

Jet analysis in Vector Boson Scattering events with the CMS experiment at LHC

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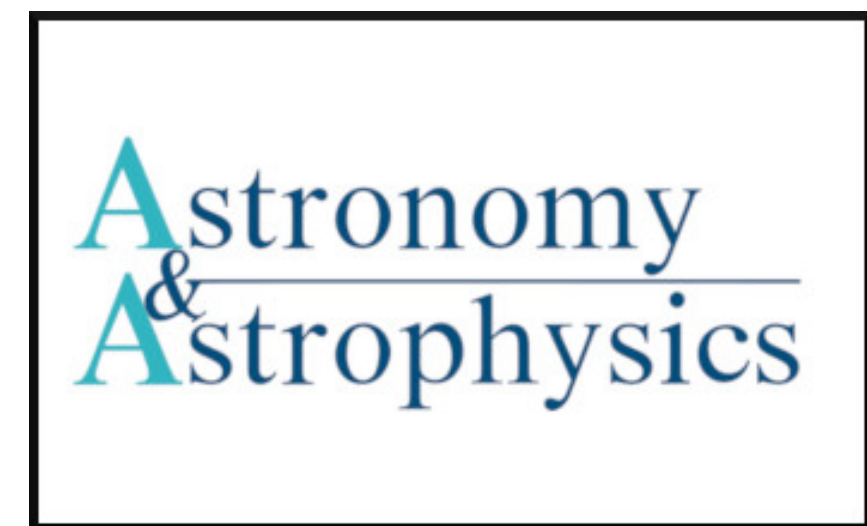
My personal background

- I attended an international High School in Florence which allowed me to obtain both my Italian degree and French Baccalauréat

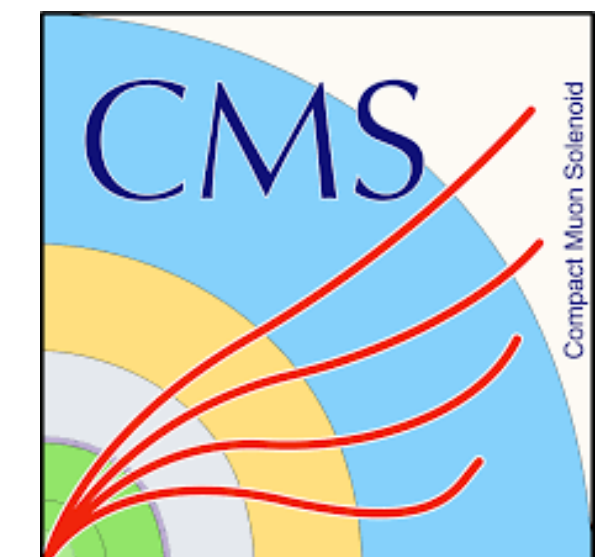


- In 2023 I got my Bachelor degree at the University of Trieste with a thesis titled “*Contributions from different types of stars to the chemical evolution of the Solar System*”

F. Fiore et al., A&A 691, A46 (2024). ArXiv: 2406.08036 [astro-ph.SR] DOI: <https://doi.org/10.1051/0004-6361/202451076>



- Last July (2025) I discussed my Master Thesis “*Study of jets substructure in heavy ion collisions with Pythia8 with the CMS experiment at LHC*” and obtained my degree at the University of Trieste



My personal background

I published my Bachelor **thesis as first author**
Fiore, F., Matteucci, F., et al. (2024). *A census of the Sun's ancestors and their contributions to the Solar System chemical composition*
Astronomy & Astrophysics, 2024(11), aa51076-24. DOI: <https://doi.org/10.1051/0004-6361/202451076> .

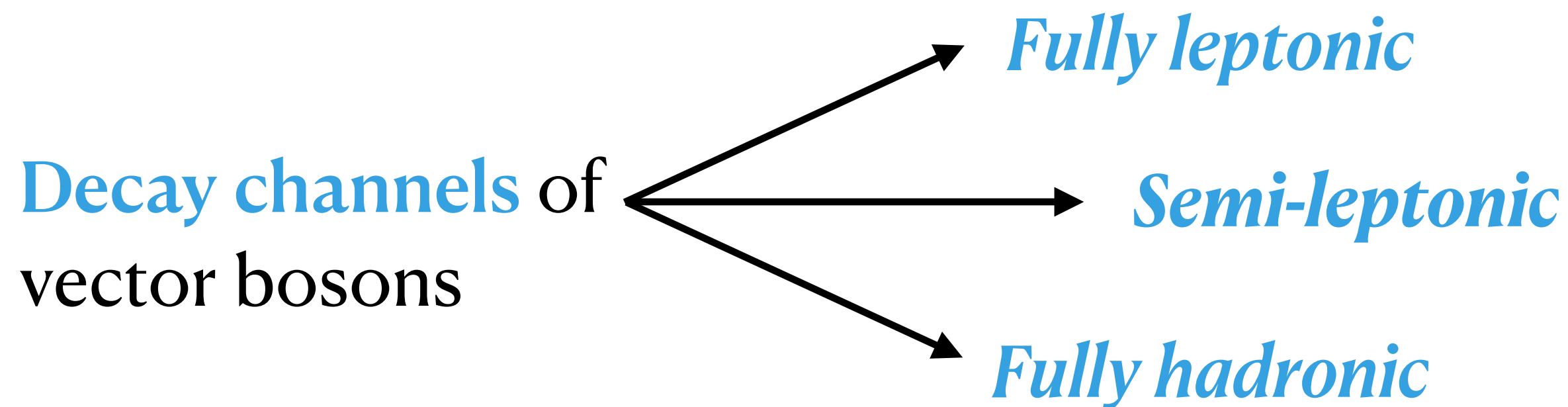
Harvard Games: I participated with my team at the CS50x Puzzle Day 2024 and we won the game. (April 2024)

Student Head Girl: During both my M.Sc years I have been elected as student representative for the curriculum of Nuclear and Subnuclear Physics (November 2023 - 2025).

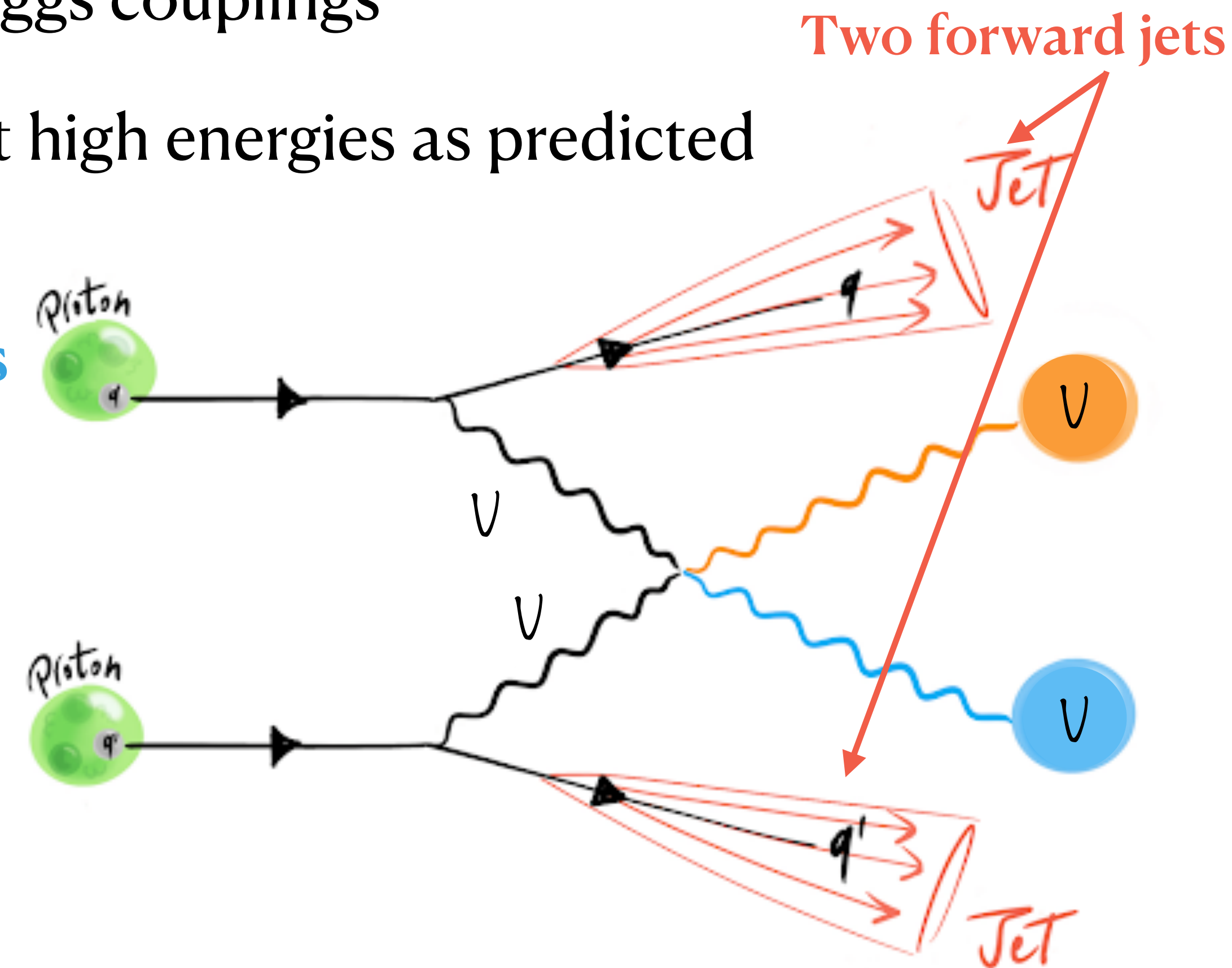
Orientation Tutor: During both my last M.Sc year I have been selected through a competitive call as orientation tutor for incoming students. (April - July 2025).

Vector Boson Scattering: a probe of new physics

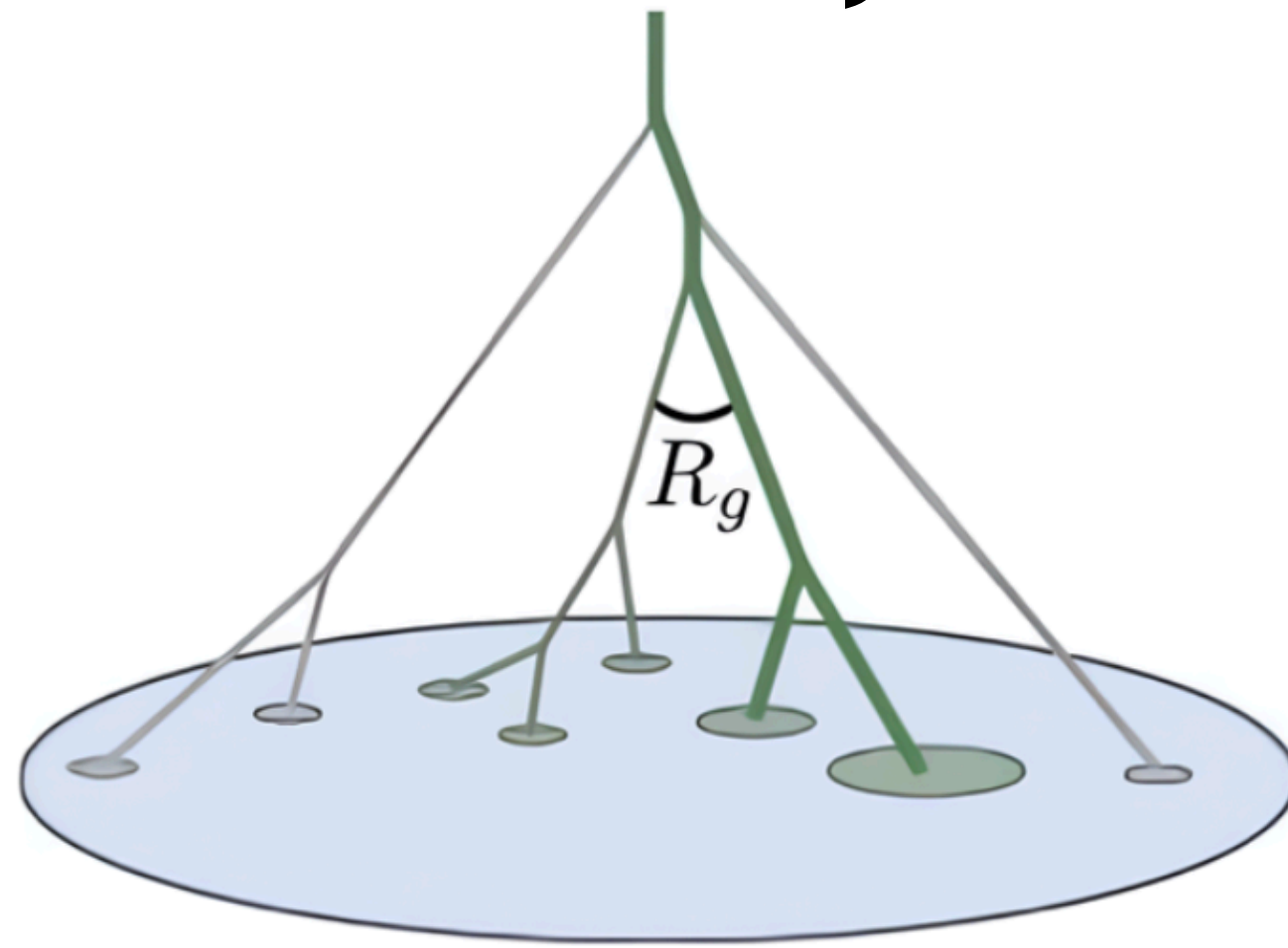
- **Vector Boson Scattering** (VBS) events are **rare processes** in the Standard Model
- Involves scattering of **electroweak bosons** (W^\pm, Z) radiated by quarks
- Connected to the **Higgs mechanism** → sensitive to Higgs couplings
- Guarantees the **unitarity of the electroweak theory** at high energies as predicted in the SM (Higgs exchange cancels divergences)
- Deviations from unitarity → possibility of **new physics**



Greater statistic in the **semileptonic channel** (and fully hadronic) → need to develop a **complex jet analysis**



Jet analysis and substructure



K. Lee et al., The soft drop momentum sharing fraction z_g beyond leading-logarithmic accuracy, DOI: <https://doi.org/10.1016/j.physletb.2022.137390>

- **Semileptonic channel**

- **Jet analysis**

Jet **substructure** techniques to probe **polarization**

Jet kinematic reconstruction

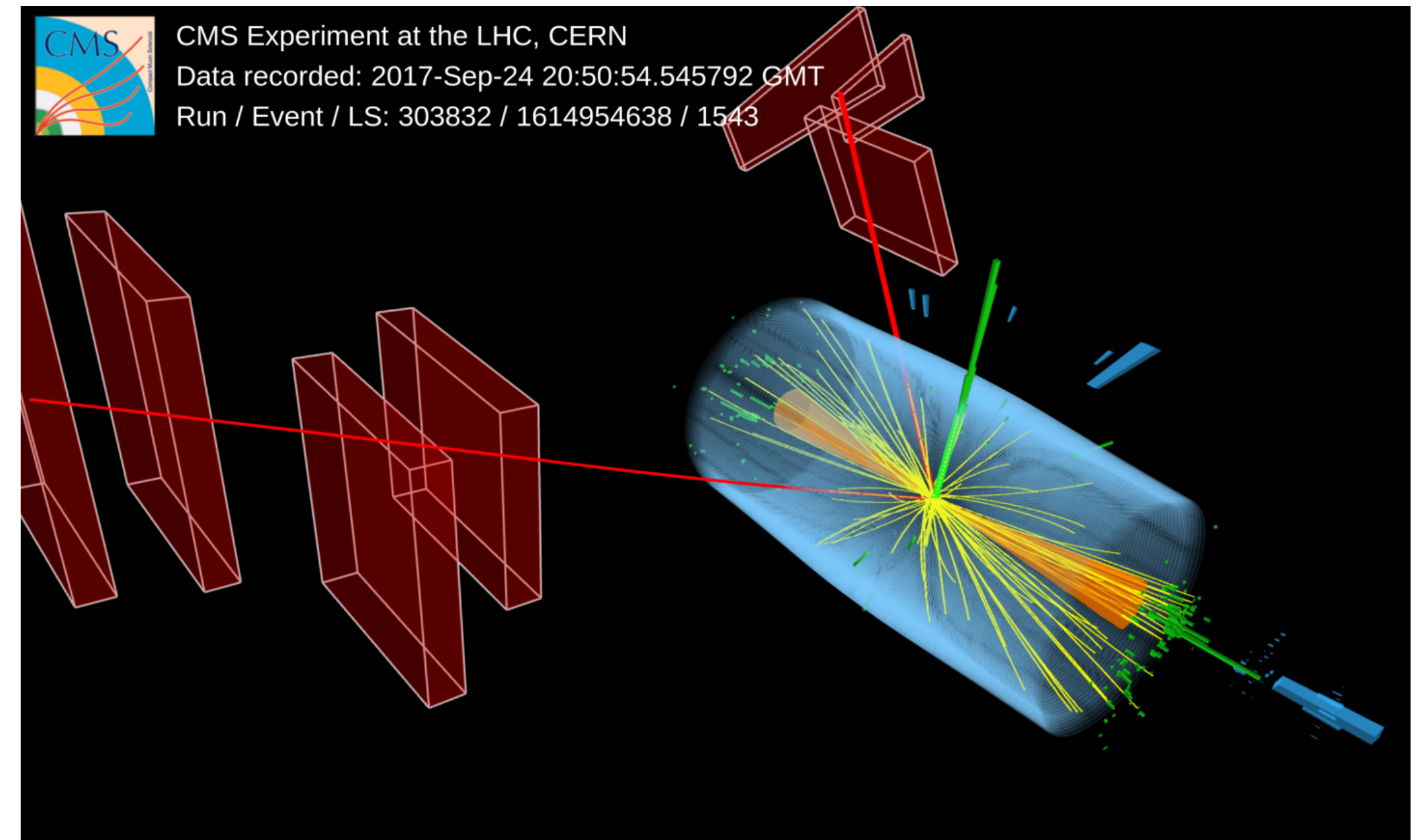
Background suppression

Polarization is a sensitive probe to new physics BSM as the **longitudinal polarization fraction of bosons** is a **well-defined** prediction of the SM in same sign VBS events.

Larger **statistics** comparing to the *golden channel*

Theoretically robust: includes non-resonant topologies, off-shell effects, EW-QCD interference

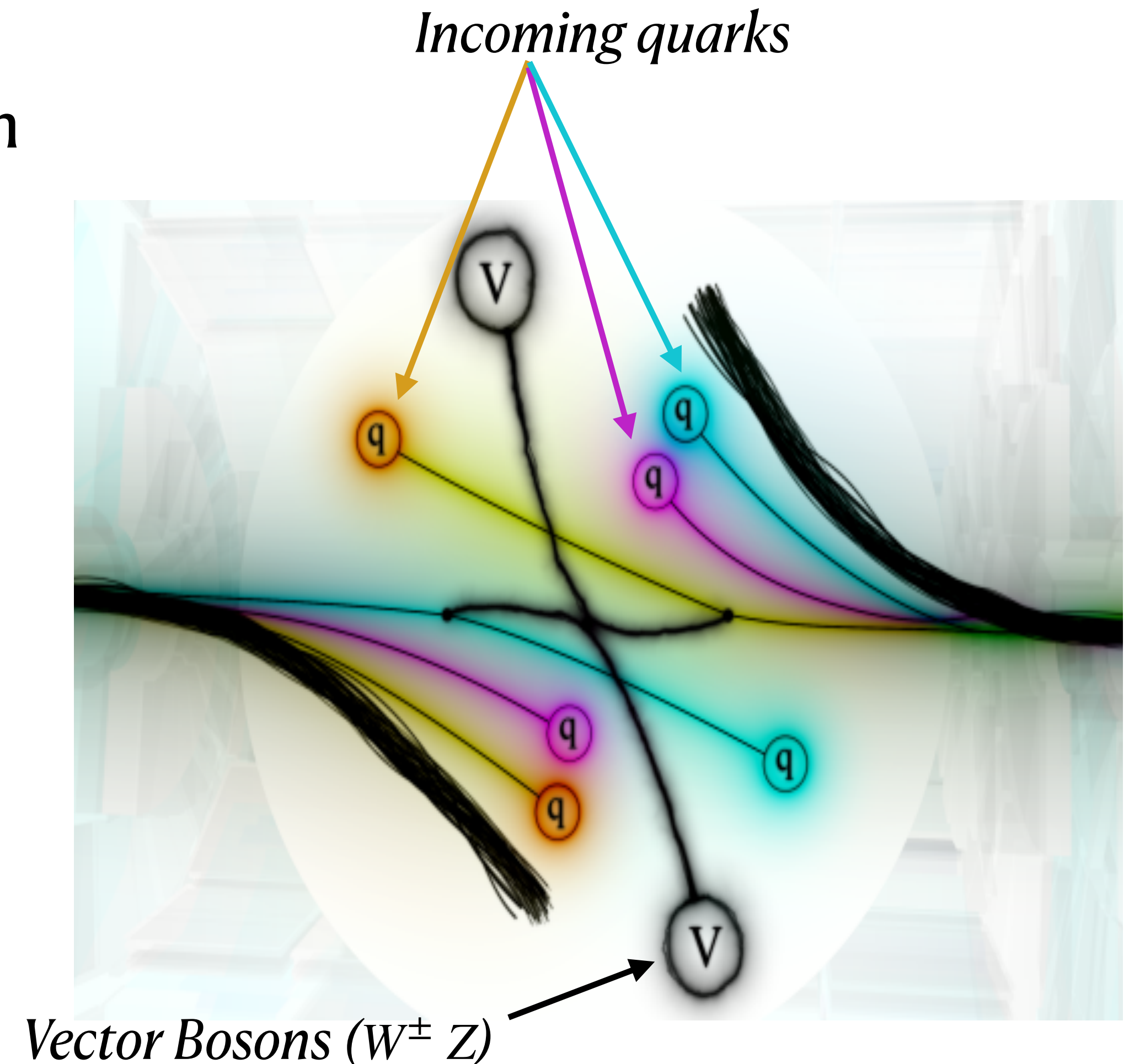
Accessible with **Run 3 data** and crucial for **HL-LHC** studies



PIECING TOGETHER THE PUZZLE: A COMPREHENSIVE LOOK AT VECTOR BOSON SCATTERING, The CMS Collaboration, URL: <https://cms.cern/news/piecing-together-puzzle-comprehensive-look-vector-boson-scattering>

PhD project

- Study of jet substructure in VBS events on data from **Run 3** using the **semileptonic** decay for $WZ \rightarrow$ objective: achieve the **Standard Model VBS observation**
- Application of the analysis to **Run2+3** data to reach the **5σ sensitivity** for the VBS signal
- Later extensions: **polarization** studies and combinations with **other final states**
- Elaboration of an analysis to be used for **HL-LHC** data when available



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The CMS Collaboration, URL: <https://cms.cern/news/piecing-together-puzzle-comprehensive-look-vector-boson-scattering>



Thanks for your attention!