Dark Shower Workshop
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Exploring Dark Shower with Radiations

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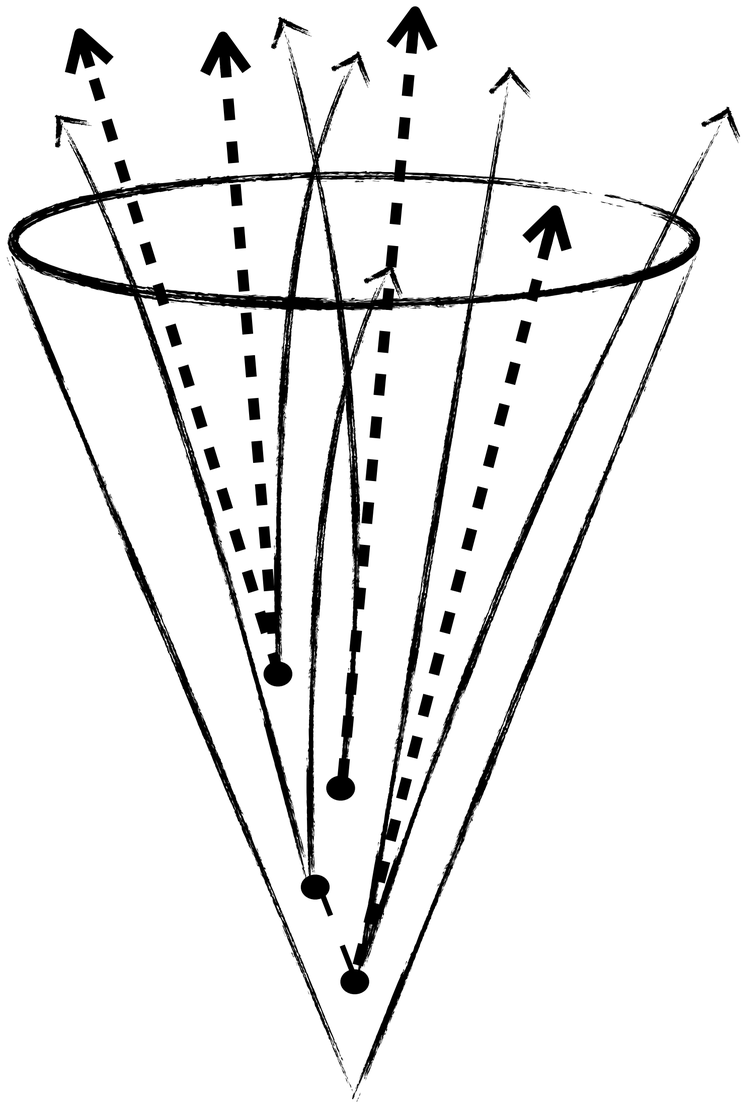
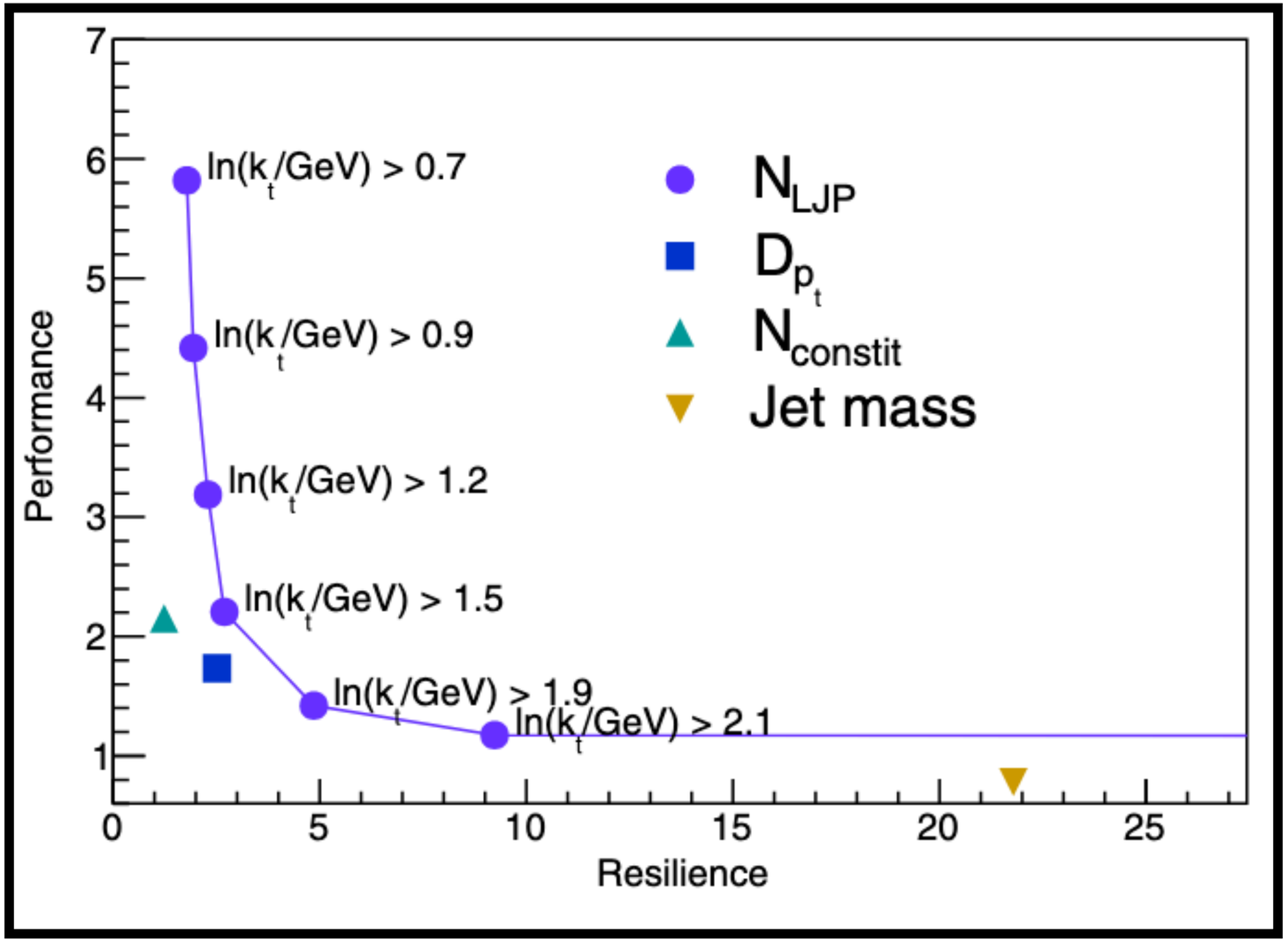


- There is no doubt that machine learning can explore the SVJ signatures
  - Large amount of decay products
  - Complicated decay chains
  - Interesting event-level features



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- Jet sub-structure variables may not be robust against various showering models
- There may exist better variables that are more resilient
- One area I find critical personally

The ISR Channel

Our recent work:

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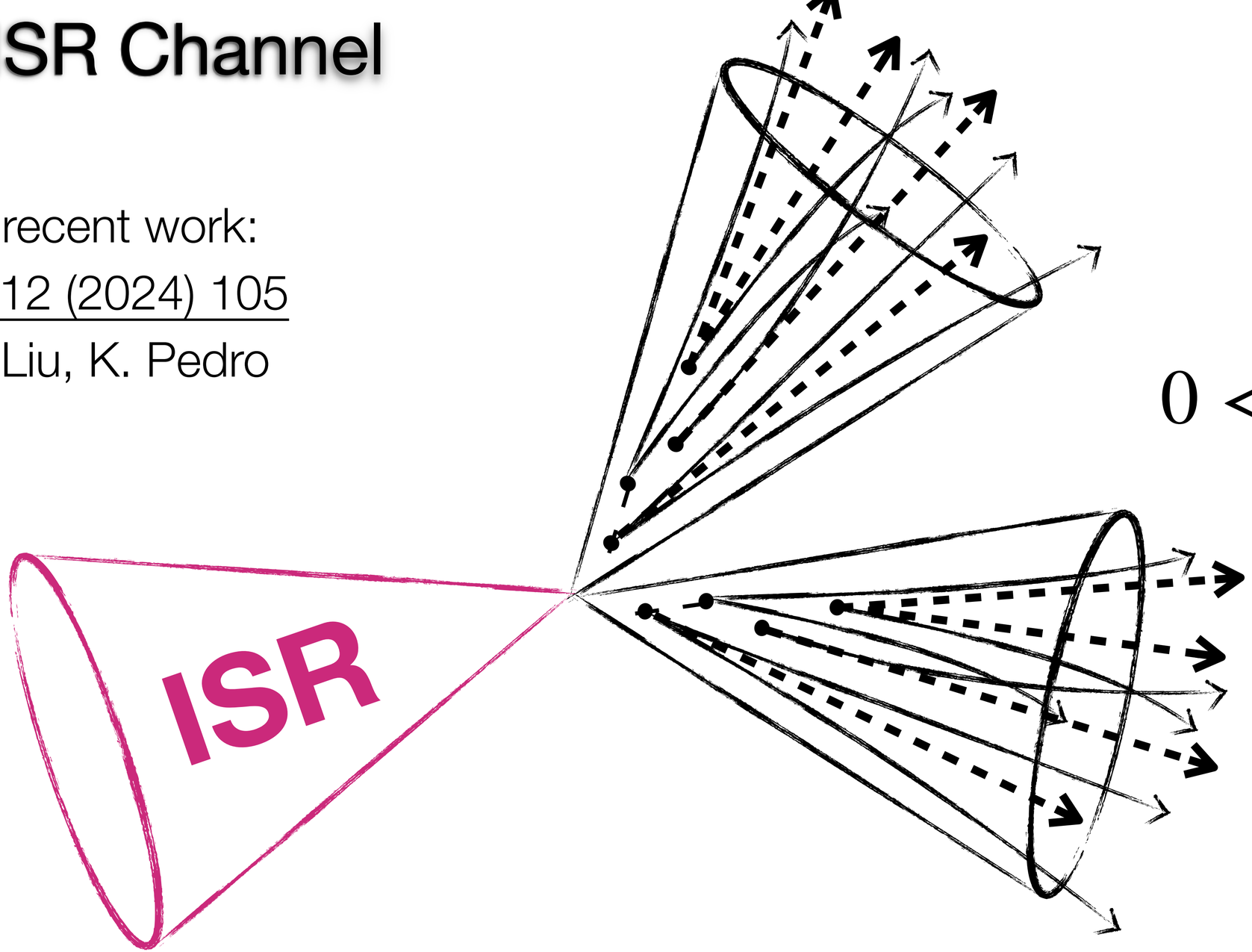

$$0 < r_{inv} < 1$$

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Semi-visible jets + X: illuminating dark showers with radiation

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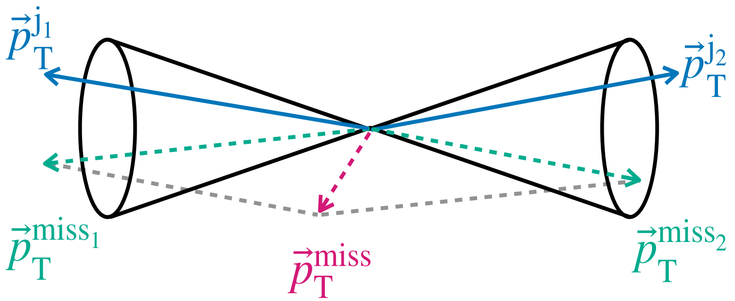
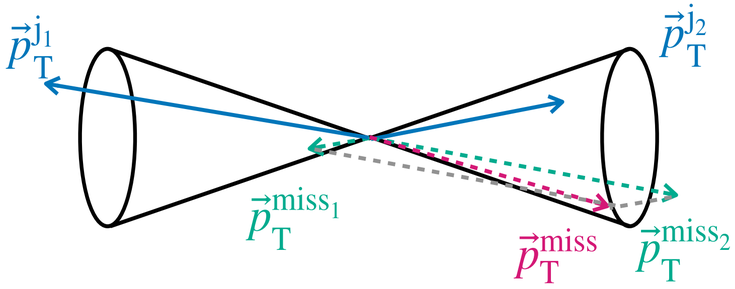
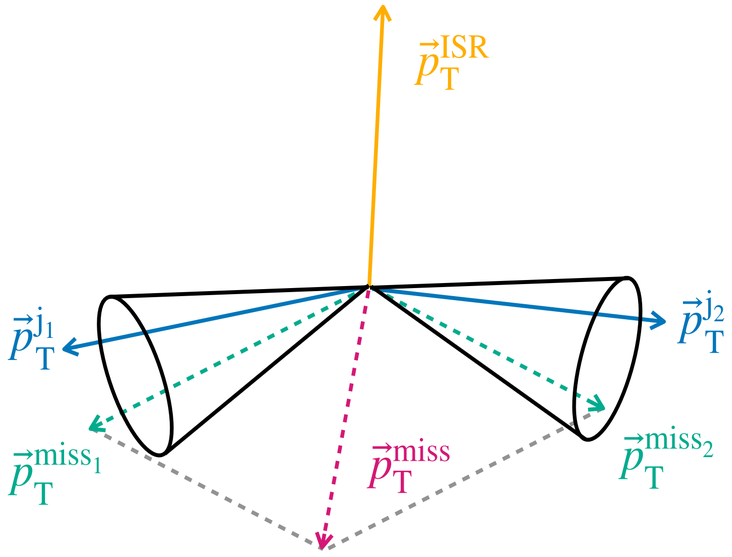
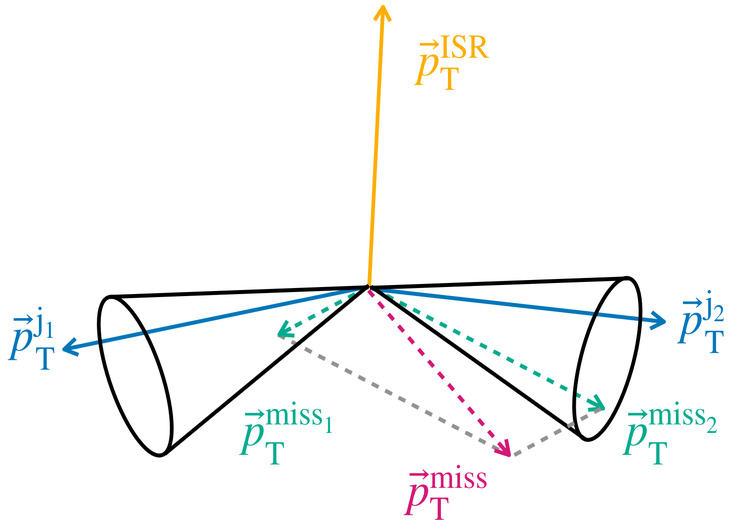
Event-level Topologies

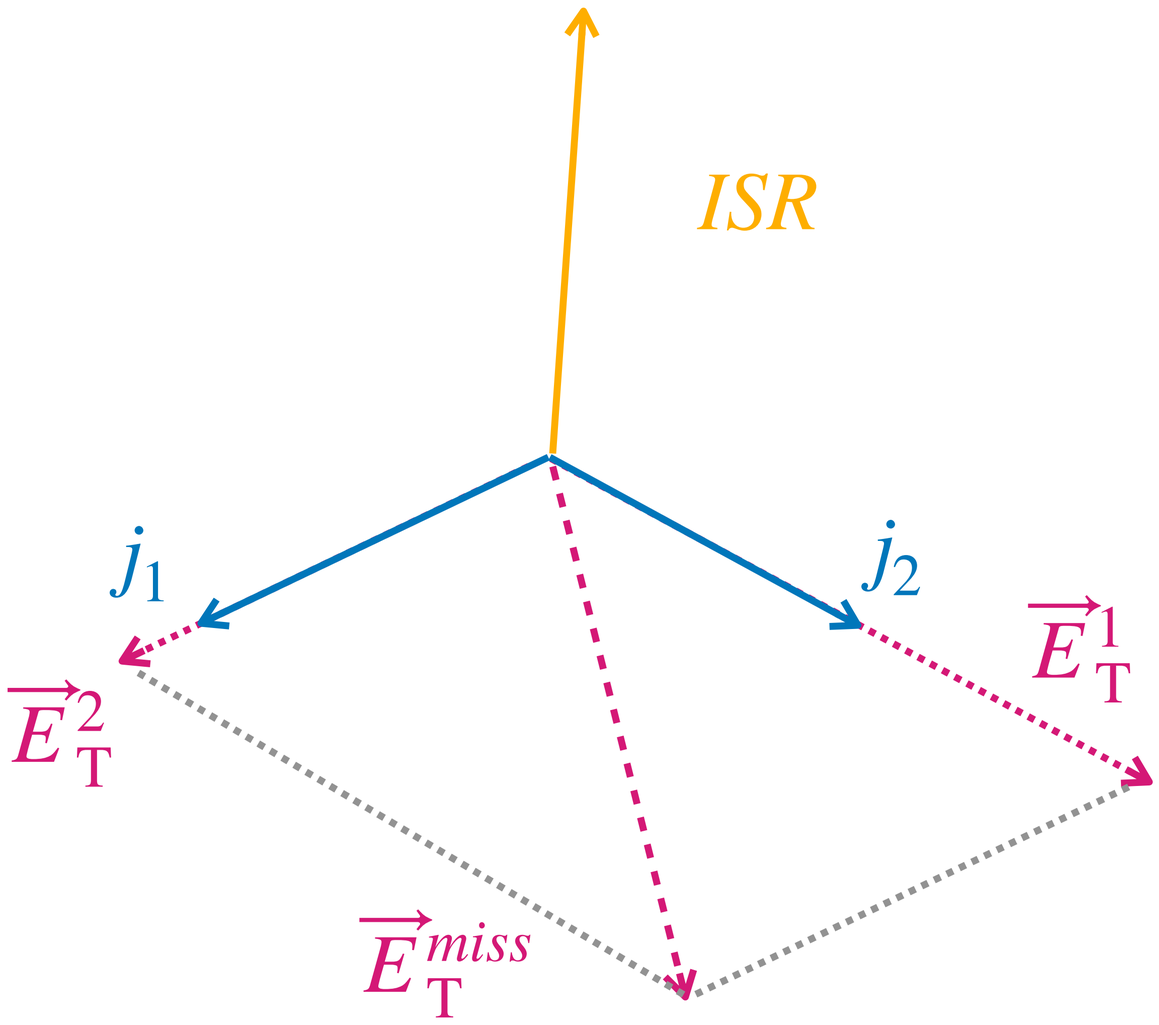






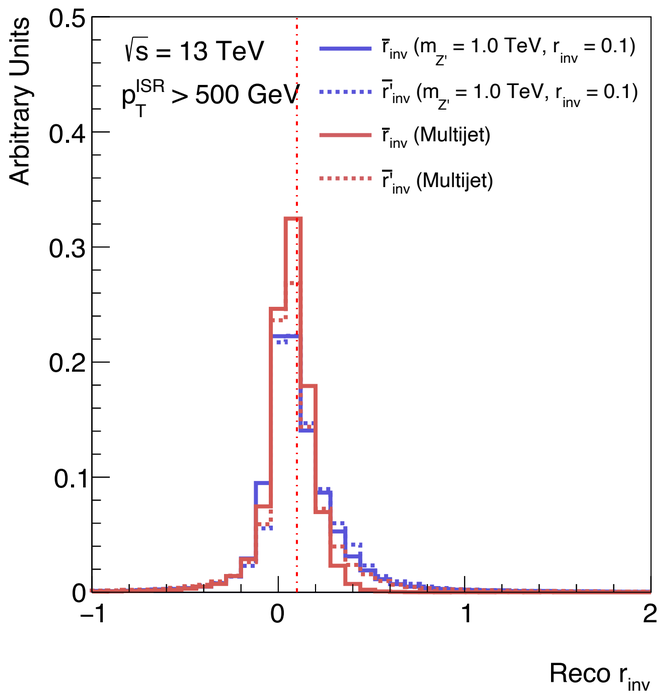


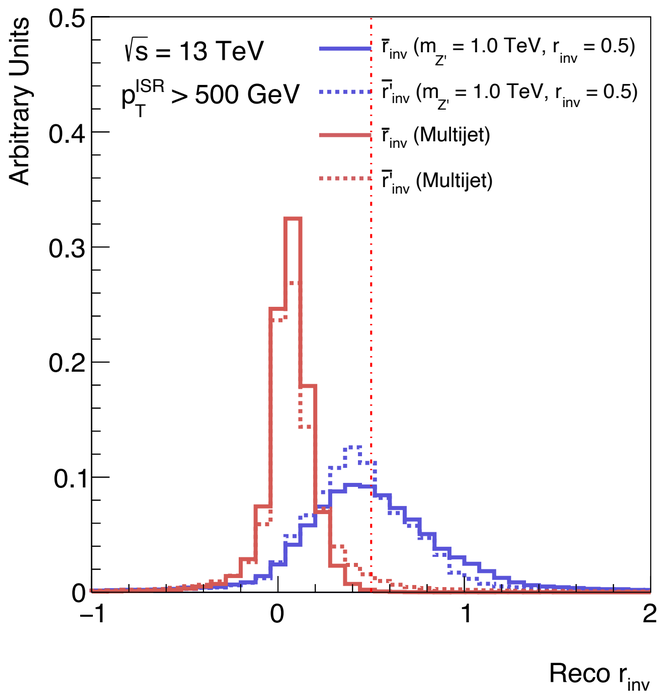
Reconstruct r_{inv}

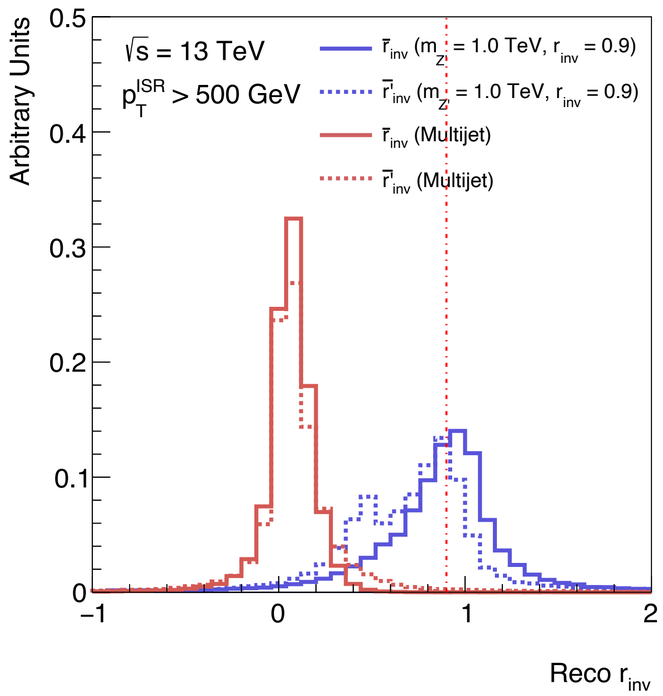


- Assume the invisible components are aligned with the visible components
- Decompose E_T^{miss} to the jet axes
- Calculate the ratio between the invisible component and the sum for each axis

Reconstruct r_{inv}

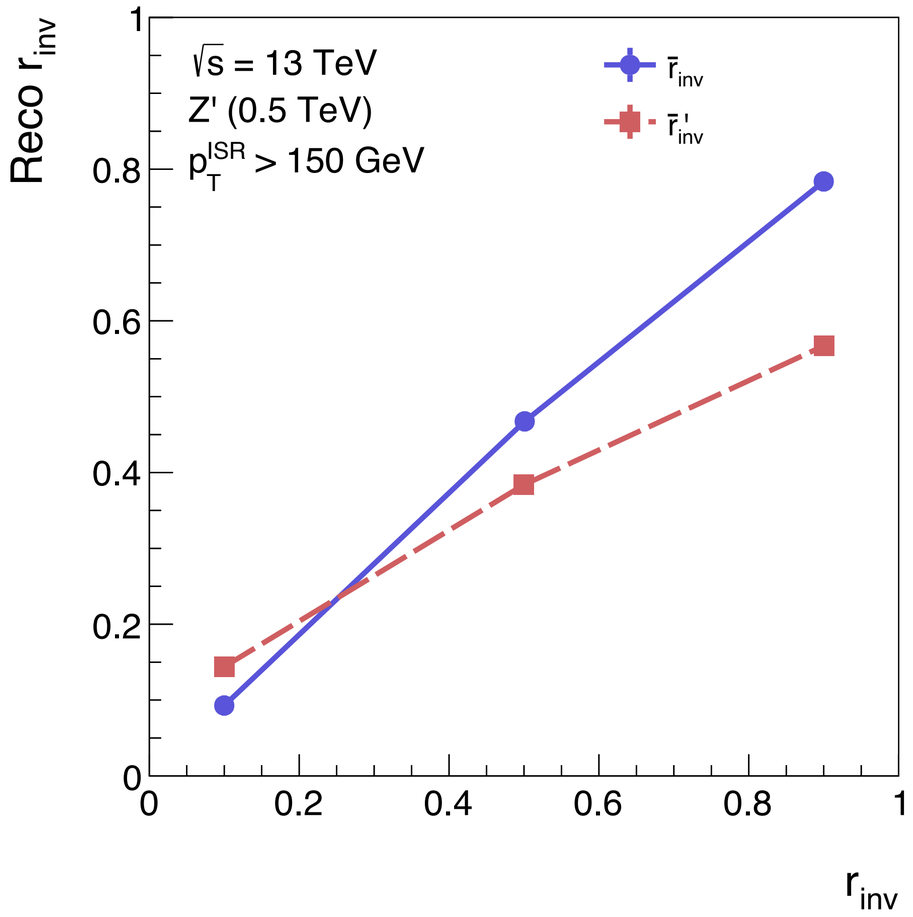


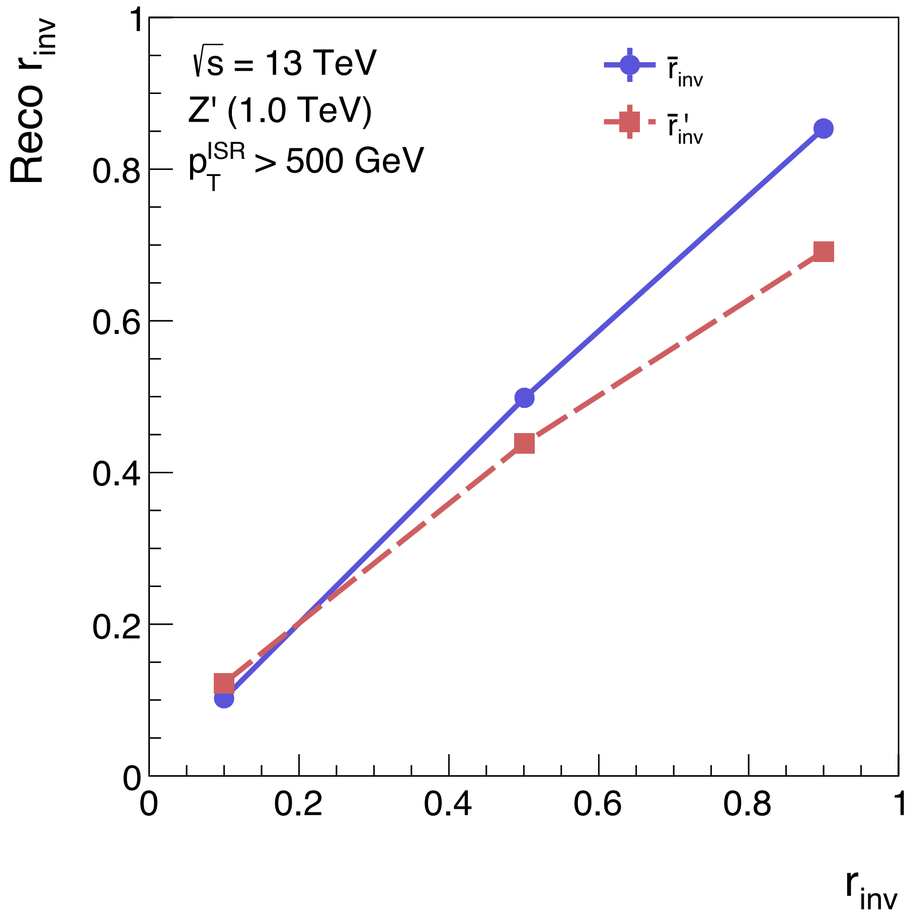




- Able to recover the theoretical parameter r_{inv}

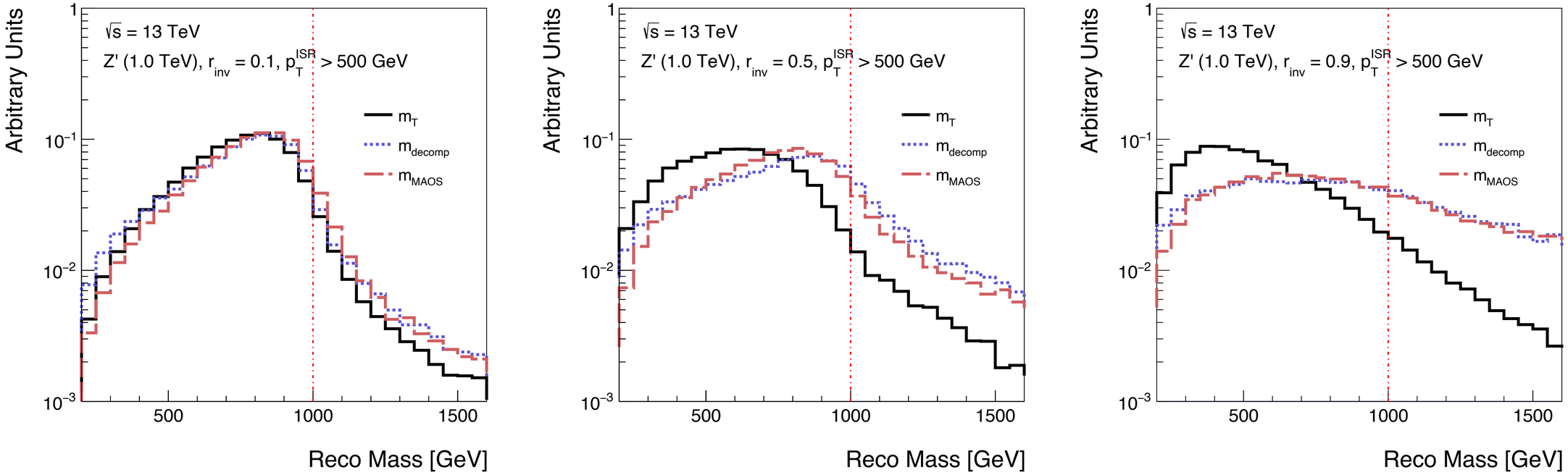
Reconstruct r_{inv}





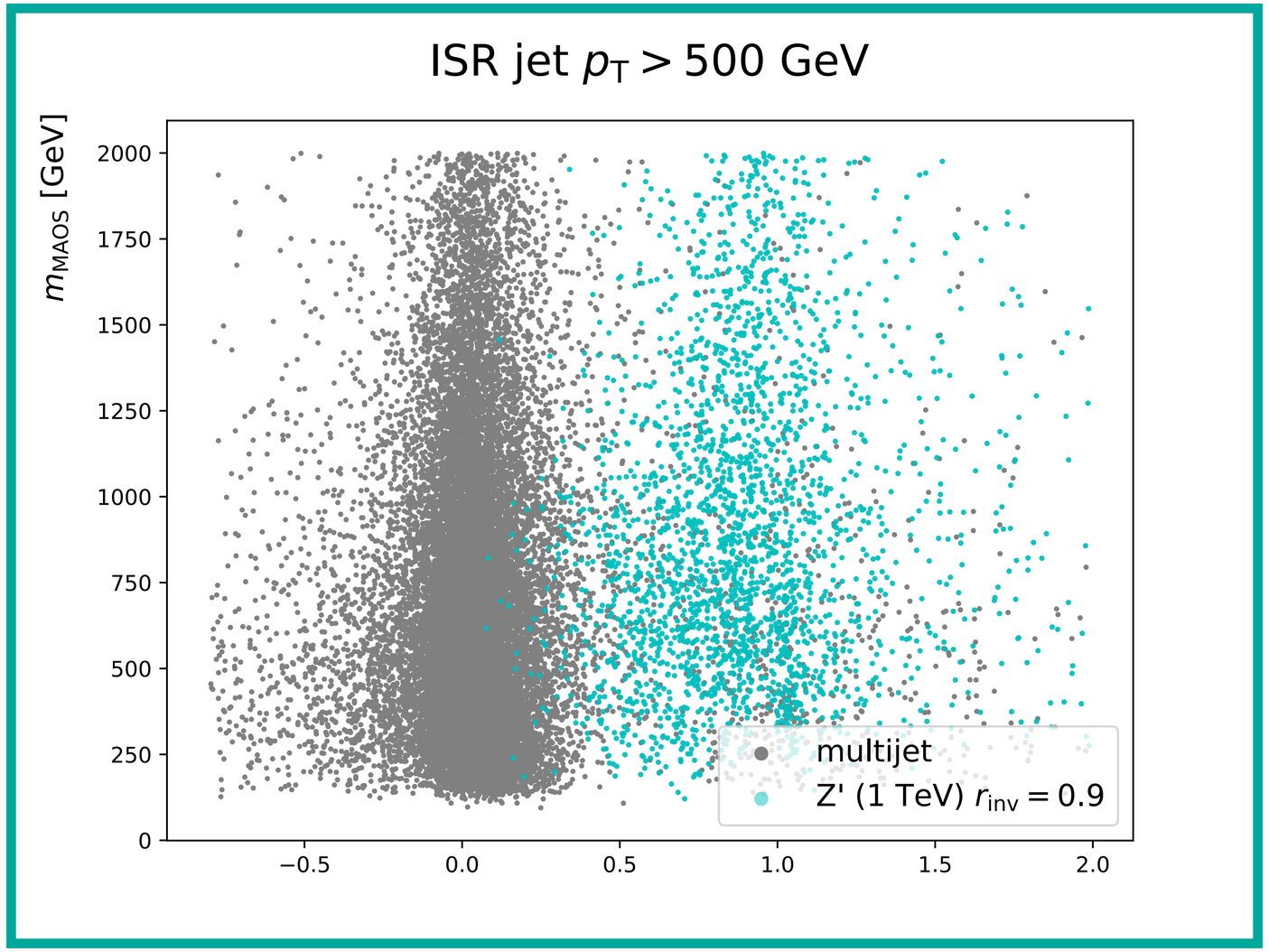
- Able to recover the theoretical parameter r_{inv}

Reconstruct $m_{Z'}$



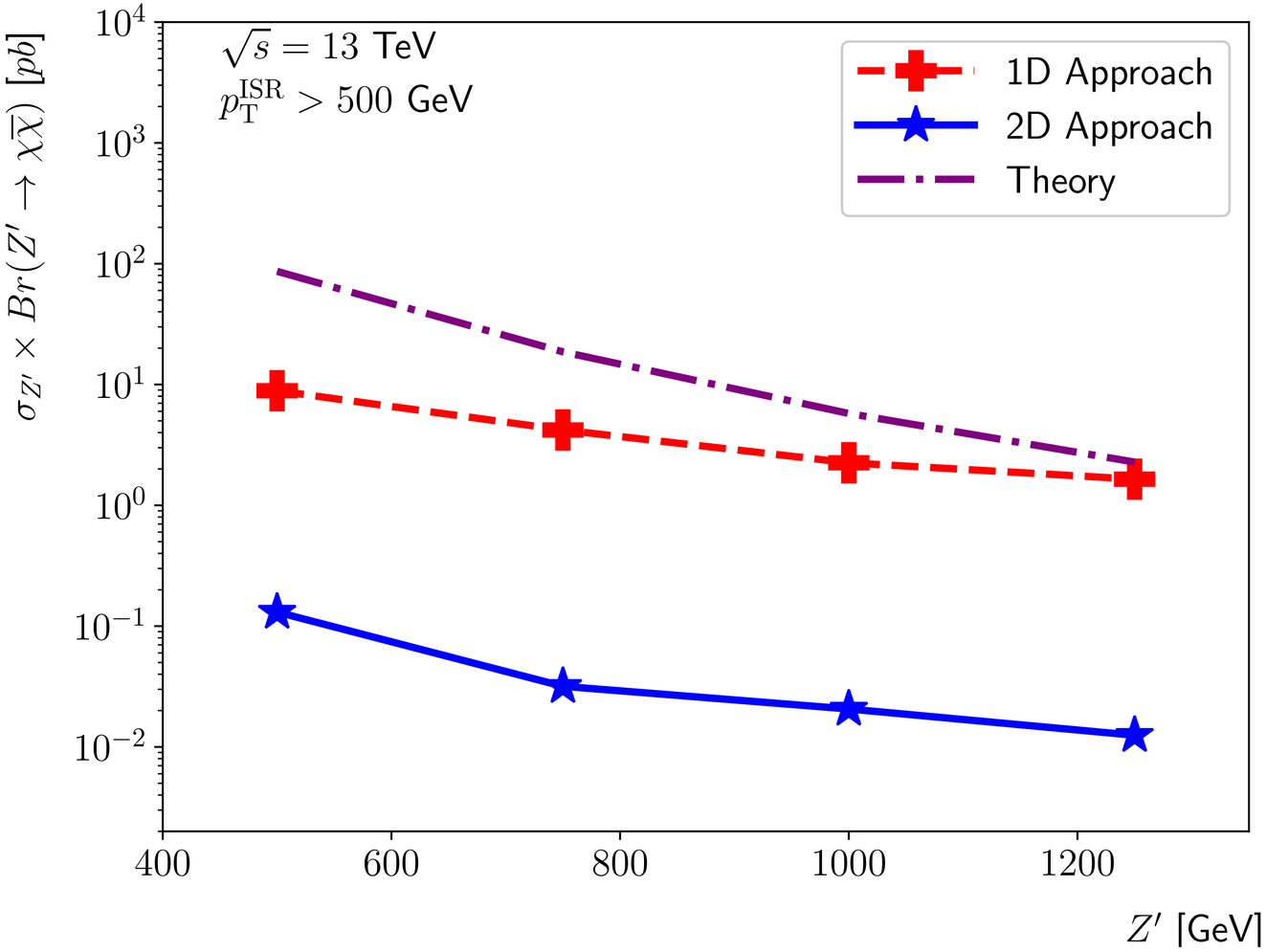
- Three different mass observables are tested:
  - Vanilla transverse mass (m_{T}), mass reconstructed using the decomposed $\vec{p}_{\mathrm{T}}^{\,\mathrm{miss}_1}$ and $\vec{p}_{\mathrm{T}}^{\,\mathrm{miss}_2}$ (m_{decomp}), or using the m_{T2}-assisted on-shell technique (m_{maos})

Reconstruct r_{inv}



- Signal and background have clear separation on this $m_{MAOS} - r_{inv}$ 2D plane
- Can perform a search on this 2D plane!

2D Approach



- We can achieve a much better sensitivity using a 2D approach
- It is also a unified approach for various r_{inv} values
- The sensitivity to the large r_{inv} region is significantly higher

Conclusion

- Pair produced SVJs from resonances share similar event topologies with $H \rightarrow \tau\bar{\tau}$ or pair produced SUSY particles
- The additional visible energy from the ISR object makes the semi-visible more visible

- A promising channel to look for SVJs

Thank You!