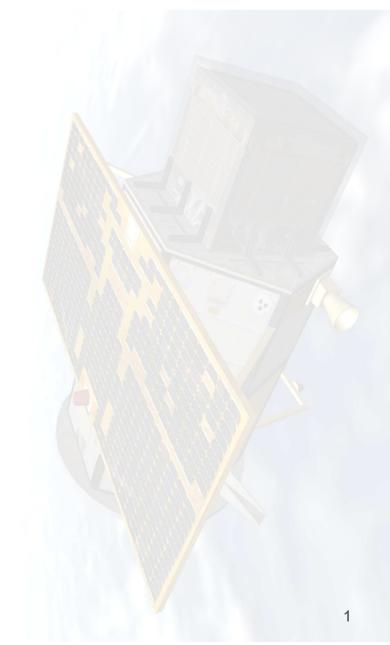


# AGILE - 13<sup>th</sup> Workshop May 25-26, 2015 ASI HQ - ROMA

P. Tempesta on behalf of TPZ Agile Team





## **Telespazio roles in the AGILE Mission**

Ground Segment Development and Management

Operations Preparation and Execution during all mission phases



### **Ground Segment Development Overview**

### **Fucino Space Center**



Provides the Mission Planning and related TC sequences generation





Provides all functions devoted to Monitor and Control the Satellite FDC Flight Dynamic Center

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

**TT&C** 



**ASI Malindi Earth Station** 

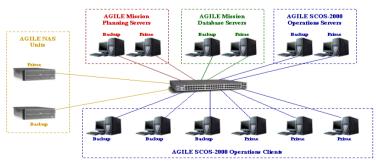
3



# 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 alphanumeric/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



## **Ground Segment Development**

## **SCC - Satellite Control Center**

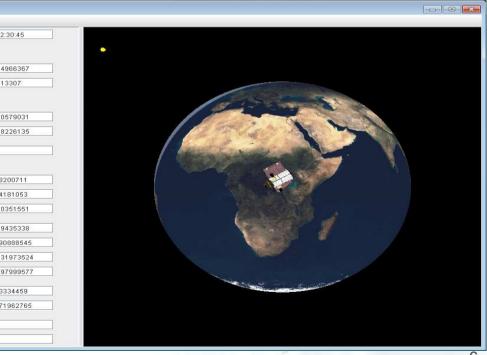




## **Ground Segment Development SCC - Satellite Control Center**

ST1 blinded true ST2 blinded false

JFrame						
Start Time	23/05/2015 22:30:12	Propa	igate Attitude			
End Time	23/05/2015 23:44:12	[23/05/2015 22:30:12	Earth SST1	START,		
Q1	0	23/05/2015 22:32:54 23/05/2015 22:32:21	Earth SST2	END, START		
		23/05/2015 22:37:30	Eanth 0012	END,		
Q2	0	23/05/2015 22:37:11	Earth SST1	START,		
Q3	0	23/05/2015 22:41:50		END,		
45	· ·	23/05/2015 22:41:48	Earth SST2			
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					Pay Beta	-31.526490671962765
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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 (between Operative and Scientific Centers)



## Ground Segment Development MCC - Mission Control Center

File Control Database Activities Payload OSM	
Status Activity Graphic	
MCC Receiver	
Planning Period	
Current Start Time:	Current Stop Time:
2015/05/15 12:00:00	2015/05/20 23:59:59
Uplink Period	
Uplink Period Start Time:	Uplink Period Stop Time:
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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

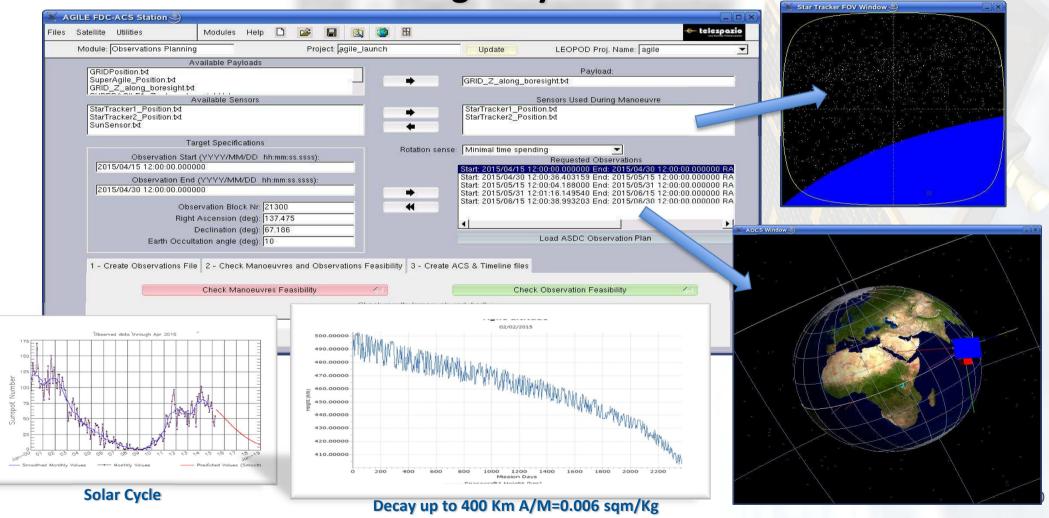
#### ACS on-board operations support

- ACS performance monitoring
- Attitude Manouvres Calculation (Superseded due to wheel failure)
- Star Trackers and GPS receiver data handling



## **Ground Segment Development**

### **FDC – Flight Dynamic Center**





**Pre-Launch** 

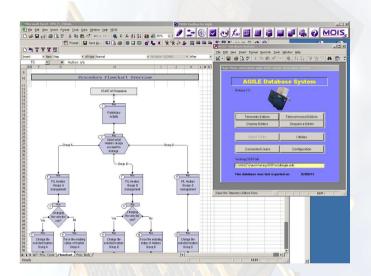
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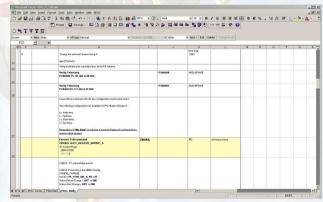
## **Operations Preparation and Execution**

### **MISSION PHASES**

- 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**

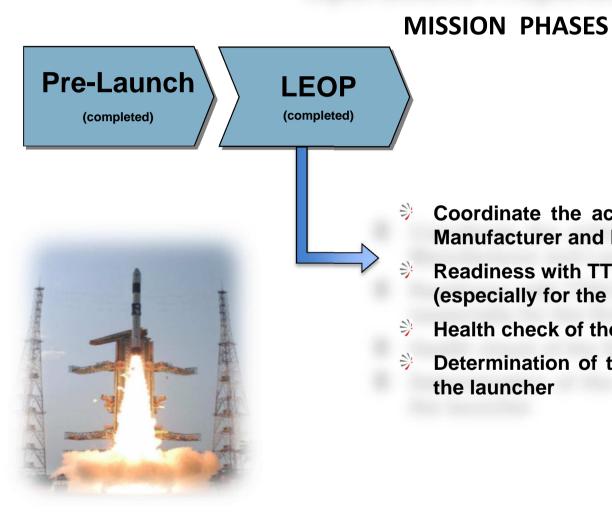




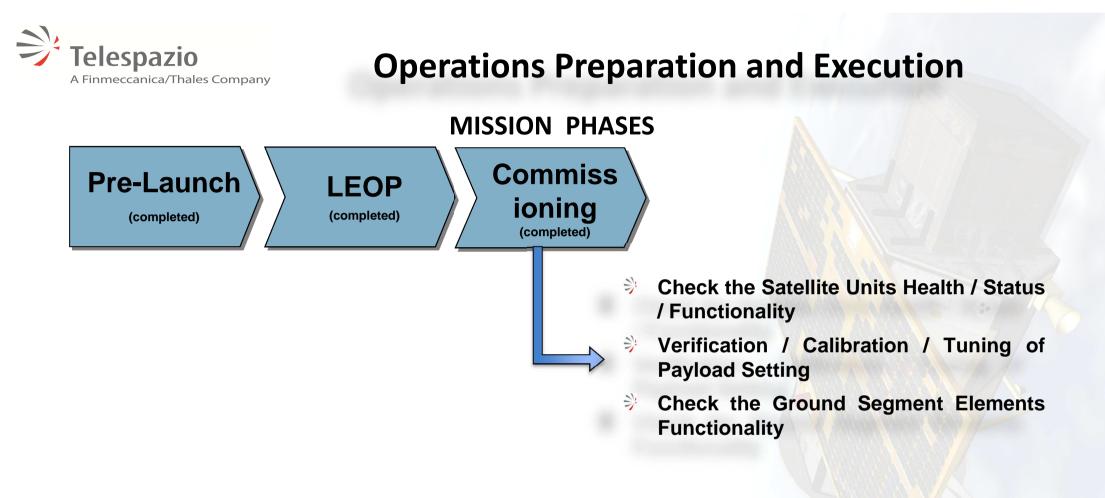


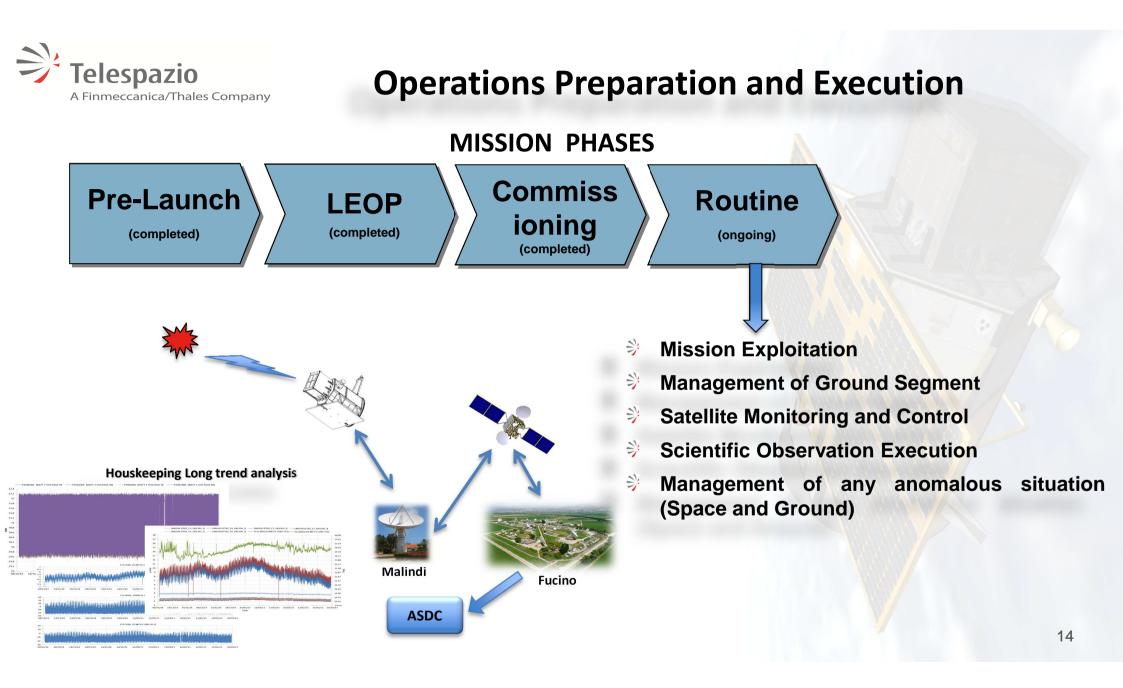


## **Operations Preparation and Execution**



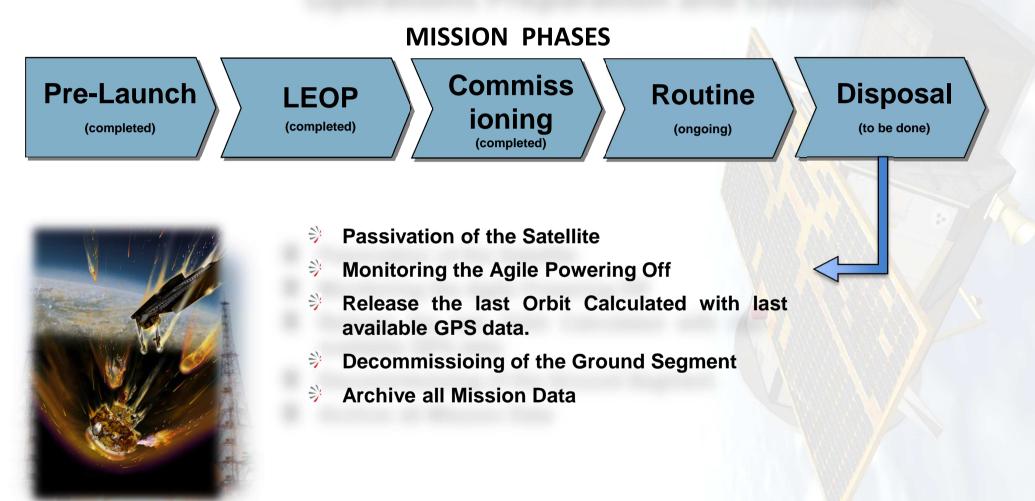
- Coordinate the activities with Satellite Manufacturer and Launch Authority
- **Readiness with TT&C Station** (especially for the first Acquisition)
- Health check of the Satellite
- 3 Determination of the orbit achieved by the launcher







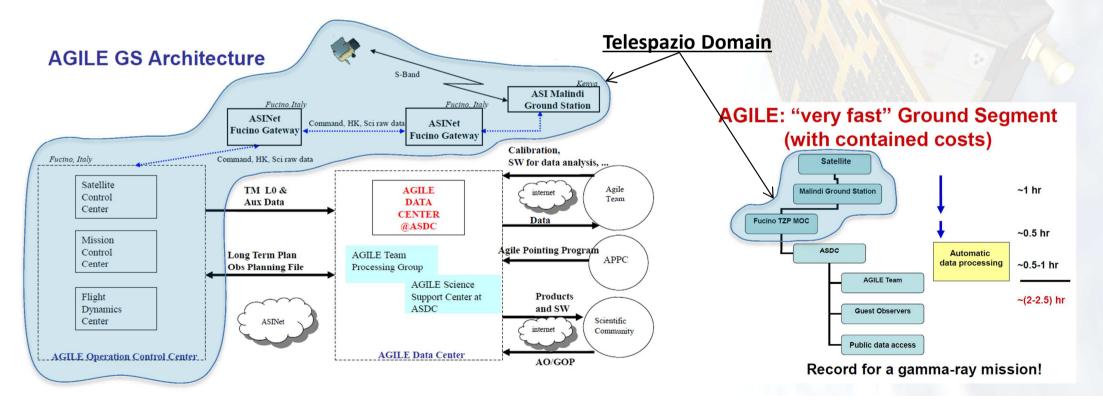
## **Operations Preparation and Execution**





## A Low Cost Mission ≠ A Low Ground Segment

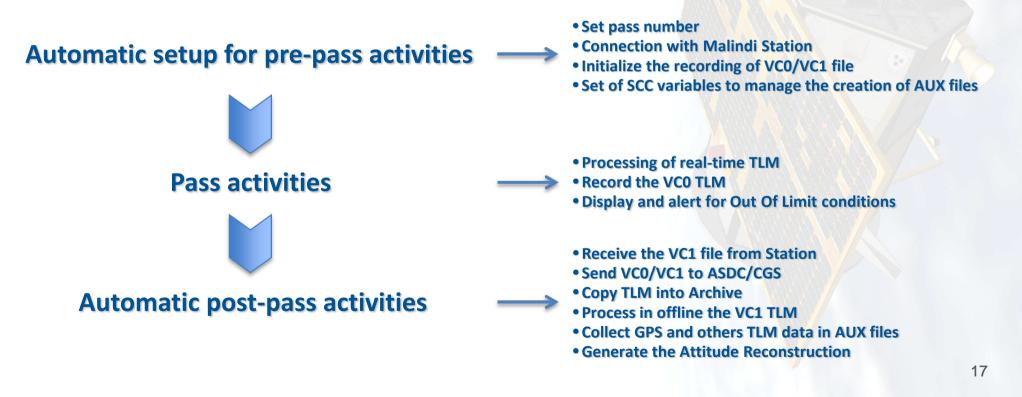
1<sup>st</sup> - It was realized simply but extremely efficiently





## A Low Cost Mission ≠ A Low Ground Segment

2<sup>nd</sup> - It was realized highly automated

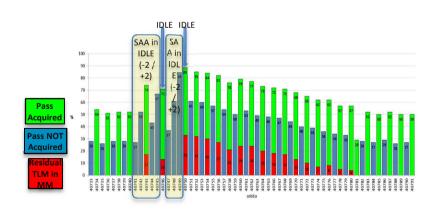


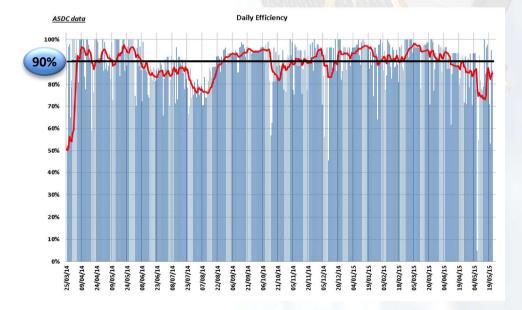


## A Low Cost Mission ≠ A Low Operations Profiles

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

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







## 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 #2388 | 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 #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 #4154 | ATel #4389 | ATel #4842 | ATel #4866 ATel #4867 | ATel #5234 | ATel #5422 | ATel #5506 | ATel #5682 | ATel #6182 | ATel #6217 | ATel #6231 | ATel #6234 ATel #3066 | ATel #6366 | ATel #6427 | ATel #657 | ATel #6733 | ATel #7193 | ATel #7203 | ATel #7207 ATel #7239 | ATel #739 | ATel #7239 | ATel #7539 | ATel #7540 | ATel #7539 | ATel #7540 | ATel #7539 | ATel #7540 | ATel #7

(http://agile.rm.iasf.cnr.it/astronomicaltelegram/astro-telegram.html)

#### 13 Scientific Workshop, a lot of Articles, Publications, and, and.....

#### **AGILE GCN**

GCN #6668 | GCN #6670 | GCN #6688 | GCN #7042 GCN #7340 | GCN #7457 | GCN #7571 | GCN #7572 GCN #7697 | GCN #7715 | GCN #7776 | 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)

2012 Rossi Prize Marco Javani and the AGILE Jean Jot the discovery of gamma-ray flares from the Crab Nebula Jot the discovery of gamma-ray flares from the Crab Nebula Jot the discovery of gamma-ray flares from the Crab Nebula Jot the discovery of gamma-ray flares from the Crab Nebula

## AGILE Mission = An Example to follow.....



# 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....)

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

