

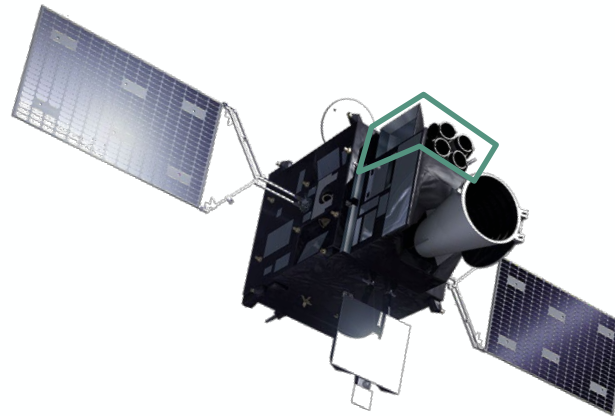


Meteosat Third Generation (MTG) Lightning Imager (LI) Development Progress and End-to-End Performance Status

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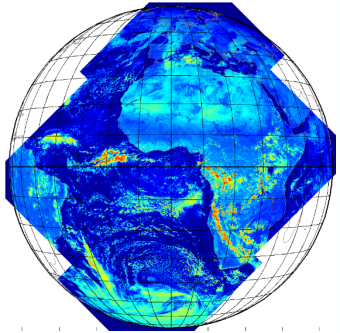
- The Lightning Imager (LI) instrument is a payload on-board the MTG-I satellites
- Meteosat Third Generation (MTG) is the next generation of European meteorological geostationary satellites, comprising six satellites: four MTG-I (Imager) and two MTG-S (Sounder)



MTG-I (artist impression)

- The LI will provide continuous lightning (cloud-to-cloud and cloud-to-ground) detection and optical observation
- The LI products will be used for near real-time monitoring and short range forecast of severe weather phenomena and for long term climate observations
- The LI instrument is built by *Leonardo* (Florence, Italy) under the industrial prime contractor *Thales Alenia Space* (Cannes, France)
- The first LI instrument will fly on MTG-I-1, set to be launched in Q4 2022.

I. Image acquisition

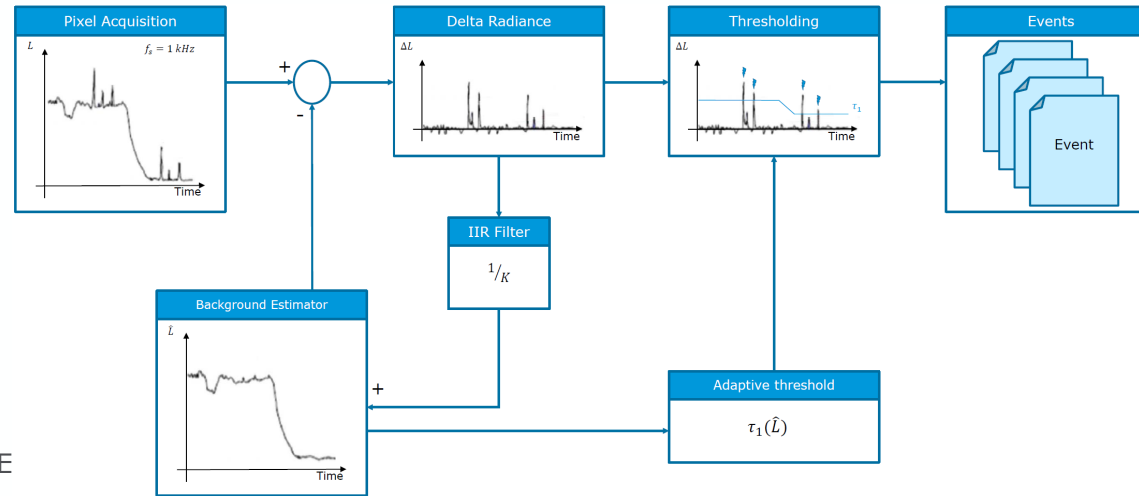


LI Field of View (FOV)

- Acquisition every 1 ms
- 2-nm bandwidth around 777.4 nm
- FOV = 84% of the visible disk from GE
- Pixel size = 4.5 km at sub-satellite point
- Full Background images are downloaded every 15/30/45/60s (selectable)

II. On-board Lightning Event Detection

The LI detection principle consists in triggering events on pixels where and when a sudden increase of energy is measured over the background level.

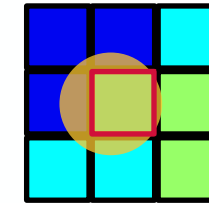


Lightning Event Detection Principle

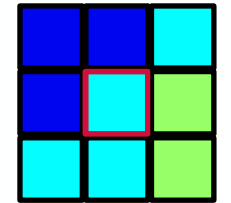
The LI basic data product sent to ground is the **Lightning Event**.

A Lightning Event is described by:

- Coordinates of the triggering pixel
- Identifier of the temporal frame
- Instantaneous measured radiance and estimated background level for the triggering pixel and its eight surrounding neighbours



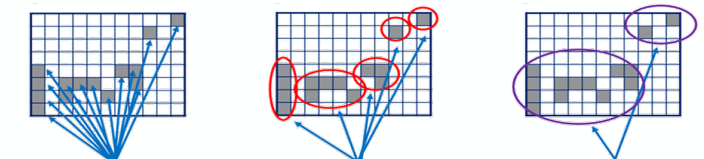
Instantaneous Measured Radiance



Estimated Background Level

III. Further Processing

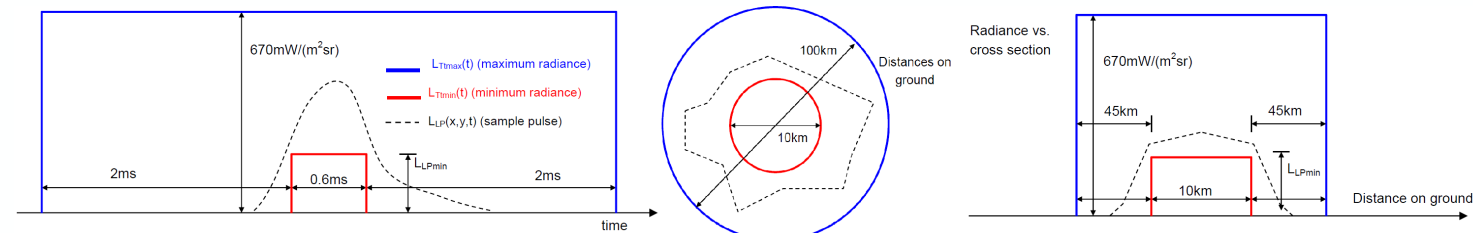
- On-board and on-ground filters remove false Events created by shot noise, jitter movements or other noise sources
- A Level-2 processor aggregates adjacent Events occurring during the same time frame into groups, and further consolidate groups that are in close temporal and spatial proximity to each other to form flashes (end-user data product).



Level 2 Aggregator Processor (Credits EUMETSAT)

- The main performance indicator for the LI is the lightning detection performance
- The detection performance is assessed using an end-to-end performance simulator correlated to on-ground measurements on flight hardware (detector QE, noise, spectral filter responses, blinking pulse tests...)
- Artificial lightning pulses are introduced in the Earth scenes. They are circular, with diameter of 10km, and rectangular in time
- Energy of the simulated pulses is tied to the background level on which the lightning is simulated by the following equation:

$$L_{LPmin} = 6.7 \sqrt{1 + 0.02 L_{bkg}} \text{ mW } / (\text{m}^2 \text{ sr}), \text{ with } L_{bkg} \text{ in } \text{Wm}^{-2} \text{sr}^{-1} \mu\text{m}^{-1}$$



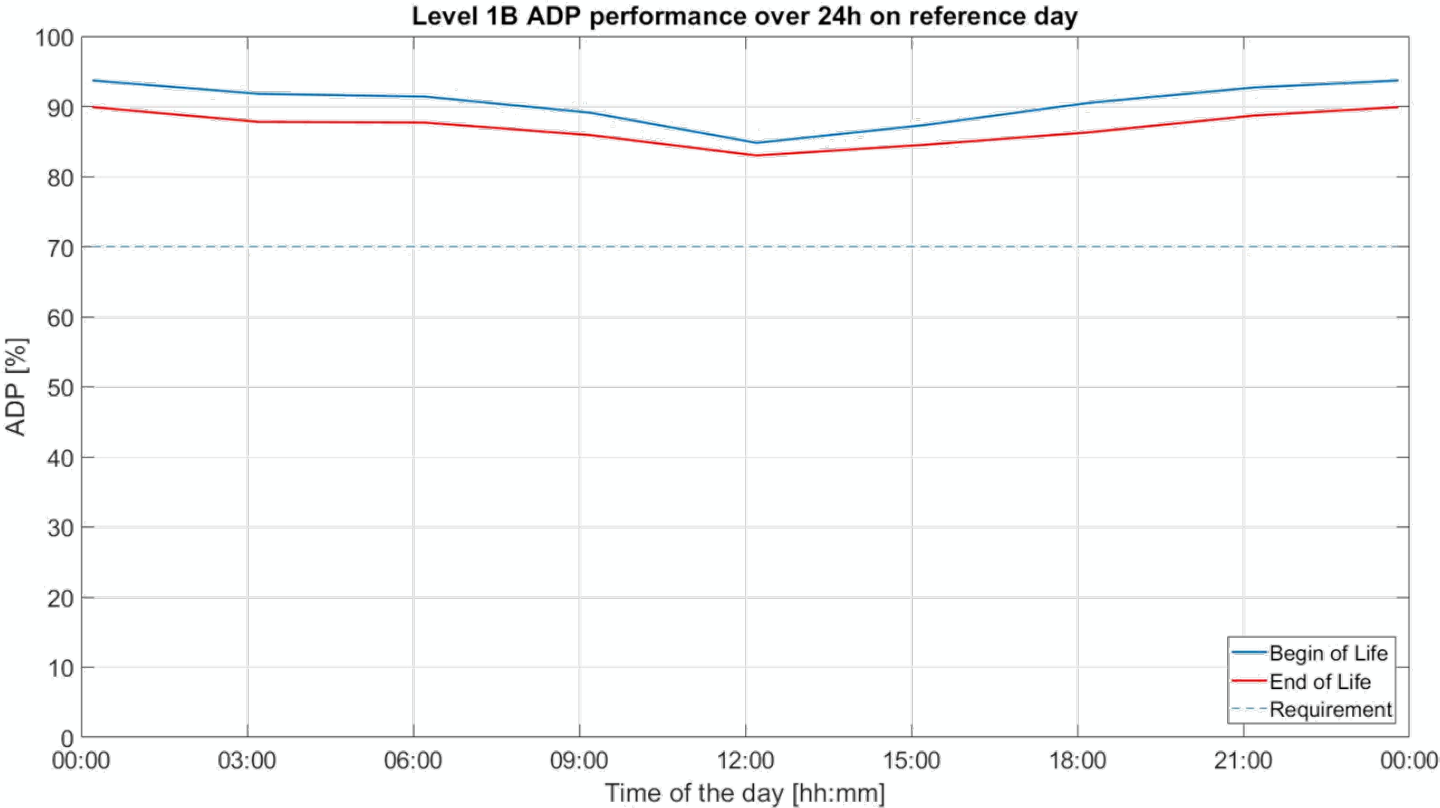
Lightning template used for detection performance assessment

- At level 1, detection performance is measured via the Instrument Averaged Detection Probability (IADP), i.e. the capability of the instrument to detect a small pulse placed randomly in space and time

Performance: status based on PFM measurements



✓ IADP averaged over the full FOV, evolution over 24h, well above required 70%:



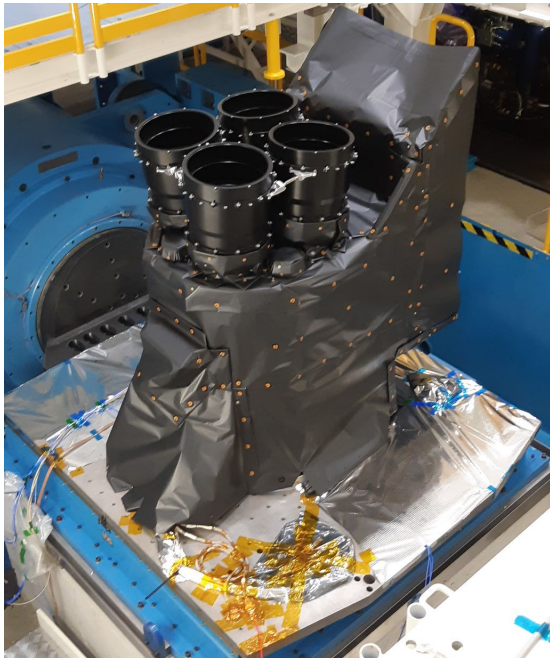
✓ False Alarm Rate: 6k/s false events at Level1, much better than the requirement of 35k/s L1 false events)
(NB: requirement is 2/s false flashes at Level2)

✓ Absolute radiometric accuracy: 10%

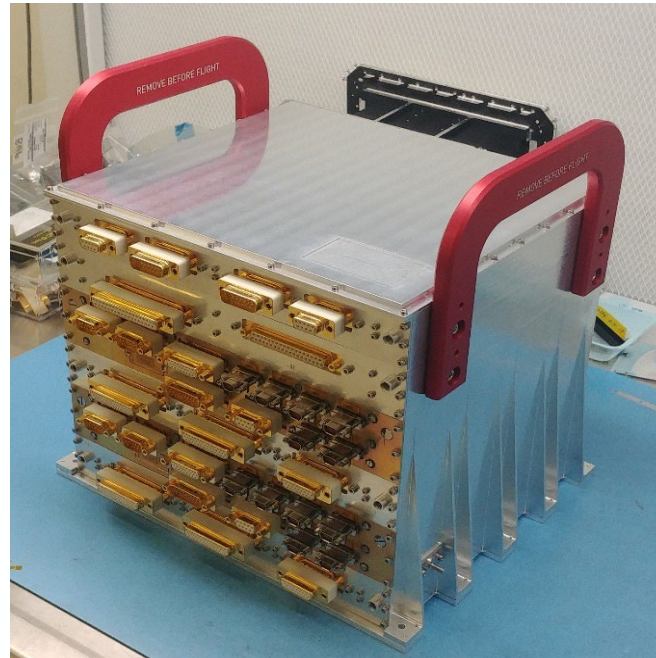


- LI PFM built, delivered and assembled on the MTG-I1 satellite
- LI FM2 scheduled for July23, FM3 for April24, FM4 for July24

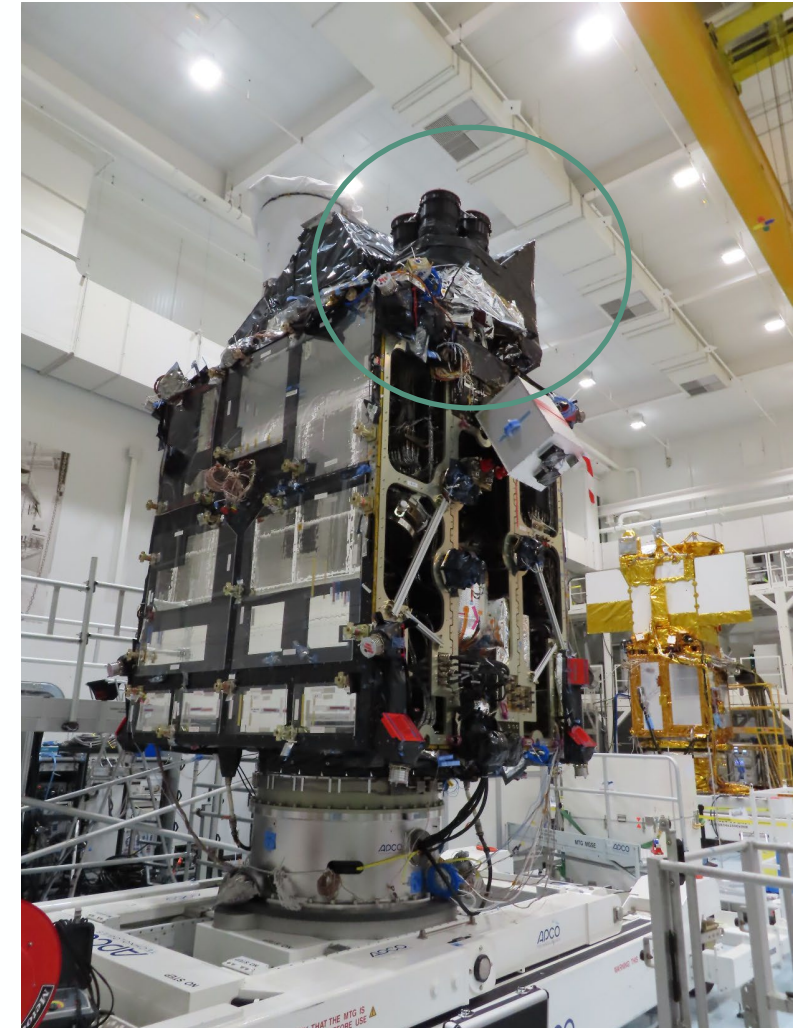
➤ **MTG-I1 launch in Q4/2022 on Ariane 5 !**



LOH PFM on the shaker
courtesy Leonardo

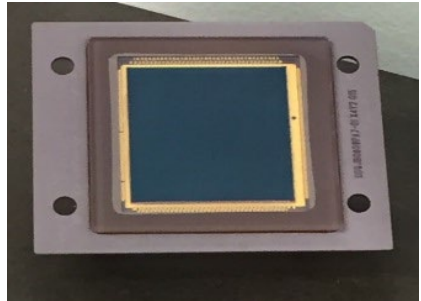


LME integrated and electrical test completed
courtesy Leonardo

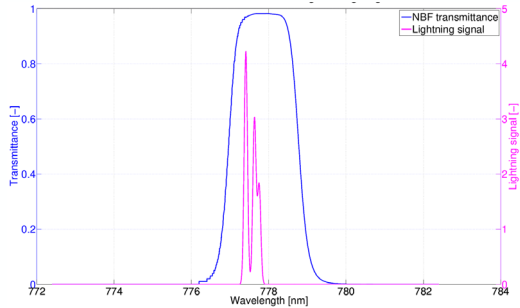


MTG-I1 assembled in the clean room
courtesy TAS-Cannes

Thank you for your attention



Detector



NBF transmittance vs lightning signal

The Lightning Imager (LI) instrument is made of 4 identical cameras (LOH) and one main electronics (LME)

- Detectors:** CMOS, back-thinned & back illuminated, 100% fill factor, $24\mu\text{m} \times 24\mu\text{m}$ pixel size, 1000×1170 pixels, on chip 12 bit ADC, 60 parallel LVDS outputs at 250Mbit/s each
- Spectral filters:** Solar Rejection Window (SRW) + Narrow Band Filter (NBF) selecting a band of 1.9 nm centred at 777.4 nm
- On-board data reduction:** data reduction factor of ~ 250 achieved through a cascade of false events filters implemented in ASICs, FPGAs and a single board computer (PowerPC)

