



# Bao Tai Le

## Masterthesis update

SoSe 2024  
16.4.2024

## **Bao Tai, Le (26/M)**

- doing my one year master project in Particle Physics in the Data Analytics research group under Dr. Biebel
- like watching movies and TV shows
- wants to show you what I am currently working at

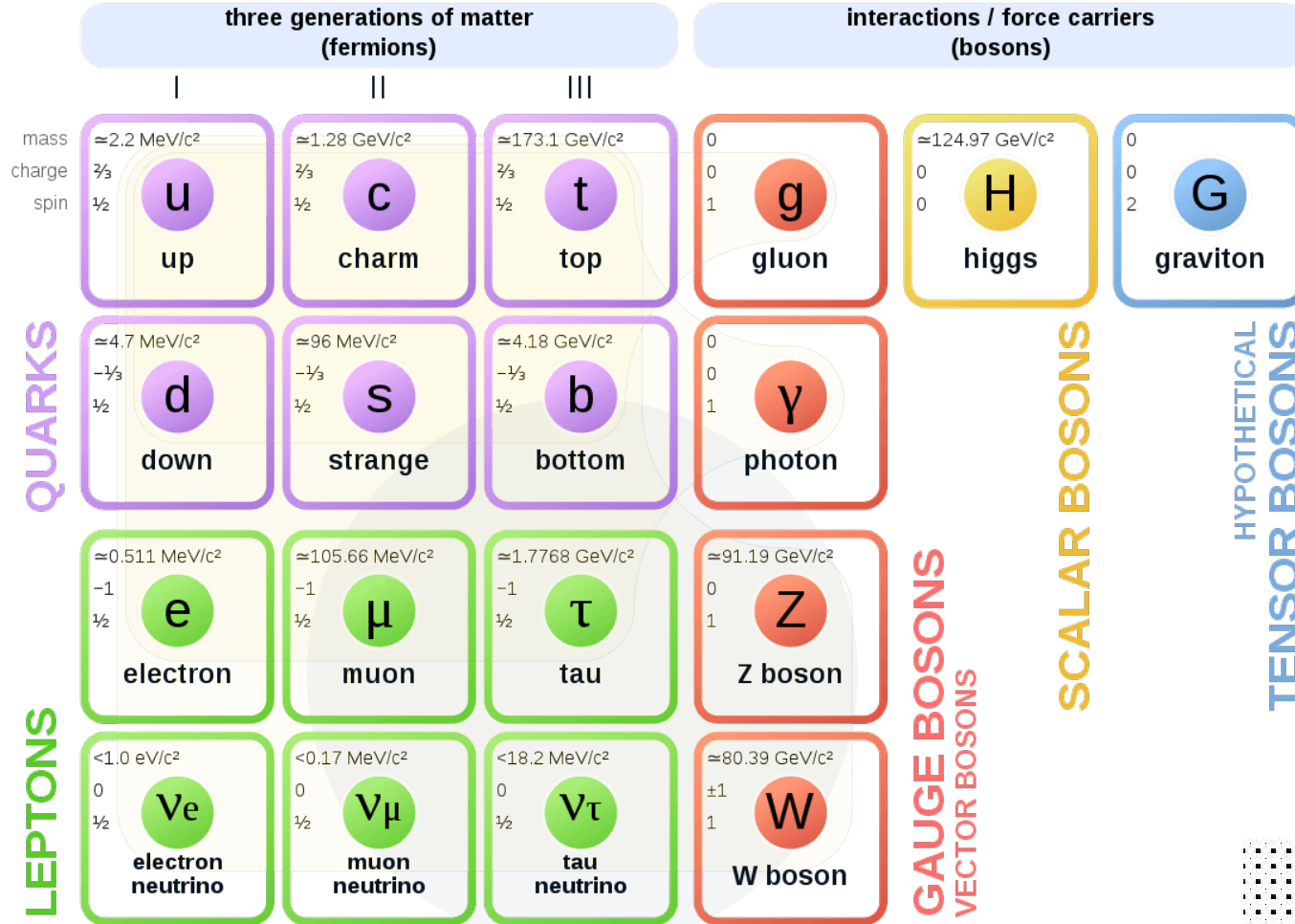




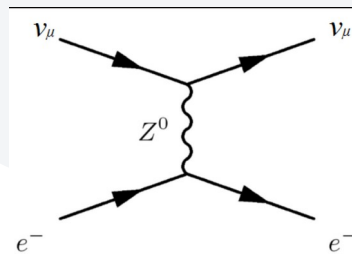
# Motivation



# Standard Model of Elementary Particles and Gravity



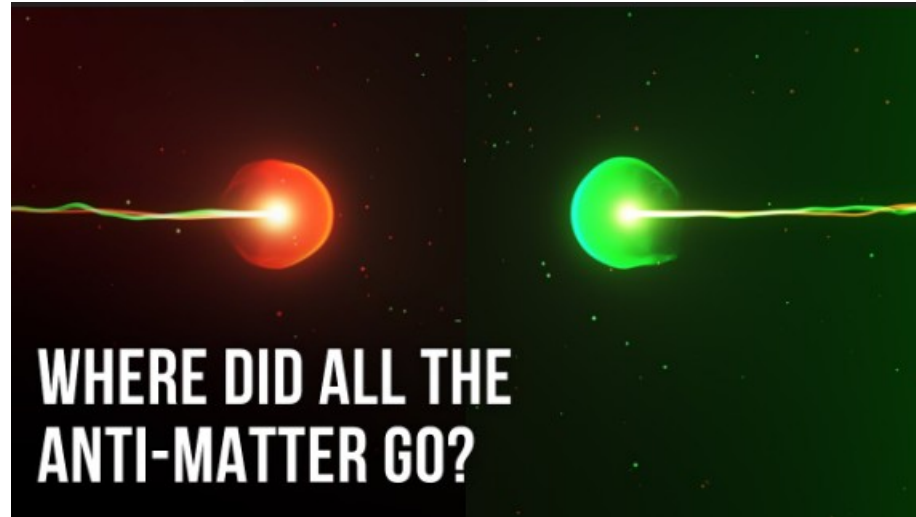
# Prediction and Detection of the weak neutral current W- and Z-Boson





# **Limitations of the SM**

# Matter/Antimatter Asymmetry of the SM



# Existence of Darkmatter/Darkenergy

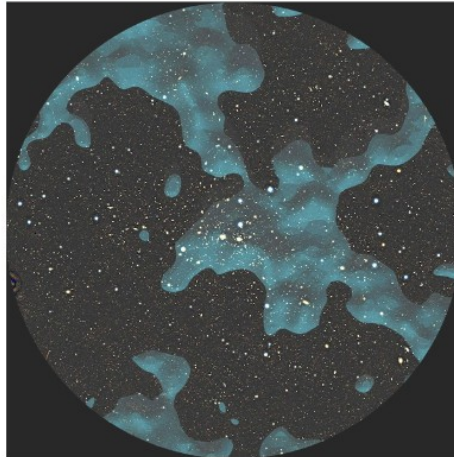
Space > Deep Space

## Astronomers Caught Dark Matter in the Cosmic Web, Revealing an Unseen Universe

We finally got a glimpse at the galactic glue holding everything together.

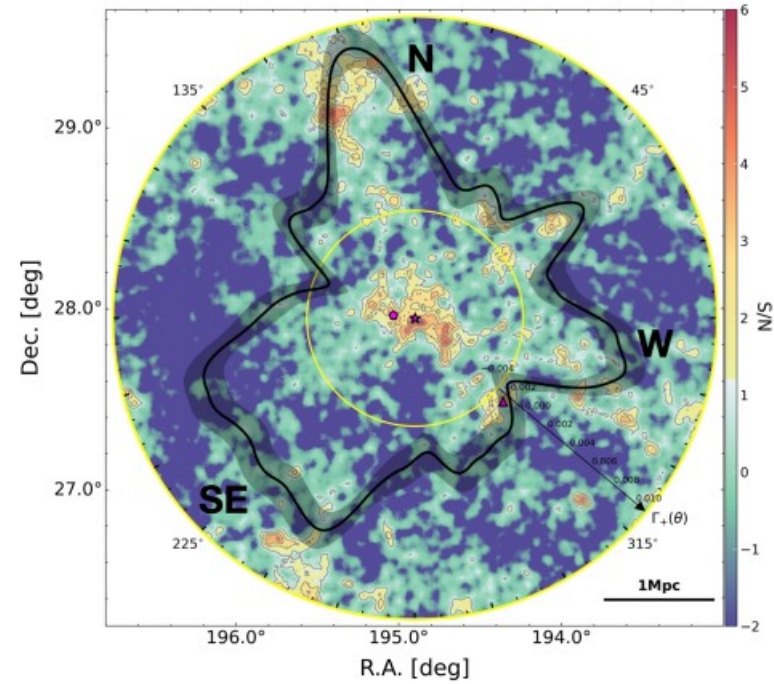
BY JACKIE APPEL PUBLISHED: FEB 17, 2024 9:38 AM EST

SAVE ARTICLE



Hyung1an et al.

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**Figure 1: Mass reconstruction and matched filter statistic of the Coma cluster.** For mass reconstruction, we used the convolutional neural network (CNN) method<sup>49</sup> after training the deep learning with a wide-field (3.5 deg × 3.5 deg) convergence field. We verify that the mass



# Introduction of the Higgs-particle



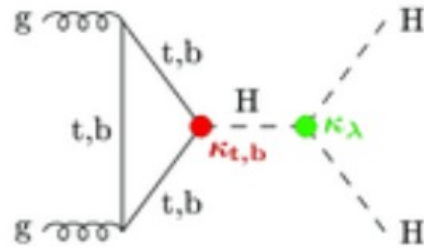
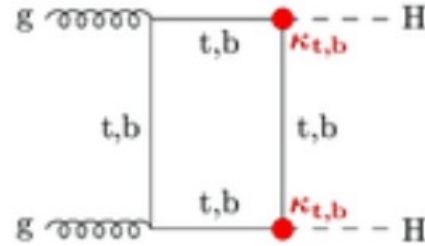
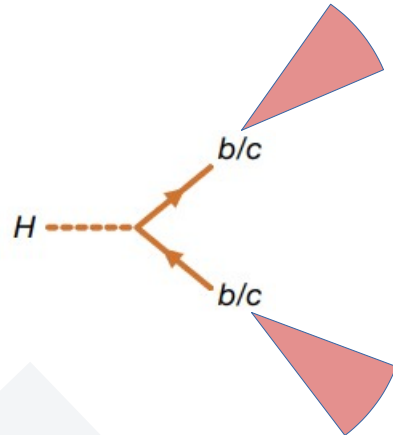
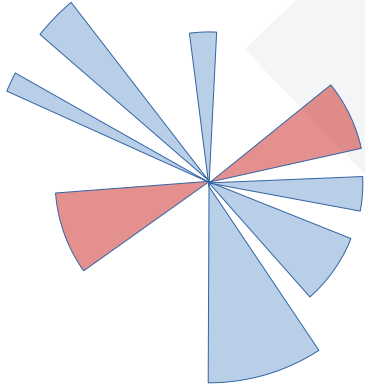
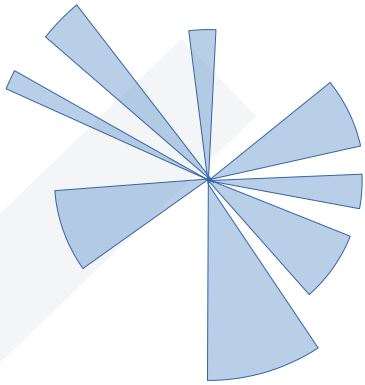
**The Higgs-sector as a point of  
research to find new physics**

All b-jets

Matched b-jets

Investigation of  
the  $2H \rightarrow 4b$

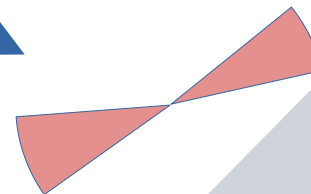
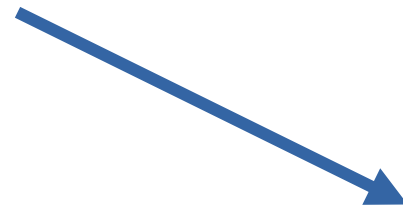
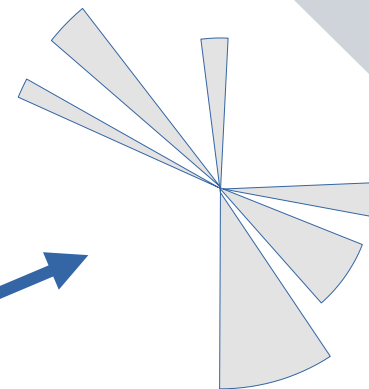
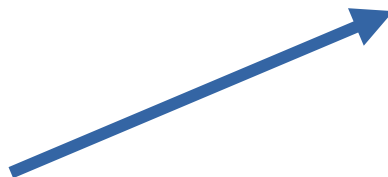
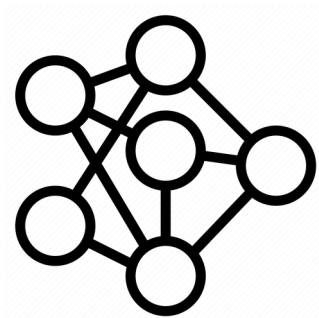
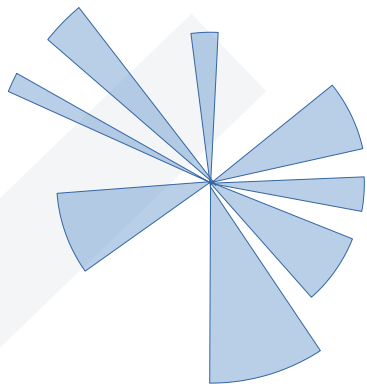
New Physics?



All b-jets

- We need a lot of data
- We need to give it „hints“

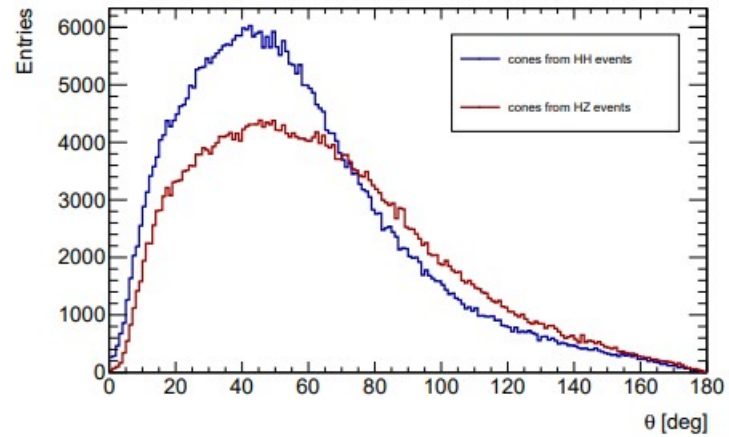
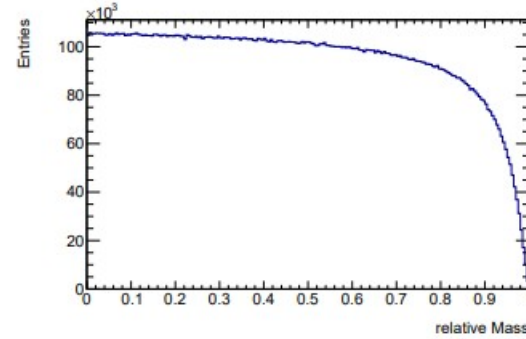
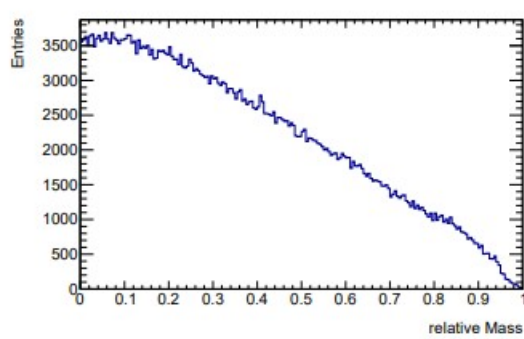
Matched b-jets



# What are hints?

Matched b-pairs

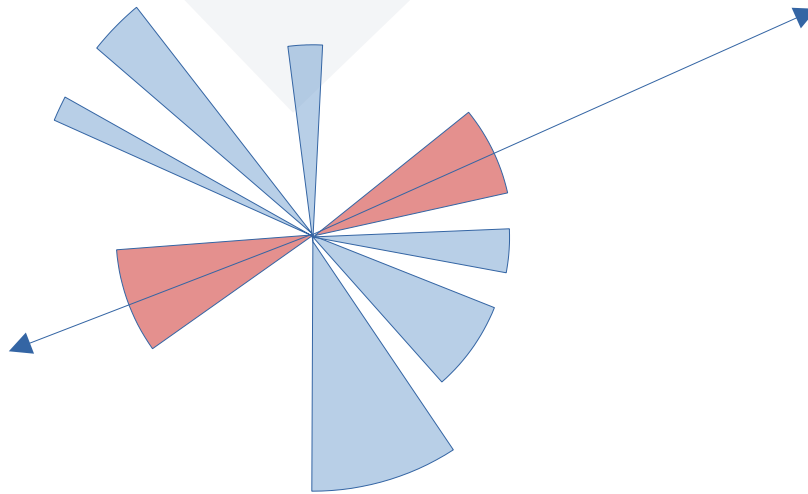
Combinatoric background



**So how do my  
graphs look  
like?**

What was the  
problem?

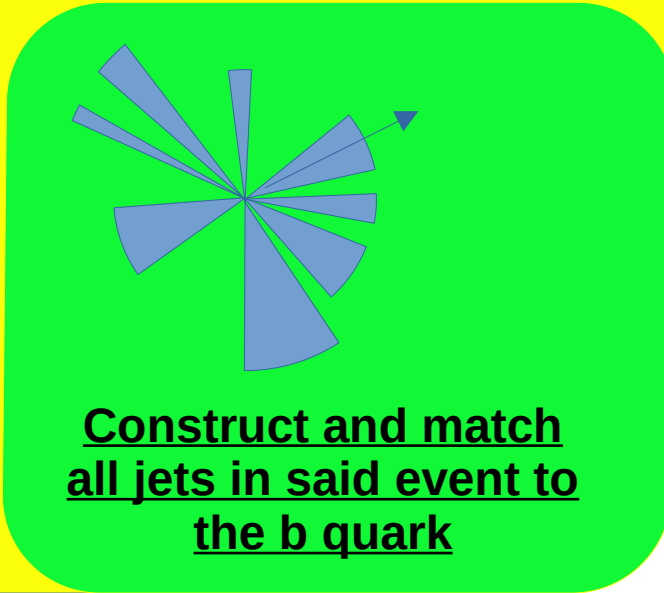
-My  
assumption



way to find the correct b-quarks-jet-  
pairs → minimal angular distance

Loop over all Events

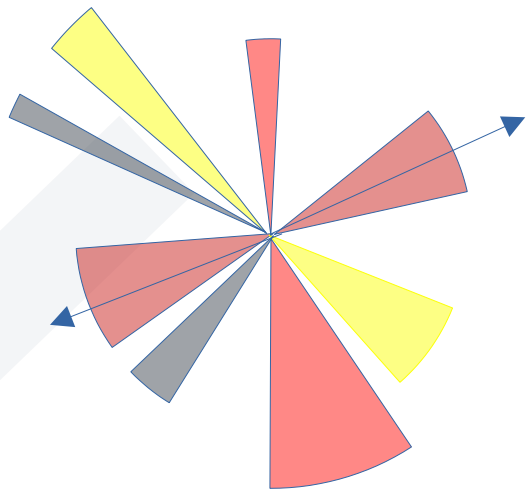
Loop over all b-quarks  
in my particle list  
In said event



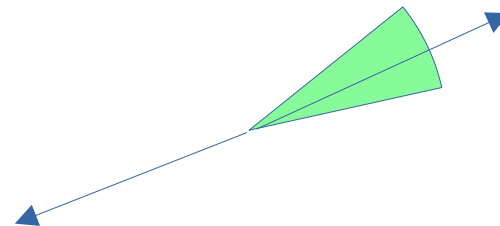
Construct and match  
all jets in said event to  
the b quark



**Over many events angular  
difference**



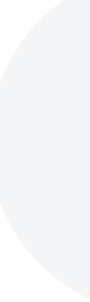
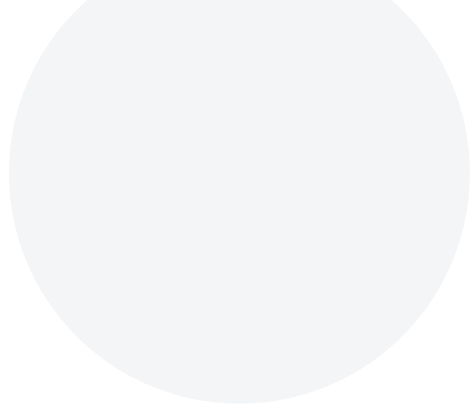
**Within one event angular  
difference**



## Open Questions

- I have multiple b-quarks in each event but only one jet? How does that work?
- Work around(?)
- ideas for variables that can be investigated
- Please let me know!





## Resources

- <https://www.curious-cravings.com/images/post/standard-model.png>
- [https://en.wikipedia.org/wiki/Gargamelle#/media/File:Neutral\\_current,\\_leptonic\\_vent,\\_muon\\_neutrino.png](https://en.wikipedia.org/wiki/Gargamelle#/media/File:Neutral_current,_leptonic_vent,_muon_neutrino.png)
- <https://arxiv.org/ftp/arxiv/papers/2310/2310.03073.pdf>
- Discrimination of HH and HZ Final States Using Neural Networks
- <https://cdn3.iconfinder.com/data/icons/data-science-11/64/neural-network-machine-learning-algorithm-1024.png>
- [https://www.researchgate.net/figure/Feynman-diagrams-for-the-leading-Higgs-boson-interactions-Higgs-boson-production-in-a\\_fig1\\_361733458](https://www.researchgate.net/figure/Feynman-diagrams-for-the-leading-Higgs-boson-interactions-Higgs-boson-production-in-a_fig1_361733458)