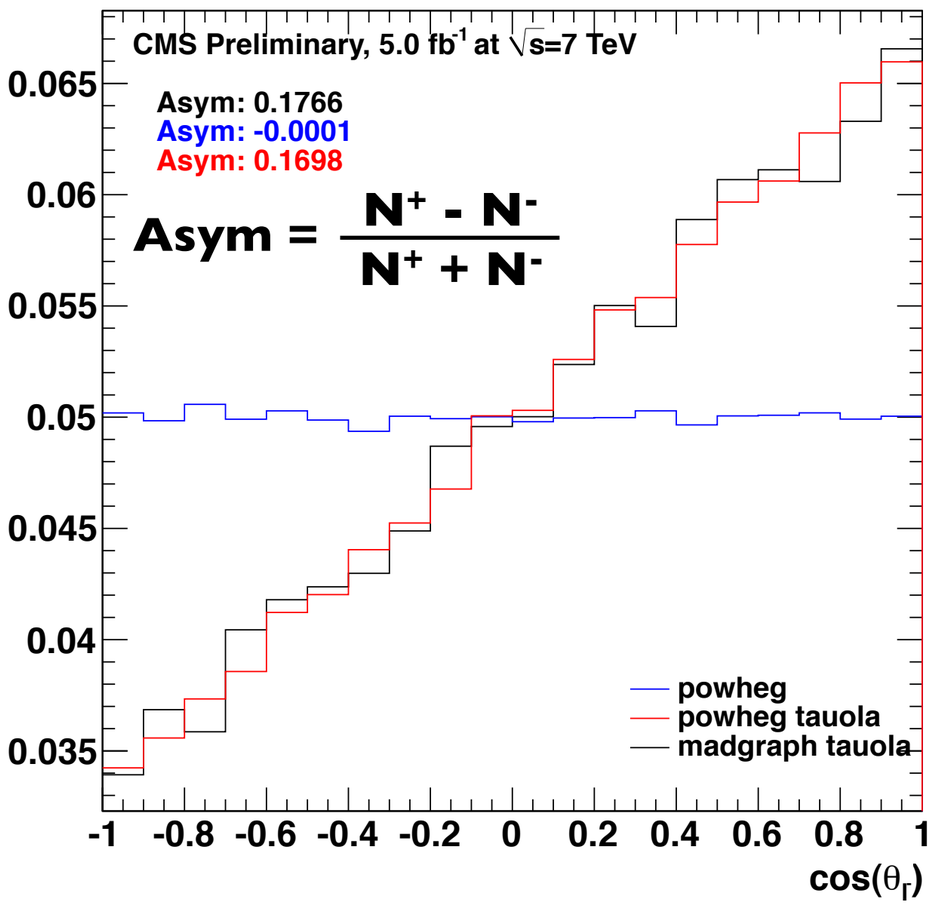
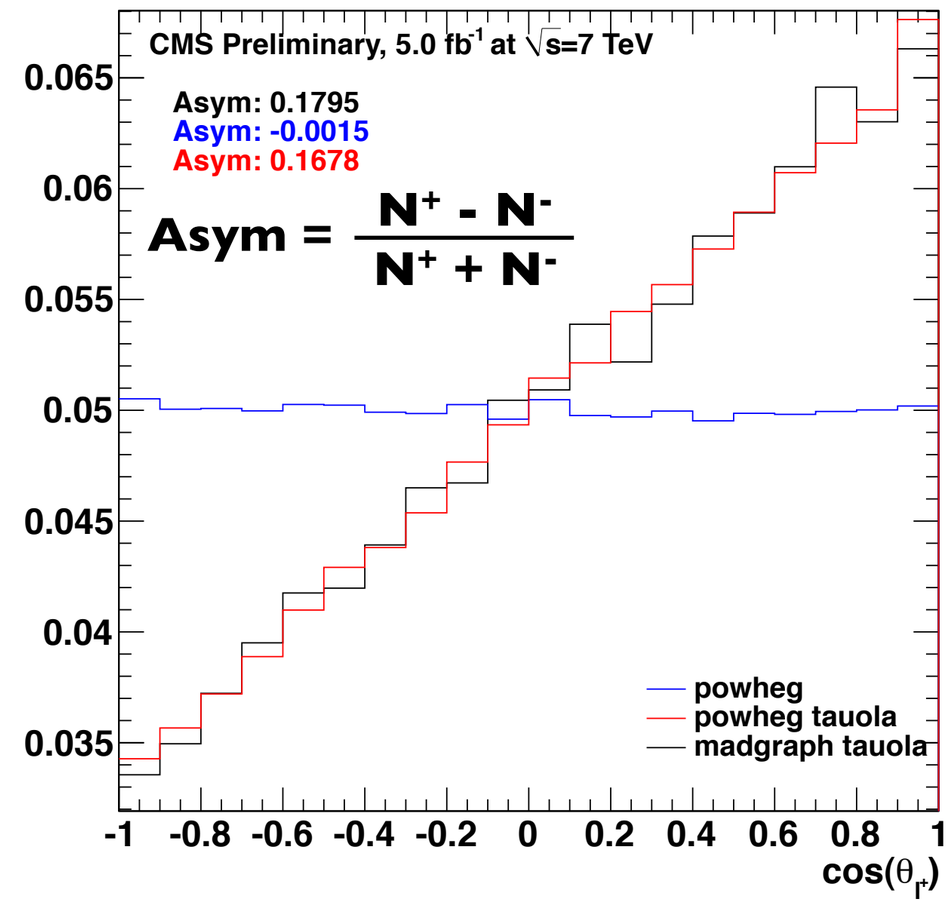
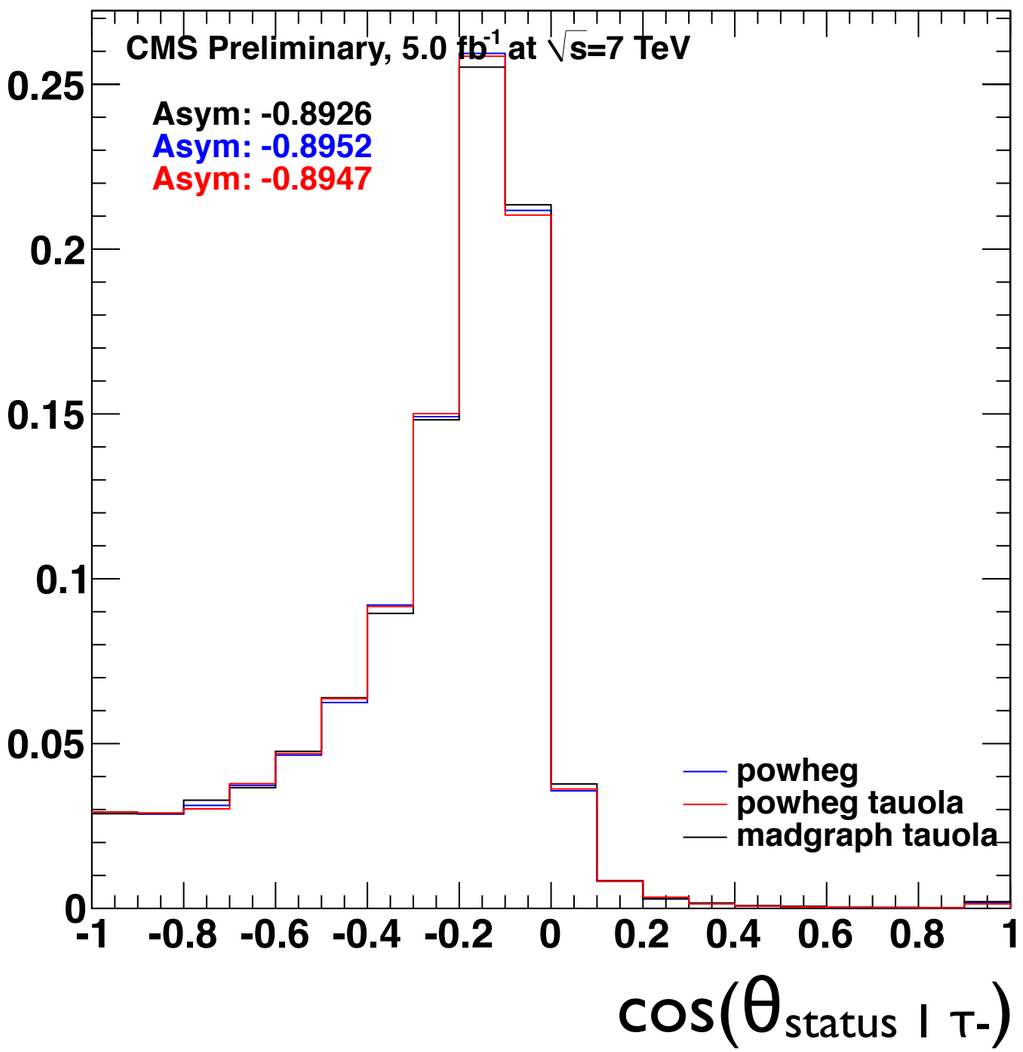
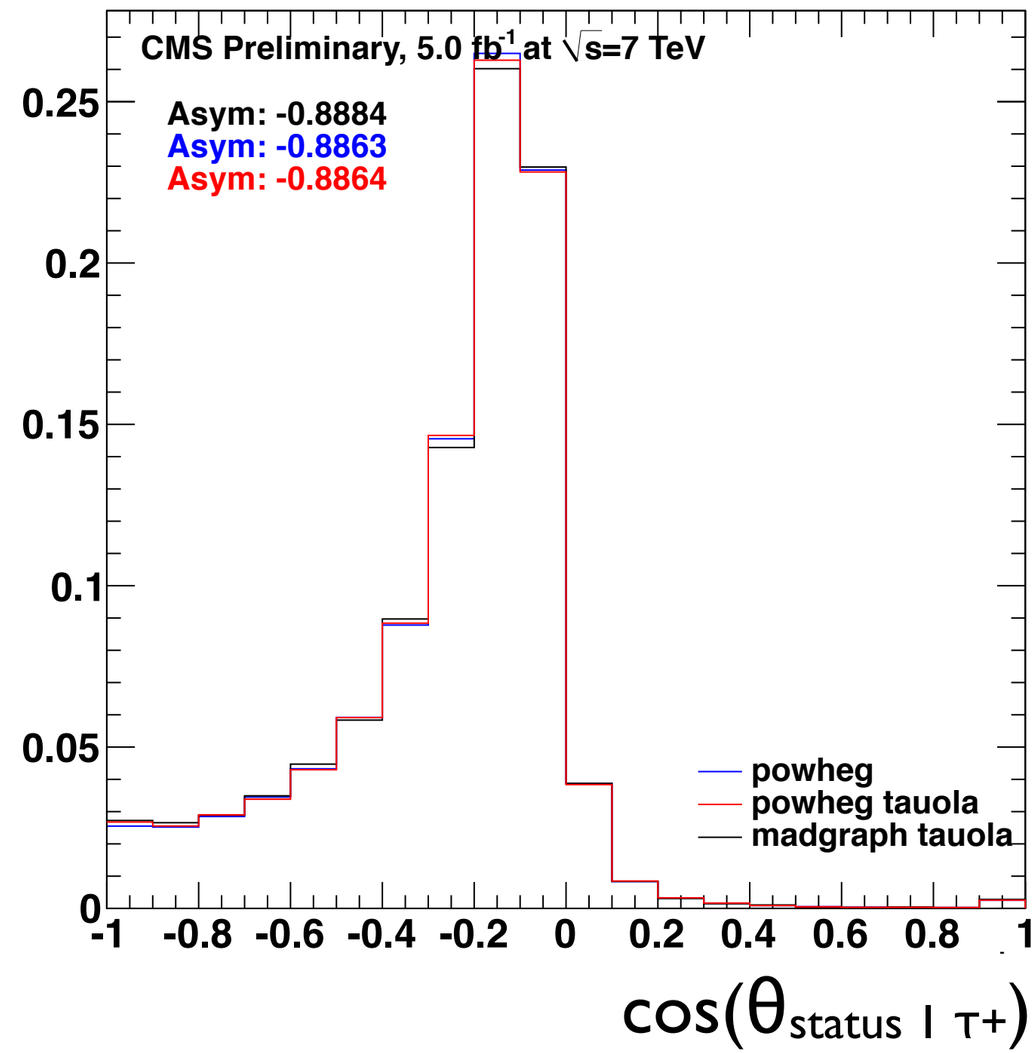
- all taus (anti-taus) from W decay should be left (right) handed, i.e. P ~= -1 (+1)
- we think that tauola uses this information correctly, but the pythia tau decay ignores the tau polarisation
- this can be tested by comparing the angular distributions of the tau decays in 3 ttbar samples (see right)

TTTo2L2Nu2B_7TeV-powheg-pythia6
TT_TuneZ2_7TeV-powheg-tauola
TTJets_TuneZ2_7TeV-madgraph-tauola

- cos(θ) of the status 1 lepton (from tau decay) in the parent's tau CM frame (defined relative to the tau's boost direction).
- this distribution should be flat for isotropic tau decay (pythia), and this is found to be the case (below)
- for correctly modeled tau decay, expect $\frac{d\Gamma(l^{\pm})}{d\Omega dx} = \frac{G^2 m_l^5}{192\pi^4} x^2 \{3(1-x) + \frac{2}{3}\rho(4x-3) + 6\eta \frac{m_e}{m_l}\frac{1-x}{x} \pm \xi P_l \cos\theta[1-x+\frac{2}{3}\delta(4x-3)]\}$
- integrating gives $\frac{d\Gamma}{d\cos\theta} \sim 1 \pm \frac{1}{3} P_\mu \cos\theta.$ This is also seen in the plots below (note, slope = asym*2). $\rho = \delta = \frac{3}{4},\ \xi = 1,\ \text{and}\ \eta = 0.$





- The last time I made these plots I calculated the boost and the angle using the status 3 parent tau.
- This time I reconstructed the parent tau at status 1 from the sum of the 3 daughter particles (charged lepton and 2 neutrinos)
- Using the status 3 tau biases the distribution because the reconstructed status 1 tau tends to be behind the status 3 tau
  - plots below show angle of the reconstructed status 1 tau in the parent status 3 tau CM. Note radiative decays with a photon at status 1 are excluded. Only decays with exactly 3 status 1 daughters (1 charged lepton and 2 neutrinos) are plotted.