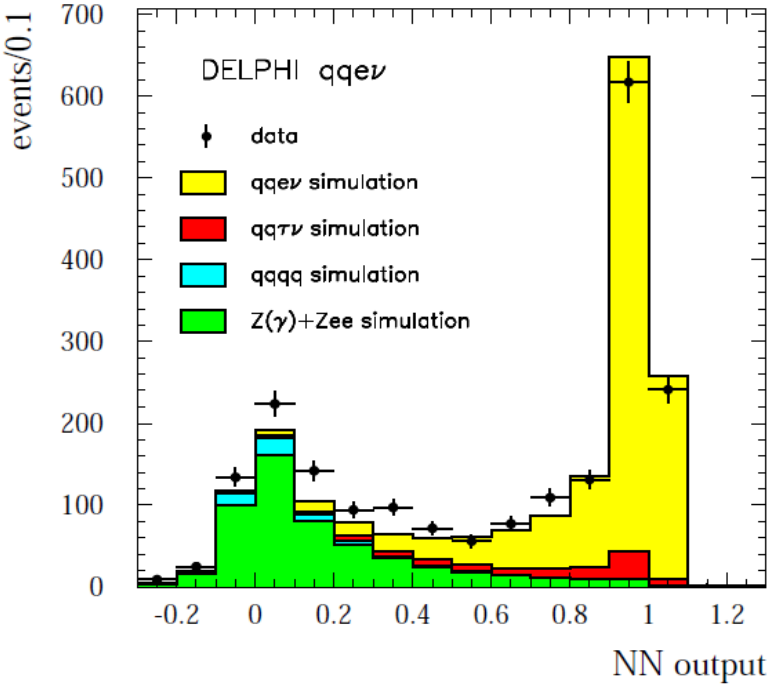
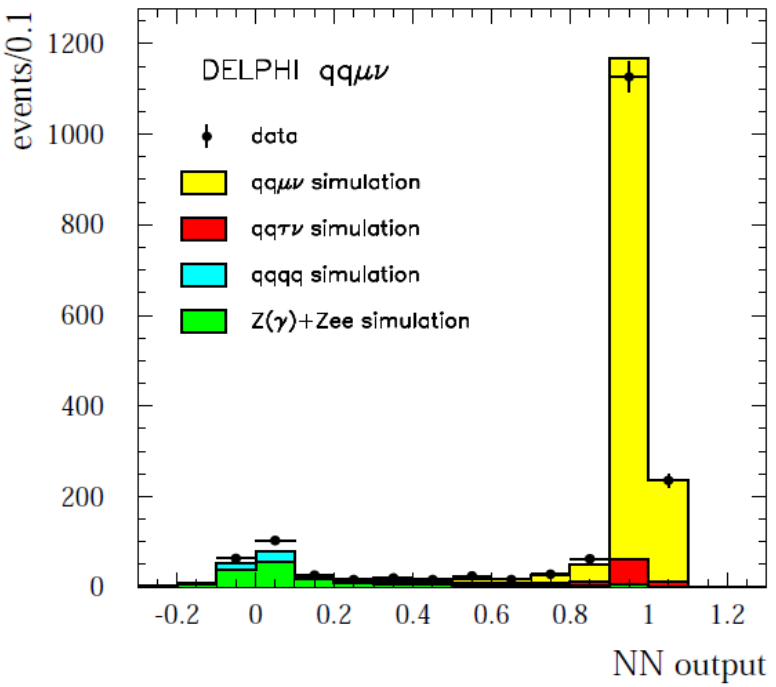
Event selections

- LEP analyses : complex neural-net analyses to differentiate signal (qqlν production) from backgrounds (Zγ, ZZ or Z+jets)





Event selections

- Variables used in neural DELPHI network (similar for other LEP collaborations)

  - Polar angle of the leptonic W (after applying the constrained fit);
  - angle of the charged lepton with respect to the direction of the leptonic W (in the W rest frame, and after the constrained fit);
  - polar angle of the lepton;
  - polar angle of the missing momentum vector;
  - angle between the lepton and the nearest jet;
  - angle between the lepton and the nearest charged hadron track (of energy greater than 1 GeV);
  - missing transverse momentum;
  - the invariant mass of the measured system of particles $\sqrt{s'}$ [25] - this is measured using planar kinematics, by forcing the event into 2 jets (using all particles in the event including the lepton) and assuming a photon is emitted down the beam pipe;
  - aplanarity (cosine of the angle between the lepton and the normal to the plane formed by the jets[2]);
  - acollinearity (complement of the angle between the two "jets" when forcing the event into a two-jet configuration);
  - the minimum d_{join} distance in the LUCLUS jet clusterisation algorithm between two jets in the final configuration, where the whole event (hadronic and leptonic system) is forced into three jets. This is known as d_{j3all}.

Simple event selection for an MC-only study

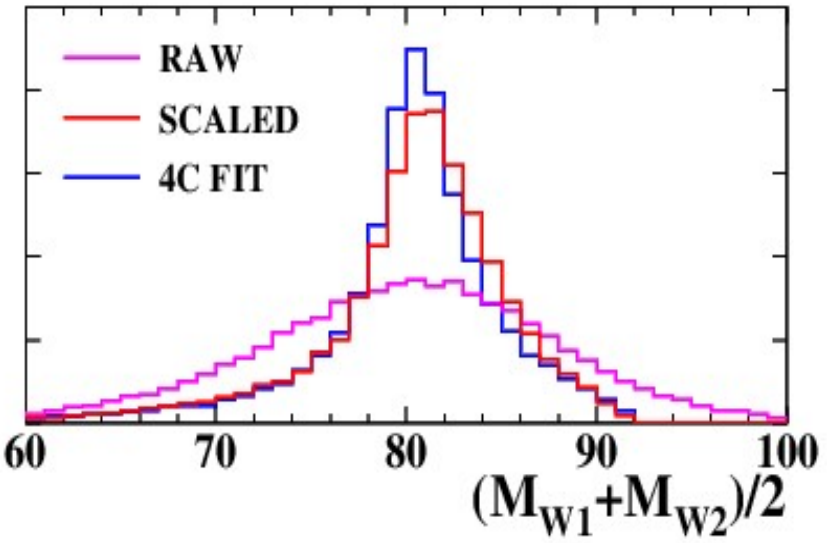
- WW → qqμν
  - Exactly one measured muon with momentum >10 GeV
  - Missing transverse momentum >10 GeV
  - Jet reconstruction :
    - force all events to two jets, or
    - Apply usual algorithm and use events with at least two jets
  - Visible mass > 0.5 root(s)
  - Variation : with and without anti-btagging cut
- ZZ → qqμμ
  - Exactly two measured muons with momentum >10 GeV
  - Jet reconstruction :
    - force all events to two jets, or
    - Apply usual algorithm and use events with at least two jets
  - Visible mass > 0.85 root(s)
  - Variation : with and without anti-btagging cut

Invariant mass reconstruction studies

- Plot invariant mass only for events surviving cuts
- Compare peak position in WW and ZZ events, with and without anti-btagging cuts
  - This will quantify the effect of b quarks on the Z mass peak

Impact of constrained fits?

- At LEP : improvement factors of 2-3 are quoted for the $m_{jet\text{-}jet}$ resolution.
  - Mostly valid for qqqq events where kinematic information is maximal, allowing 4C (E,p conservation) or 5C (E,p cons. + m_1=m_2)
  - Smaller improvement for lνqq, but no explicit number found
  - The effect is also experiment dependent, as better experimental resolution will leave less margin for improvement.



Impact of constrained fits?

- Can we get a quick estimate for the CEPC detector?
  - Initial resolution better than at LEP
  - Simplest : “rescaling”: $E_i \rightarrow \alpha_i E_i$, such that $(E_{tot}, p) = (\sqrt{s}, 0)$
  - More involved (but standard): kinematic fit