

# First Look Overview - Relevance for CU6

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1st Meeting of the Gaia CU6 “Spectroscopic Processing”



# Outline

- 1 Introduction**
  - The Basic Problem
- 2 First Look**
  - Overall QL/FL Scheme
  - “Lunch” Scheme
  - ODAS: ODIS/Ring Solution
- 3 CU3 Data Flow**
- 4 Science Quick Look**
- 5 Detailed First Look**
- 6 Remarks and Conclusion**



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# Proper functioning of all elements

## Problem

It is difficult to immediately assess proper functioning of all elements at the  $\mu$ as level!

## Specific Problem

- A full solution of the astrometric problems is possible only after more than six months!



# Proper functioning of all elements

## Problem

It is difficult to immediately assess proper functioning of all elements at the  $\mu$ as level!

## Importance

- However, this is **very important**, else risk of losing many months of data and mission time!



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## Different Levels of QL/FL

- 1 Quick-Look (QL)
- 2 Science Quick Look (ScQL)
  - ScQL monitor and evaluator
- 3 Initial data treatment (IDT)
  - Ingestion
  - Cross-matching
  - Image parameter estimations
- 4 First Look Preprocessing (FLP)
  - ODAS (One-Day Astrometric Solution)
  - PSF/LSF
  - Photometry
  - RVS, CCD
- 5 Detailed First Look (DFL)
  - First-Look monitor
  - First-Look evaluator

## Responsible

ESOC

- realtime
- HK data



## Different Levels of QL/FL

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  - First-Look evaluator

## Responsible

ESOC

+ FL Task support

- < 30 min or realtime
- $\approx 10$  mas
- S/C HK  
+Science HK





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  - First-Look evaluator

### Responsible

Core Processing

- few hours



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  - **PSF/LSF**
  - **Photometry**
  - **RVS, CCD**
- 5 Detailed First Look (DFL)
  - First-Look monitor
  - First-Look evaluator

## Responsible

### FL Task

- daily
- $\approx 10 \mu\text{s}$
- HK  
+science data



## Different Levels of QL/FL

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## Responsible

### FL Task

- daily
- $\approx 10 \mu\text{s}$
- HK  
+science data



## Responsibilities within the RVS First Look tasks

Task	Definition	Development	Integration	Operation
QL	ESOC (input from industry, CU3, CU6)	ESOC	ESOC	ESOC
ScQL	CU3, CU6, ESOC, industry	under discussion	ESOC	ESOC
DFL Monitor (using IDT)	CU6, CU3	CU6	ESAC	ESAC (automatic)
DFL Evaluator (using IDT)	CU6, CU3	CU6	ZAH (CNES)	ZAH (mirrored → CU6)
DFL Monitor	CU6, CU3	CU6	CNES	CNES (automatic)
DFL Evaluator	CU6, CU3	CU6	ZAH (CNES)	ZAH (mirrored → CU6)





## ODAS: ODIS/Ring Solution

Spacecraft Orbit

Earth/Solar System Ephemeris

Initial Geometric Calibration

On-ground Attitude 1

Main Star Catalogue

Initial Source Parameters





## ODAS: ODIS/Ring Solution

Spacecraft Orbit

Earth/Solar System Ephemeris

Initial Geometric Calibration

On-ground Attitude 1

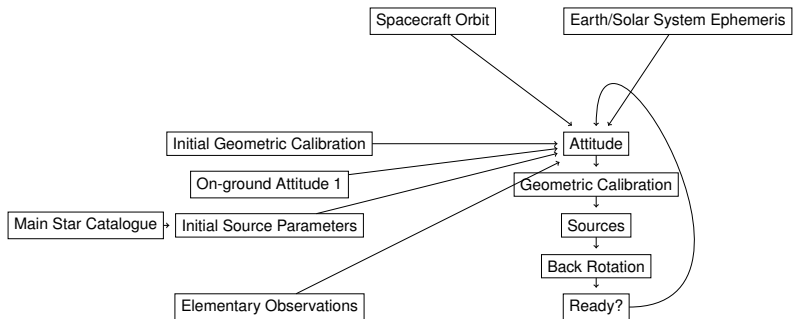
Main Star Catalogue

Initial Source Parameters

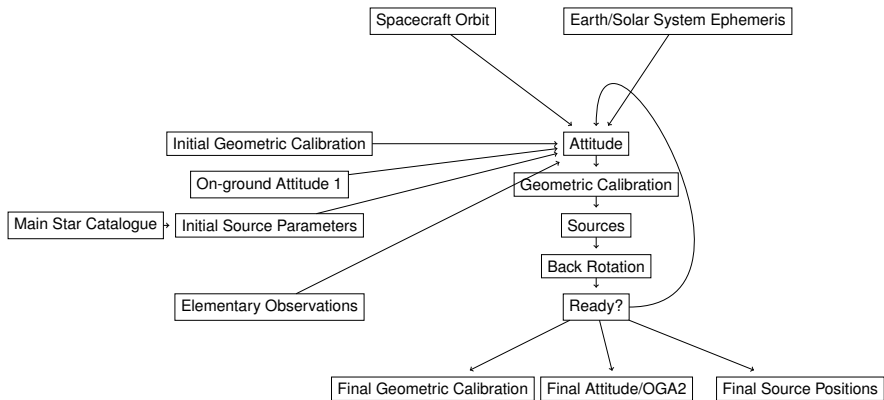
Elementary Observations



## ODAS: ODIS/Ring Solution

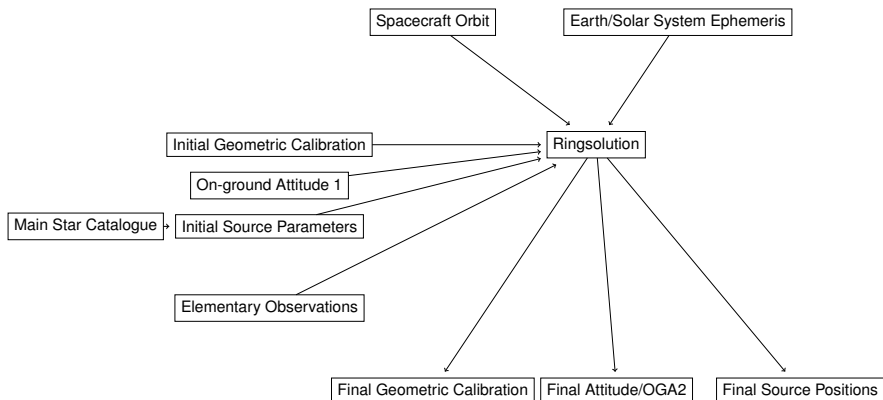


## ODAS: ODIS/Ring Solution

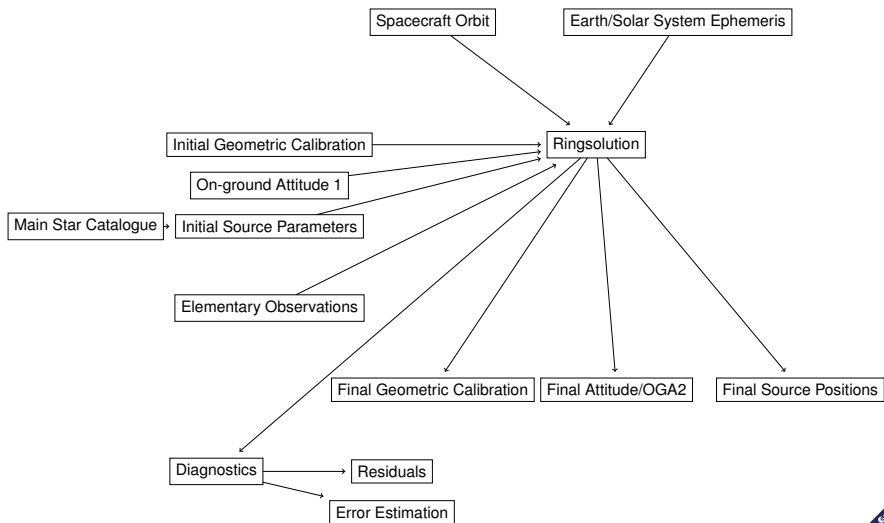




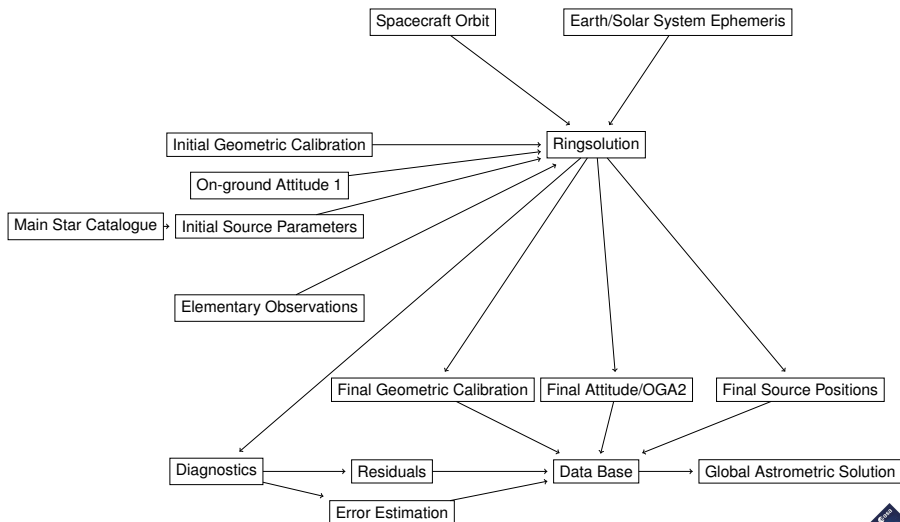
## ODAS: ODIS/Ring Solution



## ODAS: ODIS/Ring Solution



## ODAS: ODIS/Ring Solution



## ODAS Results

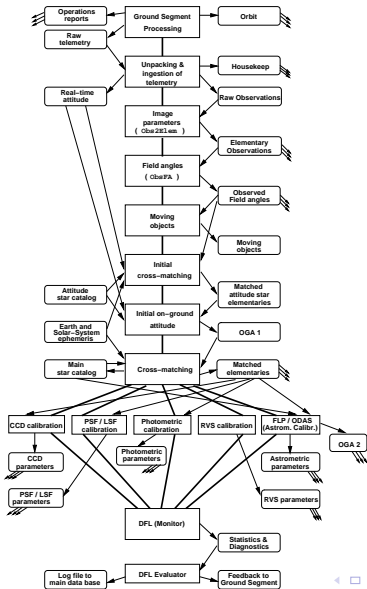
- Starting from large errors ( $150000 \mu\text{as}$ ) in geometric calibration, source positions, and attitude we obtain final errors in
  - calibration:  $< 1 \mu\text{as}$  (along scan),  $< 10 \mu\text{as}$  (across scan)
  - source positions:  $\approx 80 \mu\text{as}$  (along scan),  $\approx 900 \mu\text{as}$  (across scan)
  - attitude:  $\approx 20 \mu\text{as}$  (along scan),  $\approx 600 \mu\text{as}$  (across scan)
- Convergence is very slow in ODIS, but can be accelerated
- Ring Solution: Direct solution in one/two steps, same result as with ODIS but allows a direct evaluation of the statistical errors
- The solution is extremely valuable as input for the Global Astrometric Solution or any alternative of it (e.g. Ring2Sphere)

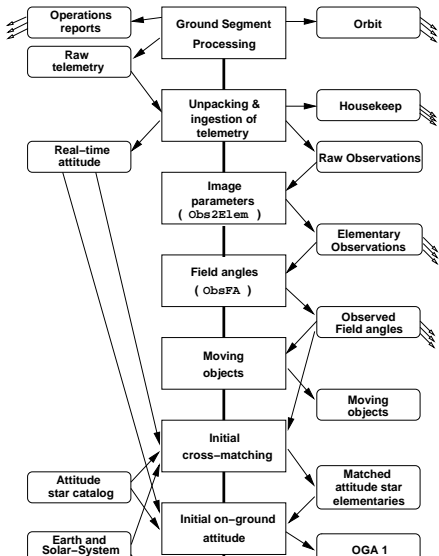


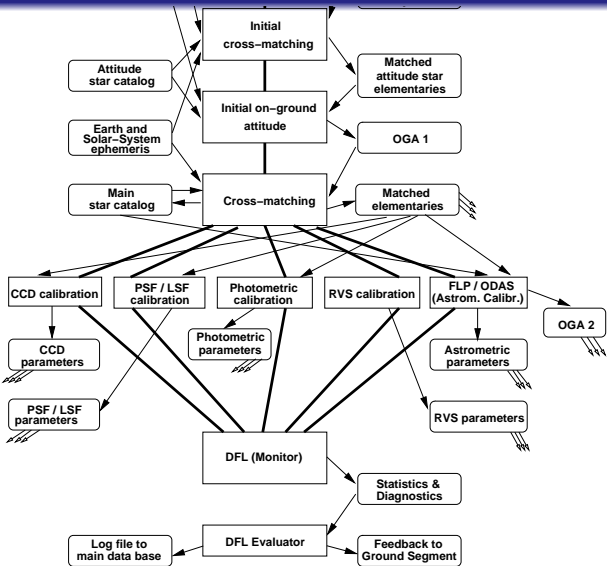
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# Science Quick Look

## General idea

The Science Quick Look looks at a tiny part of the science data (Science HK data)

## Selection

- For the SM/AF/BP/RP chain: a randomly selected tiny sample of windows with stars  $13 < G < 16$



# Science Quick Look

## General idea

The Science Quick Look looks at a tiny part of the science data (Science HK data)

## Amount

- About 1/2000 of all data



# Science Quick Look

## General idea

The Science Quick Look looks at a tiny part of the science data (Science HK data)

## Typical Diagnostics

- Are the stars centered in the window?



# Science Quick Look

## General idea

The Science Quick Look looks at a tiny part of the science data (Science HK data)

## Typical Diagnostics

- How does the width of an image compare to the assumed PSF/LSF (color dependent)



# Science Quick Look

## General idea

The Science Quick Look looks at a tiny part of the science data (Science HK data)

## Typical Diagnostics

- What is the background, how large is the noise?
- Does the onboard background match the value computed on ground?



# Science Quick Look

## General idea

The Science Quick Look looks at a tiny part of the science data (Science HK data)

## RV ScQL?

- What kind of diagnostics are possible with the RV windows for single transits (without knowledge of the star's identity!) or a statistic thereof?



# Science Quick Look

## General idea

The Science Quick Look looks at a tiny part of the science data (Science HK data)

## RV ScQL?

- What kind of diagnostics are possible with flags/counters integrated into the on-board software?





# Science Quick Look

## General idea

The Science Quick Look looks at a tiny part of the science data (Science HK data)

## RV ScQL?

- Onboard-diagnostics: number of removed cosmics (one example from Katz et al., GAIA-C6-TN-OPM-DK-001-2)



# Science Quick Look

## General idea

The Science Quick Look looks at a tiny part of the science data (Science HK data)

## RV ScQL?

- Window-diagnostics: Is the number of photons in the spectra consistent with the brightness/color type?



# Science Quick Look

## General idea

The Science Quick Look looks at a tiny part of the science data (Science HK data)

## RV ScQL?

- Do you need the information from AF/BP/RP instruments?
- In this case one must define that the same objects are selected for ScQL?



# Science Quick Look

## General idea

The Science Quick Look looks at a tiny part of the science data (Science HK data)

## Onboard diagnostics

- Please provide us with input to coordinate this!
- Coordination between GWP-S-610-00000 (Desert with Mignot, Hébrard, Lecavelier) and GWP-M-355-00000 (Jordan/Biermann et al.)



# Science Quick Look

## General idea

The Science Quick Look looks at a tiny part of the science data (Science HK data)

## Science Quick Look

- Please keep everything as simple as possible!



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# Detailed First Look

## General idea

First Look Preprocessing (calibration, etc...) + other diagnostic on a time scale of up to one day

## Astrometric diagnostics

- Breakdown into time intervals.



# Detailed First Look

## General idea

First Look Preprocessing (calibration, etc...) + other diagnostic on a time scale of up to one day

## Astrometric diagnostics

- Is the attitude stable?





# Detailed First Look

## General idea

First Look Preprocessing (calibration, etc...) + other diagnostic on a time scale of up to one day

## Astrometric diagnostics

- Is the geometric calibration stable?



# Detailed First Look

## General idea

First Look Preprocessing (calibration, etc...) + other diagnostic on a time scale of up to one day

## Astrometric diagnostics

- Are the residuals from ODAS compatible with the desired accuracy of the elementary measurements?



# Detailed First Look

## General idea

First Look Preprocessing (calibration, etc...) + other diagnostic on a time scale of up to one day

## Non-astrometric Diagnostics

- These have to be provided by other tasks (photometry, RVS, CCDs, ... )!!



# Detailed First Look

## Non-calibrational diagnostics

Diagnostics not directly connected to calibrational issues (like ODAs in the case of astrometry)

## Non-calibrational diagnostics

- The DFL uses fainter stars than QL or ScQL.



# Detailed First Look

## Non-calibrational diagnostics

Diagnostics not directly connected to calibrational issues (like ODAs in the case of astrometry)

## Non-calibrational diagnostics

- Is the number of windows as large as expected for different magnitudes, types of stars ... ?



# Detailed First Look

## Non-calibrational diagnostics

Diagnostics not directly connected to calibrational issues (like ODAs in the case of astrometry)

## Non-calibrational diagnostics

- Are the centroids of the images in the center of the windows?



# Detailed First Look

## Non-calibrational diagnostics

Diagnostics not directly connected to calibrational issues (like ODAs in the case of astrometry)

## Non-calibrational diagnostics

- Are the images focused (PSF, LSF)?



# Detailed First Look

## Non-calibrational diagnostics

Diagnostics not directly connected to calibrational issues (like ODAs in the case of astrometry)

## Non-calibrational diagnostics

- Are there CCD defects?





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# Remarks & Conclusions

## First Look

The First Look checks the overall functioning of Gaia on many different levels of accuracy and by different means

## Breakdown

- QL, ScQL, DFL



# Remarks & Conclusions

## First Look

The First Look checks the overall functioning of Gaia on many different levels of accuracy and by different means

## Importance

- Its provides important diagnostics for astrometry, photometry, RV, etc. . .



# Remarks & Conclusions

## First Look

The First Look checks the overall functioning of Gaia on many different levels of accuracy and by different means

## Importance

- Moreover, it is an essential ingredient of the overall data flow



# Remarks & Conclusions

## First Look

The First Look checks the overall functioning of Gaia on many different levels of accuracy and by different means

## Importance

- (At least) on the astrometric side it provides important initial values for the following Global Data Analysis (GIS, Ring2Sphere, ...)



# Remarks & Conclusions

## First Look

The First Look checks the overall functioning of Gaia on many different levels of accuracy and by different means

## Important!

- The FL team need input from other tasks (IDT, Photometry, RV, ...) to perform its assignment!



# Remarks & Conclusions

## First Look

The First Look checks the overall functioning of Gaia on many different levels of accuracy and by different means

## Important!

- The FL team is the single contact point between science and the ground segment!



# Remarks & Conclusions

## First Look

The First Look checks the overall functioning of Gaia on many different levels of accuracy and by different means

## Important!

- → there should be no separate FL for the different tasks

