The ECLGRM pipelines at the FSC:

First thoughts towards DC-1

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SVOM FSGS key point – IAP, 01/24/2019

ECLGRM goals for DC-1

- **Design the VHF and X-band containers from the service delivered for DC-0**

- **Adapt the VHF and X-band containers to the FSC evolutions**
  - Use the common JSON message scheme more extensively
  - Add interactions of the containers with the MDB
  - Etc

- **Input data: add scientific content (unlike DC-0)**
  - Define and simulate ECLAIRs and GRM data to test the algorithms along their development
  - Contribute to the definition of physical scenarios for DC-1 (general effort)

- **Develop more elaborate analysis algorithms**
  - But not necessarily final
  - Focus on few analysis tasks (in agreement with APC/CEA/IRAP partners)

- **Output data: generate meaningful products**
  - Contribute to the definition of SP format / headers (general effort) following the working session at IAP in Oct. 2018

ECLGRM VHF pipeline for DC-1 (TBC)

- **Provide a VHF pipeline with complete analysis of the count LC**
  - Quick bkg-subtracted count LC, count peak fluxes, T90, hardness ratios

- **Input VHF data**
  - Use the IAP GRB DB to define:
    - Test cases for the software development
    - Larger samples for statistical analysis
  - Use the IAP static simulator to generate ECLAIRs and GRM photon lists
    - Also to optimize the definition of the HR energy bands (several possibilities)
  - Add a constant bkg
  - Use the CEA packet simulator to generate count LC with official sampling

- **Optional (likely in 2020)**
  - Simulate a variable bkg (e.g. during slew)
  - Meaningful T90 error
  - Use more realistic instrument responses and bkg (see next slide)
  - Quick LC and peak fluxes in physical units? Needs the GRM quick spectrum

ECLGRM X-band pipeline for DC-1 (TBC)

- **Provide an X-band pipeline with simplified algorithms**
  - S/w to identify the main episodes in the LC (time intervals for spectral analysis)
  - S/w to compute T90 and time-dependent source spectra (“simple” fits)
  - Implement communication with the ECLAIRs GP pipeline (imaging)

- **Input X-band data**
  - Use the IAP GRB DB to define:
    - Test cases for the software development
    - Larger samples for statistical analysis
  - Use the IRAP simulator (based on GEANT4) to generate ECLAIRs counts (source signal + bkg along the orbit)
    - OGIP compliant FITS files needed for spectral analysis
  - Ask IHEP again to run GRM simulations (update request in backup slide)
    - Or ask for J. Zhang's scripts and couple them to the IRAP simulator

- **Optional (likely in 2020)**
  - Simulate a slew
  - Meaningful T90 error
  - Secondary products from spectral analysis: source light curves and peak fluxes, time-dependent fluences and hardness ratios
  - Lags

Backup

VHF scientific products

	PRODUCT	SHORT DESCRIPTION	DEVELOPMENT
1	TT_ECL	Trigger time -- ECLAIRs VHF Alert (T$_0$)	CEA (S. Schanne)
2	QCL_ECL	Quick confidence level -- ECLAIRs VHF Alert	CEA (S. Schanne & A. Claret)
3	QPO_ECL	Quick position -- ECLAIRs	CEA (S. Schanne)
4	TT_GRM	Detection time -- GRM	IHEP (S. Jianchao)
5	QCL_GRM	Quick confidence level -- GRM	IHEP (S. Jianchao)
6	QPO_GRM	Quick source position -- GRM	IHEP (S. Jianchao)
7	QSP_PARAM_GRM	Quick spectral parameters -- GRM	IHEP (S. Jianchao)
8	OBLC_ECL	On-board count light curves -- ECLAIRs	CEA (S. Schanne)
9	OBLC_GRM	On-board count light curves -- GRM	IHEP (S. Jianchao) / CEA (S. Schanne)
10	QLC_ECL	Quick light curves -- ECLAIRs	LUPM (F. Piron)
11	QLC_GRM	Quick light curves -- GRM	IHEP (S. Jianchao) / LUPM (F. Piron)
12	QPF_ECL	Quick peak flux -- ECLAIRs	LUPM (F. Piron)
13	QPF_GRM	Quick peak flux -- GRM	IHEP (S. Jianchao) / LUPM (F. Piron)
14	QT90_ECL	Quick duration -- ECLAIRs	IAP (F. Daigne)
15	QT90_GRM	Quick duration -- GRM	IHEP (S. Jianchao) / IAP (F. Daigne)
16	QHR_ECL	Quick hardness ratios -- ECLAIRs	IAP (F. Daigne)
17	QHR_GRM	Quick hardness ratio -- GRM	IHEP (S. Jianchao) / IAP (F. Daigne)
18	**QHR_ECLGRM**	**Quick hardness ratios -- ECLAIRs and GRM**	**IAP (F. Daigne) / IHEP (S. Jianchao)**
19	**CRCLASS**	**Crude classification**	**IRAP (J.-P. Dezalay) / IHEP**

- **Products 1 – 3 based on ECLAIRs data only**
  - and requiring an excellent knowledge of the ECL flight software
- **Products 4 – 7 based on GRM data only**
  - and requiring an excellent knowledge of the GRM flight software
- **Products 8 – 19 products based on ECLAIRs and GRM data**
  - and obtained with very similar or identical methods → *_ECLAIRs and *_GRM “mirror” products
  - **or obtained in joint analyses (QHR_ECLGRM & CRCLASS)**

VHF data analysis tasks (→ s/w modules)

- **OTLOC task: onboard trigger time and localisation (ECL and/or GRM)**
  - Products [1-3, 4-6]: trigger confidence level, T0, quick position
- **QTEMP task: quick temporal analysis (ECL and/or GRM)**
  - Data preparation: background time-dependent modeling & subtraction
  - Analysis of bkg-subtracted count light curves (+ selection of the useful GRDs)
  - Products [8-15]: source count light curves, peak flux, T90
- **QSPEC task: quick spectrum (only GRM)**
  - Use GRD total count spectra and bkg count spectra (generated onboard)
  - Use GRD response matrices (DRMs); no imaging → GRD DRM generator needed
  - Spectral fits with XSPEC (PGstat) using simple spectral models (PL, COMP, Band)
  - Products [7]: crude time-integrated spectrum, parameters and covariance matrix
- **QHR task: quick hardness ratios (ECL and/or GRM, ECLGRM)**
  - Use the results of the previous tasks
  - Products [16-18]: time-integrated HR
- **CLASS task: trigger crude classification from the products above**
  - Products [19]: GRB, other?
- **The analysis procedures for ECL and GRM are identical**
  - Apart from OTLOC and QSPEC tasks

X-band scientific products

	PRODUCT	SHORT DESCRIPTION	DEVELOPMENT
1	PO_ECL	Source position -- ECLAIRs	CEA (A. Gros, A.Goldwurm) / LUPM (F. Piron)
2	PO_GRM	Source position -- GRM	IHEP
3	T90_ECL	Duration -- ECLAIRs	IAP (F. Daigne) / LUPM (F. Piron)
4	T90_GRM	Duration -- GRM	IHEP / IAP (F. Daigne) / LUPM (F. Piron)
5	SP_ECL	Spectra in physical units -- ECLAIRs	LUPM (F. Piron)
6	SP_GRM	Spectra in physical units -- GRM	IHEP / LUPM (F. Piron)
7	**SP_ECLGRM**	**Spectra in physical units -- ECLAIRs and GRM**	**LUPM (F. Piron) / IHEP**
8	LC_ECL	Light curves in physical units -- ECLAIRs	LUPM (F. Piron)
9	LC_GRM	Light curves in physical units -- GRM	IHEP / LUPM (F. Piron)
10	PF_ECL	Peak fluxes -- ECLAIRs	LUPM (F. Piron)
11	PF_GRM	Peak fluxes -- GRM	IHEP / LUPM (F. Piron)
12	FLUENCE_ECL	Fluences -- ECLAIRs	LUPM (F. Piron)
13	FLUENCE_GRM	Fluences -- GRM	IHEP / LUPM (F. Piron)
14	**FLUENCE_ECLGRM**	**Fluences -- ECLAIRs and GRM**	**LUPM (F. Piron) / IHEP**
15	HR_ECL	Hardness ratios – ECLAIRs	IAP (F. Daigne)
16	HR_GRM	Hardness ratios – GRM	IHEP / IAP (F. Daigne)
17	**HR_ECLGRM**	**Hardness ratios -- ECLAIRs and GRM**	**IAP (F. Daigne) / IHEP**
18	LAG_ECL	Time lags between light curves – ECLAIRs	IAP (F. Daigne)
19	LAG_GRM	Time lags between light curves – GRM	IHEP / IAP (F. Daigne)
20	**LAG_ECLGRM**	**Time lags between light curves -- ECLAIRs and GRM**	**IAP (F. Daigne) / IHEP**

Eiso and Liso not included here (external redshift needed)

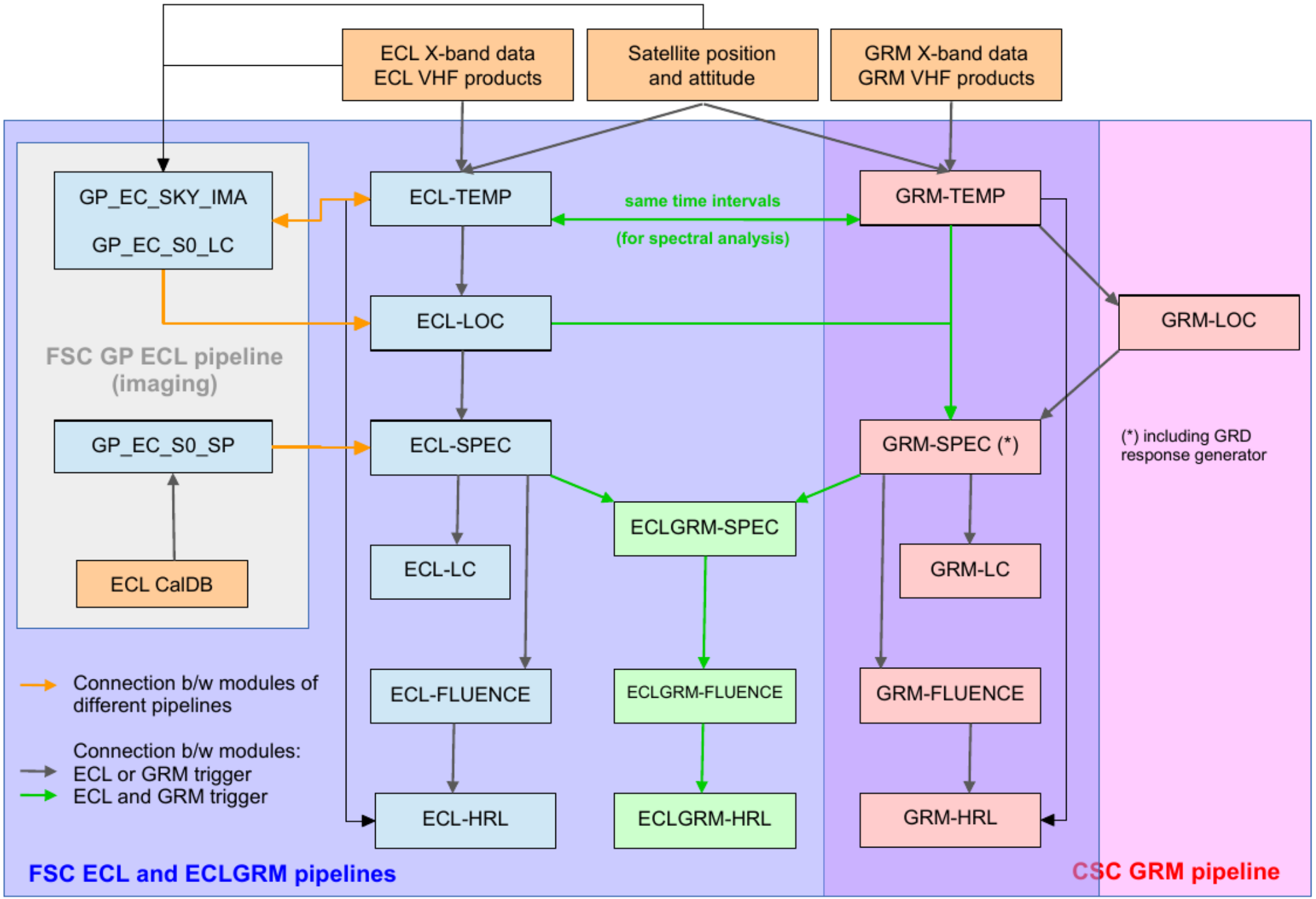
- **Product 1 based on ECLAIRs data only**
  - and requiring an excellent knowledge of the ECL instrument
- **Product 2 based on GRM data only**
  - and requiring an excellent knowledge of the GRM instrument
- **Products 3 – 20 based on ECLAIRs and GRM data**
  - and obtained with very similar or identical methods → *_ECLAIRs and *_GRM “mirror” products
  - **and obtained in joint analyses (*_ECLGRM joint products)**

X-band data analysis tasks (→ s/w modules)

- **TEMP task: temporal analysis (ECL and/or GRM)**
  - Data preparation: background modeling & subtraction
    - *ECL: imaging with GP pipeline*
    - *GRM: no imaging → time-dependent bkg model*
  - Analysis of bkg-subtracted count light curves (+ selection of the useful GRDs)
  - Products [3-4]: source count light curves, T90, time intervals for spectral analysis (main episodes)
- **LOC task: localisation (ECL and/or GRM)**
  - *ECL: imaging with GP pipeline*
  - *GRM: if significant signal in the 3 GRDs*
  - Products [1, 2]: source position
- **SPEC task: spectral analysis (ECL and/or GRM, ECLGRM)**
  - Data preparation: generate count spectra and detector response matrices (DRMs)
    - *ECL: source count spectra from GP pipeline; DRM from ECL CalDB*
    - *GRM: GRD total count spectra and bkg count spectra (model)*
    - *GRM: no imaging → GRD DRM generator needed*
  - Spectral fits with XSPEC (PGstat) using simple spectral models (PL, COMP, Band)
  - Products [5-7]: time-dependent source spectra, parameters and covariance matrices
- **LC, FLUENCE and HRL tasks (ECL and/or GRM, ECLGRM)**
  - Use the results of the previous tasks
  - Products [8-20]: flux light curves and peak flux, (time-dependent) fluences, hardness ratios & lags

- **The analysis procedures for ECL and GRM are identical**
  - Apart from LOC task and data preparation steps (TEMP and SPEC tasks)

X-band pipelines



Need for GRM simulations

- **GEANT4 simulations using the new GRM design to support the development of the analysis software**

- **GRD background simulations**
  - Simulations for several pointings of the GRM, in order to sample the effect of the Earth occultation in each of the 3 GRDs for different orbital configurations

  - Simulations of detector activation due to SAA passage: possible feedback from (or reuse of) HXMT data?

- **GRD response simulations**
  - One GRD with a gamma-ray source placed at different angles, e.g., equally spaced in cos(theta) by steps of 0.05

  - DRM generator in any GRB-Earth-detector configuration to account for the GRB signal scattering on the Earth atmosphere and on the spacecraft
    (e.g., see the Fermi/GBM gbmrsp tool at the Fermi Science Support Center)

- **Documentation for each simulation**
  - Detailed summary, posterior analysis and verification of the generated bkg / rsp files