MMS Annual Meeting

Project: Search for Low Luminosity GRBs

Jean Damascene Mbarubucyeye

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HELMHOLTZ RESEARCH FOR GRAND CHALLENGES

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Outline

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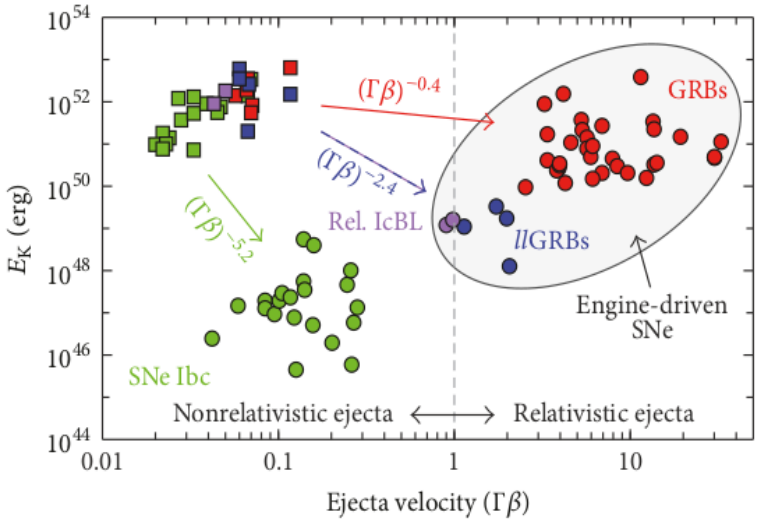
- Finish Simulations
- Train the DL pipeline

Background

What are LL-GRB and why them?

- A sub-class of GRBs, short lasting with energetic events due to high ejecta velocity in the jet.
- With Low isotropic Luminosity: 10^{46} – 10^{48} erg/s (~10^{-4} than long GRBs) and low energy: 10^{48} –10^{50} erg.
- Smooth Lightcurves compared to average observed GRBs.
- LL-GRBs are interesting as they are promising source of UHE cosmic rays and HE neutrinos (Samuelisson et al 2018, Boncioli et al 2018).
- They appear to be SNe in optical band.
- Only less than 20 LL-GRBs have been detected yet they are expected to be numerous in our local universe.
- Can we expect more with future generation of instruments like CTA?



Aim

→ Search and develop algorithm to detect faint transients, particularly LL-GRBs.

Long-term goals

- Introduction to VHE Astroparticle physics/transients.
- Introduction to HESS experiment (Transient science + HESS analysis tools).
- Introduction to machine learning methods in Astroparticle transients.
- Using HESS data for transient search (Extra-galactic focus).
- Transients MWL follow-up that combine gamma-ray & optical data.
- Preliminary analysis of CTA/LST verification data (if available).
- Set limits on physical source populations (i.e., low-luminosity GRBs) if no transient is found.
- Physical interpretation of discovered transients.

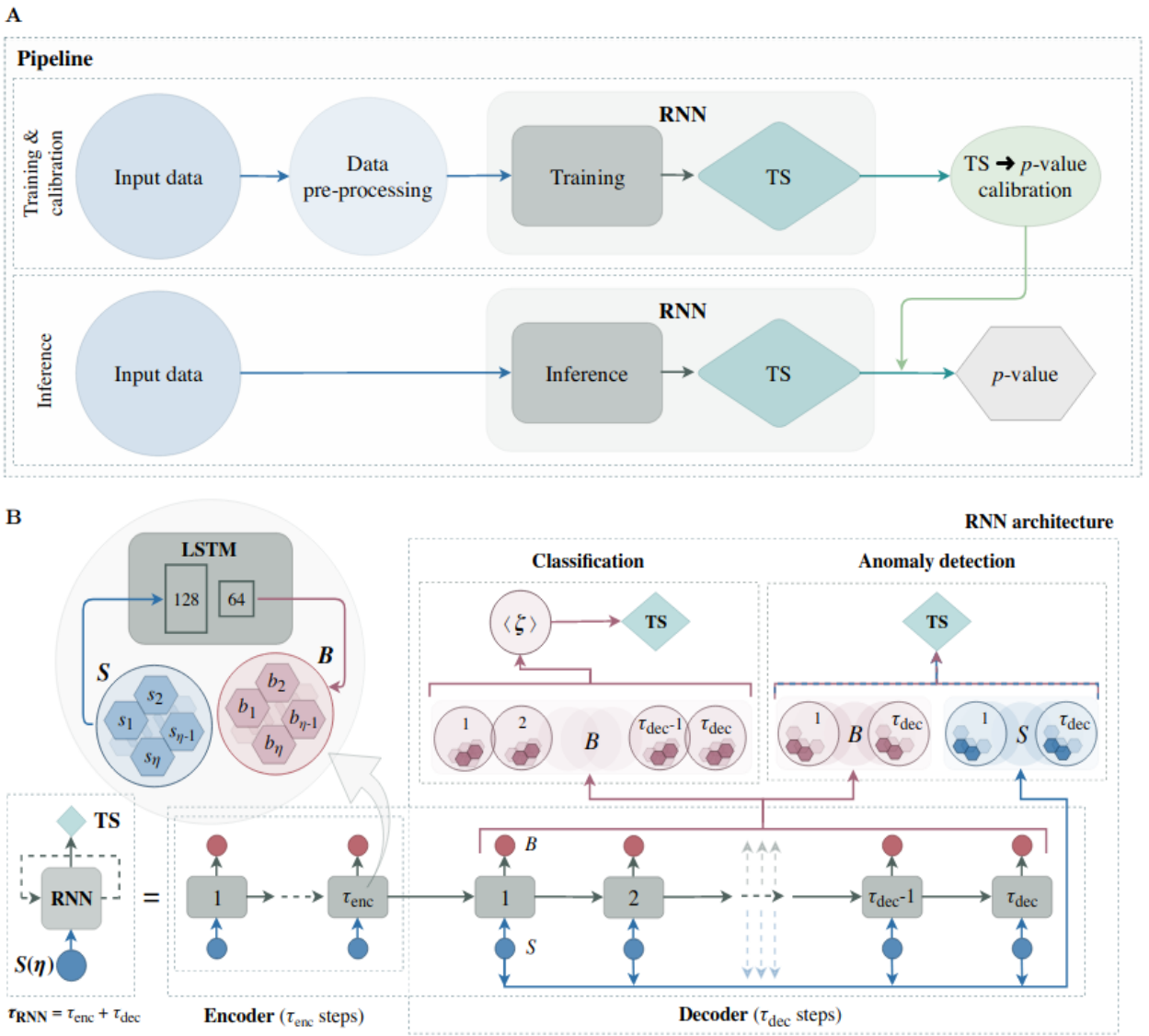
Motivations

- Time variation analysis instead of an ON/OFF analysis. Hence, maintain as much gamma-ray events as possible.
- Train both the signal and Bkg events in DL pipeline (**Sadeh 2020**) to discriminate Hadrons from gamma-ray events.

Background (cont')

Structure of the DL-pipeline (see I. Sadeh, 2020)

- The inputs to the RNN are bkg and signal counts within binned energy range and integrated in ROIs.
- For anomaly detection approach, the RNN is trained to predict gamma-ray-like events in the absence of signals.
- The method out-perform previous background models.



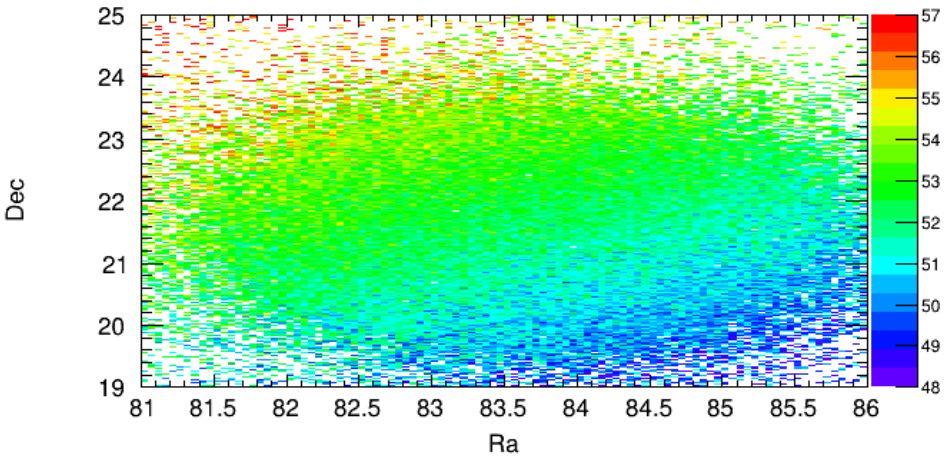
Current Status

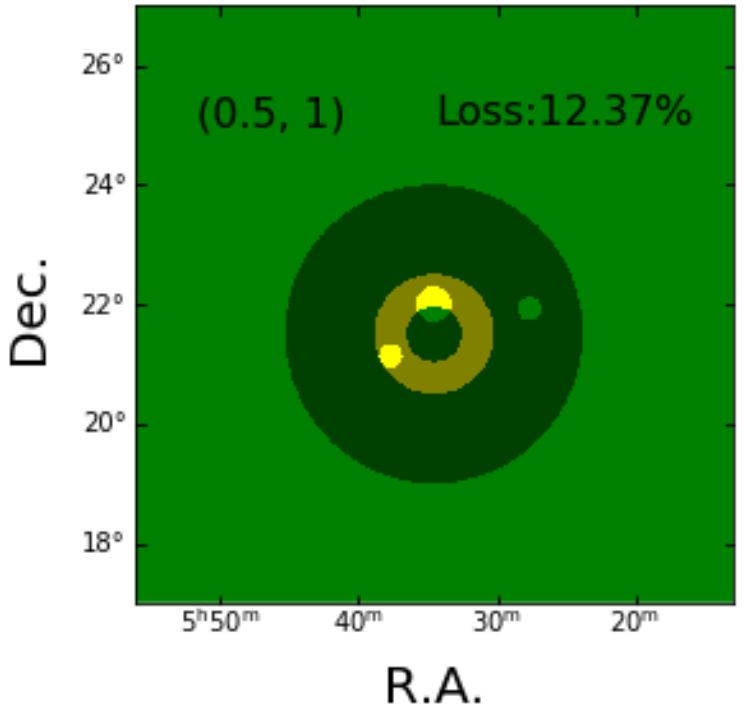
Understanding Data and do MC simulations.

→ **Example: Crab field**

- HESS/HAP tools → loose-cuts.
- Selecting Background events (i.e. mask TeV sources in the FoV and Crab itself).
- Correct for overlap of exclusion regions with our ROIs in which events are uniformly distributed.
- The Goal is to understand the Distribution of events parameters and their variation across the FoV before feeding information in the DL algorithm.

Zenith profile vs sky positions



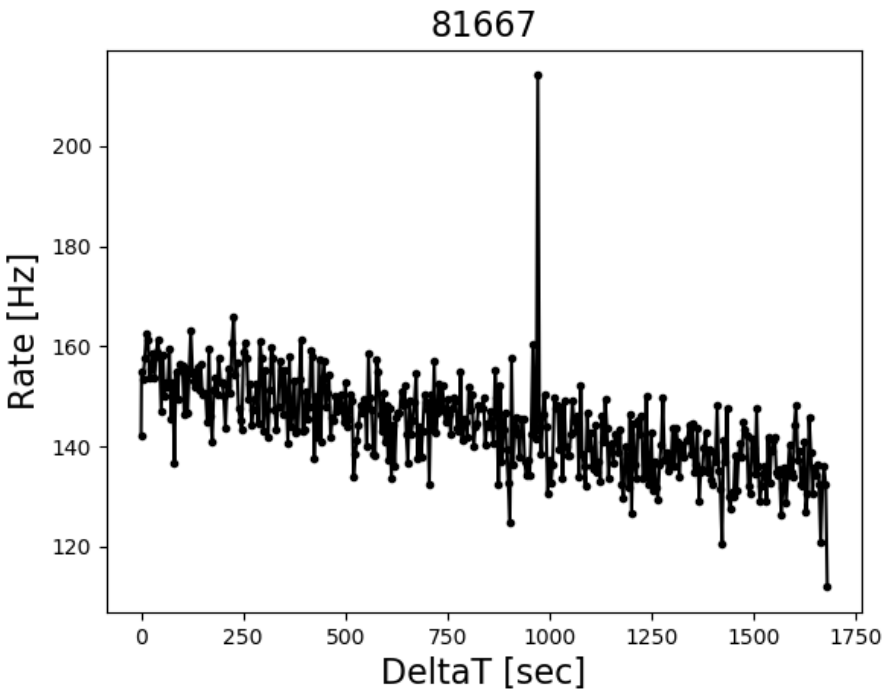


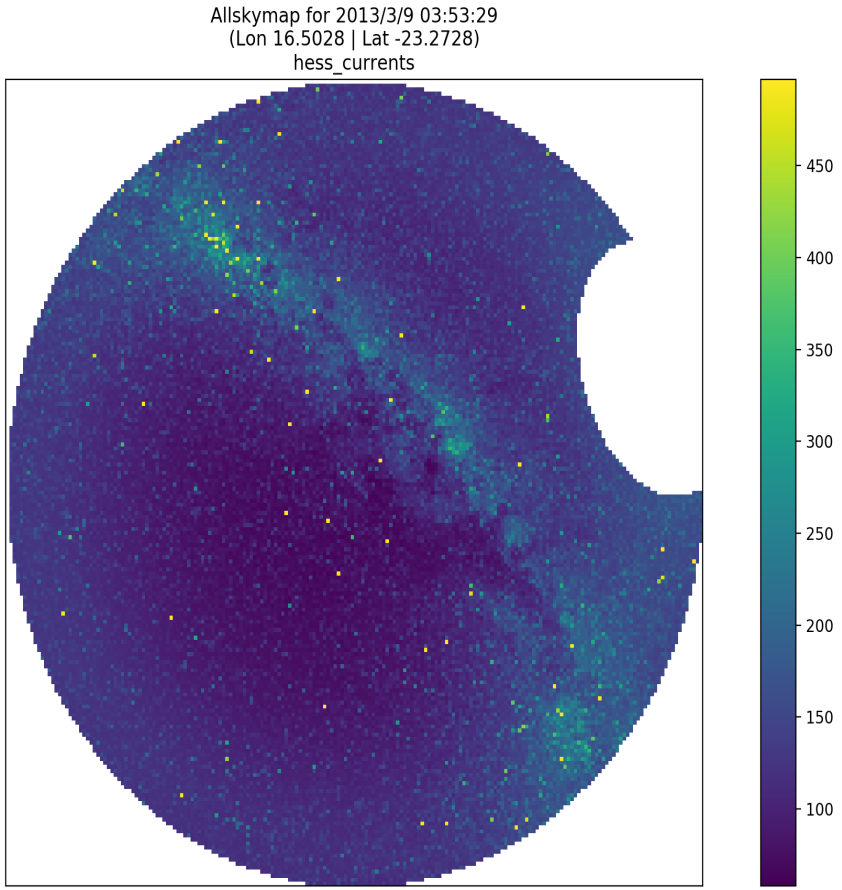
Current Status (cont')

Some parameter:

- Livetime
- NSB if high would affects camera efficiency to reconstruct events.
- Trigger rate distribution (clouds, atmospheric transparency).

→ **NSB**





Summary and Future Plan

- So far, I understand the analysis steps for HESS/HAP internal software.
- I am building up the pipeline for Monte-Carlo simulation (bkg & signal rates)
- I am including more off runs (covering different zenith) as this is a blind search.
- I will soon start to look into different parameter distributions
- Start DL sample training.
- Implementation of the DL method in the HESS-DAQ and real-time analysis.
- Start transients search using HESS data.
- ….

Thank you

Contact

DESY. Deutsches Elektronen-Synchrotron

www.desy.de

Jean Damascene Mbarubucyeye
Department: Astroparticle
E-mail: jean.mbarubucyeye@desy.de
Phone: 7126