LST (DL1) data quality monitor

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LST1 DL1 data check

- It is run as part of the R0 → DL1 stage of lstchain

- It is mostly based on the DL1 (A and B) output, but also on a dedicated analysis of good muon ring candidates (using GlobalPeakWindowSum integration)

  – this means we cannot simply run it *after* producing the DL1, it is currently *integrated* in lstchain's DL1 stage

- Note on LST-1 data:

  – a "run" is the equivalent of a CTA observation block. It lasts typically 20 minutes

  – a "subrun" is a group of 53000 events which typically corresponds to about 9 seconds of observation

- A datacheck .h5 file is produced for each subrun. Then they are merged in a single file for the whole run. From these, a summary file for the whole night (also .h5), containing less information, is produced.

Datacheck file sizes

- The run-wise .h5 files still contain the subrun-wise information, in tables with one row per subrun
  - there is one table per event type (cosmic, pedestal, flatfield)

- After the merging: ~120 KB per subrun
  - ~72 GB for 1500 h of observation (~1 year)
  - contains also pixel-wise info (averages per subrun)
  - subruns should be replaced by "time bins" in DPPS

- **night**-wise h5 files: ~30 times smaller (2.4 GB / 1500 h)
  - only contain **run**-averages, but still including pixel-wise info

Graphical outputs

- From each run-wise h5 file we produce a pdf file containing many different plots (see file datacheck_dl1_LST-1.Run13629.pdf)
    - This was the first output we tried, it is not very user-friendly, and rarely used now.

- From each night-wise h5 file we produce an **interactive html** file (15 - 20 MB) which can be quickly scanned to search for issues

    - Only contains run averages – if checks are needed at a smaller time scale we just access the run-wise .h5 files (see example explore_dl1_run_check.ipynb)

    - html is still quite incomplete: more focused as of now on "DL1a checks", no plots yet of image parameters (just COG distributions)

    - Note: code for the bokeh camera display "borrowed" from ctapipe long – to be fixed! Added several useful features, e.g. pixel info when hovering mouse over camera displays, or sliders to select different runs in a given plot

Text output

- See example file DL1_datacheck_20201120.log

- Contains warnings about quantities which are beyond some pre-defined limits

- The main problem is how to define the limits considering the very varying observation conditions (NSB, pointing)… WIP!

  - For example, to compute some averaged pixel-wise quantities we exclude subruns in which a pixel had a nearby bright star (closer than 0.25 deg). This avoids that we flag a pixel as "noisy" just for this reason

  - Zenith angle is already considered when relevant (e.g. cosmics rates). We could also consider e.g. the position and phase of the moon to define the validity limits.