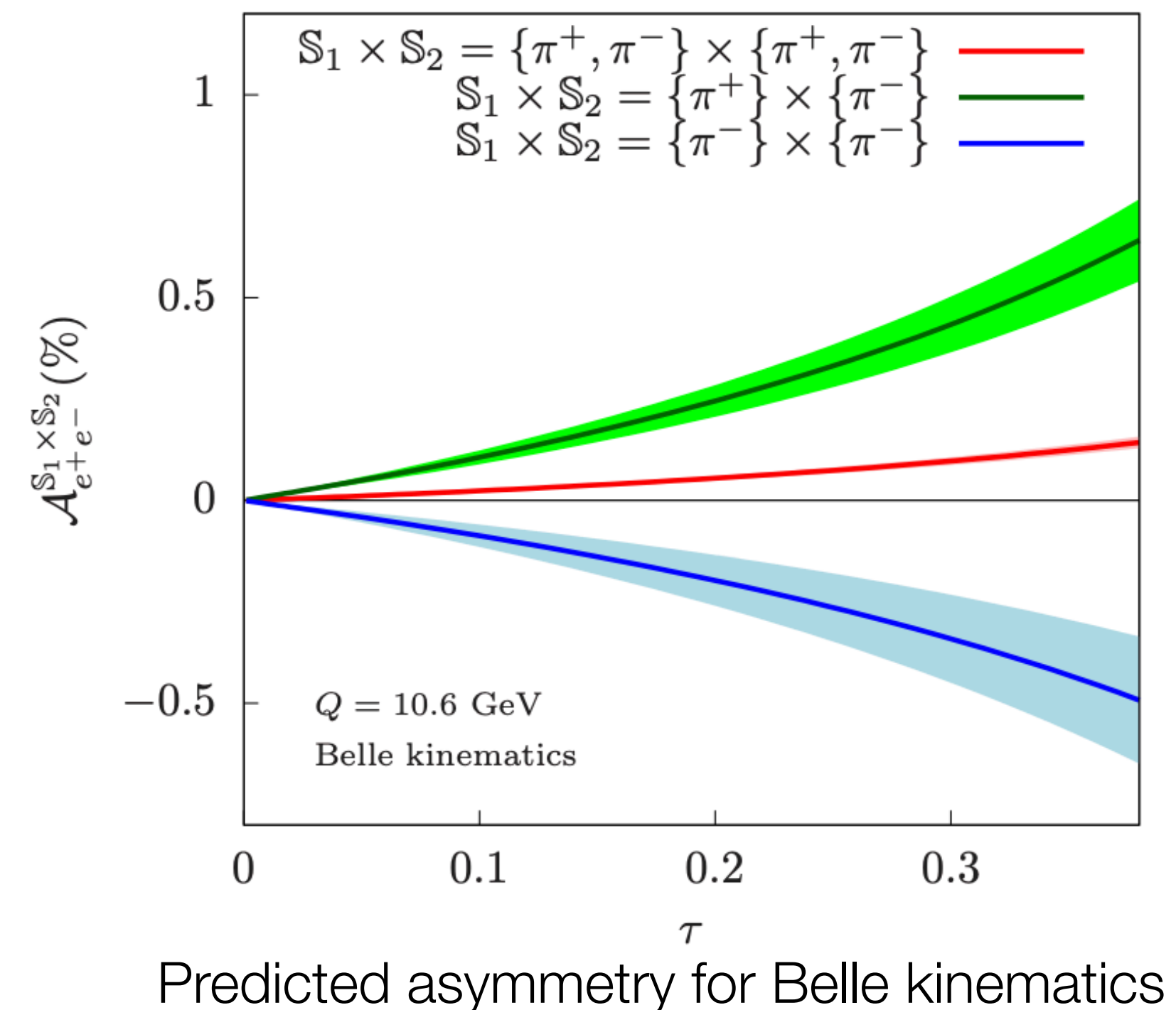
Back to back $\Theta_L \sim \pi$

Collinear $\Theta_L \sim 0$

Collins Effect
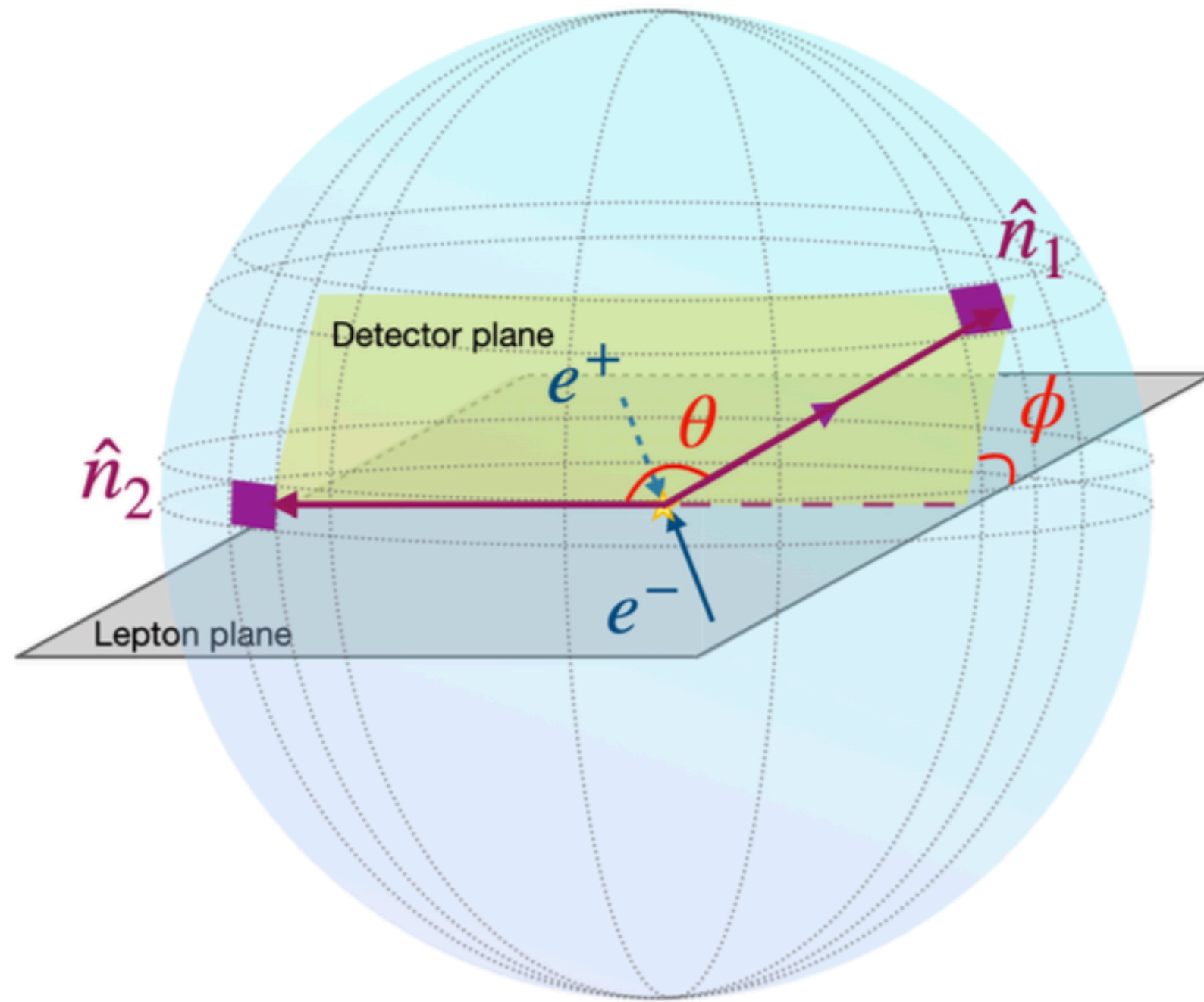
* Collins fragmentation function: correlates hadron p_T with transverse polarization of the quark

    * Can cause asymmetries

* In e^+e^- collisions two transversely polarized quarks can be produced

See [arXiv: 2310.15159] for more

Predicted asymmetry for Belle kinematics

* Idea: Collins asymmetries will be visible in azimuthally (ϕ)-dependent EECs

Discussion: What is the priority?

Backup