Cherenkov Telescope Array (CTA) Observatory

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CTA as an Observatory

- An Open Observatory / User Facility
  - Proposal-driven observatory for the first time in this waveband
  - Public science data archive (after proprietary period)
- High-quality science-ready data products are the final ‘product’ of CTA
  - DL3 data package (event lists, IRFs, auxiliary data, metadata), quicklook DL5 data products (sky maps, spectra, light curves)
  - Science analysis tools
  - CTAO = Provider, Science User = Customer
- CTAO responsible for the construction of all software
  - SW centrally managed in CTAO, includes responsibility for the data products
- CTAO responsible for the construction and operation of the Observatory
  - CTAO staff to prepare and deliver science data to users
    - Service work to acquire, process, and calibrate the data (DL0 → DL3/DL5), including simulations and production of IRFs
  - CTAO staff to provide User Support Services
    - Help desk, science analysis tools, science portal, etc.

Data Model and Data Format

- **Data Model:** Description of the data elements, contents and their *relationships*
- **Data Format(s):** how to serialize the model into a Data Product
- CTA Data Models are expressed in UML

Requirements for a CTA Data Model

- Support the CTA science cases
  - Includes multi-messenger / multi-wavelength → support joint analysis → interoperability
- Support the word-wide science user community
  - Robustness → data quality aspects
  - Flexibility → versatile event data and instrument response function
  - Discoverability → rich metadata
- Highest quality science data
  - Reprocessing planned (e.g. improved calibration, simulation) → may include updates of the data model over time
- FAIR principles
  - Provenance (among others) → metadata
- Open format
  - Formal Data model definition
  - Documentation
- IVOA combability
- And more

Current Activities in CTA

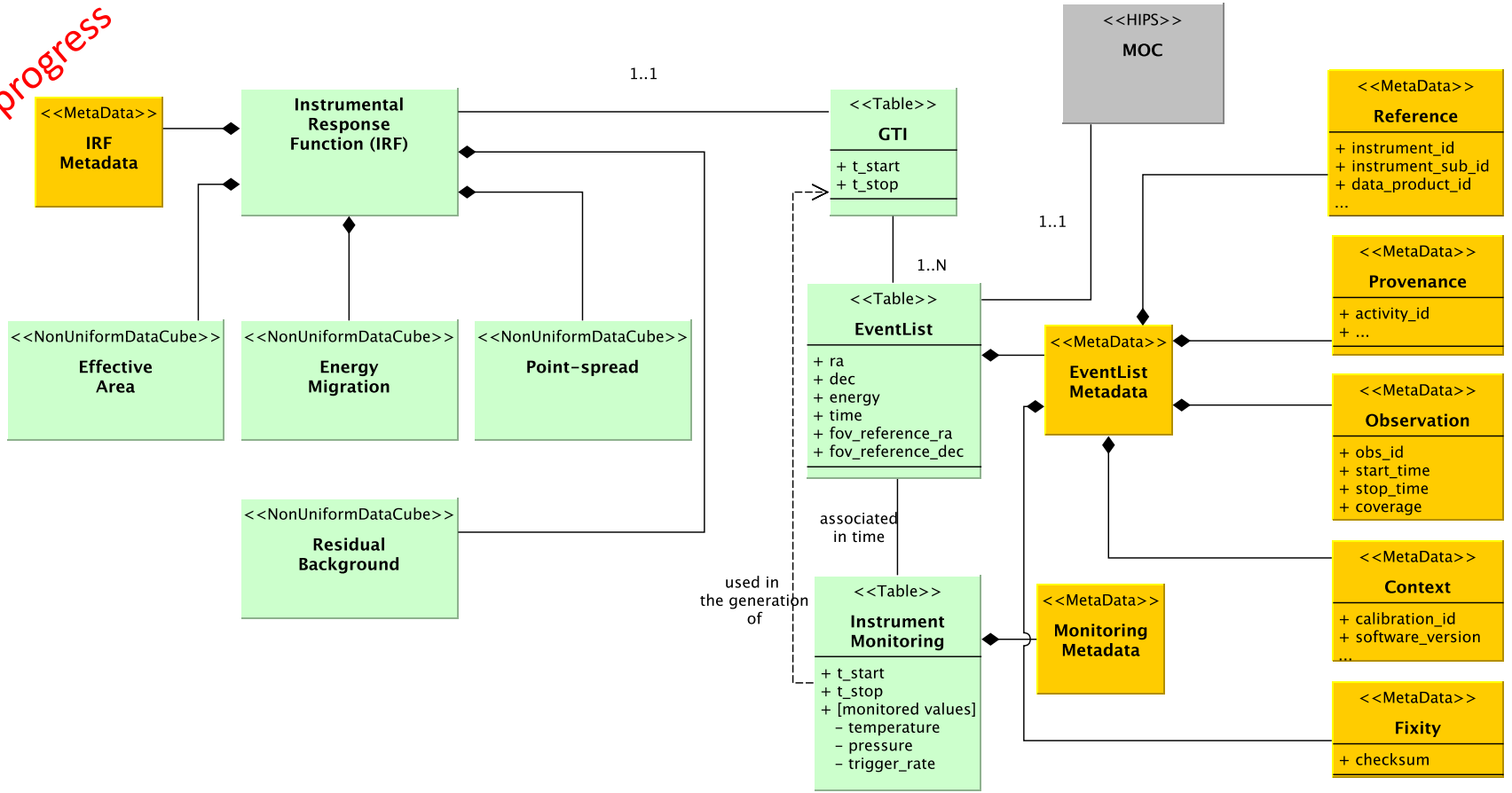
- Collaboration of CTAO and experts from CTAC analysis and simulations working group
  - Involves members of the GADF initiative, and other experiments

- Focus on lower-level data products
  - R1/Event is defined down to the lowest level
  - DL1/Event+DL2/Event are defined to fairly low level, and parts of DL1[2]/Monitoring are defined
  - Parts of Observation Configuration (e.g. SB and OB models) have a first version
- On-going work towards DL3:
  - Detailed studies of IRF
    - Format, parameterisation
    - event classes and types

- Not yet started: DL5, DL6

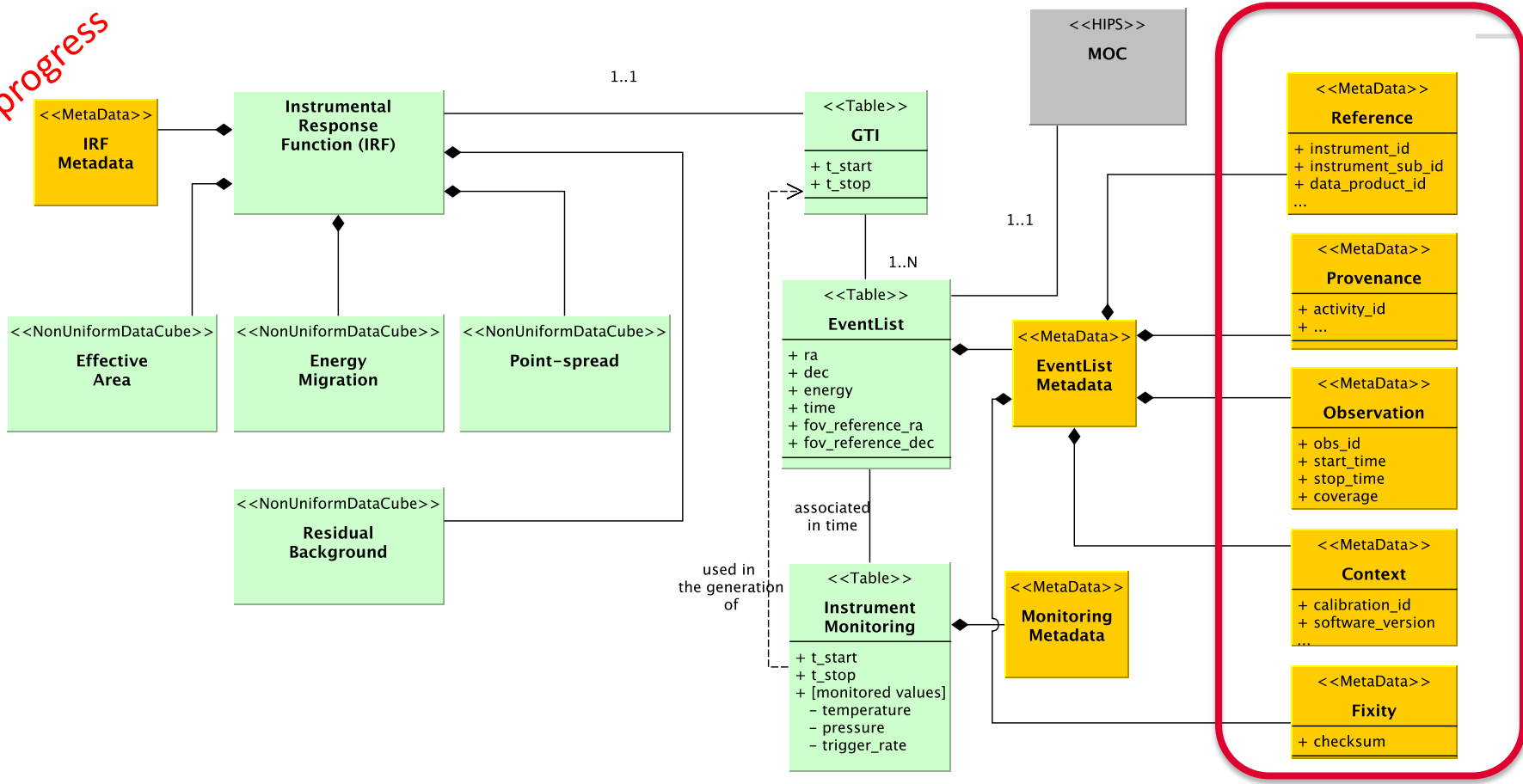
Examples: DL3

Work in progress



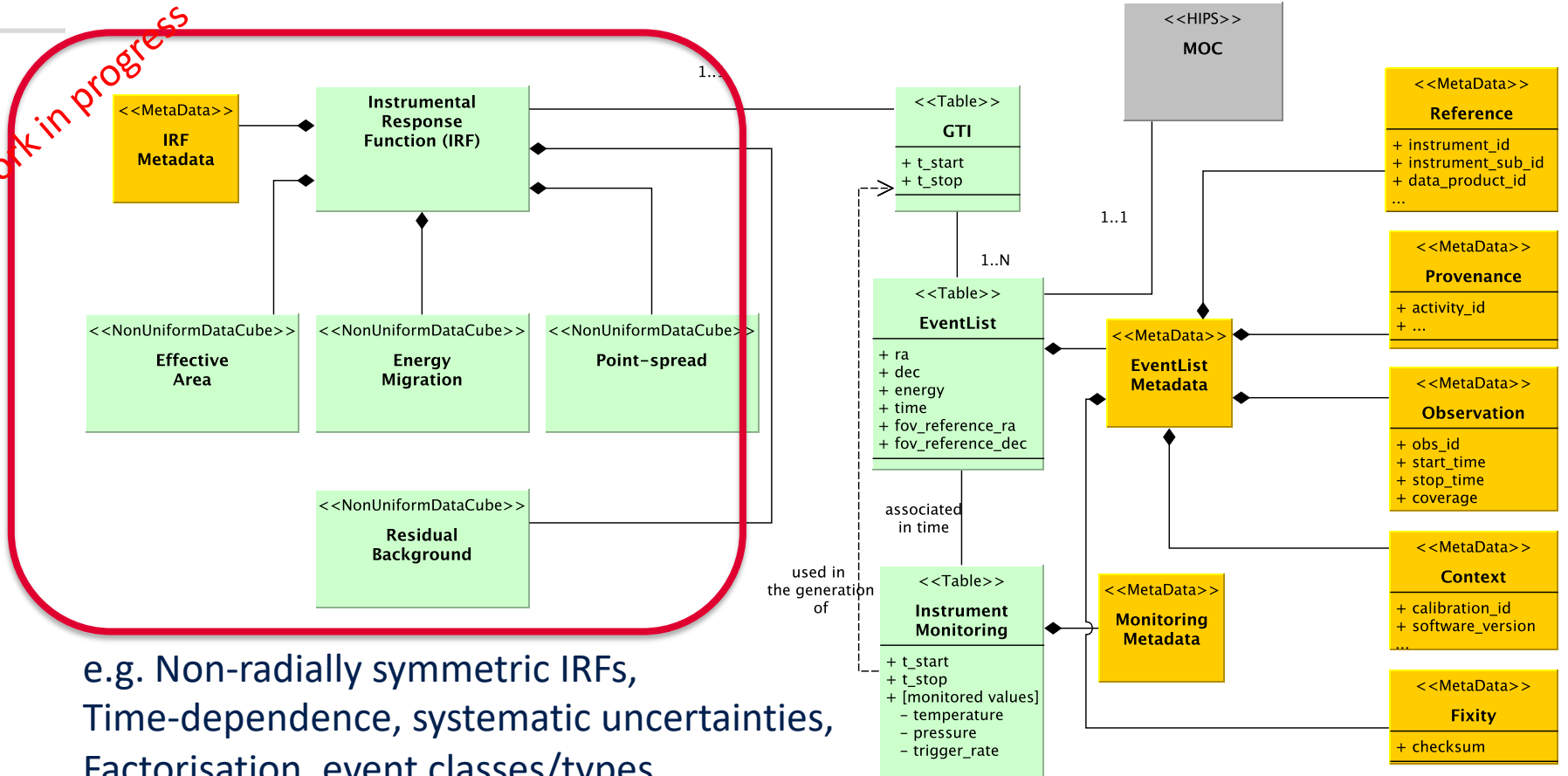
Examples: DL3

Work in progress



Examples: DL3

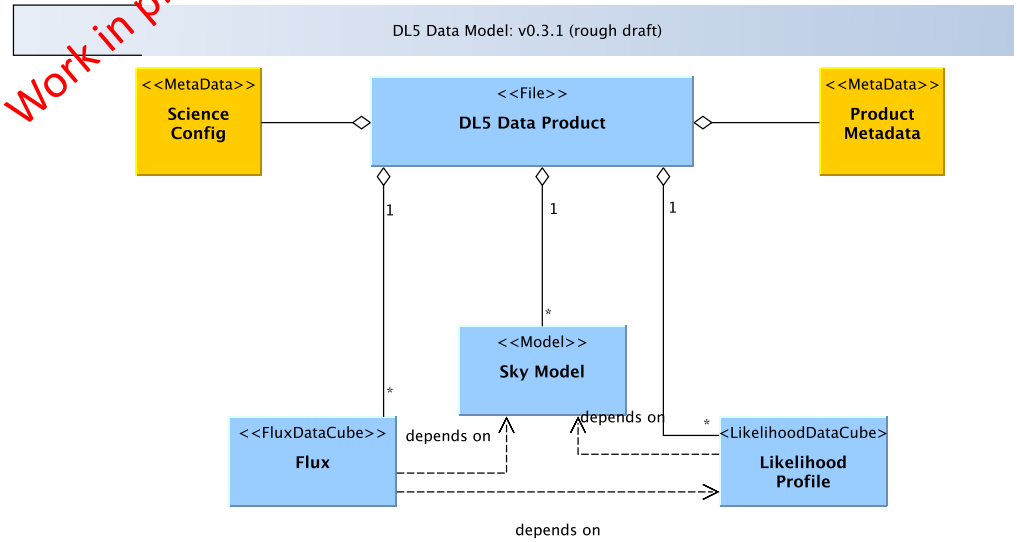
Work in progress

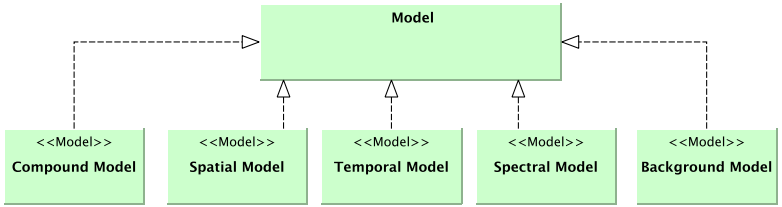


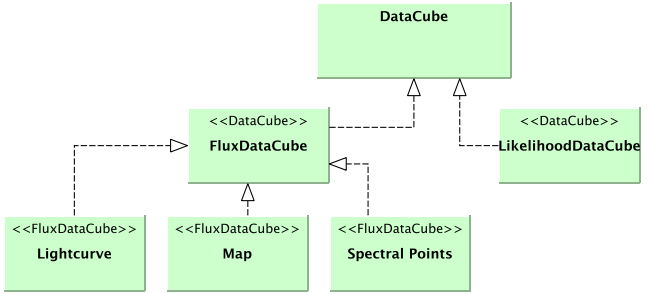
e.g. Non-radially symmetric IRFs,
Time-dependence, systematic uncertainties,
Factorisation, event classes/types, …

Examples: DL5

Work in progress







e.g. hierarchy, …?

A possible Strategy

- Definition of CTA data model in CTAO
  - CTA-DL3/DL5 initially based on GADF
  - likely will have to be extended/modified to meet CTA's needs
- Responsibility of CTA data model stays with CTAO
  - consider git-like workflow?
  - Fork from GADF and then feed back
- Support for the GADF initiative as a standing forum / framework to enable discussions between scientific facilities
  - discussions and studies on common topics
  - Ensure some common rules for naming
  - test model against use cases, and identify missing info
  - Interoperability to support multi-messenger

Some further Considerations

- Definition of GADF needed
  - A forum? A committee?
- Clear definition of workflows and roles are needed
  - How to define a ‘reference'? Who decides? How?
- Definition of ‘Standardisation’ needed
  - What makes a standard a standard?
  - Do we need one standard, a reference model, a baseline, an interoperable model with documented mapping?
  - Minimum vs. inclusive set of parameters?
- Connection to the IVOA
  - Standardisation as part of the IVOA?
    - See examples of the recent radio interest group in IVOA