OPTICS UPDATE

Université de Montréal
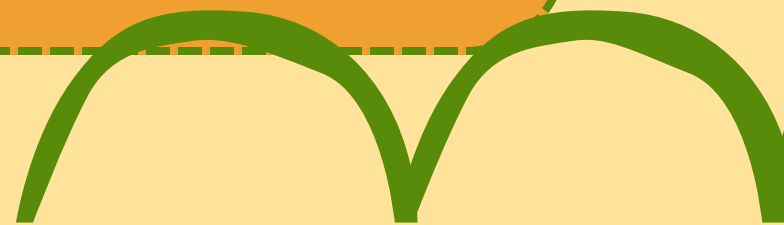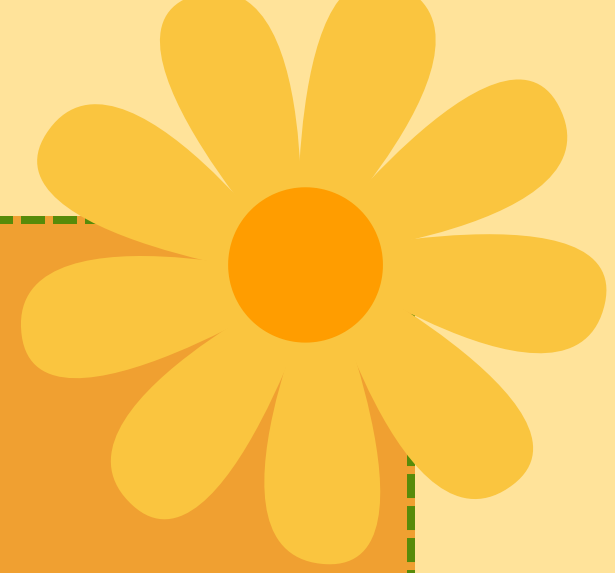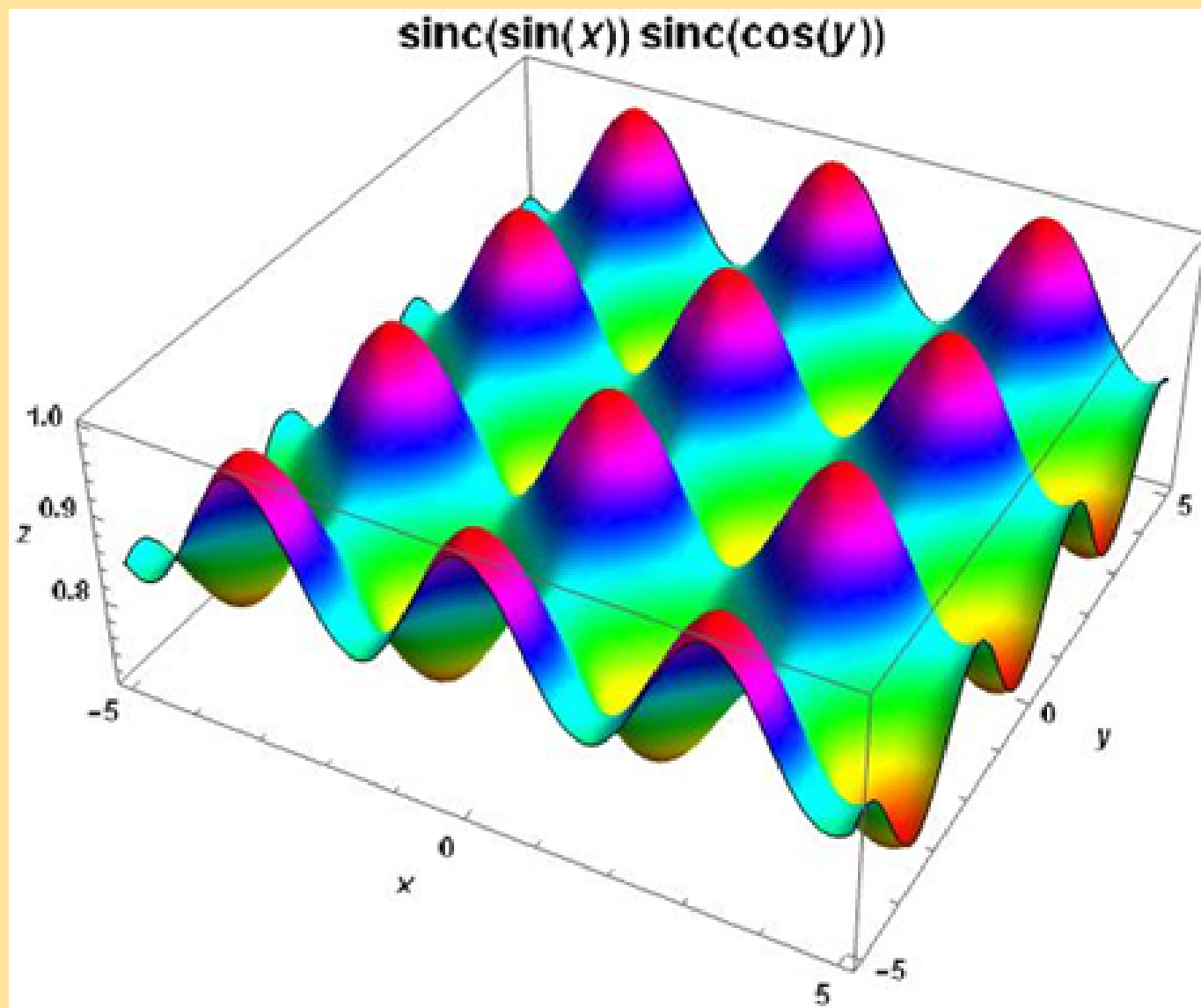
PICO

By Jeremy Savoie

RAY TRACING UPDATE

- Translated into python
- Improved code structure with focus on PICO-500 implementation
- Still some issue with LUT, but otherwise fully functional
- Current work on jar defect with aim to tackle low z region and dome

JAR DEFECT

sinc(sin(x)) sinc(cos(y))

Proposal from a recent software meeting:
- Variation in the scattering angle (milliradian scale)
  - Periodic surface
- Thickness variation (0.5mm), jar bubble (??)

Uncertainty proposal

Following feedbacks from a recent analysis meeting

- Previously used the wall thickness as the uncertainty, but difference front to back
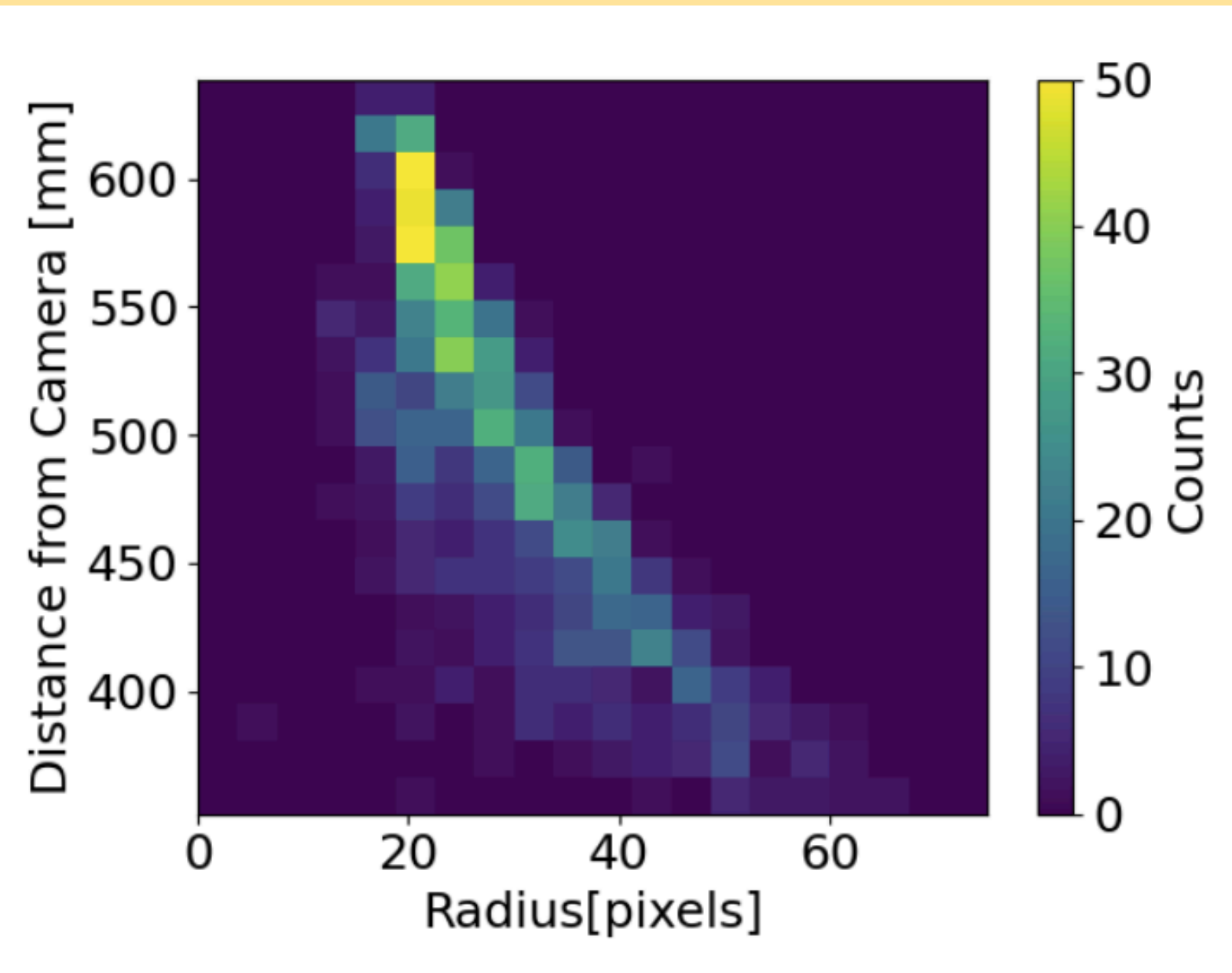- Low z and dome have poor reconstruction
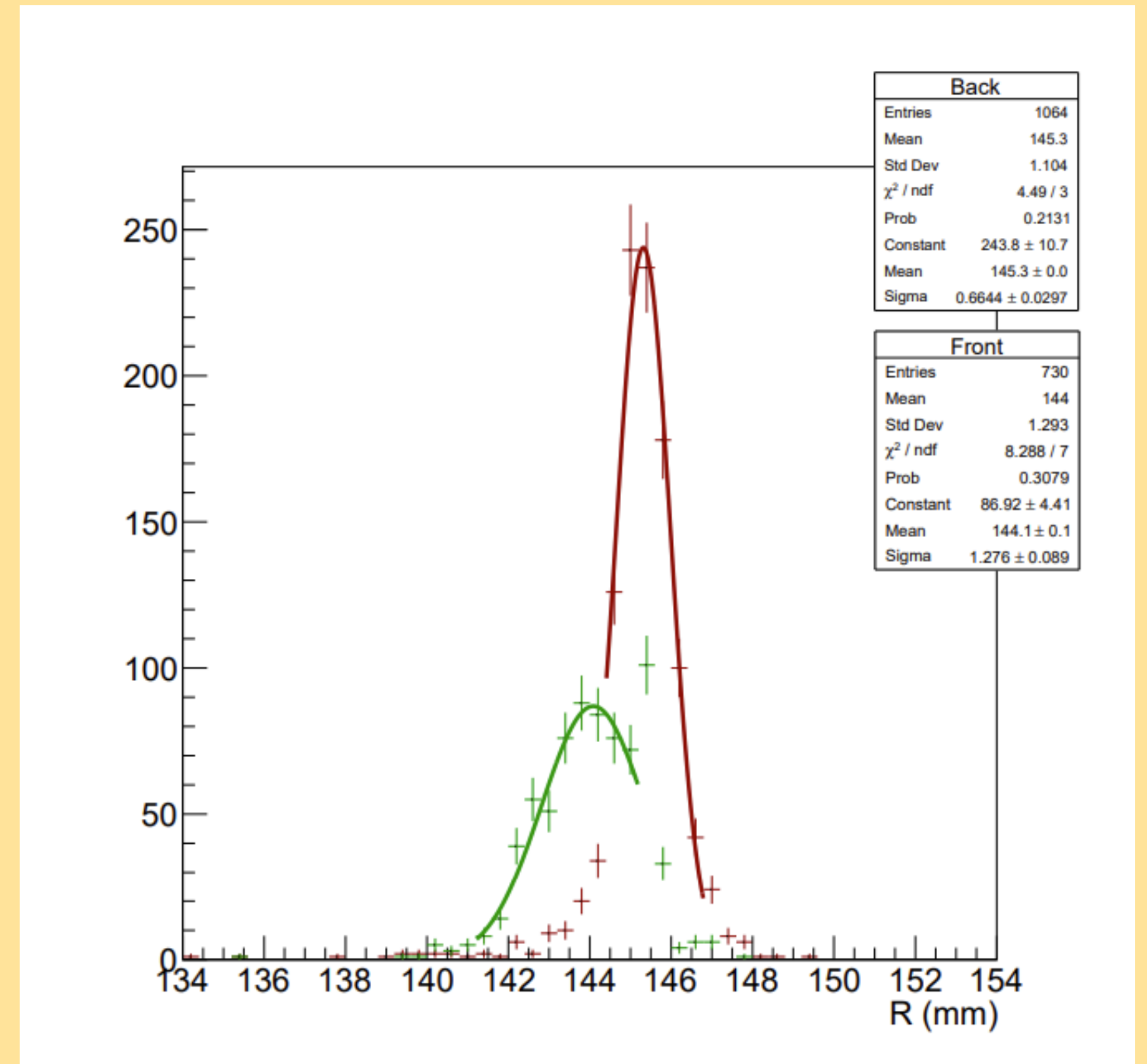
Pitam's thesis

UNCERTAINTY TEST

Bubble size

- Seems like the bubble size distribution is consistent and roughly uniform in the jar
- From this assumption, we can use a 2D bubble size distribution to determine the uncertainty in the position reconstruction
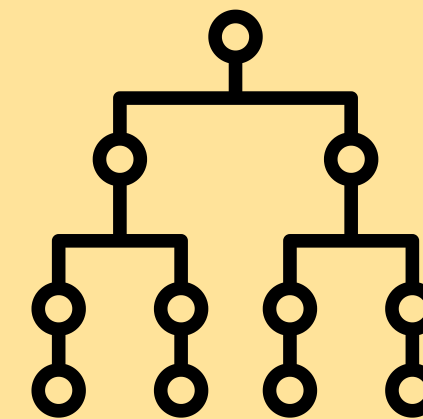
ISSUES

Uncertainty is not well defined especially in the bulk
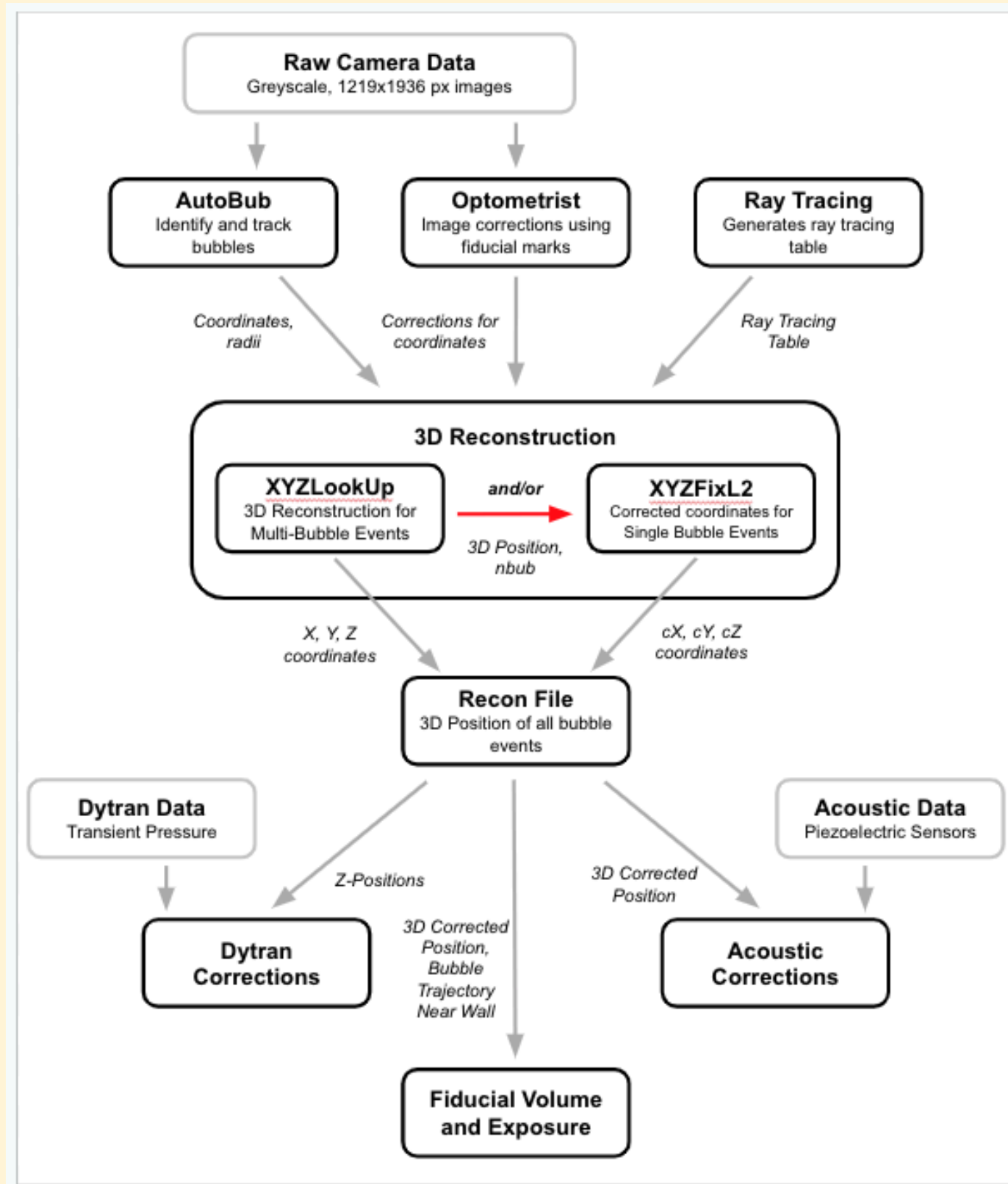
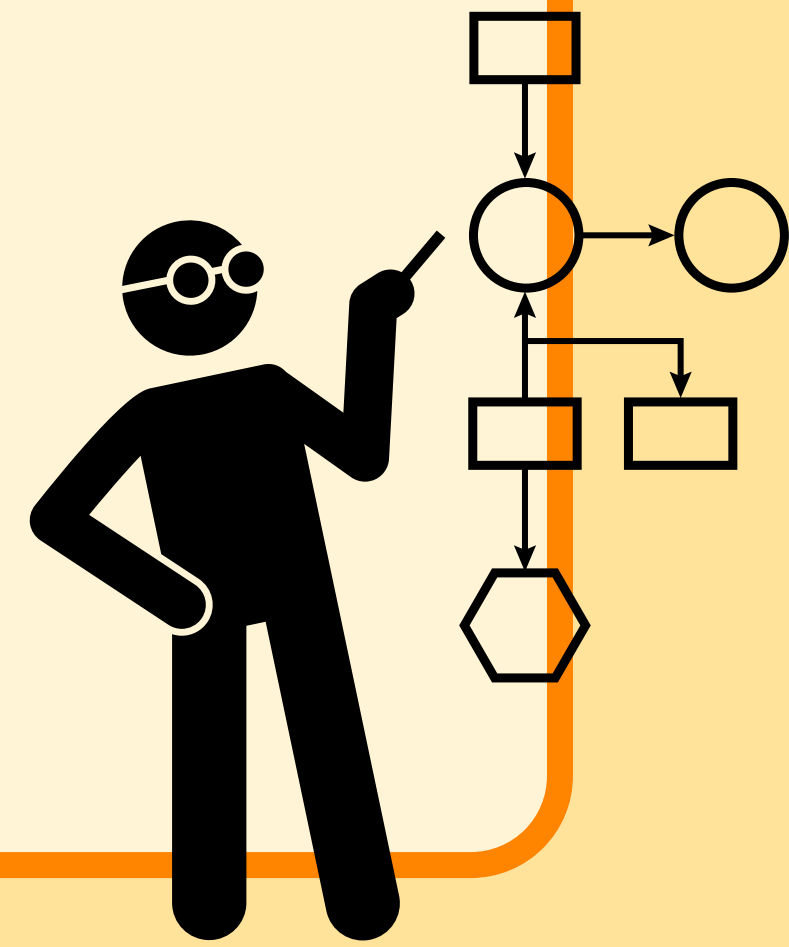Multi-bubble counting

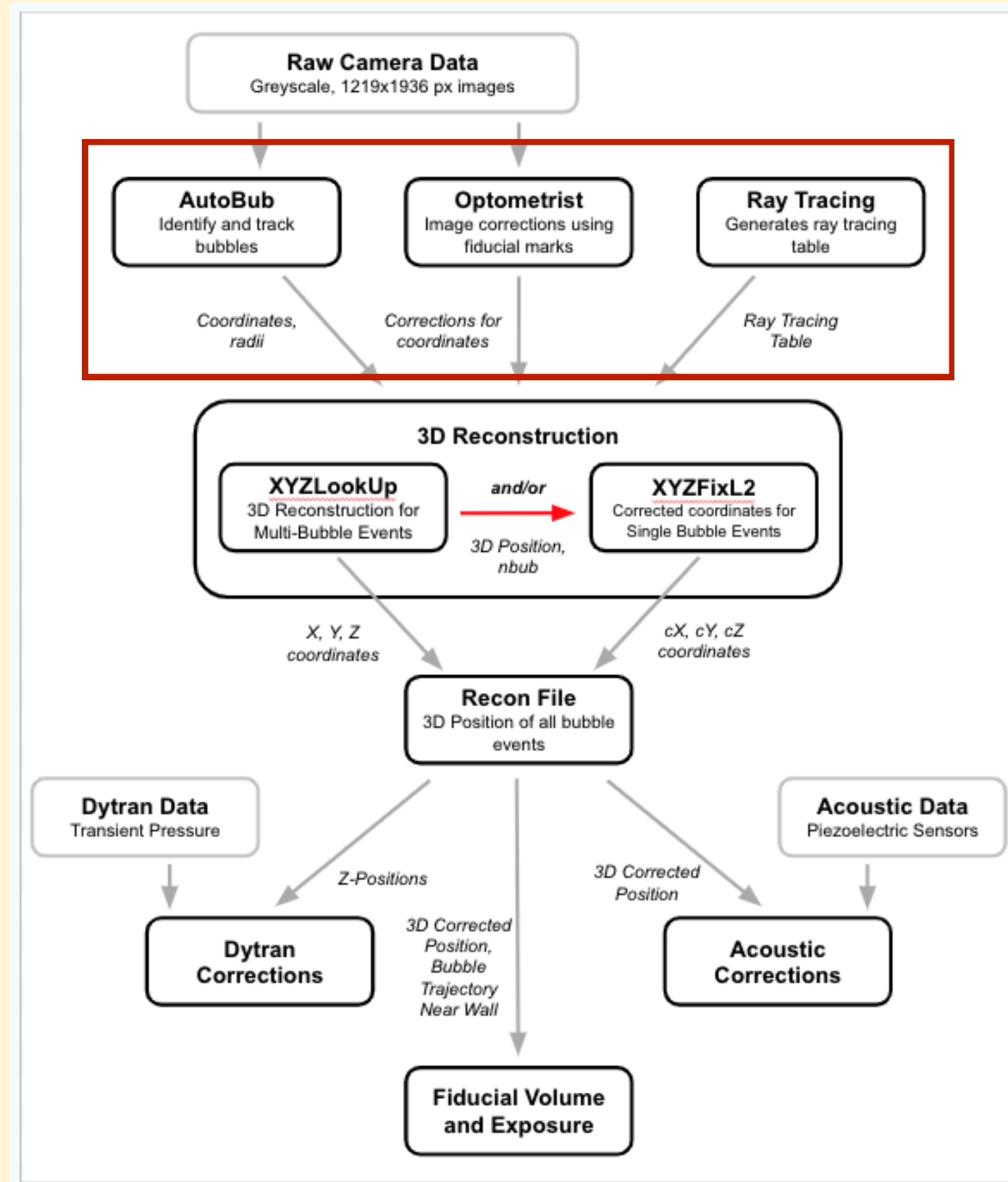Artefacts and Camera Bias

Software structure

CURRENT STRUCTURE

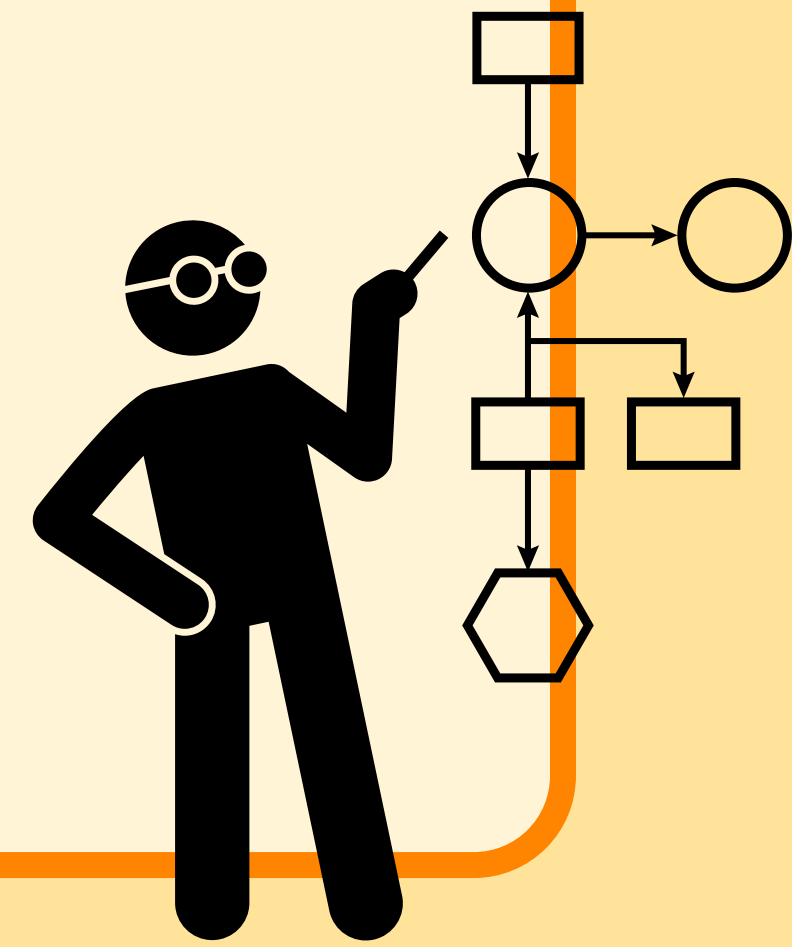
Flowchart wonderfully made by Minya

CURRENT STRUCTURE

- Does a very good job at 3D reconstruction in the active region
- Struggles in the dome and low z regions which limit our fiducial volume. Probably higher uncertainty in the back

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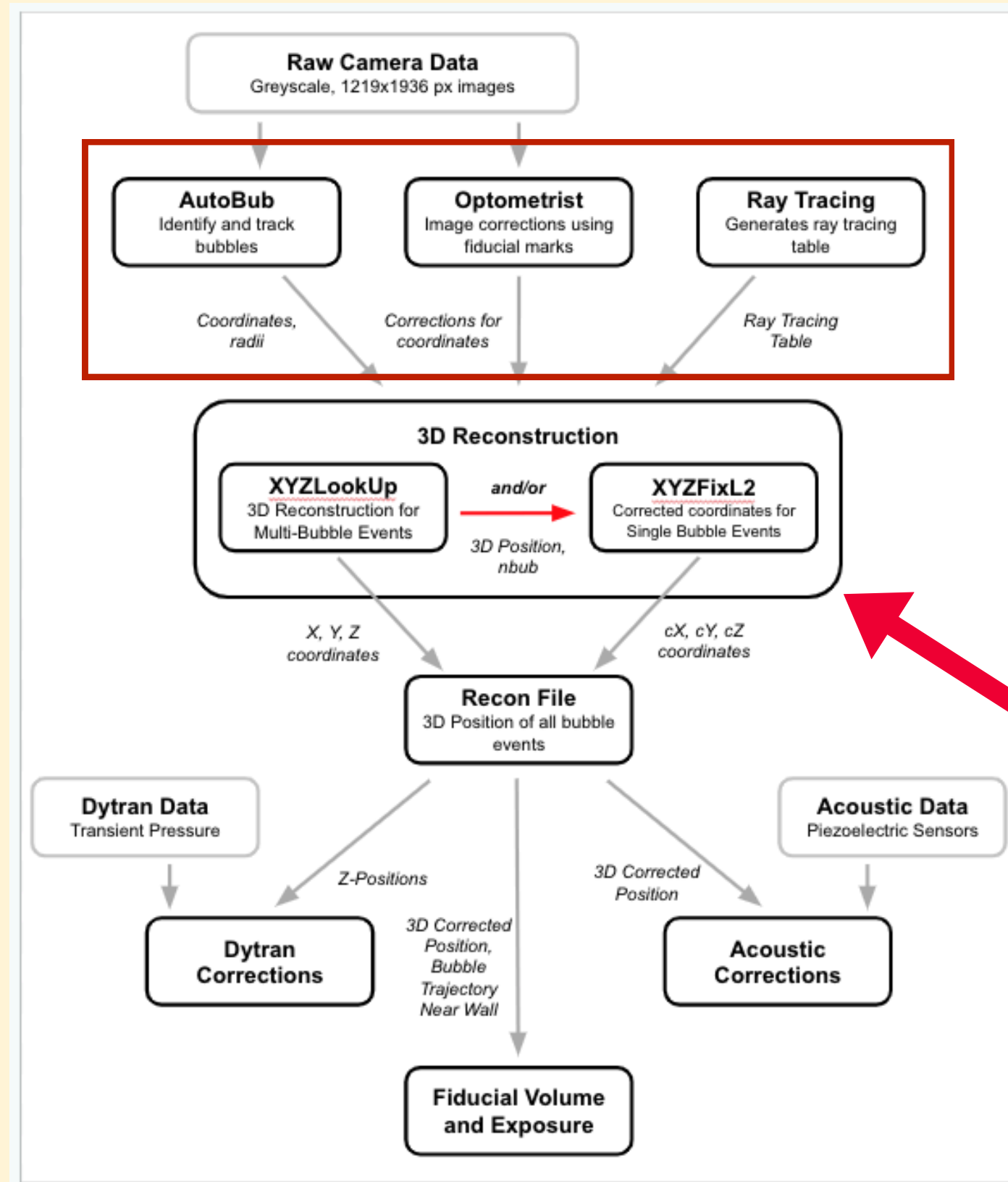

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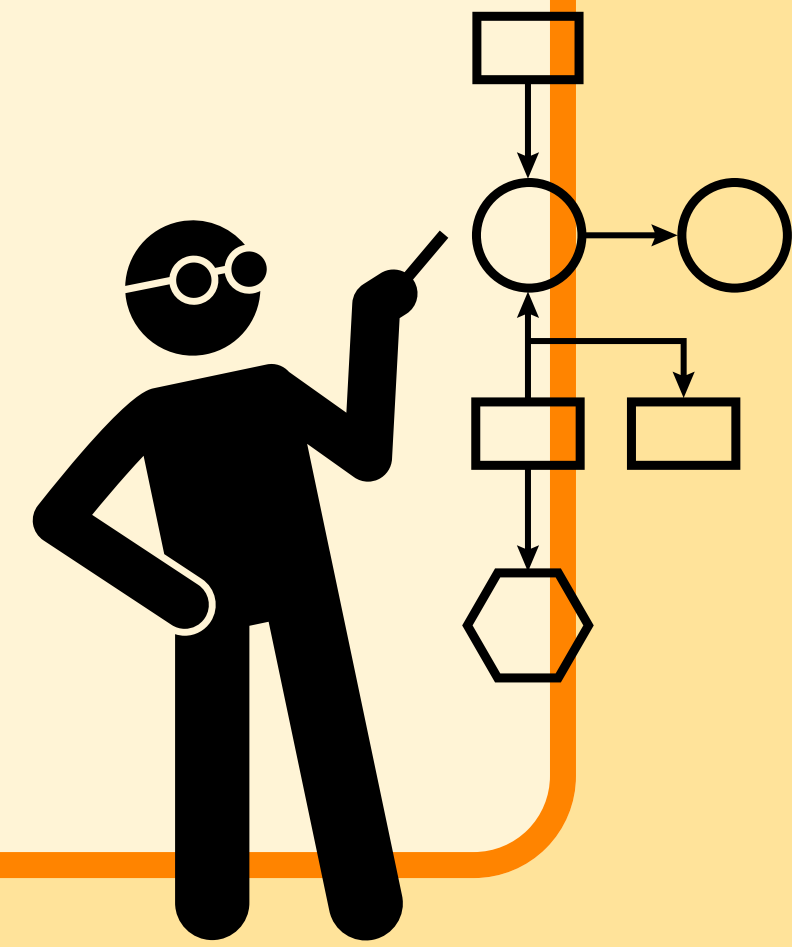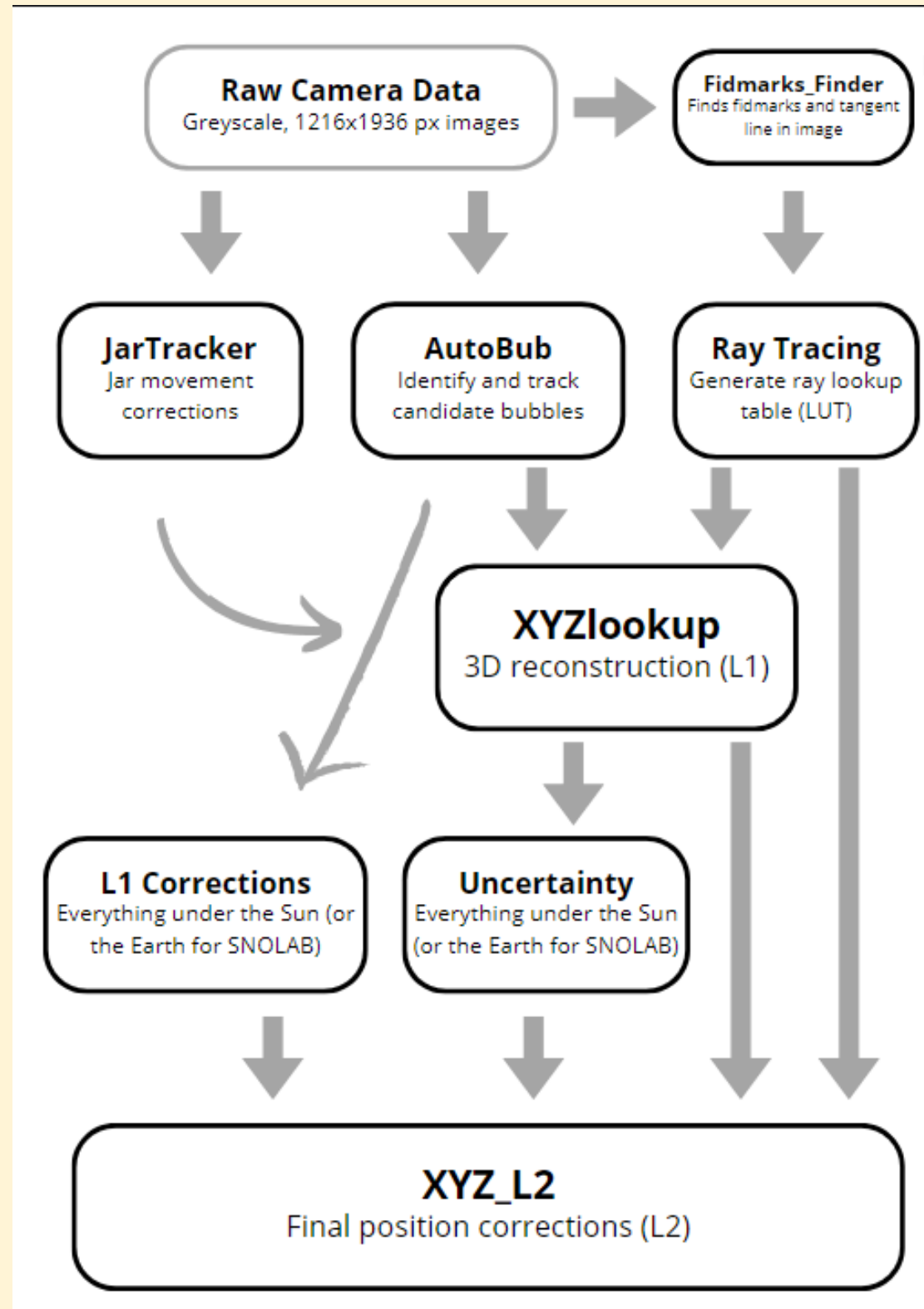
PROPOSAL

- Restructure of the optics processing
- Focus made on modularity (easy to add new position corrections)
- Will allow for easier and better analysis

PROS & CONS

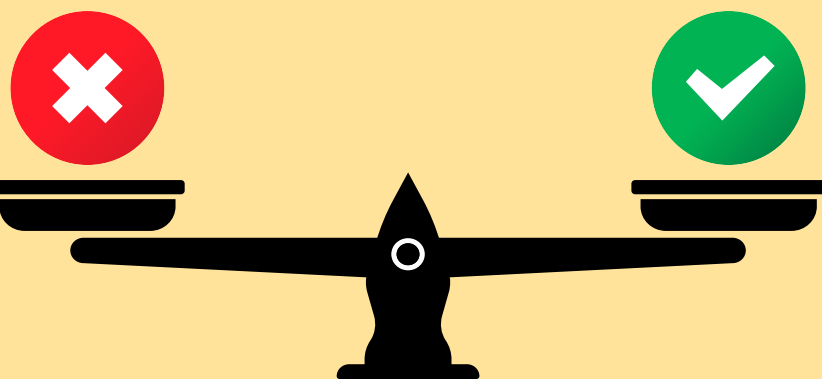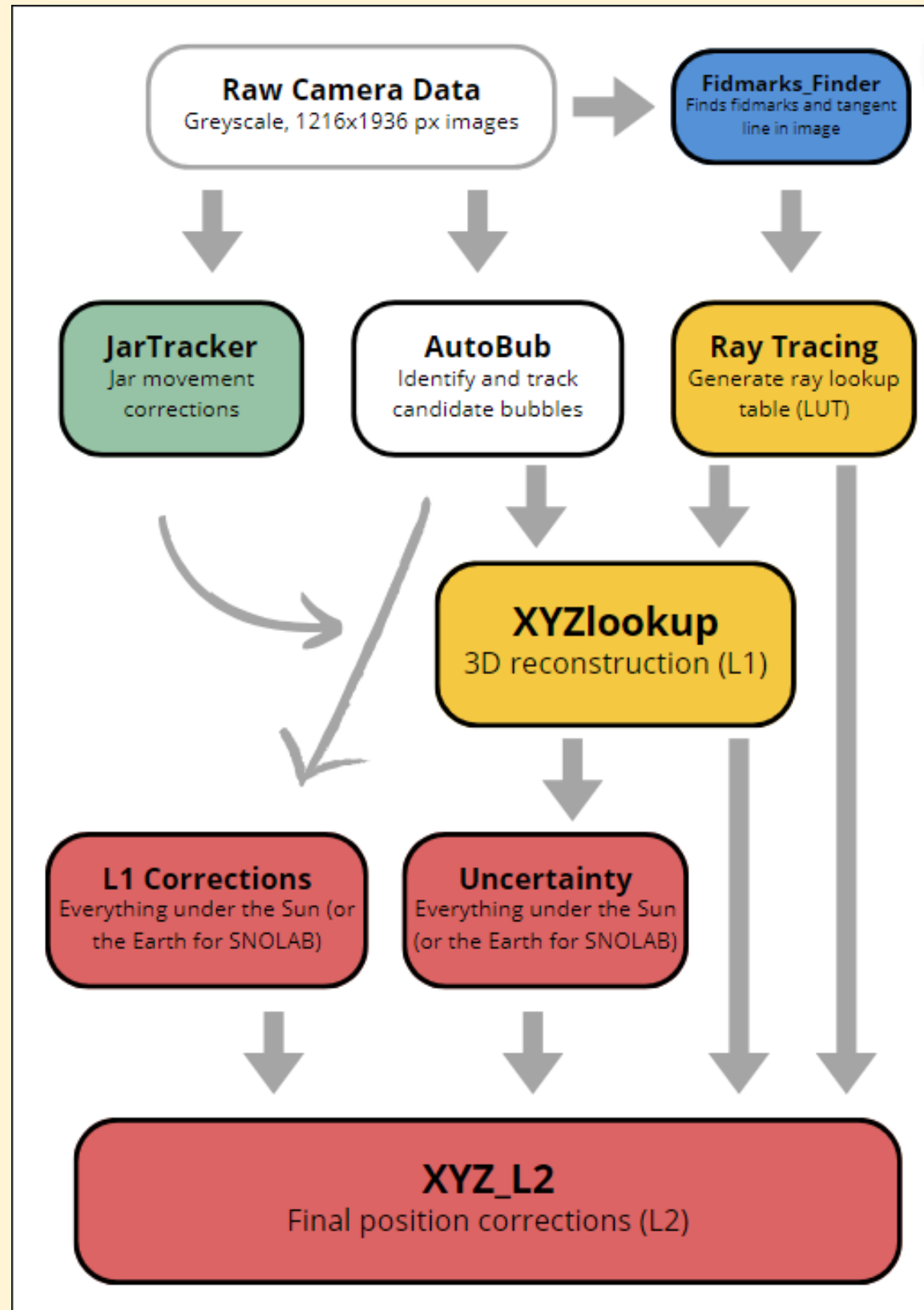## Pros

- Easy to add new position corrections
- Reduce the bias and artefacts
- Could easily make a paper out of all this effort

Cons

- A lot of work is needed to restructure
- Optics is in a "good" position for PICO-40L

WORK NEEDED

- Lower level (L0) is left virtually untouched
- Separate XYZFixL2 into several scripts + L1 corrections
- Create this L2 final decision script from XYZFixL2
- XYZLookup upgrade
- (Low priority) Have a fidmarks finder script that will increase our possibility
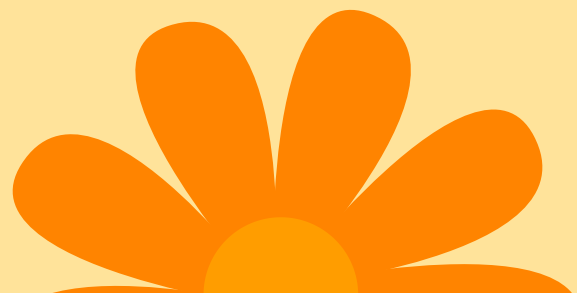
OTHER OPTICS WORK

- Documenting how it works through a tech note, ReadMe on Github
- Characterization of the camera bias (bubble size distribution)

Optics Paper Goals

- Single vs multiple bubble discrimination
- Trigger
- Ray tracing geometries
- Lowest z reconstruction
- Error propagation

THANK YOU

OPTICS IN A NUTSHELL

Ray Tracing

- Starting at each pixel, it retraces the path taken by a ray
- The geometry is optimized by the fiducial marks
- Saves every interaction position in a LookupTable (LUT)

Autobub

- You saw Minya's talk, so mainly find pixels where bubbles are located

XYZLookup

- Using every hit pixels, it tries to find crossing rays in pairs of cameras
- The position is the average of the closest point between two rays
- It also averages over every matched pair of cameras