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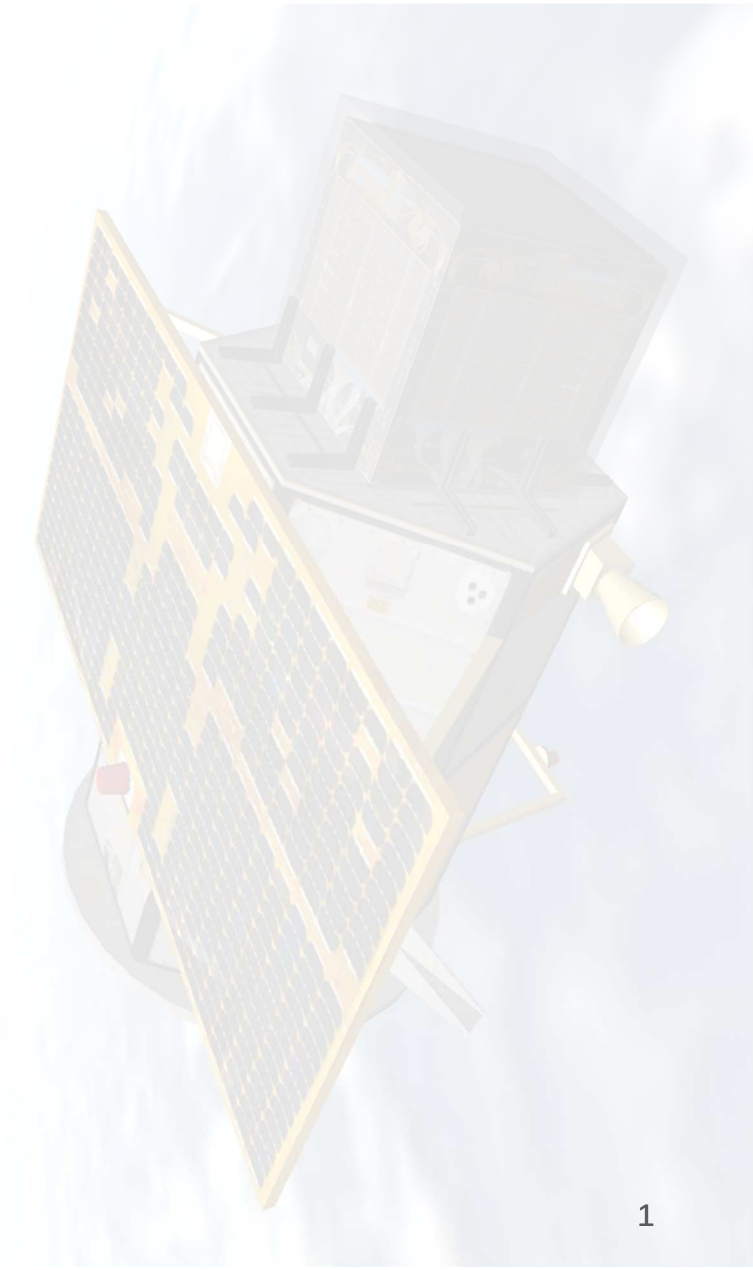
AGILE - 13th Workshop

May 25-26, 2015
ASI HQ - ROMA

P. Tempesta on behalf of TPZ Agile Team



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Telespazio roles in the AGILE Mission

- **Ground Segment Development and Management**
- **Operations Preparation and Execution during all mission phases**

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Ground Segment Development Overview

Fucino Space Center

MCC
Mission Control Center

Provides the Mission Planning and related TC sequences generation

FDC
Flight Dynamic Center

Provides Orbit/Attitude Operations Products generation used for Satellite M&C, Mission Planning and Scientific processing support.

SCC
Satellite Control Center

Provides all functions devoted to Monitor and Control the Satellite

TT&C

Provides the S-Band link between Agile and the Ground Segment

ASI Malindi Earth Station

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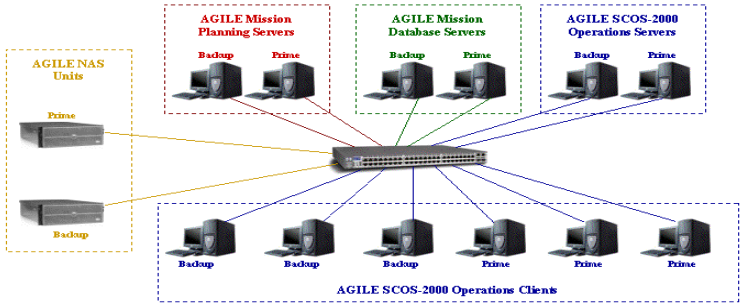
Ground Segment Development
SCC - Satellite Control Center

AGILE SCC Room



HW Configuration

SCC Functions

- Satellite telemetry *acquisition* from TT&C ground station, TM processing, display and archiving
- Handling of the satellite acquisition automatic procedures
- Satellite database handling and maintenance
- Satellite sub-systems and payload health monitoring and control through housekeeping
- Telemetry processed data presented on alpha-numeric/graphic and mimic displays
- Real time or time-tagged telecommand preparation, TC to be uplinked to the satellite
- Co-ordination with the TT&C ground station for passages acquisition plan
- Communication network management

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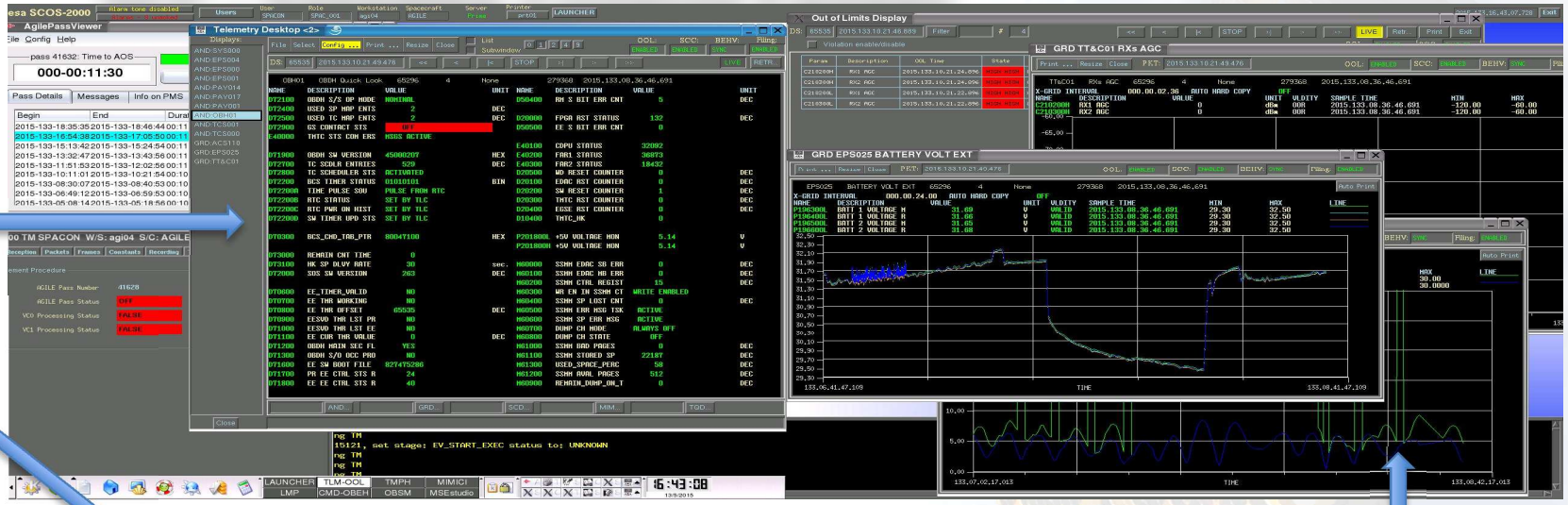
Ground Segment Development
SCC - Satellite Control Center

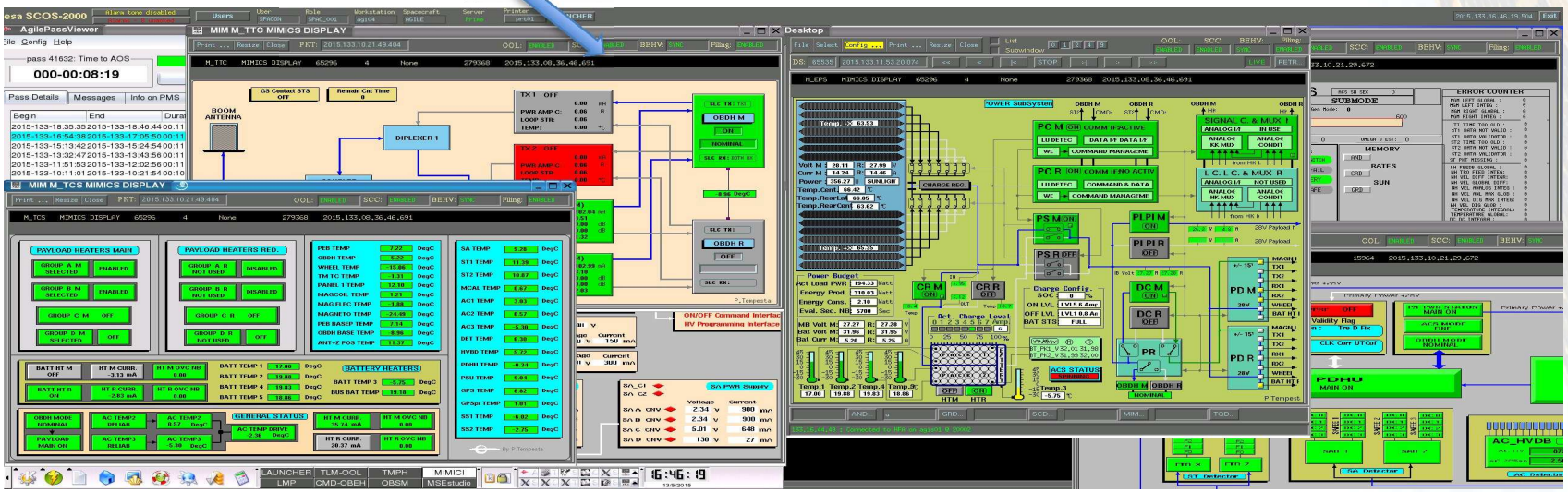
7838 Telemetries Parameters….

92 Telemetries Pages (ANDs)….

10 Mimics Display….

336 Telecommands….





91 Telemetries Graphics (GRAs)….

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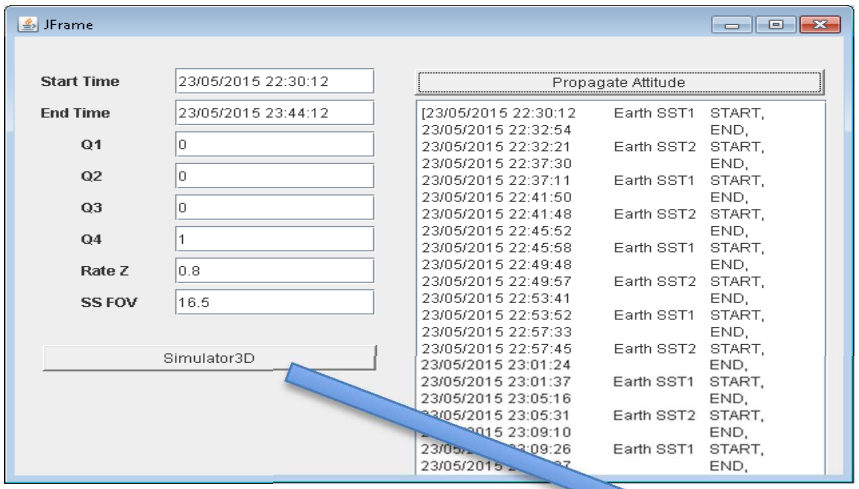
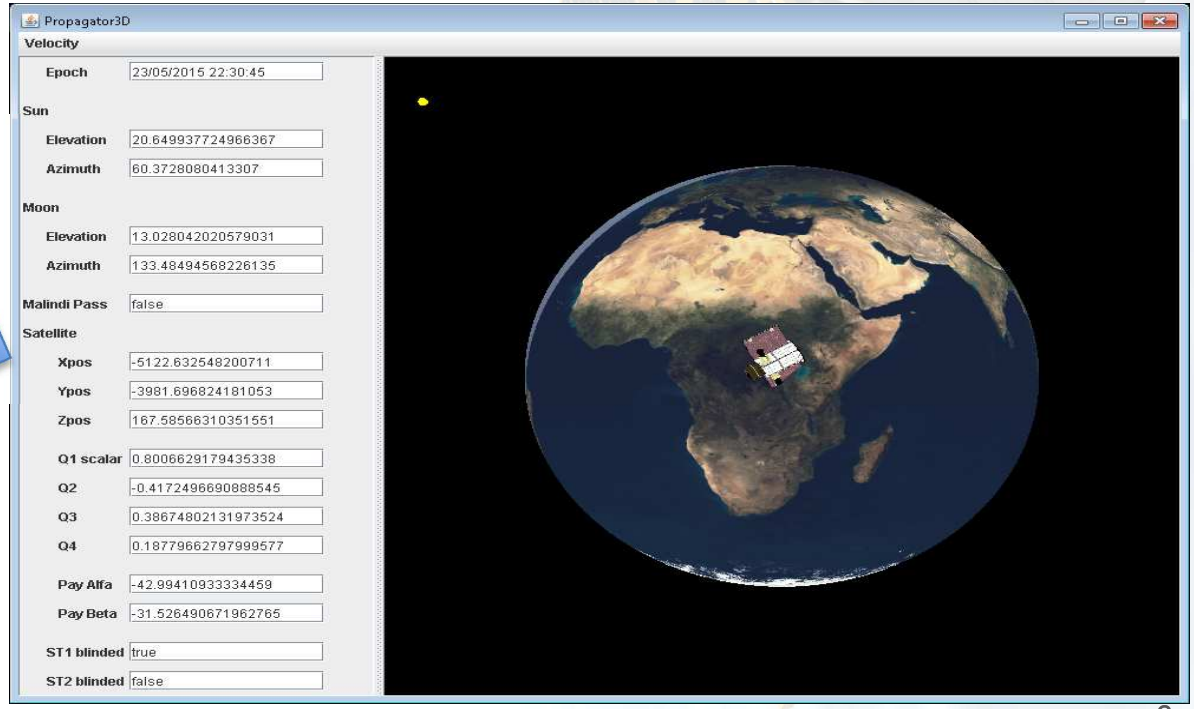
Ground Segment Development
SCC - Satellite Control Center





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Ground Segment Development
MCC - Mission Control Center

AGILE MCC Workstation

MCC Functions

- Programming Payload Science acquisition (from ASDC LTP)
- Generates Telecommands Mission Plan (Payload and Platform activities)
- Manages the OSM comunications (betwen Operative and Scientific Centers)

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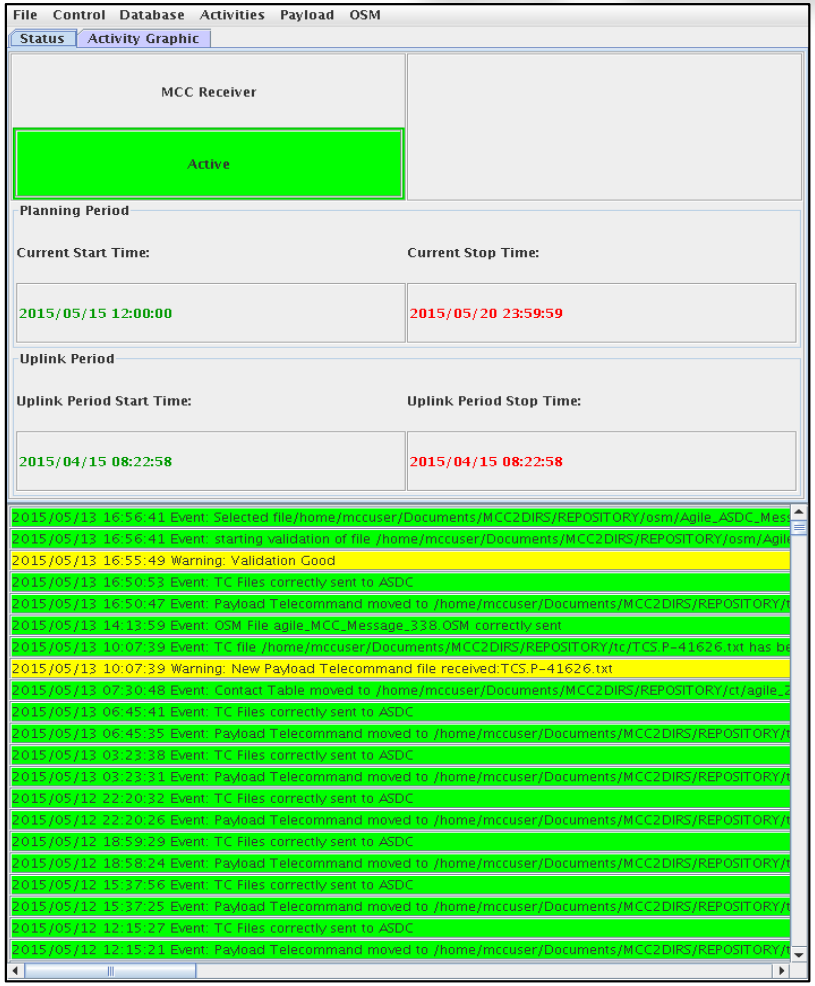
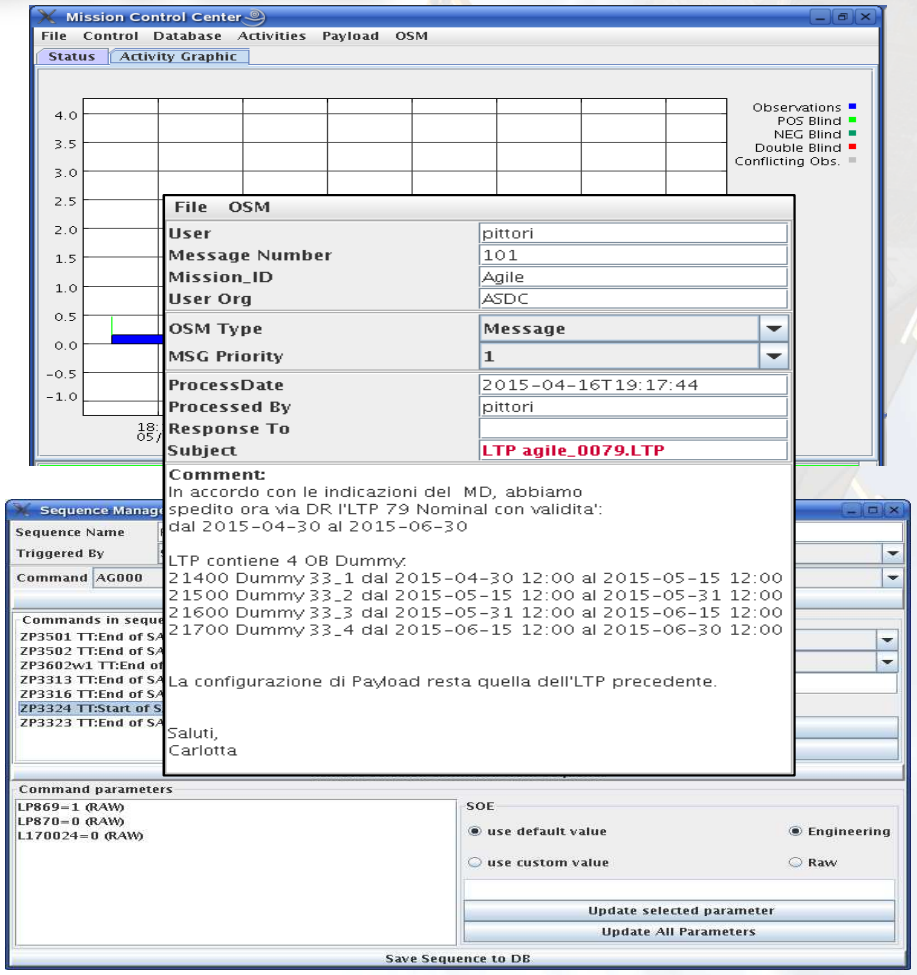
Ground Segment Development

MCC - Mission Control Center





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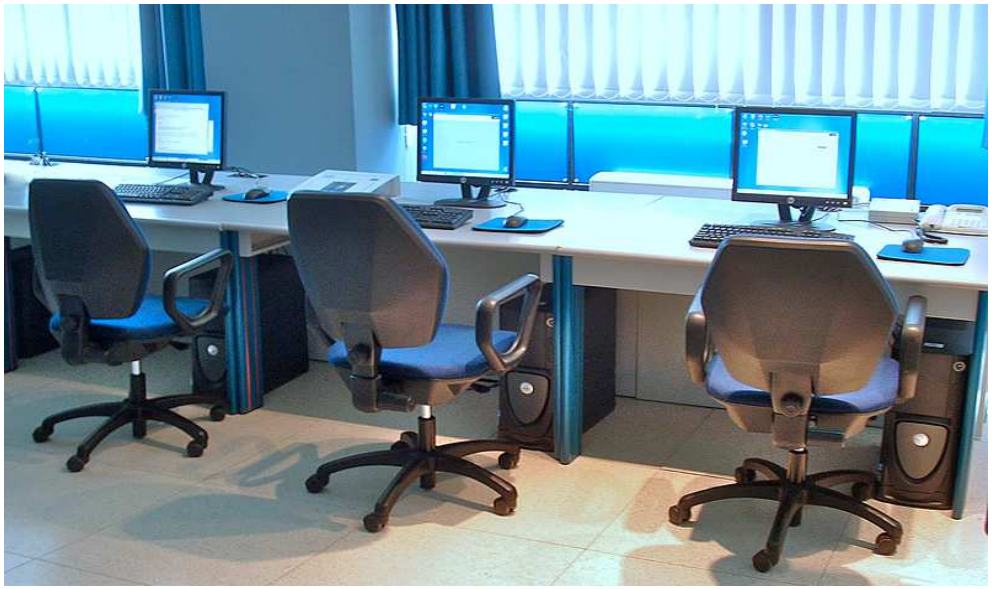
Ground Segment Development
FDC – Flight Dynamic Center



AGILE FDC Workstation in FDS Room

FDC Functions

- **Orbit determination and propagation**
  - Processing GPS telemetry data
  - Processing AMD (Angular Measurement Data) (coming from TT&C Antenna – as backup in case of unavailability of GPS)
  - Orbit Decay prediction
- **Generation of mission products**
  - Sequence of the Events (SOE)
  - Two Line Elements (TLE) to be used for the TT&C ground antenna for tracking
  - Orbital Files, necessary for the satellite in-orbit operations and for the mission planning activity (Contact tables, SAA tables etc etc)
  - Attitude File, containing the reconstructed satellite attitude, necessary for the satellite in orbit operations and for scientific activities support
- **ACS on-board operations support**
  - ACS performance monitoring
  - Attitude Manouvres Calculation
    (Superseded due to wheel failure)
  - Star Trackers and GPS receiver data handling

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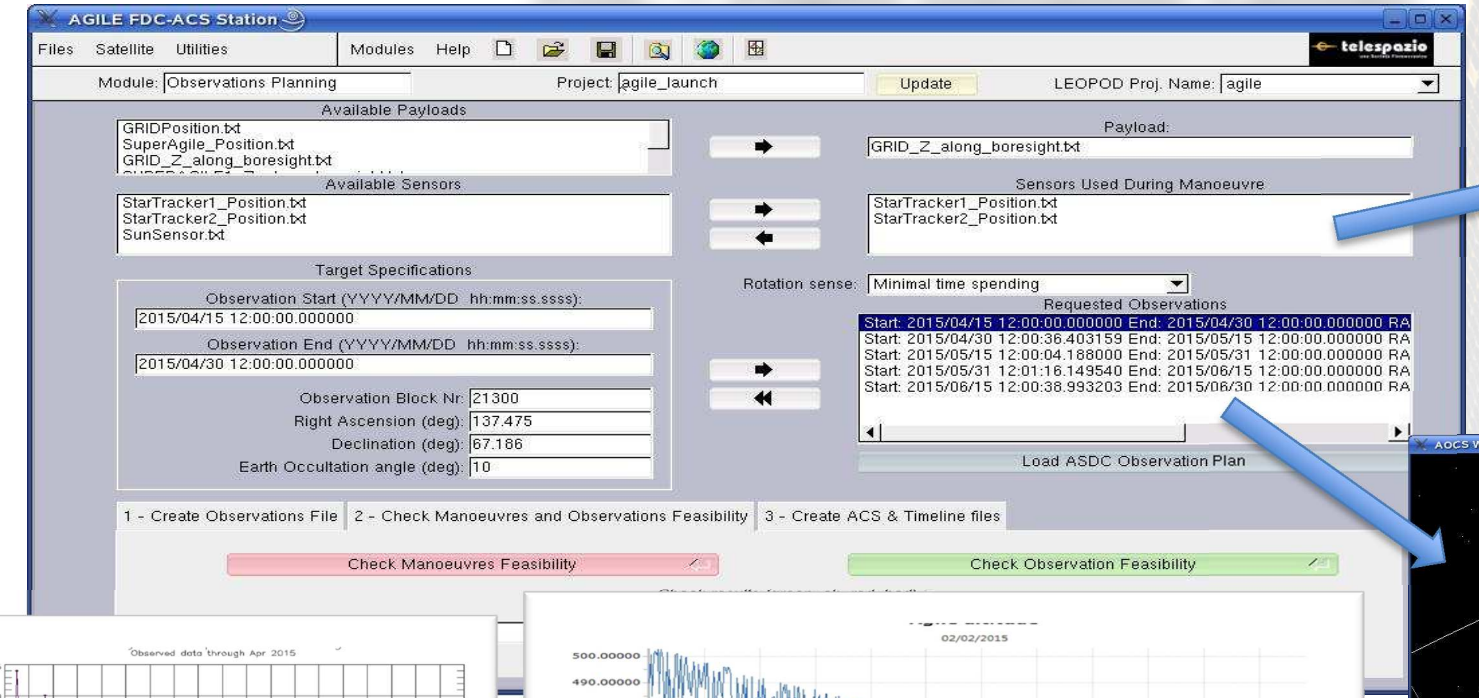
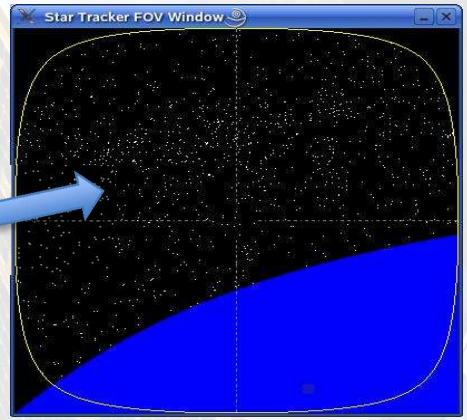
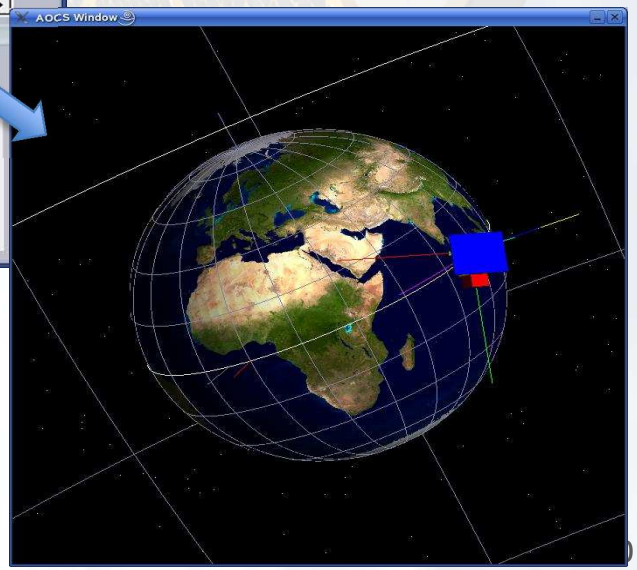
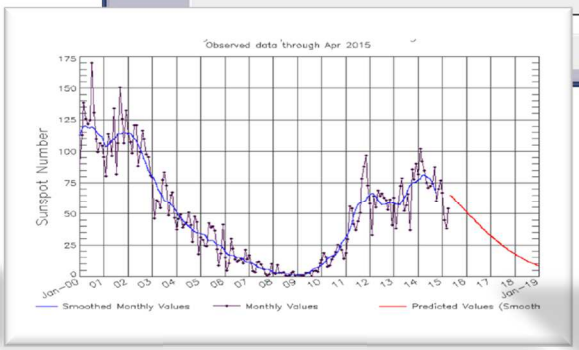
Ground Segment Development

FDC – Flight Dynamic Center

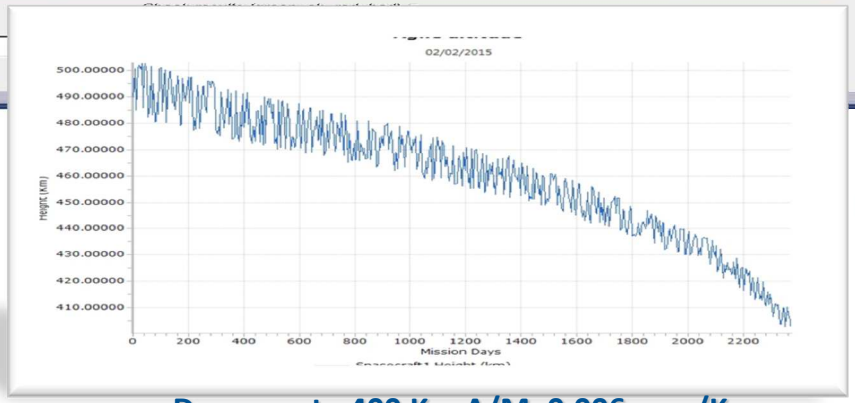








Solar Cycle



Decay up to 400 Km A/M=0.006 sqm/Kg

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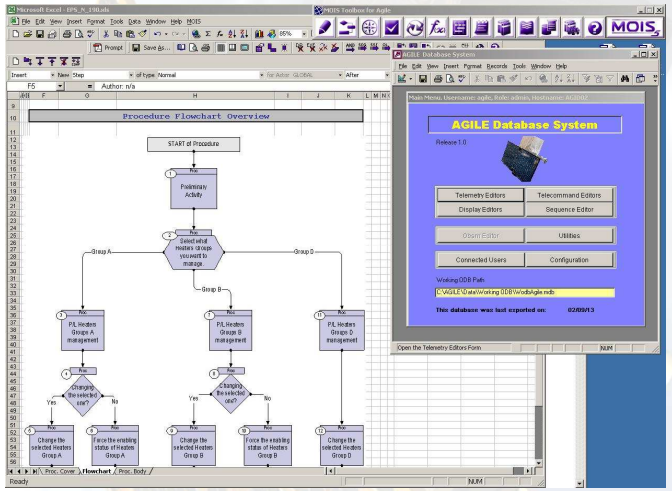
Operations Preparation and Execution

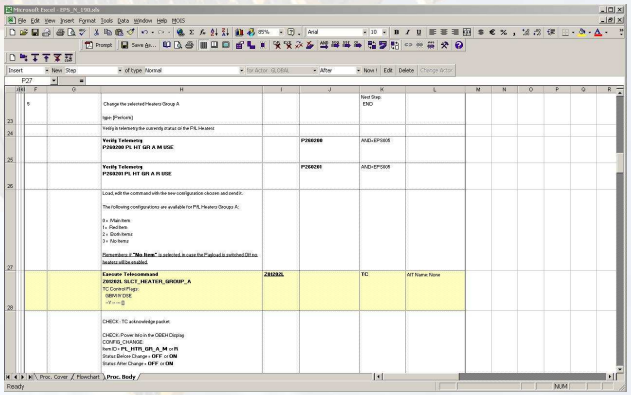
MISSION PHASES

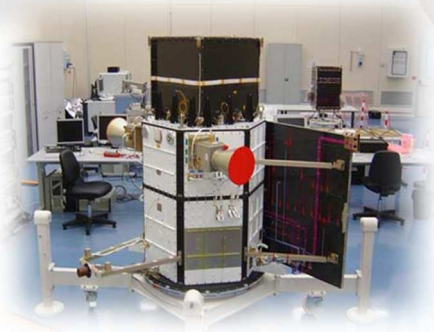
Pre-Launch

(completed)

- Analysis of Mission Requirement and input Documentations
- Database and SCC Customization (Telemetries, Telecommands, ANDs, GRDs, etc etc)
- Writing the FOP/GOP procedures (NOM and CNTG)
- Perform the System Validation Tests (SVT)
- Run the Simulations Campaing







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Operations Preparation and Execution

MISSION PHASES

Pre-Launch (completed) → **LEOP** (completed)

- Coordinate the activities with Satellite Manufacturer and Launch Authority
- Readiness with TT&C Station (especially for the first Acquisition)
- Health check of the Satellite
- Determination of the orbit achieved by the launcher

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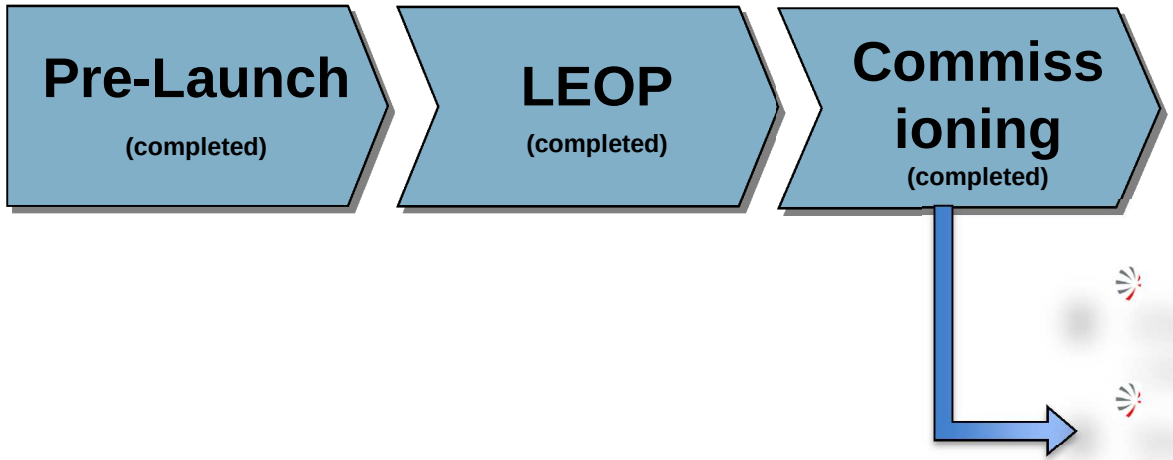
Operations Preparation and Execution

MISSION PHASES



- Check the Satellite Units Health / Status / Functionality
- Verification / Calibration / Tuning of Payload Setting
- Check the Ground Segment Elements Functionality

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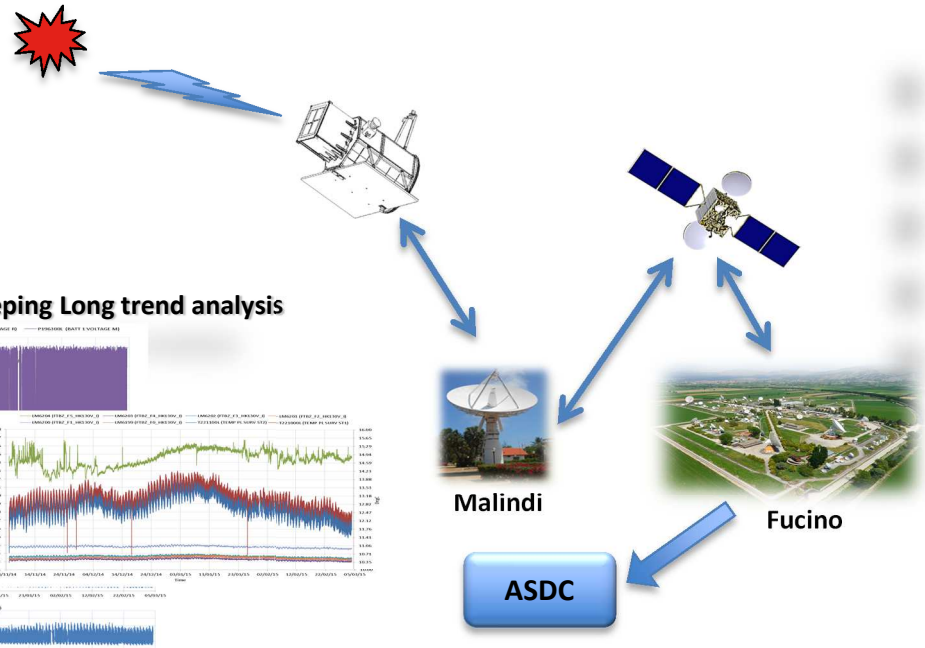
Operations Preparation and Execution

MISSION PHASES

Pre-Launch (completed) → **LEOP** (completed) → **Commissioning** (completed) → **Routine** (ongoing)



- Mission Exploitation
- Management of Ground Segment
- Satellite Monitoring and Control
- Scientific Observation Execution
- Management of any anomalous situation (Space and Ground)

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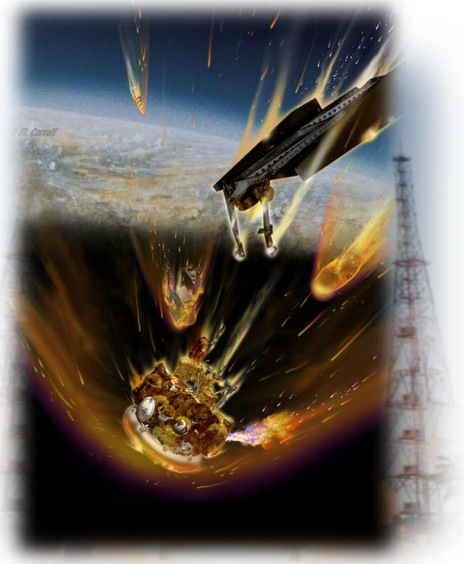
Operations Preparation and Execution

MISSION PHASES

Pre-Launch (completed) → **LEOP** (completed) → **Commissioning** (completed) → **Routine** (ongoing) → **Disposal** (to be done)



- Passivation of the Satellite
- Monitoring the Agile Powering Off
- Release the last Orbit Calculated with last available GPS data.
- Decommissioing of the Ground Segment
- Archive all Mission Data

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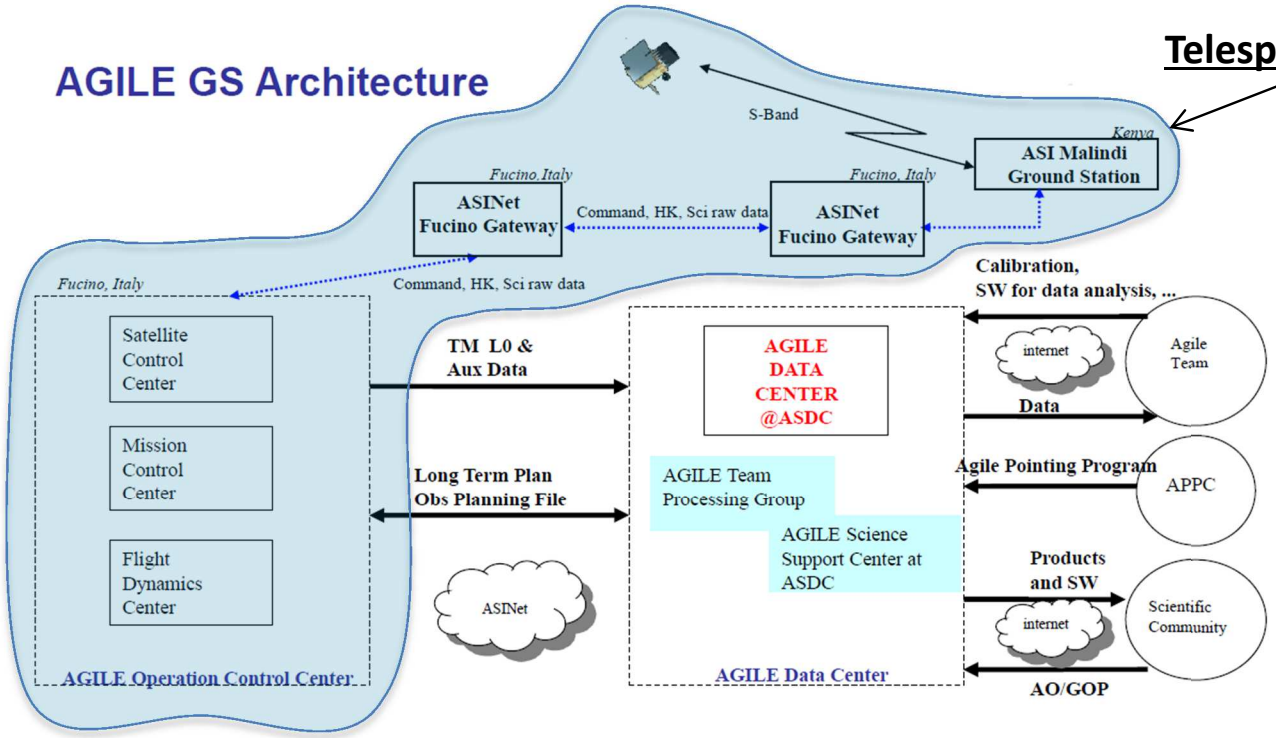
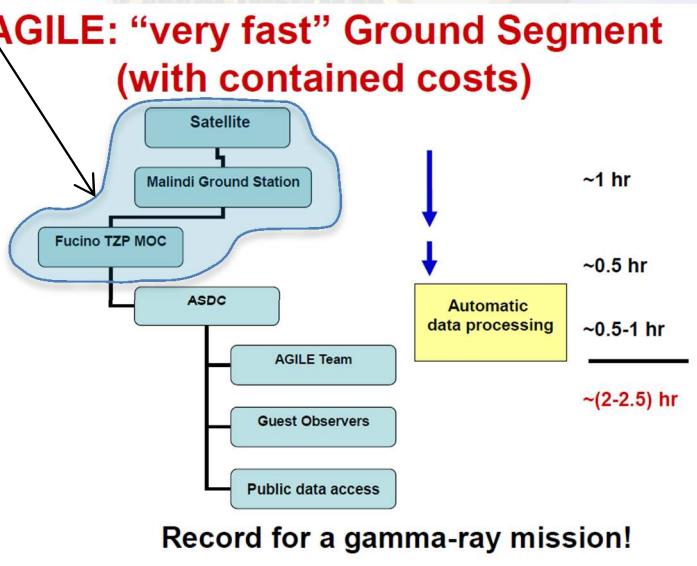
Agile Lesson Learnt….

A Low Cost Mission ≠ A Low Ground Segment

1st - It was realized simply but extremely efficiently



Telespazio Domain



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Agile Lesson Learnt….

A Low Cost Mission ≠ A Low Ground Segment

2nd - It was realized highly automated

Automatic setup for pre-pass activities →
- Set pass number
- Connection with Malindi Station
- Initialize the recording of VC0/VC1 file
- Set of SCC variables to manage the creation of AUX files

Pass activities →
- Processing of real-time TLM
- Record the VC0 TLM
- Display and alert for Out Of Limit conditions

Automatic post-pass activities →
- Receive the VC1 file from Station
- Send VC0/VC1 to ASDC/CGS
- Copy TLM into Archive
- Process in offline the VC1 TLM
- Collect GPS and others TLM data in AUX files
- Generate the Attitude Reconstruction

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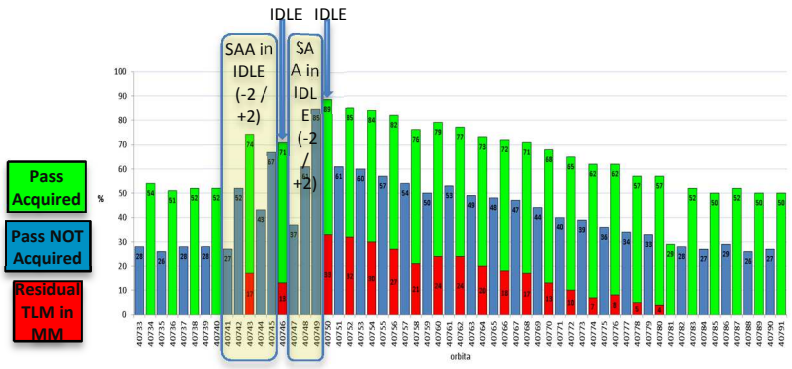
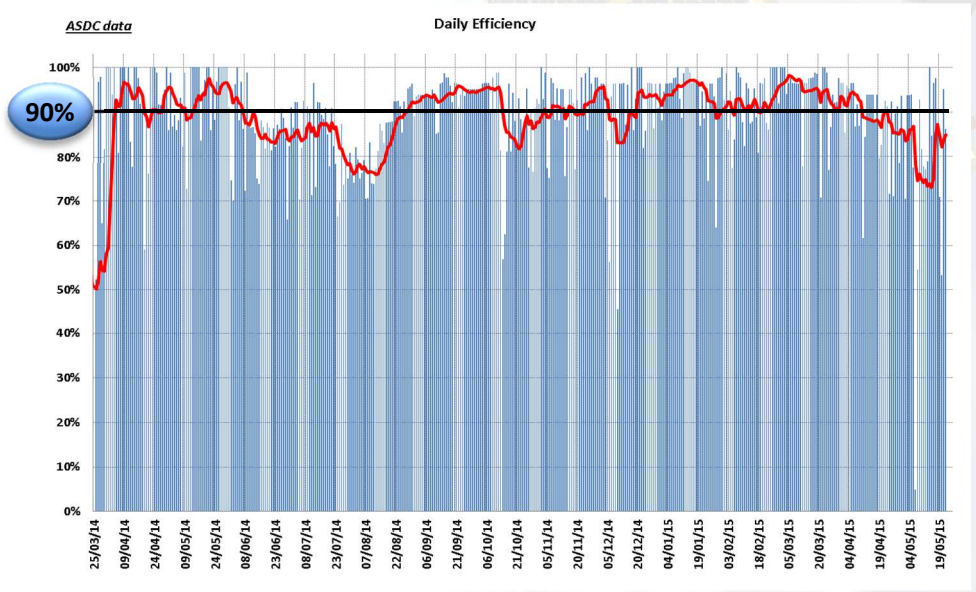
Agile Lesson Learnt….

A Low Cost Mission ≠ A Low Operations Profiles

Some changes of mission profile are occurred due to Space and Ground variations during time….

- **Momentum Wheel failure → Only Satellite Spinning Mode Available**
- **TT&C Antenna not more available for all passages → Modulate the Planning of Observation periods**





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Agile Lesson Learnt….

A Low Cost Mission ≠ A Low Mission Results

AGILE Astronomical Telegrams

ATel #1160| ATel #1167| ATel #1199| ATel #1221| ATel #1278| ATel #1300| ATel #1308| ATel #1320| ATel #1394
ATel #1428| ATel #1436| ATel #1445| ATel #1492| ATel #1495| ATel #1545| ATel #1547| ATel #1574| ATel #1581
ATel #1582| ATel #1583| ATel #1585| ATel #1592| ATel #1619| ATel #1634| ATel #1641| ATel #1705| ATel #1713
ATel #1732| ATel #1775| ATel #1782| ATel #1827| ATel #1830| ATel #1848| ATel #1917| ATel #1957| ATel #1968
ATel #1976| ATel #2017| ATel #2019| ATel #2047| ATel #2238| ATel #2242| ATel #2310| ATel #2322| ATel #2326
ATel #2344| ATel #2348| ATel #2361| ATel #2376| ATel #2382| ATel #2385| ATel #2403| ATel #2416| ATel #2454
ATel #2461| ATel #2467| ATel #2484| ATel #2512| ATel #2551| ATel #2552| ATel #2609| ATel #2641| ATel #2645
ATel #2686| ATel #2698| ATel #2715| ATel #2724| ATel #2761| ATel #2772| ATel #2855| ATel #2866| ATel #2880
ATel #2882| ATel #2903| ATel #2950| ATel #2971| ATel #2994| ATel #2995| ATel #3008| ATel #3034| ATel #3043
ATel #3049| ATel #3058| ATel #3059| ATel #3141| ATel #3151| ATel #3199| ATel #3239| ATel #3282| ATel #3286
ATel #3357| ATel #3386| ATel #3387| ATel #3448| ATel #3470| ATel #3544| ATel #3658| ATel #3858| ATel #3862
ATel #3907| ATel #3910| ATel #3934| ATel #3939| ATel #4153| ATel #4154| ATel #4389| ATel #4842| ATel #4856
ATel #4867| ATel #5234| ATel #5422| ATel #5506| ATel #5682| ATel #6182| ATel #6217| ATel #6231| ATel #6234
ATel #6365| ATel #6366| ATel #6427| ATel #6457| ATel #6733| ATel #7155| ATel #7193| ATel #7203| ATel #7227
ATel #7239| ATel #7457| ATel #7539
(http://agile.rm.iasf.cnr.it/astronomicaltelegram/astro-telegram.html)

AGILE GCN

GCN #6668| GCN #6670| GCN #6688| GCN #7042
GCN #7340| GCN #7457| GCN #7571| GCN #7572
GCN #7697| GCN #7715| GCN #7716| GCN #7723
GCN #7866| GCN #7903| GCN #8003| GCN #8006
GCN #8020| GCN #8133| GCN #8151| GCN #8305
GCN #8817| GCN #8852| GCN #9014| GCN #9029
GCN #9069| GCN #9075| GCN #9343| GCN #9524
GCN #10004| GCN #10022| GCN #10560| GCN #10810
GCN #10994| GCN #10996| GCN #12274| GCN #12341
GCN #12666| GCN #14344| GCN #14823| GCN #15479
GCN #16058| GCN #16350
(http://agile.rm.iasf.cnr.it/gnc/gcn.html)

13 Scientific Workshop, a lot of Articles, Publications, and, and……

2012 Rossi Prize


The High Energy Astrophysics Division
of the
American Astronomical Society
hereby awards the
2012 BRUNO ROSSI PRIZE
to
Marco Tavani and the AGILE Team
For the discovery of gamma-ray flares from the Crab Nebula.

AGILE Mission = An Example to follow……

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Numbers…

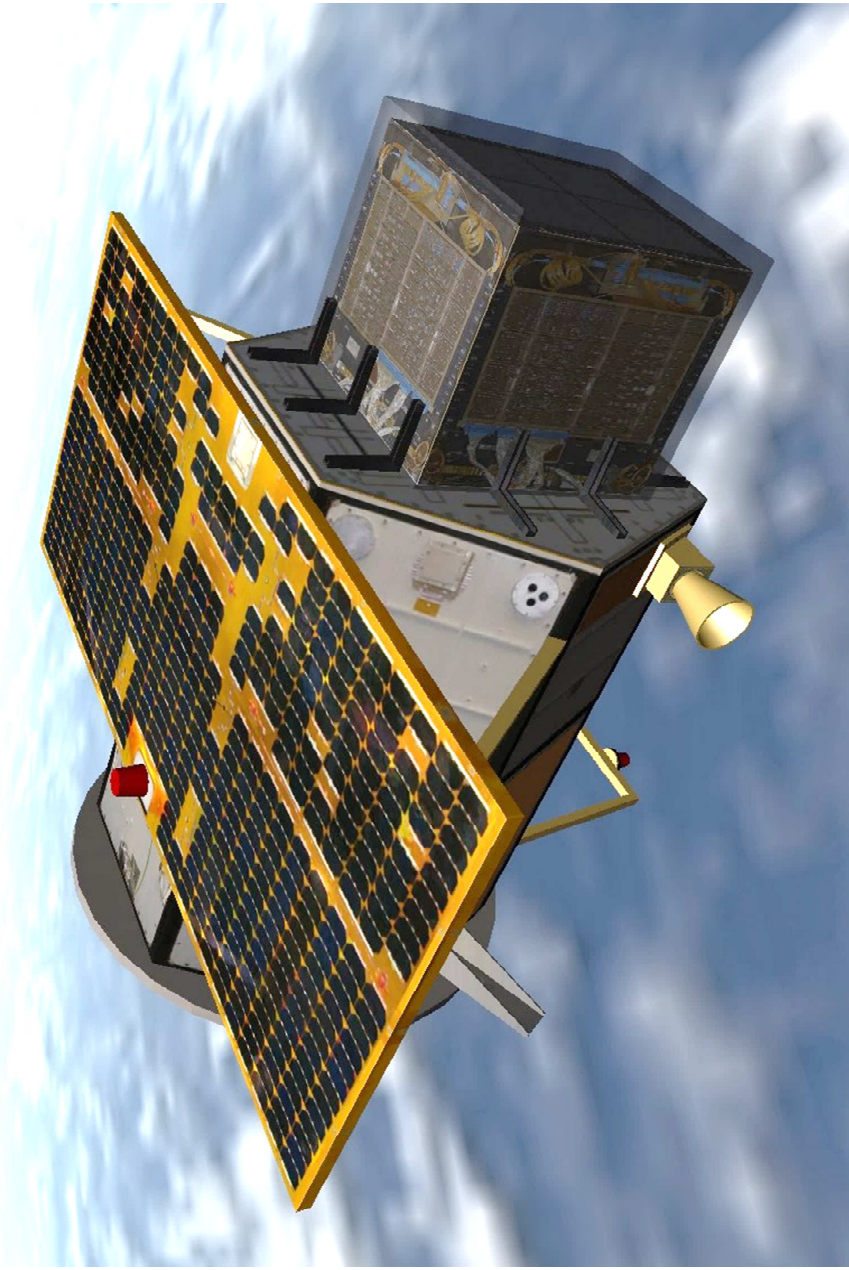
8 years in orbit….

Up to day > 41800 Orbits around the world…

Lost only 146 passages in 8 years….

Downloaded ~500GB of telemetry data….

(TLM VC1 raw, value of compressed data….)



The End

Thank you

For any matter related to the AGILE Operations
conducted by Telespazio write to:
patrizio.tempesta@telespazio.com