Massachusetts Institute of Technology

Observables for Jet Quenching

Hannah Bossi (MIT)

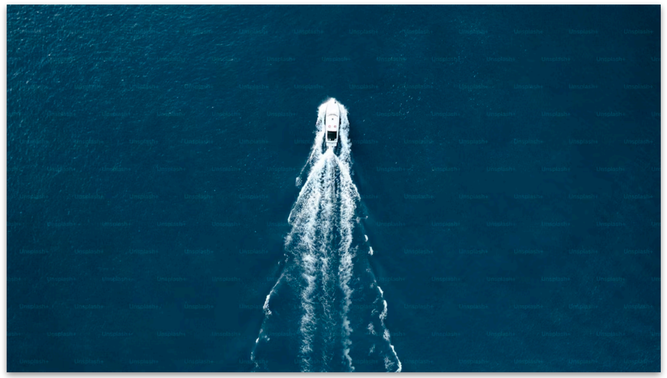
New jet quenching tools to explore equilibrium and non-equilibrium dynamics in heavy-ion collisions

ECT* Trento, Italy

February, 12th, 2024

MIT HIG's work was supported by US DOE-NP

Exposing the nature of the medium response



Medium impacts the jet (jet energy loss) but jet also impacts the medium creating a “medium response”.

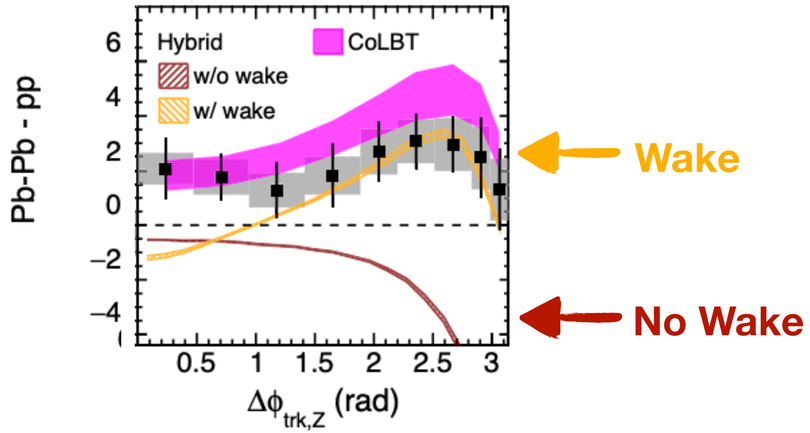
See Yeonju (Mon 2:30pm) Krishna (Mon 3:30pm) Hannah (Tues 10:30am)

Observables to tackle this issue…

❃ γ and Z tagged jets See Yeonju’s Talk!

→ Need detailed study of substructure

→ *Doable with available data!*



[CMS, PRL 128 122301 (2022)] [ATLAS-CONF-2023-054]

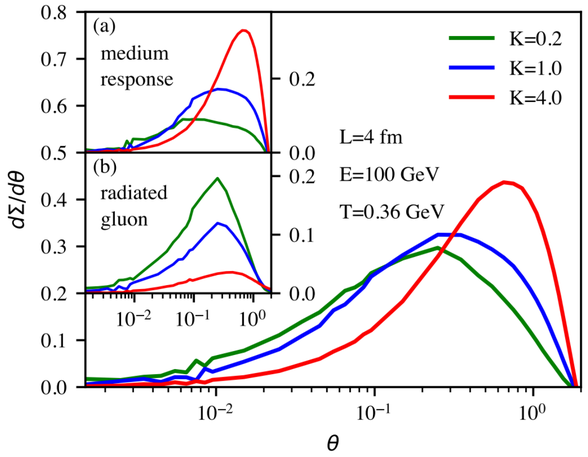
❃ Energy-Energy Correlators See Tuesday Talks

→ Direct theory-experimental comparison

→ *Requires careful background treatment in experiment*

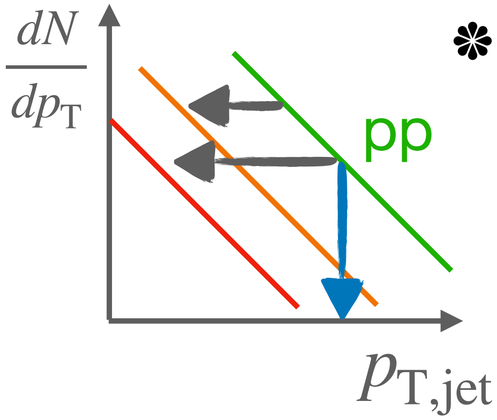
❃ New observables?

See Krishna’s Talk!



[Yang, He, Moult, Wang PRL132 (2024) 1, 011901]

Data driven comparisons to vacuum



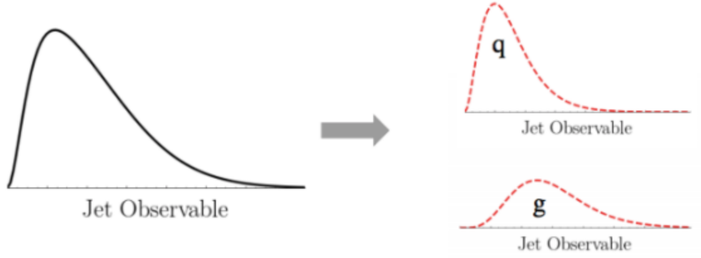
- The selection bias introduced by comparing jets in medium to vacuum at a fixed p_T is a persistent challenge in interpreting jet quenching measurements
  - → Different populations of jets losing different amounts of energy

Observables to tackle this issue…

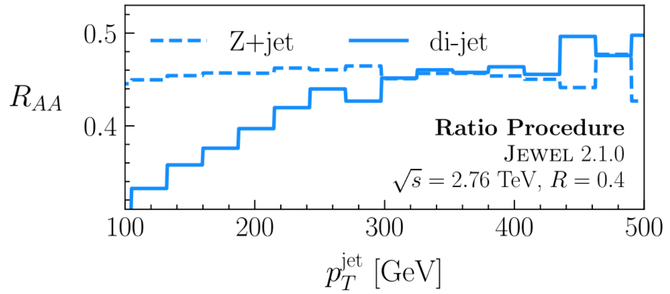
- Q_{AA}: Compare jets in same quantile
  - → *Requires large amounts of stats.*
- **Topic modeling**

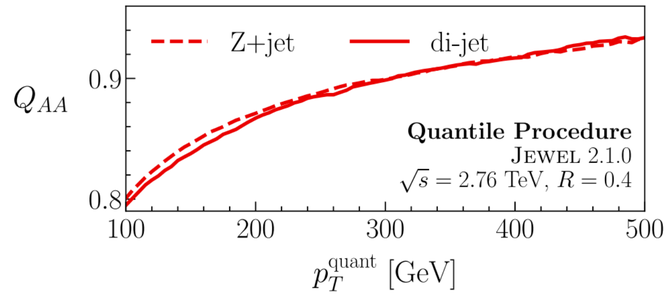
[Ying, Brewer, Chen, Lee CERN-TH-2022-057]

→ Separate out populations of jets that lose different amounts of energy



[Brewer, Milhano, Thaler PRL 122 222301 (2019)]





- **Machine learning** See Antika (Mon 10:30am)

[Du, Pablos, Tywoniuk JHEP 03 (2021) 206]

→ Construct a jet-by-jet mapping to extract the energy loss ratio

→ *Can be challenging to quantify bias*

[ALICE Collaboration, PLB 849 (2024) 138412]

Backup