Measurement of R_b of Z hadronic decay

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Status:

✓ Preliminary calculation of Rb based on toyMC samples

 $\checkmark\,$ Calculation method improvement

Under going:

• Result based on full simulation samples

	$\sigma_{R_b}(10^{-6})$	$\sigma_{R_c}(10^{-6})$	$\sigma_{R_q}(10^{-6})$	flavor tagging method
LEP+SLC	659	3015	-	-
FCC-ee	2.1(0.3)	-	-	-
Template fit	1.2	2.3	2.1	LCFIPlus
Double + Single	1.3	1.4	-	Particle Net 10^{11} events
Double + Single	0.52	-	-	ParT (PFOAna) 10^{10} events

Still some room for further improvement, better than pervious work

Model performance



Comparing with Liao's study (arXiv:2208.13503v4)

	This work	arXiv:2208.13503v4
Vertex Geo	Baseline (Ladder + stitching)	Backup (Ladder)
Algorithm	Particle Transformer	Particle Net
Training Set Size	450k per channel (b c q)	1M per flavor Total 11M)
Training Set Type	Jets	Jets
Number of Samples	1e11 Z hadronic decay	1e11 Z hadronic decay
Method	Single + Double Tagging	Single + Double Tagging

Confusion Matrix:





Data Type	Total Events	Ave. Rb	Std. Rb (LSM only)
toyMC (Previous)	5e6	22.833	0.865
FullSim (Previous)	5e6	22.808	0.733
toyMC (Now)	5e6	21.9343	9.5e-4
toyMC (Now)	1e10	21.9297	5.2e-5
Ref	-	21.9300	-

Update:

- Method:
 - Double tagging \rightarrow Single + Double tagging
- Model:
 - Three categories (B, C, Q) \rightarrow Two categories (sgn, bkg)
 - More detailed confusion matrix merging method
 - Specific working point
- Other:
 - Calculation algorithm improvement

Current results can guarantee the correctness of the calculation method (based on toyMC).



Previous todo list:

- ✓ Optimizing tagging algorithm
- ✓ Figuring out what leads to the bias of mean value
- ✓ Trying to reduce the statistical error
- Considering removing the limits Rb + Rc + Rq = 1, no need

Issues:

• Categories merging method depend on tagging methods

To do:

- Develop the calculation method based on fullsim results
- More comprehensive error analysis
- Other two channel (C, S) results