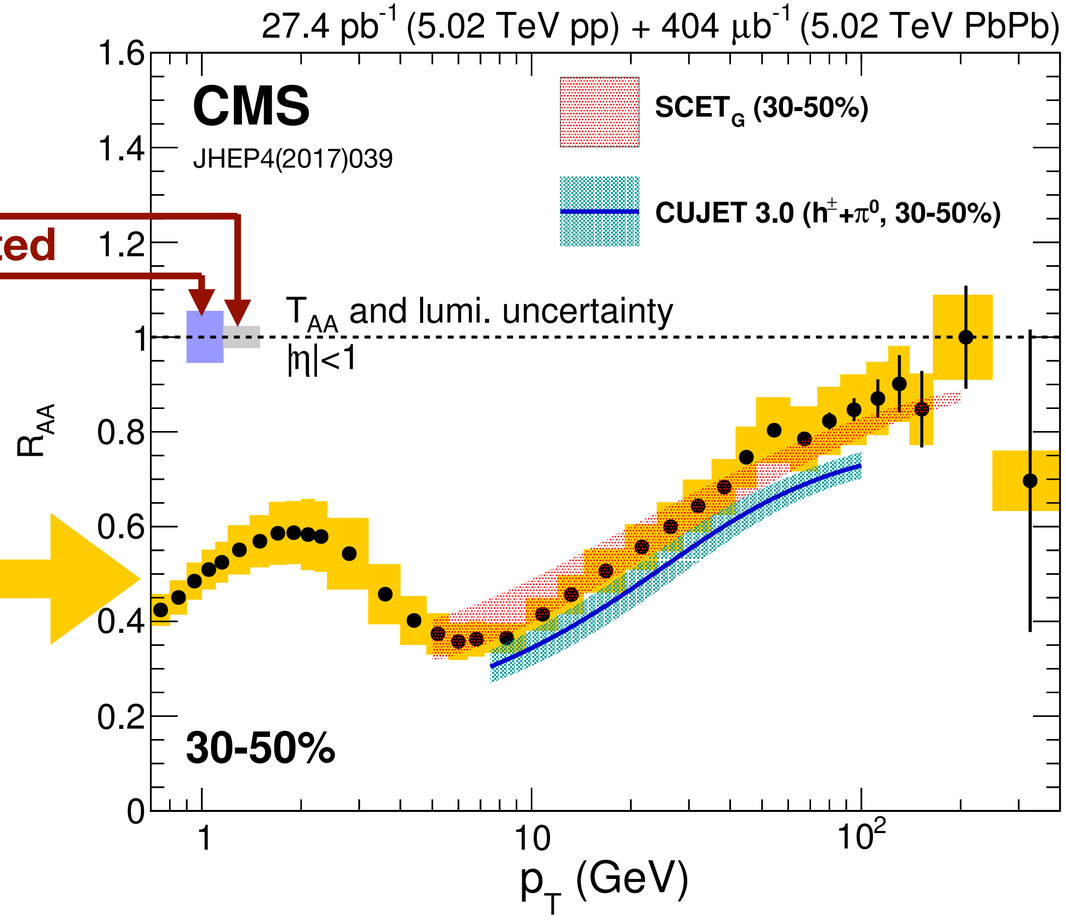
# 3-Types of Experimental Errors (Recap)

- Uncorrelated
  - Source: stochastic processes
  - Point-by-point 1-sigma error bars reported by all experiments
  - Poisson/Gaussian distributions assumed
- Fully Correlated
  - Source: luminosity/normalization corrections
  - Reported as 1-sigma error-box by most HEP/HI experiments
  - Gaussian distributions assumed for small deviations
- Partially Correlated/Anti-correlated
  - Source: detector response, efficiencies, various analysis cuts/corrections
  - Reporting varies, co-variance table preferred
  - Gaussian distributions assumed for small deviations

# Experimental Systematic Error Table Example

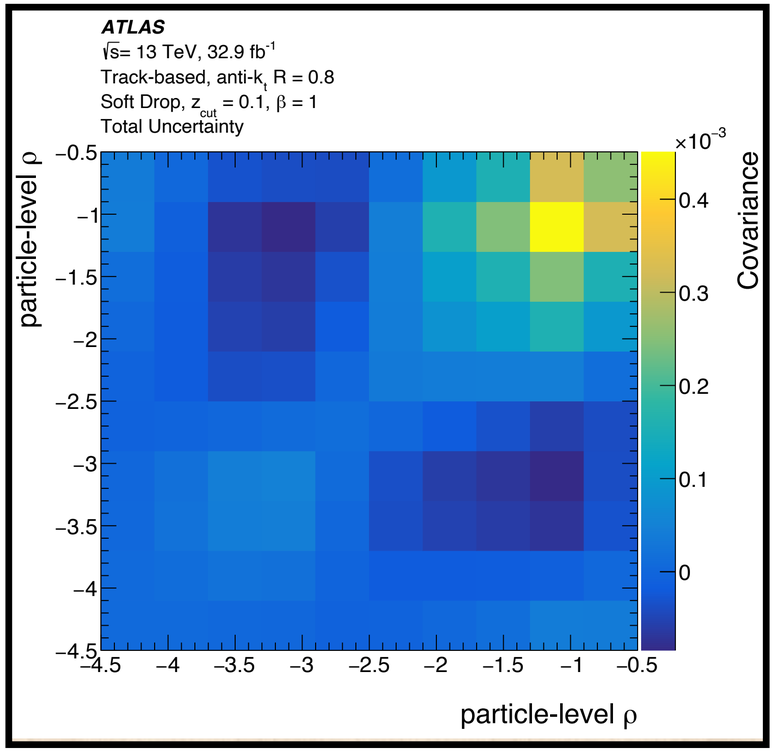
| Systematic uncertainties [%] | | | | | |
|---|---|---|---|---|---|
| Source (**ATLAS** JHEP09(2015)50) | Spectra Pb+Pb | Spectra $pp$ | $R_{CP}$ | $R_{AA}$ | Strongest variation |
| Luminosity | | 3 | | 3 | |
| $\langle T_{AA} \rangle$ | | | | 1.5–13 | centrality |
| $\langle T_{AA} \rangle / \langle T_{AA}^{60-80\%} \rangle$ | | | 3.8–12 | | centrality |
| Jet trigger efficiency | 1 | 3 | 1 | 3 | $p_T$ |
| Track selection | 10 | 4 | 10 | 10 | $p_T$ |
| Fake and secondary tracks | 5 | 0.5 | 5 | 5 | $p_T$, centrality |
| Matching gen — rec | 20 | 15 | 15 | 13 | $p_T$ |
| Unfolding | 8 | 2 | 4 | 2 | $p_T$ |
| $p_T$ resolution | 20 | 7 | 14 | 12 | $p_T$ |
| Efficiency correction | 5 | 1 | 4 | 4 | $p_T$, $\eta$ |
| Detector material | 2–6 | 2–6 | | | $\eta$ |

**fully correlated**




- Correlated (systematic) errors are often combined without considering
- **We need to know the separate sources and ranges/correlations of these errors**

# Error Covariances examples from high and low energy




ATLAS Total Covariance
(shown by Yi last meeting)

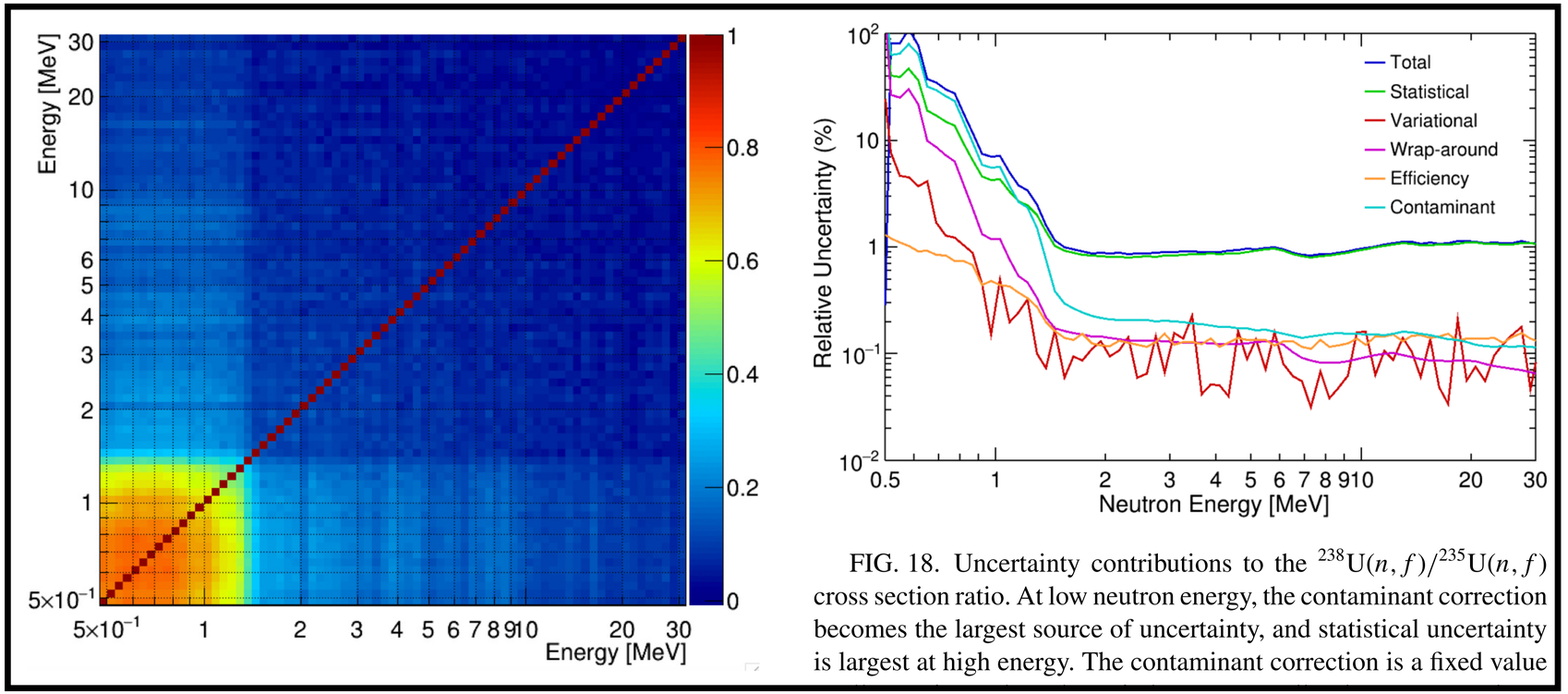
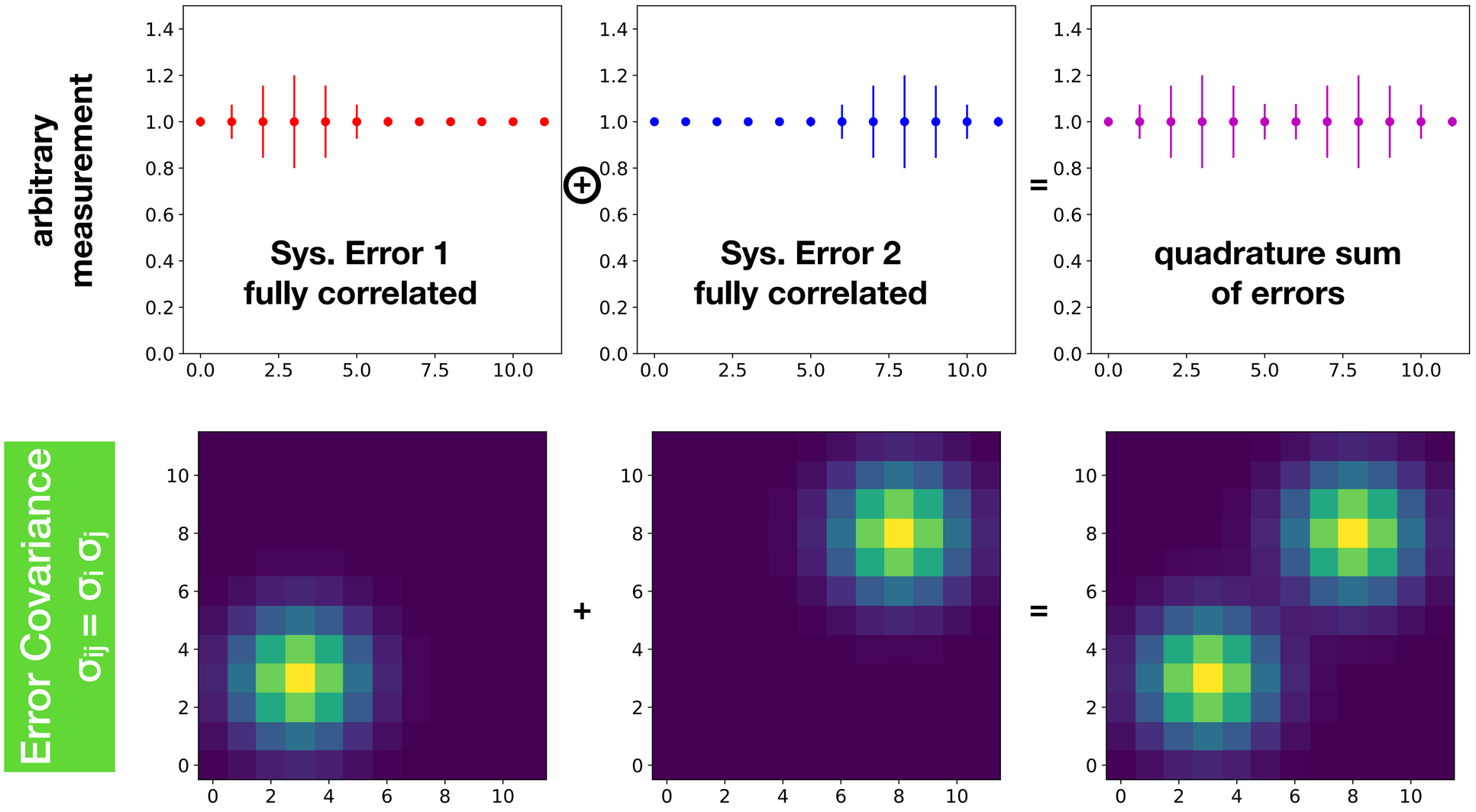



FIG. 18. Uncertainty contributions to the $^{238}\mathrm{U}(n,f)/^{235}\mathrm{U}(n,f)$ cross section ratio. At low neutron energy, the contaminant correction becomes the largest source of uncertainty, and statistical uncertainty is largest at high energy. The contaminant correction is a fixed value

Error Covariances for neutron induced fission ratio measured by NIFFTE Collaboration
https://doi.org/10.1103/PhysRevC.97.034618

# A Tale of Two Systematic Errors



# A Tale of Two Systematic Errors