Overview of Analyzing GLAST Data

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The Goal of Today's Presentation

- Last meeting we presented details on the definition and development of the Standard Analysis Environment (SAE).
  - Definition by a joint LAT-GSSC working group
  - Development managed by the LAT team with major GSSC participation
  - Supplements and is compatible with FTOOLS
  - Will also analyze GBM burst data with the addition of two GBM-specific tools

- Today we focus on the methods underlying the SAE. We also present the relationship between the SAE and the standard FTOOLS.

- In the future we will address the user interface and the documentation, and arrange for the Users' Committee to beta test the tools.

Data Analysis Issues

- The PSF is large at low energy, small at high energy.
- With the LAT's large effective area, many sources will be detected; their PSFs will merge at low energy.
  - ∴ Analysis is inherently 3D—2 spatial and 1 spectral (& users are interested in temporal!)
- For a typical analysis the source model must include
  - All point sources within a few PSF lengths of the region of interest
  - Diffuse sources (e.g., supernova remnants)
  - Diffuse Galactic emission (modeled)
  - Diffuse extragalactic emission
- Sources are defined by position, spectra, and perhaps time history. Initial values may be extracted from the point source catalog that will be compiled by the LAT team.
- The source model will have many parameters. In an analysis some will be fitted, some will be fixed.

Data Analysis Issues-II

- The instrument response (PSF, effective area, energy resolution) will most likely be a function of energy, angle to the LAT normal, conversion layer (the front or back of the LAT), and the electron-positron vertex angle. The IRF may also depend on the charged particle background resulting from the geomagnetic latitude, Solar cycle phase, etc.
- The LAT will usually survey the sky. Therefore a source will be observed at different instrument orientations.
- Pointed observations will keep the source of interest within 30° of normal.

Observables

- The observables for a photon are:
  - Apparent energy
  - Apparent origin in sky coordinates (2 observables)
  - Apparent origin in instrument coordinates (2 observables)
  - Time
  - Front vs. back of LAT
  - Other detailed information from the LAT (e.g., the vertex angle between the electron-positron pair)

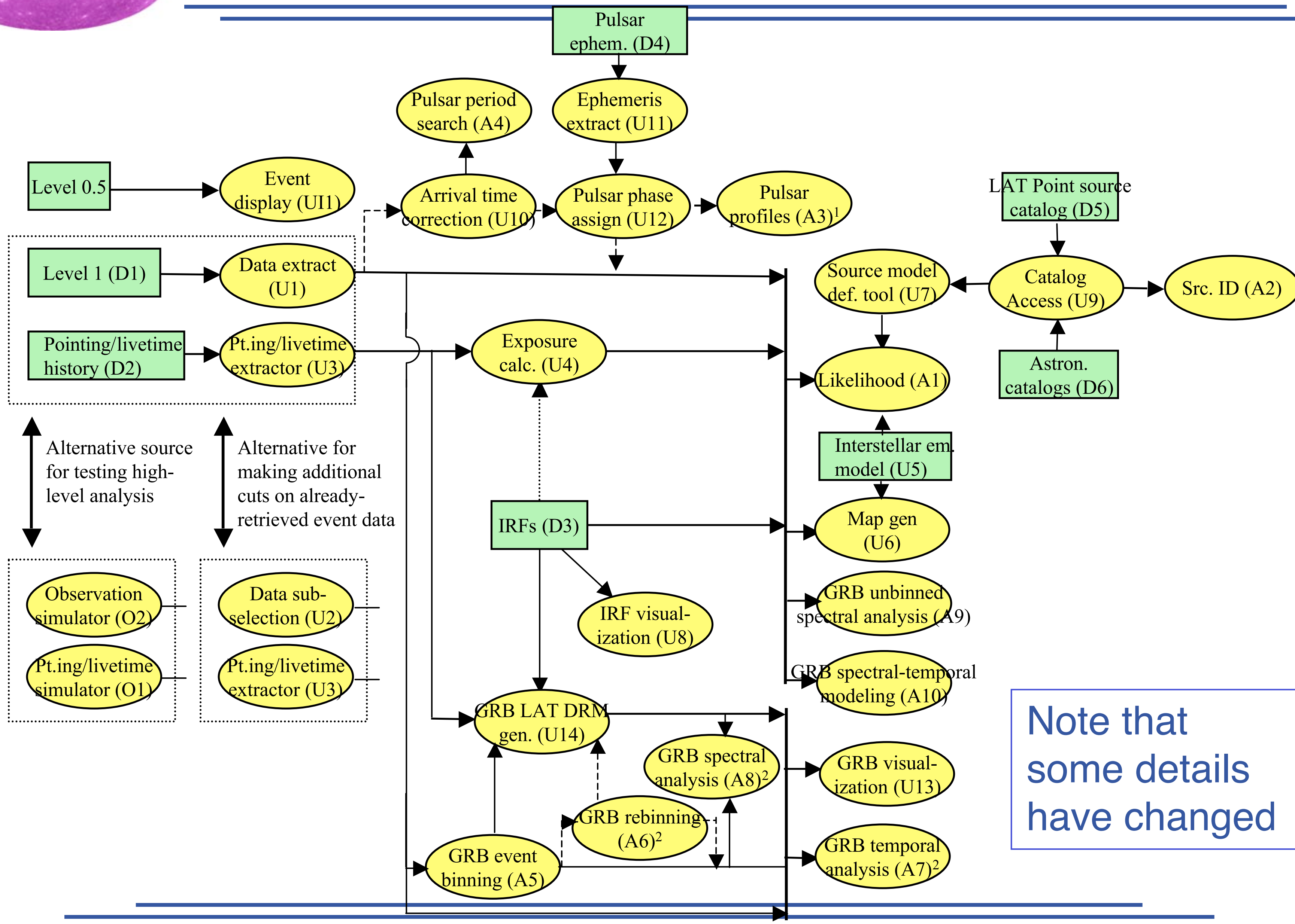
  Note that with aspect information—where the instrument was pointed as a function of time—there is a redundancy among the time and the apparent origins in sky and instrument coordinates.

- Therefore, a very large data space results. Even with 10^5 counts, this data space will be sparsely populated.

Planned Basic Analysis Strategy

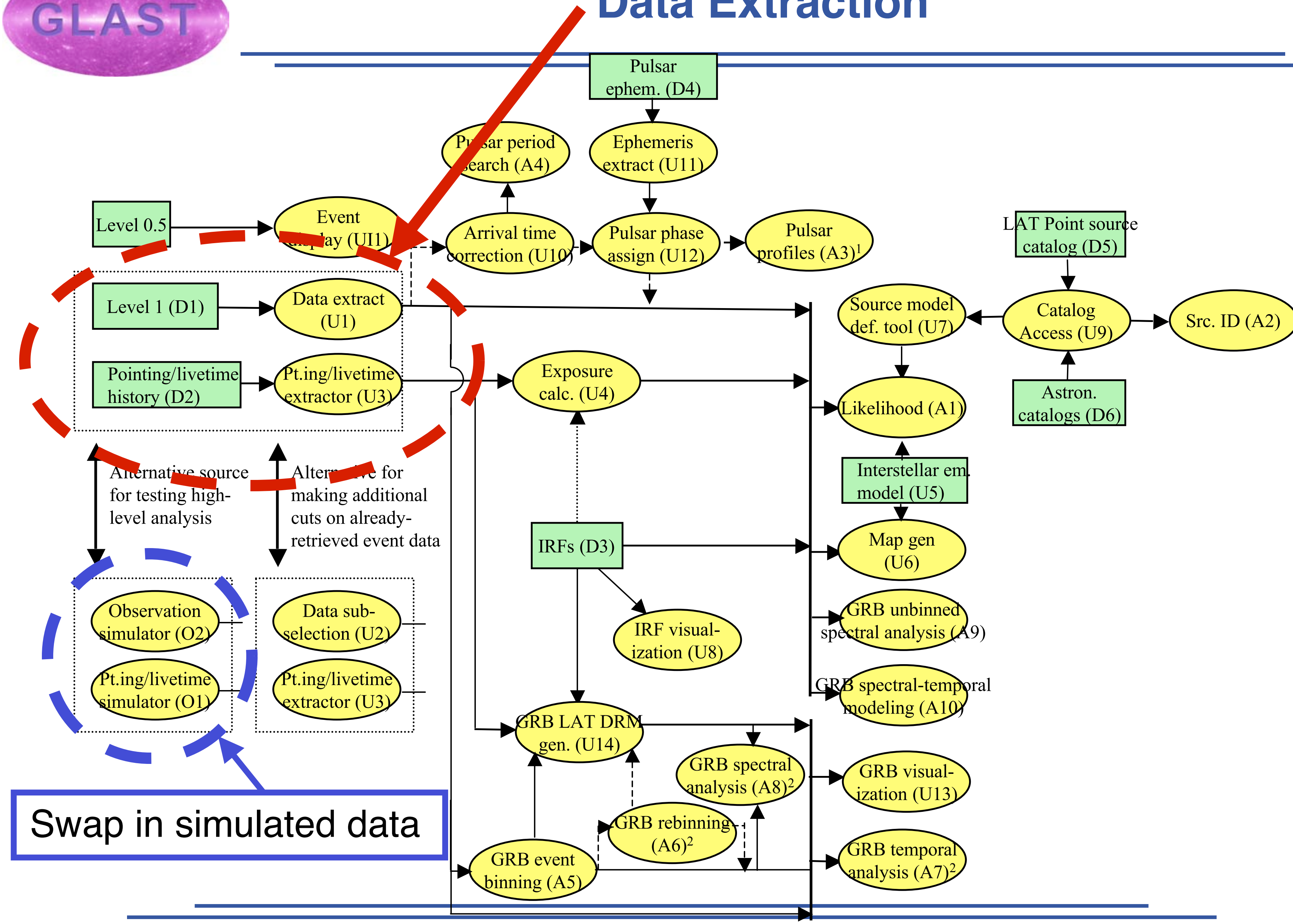
- We plan to detect sources, determine source intensities, fit spectral parameters, set upper limits, etc., using the likelihood Λ of the observed counts given a source model.
- Burst, pulsar analysis will take advantage of the source's temporal variations.
- Today methodology is the focus, but a schematic of the SAE architecture is helpful for context.

Schematic of SAE

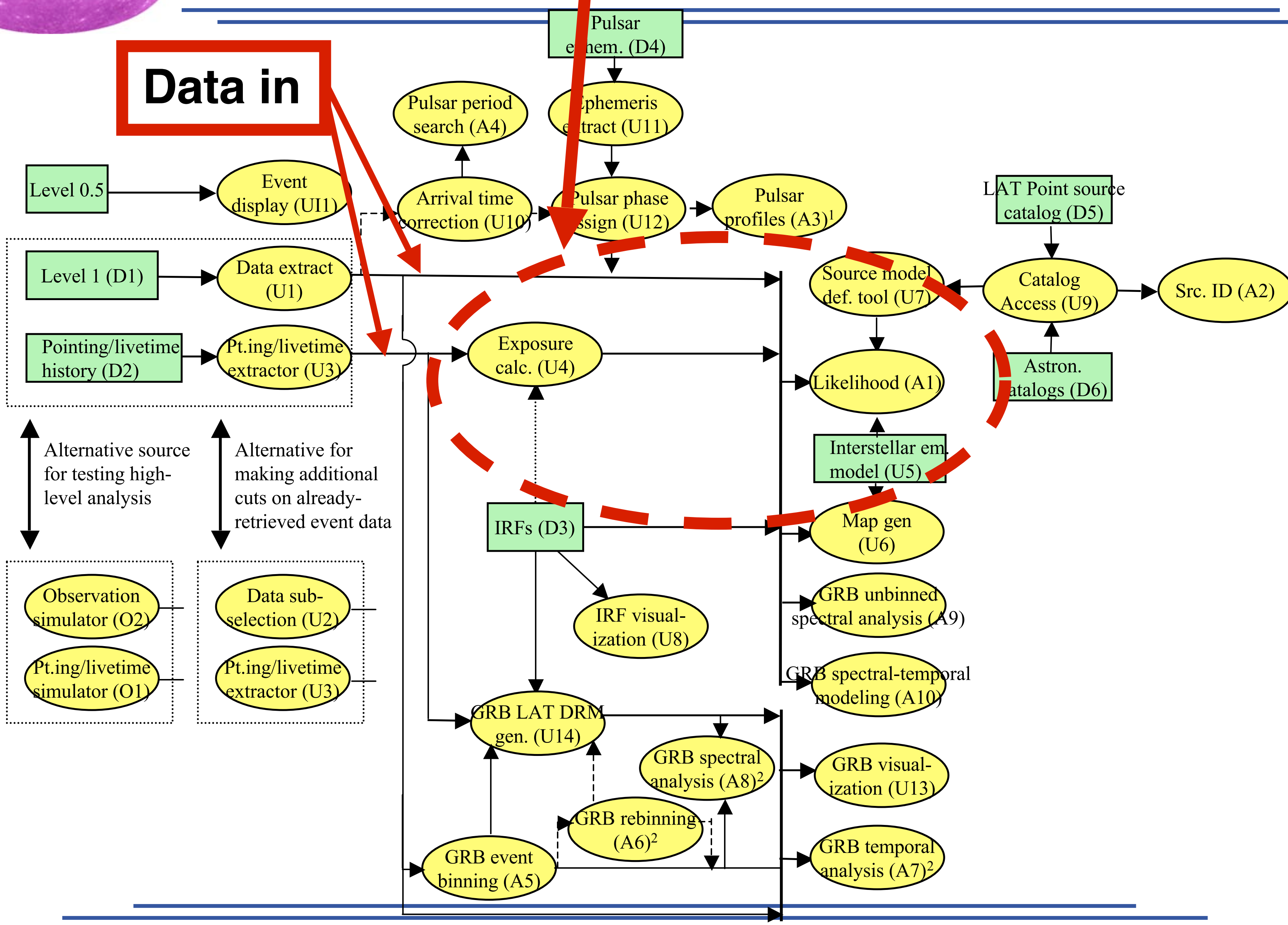


Note that some details have changed

Data Extraction

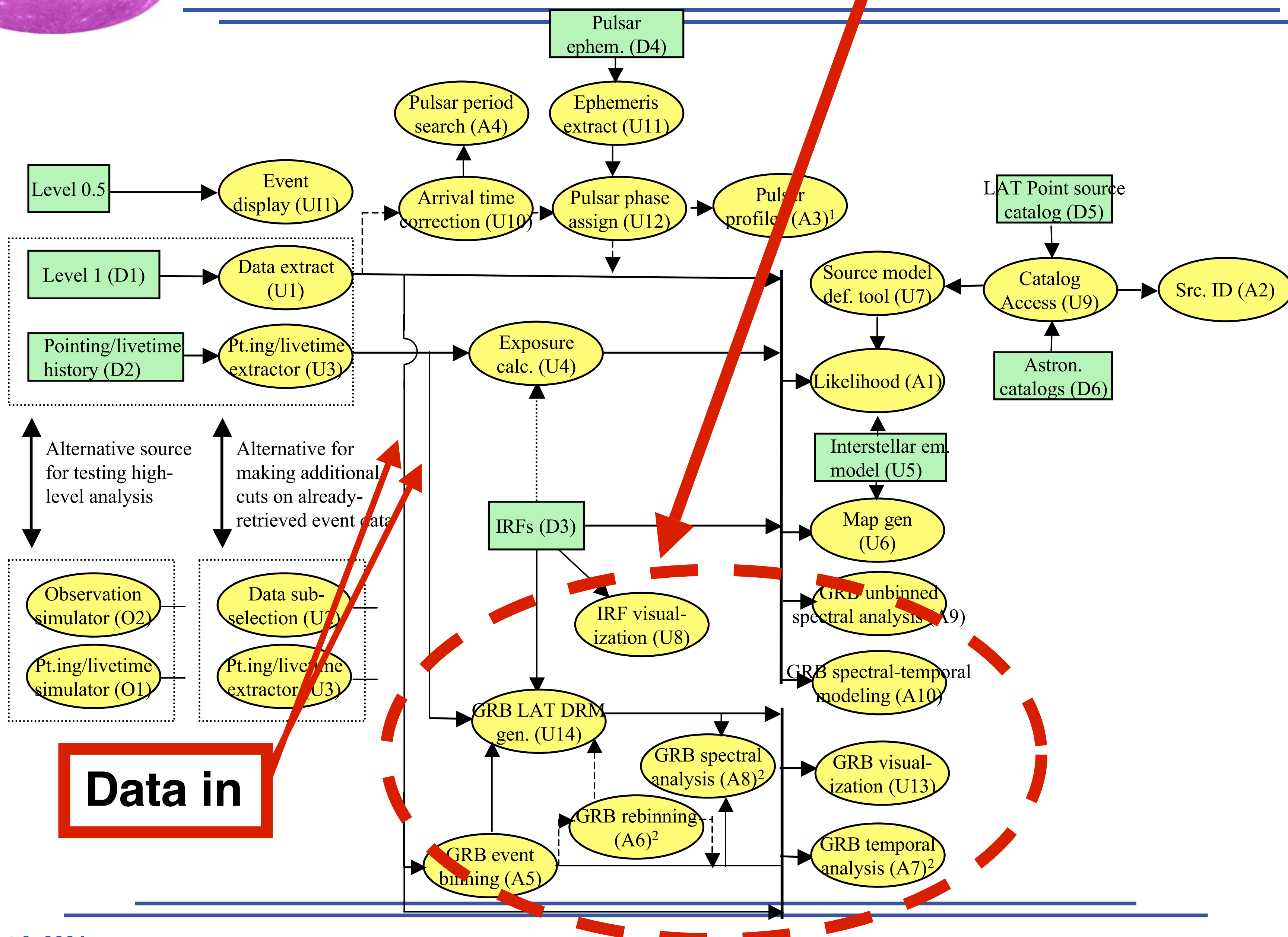


Likelihood



Data in
Pulsar ephem. (D4)
Pulsar period search (A4)
Ephemeris extract (U11)
Level 0.5
Event display (UI1)
Arrival time correction (U10)
Pulsar phase assign (U12)
Pulsar profiles (A3)1
LAT Point source catalog (D5)
Level 1 (D1)
Data extract (U1)
Source model def. tool (U7)
Catalog Access (U9)
Src. ID (A2)
Pointing/livetime history (D2)
Pt.ing/livetime extractor (U3)
Exposure calc. (U4)
Likelihood (A1)
Astron. catalogs (D6)
Alternative source for testing high-level analysis
Alternative for making additional cuts on already-retrieved event data
Interstellar em. model (U5)
IRFs (D3)
Map gen (U6)
Observation simulator (O2)
Data sub-selection (U2)
IRF visual-ization (U8)
GRB unbinned spectral analysis (A9)
Pt.ing/livetime simulator (O1)
Pt.ing/livetime extractor (U3)
GRB spectral-temporal modeling (A10)
GRB LAT DRM gen. (U14)
GRB spectral analysis (A8)2
GRB visual-ization (U13)
GRB rebinning (A6)2
GRB event binning (A5)
GRB temporal analysis (A7)2

GRB Tools



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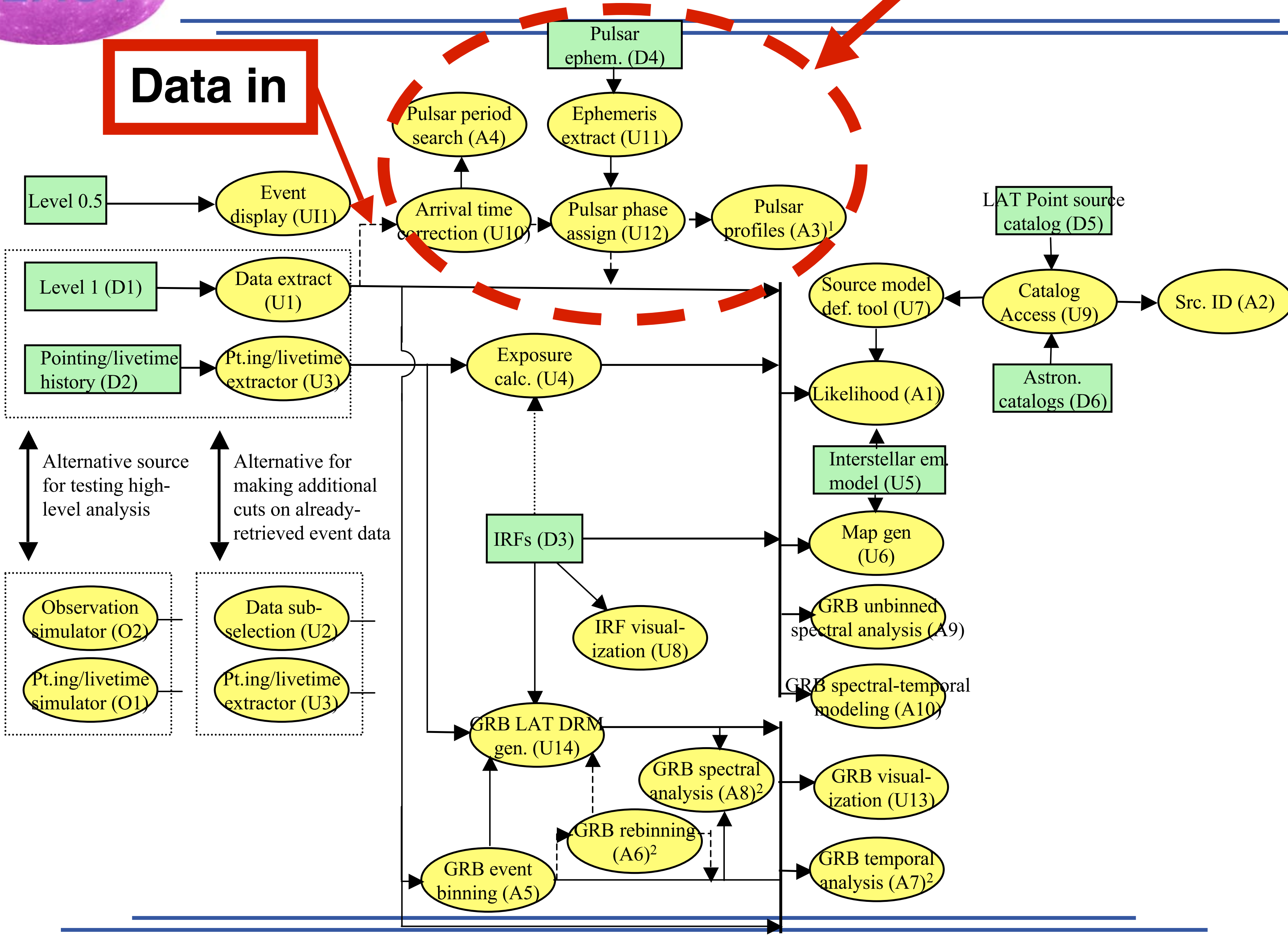
Pulsar Tools



Catalog Tools