Asymmetric Z Running for Calibration?

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Introduction

Z Running with Symmetric Beams

- High Statistics but Fixed Energies of Jets/Leptons (45.6 GeV).
- Efficient illumination of full detector acceptance.
- Response Function Width determined by Beam Energy Spread ($\approx$ 0.2 GeV)

Calibration with High Energy Z's

- Much lower statistics - also backgrounds.
- Range of energies for jets/leptons
- Many are very forward
- Response Function Width determined by Z Width (2.5 GeV)

Z Running with Asymmetric Beams? Helpful Addition?

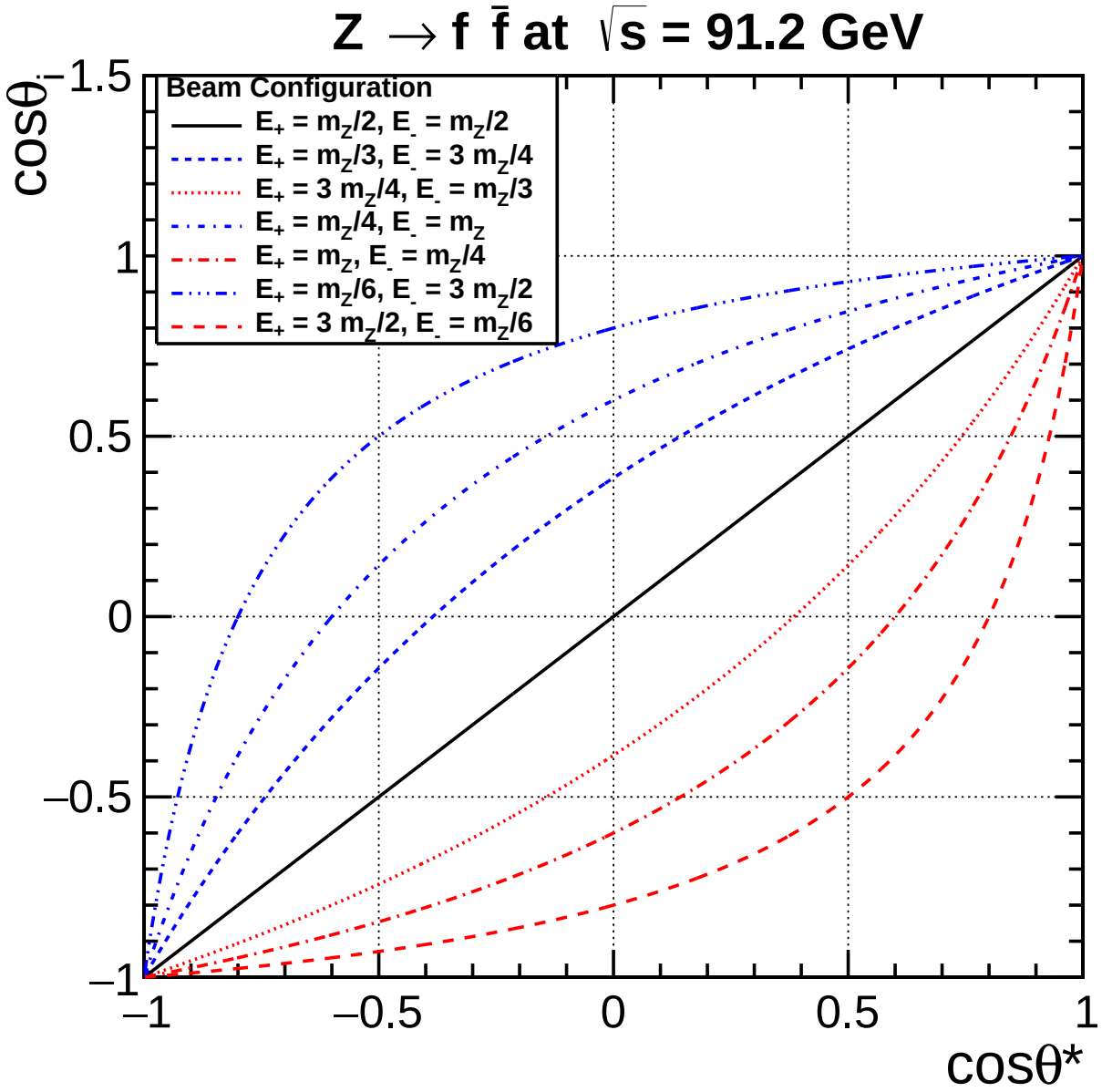
- Same high statistics (potentially higher event rates ... e^+ production issues)
- Can calibrate with a range of energies for jets/leptons.
- But energies are correlated with polar angle.
- Response Function Width determined by Beam Energy Spread ($\approx$ 0.2 GeV)

Asymmetric Z?

Consider various beam energy asymmetries.

$\sqrt{s} \approx 4E_+E_- =$
$m_Z = 91.2$ GeV

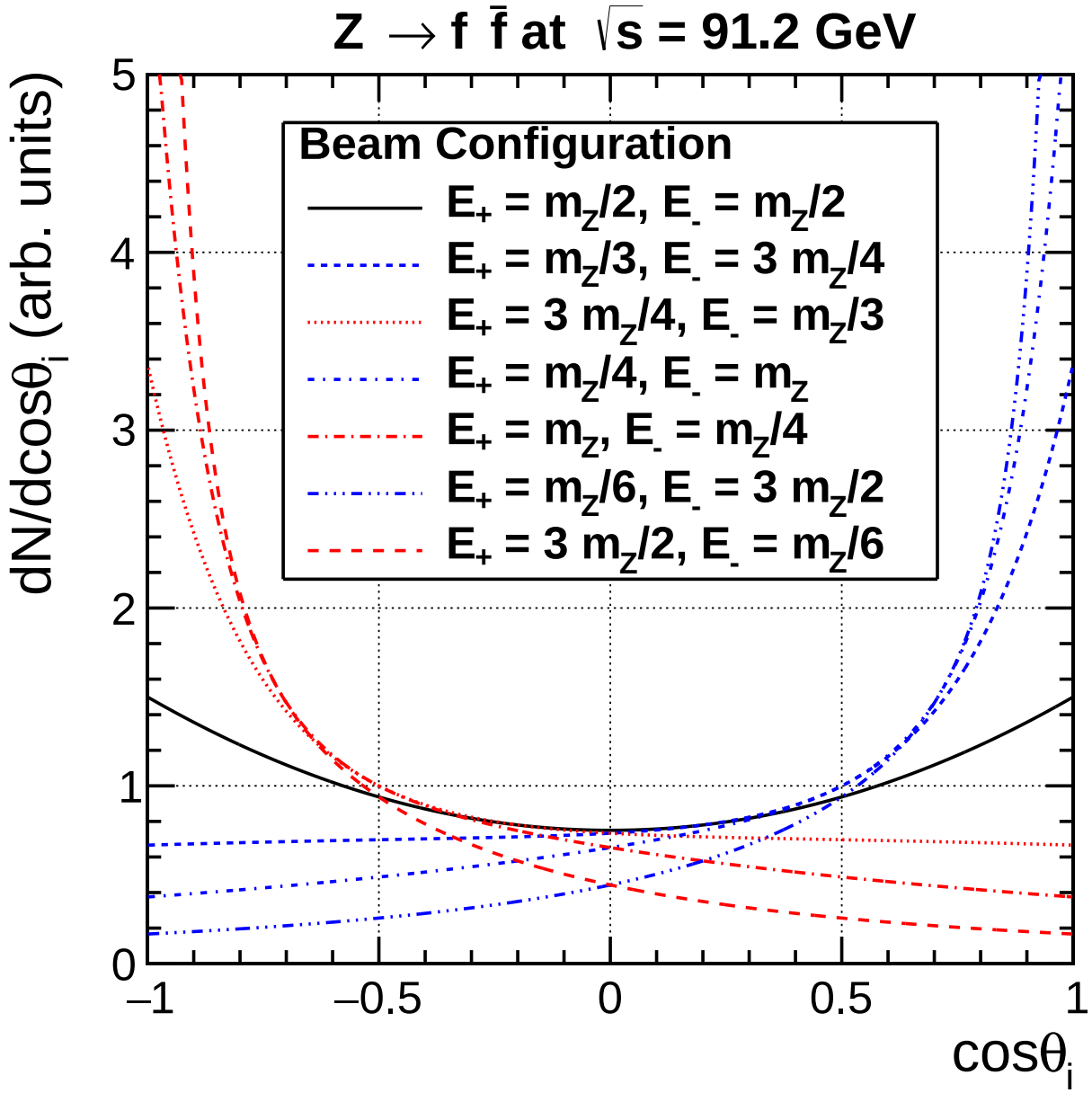
Lorentz boost - leads to new relationship between CM decay angle (θ^*) and detector polar angle, θ_i, of each jet/lepton.



Asymmetric Z? Angular Distribution in the Lab

CM angular distribution of $1 + \cos^2\theta^*$ is transformed.

To populate $\cos\theta$ symmetrically need data with both +ve and -ve beam asymmetry.

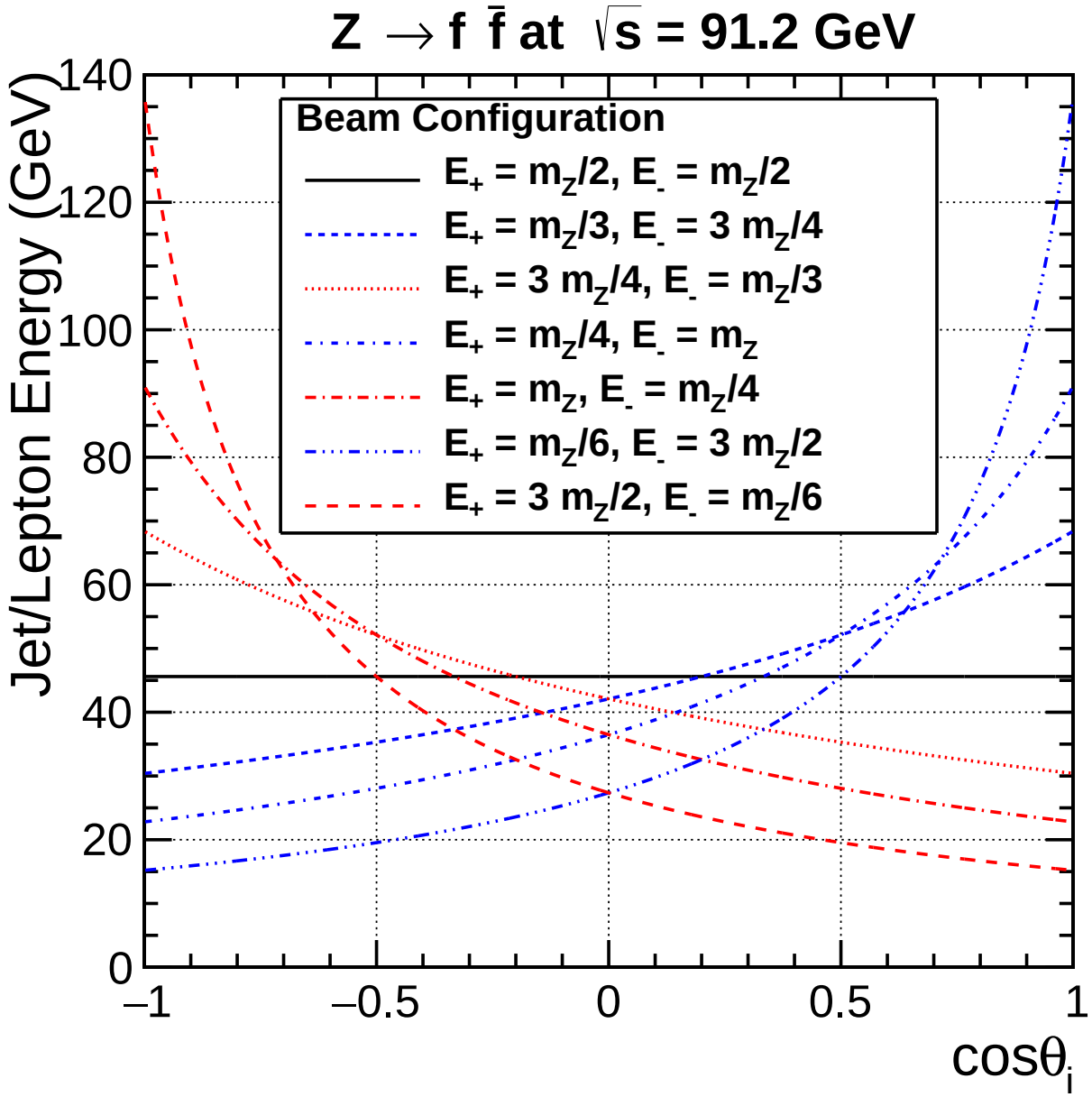


Asymmetric Z? Energy Distributions in the Lab

With asymmetric beams, and the asymmetries shown, fermion energies ranging from as small as 15 GeV to as large as 130 GeV are feasible.

Energy range is modest for central $|\cos\theta|$.

Boost can only lower the energy at $|\cos\theta| \approx 0$.



Summary and Conclusions

- One of the limitations of Z running for calibration with symmetric beams is that the jet or lepton energy is limited to 45.6 GeV.
- Asymmetric collisions at the Z can provide a range of jet/lepton energies in a way that is correlated to the CM decay angle.
- This may be a useful additional systematic check for detector calibration that allows a range of energies to be studied with high statistics using the same physics model.
- However the particular strong correlation of achievable energy range with $\cos\theta$ limits the ability to test linearity comprehensively over a large range.

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