LST – DL0, initial discussion

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Goals of this task

- To have the whole LST-1 data sample converted to standard DL0 format for long-term storage – it will allow for future analysis with CTA's DPPS
  - Currently we use as raw data something "in-between R0 and DL0"
  - R0: as written out during observations; 2 gains for all events, all pixels saved
  - R0G: only one gain kept for each pixel in physics triggers (both kept for interleaved)
  - R0V: like R0G, but in physics triggers only pixels which are likely to contain Cherenkov signal are saved
  - We store R0G off-site and R0V on-site
  - In all R0, R0G, R0V the waveforms only have the calibrations that are applied on-the-fly by the EvB (the rest is now done by lstchain)
  - $\Longrightarrow$ **We should create an R0V → DL0 converter**
- To prepare for the stereo era
  - in which (to save us future headaches) all LST data should be stored directly in DL0 (either by ACADA or by LST-dedicated software), and the DPPS analysis start from there

DL0 files…

- In short, the content of DL0 is similar to our R0V, but with waveforms already calibrated to photoelectrons (which we do now in cta-lstchain, to produce in-memory R1 waveforms for further analysis)
- In the future DL0 will be produced on-the-fly by ACADA, using the already-calibrated R1 waveforms sent by the Event Builder

To be done, starting from an R0V file…

- For details on the DL0 contents and structure, check the DL0 data model specification document:
  - https://redmine.cta-observatory.org/dmsf/files/17552/view
- Calibrate the waveforms, both at low-level, i.e. sample-wise “DRS4 corrections” and at “high-level” (convert to photo-electrons). This is basically to obtain the R1 waveforms. An example notebook is provided in the last slide
- Write out interleaved events (pedestal & flat-field) in a separate DL0 file
  - Q: Should they also be calibrated? I guess so… it would be dangerous to have interleaveds processed in a different way from that of shower events
  - Q should both gains be kept? May be, but interleaveds will completely dominate the data volume. Keep only a fraction of them? Should be an option, I think.
- Muon ring candidates written to a separate DL0 file (while keeping them also with the rest of the “physics triggers” in the main DL0 file)
  - In the muon-dedicated file they should (I think) keep all the pixels. But details should be clarified with CTAO

Further questions

- Waveform calibration:
  - I think DL0 will be produced only once by ACADA with the so-called “level-A” calibration that can be applied on-the-fly. DPPS will later apply better calibrations (level-B & C) in re-analysis, but I think DL0 will stay unchanged.
  - For producing LST-1’s DL0, should we do the same? That is, use “level-A” calibration (obtained from pedcal files, and NOT using info from interleaveds). I’d say yes, because then the DL0 can be used to test the application of the level-B calibration inside DPPS
- Is there any file naming standard for the different DL0 files?
- Involve from the start experts from CTAO? (mainly Max & Karl)
  - I’d say yes, they must be interested (for the DPPS development) and we would certainly benefit from their expertise
- Create a GitHub Project to follow the progress?

Simple notebook to obtain R1 waveforms

May be useful as a starter (path @ the IT cluster):

`/home/abelardo.moralejo/python_notebooks/getR1/get_LST_R1.ipynb`