

# Handling Systematic Errors

# Basics

- ◆ Define as errors in modeling of instrument
- ◆ Discuss how to handle *systematic* errors, not how to generate them
  - ◆ Generating real *systematic* errors is very difficult
  - ◆ Most are merely estimated
- ◆ Cal scientists asked to quantify *systematic* errors but quotes may be too simplistic
- ◆ Admonish users to avoid `xspec syserr`

# Systematic Error Effects

- ◆ parameters can depend on systematic errors in nontrivial ways
- ◆ avoid two types of problems
  - ◆ A: claims of new physics that actually result from known cal errors
  - ◆ B: features may be ignored because they are erroneously assumed to be due to poor calibration

# Delineate Cases: Triage?

- ◆ Simplest: statistical errors dominate → ignore systematic errors
- ◆ Easy cases: e.g. line fluxes, ratios, energies
- ◆ Hardest cases: contact PI or project team
  - ◆ consider collaborations
  - ◆ e.g.: separating instrumental & source edges
- ◆ In between: need something more for users

# Options for Users

- ◆ Avoid xspec syserr: errors are correlated
- ◆ Simulate full detector (e.g. GEANT) ? No.
  - ◆ detector physics is poor
  - ◆ instrument parameters inaccurate
- ◆ Fake it to get lower limits to errors
  - ◆ fit model to observed data
  - ◆ use model to generate random data
  - ◆ fit fake data and estimate parameter errors
  - ◆ errors are statistical contribution to true errors
  - ◆ can still make A & B errors

# Options for Users (cont.)

- ◆ Generate many response functions (RFs) (see Drake et al. 2005, Chandra Cal W/S)
  - ◆ new functions are consistent within syst. errors
  - ◆ fit data; param distribution from syst. errors
  - ◆ problem: physically unreasonable RFs
  - ◆ cal scientists should test method
- ◆ Allow users to adjust RFs within syst. errors
  - ◆ problem: consistency of adjustments (As)
  - ◆ problem: As can mask or fake new physics
  - ◆ user As should be posted or sent to cal group
  - ◆ if similar RF As found, cal fixes RFs

# Other

- ◆ Consider software errors
  - ◆ post results from standard reductions
  - ◆ admonish users to avoid `xspec syserr`
- ◆ include errors in background model
  - ◆ cal provides particle flux predictions
  - ◆ cal provides spatial, spectral dependencies
- ◆ Missions should include "watch-out" or caveats web pages

# Actions

- ◆ Cal scientists should
  - ◆ admonish users to avoid `xspec syserr`
  - ◆ try Drake et al. method
  - ◆ publish algorithm for calc'ing statistical errors
  - ◆ obtain/post user's adjustments and feedback
- ◆ Missions should
  - ◆ include "watch-out" or caveats web pages
  - ◆ post results from standard reductions
  - ◆ provide background models, usage details
  - ◆ give examples of simple handling of `syst.` errors

