Contribution ID: **11** Type: **Talk**

GammaLib and ctools: A Framework for the Analysis of Astronomical Gamma-ray Datasets

Wednesday, 20 March 2019 14:30 (45 minutes)

ctools is an open source data analysis package targeted towards the upcoming Cherenkov Telescope Array. The tools employ both a three-dimensional likelihood analysis similar to that used in the Fermi Science Tools, and a standard On/Off analysis typical of current generation atmospheric Cherenkov telescopes. Built on top of the GammaLib software, *ctools* is designed to be easily adapted for use with data from past, present, and future high energy photon-counting detectors. Already, the tools have been applied to H.E.S.S., Fermi-LAT, and COMPTEL data as well as simulated CTA observations. Data from multiple instruments can also be fit simultaneously, an important feature for understanding astrophysical processes across a broad energy range. In terms of the software, GammaLib exists primarily in C++ to optimize computation speed. Python wrappers are used to provide a user-friendly interface to the GammaLib classes. *ctools* consists of both Python modules and C++ classes that can be accessed via Python wrappers. At a higher level, the individual tools are also designed to be run directly from the command-line. This modular aspect of ctools means it can adapt to suit a range of different analyses workflows. This contribution will focus on the design and development principles behind the *ctools* and GammaLib software. A demonstration of the capabilities of ctools will also be presented using test data recently released by the H.E.S.S. collaboration.

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Session Classification: Wednesday