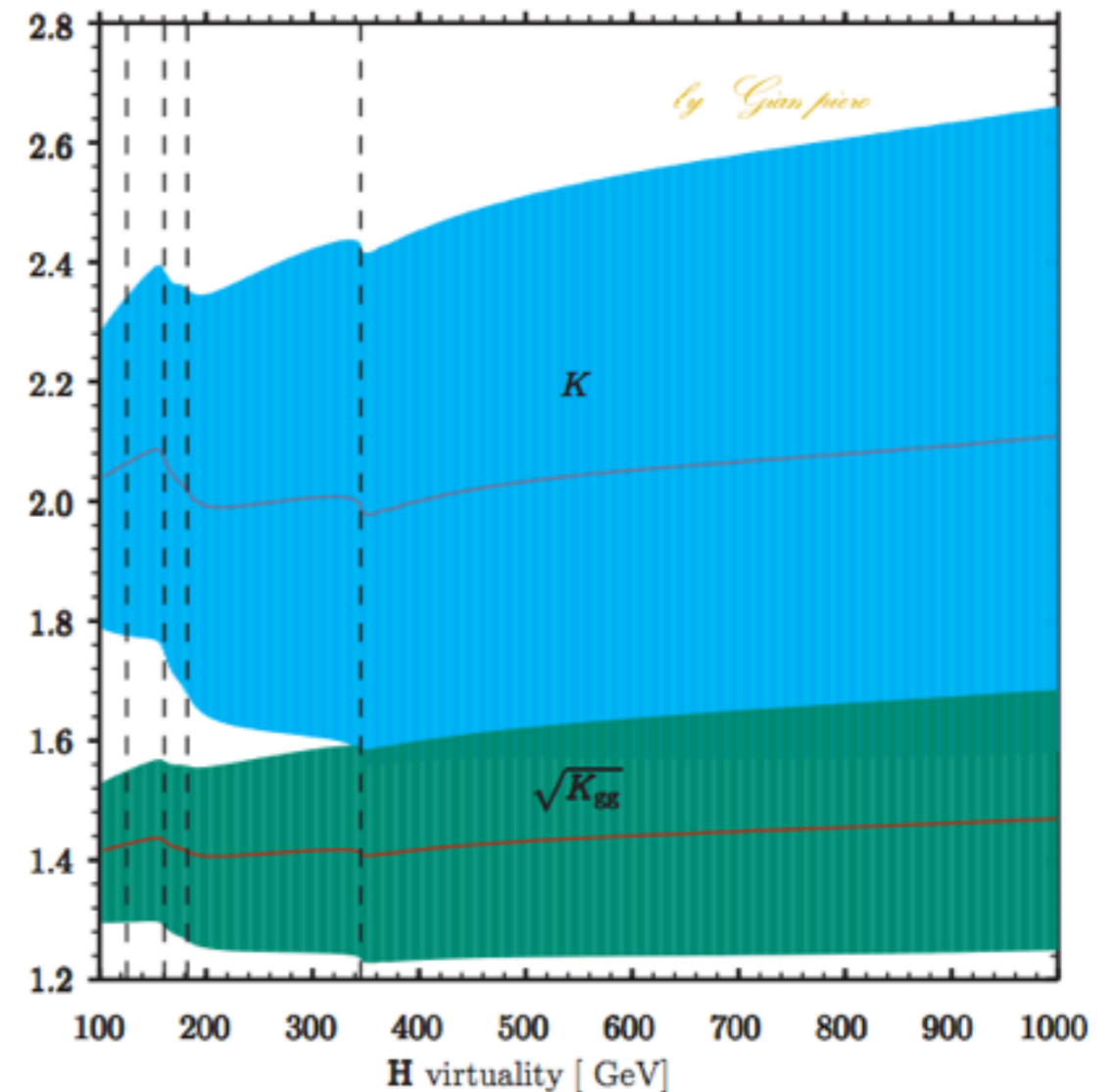


ATLAS Questions on Theoretical Inputs to  
Higgs  $\rightarrow$  ZZ  $\rightarrow$  4l Width Measurements

# Q1: k-factors for $gg \rightarrow ZZ \rightarrow 4l$ Processes

- Key processes
  - $gg \rightarrow H \rightarrow ZZ$
  - $gg \rightarrow ZZ$
  - Interference is fixed from above
- $gg2VV$ /MCFM generate LO events
  - Need to estimate NLO effects and systematic uncertainties
- Passarino calculates k-factors and scale variations for signal and interference
  - Q: are uncertainties between different mass points correlated?
- What about the background?
  - Q: Can we assume the same k-factor as the signal for the background?
    - Since both signal and background are generated with gg processes
    - Shown in WW <http://arxiv.org/pdf/1304.3053v2.pdf>



Giampiero Passarino:  
<http://arxiv.org/pdf/1312.2397v1.pdf>

Figure 7: Differential  $K$ -factors in Higgs production for  $\mu_{H1} = 125.6 \text{ GeV}$ . The central values correspond to  $\mu_R = \mu_F = M_f/2$ , where  $M_f$  is the Higgs virtuality. The bands give the THU simulated by varying QCD scales  $\in [M_f/4, M_f]$

# Q2: $qq \rightarrow ZZ$ Theoretical Uncertainties

- As the main background to the analysis, is there any latest calculations on the QCD uncertainties of the k-factors?
  - As a function of the 4lepton masses
  - Q: Whether it is sufficient to do the usual scale variation procedure (2 and 1/2)

# Q3: Additional Systematics in Kinematic Discriminants?

- If one uses the kinematic discriminants, (such as the matrix element based or qq vs gg discriminant)
  - Q: Is there any additional theoretical systematics?
  - Q: Can we simply propagate the systematic uncertainties on the m4l based k-factors?

# Q4: Same flavour Interferences

- Neither  $gg2VV$  or MCFM considers the 4-lepton same flavour interference
- Effects are almost negligible above the  $2m_Z$  threshold
  - Q: Any approach to estimate the effects and assign relevant uncertainties?
    - With Prophecy4f?
  - Q: Is it safe to ignore the same flavour interference above the threshold?