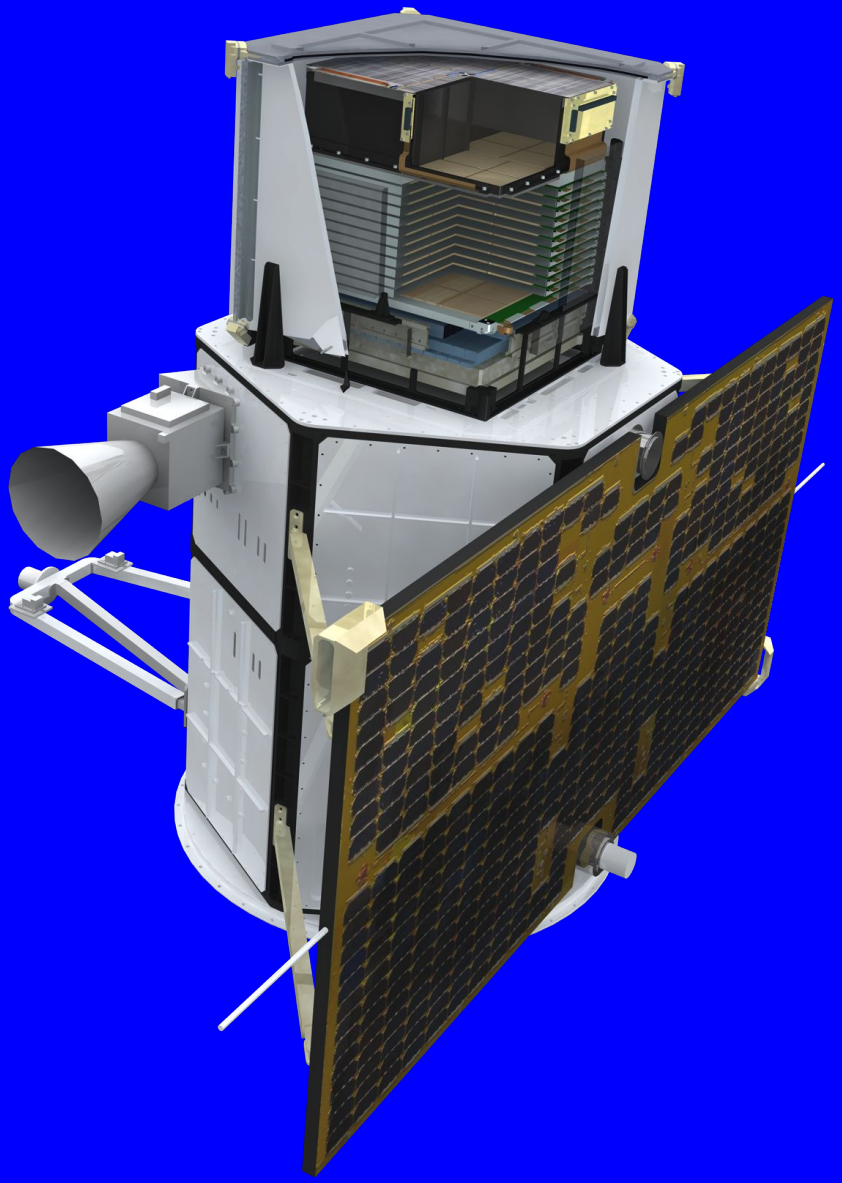
The AGILE's Secrets

A. Argan, INAF
on behalf of the AGILE Team

THE AGILE MISSION



- Industrial Phase C/D contract signed on March 2003
- Phase C/D lasting 4 years
- Low financial budget
- All the P/L requirement specs written by the Scientific Team
- P/L: industrial prime ship
- ST, AC and SA developed under the responsibility of the Scientific Team

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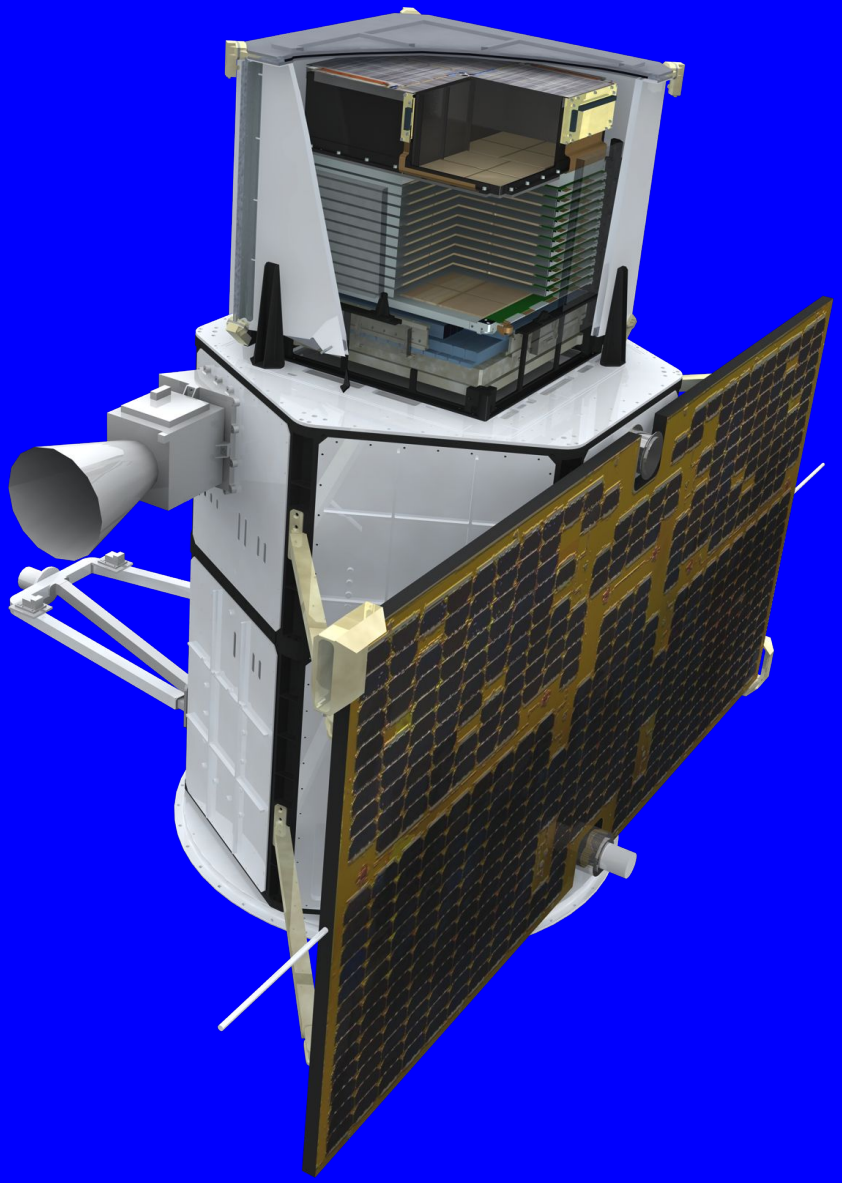

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AGILE PAYLOAD DEVELOPMENT

- **Model philosophy:**
  - **Breadboards**
  - **Simplified Eng. Model (SEM)**
  - **STM (used to qualify the satellite mechanical design)**
  - **PDHU Fu.Mo.**
  - **S/S-Unit PFMs**
  - **IPL**

- **P/L Reliability:**
  - **High Rel components + components qualified for the mission**
  - **No redundancy**

AGILE MISSION DEVELOPMENT

ASI, Scientific and Industrial joint Team

THE AGILE ON-GROUND TESTING

ACTIVITY	FACILITY	DATE
Payload AIV	Thales-Aleniaspace Italia, Milano (Italy)	December 2004 - October 2005
Bus AIV	CGS, Tortona (Italy)	December 2004 -November 2005
GRID Calibration	Laboratori Nazionali di Frascati-INFN, Frascati (Italy)	November 2005
Satellite AIV	CGS, Tortona (Italy)	December 2005 – May 2006
Satellite Qualification	IABG, Munchen (Germany)	June-July 2006
Scientific Configuration finalization	CGS, Tortona (Italy)	August-September 2006
Satellite refurbishment	CGS, Tortona (Italy)	October-November 2006
Satellite AIV post refurbishment	CGS, Tortona (Italy)	December 2006
Super-AGILE and MCAL-Burst Calibration	CGS, Tortona (Italy)	January 2007
Satellite Qualification post refurbishment	IABG, Munchen (Germany)	February-March 2007
Launch Campaign	Satish Dhawan Space Center SHAR, Sriharikota, Chennai (India).	April 2007

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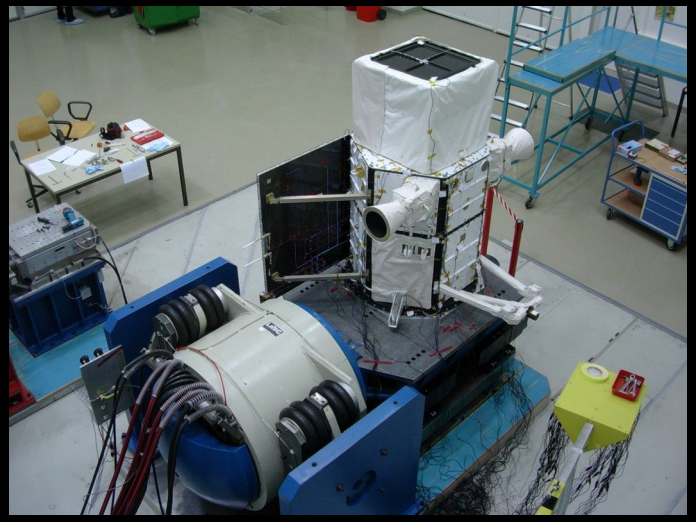
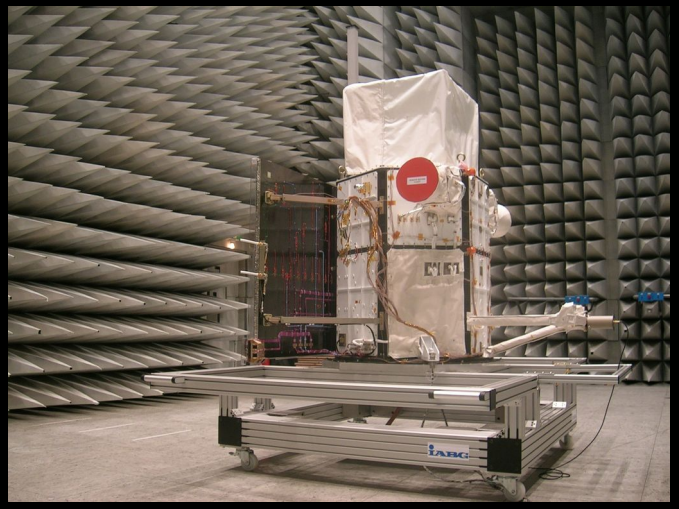
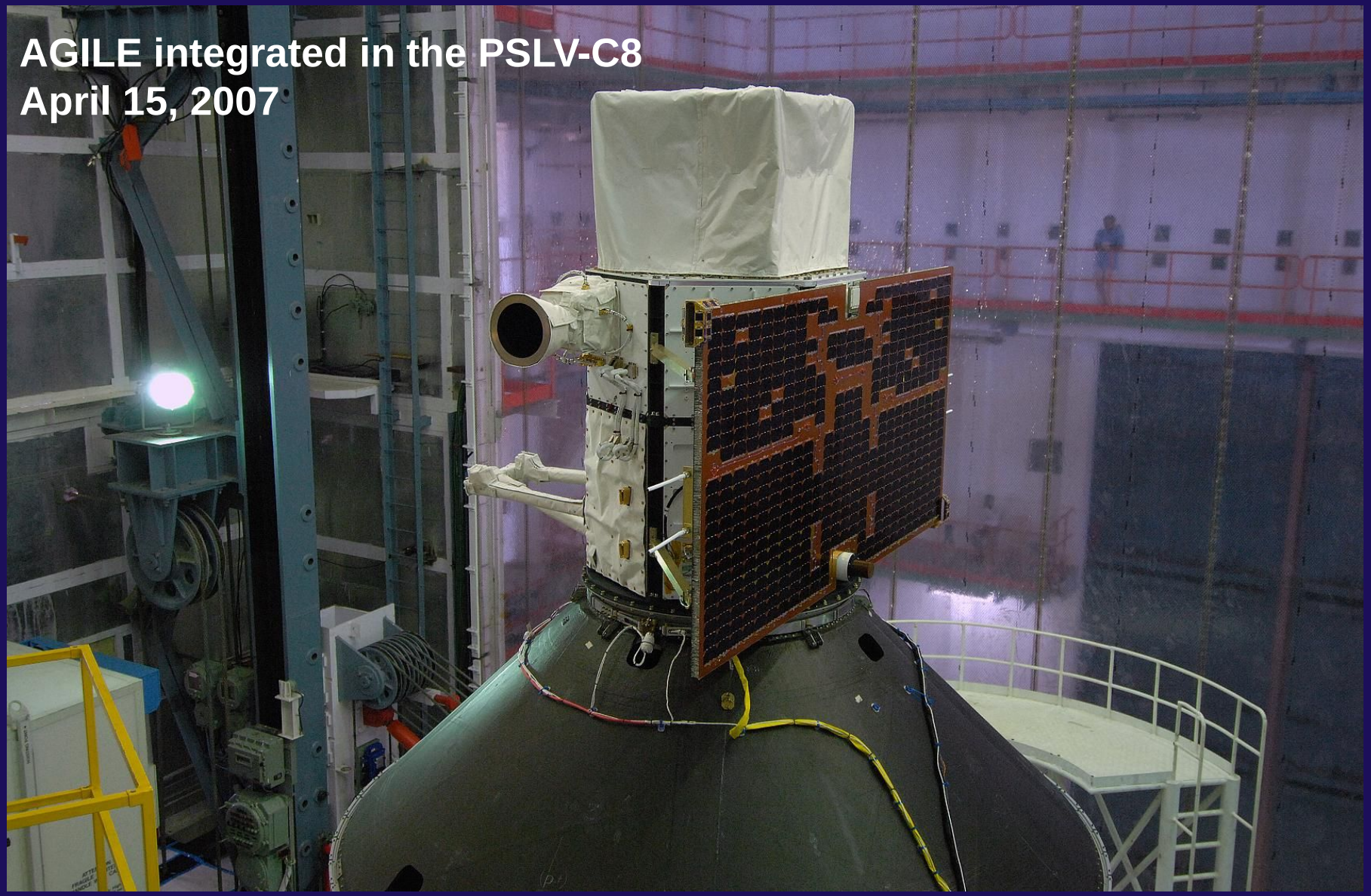
THE AGILE INTEGRATION AND QUALIFICATION





THE AGILE LAUNCH CAMPAIGN

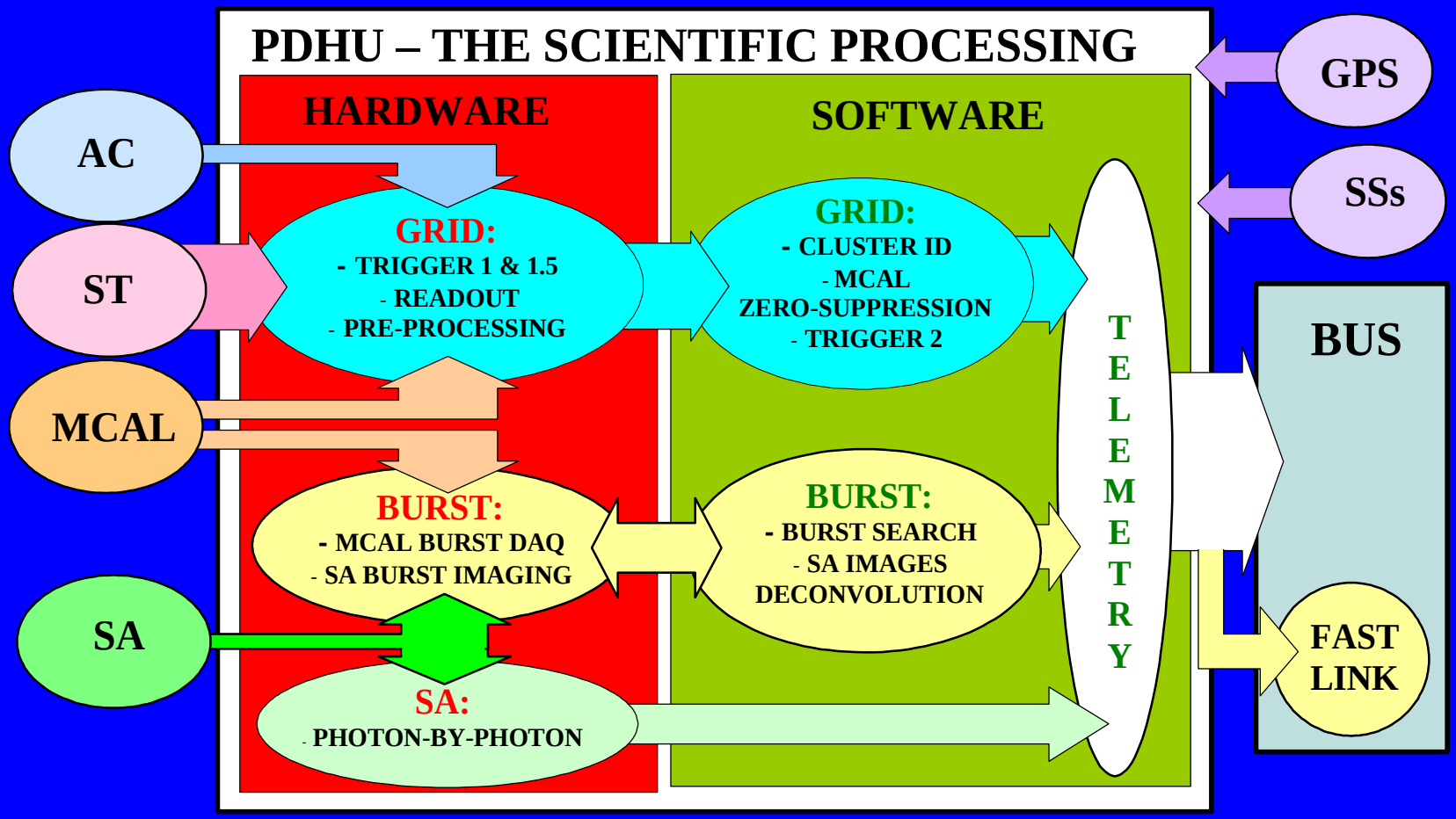


THE AGILE INSTRUMENT - GLOBAL VIEW

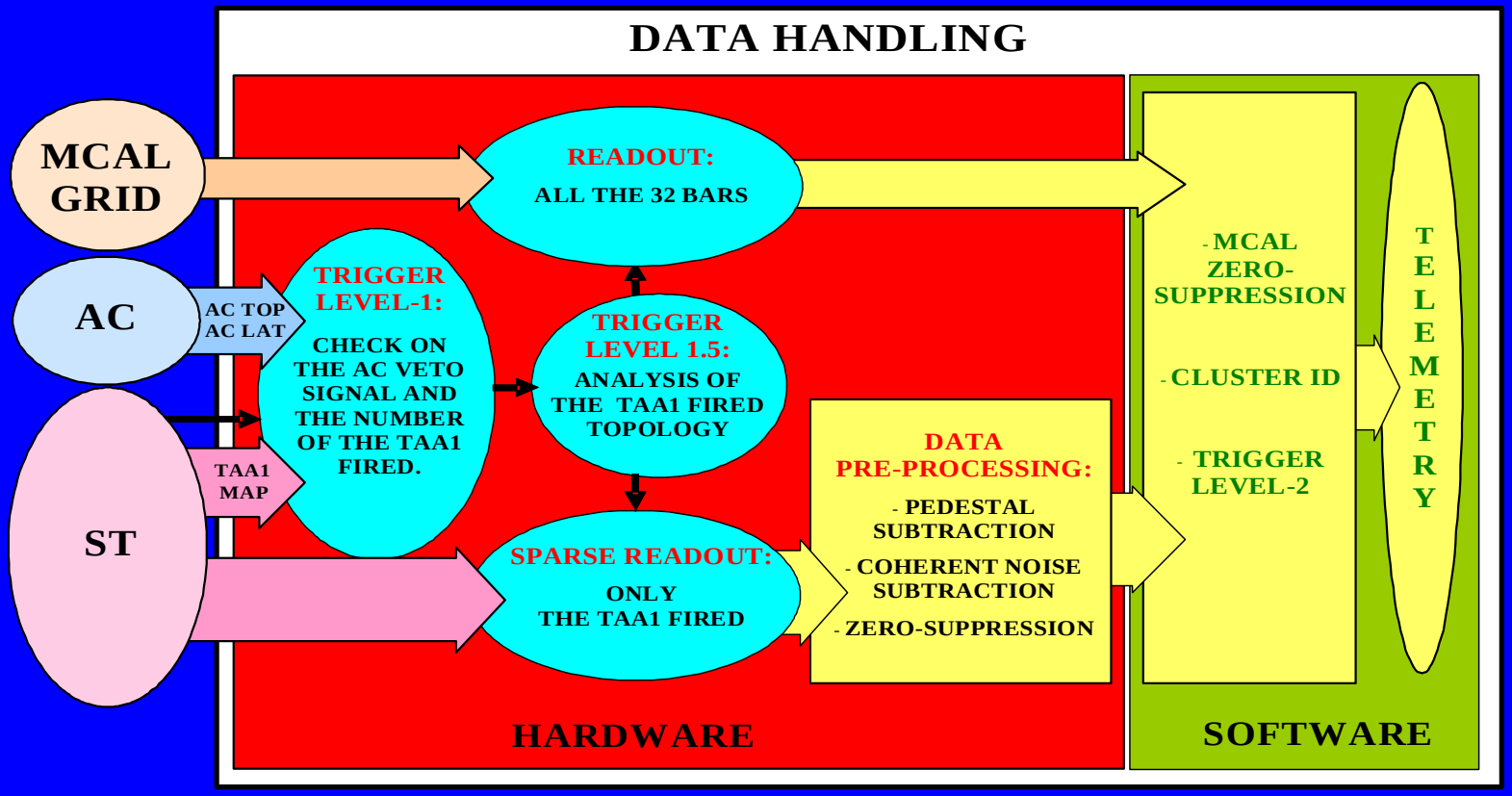
The most compact and low-power Instrument ever developed in High Energy Astrophysics.

1. Detector volume: ~ 0.25 m^3
2. Detector mass: ~ 120 kg
3. Detector power consumption: ~ 60 W
4. Complex data acquisition system:
   1. 36.864 Silicon Tracker (gamma-ray imager) channels
   2. 6.144 Super-Agile (hard X-ray imager) channels
   3. 60 Mini-Calorimeter channels
   4. 15 AC channels
   5. 27 FPGA's
   6. 1 DSP

OVERVIEW ON THE ON-BOARD DAQ (I)



THE ON-BOARD DAQ (II): GRID



SYNCHRONOUS PHASE

TRIGGER 1 + TRIGGER 1.5 < 25μs
TYPICAL DEATHTIME ~200μs

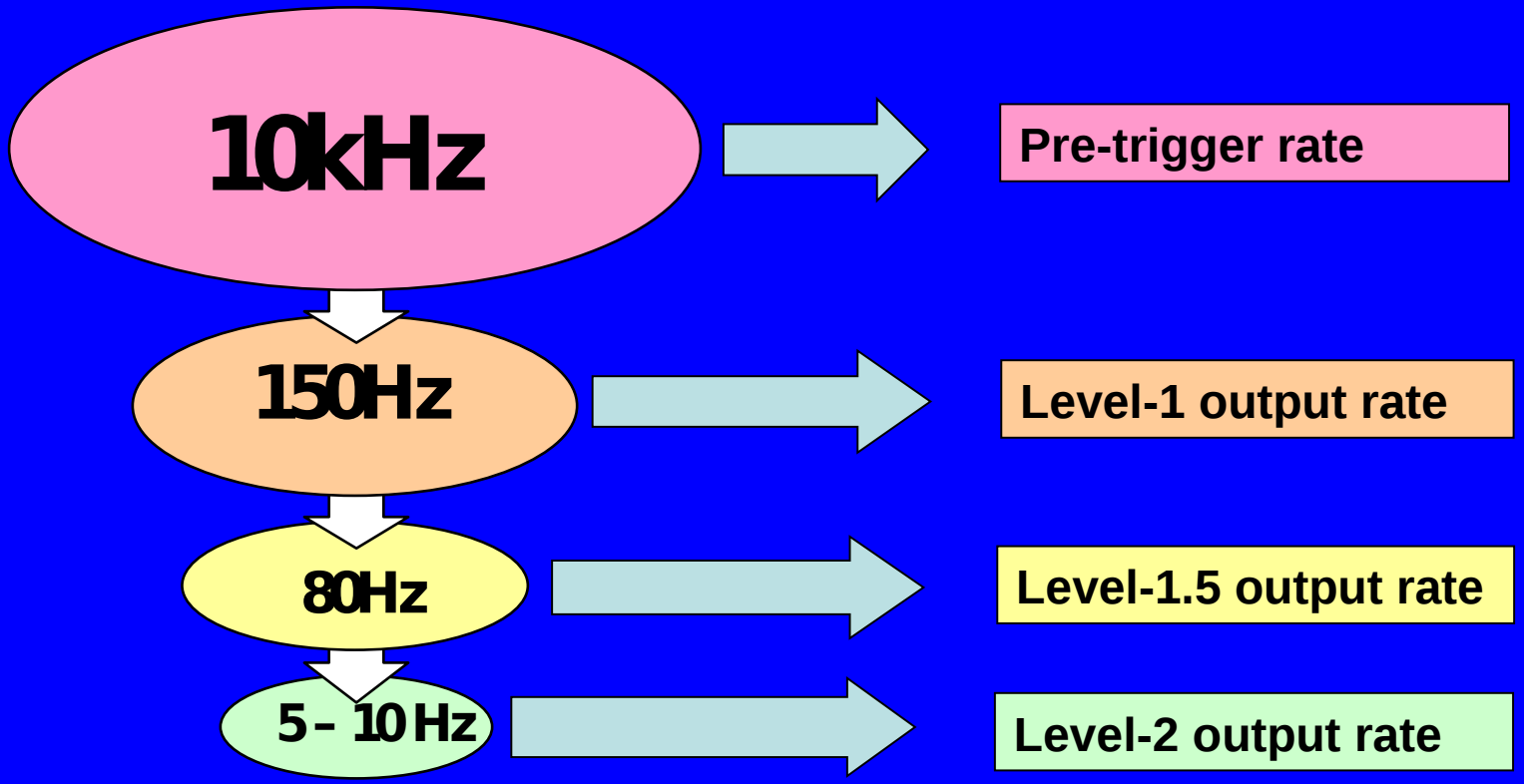
ASYNCHRONOUS PHASE

TOTAL DURATION ~ 3-4ms
NO DEATHTIME

20 independent trigger algorithms

GRID FUNCTIONAL PERFORMANCE

The GRID Trigger background rejection



THE ON-BOARD SCIENTIFIC PROCESSING

The AGILE scientific processing:

high flexibility
through high modularity
& high programmability

ON-BOARD SCIENTIFIC CONFIGURATION TELECOMMANDS

- **AC FEE configuration:**
  - **1 TC33S5: AC Obs. configuration (RAM/EEPROM)**
  - **1 TC33S6: AC El. Cal. configuration (RAM/EEPROM)**
- **ST FEE configuration:**
  - **1 TC33S7: ST General Obs. configuration (RAM/EEPROM)**
  - **96 TC33S8: ST Regin configuration (RAM/EEPROM)**
  - **1 TC33S9: ST El. Cal. configuration (RAM/EEPROM)**
- **SA FEE configuration:**
  - **1 TC33S10: SA General Obs. configuration (RAM/EEPROM)**
  - **48 TC33S11: SA Obs. Regin configuration (RAM/EEPROM)**
  - **48 TC33S11: SA Cal. Regin configuration (RAM)**
  - **4 TC33S12: SA El. Cal. configuration (RAM/EEPROM)**
- **MCAL FEE configuration:**
  - **1 TC33S13: MCAL Obs. configuration (RAM/EEPROM)**
  - **1 TC33S14: MCAL El. Cal. configuration (RAM/EEPROM)**

ON-BOARD SCIENTIFIC CONFIGURATION TELECOMMANDS

- **PDHU – GRID logic configuration:**
  - **1 TC33S2: GRID HW configuration (RAM/EEPROM)**
  - **1 TC33S3: GRID SW step-1 configuration (RAM/EEPROM)**
  - **1 TC33S4: GRID SW step-2 configuration (RAM/EEPROM)**
  - **1 TC33S37: GRID SW step-3 configuration (RAM/EEPROM)**
- **PDHU - BURST logic configuration:**
  - **1 TC33S15: Burst Search general configuration (RAM/EEPROM)**
  - **1 TC33S16: Burst Search HW configuration (RAM/EEPROM)**
  - **4 TC33S17: SA Burst Search SW configuration (RAM/EEPROM)**
  - **4 TC33S19: MCAL Burst Search SW configuration (RAM/EEPROM)**
  - **1 TC33S18: SA Imaging configuration (RAM/EEPROM)**
- **PDHU - General scientific configuration:**
  - **1 TC33S1: Scientific general configuration (RAM/EEPROM)**
  - **1 TC33S20: Telemetry Partition Table configuration (RAM/EEPROM)**

ON-BOARD SCIENTIFIC CONFIGURATION
LOOK-UP TABLES

- **PDHU – GRID logic configuration:**
  - **¾ Trigger: 4 LUTs Obs. + 2 LUTs Cal.**
  - **AC Veto: 4 LUTs Obs. + 1 LUT Cal.**
  - **R-Trigger: 4x8 LUTs Obs. + 2 LUTs Cal.**
  - **1.5 Trigger: 4 LUTs**
  - **CDIS Trigger: 4 LUTs**
  - **ST Offsets: 1 LUT**
  - **FVC1: 1 LUT**
  - **FVC2: 1 LUT**
  - **Kalman Filter: 7 LUTs**
- **PDHU – SA Photon-by-Photon configuration:**
  - **Address Corr.: 4 LUTs**
- **PDHU - BURST logic configuration:**
  - **SA Burst Trigger: 4x4 LUTs**
  - **SA Imaging Trig.: 4 LUTs**
  - **MCAL Burst Trig.: 4x4 LUTs**
  - **MCAL BBFP: 4x4 LUTs**
  - **SA Burst Imag.: 7 LUTs**

OVERVIEW ON THE ON-BOARD DAQ

A complete AGILE scientific configuration is composed of:

220 TCs (~100000 parameters)

126 LUTs

THE IN-FLIGHT OPERATIONS: POINTING

EVENT	DATE
Commissioning **Engineering & Science**	**May – July 2007**
Delta-Commissioning **Burst Trigger setup**	**November 2007**
Delta2-Commissioning **Burst Trigger (SIT short) setup**	**July 2008**
Failure of the Reaction Wheel **ACS in Spinning mode**	**October 2009**

THE IN-FLIGHT OPERATIONS: SPINNING

EVENT	DATE
Conflicts between AGILE and SWIFT	January 2010
Payload reconfiguration Configuration based on the Recovery phase aimed at limiting the TM producton during the conflicts	March - April 2010
Further reduction of the available Ground Station contacts SA pbp inhibition (scientific ratemeters only)	September 2012
Satellite Watchdog activation Switch of the OBDH section	January 2013
Issues on the Operations contract renewal AGILE in IDLE mode	January – March 2014
Payload reconfiguration P/L configuration aimed at optimizing the scientific results both in astrophysics and in the Earth observation. Albedo filtering inhibition. AC veto inhibition for the MCAL trigger.	July 2014 March 2015
PPSE anomaly Orbit data no more available.	July 2015
Delta3-Commissioning MCAL Burst Trigger tuning	August 2016
Research of the GW counterparts Baseline; Full GW; Half GW; B+MCAL1; B+MCAL1+SA	September 2016 - Today

CONCLUSIONS