Modeling Dijet Asymmetry From QGP Energy Loss

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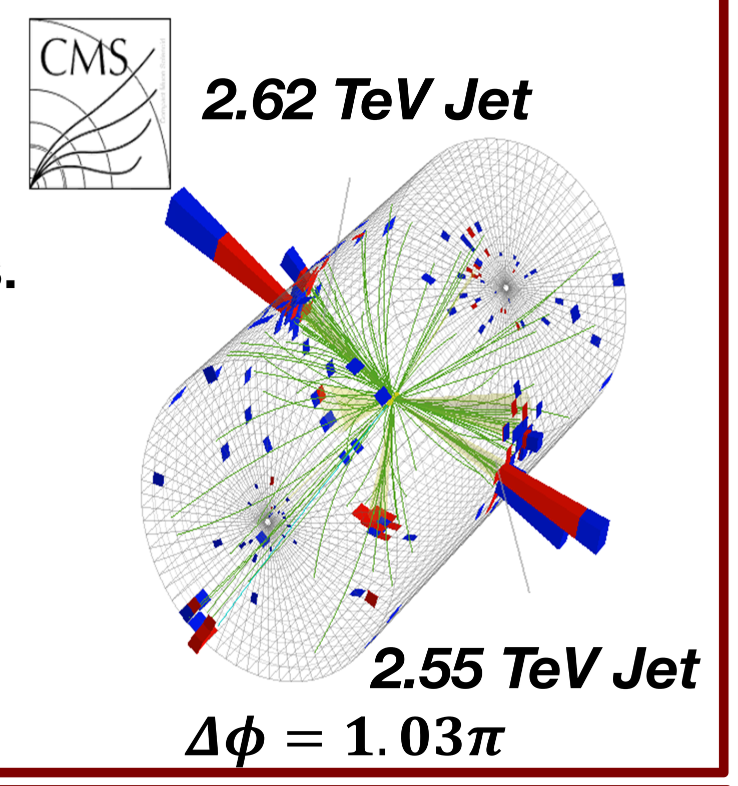
Physics

Dijet Events

Dijet events occur during high momentum particle collisions. High-energy quarks & gluons create transversally opposite jets.

(p+p)—Dijets have approximately equal momentum.
(Pb+Pb)—Dijets interact with quark-gluon plasma resulting in unbalanced momenta, referred to as ***Dijet Asymmetry.***

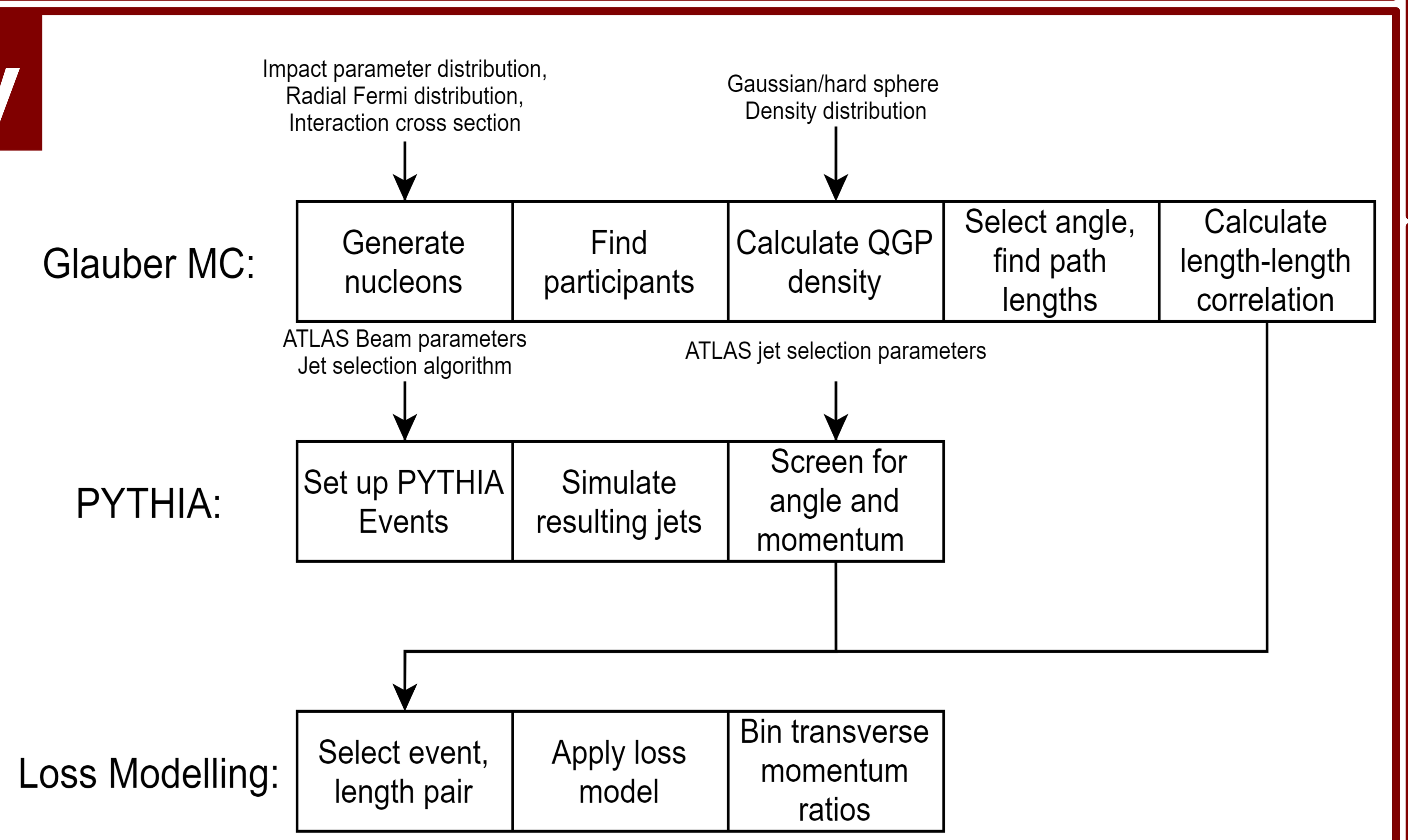
Dijet Asymmetry is enhanced by increased event centrality.



Methodology

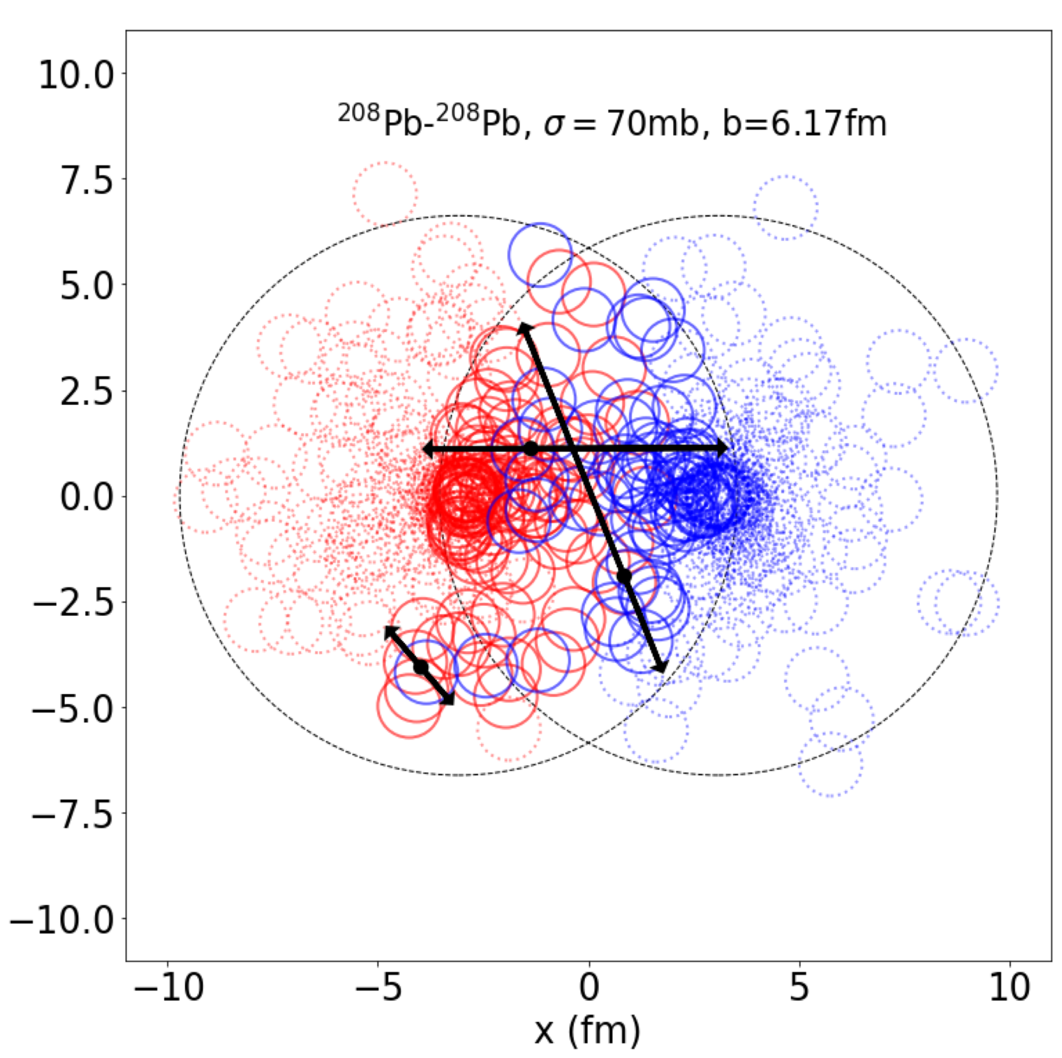
Glauber Monte Carlo (GMC) used for collision simulation.

Combined GMC with PYTHIA jet simulation to mimic asymmetric momentum loss.

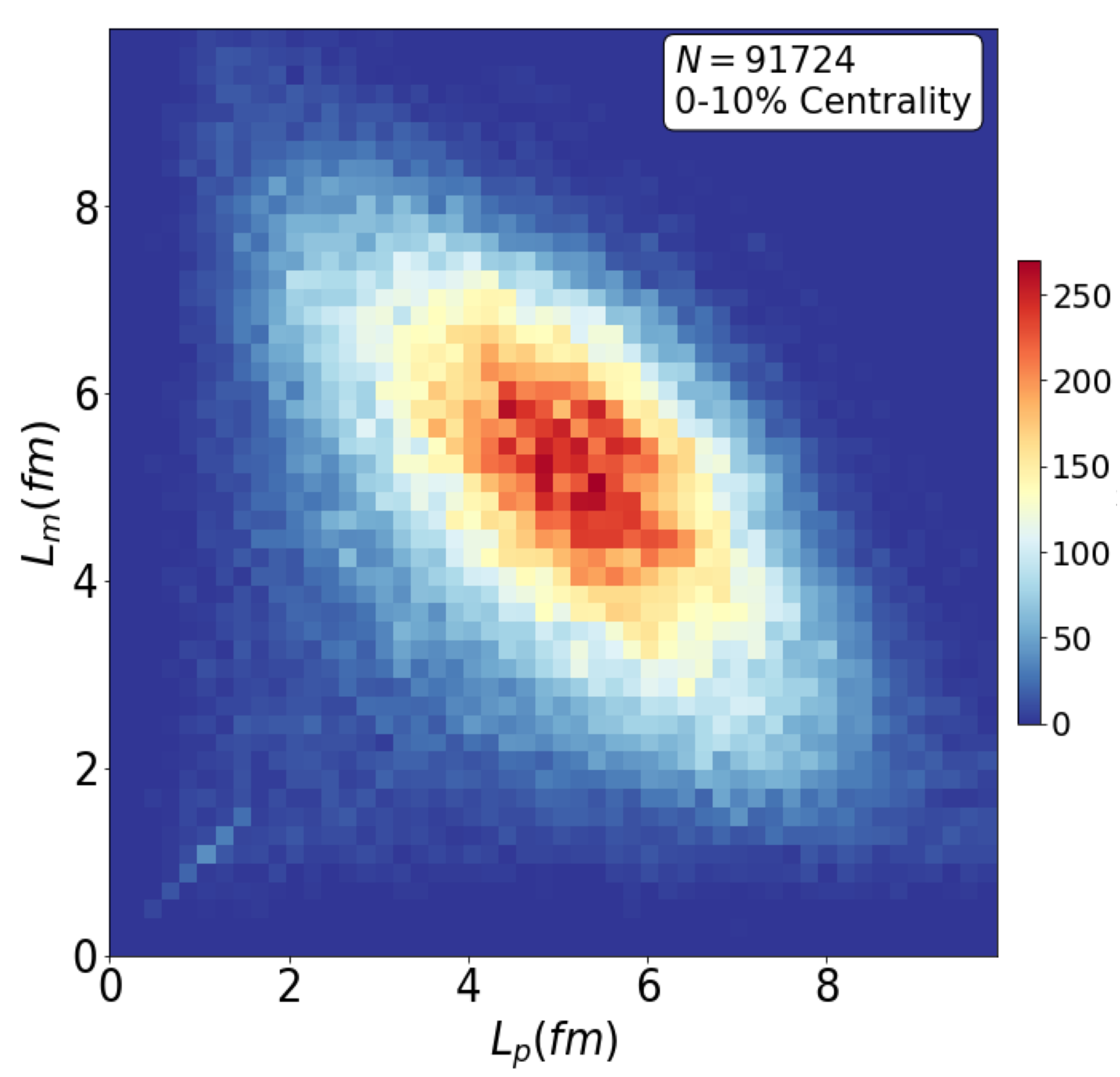


Glauber Monte Carlo

Collisions modeled as Fermi-distributed circles with cross-section of two nucleons.
Separations established via event centrality; participant nucleons totaled.
Dijets assumed to have transversally opposite emergence.
Path-lengths of jets travelling through remaining plasma are calculated. Resultant anticorrelation for each pair plotted.



Typical collision with selected path lengths
Participants designated with solid border



Length-length anticorrelation

Loss Model

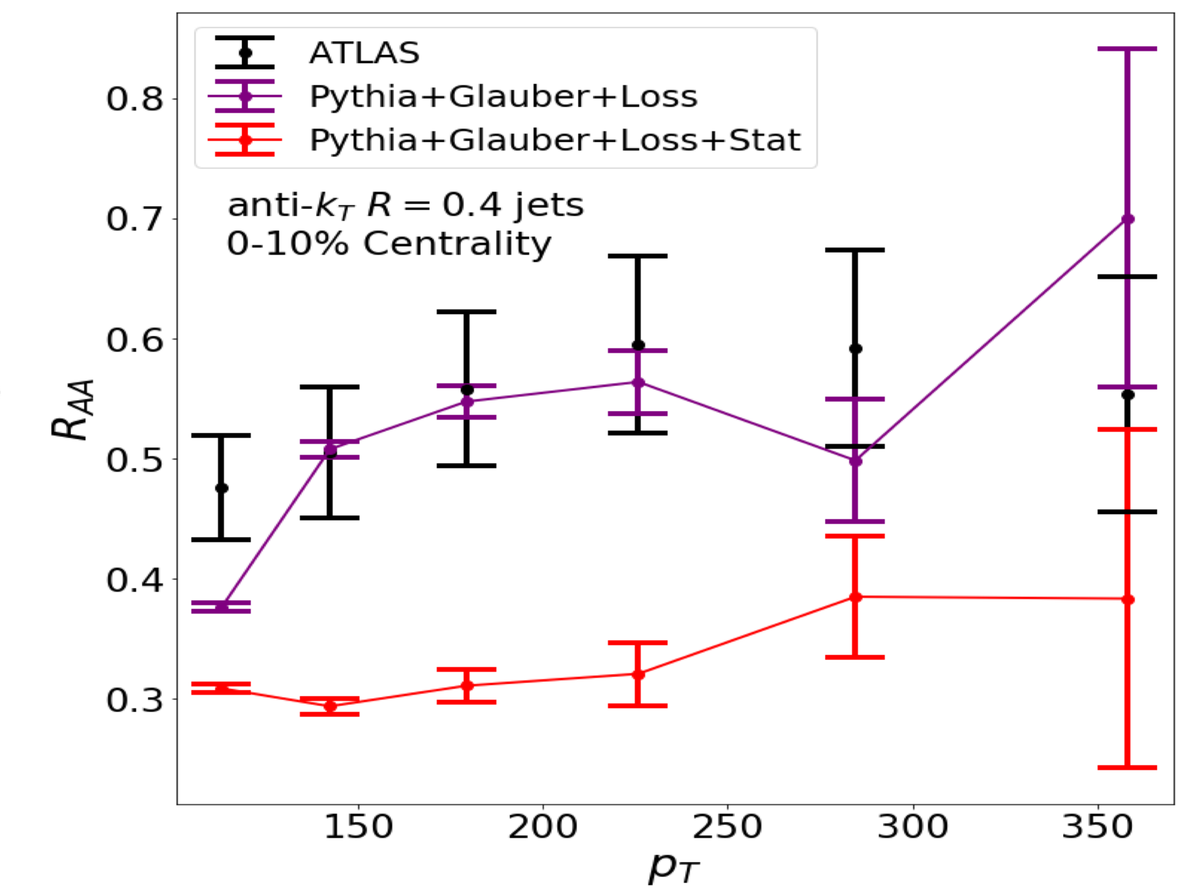
Momentum loss proportional to:

- Transverse momentum raised to constant parameter.
- Path length (from GMC) raised to flavor-dependent parameter.

Overall coefficient differs by 9/4 for gluons and quarks.

Stochastic term included.

$$S = A_F p_T^{\alpha} \ell^{k_F} + G$$



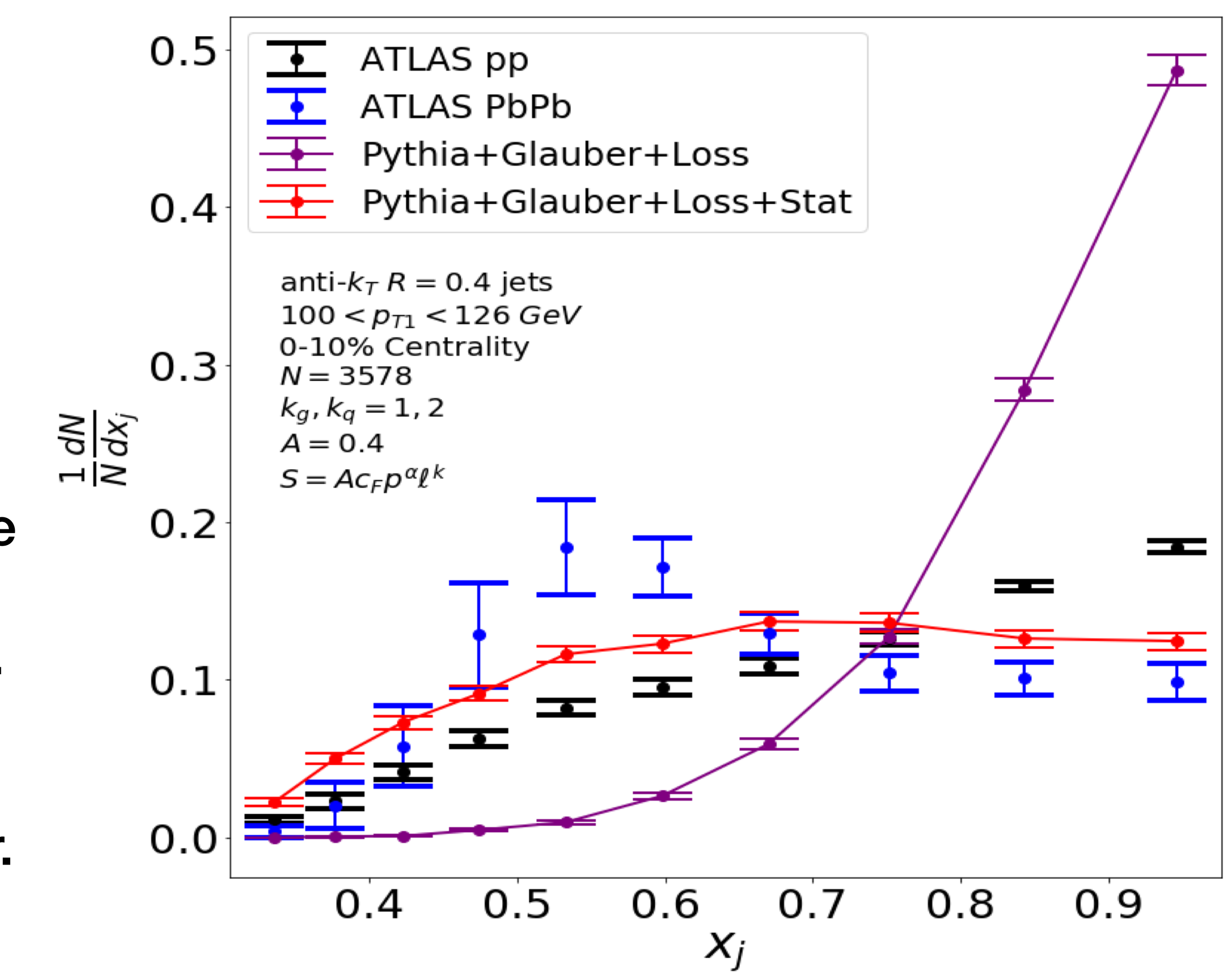
Nuclear modification factor for different models

Asymmetry

Jet Momentum Ratios calculated using jet momenta from PYTHIA and path-lengths from GMC.

Multiple Poisson dependencies are required to reconstruct the 0.55 peak presented in the ATLAS data.

This method will not yield the correct nuclear modification factor.



Jet momentum ratio for different models

Conclusions

To fully justify 0.55 ATLAS peak a more sophisticated model must be developed.

Loss function must aim to balance both path-length and flavor dependence with dominating stochastic radiation losses from gluons.

A deterministic loss applied over path-lengths optimized for number of jets does not yield significant asymmetry.

A statistical component optimized for asymmetry does not yield enough jets for useful analysis.

Acknowledgements

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References

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