Photon Energy Calibration Systematics

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Model Comparison

Two correlation models of systematics are proposed :

- FULL model decorrelate all NP.
- ALL model sum in quadrature respectively all systematic sources into respectively a single nuisance parameter for scale and resolution.
- The fit with $m_{\gamma\gamma} \in [115, 135]$GeV is used as closest to the signal model tool default behaviour.
- Major (surprising?) difference for scale uncertainty

Total Inclusive Uncertainty :

%	Scale	Resolution
FULL	0.27	8.26
ALL	0.46	9.02

Exact uncertainty

(Thanks Guillaume for explanation)

- Consider N_{NP} NP with constant values N_B bins (in η, p_T, conversion status).
- The covariance matrix V is then defined as :

$$V_{ij} = \sum_{n}^{N_{NP}} \sigma_{n,i}\sigma_{n,j} \tag{1}$$

- The total inclusive uncertainty on measured mass is then,

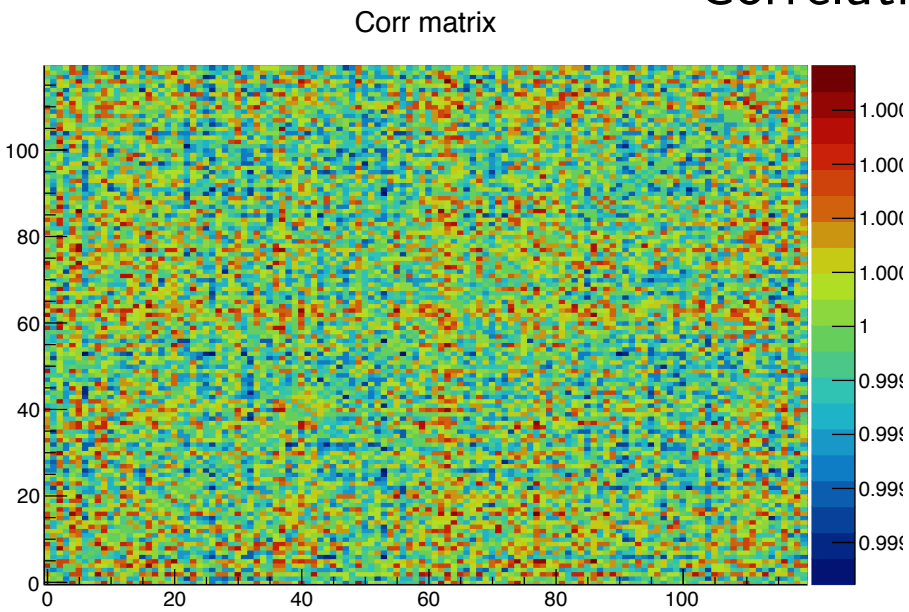
$$\frac{\sigma_M}{M} = \frac{1}{N_\gamma}\sqrt{\sum_{ij}^{N_B} N_i N_j V_{ij}} \tag{2}$$

N_i = number of photons in bin i,

Models total mass uncertainty

(Thanks Guillaume for cross-check)

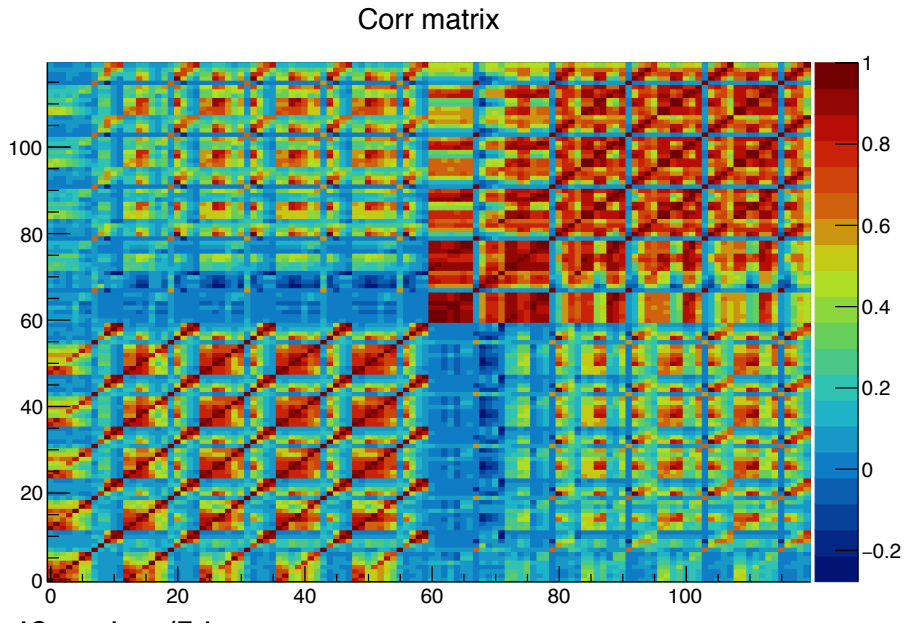
ALL



$$\frac{\sigma_M}{M} = 0.47\%$$

FULL

Correlation matrix



$$\frac{\sigma_M}{M} = 0.26\%$$

Cross-checks validate values obtained by mass fitting.

Category comparison

The previous inclusive results are compared to asimov with 13 categories.

Total Scale Uncertainty :

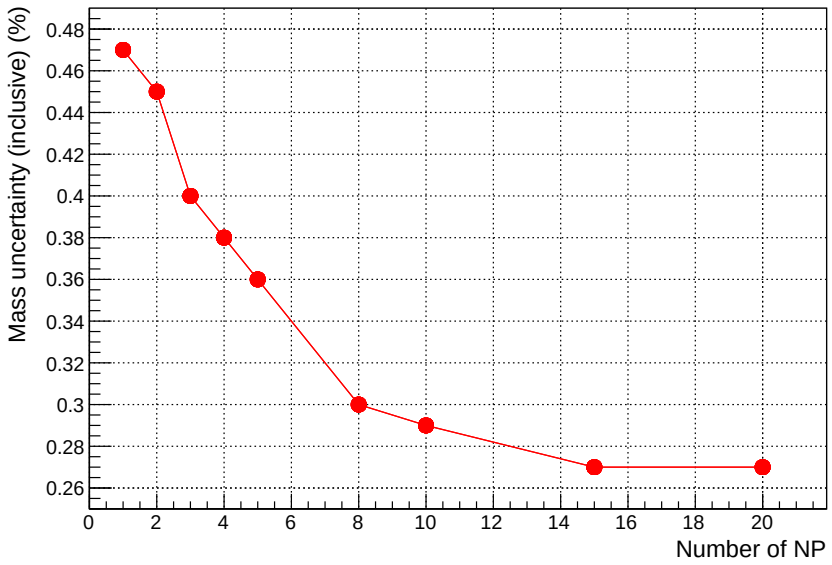
%	ALL	FULL	ratio
Mass fit (inclusive)	0.46	0.27	41
Formula (inclusive)	0.47	0.26	45
Asimov (categorized)	0.42	0.28	67

Bad calibration categories have a higher contribution to the resolution.

Diagonalization

A solution to reduce number of nuisance parameters is the diagonalization method.

- Diagonalize covariance matrix
- Select N highest eigen values
- Merge the rest in a single NP
- **10-15 parameters could be necesarry**



Conclusion

- Differences in mass uncertainty between correlation models understood as theory expected.

Ongoing :

- Resolution difference between ALL and FULL using h014.
- Asymmetry in resolution
- Official values for Moriond.