

First CTA Data Challenge (1DC)

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Outline



- Goals of the 1DC
- Extragalactic sky for the 1DC
 - EGAL Survey
 - AGN monitoring
- Simulations details
- Details of 1DC
- Retrieve data
- Additional Informations

Goals of DC1



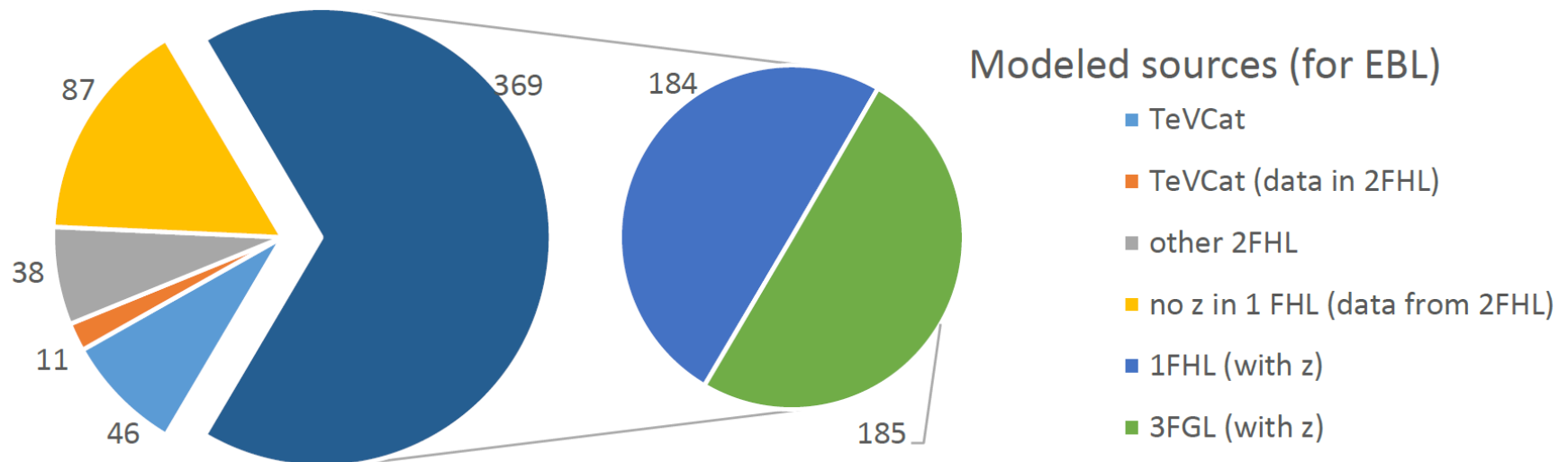
- Familiarise collaboration with data content, formats, tools and details of analysis issues (both instrumental and astrophysical).
 - Grow the science analysis team
 - Provide feedback to the Use cases and to the DATA WP on what works and what is missing from the data formats and tools.
- “End-to-end” testing of analysis software.

Combined effort by ASWG, PHYS and many others

- Physics sky model (provided by science WG)
- Simulation and analysis tools (ctools, gammapy, ...)
- IRFs (provided by ASWG)
- Data-related things (data format, ...)



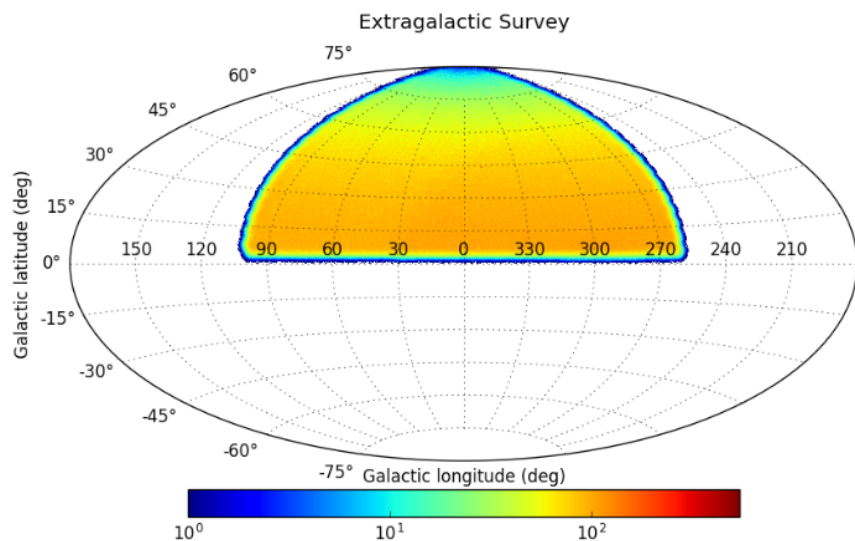
We created the **extragalactic sky model**, taking data from different catalogues (TeVCat, 1FHL, 2FHL, 3FGL): XML model created with Python script with *gammalib*.



Selection criteria:

- Sources with data at VHE (data in TeVCat and 2FHL)
 - taken from the catalog (EBL is already included)
 - 1FHL and 3FGL: Spectra absorbed according to **Franceschini** Model of the EBL
 - thanks to Carlo and Tristano
 - 3FGL sources selected by Filippo
- ...35 of these sources are variable: data taken from Fermi Light Curves Catalog.

Figure 1 shows a map of the TeV sky with 15 Fermi-LAT sources marked by white circles. The sources are labeled with their names: TeV J1428+4240, TeV J1427+2347, 1FHL J1204.4-0708, TeV J1103-2329, 1FHL J1256.4-1146, TeV J1728+5013, TeV J1653+3945, 2FHL J1838.9+4802, 2FHL J1119.3-0205, TeV J1555+1111, TeV J1512-0906, 2FHL J1725.1+1154, 1FHL J1548.8-2701, TeV J1517-2422, 1FHL J1444.0-3908, 2FHL J1714.0-0553, and 2FHL J1745.4-0752. The map is a grayscale image of the sky with a color bar on the right indicating intensity from 0 to 1.



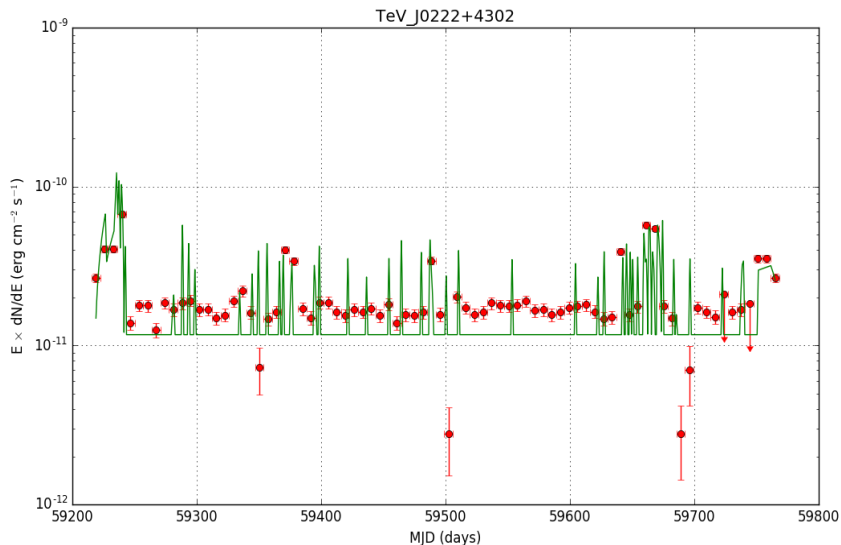
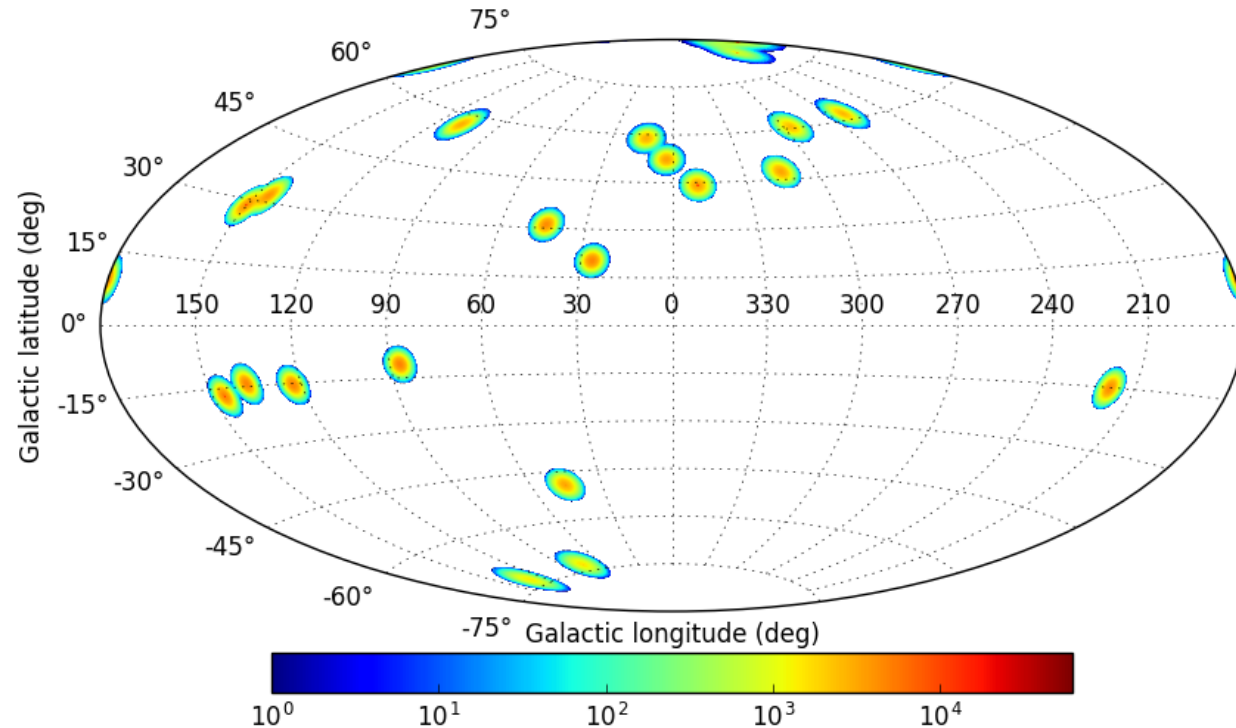
AGN monitoring

From: https://forge.in2p3.fr/projects/data-challenge-1-dc-1/wiki/AGN_monitoring

Each source is observed for half an hour for 80 weeks.

NOTE: only simulated for CTA North.

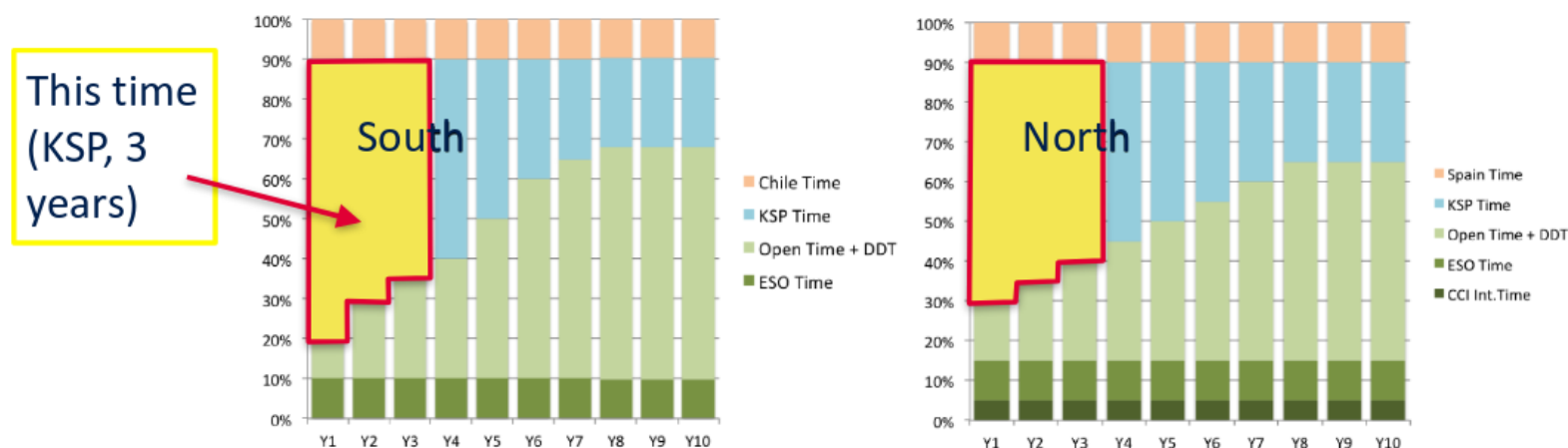
AGN monitoring program



DC1 simulations



- Simulate **three** years of data **north and south** with observation time that could match the original KSP-allocated time (2050 hours in the south, 1800 hours in the north).
- Focus on the following surveys: Galactic plane survey (GPS), Galactic centre survey (GC) and extragalactic survey (EGal). In addition add AGN monitoring:
 - GPS: total 1620 hours (1020 South, 600 North)
 - Extragalactic survey: total 500 hours (200 South, 300 North)
 - GC survey: total 825 hours (South)
 - AGN monitoring: 960 hours (North)



From S. Funk @ Heidelberg Phys Meeting September 2017

Wiki of the DC1:

- <https://forge.in2p3.fr/projects/data-challenge-1-dc-1/wiki>

Complete description of the models:

- <https://forge.in2p3.fr/projects/description-of-physics-models/wiki/>

Getting the data:

- https://forge.in2p3.fr/projects/data-challenge-1-dc-1/wiki/Getting_data

NOTE: There is also an older `agn.tar.gz`, please don't use that one, or update to **agn.wobble.tar.gz** if you have the old one.

Data organization:

- <https://forge.in2p3.fr/projects/data-challenge-1-dc-1/wiki>

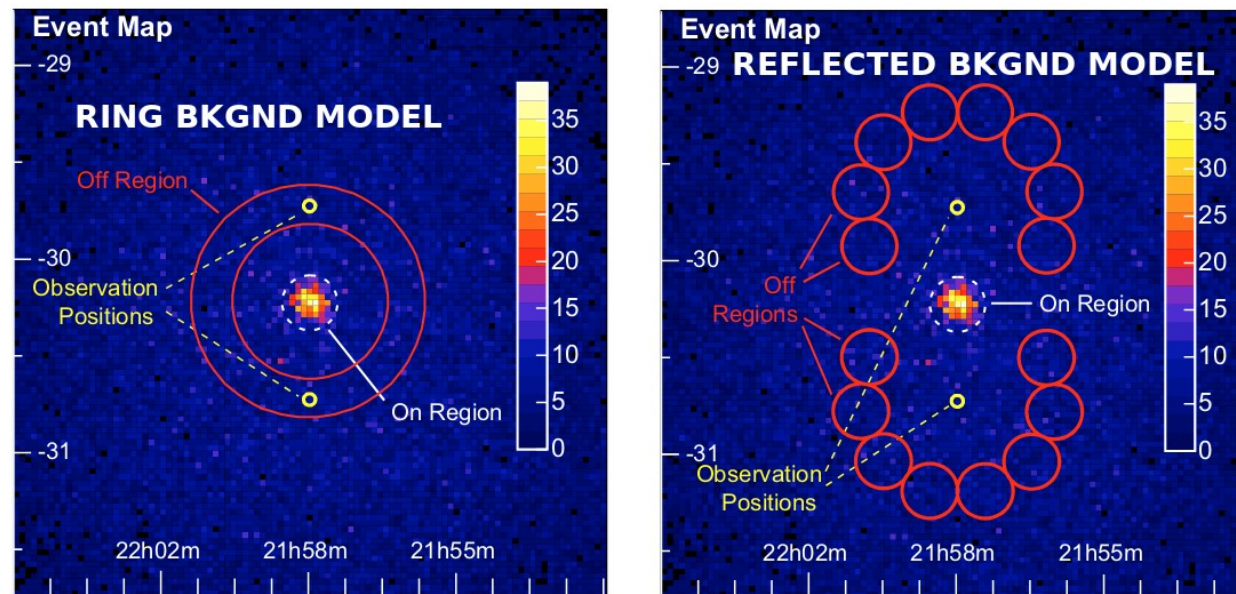
Some updates:

- Dark Matter data were re-simulated at request of DM group produced alternative GCS data with increased value for the DM cross-section of $1e-25 \text{ cm}^3/\text{s}$
- AGN data were resimulated in “wobble mode”, with a 0.5° offset from.

AGN DC1 re-simulated with 0.5° offset

Ctools: → usually Fermi-like (likelihood fitting the background as a source)
→ From 1.5.0 (28/1/2018) also standard IACT
- ON/OFF analysis included in many ctools

Gammapy: `$GAMMAPY_EXTRA/notebooks/cta_data_analysis.ipynb`



From: Berge, Funk, Hinton, “Background modelling in very-high-energy γ -ray astronomy”, A&A 466, 1219

From \$CTADATA you should be able to find:

- spectral models (file function with flux specified at different energies)
 - models/spectra_1FHL_*.out
 - models/spectra_3FGL_*.out
- temporal models (variable sources)
 - models/lightcrv_*.fits
- Cumulative xml model:
 - models/model_agn.xml

Inspected with **Gammalib library** (via Python): if you use ctools, have a look also at the gammalib documentation. You may find some very useful functions.

These are the files given in input for the simulation, so if you have doubts, you can cross-check your results with the input data given to the simulation.

The **simulated data** are in:

- data/baseline/agn/agn_baseline*.fits → for the AGN monitoring
- data/baseline/egal/egal_baseline*.fits → for the EGAL survey

Summary



- Follow the DC1 calls (one every two weeks)
- There has been many analyses...keep going!
- Tutorials both in ctools and gammapy for 1DC analysis
 - ctools: <http://cta.irap.omp.eu/ctools/users/tutorials/1dc/index.html>
 - gammapy: Jupyter notebook in
\$GAMMAPY_EXTRA/notebooks/cta_1dc_introduction.ipynb

