



CTAO Data Model group

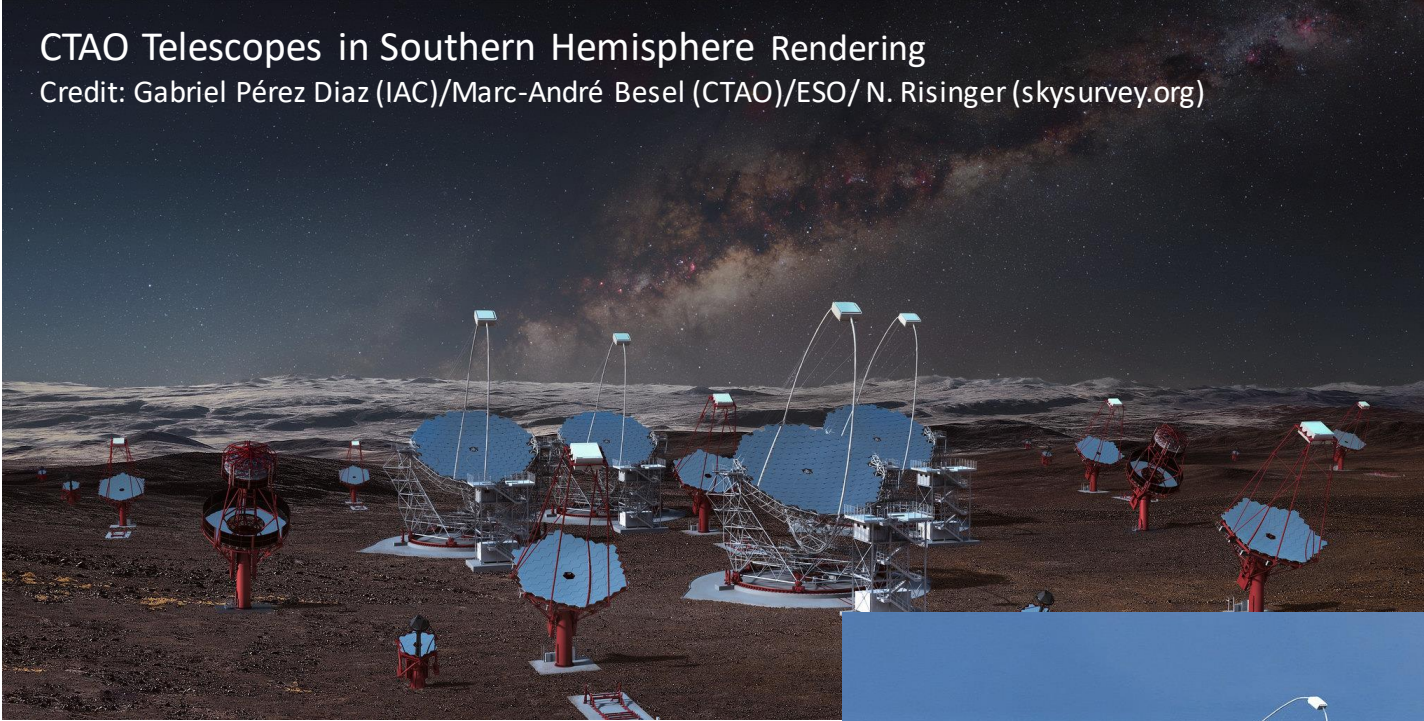
Mathieu Servillat (CTAO secondee / LUTH - Observatoire de Paris - CNRS)
for the CTAO Data Model group

The Cherenkov Telescope Array



CTAO Telescopes in Southern Hemisphere Rendering

Credit: Gabriel Pérez Díaz (IAC)/Marc-André Besel (CTAO)/ESO/ N. Risinger (skysurvey.org)



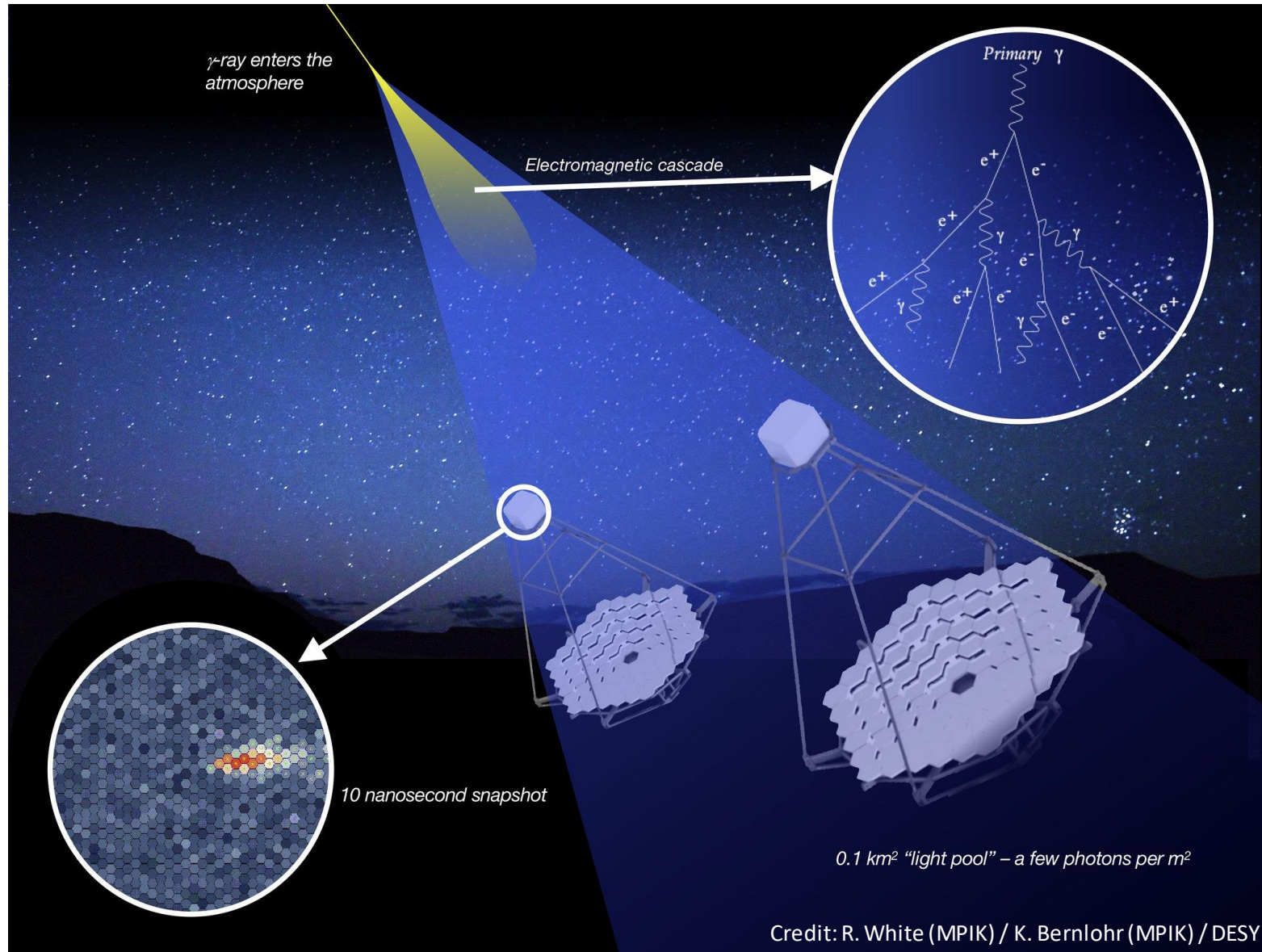
- Next generation ground-based gamma-ray observatory
- More than 60 telescopes (4m to 23m)
- South: 150 GeV to 300 TeV
- North: 20 GeV to 5 TeV

<https://www.cta-observatory.org>

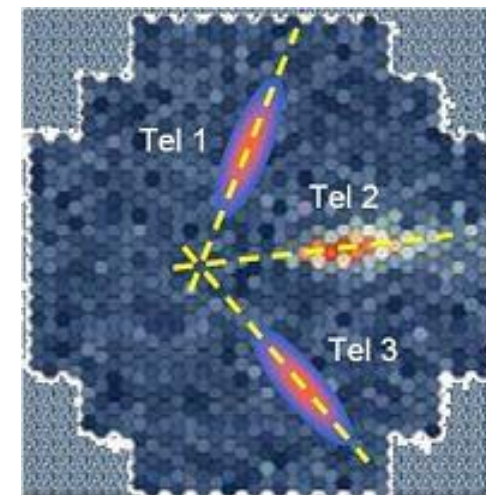


CTAO Northern Hemisphere Array Rendering - Credit: Gabriel Pérez Díaz, IAC

Cherenkov Telescope observations



- Detection of "events"
- Each event is **probably** due to the interaction of a **particle** (photon, hadron, lepton) in the upper atmosphere (10 km altitude)
- This interaction emits Cherenkov light for a few ns
- **Indirect** detection



Open Observatory and Open Science



CTA will operate as an **open observatory** and will provide data to the scientific community.

In the context of Open Science, the data provided by CTA must follow the **FAIR Guiding Principles** for scientific data management:

- **Findable**
- **Accessible**
- **Interoperable**
- **Reusable**

See e.g. Servillat et al. 2022

"FAIR high level data for Cherenkov astronomy"

ADASS XXXI , ASP Conference Series

<https://hal-obspm.ccsd.cnrs.fr/obspm-03516688>

CTAO Operations

ACADA

Array Control and Data Acquisition System

DPPS

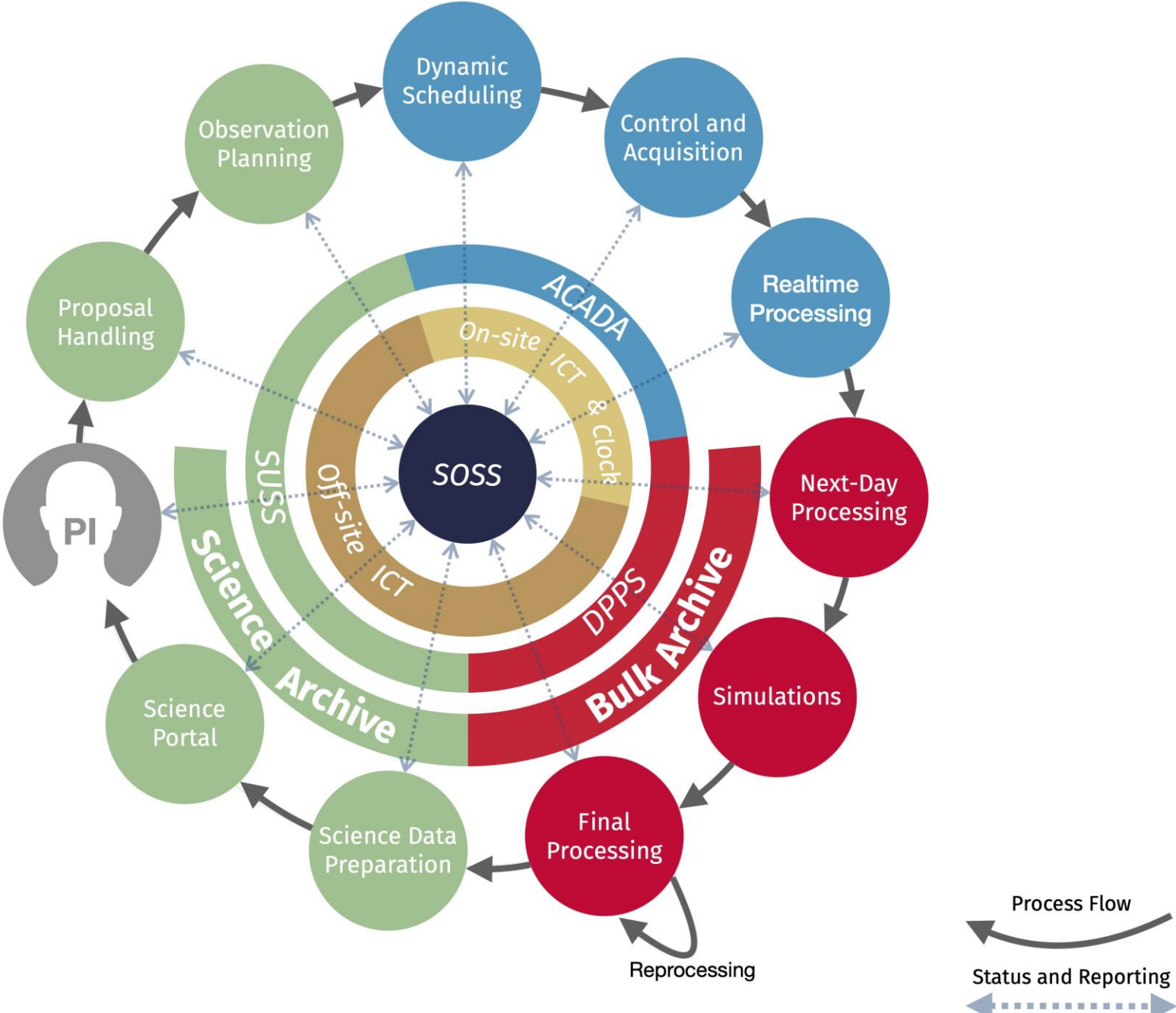
Data Processing and Preservation System

SUSS

Science User Support System

SOSS

Science Operations Support System

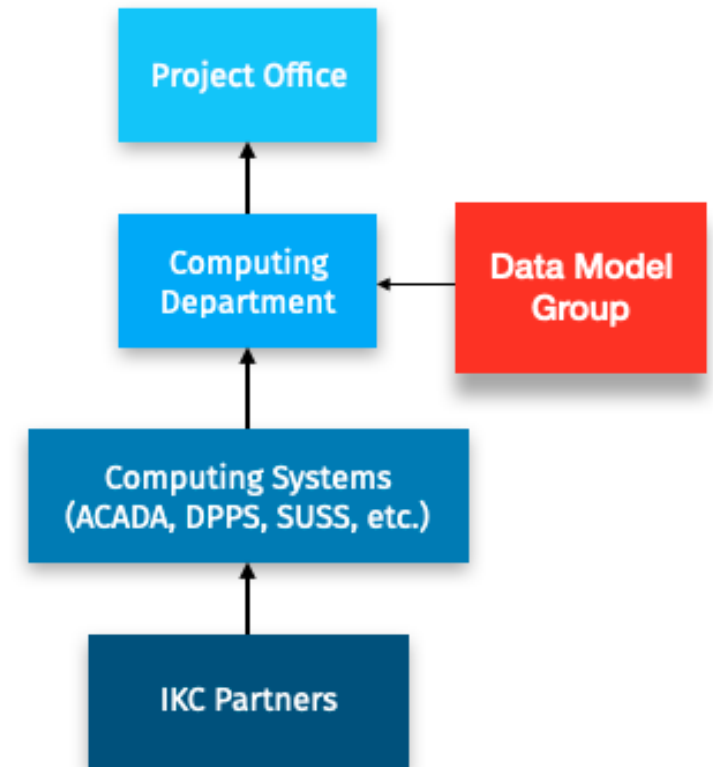


CTAO Data Model group



- **Karl Kosack**, CTAO DPPS Coordinator (**Chair**)
- **Matthias Füßling**, CTAO SUSS/SOSS Coordinator
- **Igor Oya**, CTAO ACADA Coordinator
- **Catherine Boisson**, Secondee from Obs. Paris
- **Mathieu Servillat**, Secondee from Obs. Paris
- **Maximillian Linhoff**, Secondee from TU Dortmund

Tasked with coordinating data model documentation
Release and change procedures
Maintain a Data Model Document Tree



CTAO Data Model specifications



Top-level Data Model Specification

Doc. no.: CTA-SPE-COM-00000-0001-2a_d1
2023-04-18

	First/Last Name, Organization, Role	Digital signature
Prepared by	K. Kosack CTAO, CEA Paris-Saclay DPPS Coordinator, Data Model Group	
Approved by	Matthias Fülling CTAO SUSS Coordinator	
Approved by	Igor Oya CTAO &CIDA Coordinator	
Released by	Stefan Schlenstedt CTAO Coordinating Coordinator	

DL3 Data Model Specification

Doc. no.: CTA-SPE-COM-00000-0000-1a_d3
2023-04-20

	First/Last Name, Organization, Role	Digital signature
Prepared by	Maximilian Liebust CTAO, TU Dortmund University Data Model Team	
Approved by	Karl Kosack CTAO CEA Saclay DPPS Coordinator	
Approved by	Matthias Fülling CTAO SUSS Coordinator	
Released by	Stefan Schlenstedt CTAO Computing Coordinator	

Scheduling Block Data Model Specification

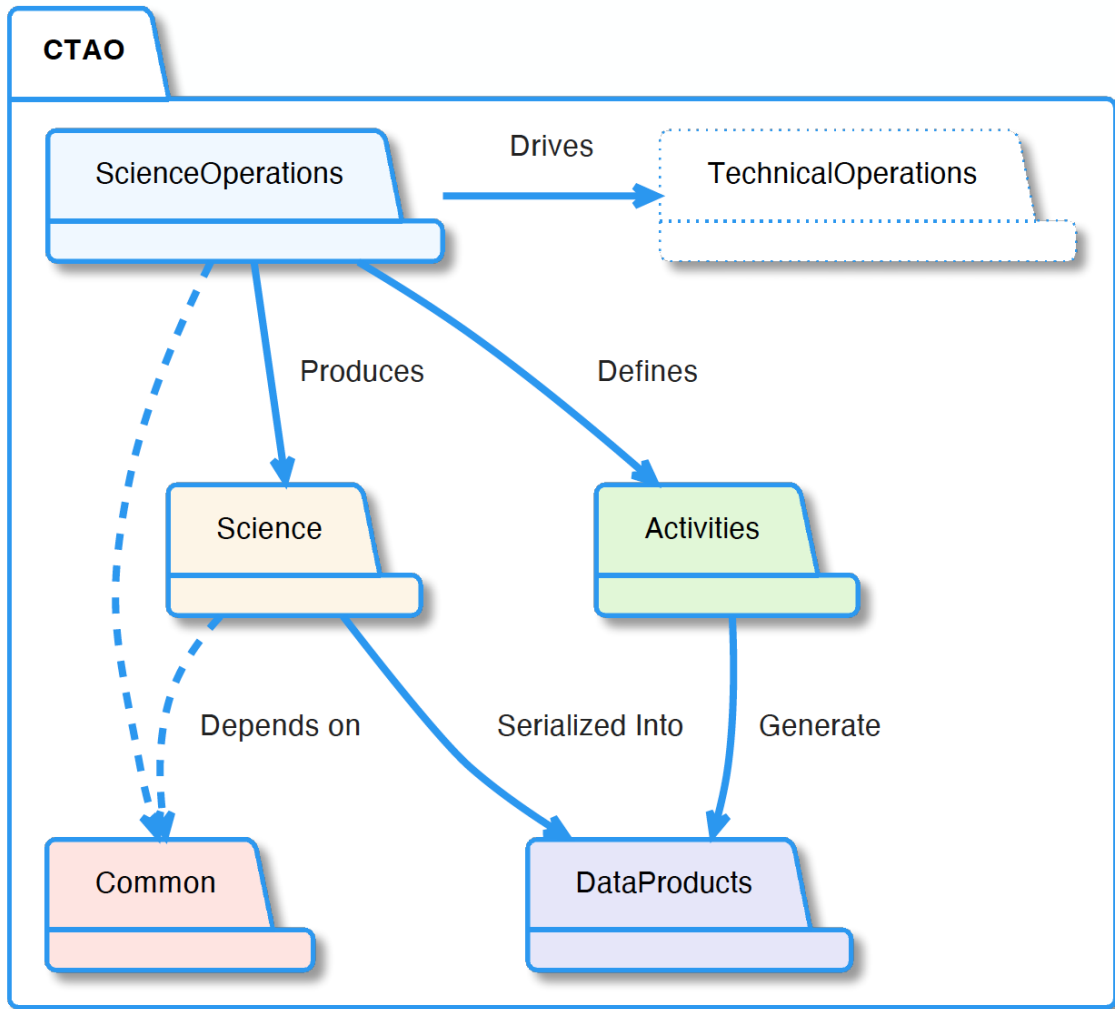
	Name	Date	Signature
Prepared by	I. Oya, &CIDA Coordinator (CTAO)		Igor Oya
Approved by	I. Oya, &CIDA Coordinator (CTAO) and M. Fülling, SUSS Coordinator (CTAO)	Igor Oya Matthias Fülling	Matthias Fülling
Released by	S. Schlenstedt, Computing Coordinator (CTAO)		Stefan Schlenstedt

Observatory Configuration Data Model Specification

Doc. no.: CTA-SPE-COM-00000-0000-0a_d1
2023-04-12

	First/Last Name, Organization, Role	Digital signature
Prepared by	Mathieu Servillat CTAO, LUTH, Observatoire de Paris, CNRS Data Model Group	
Approved by	Karl Kosack CTAO DPPS Coordinator	
Approved by	Matthias Fülling CTAO SUSS Coordinator	
Released by	Stefan Schlenstedt CTAO Computing Coordinator	

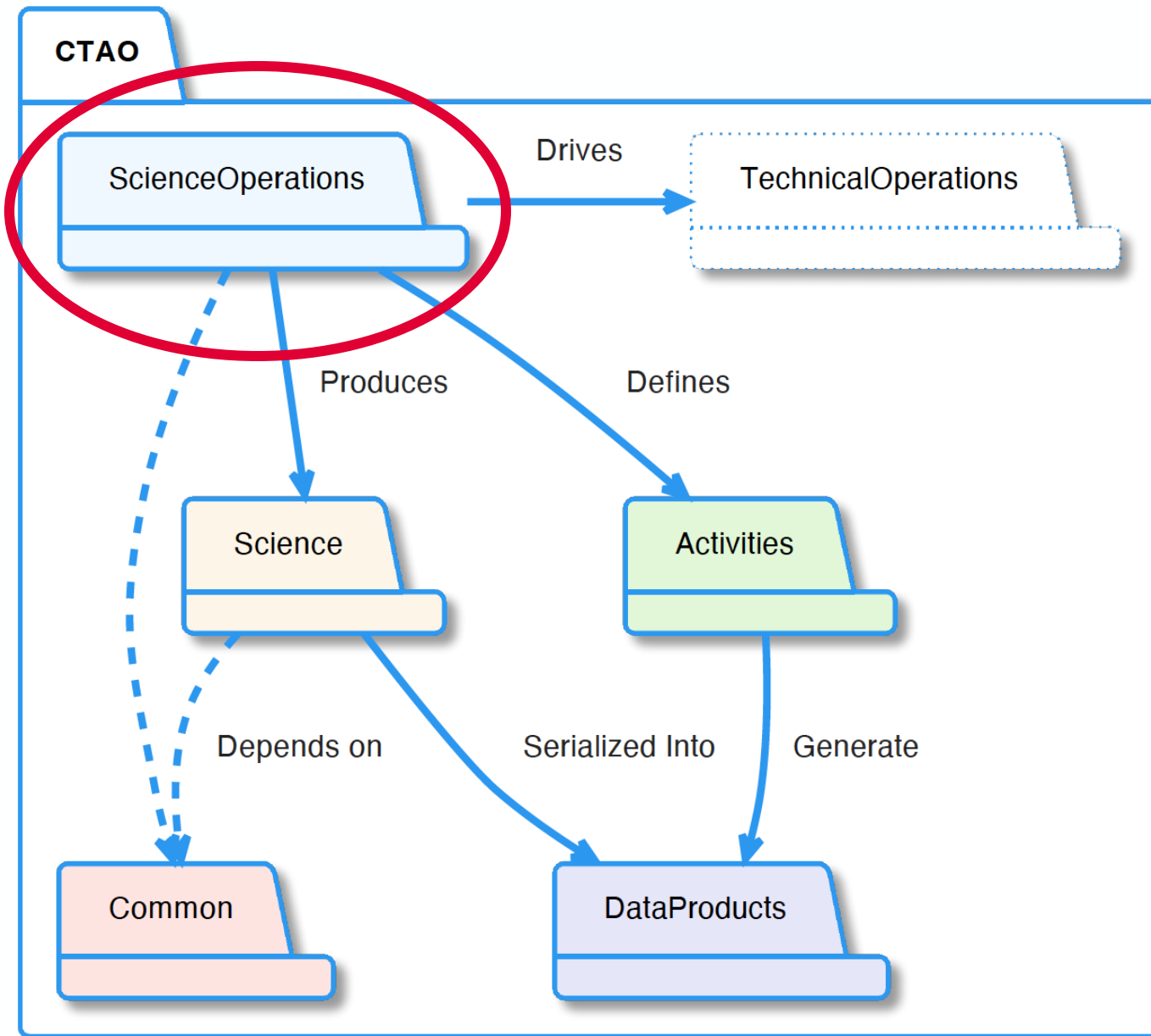
Top-Level Data Model



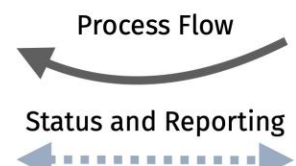
Defines high-level package structure

Including enough detail for context

Top of a *document tree* that will cover all details



Observing Program



Observing Program

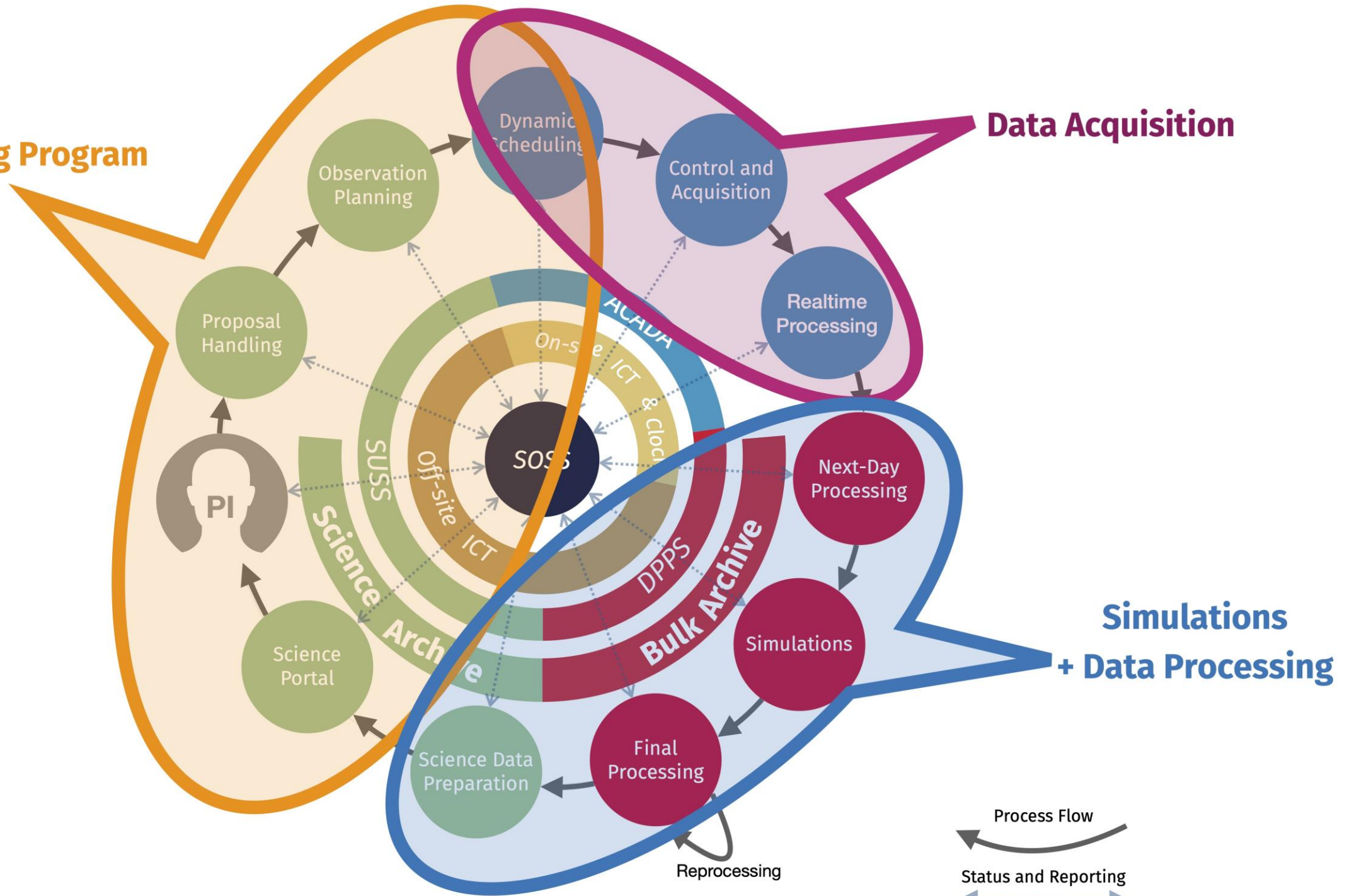
Data Acquisition



Observing Program

Data Acquisition

Simulations + Data Processing

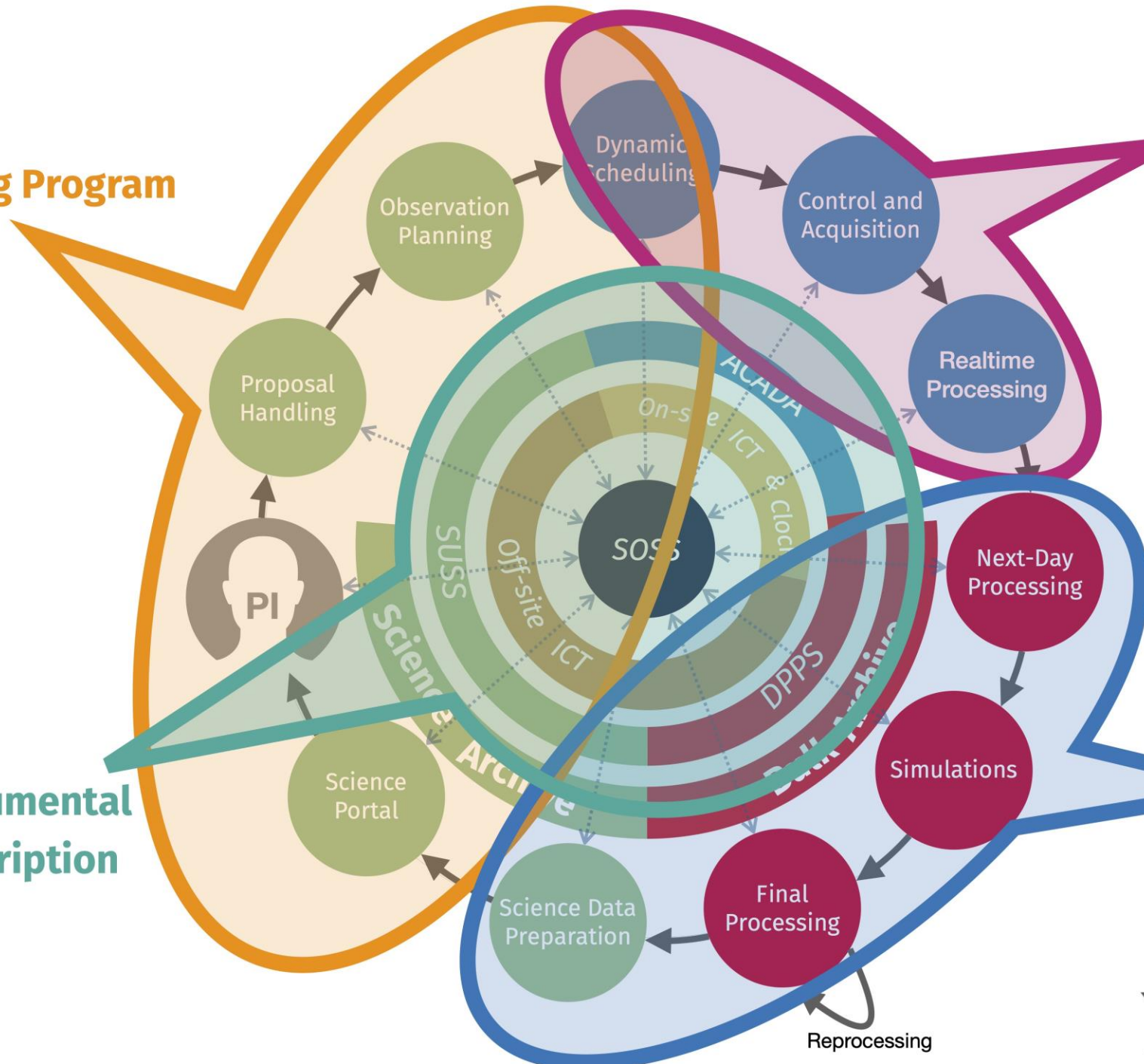


Observing Program

Data Acquisition

Instrumental Description

Simulations + Data Processing



Science Operations model

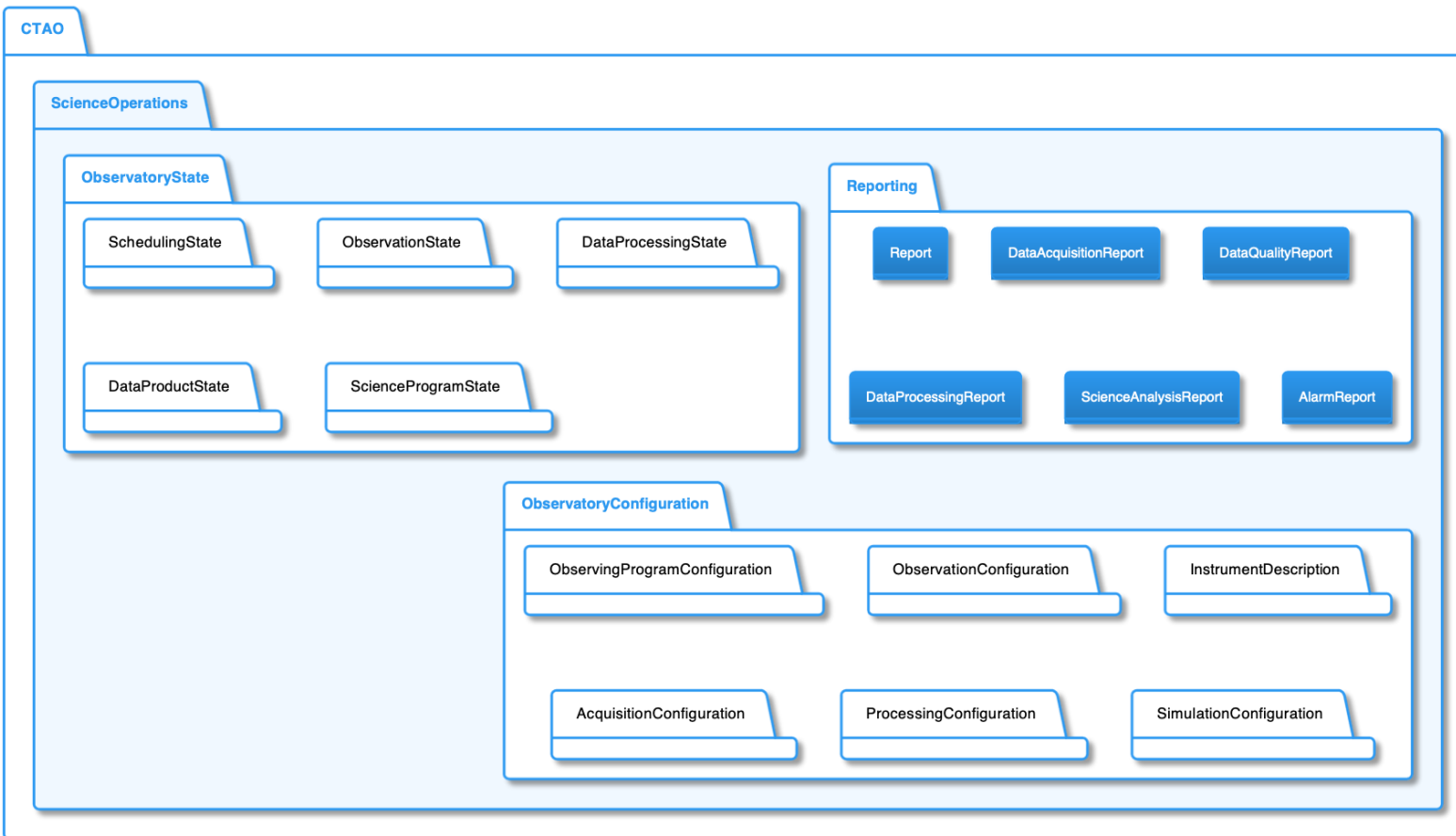


Covers the main SciOps processes:

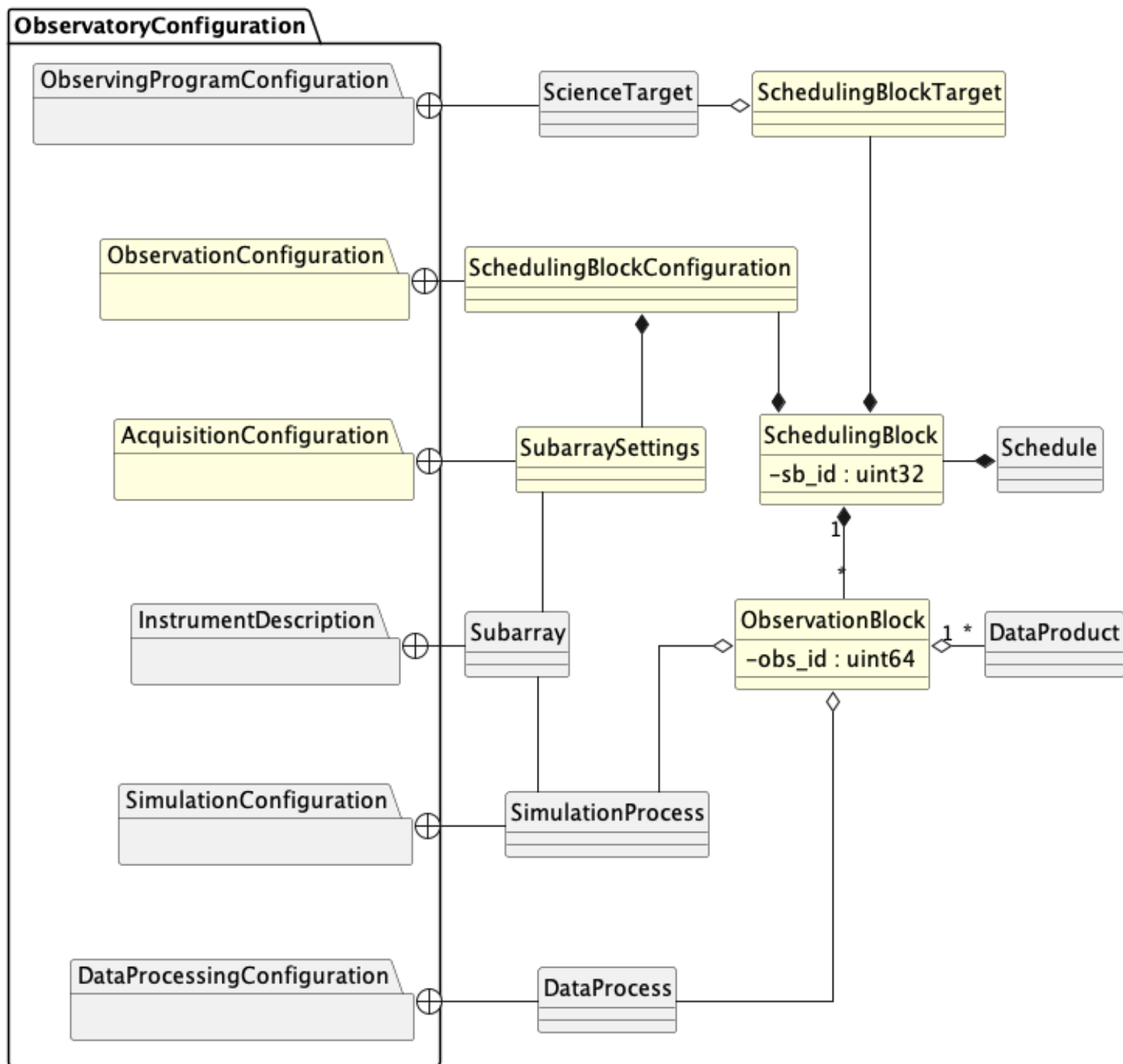
- ▶ Instrument description and options
- ▶ Simulation
- ▶ The Observing Program
- ▶ Data Acquisition
- ▶ Observing
- ▶ Data Processing

Each has aspects of:

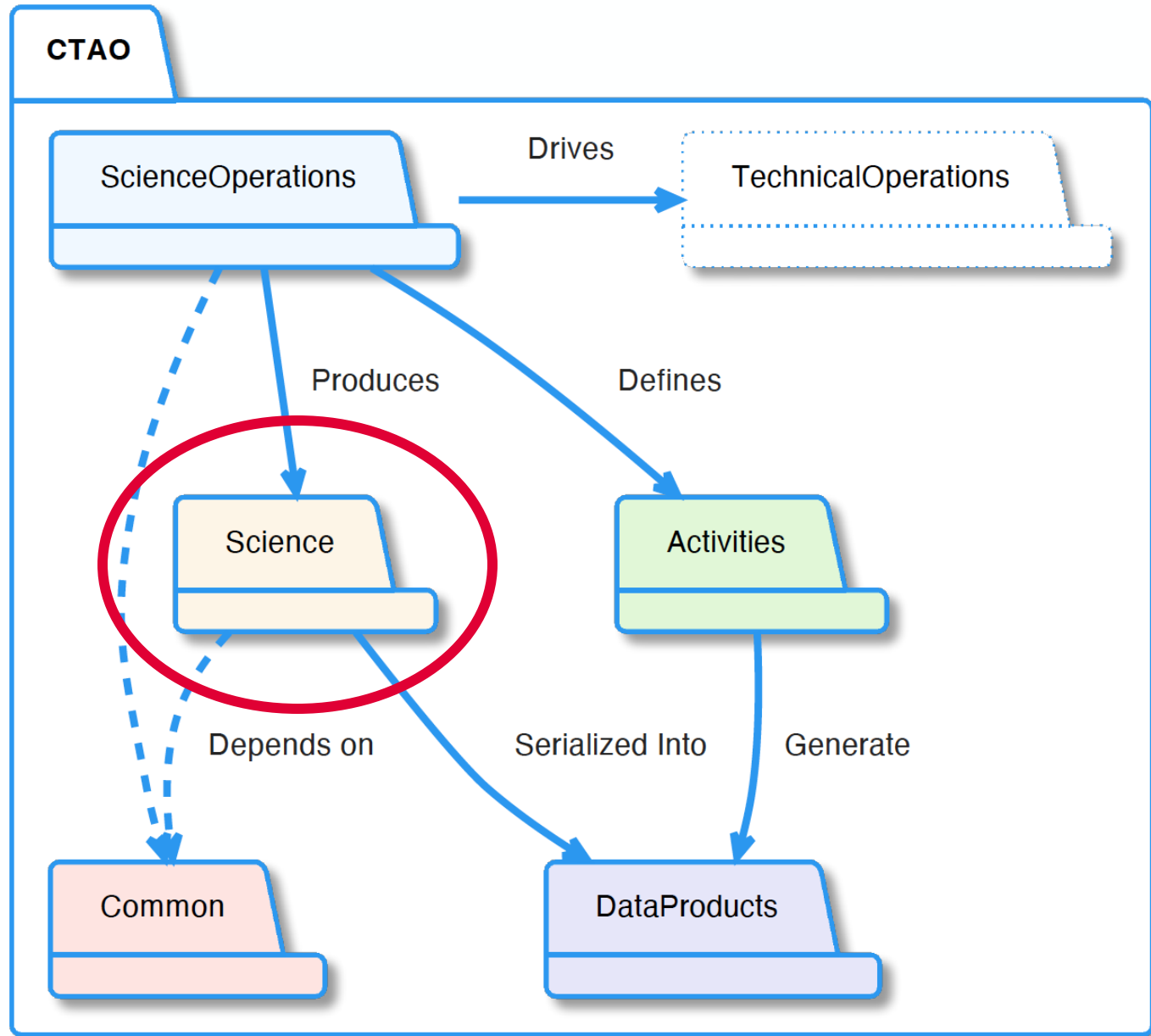
- ▶ Configuration
- ▶ State
- ▶ Reporting



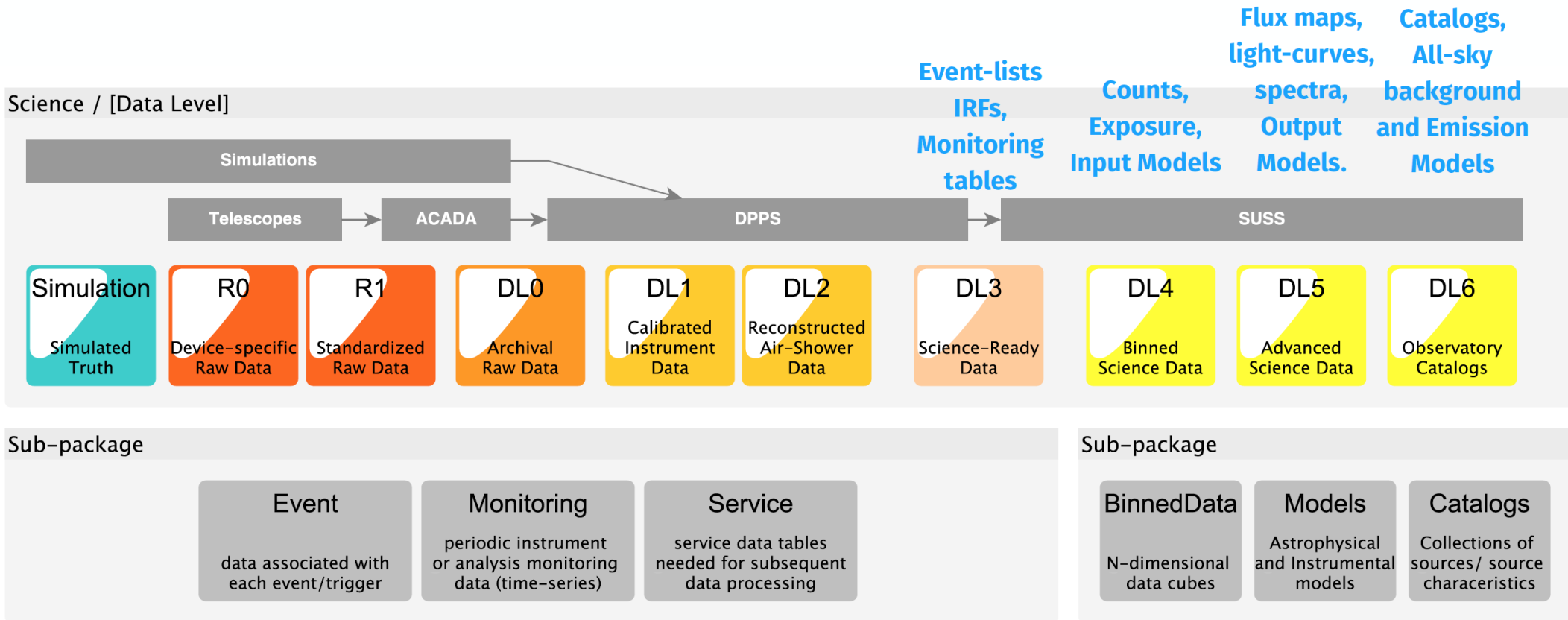
CTAO top-level data model draft_2a_dr1-32-g0330d82



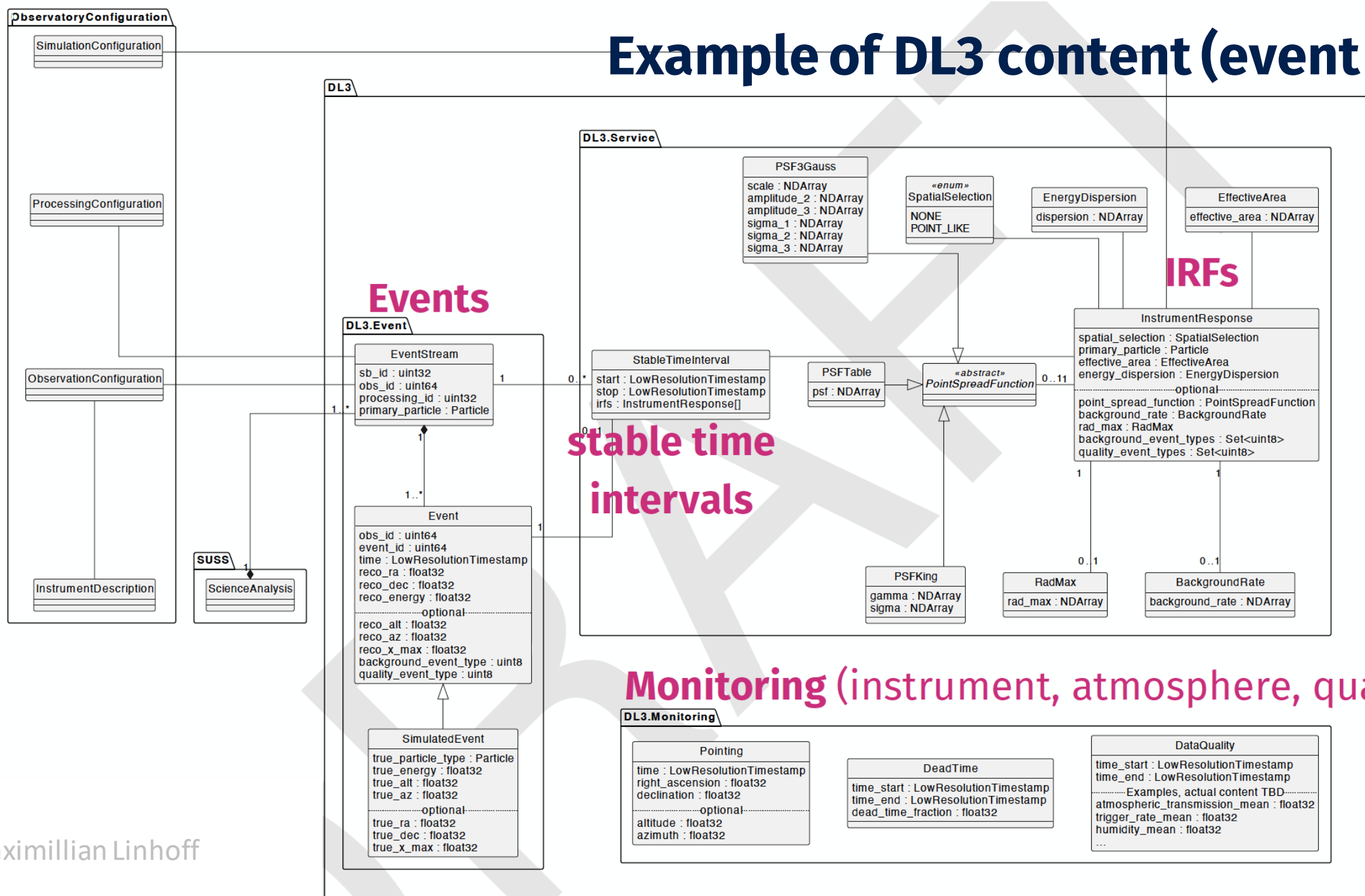
In **yellow** :
concepts already defined
in the Scheduling Block
Data Model

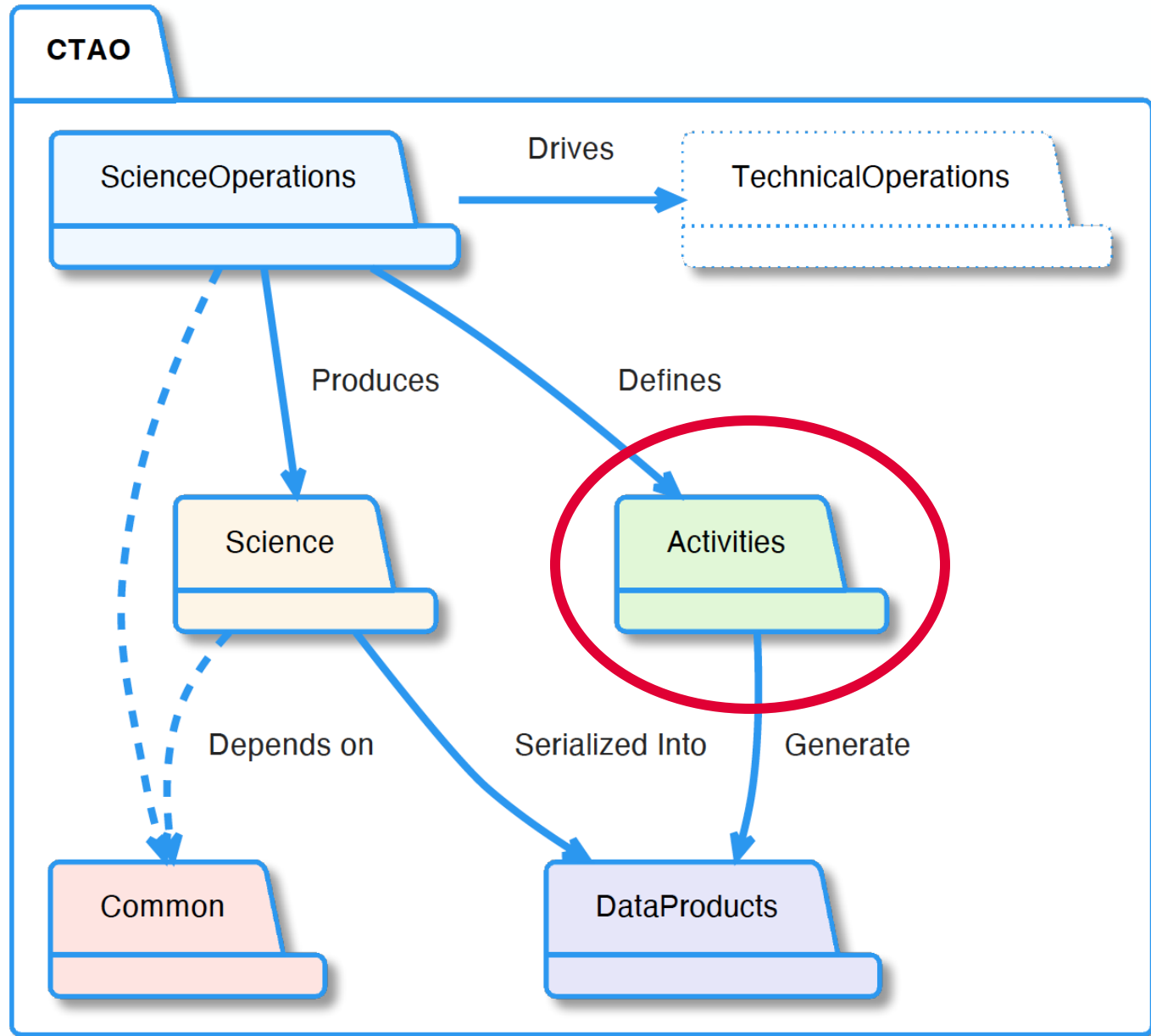


Science Data Levels

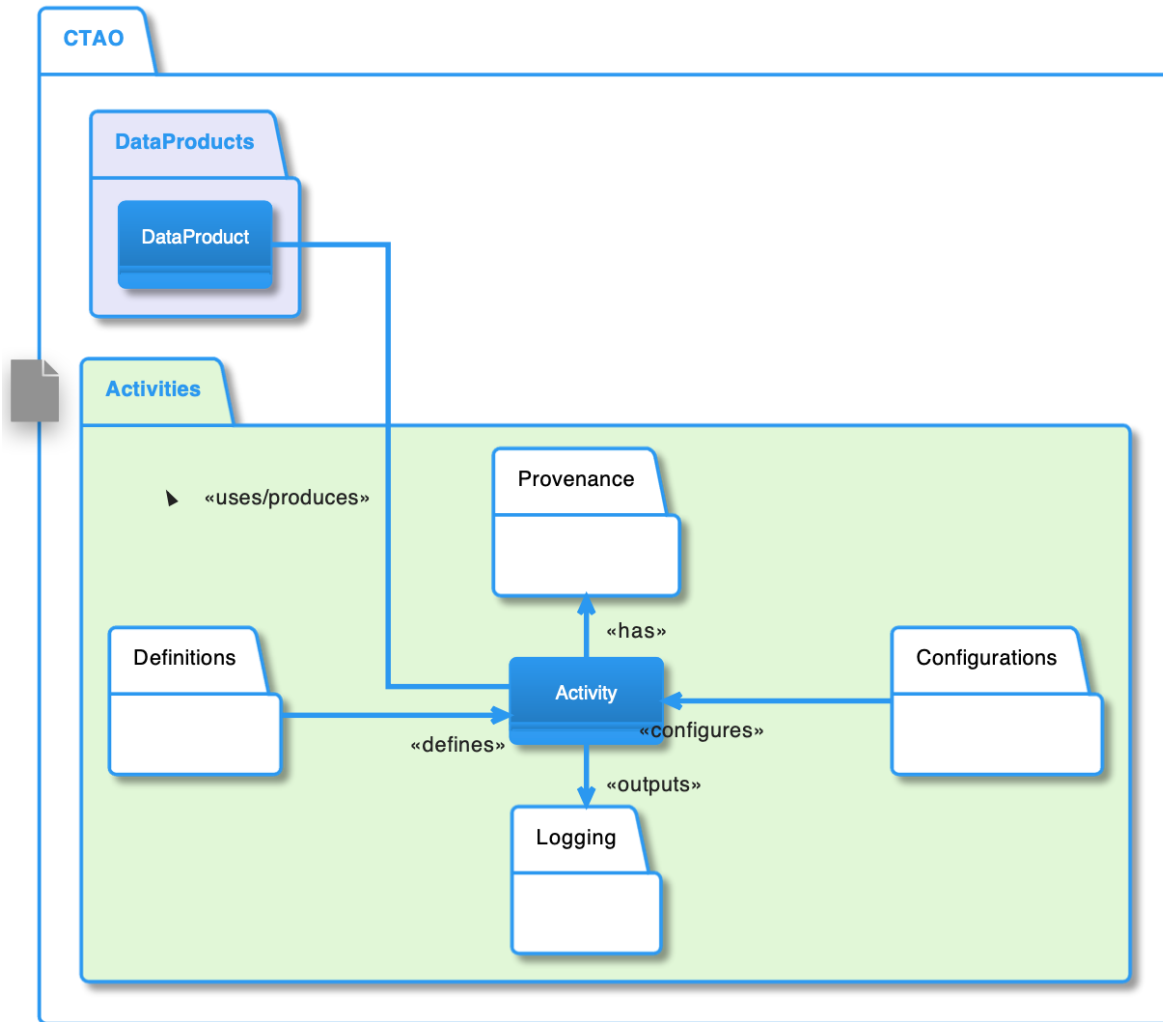


Example of DL3 content (event lists)





Activities model

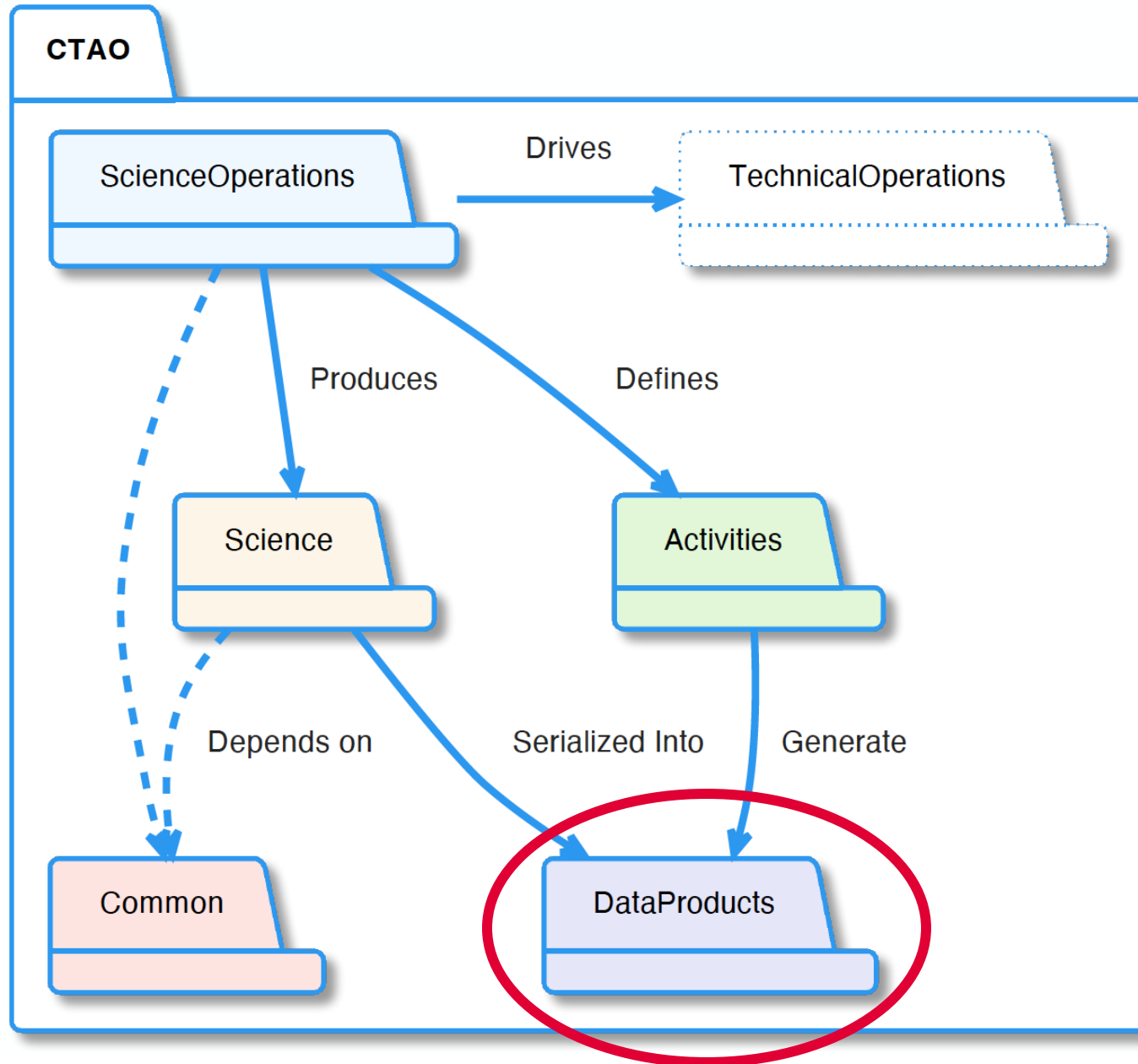


Common models used in multiple SciOps categories

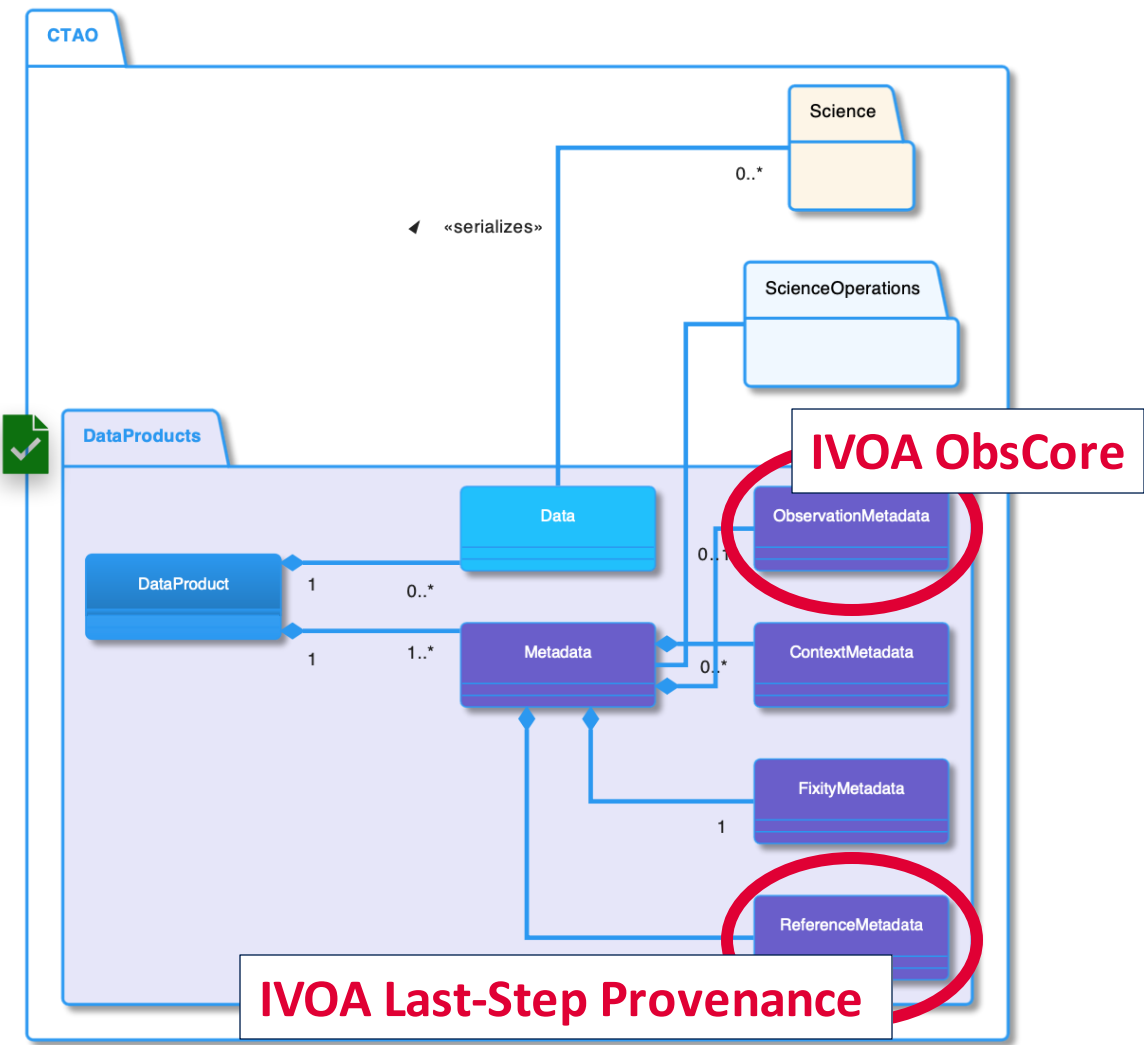
Defines:

- ▶ **Atomic activities**
(e.g. command-line tool or running process)
- ▶ **Composite activities like Workflows**
(directed graph of atomic activities)
- ▶ **Activity and data product provenance ***
- ▶ **Activity Configurations (input)**
- ▶ **Logging (output)**

**Strong link with IVOA
Provenance Data Model**



Data Products model



Defines the relationship between Science and Sciops data models and data products

- ▶ serialized data and metadata

Document contains from previous "top-level" spec:

- ▶ product naming scheme
- ▶ Reference metadata model
- ▶ Data product categories (Cat-A/B/C)
 - which all share the same *data model!*
- ▶ Recommendations for serialization

See Apps II presentation by Jutta

Serialization format will be coordinated with

- ▶ VODF (DL3-DL6) → open standard for the serialization of our model (plus extensions to it to support other instruments)
- ▶ IVOA (metadata, particularly ObservationMetadata ObsCore)

- CTAO develops data model specifications
- Compatibility with IVOA is a requirement
- Several topics of discussion with IVOA experts:
 - Metadata mapping for products from DL3 to DL6 (e.g. ObsCore)
 - VODF effort (talk in Apps II), ESCAPE meetings discussions
 - Compatibility of data model base/common (coord, time...)
 - CTAO provenance/activities links to the IVOA provenance model
 - CTAO will exchange observation schedules (ObsLocVis, ObsLocTAP)
 - CTAO will exchange Science Alerts (VOEvent explored)