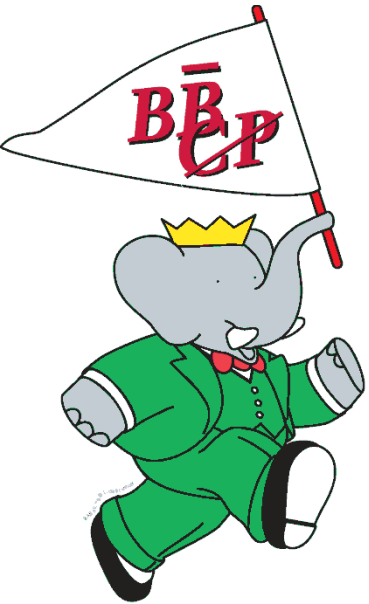
Science & Technology Facilities Council
Rutherford Appleton Laboratory

RooUnfold developments



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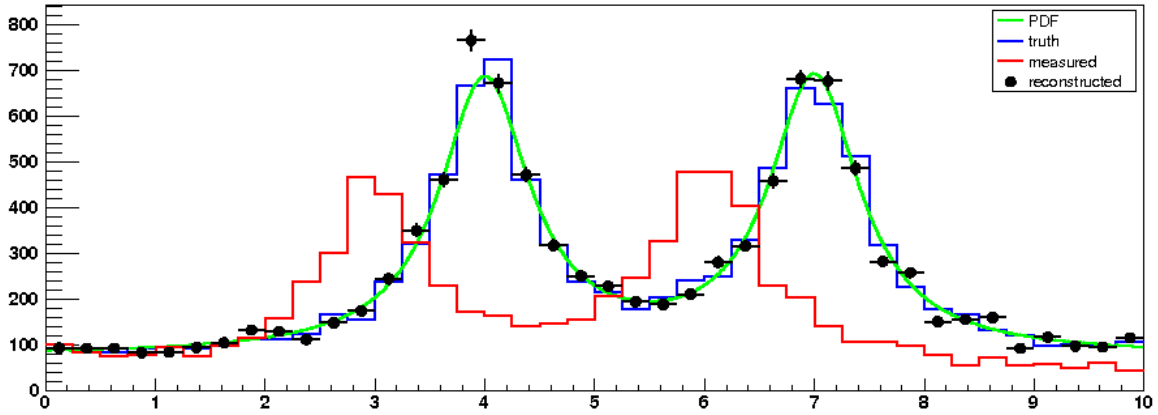
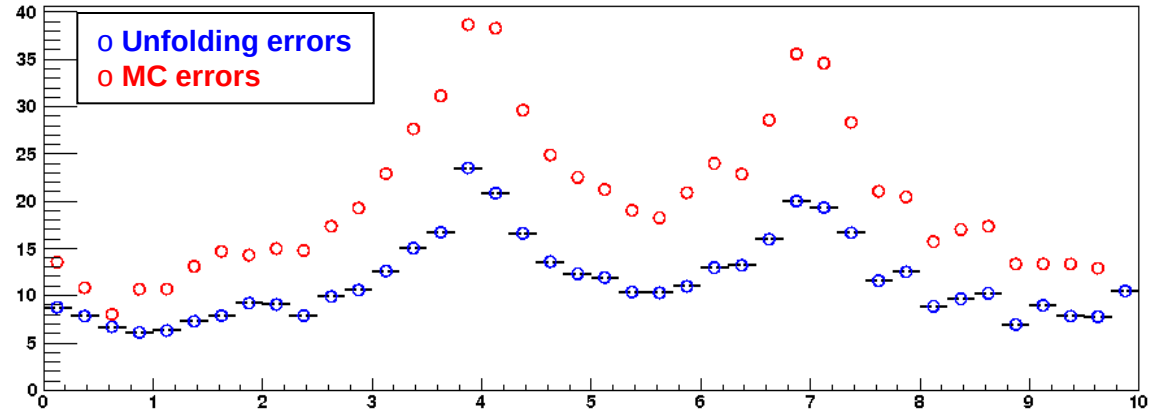
Unfolding Framework
Project Meeting
15th September 2010

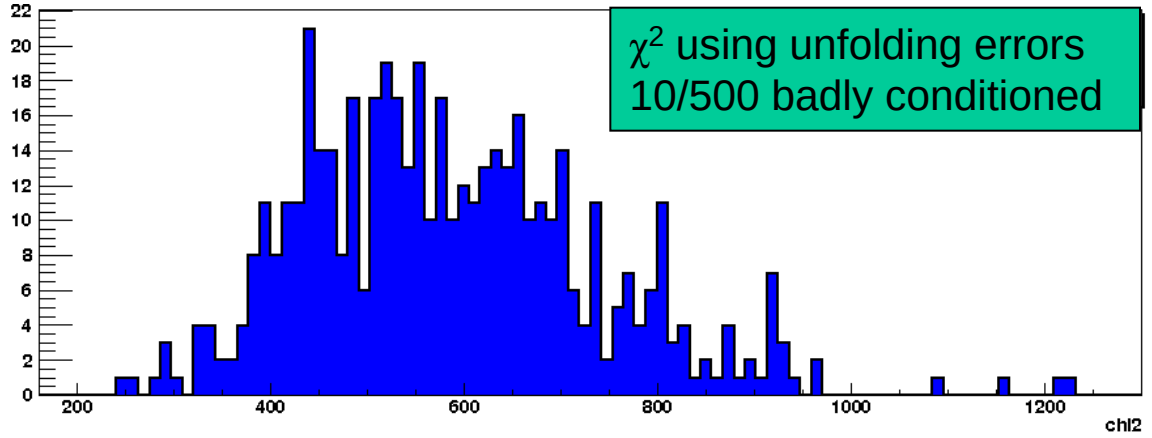
RooUnfold version 1.0.2 improvements

- A simple (though not yet fully-featured) interface to TUnfold
  - Handles 0-, 1-, 2-order polynomial regularisation for 2D and 3D distributions
- Unregularised matrix inversion method (eg. for comparison)
- Unfolding errors for all algorithms can be calculated using MC toys: can switch between
  - bin-by-bin errors (fastest),
  - full covariance matrix from the propagation of errors in the unfolding, or
  - covariance matrix from MC toys (slow)
- Regularisation parameter and errors test procedures
- An option to include the histogram underflow and overflow bins in the unfolding
  - Currently just for 1D histograms
- New convenience methods
  - generic constructors (`New(alg)`, `Clone()`)
  - χ^2 calculation
  - vector accessors
- Class documentation

Error analysis for Bayesian algorithm

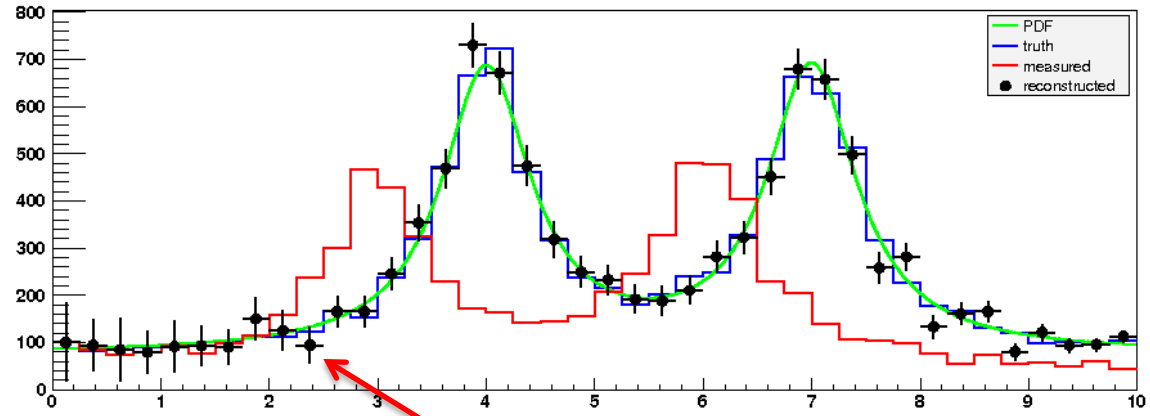


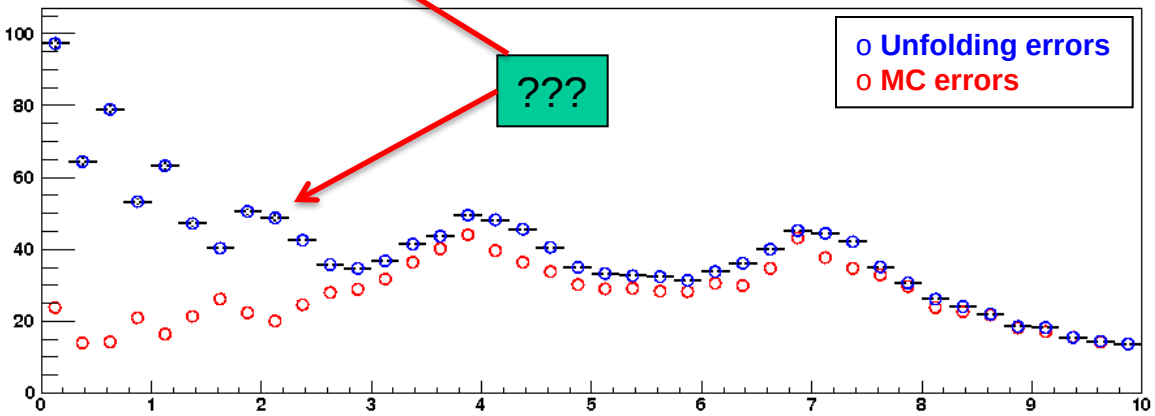


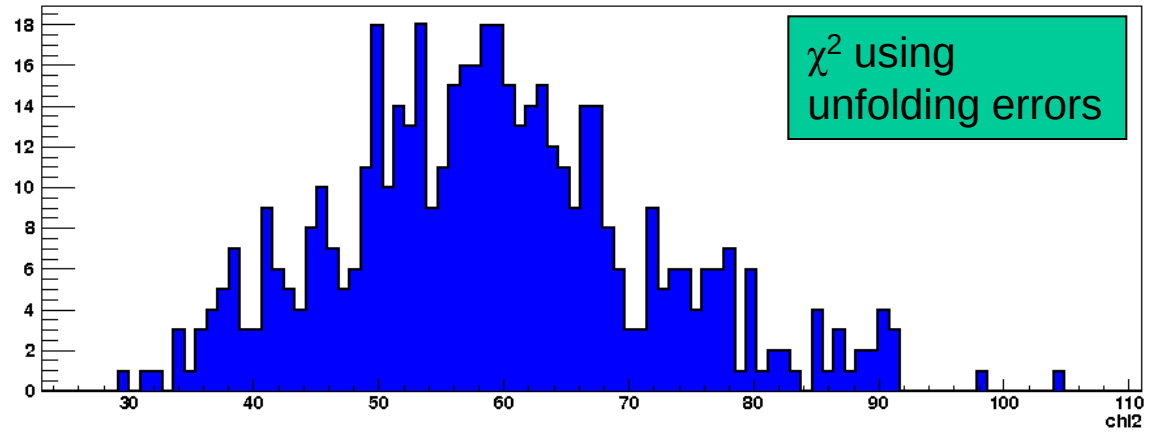


Error propagation in SVD method would be even worse – if we hadn't used the MC errors all along

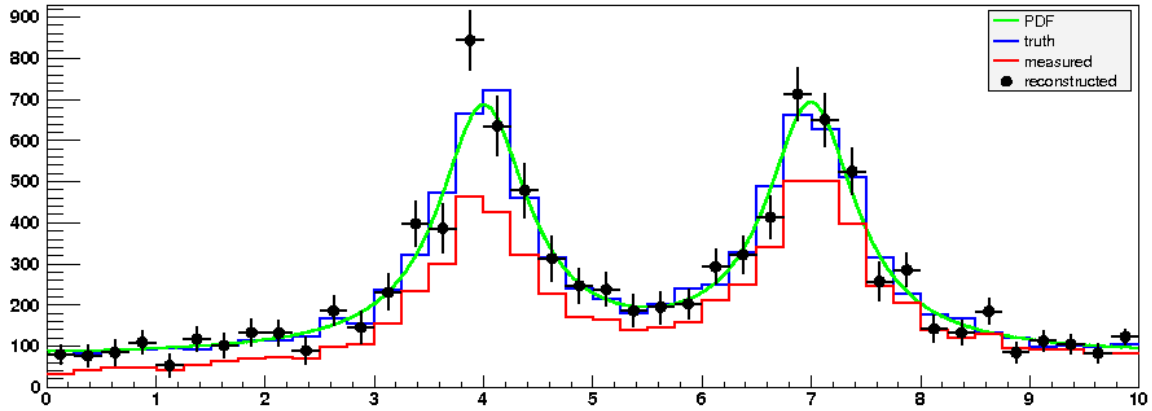
TUnfold

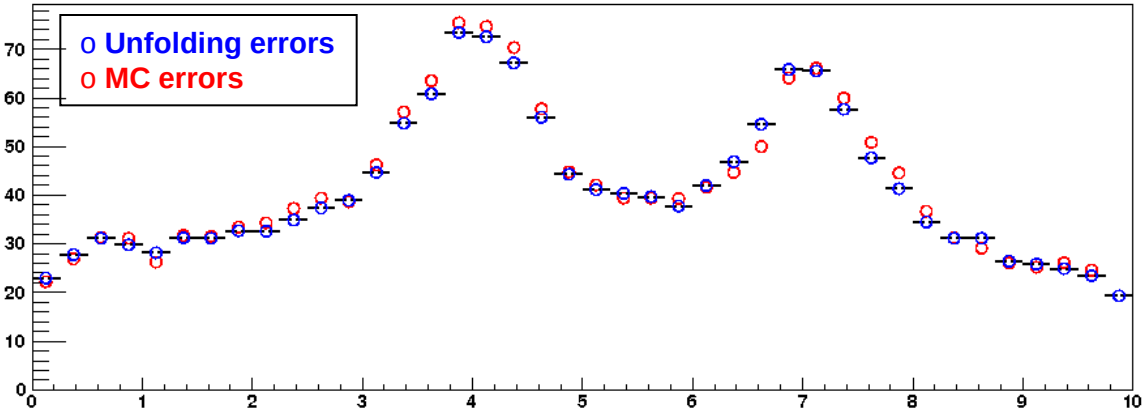

PDF
truth
measured
reconstructed

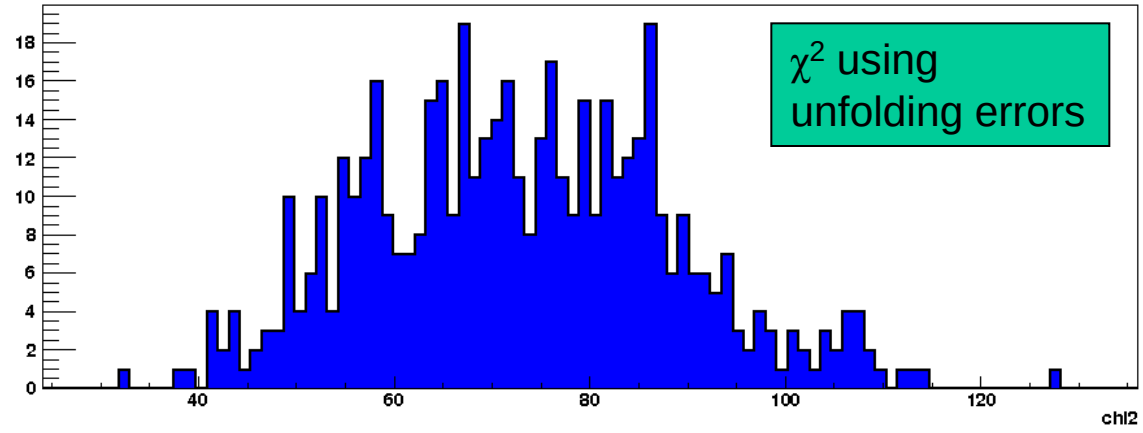

Unfolding errors
MC errors
???


χ^2 using unfolding errors
chi2

Unregularised matrix inversion







Does not work with large bin migrations, so here we test with no systematic bias

χ^2

- Covariance matrix is often nearly singular or poorly conditioned
  - Is there a better way to calculate χ^2?
  - SVD helps, but still gives occasional problems (crazy χ^2)

- In any case, χ^2 is not a good figure of merit when testing unfolding
  - can improve χ^2 by relaxing regularisation → smaller errors, but larger residuals

  but still useful to show, since its meaning is well-known

- What is a better objective figure of merit?