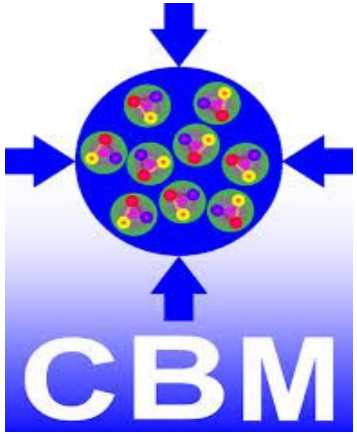
Work Status



Sumit Kumar Kundu, IIT Indore

CBM PWG Di-Lepton meeting

J/Ψ simulation with latest MuCh setup:

“Due to the poor planarity of the 5th Absorber made of the cast iron,
we agreed to move 5th absorber 2 cm downstream otherwise it could touch Station 4.”
... **V. Nikulin (Email communication)**

Effect of this change need to be check.

Geometry 1:
muchGeoTag = "v20a_sis100_1m_jpsi”
Gap between 4th and 5th absorber is **30 cm**.

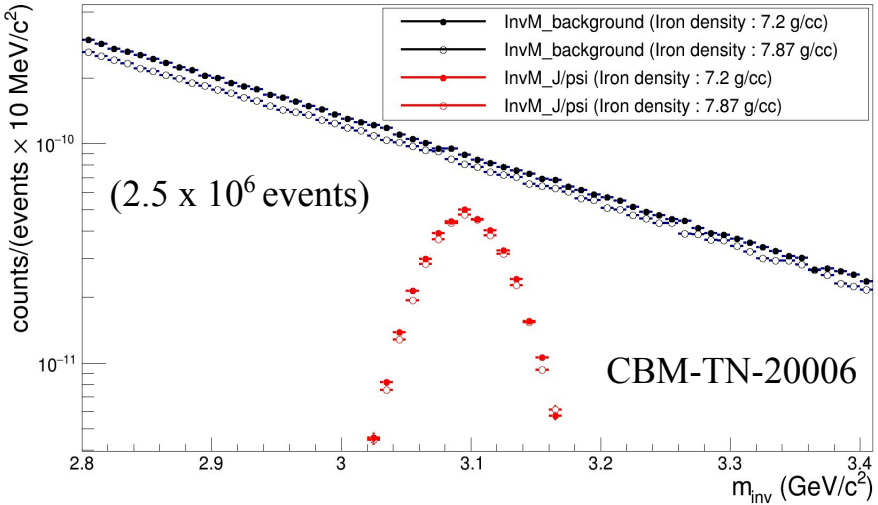
Geometry 2:
muchGeoTag = "v21a_sis100_1m_jpsi”
Gap between 4th and 5th absorber is **32 cm**.

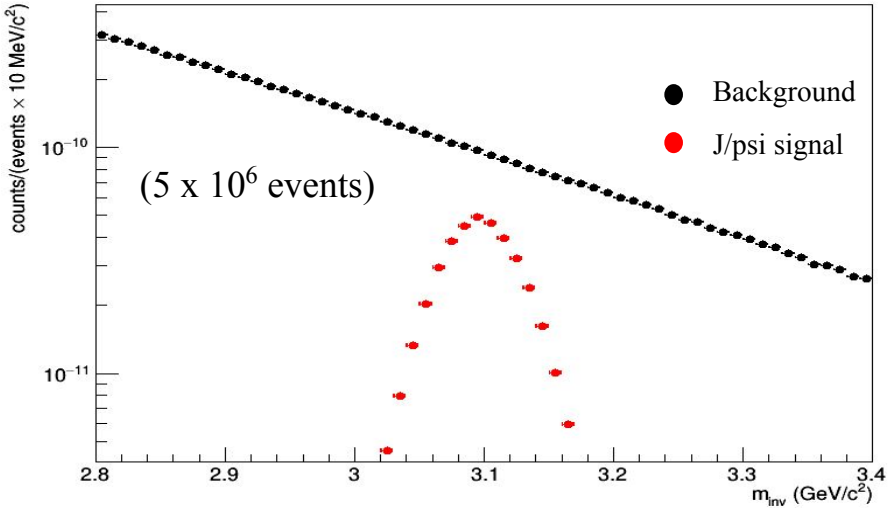
Keeping all other configurations same.

Conclusion:
There is no significant change in the result by increasing the gap from 30 to 32 cm in between 4th and 5th absorber.

Invariant Mass distribution:

10A GeV central Au-Au collision





Track selection cuts:

Accepted tracks: STS hit ≥ 7, MuCh hit ≥ 11, TRD hit ≥ 3, TOF hit ≥ 1

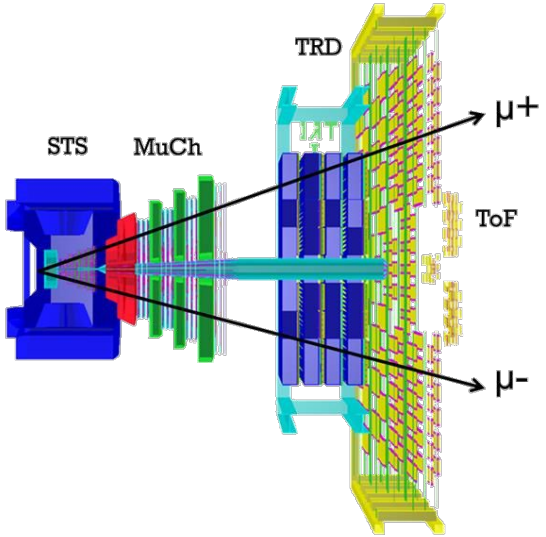
Reconstructed tracks: $\chi^2_{VERTEX} \leq 3.0$, $\chi^2_{STS} \leq 2.0$, $\chi^2_{MuCh} \leq 3.0$, $\chi^2_{TRD} \leq 5.5$, 2σ Mass cut in TOF

	Gap between 4th and 5th absorber (cm)	Iron Density (g/cm^2)	Efficiency (%)	S/B	Significance (x 10^{-6})
Geometry 1	30	7.2	1.29 ± 0.02	0.27 ± 0.02	9.04
Geometry 2	32	7.2	1.273 ± 0.004	0.260 ± 0.001	8.88

Detection of Muon track candidates from J/Ψ with Artificial Neural Network (ANN):

Simulation Details:

- CBMROOT trunk
- Central Au-Au 10A GeV/c (UrQMD) events
- J/Ψ generated using pluto
- sis100_muon_jpsi setup
- Statistics 10^6 events

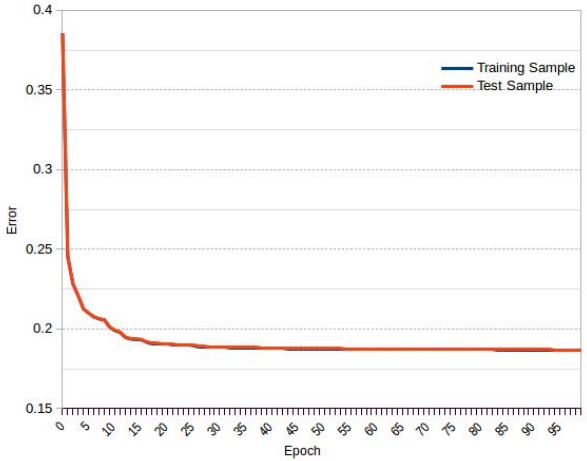


ANN Training:

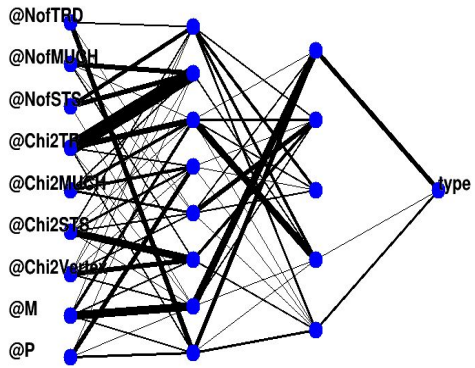
- Track parameters for training:
  - χ^2/ndf
    - in primary vertex (≤10)
    - in STS (≤10)
    - in MuCh (≤10)
    - in TRD(≤10)
  - Number of Hits
    - In STS (≥5)
    - In MuCh (≥8)
    - In TOF (≥1)
    - In TRD (≥1)
- Momentum (≤20)
- Mass calculated from time measurement in TOF (≤5)
- Particle ID: 0 for background, 1 for muon from J/Ψ

Variable Parameters:

- Number of Iteration (epochs)
- Hidden layers and Neurons
- Learning Method:
  1.) Stochastic,
  2.) Batch,
  3.) Steepest Descent,
  4.) Ribiere Polak,
  5.) Fletcher Reeves,
  6.) BFGS (Default)



$$error = \frac{\sum_{N} (X_N - \mu)^2}{N}$$



ANN training: Learning Method

1.) Stochastic,

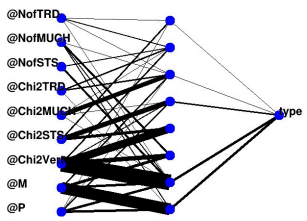
2.)Batch,

3.)Steepest Descent,

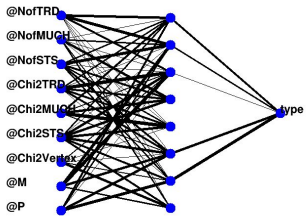
4.)Ribiere Polak,

5.)Fletcher Reeves,

6.)BFGS (Default)



(1)



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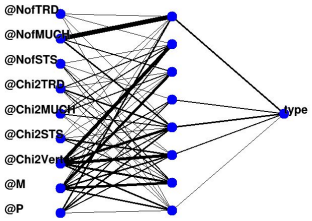

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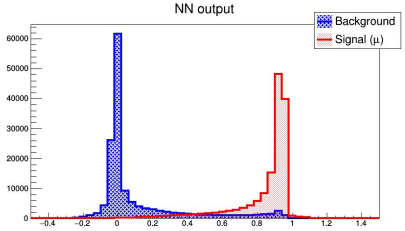

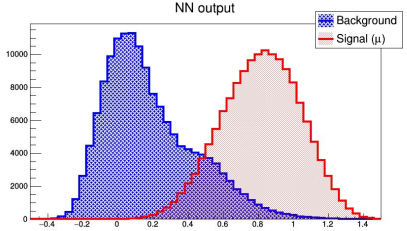

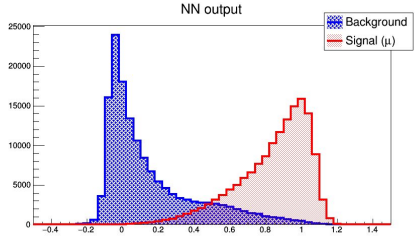

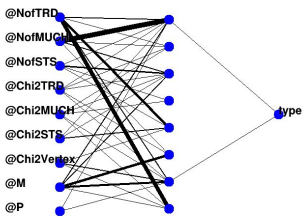

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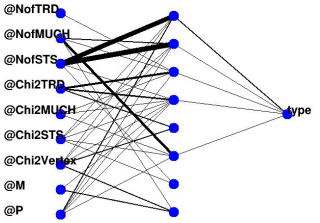

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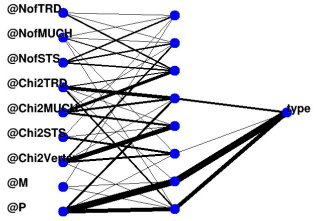

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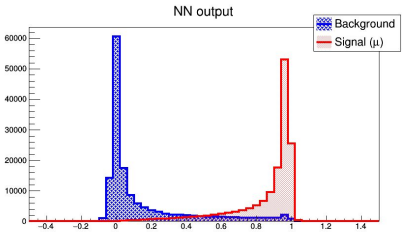

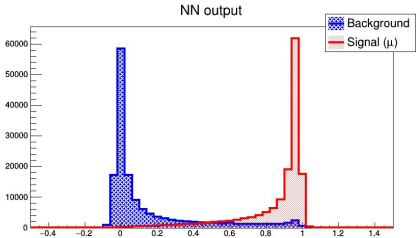

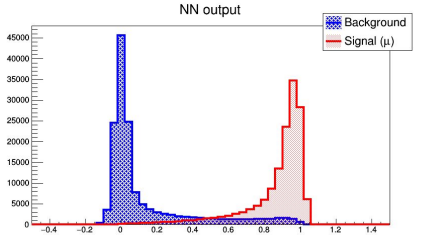

ANN test:

- Output of ANN training provide weights for each parameter.
- Run ANN with predefined weights without using true particle ID.
- It provides ANN ID for each track.
- Based on ANN ID value, put a cut to distinguish signal and background tracks.

Number of Iterations = 300
Number of layers = 1 with 8 neurons
BFGS Learning method
Tested on 10^5 events of 10A GeV central Au-Au collision

ANN ID cut >	Efficiency	S/B
0.5	3.22%	0.0614
0.6	1.97%	0.0512
0.7	0.96%	0.0413

Cut Based Method
Efficiency = 1.29 %
S/B = 0.27 %
CBM-TN-20006

To Do:

- Work on better parameters tuning
- Increase the statistics

Thank You