Introduction

- **Search for massive resonances** decaying into a pair of vector (V) bosons, with V = W/Z boson, in the ℓνqq final state, where ℓ = e, μ.
- **Targets**: models which aim to explain open questions of the standard model (SM), e.g. integration of gravity using extra dimensions.
- These models usually predict the existence of heavy particles that decay to pairs of bosons.
- **Examples**:
  - Spin-2 bulk scenario, Randall-Sundrum Warped Extra Dimensions model [2]
  - Composite heavy vector triplet (HVT) model [3], predicting spin-1 particles.

Background estimation: shape

- **Step 1**: extract \( F_{\text{MC}}^{\text{W+jets}}(M_{WV}) \), i.e. the W+jets \( M_{WV} \) distribution in the lower sideband region, from a fit on the observed \( M_{WV} \) distribution in data, correcting for the presence of minor backgrounds.
- **Step 2**: derive the transfer function \( \alpha_{\text{MC}}(M_{WV}) \) from W+jets simulation:
  \[
  \alpha_{\text{MC}}(M_{WV}) = \frac{F_{\text{MC}}^{\text{W+jets}}(M_{WV})}{F_{\text{MC,SB}}^{\text{W+jets}}(M_{WV})},
  \]
  \( F(M_{WV}) \) = probability density function used to describe the \( M_{WV} \) spectrum in the different regions.
- **Step 3**: extract shape of the \( M_{WV} \) distribution of the W+jets background in the signal region, by rescaling \( F_{\text{SB}}^{\text{W+jets}}(M_{WV}) \) by \( \alpha_{\text{MC}}(M_{WV}) \). Then add the minor backgrounds to the W+jets background to obtain the total SM prediction in the signal region (Fig. 3).

Event reconstruction and analysis strategy

- Reconstruct the full event, to search for a local excess in the diboson invariant mass spectrum.
- Leptonically decaying W bosons reconstructed by identifying isolated high-momentum leptons.
- Measured missing transverse energy (E_T) used to estimate the neutrino longitudinal momentum, by imposing the constraint \( M_T = M_W \).
- High boosted regime: quarks coming from the hadronically decaying vector boson very collimated, reconstructed as a single jet.
- Information from jet substructure used to identify these jets.
- Two main observables:
  - \( M_J \): mass of the merged jet. Events split according their \( M_J \) value in:
    - Signal region (SR) [65 – 105 GeV]
    - Sideband region (SB) [(40 – 65) and [135 – 150 GeV)], for the estimation of the background.
  - \( M_{WV} \): four-body invariant mass, used for the final limit computation.

Background estimation: normalization

- Normalization of the W+jets background in the signal region determined from a fit to the \( M_J \) distribution in the lower and upper sidebands of the observed data (Fig. 2).

Statistical interpretation

- Compare \( M_{WV} \) distribution observed in data with SM background prediction.
- Exclusion limits in the context of bulk graviton model and HVT model B scenarios. Combination with another channel (X → VV)
- Assumption: narrow-width approximation

Conclusion

- Search for new resonances decaying to WW or WZ
- No evidence for a signal is found
- Results interpreted as upper limit on the production cross section for bulk graviton and HVT models.

References