## Error information in ctools/gammalib

Alexander Ziegler ctools coding sprint IRAP, October 2016



## Confidence regions/ covariance matrix information

- analysis: fitting of a model $\rightarrow$ ctlike

| $\stackrel{\downarrow}{ }$ |  |
| :--- | :--- |
| - ctlike.log | $\leftarrow$ curvature matrix (not helpful) |
| - model-xml file | $\leftarrow$ error information |

- no direct access to covariance matrix
- no access to error ellipses/conf. regions
$\rightarrow$ no handle on correlation of parameters and related uncertainties

This is important information which should be provided

What to provide, how to provide?

- covariance matrix, e.g. fits file, structured information (flag)
- likelihood profiles $\rightarrow$ which parameters? output format?
$\rightarrow$ very much related to cterror I think...


## Integral flux/eflux \& error handling

- GModelSpectral.hpp

```
// Pure virtual methods
virtual void clear(void) = 0;
virtual GModelSpectral* clone(void) const = 0;
virtual std::string classname(void) const = 0;
virtual std::string type(void) const = 0;
virtual double eval(const GEnergy& srcEng,
    const GTime& srcTime = GTime()) const = 0;
virtual double eval_gradients(const GEnergy& srcEng,
virtual double 
virtual double eflux(const GEnergy& emin,
    const GEnergy& emax) const = 0;
virtual GEnergy mc(const GEnergy& emin, const GEnergy& emax,
virtual void read(const GXmlElement& xml) = 0;
virtual void write(GXmlElement& xml) const = 0;
virtual std::string print(const GChatter& chatter = NORMAL) const = 0;
```

- methods for flux/eflux calculation in the base class fitted models: parameter errors need to be taken into account
$\rightarrow$ no handle on uncertainties for flux/eflux at the moment?


## ctbutterfly - confidence bands for spectrum plots

## Purpose

- calculate confidence band around best fit model, according to a specified confidence level (e.g. 68\%)


## Status

- only working for pure power law
- from covariance matrix calculate error ellipse
- for discrete energy values 'walk around the ellipse'
$\rightarrow$ take min/max (envelopes)

$\rightarrow$ this needs some kind of generalization to get confidence bands for arbitrary spectral models


## Conclusion

- lack of the addressed information/ features became obvious during daily work = standard usage
$\rightarrow$ really needed to get a reasonable overview of analysis results
- additional topic (I was asked about that):
is somewhere a detailed documentation available how to built a template map for analysis (format specifications, keywords, normalization...)?

