Overview of SPIRE Photometer Pipeline

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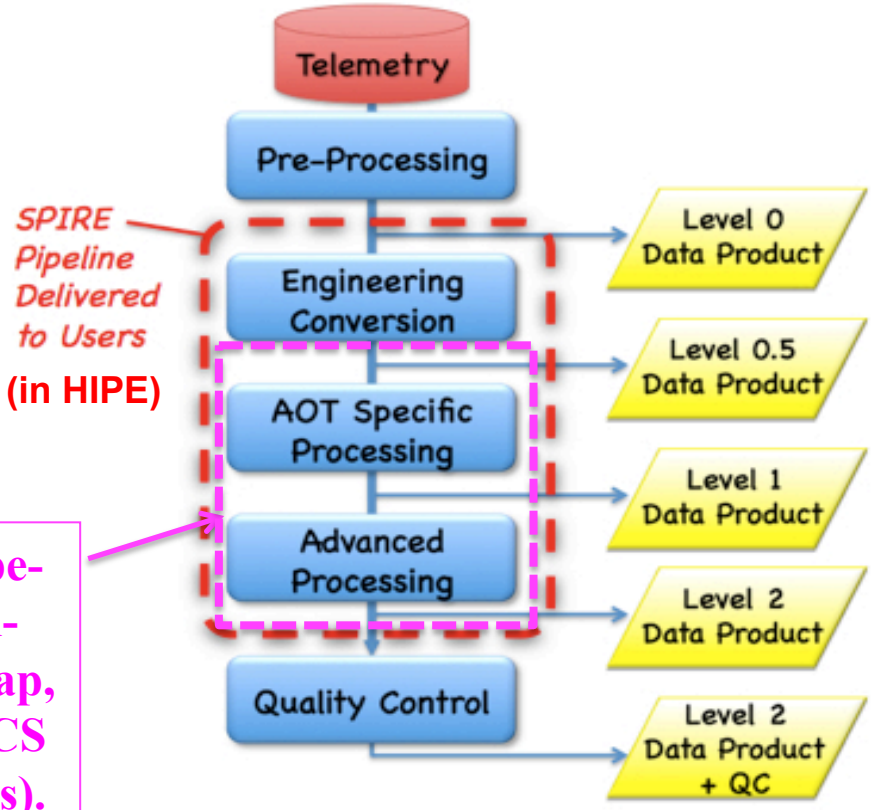
on behalf of the SPIRE ICC

The Goal

- Show how SPIRE Photometer pipeline works (functionalities of major modules).

Reference: *"SPIRE Data Reduction Guide"* in HIPE (under "Help") or in:
http://herschel.esac.esa.int/hcss-doc-11.0/load/spire_drg/html/spire_drg.html

Pipeline & Data Products



Scan Map Pipeline (for small-map, large-map, & SPIRE/PACS parallel modes).

New in HIPE 11 (only in archive data from HSA) →

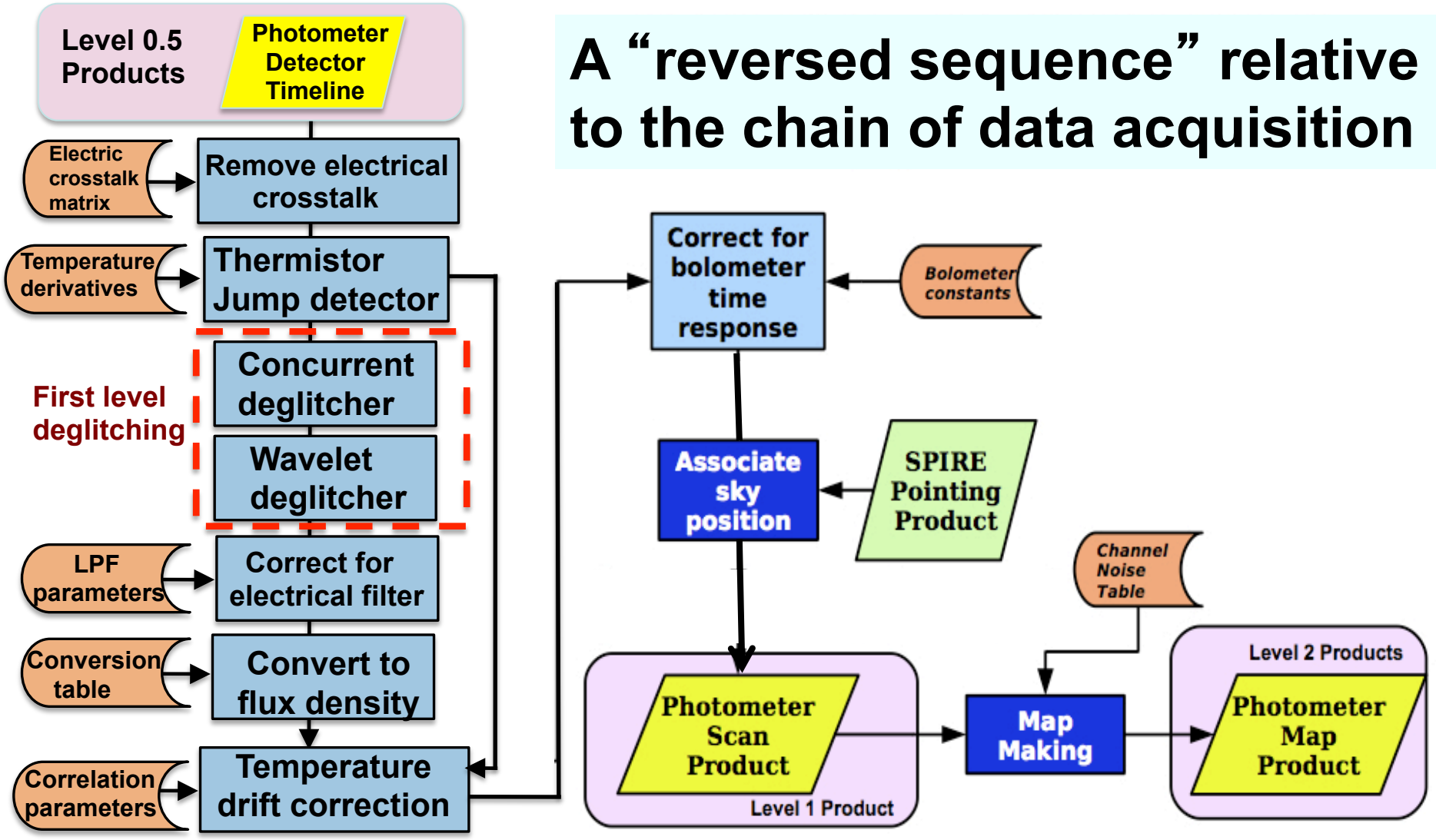
Level 2.5 Data Product

- **Maps of combined parallel observations with cross-scans**

Level 3 Data Product

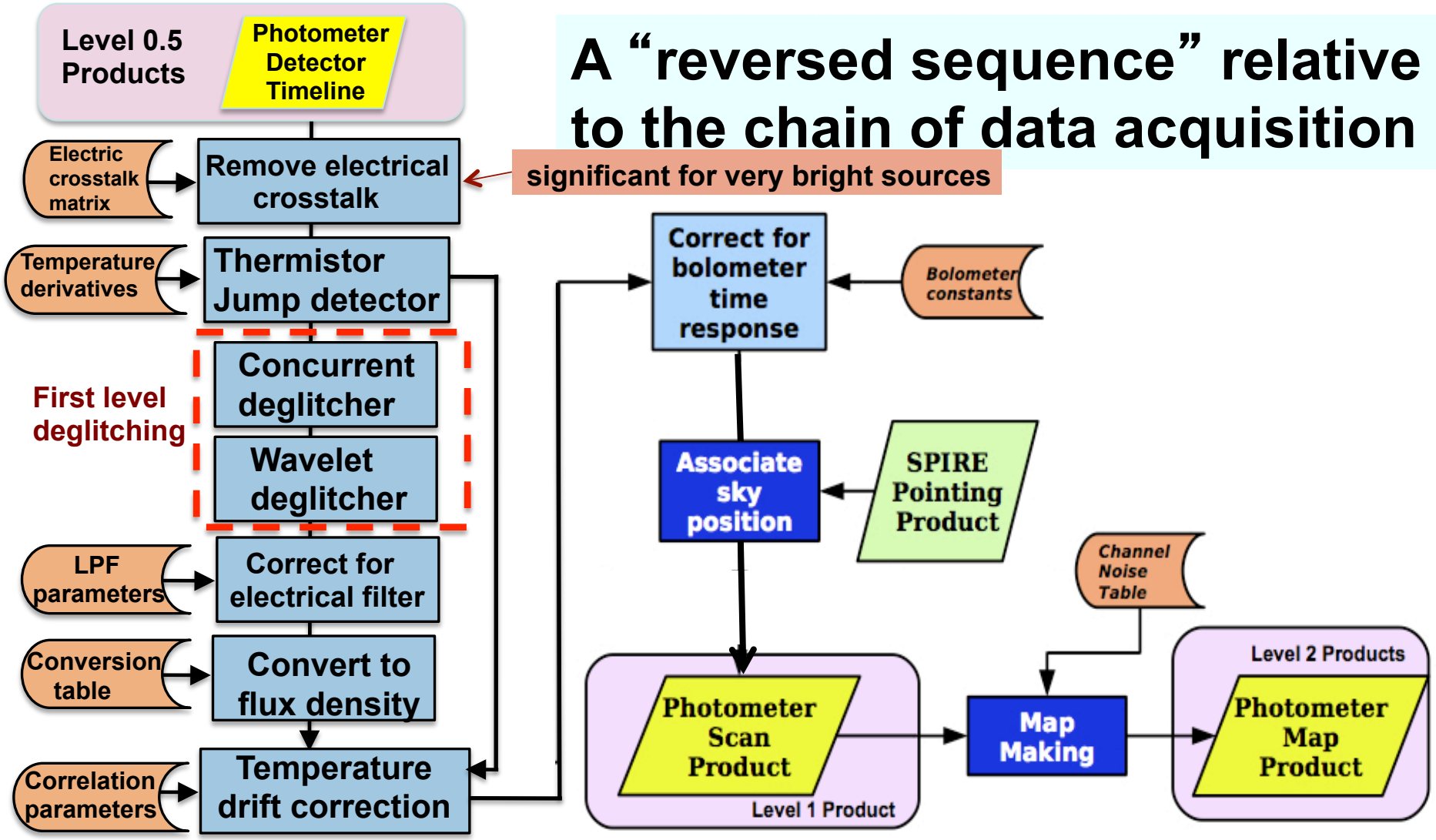
- **Maps of overlap observations belonging to the same proposal**

Scan Map Pipeline Flow Chart



A "reversed sequence" relative to the chain of data acquisition

Scan Map Pipeline Flow Chart



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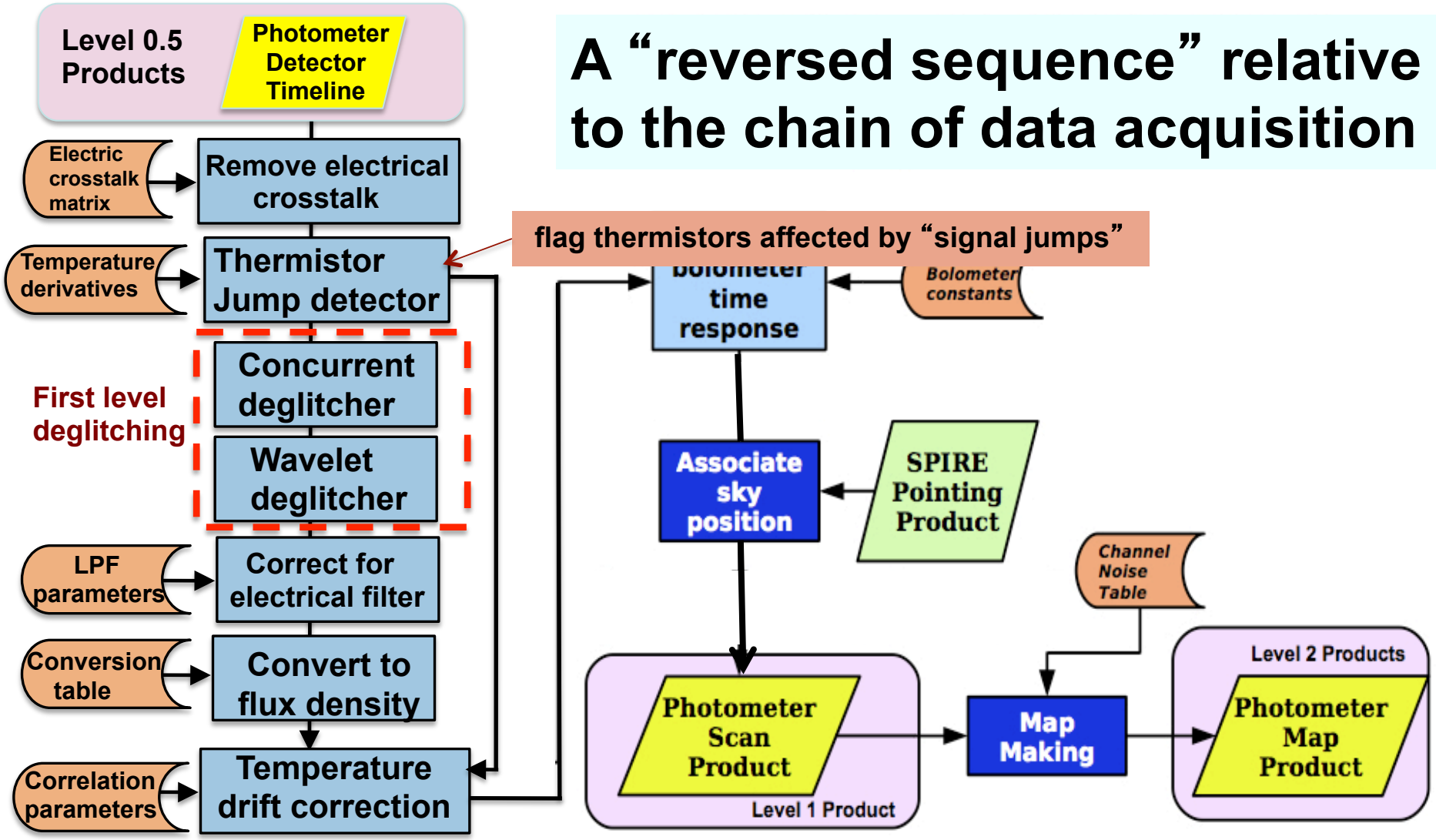

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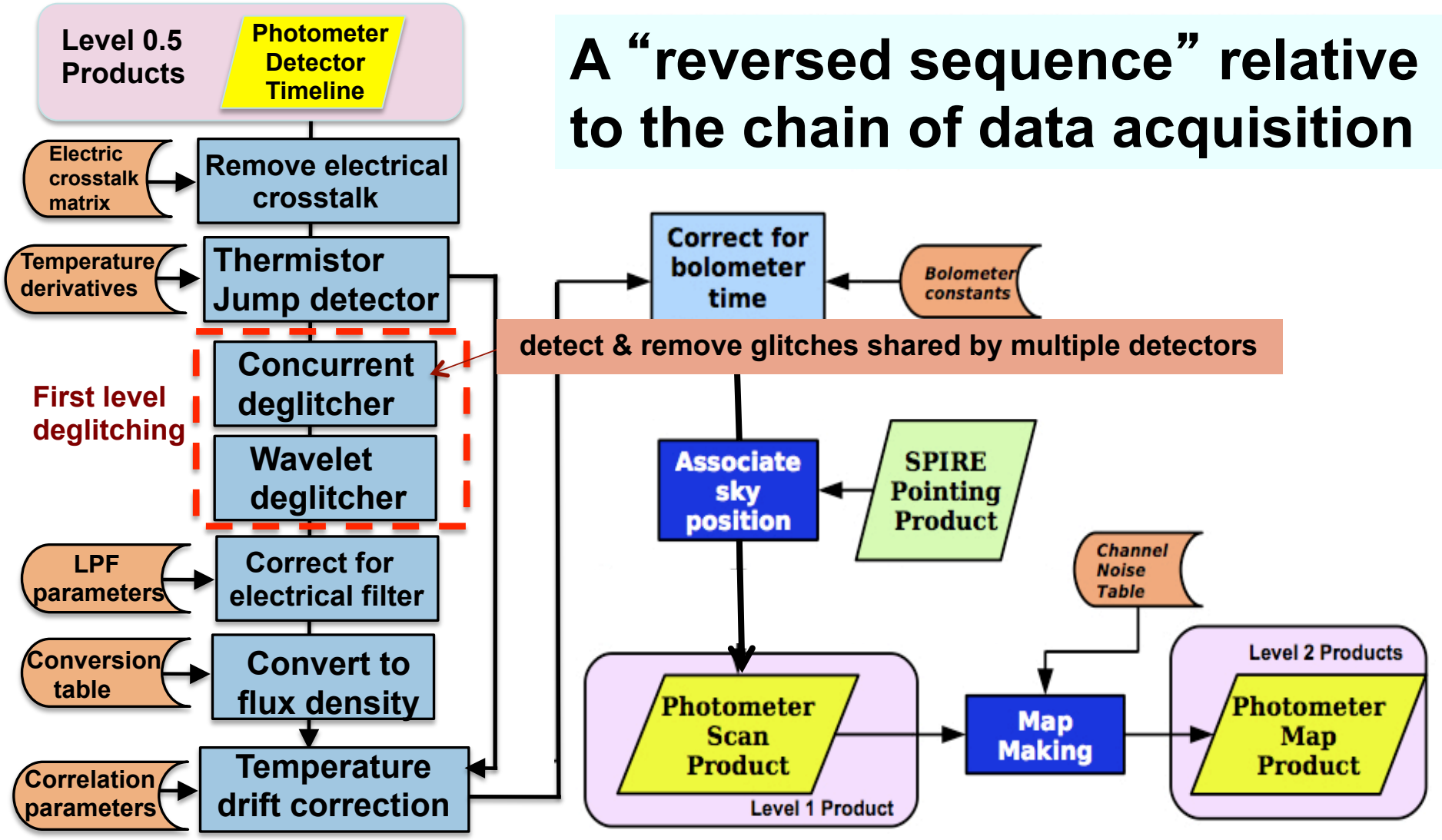

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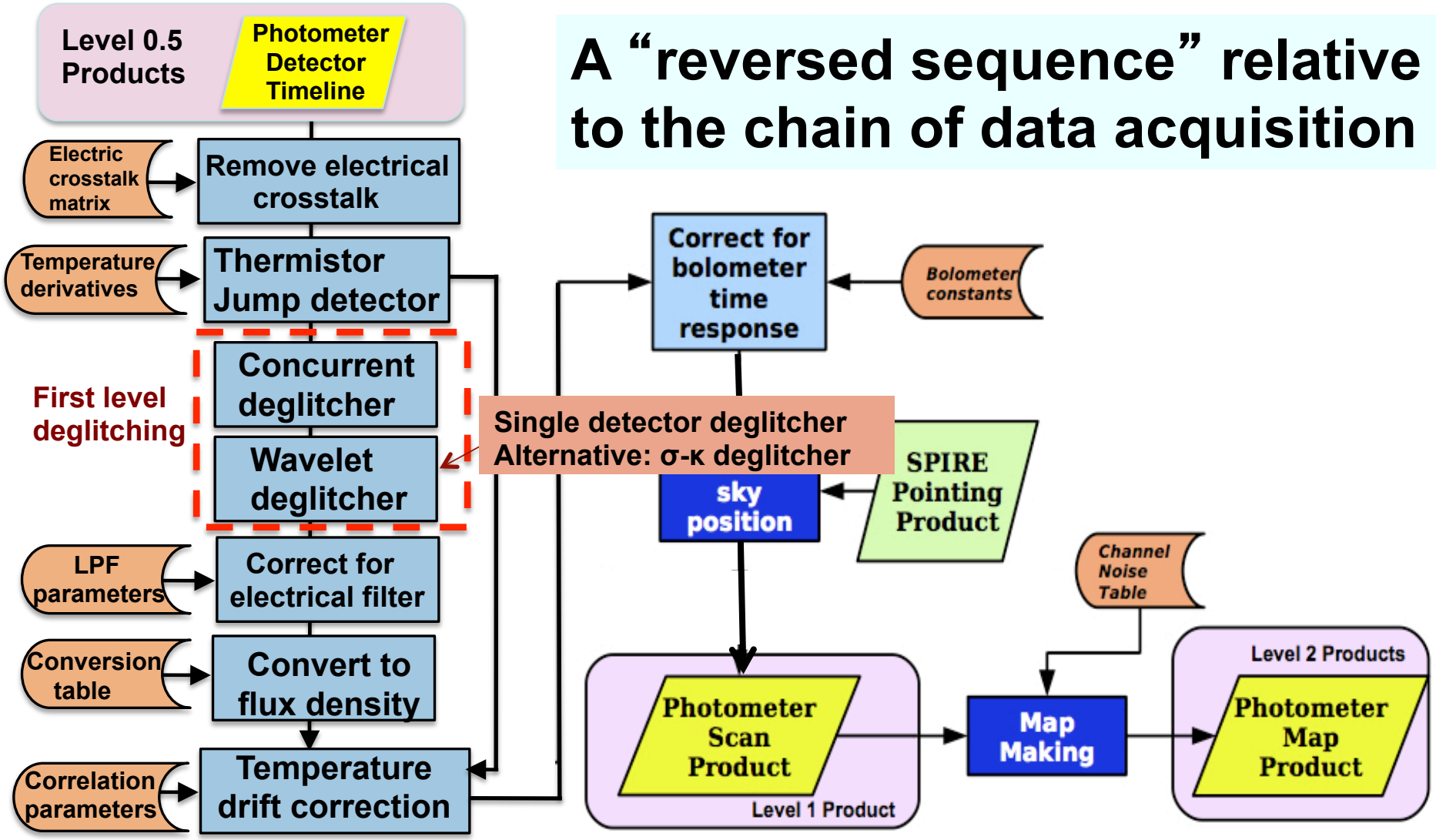

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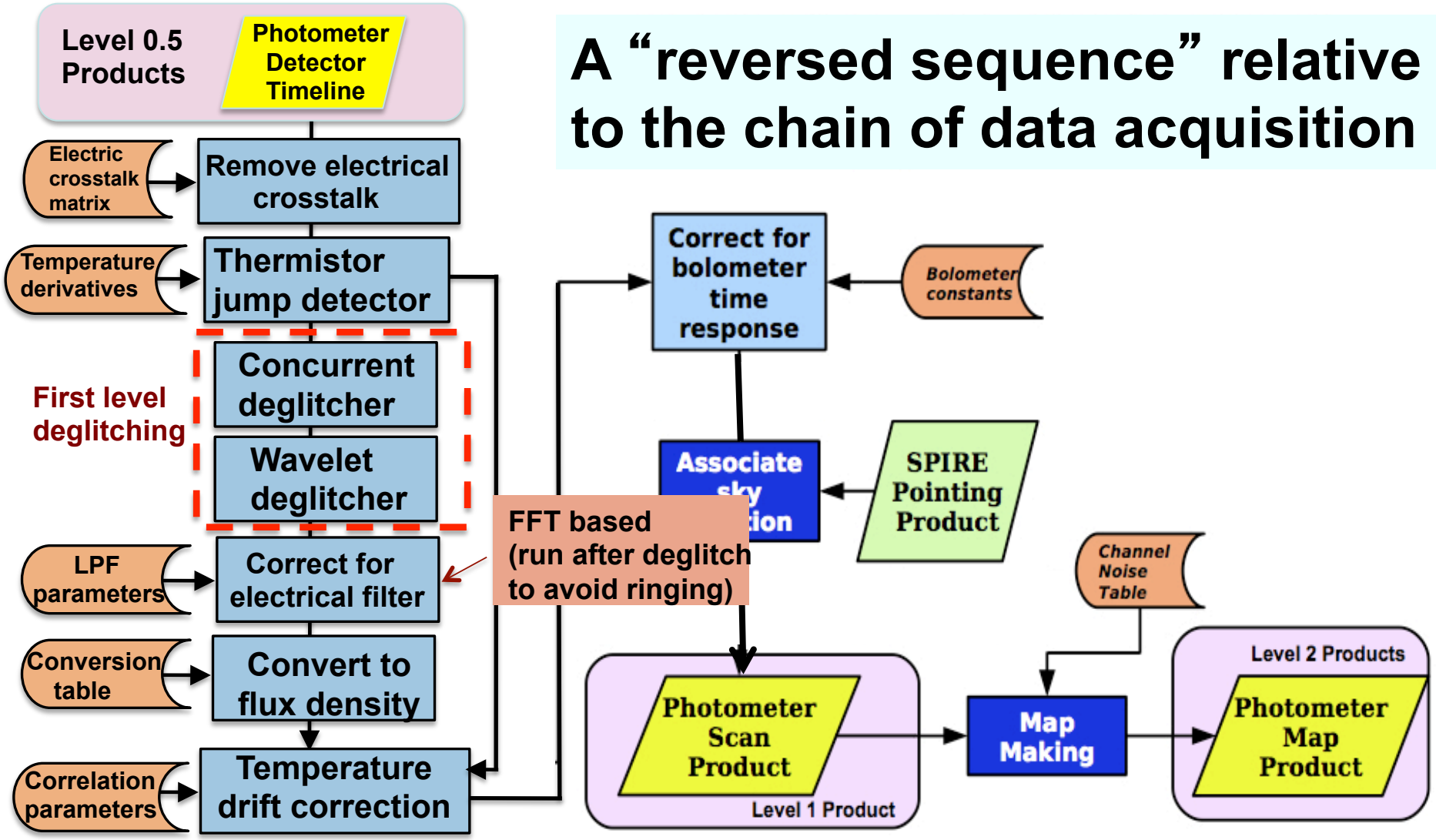

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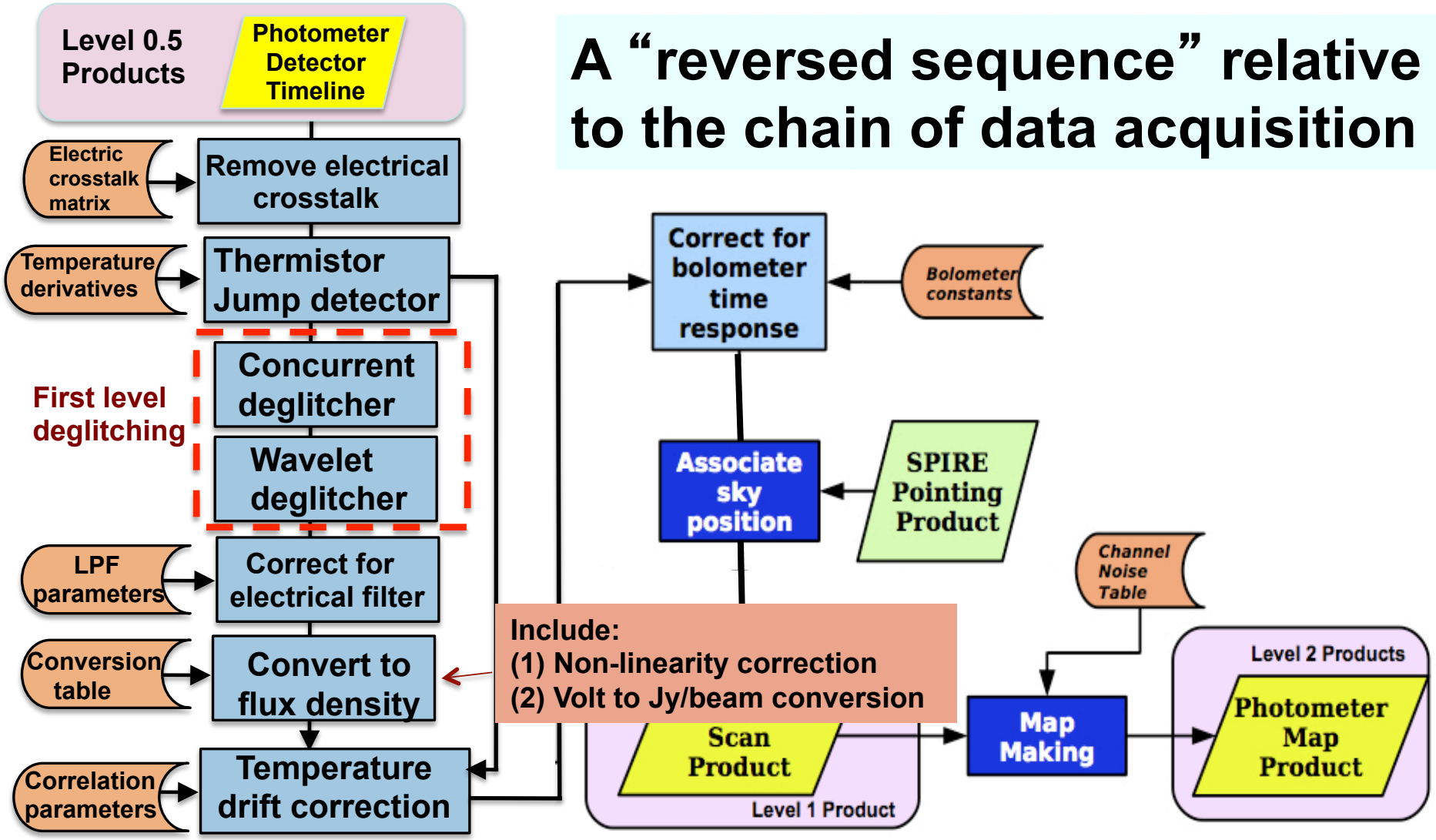

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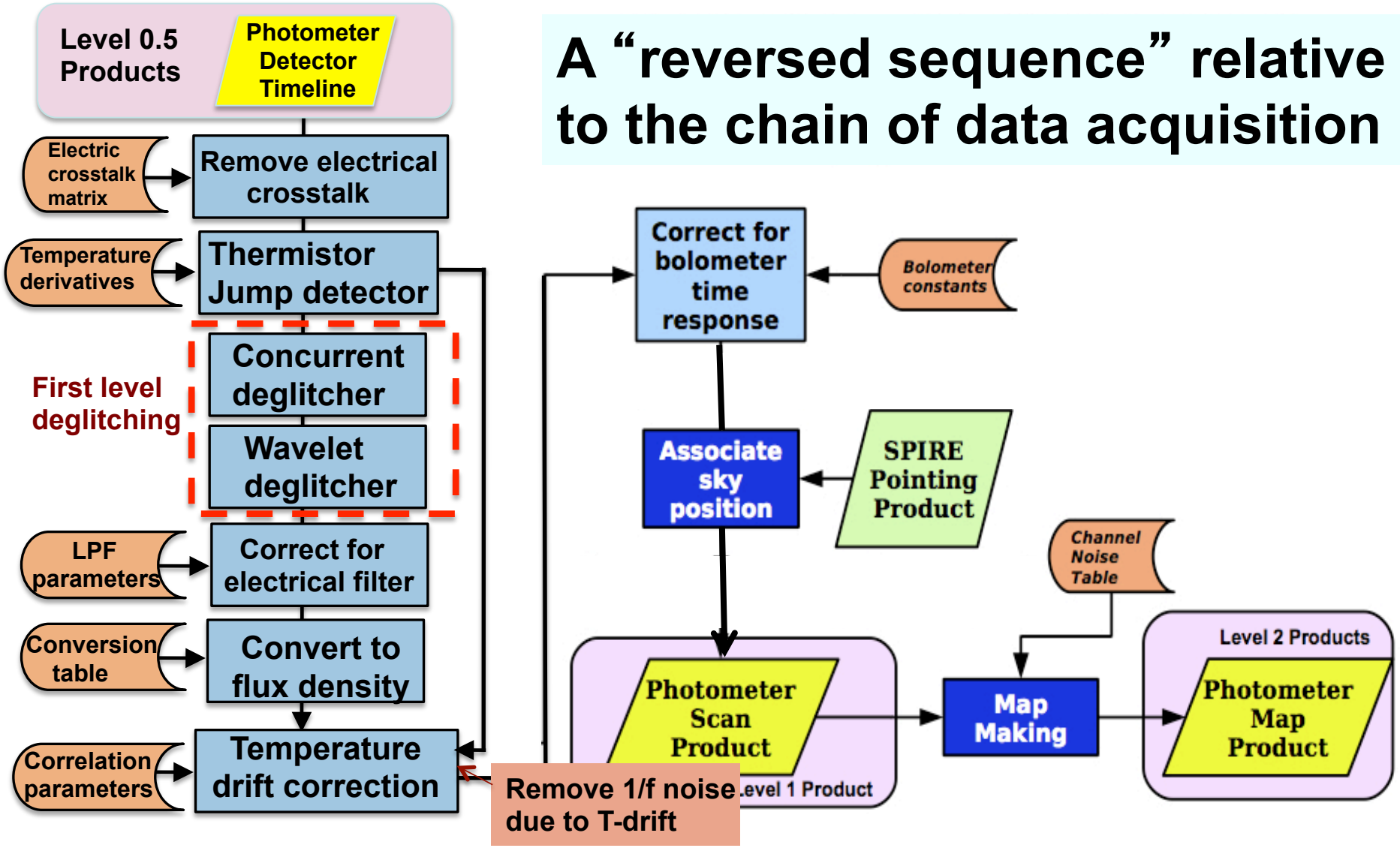

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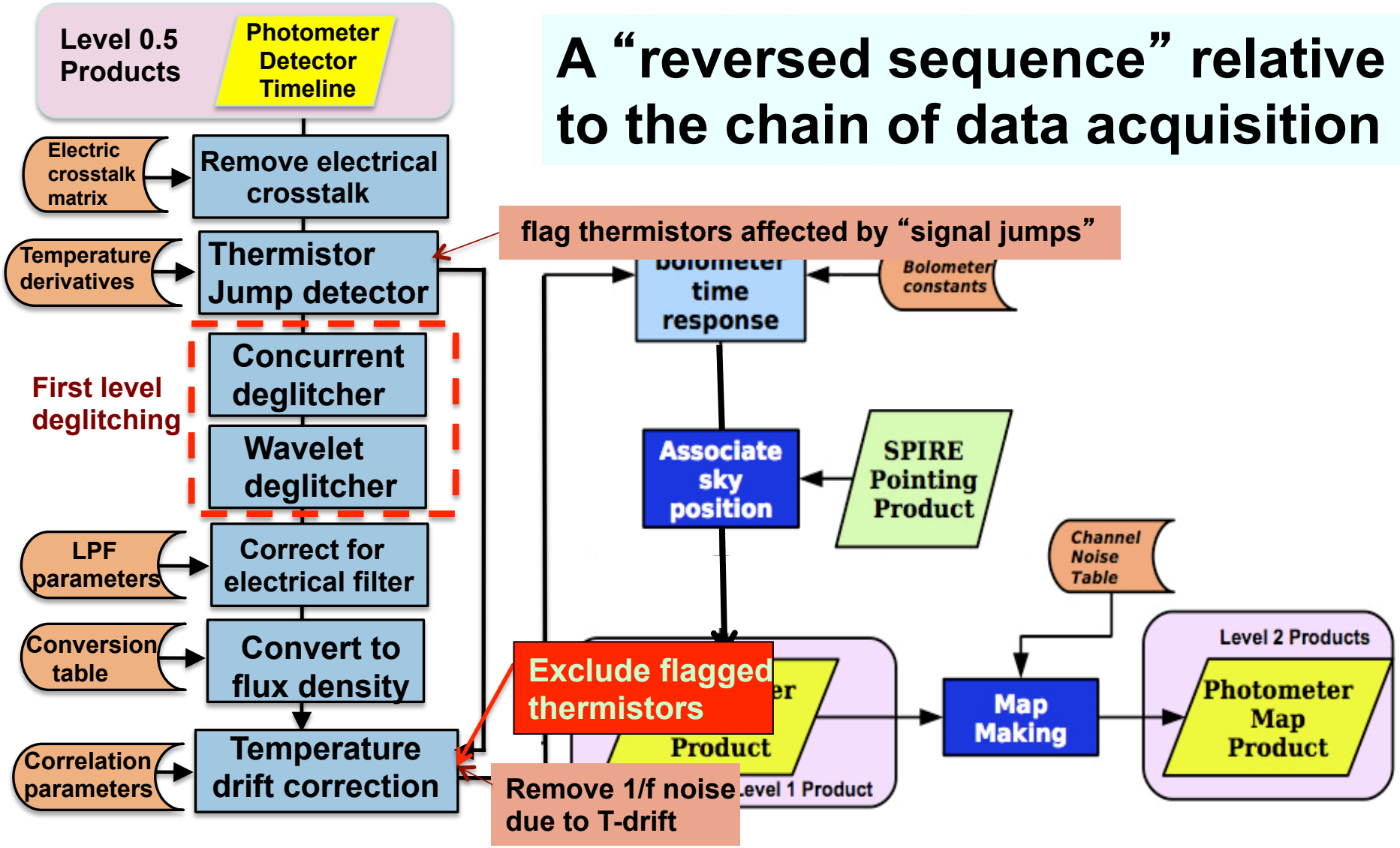

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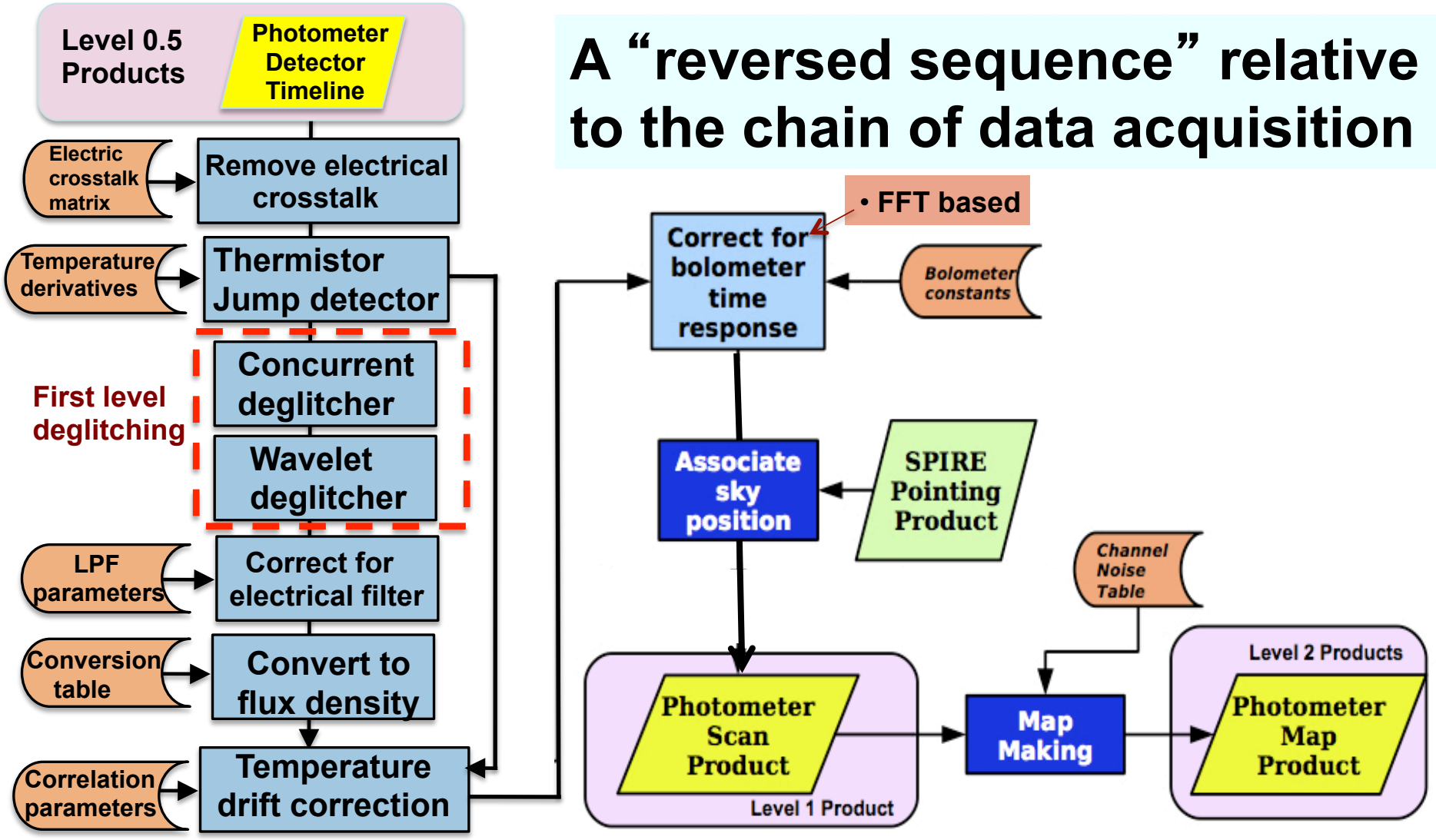
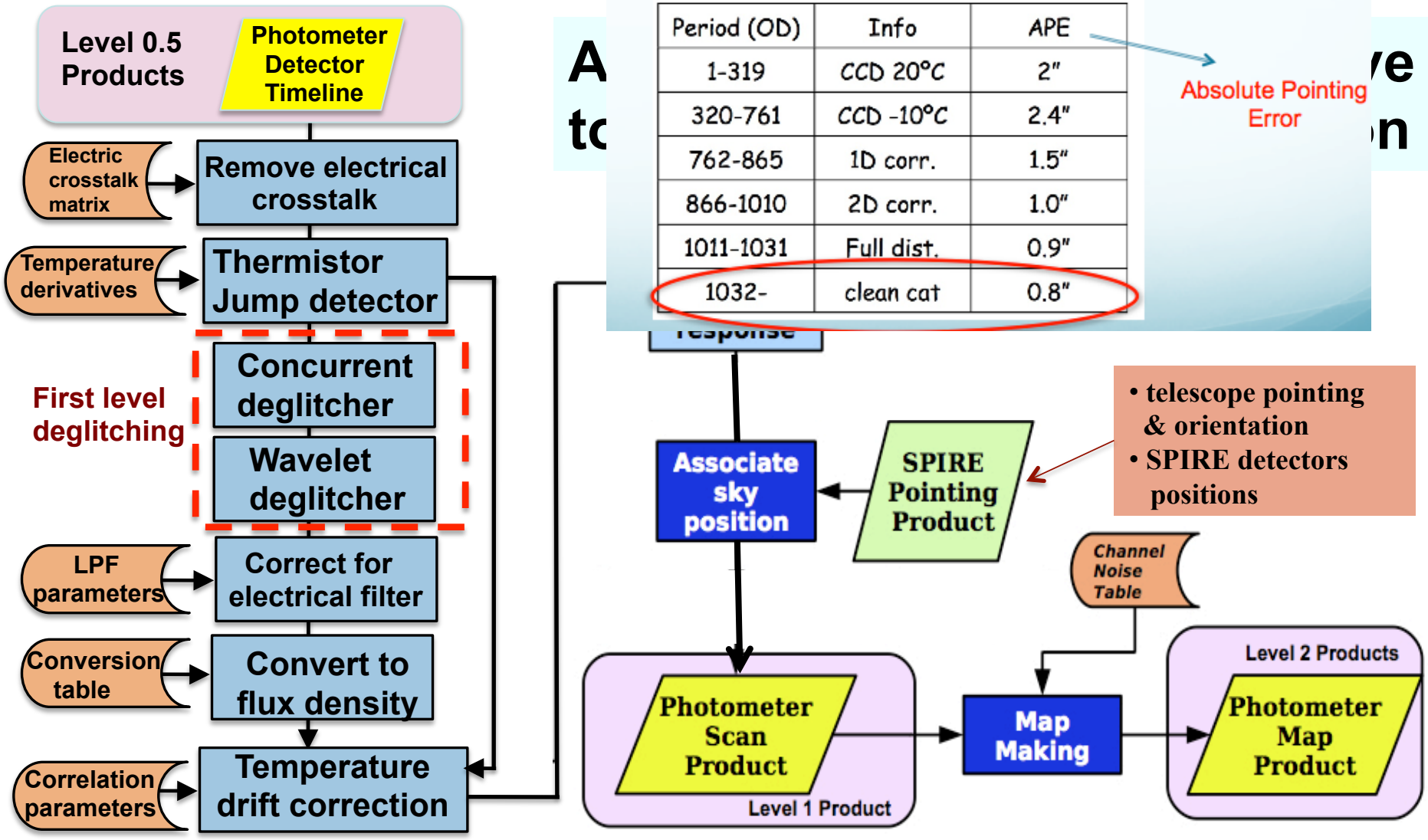
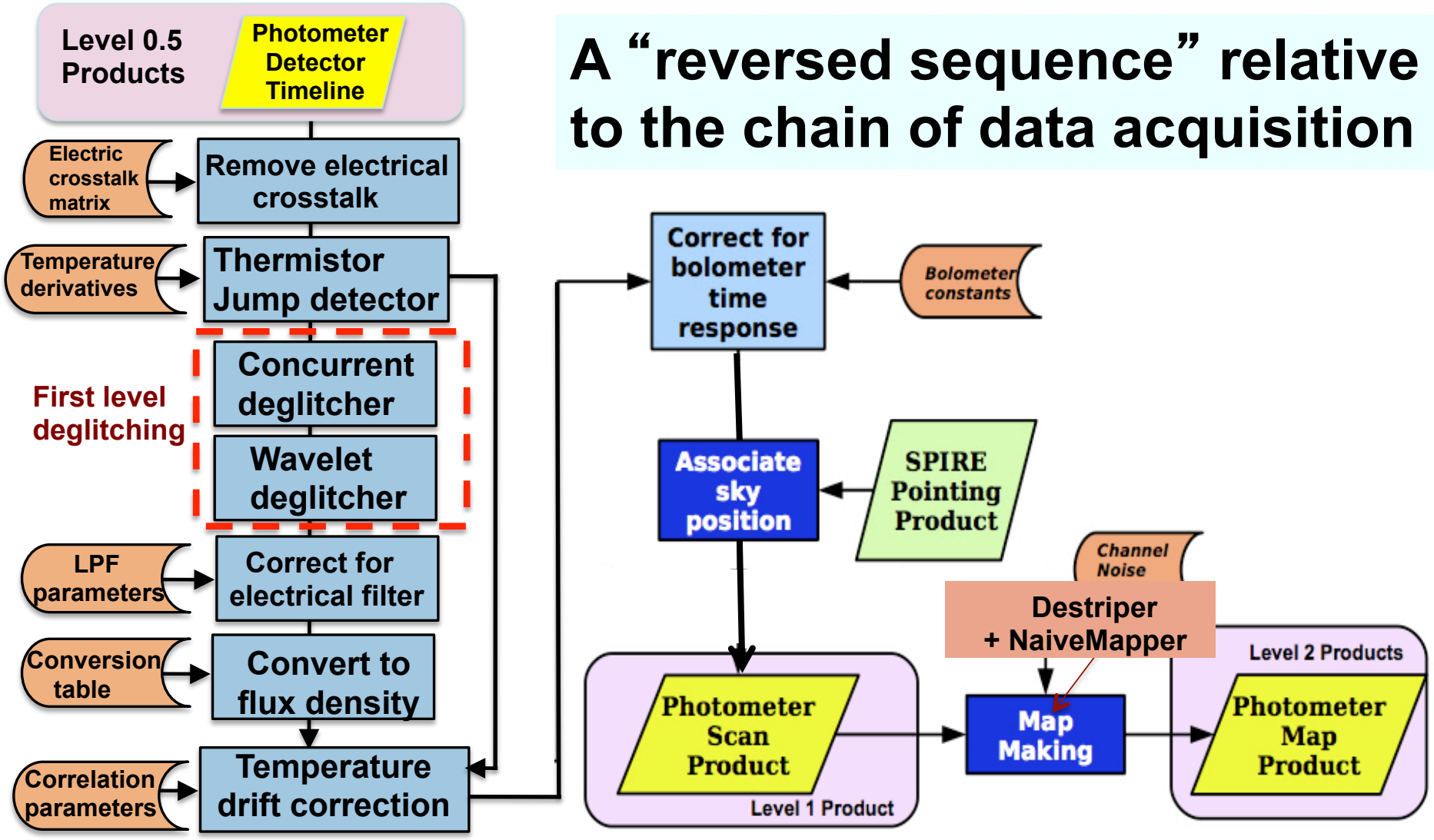


Scan Map Pipeline Flow Chart



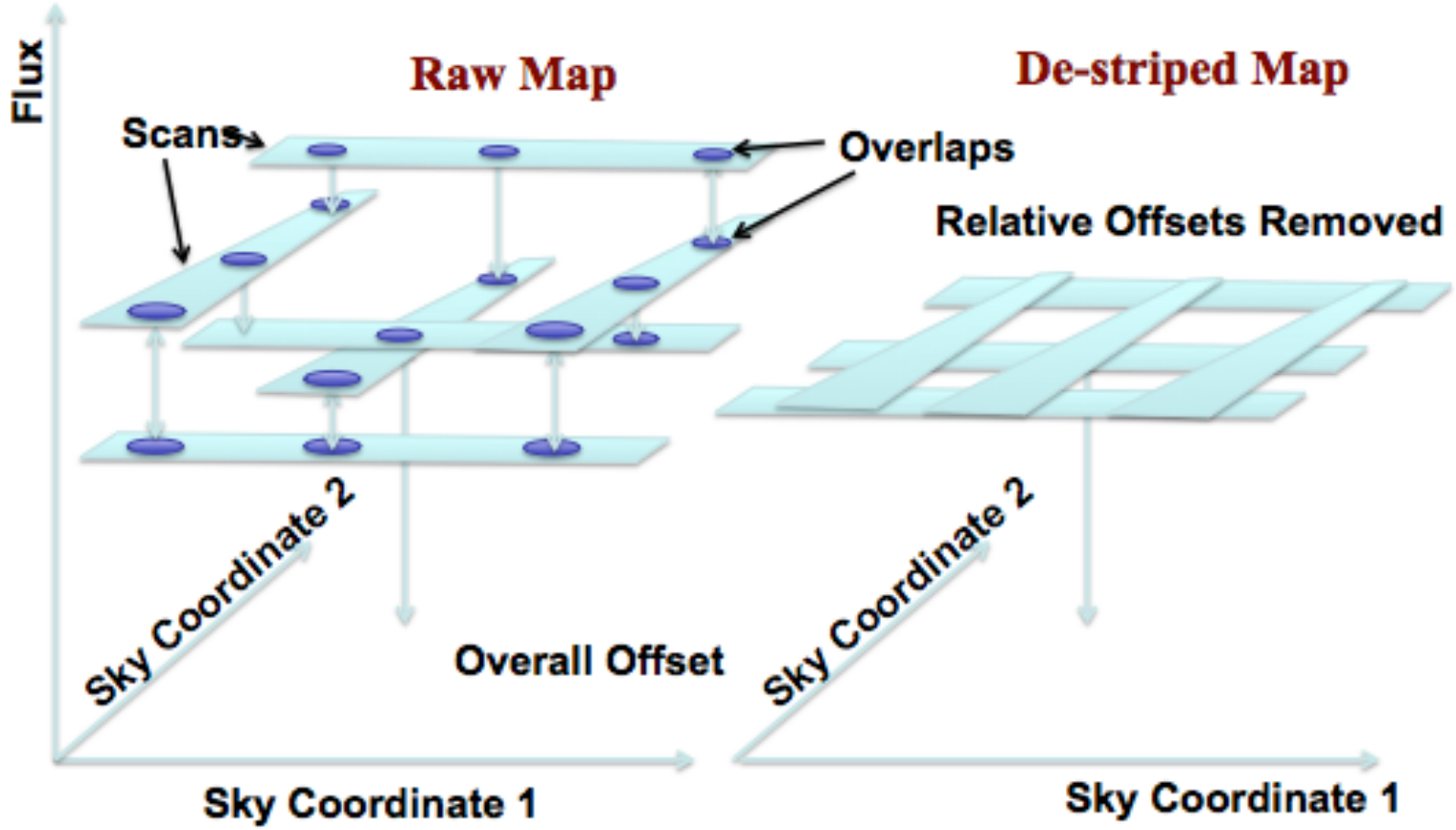
Scan Pipeline Flow Chart



A "reversed sequence" relative to the chain of data acquisition

Destriper: Offsets Removal

Destriper: remove the relative offsets of timelines of individual bolometers by minimizing the dispersions in overlap sky pixels (using the Naïve-Mapper iteratively).

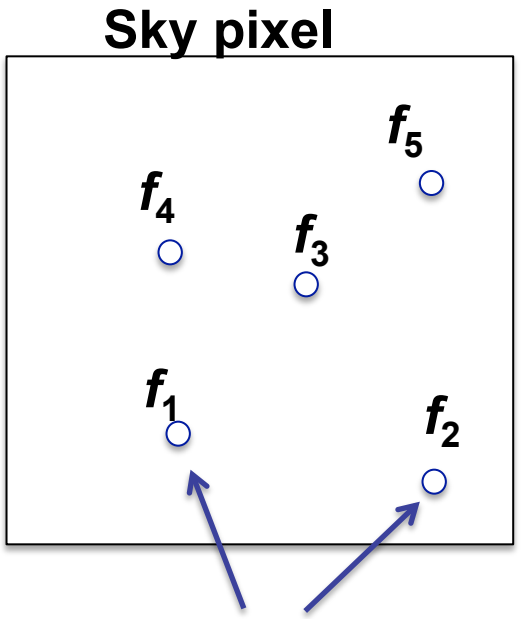


SPIRE Naïve Mapper

Two options:

(1) **No weighting** (pipeline default): Flux of a sky pixel is the **simple average** of all signal samplings (by all bolometers) in the pixel:

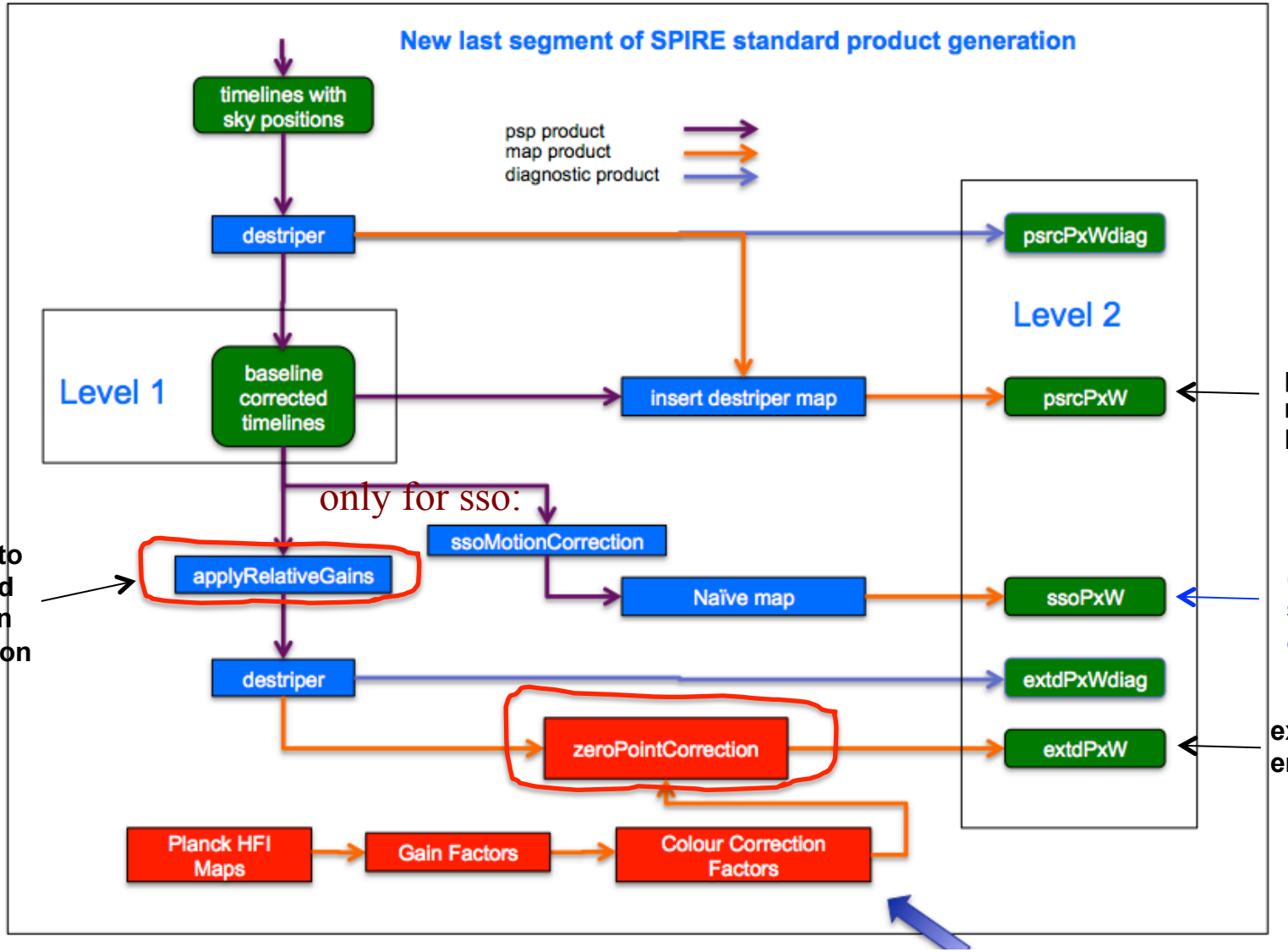
$$f_{pixel} = \frac{\sum_i^n f_i}{n}, \qquad error_{pixel} = \sqrt{\frac{\sum_i^n (f_i - f_{pixel})^2}{n(n-1)}}$$



(2) **Inverse variance (of instrument noise) weighted:** Flux of a sky pixel is the **inverse variance weighted mean** of all signal samplings in the pixel, the variance is calculated using the white noise of the bolometer with which a given sampling is taken:

$$f_{pixel} = \frac{\sum_i^n f_i/\sigma_i^2}{\sum_i^n 1/\sigma_i^2} \qquad error_{pixel} = \sqrt{\frac{\sum_i^n (f_i - f_{pixel})^2/\sigma_i^4}{\left(\sum_i^n 1/\sigma_i^2\right)^2 - \sum_i^n 1/\sigma_i^4}}$$

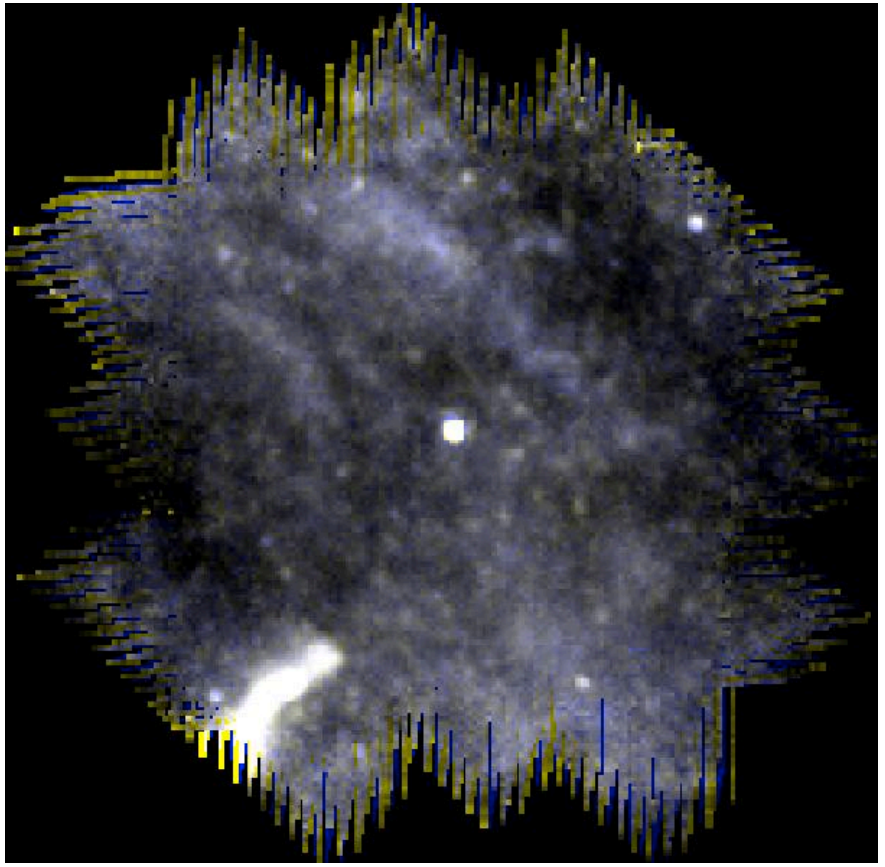
Details on Level 2 Products Generation



Status of SPIRE Photometer Pipeline in HIPE 11.0

- General assessment
  Overall, It works very well.
  In most cases, data from HSA are already of science quality!
- The official calibration accuracy is ±6% (4% from model, 2% RMS).
- An example (on the right):
  The image from HSA looks good.

SPIRE 3-color map of NGC 5315 (a planetary nebula)



(Public data taken from HSA)

Summary

- SPIRE Photometer Scan Map Pipeline handles data in the following observational modes: Small Map, Large Lap, SPIRE/PACS Parallel Mode.
- Corrections for instrumental effects (between Level 0.5 and Level 1 products) follow a "reversed sequence" relative to the chain of data acquisition.
- The map-making (between Level 1 and Level 2 products) is carried out using a Destriper-NaiveMapper combination.
- The current pipeline (HIPE 11.0.1) does a good job ("science ready") in general.
- In subsequent talks, we will discuss how to use the "user pipelines" (HIPE scripts) and other tools in HIPE to resolve data problems caused by known issues.