Simulation and Auxiliary Data Management

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Simulation/Test and Auxiliary data

➢ *Test data* *are the* *simulated* *RVS data needed to test the data reduction algorithms. They are produced by the CU2 (simulation)*

➢ *Auxiliary data* *are any additional data needed. Spectral libraries are produced by the CU8 (astrophysical parameters) and are the "starting-point" for the RVS data simulation.*
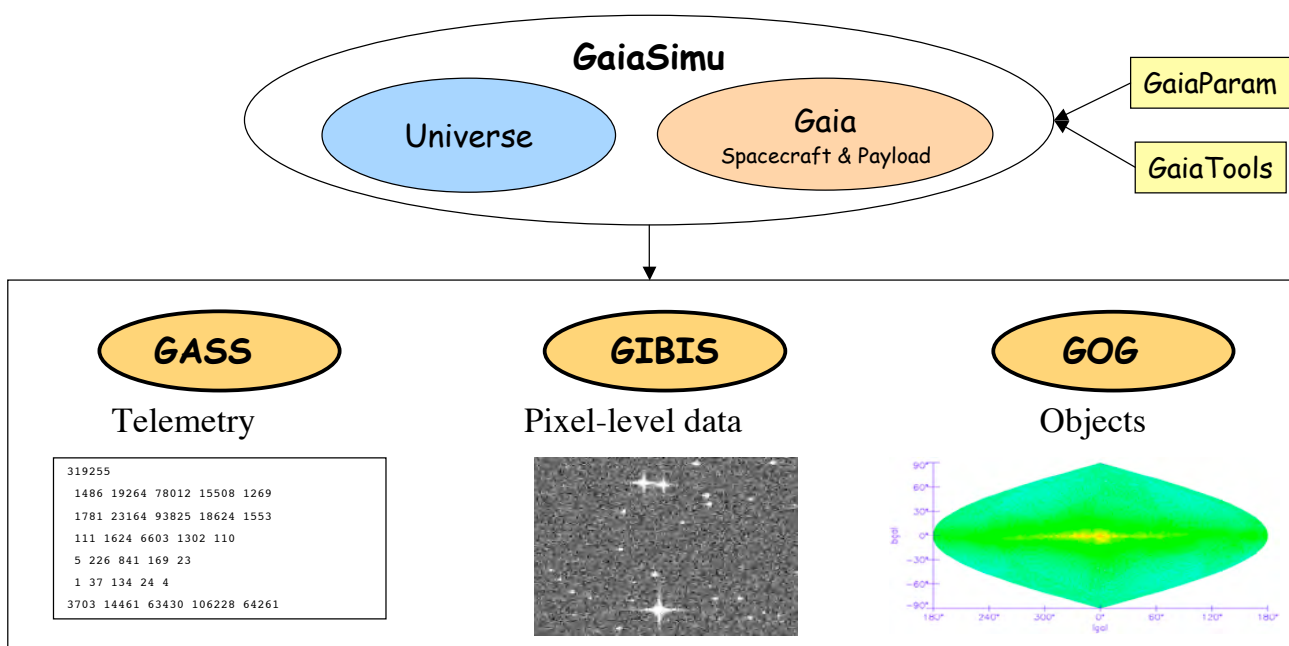
WP Simulation and auxiliary data management
(GWP-604-10000)

➤ *Collect the requirements:* contact the DU-coordinators every 6 month *(now requirements for cycle3 starting May 2007)*

➤ *Synthesize the requirements*

➤ *Consult CU2* (simulation) *and CU8* (auxiliary data) to define feasibility and to set priorities on the production of the required data

➤ *Write a schedule report* to inform the DU-coordinators about the status of the data they required

➤ *Collect the data,* verify they correspond to requirements, distribute to DU-coordinators *(cycle3 data distributed in April 2007)*

Simulation data: the GaiaSimulator

test data are produced using the GaiaSimulator (CU2)

GaiaSimu

Universe

Gaia
Spacecraft & Payload

GaiaParam

GaiaTools

GASS

Telemetry

```
319255
 1486 19264 78012 15508 1269
 1781 23164 93825 18624 1553
 111 1624 6603 1302 110
 5 226 841 169 23
 1 37 134 24 4
 3703 14461 63430 106228 64261
```

GIBIS

Pixel-level data

GOG

Objects

Spectral libraries integrated in the « Universe » to be provided by the CU8

GaiaSimulator: Status of the data generators

➢ GASS (Gaia System Simulator) simulate the telemetry stream of GAIA, no detailed data simulation. The RVS simulations are not yet operational (December 06).

➢ GIBIS (Gaia Instrument and Basic Image Simulator). Raw data simulations as realistic as possible at the pixel-level. Limited sky regions and time periods. The RVS simulations are operational at:

http://gibispc.obspm.fr/~gibis

Gibis will be soon deployed at CNES.

➢ GOG (Gaia Object Generator) Is in a definition phase. Intermediate processed data, end of mission data simulation, data catalogue. Need requirements for defining development priorities for V1.0.

Auxiliary data: Spectral Libraries

synthetic spectral libraries are going to be produced by the CU8

▶ The RVS data simulation is based on the spectral libraries:

● For accurate spectra simulation:
R > 200000 (PSF convolution)
spectral range: 844 < λ < 877 nm (filter leaks for bright sources)

● For various source types simulation: the corresponding spectral libraries are needed with the appropriate R and spectral range (asteroids, galaxies..)

● For simulation of star sources with specific physical parameters (e.g. rotational velocity, alpha elements enhancement…) the appropriate spectral library is needed (standard star library parameters are Teff, logg, Fe/H)

The source types that can be simulated depend on availability of spectral libraries. The requirements on test data of specific source types are implicitly equivalent on requirements on the specific libraries.

At the moment the RVS simulations are run with a small library of 15 star spectra(Kurucz)

Simulation: status of GIBIS RVS

Simulation purpose: Raw data. CCD images. Pixel level detail.

▶ **Instrument model**: effective PSF, instrumental response,total detection noise (RON, dark, quantization noise). No variations dependent on FoV position. No t variability.

▶ **Sky model**: Besançon Galaxy model (star sources only)/ User input source file. Reddening, cosmics, zodiacal background. Gibis works per sky regions and **crowding** effects are automatically modelled

▶ **Multitransit** simulations are operational (scanning law).
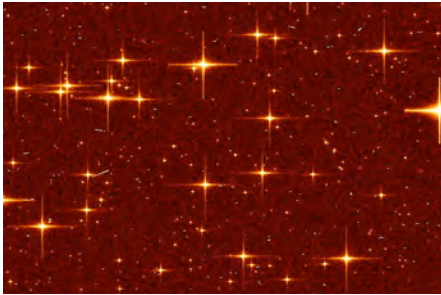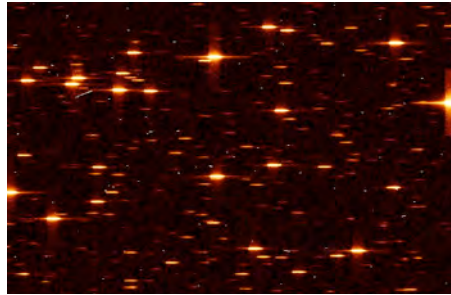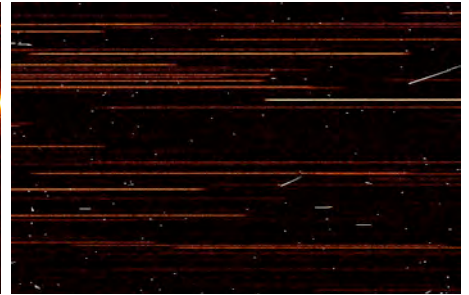
| AF | RP | RVS |

▶ not yet developed for RVS:

● Simulation of on board detection/selection/tracking algorithms. Windows extraction will be done directly.

● Gibis simulates raw data: Need of calibrated data? / tools for calibrating data?

Simulation data: GOG RVS proposal for V1.0

● **Goals of GOG (Gaia Object Generator)**

▶ Simulate Intermediate processed data, mission final data and object catalogues.

▶ Use error models for rapid simulations of large amount of data. The noise model is user-selectable in order to enable simulation of data at any step of processing.

● **Instrument model in V1.0**

Effective PSF: Diffraction, aberration (WFE), pixel size integration,TDI smearing, attitude induced motion, attitude rate errors, optical design distortion,additional rate errors, charge diffusion, charge transfer inefficiency.

Response curves: Optical elements and CCD QE as in GaiaParamBD

Sampling scheme: as in GaiaParamDB, (1x10) pix samples for G<10 (3x10)

Total detection noise: RON, dark, quantization (option to add in data)

GOG RVS proposal for V1.0 - Sky model

● Sources

From Input file: The input file contains the source physical parameter necessary for finding the star spectrum in the spectral library and the simulation parameters (Av, mag V/G, vR) needed to transform to observable spectrum (SINGLE not variable stars only in V1.0)

From Input Spectra: The user provides source spectra (any type of not variable sources)

From Universe model (in V1.0?): *The user provides the coordinate of the sky region/the time interval of observation and the sources are produced by the Universe model (Besancon for the galaxy)*

● Background

Constant: selectable value (default zodiacal light)

Contamination by close sources (not in V1.0) GOG works per-object and not per-sky region like GIBIS source contamination is not automatically modelled.

GOG RVS proposal for V1.0 - Noises

● Selectable noises

Total detection noise: (RON, dark, quantization)
Background
Poisson noise
Cosmics/cosmics subtraction noise
Saturation
CCD defaults

→ Calibration noises: need input from calibration algorithms developers. In V1.0 simply add a selectable value.
→ Spectra combination noises for multi-transit data not included in V1.0. Need input from algorithm developers.

● Output

Format and spectra units as similar as possible to the intermediate processed data /end of mission data to simulate (MBD data format definition CU1). Requirements helpful.

Test data for Cycle3: Collect requirements

The development of the GaiaSimulator data generators will be based on your requirements.

Now collect requirements for Cycle 3 starting May 2007. The deadline for the requirement collection is November 10th. The data delivery in April 2007.

Which type of data the CU6 needs for testing algorithms in cycle3?

- At which step of the processing (from raw data to end-of mission)
- single/multi-transit/combined
- which are the instrumental effect to include
- what type of sources
- which grid of magnitudes, absorption (Av), radial velocity/or use the Besançon Galaxy model
- which info from other instruments (RP flux..)

Test data for Cycle2: sources

Provide a set of standard RVS spectra (single CCD/not combined) for test in cycle2 (ends April 2007)
available from http://wwwhip.obspm.fr/gaia/cu6/cu6_cycle2.html
Sources : star spectra Kurucz model R=250000, [Fe/H]=0, vR = 0 and Av=0. Grid of magnitude (V) and number of spectra in table

	500	1000	1000	2000	2000
K0V	13.5	14.5	15.5	16.5	17.0
G0V	13.5	14.5	15.5	16.5	
F0V	12.5	13.5	14.5	15.5	
A0V	11.5	12.5	13.5	14.5	
B0V	10.5	11.5	12.5		

Test data for Cycle2: instrument model

- **Instrument model for the cycle2 set of RVS spectra**

  Gaussian PSF: FWHM corresponding to 0.0748 nm (860.5nm/11500).

  Response curves: Mirrors transmission and CCD QE as in GaiaParamBD, RVS spectral response not yet in DB - rectangular function.

  CCDs : red variant of CCD91-72 from e2v technologies.

  Sampling scheme V<11 (1x10) pix 1104 samples, for V>11 (3x10) 368 samples.
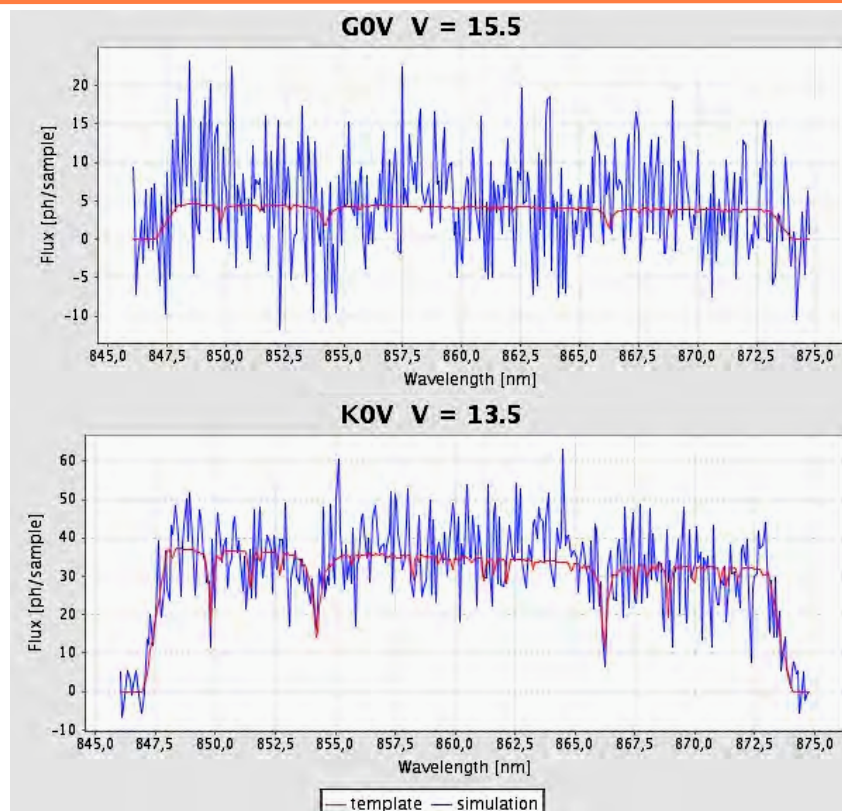
  Dispersion: constant (value of GaiaParamBD). The wavelength of middle sample is given in each file.

  Total detection noise: RON, dark, quantization.

- **Background zodiacal 22.5 V/arcsec2, V-I=0.7. No contamination by other sources.**

▶ A template spectrum with no poisson noise and no total detection noise, is provided for each star and each magnitude

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Test data for Cycle 2: spectra

Summary

➢ *Starting from* *Cycle 3* *test data will be produced based on your requirements, after CU2 and CU8 approval.*
  We are collecting the requirements now.

➢ *We have "informally" made available a set of test data for* *Cycle 2* *for the simplest nominal conditions.*
  The data are produced using GaiaSimulator.
   The files format is also "informal", as simple as possible (ASCII 2 columns, 1 file per spectrum). Will change in cycle3 (following CU1 definition "interface control for MDB" / simplified version)
  Feedback about the data is welcome.