

# COTS-based Data Processing Units for the SCIP and IMax+ balloon- borne instruments

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**Instituto de Astrofísica de Andalucía – CSIC**  
**Granada, España**



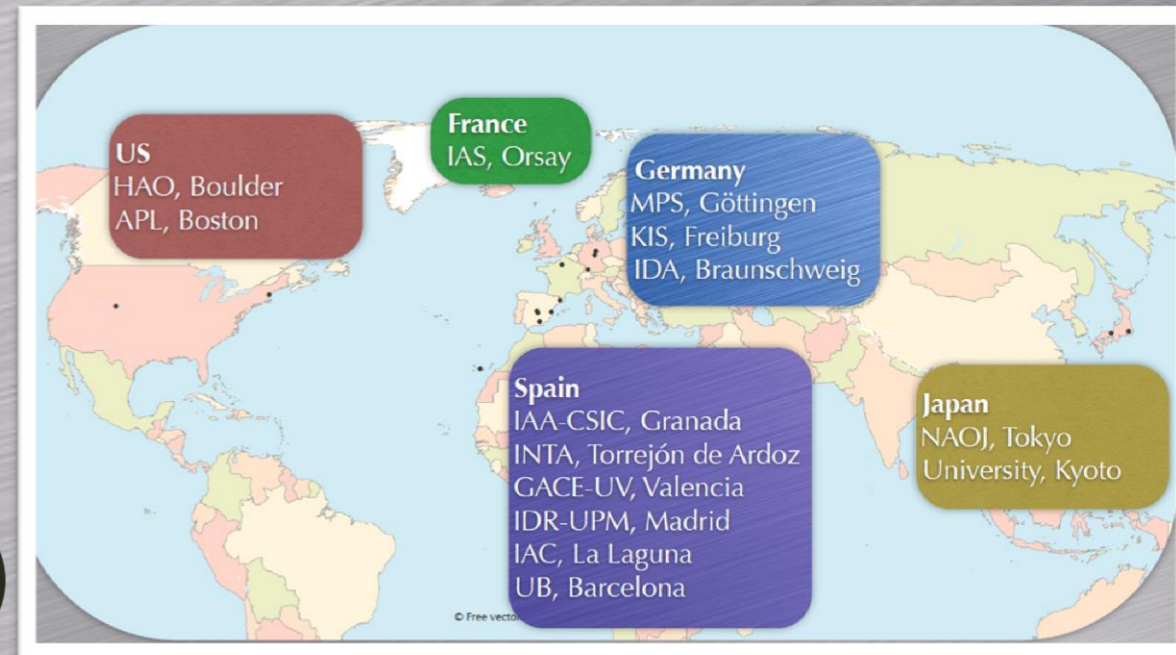
25<sup>th</sup> Feb. 2019, OBDP 2019



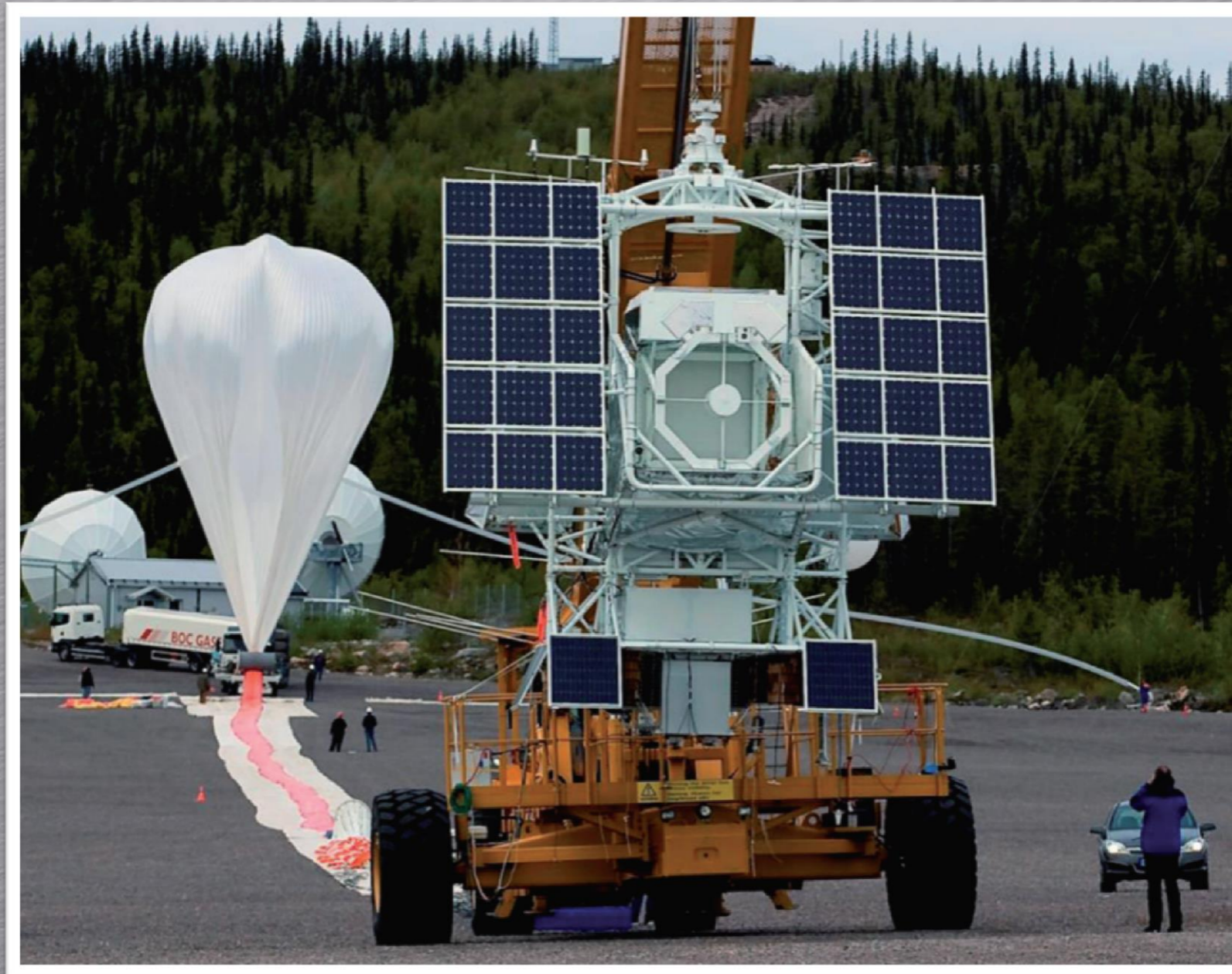
**SPG**

# Introduction

- Instruments:
  - IMaX : Imaging Magnetograp Experiment
  - SCIP: Sunrise Chromospheric Infrared Spectropolarimeter.
- IMaX. Sunrise-I (2009)
- IMaX. Sunrise-II (2013)
- PHI. Solar Orbiter (2020)
- IMaX+ and SCIP. Sunrise-III (2021)



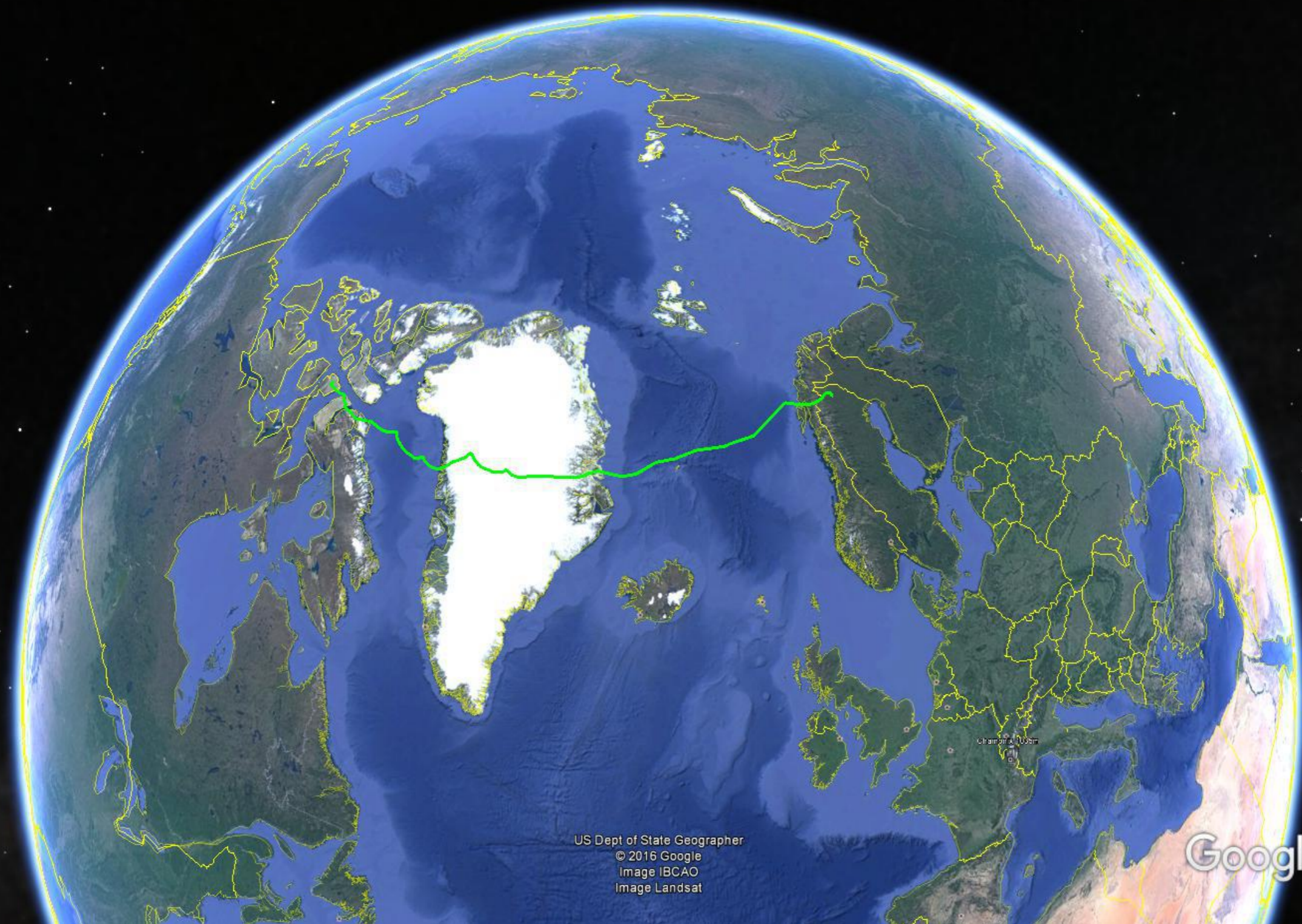
# *The Sunrise mission*



- Low cost access to near space (99 % atmosphere)
- Low investment level compared to space instruments
- Ultraviolet



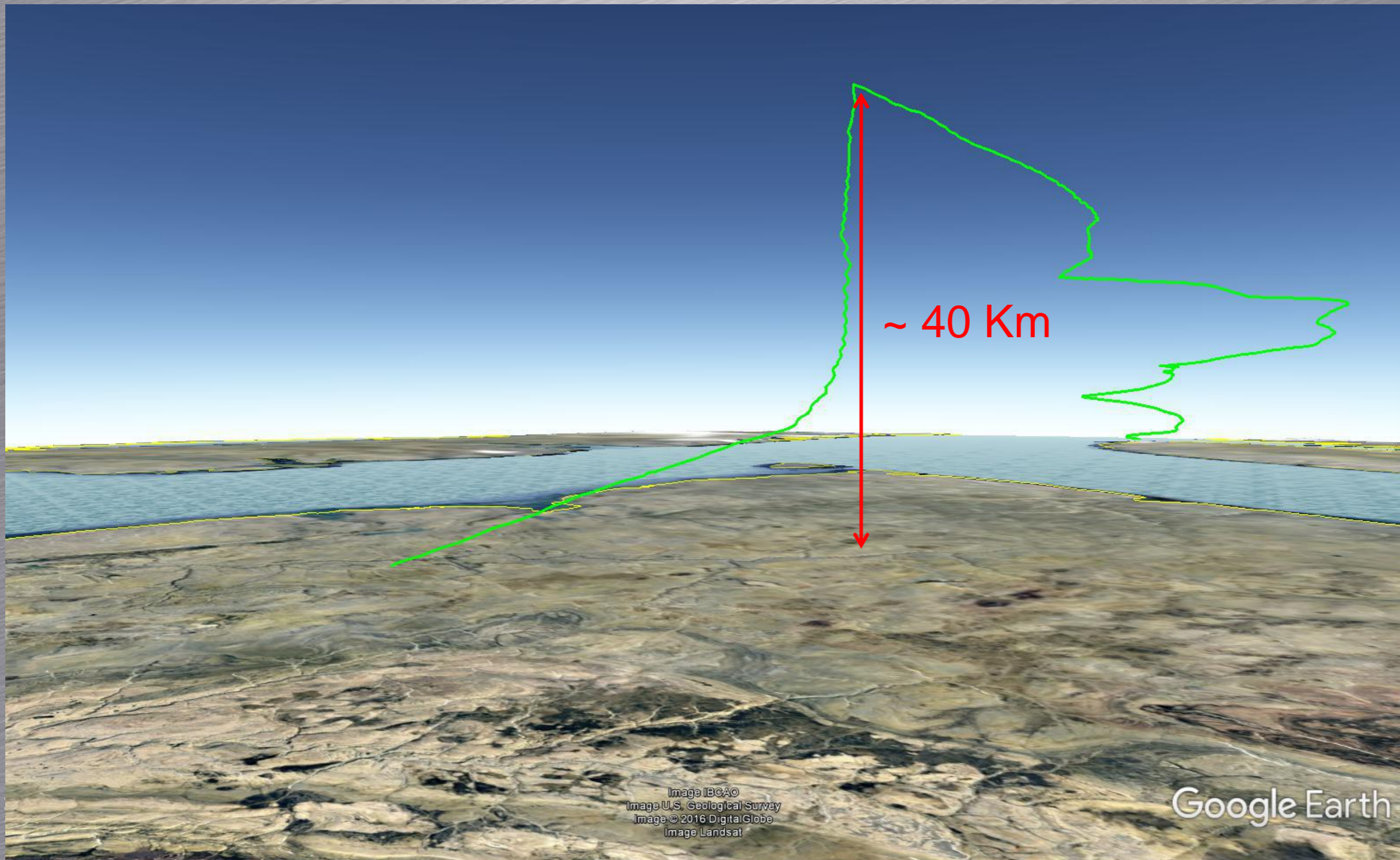
# The Sunrise journey



US Dept of State Geographer  
© 2016 Google  
Image IBCAO  
Image Landsat

Google Earth

# The Sunrise landing...



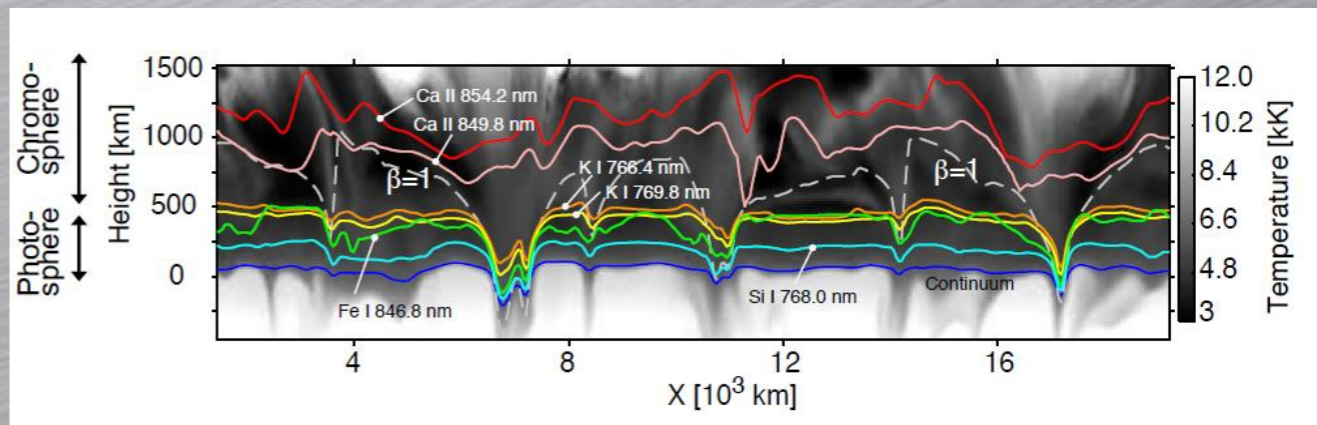
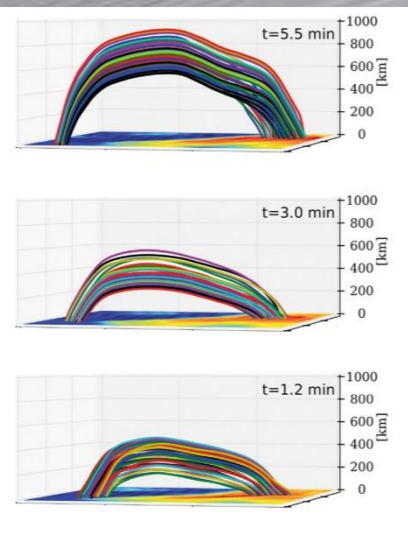
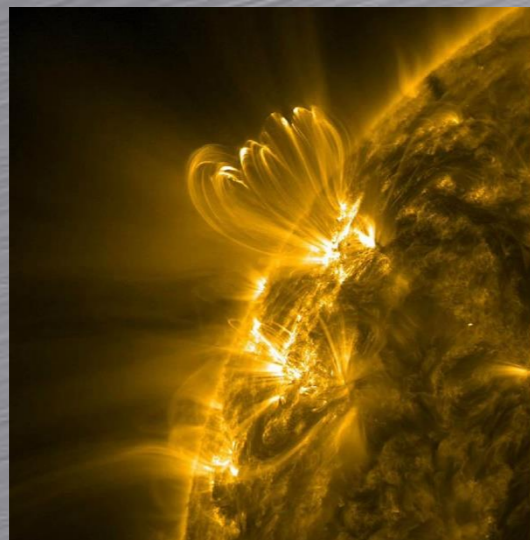
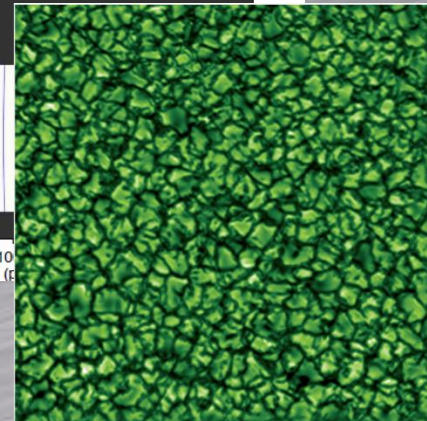
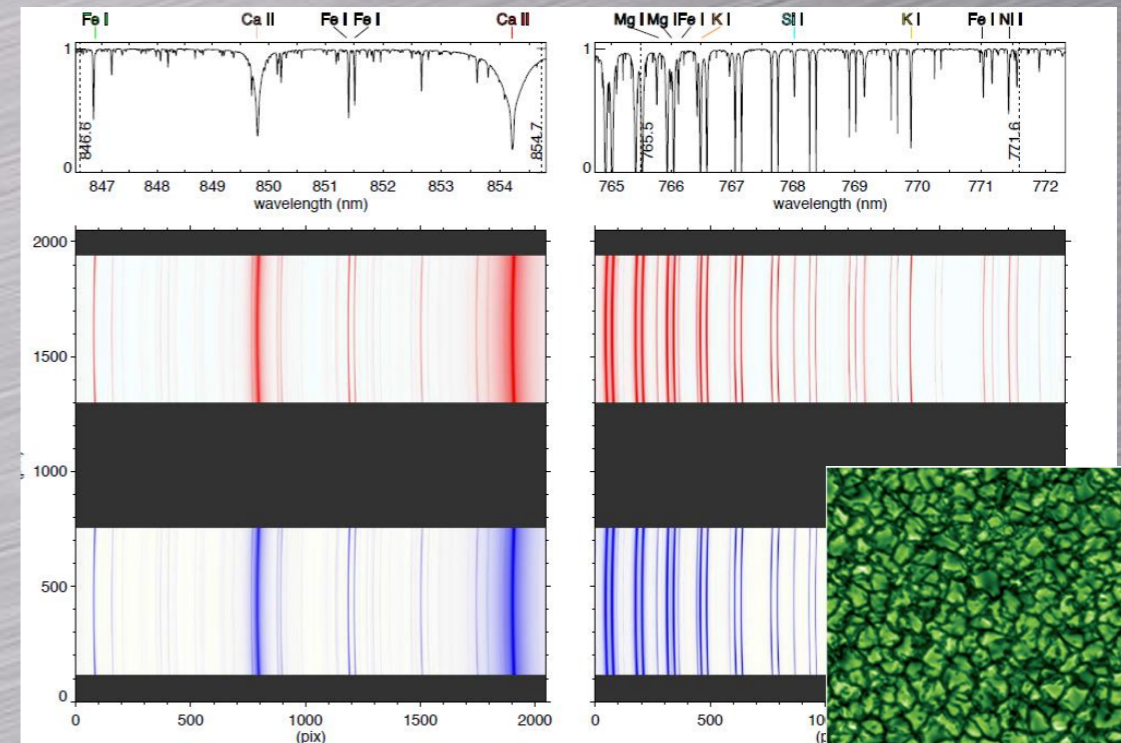
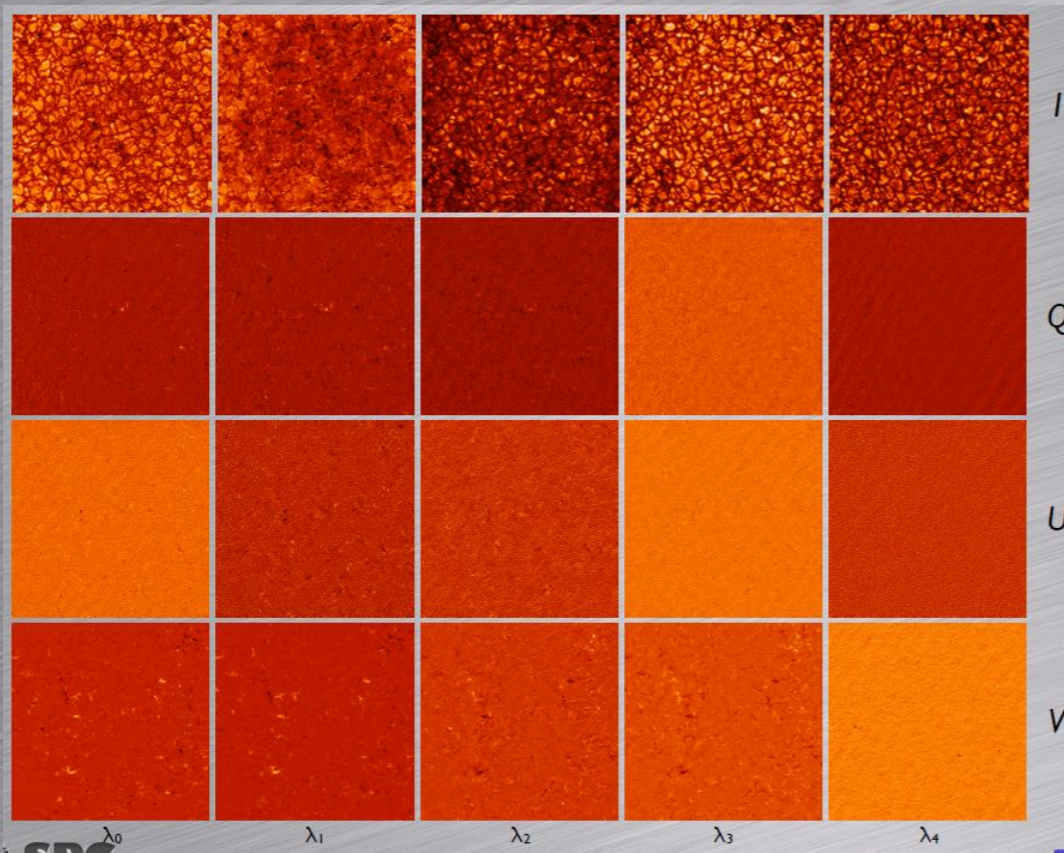
# ...a “peaceful” landing



# The instrument goals..

IMaX+

SCIP





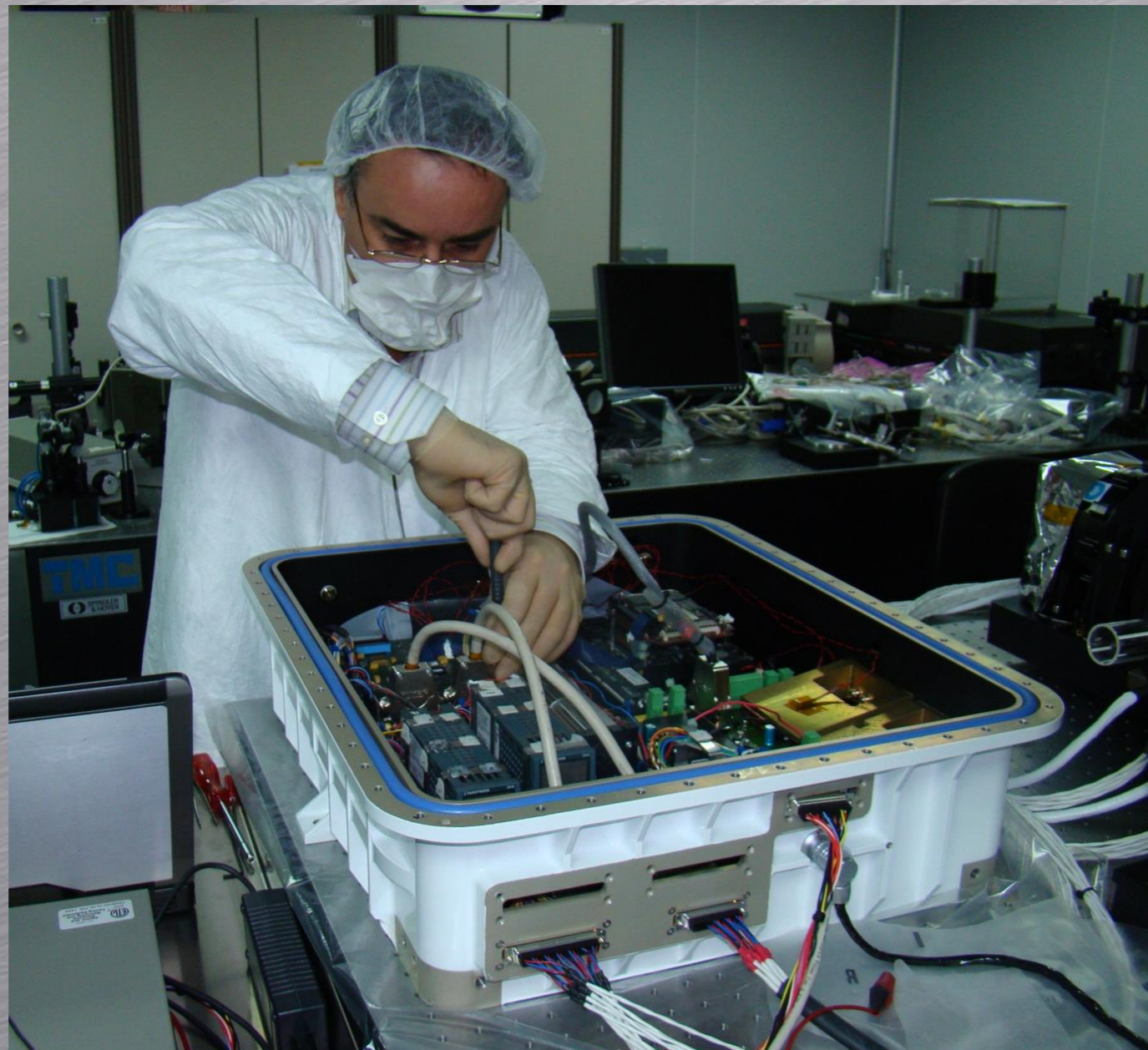
# COTS: Commercial Off-The-Shelf

- Why?
  - Budget
- How?
  - Commercial boards.
  - Custom boards.
  - Mixed.



# The first IMaX Data Processing Unit (2004-2009/13)

- Pressurized and controlled temperature box

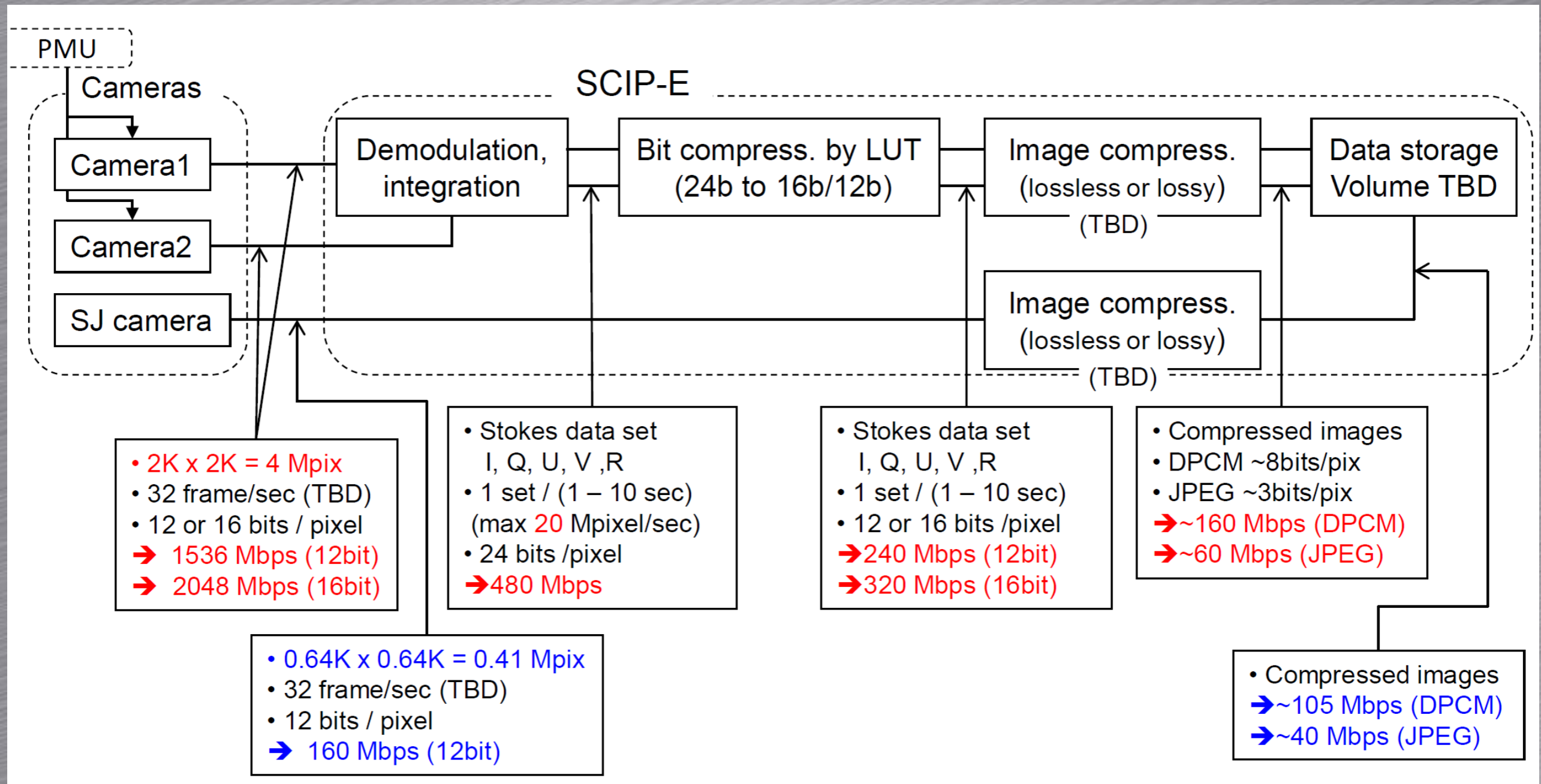


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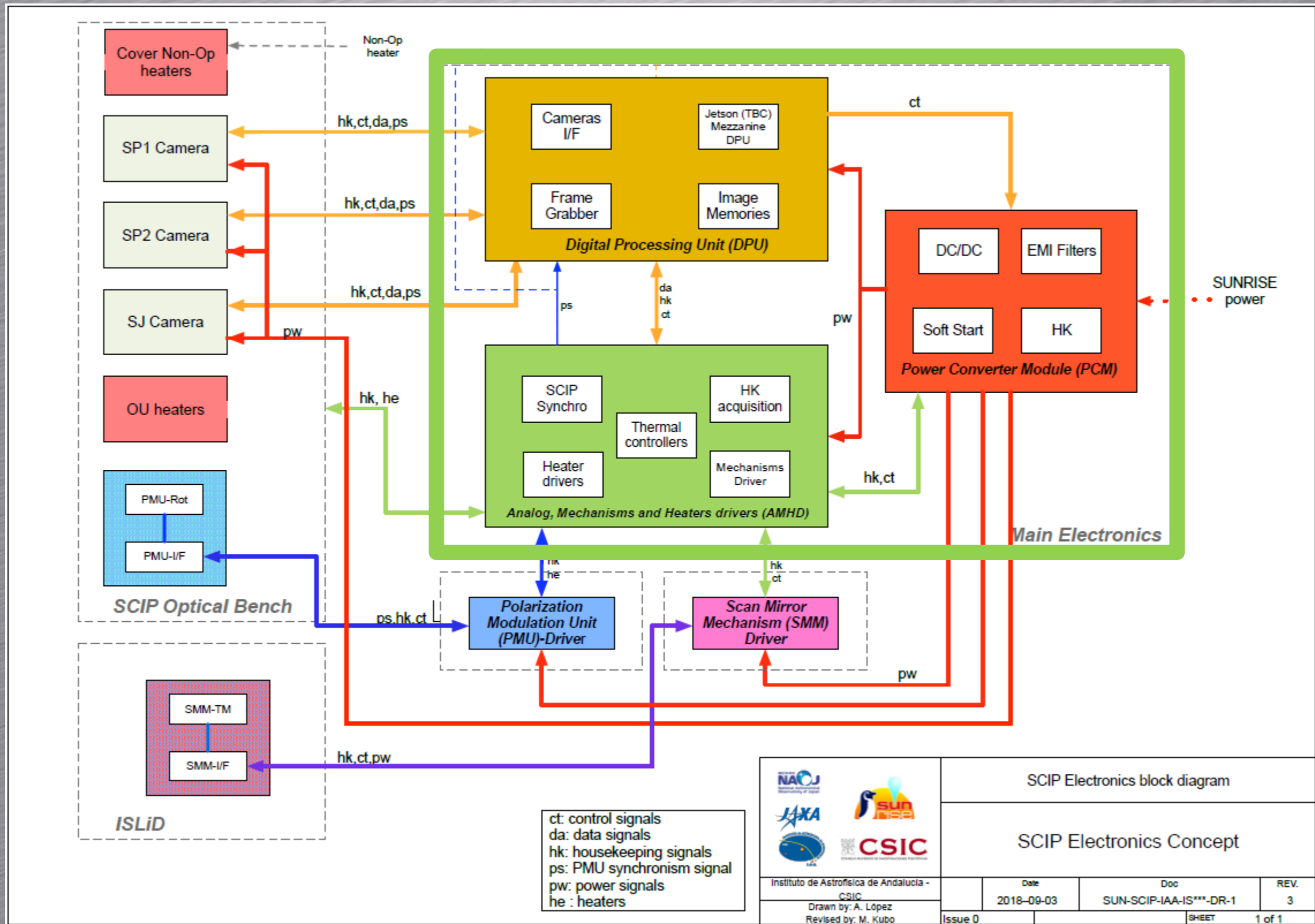
# NOW: upgrading to IMax+ (and SCIP)

- More ambitious scientific instruments
- More difficult the instrument control
- 3 cameras ( 3Gbps per camera)
  - Coaxpress
- The image storage is onboard.
- Real-time processing: integration, demodulation and compression.
  - Final data reduction around 10%.

# NOW: the SCIP data flow



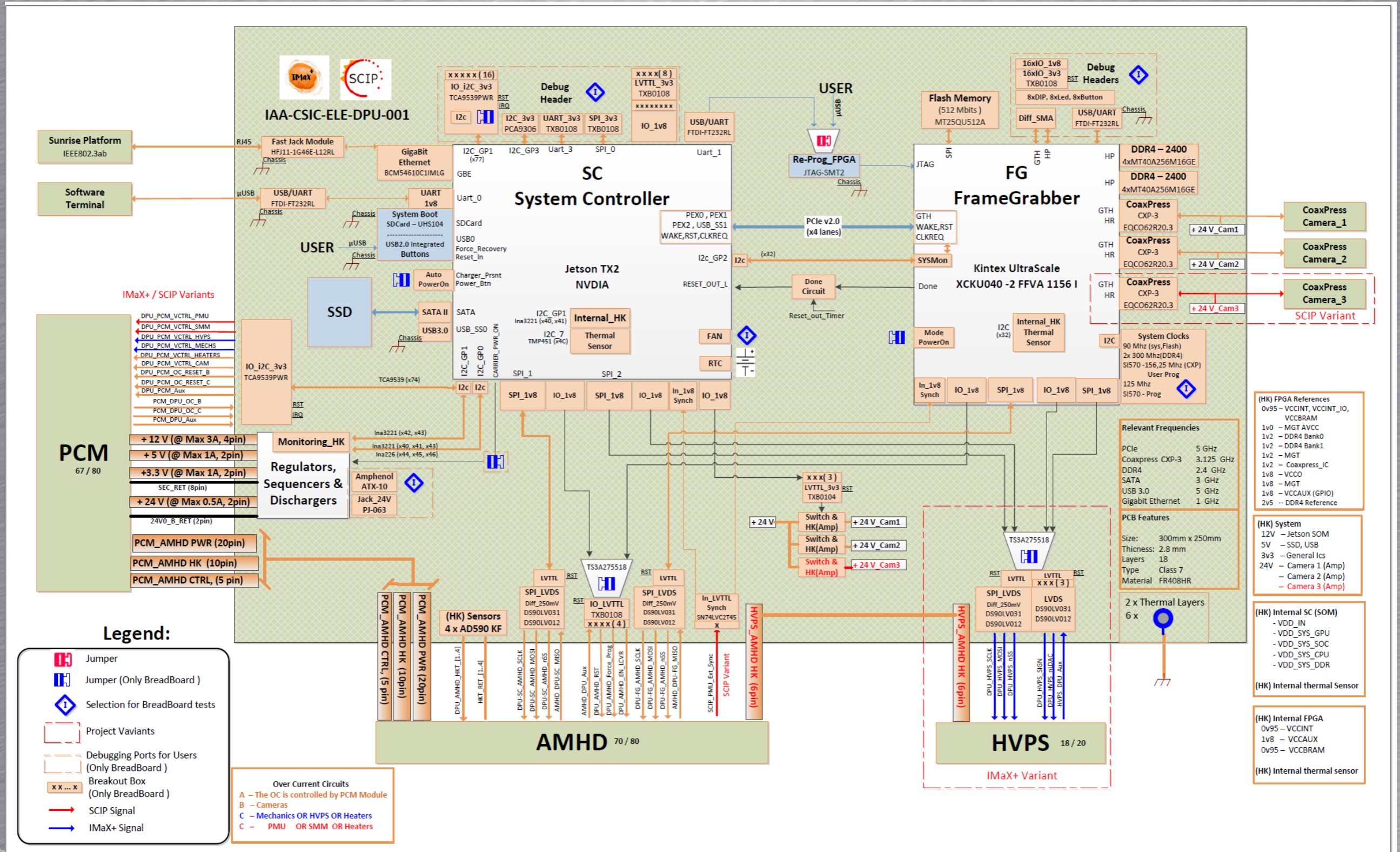
# The IMaX+/SCIP block diagram



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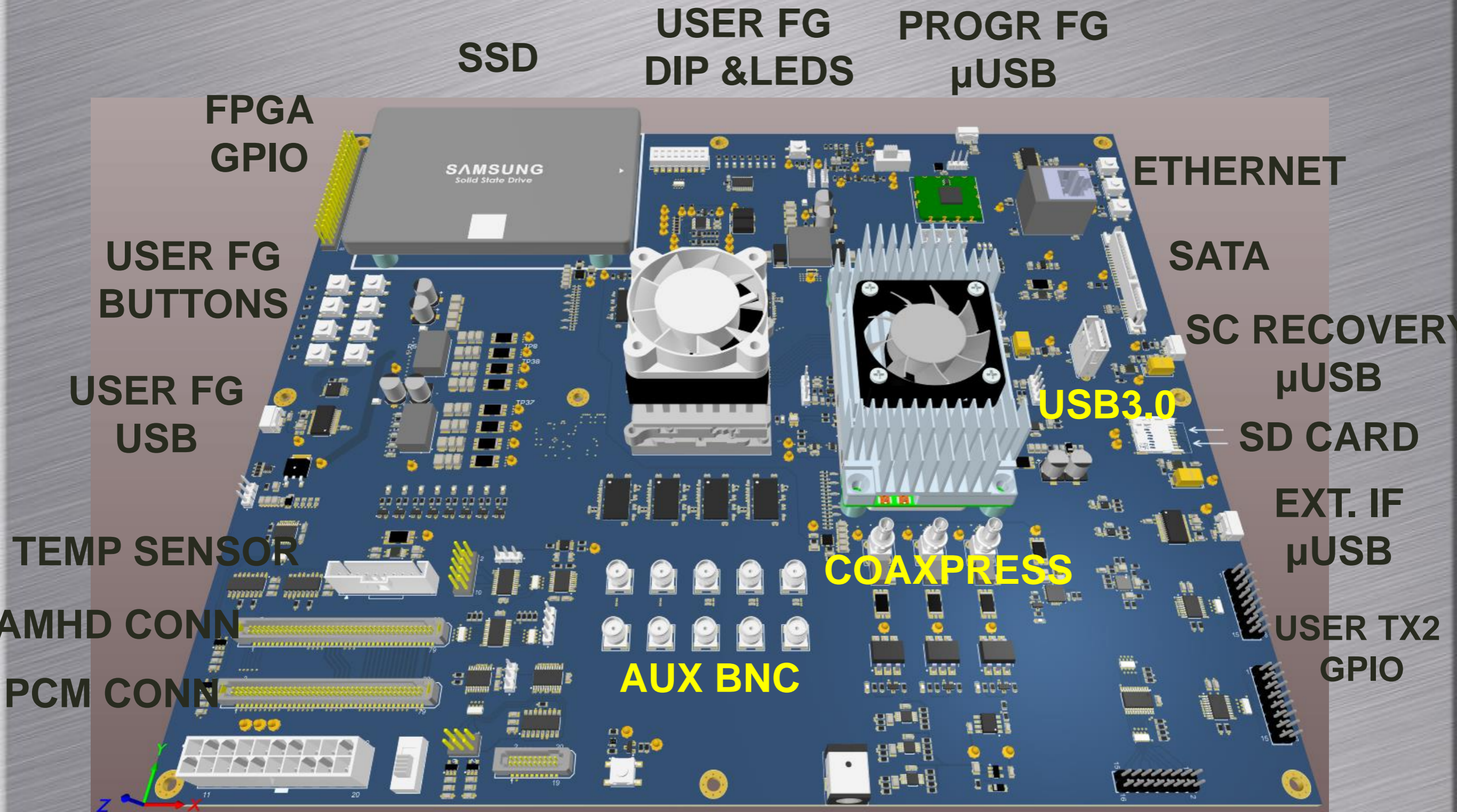
# The IMax+/SCIP DPU



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# The IMaX+/SCIP DPU



ATX CONN

HVPS  
CONN

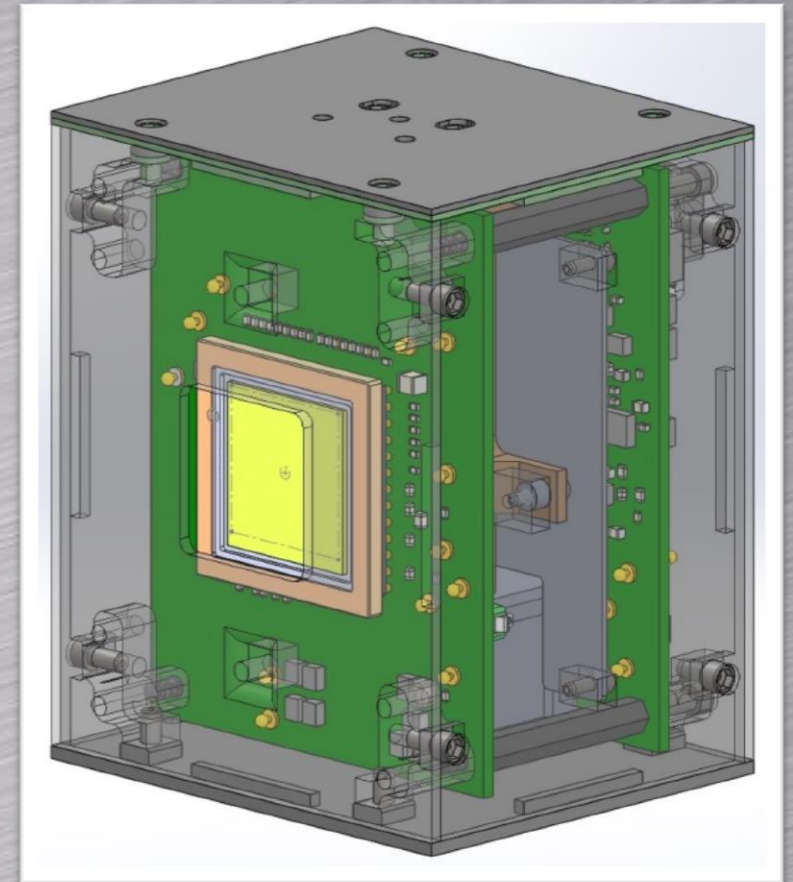
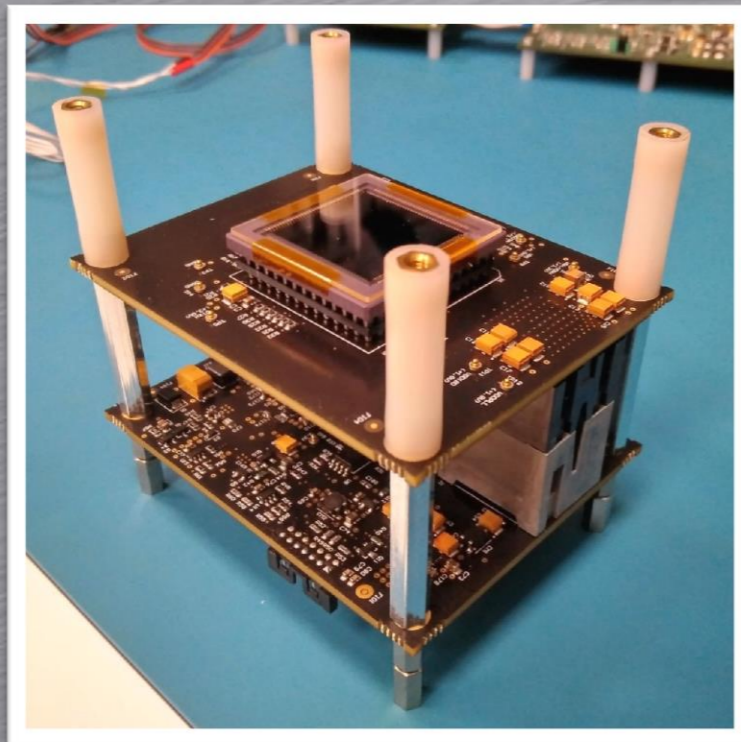
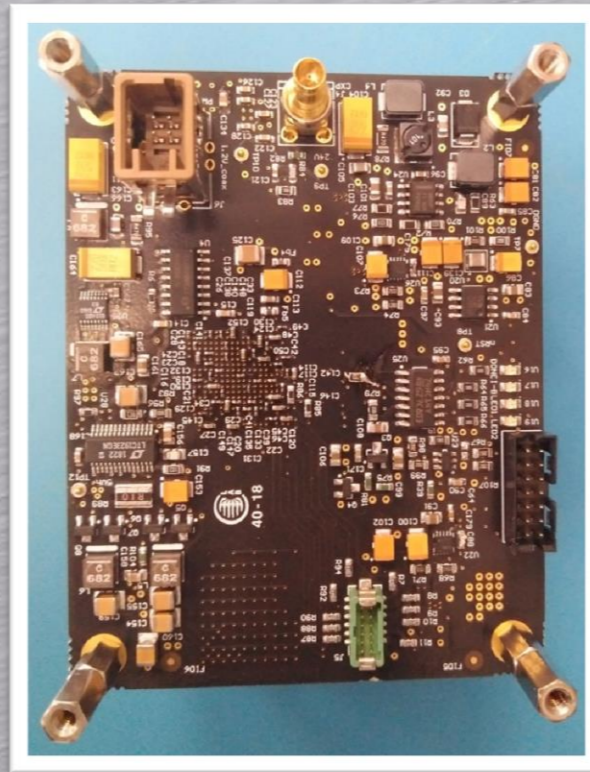
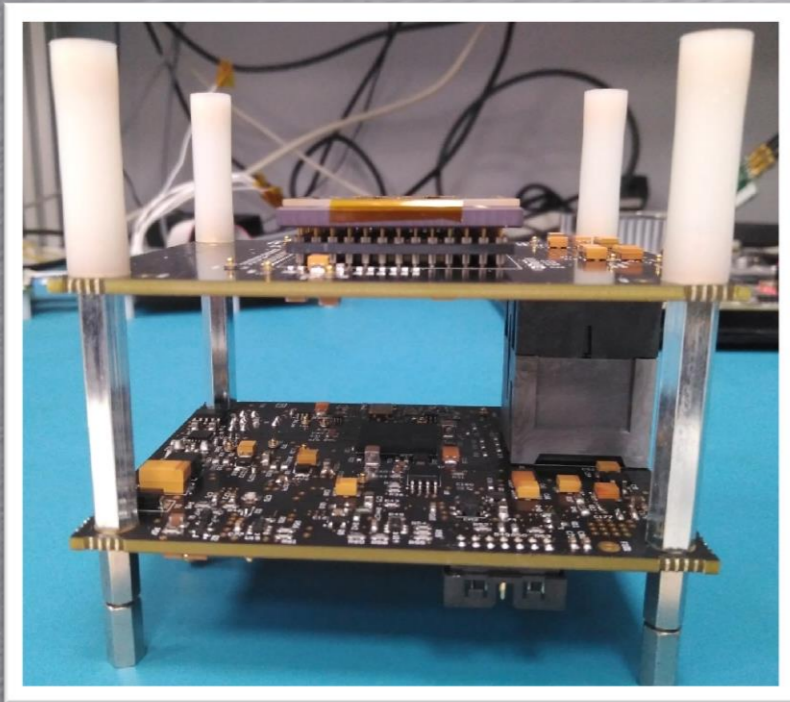
EXT. 24V  
CONN

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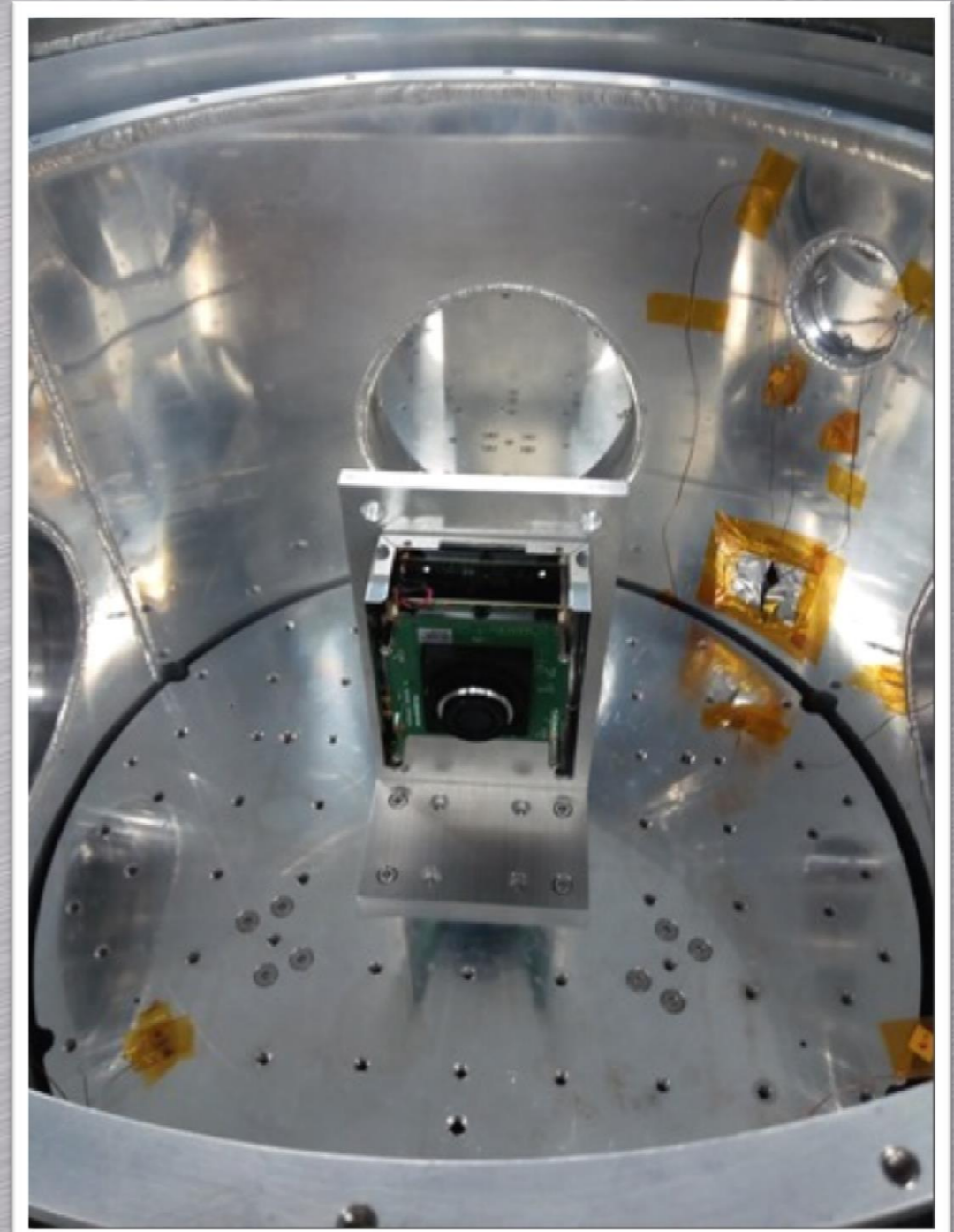
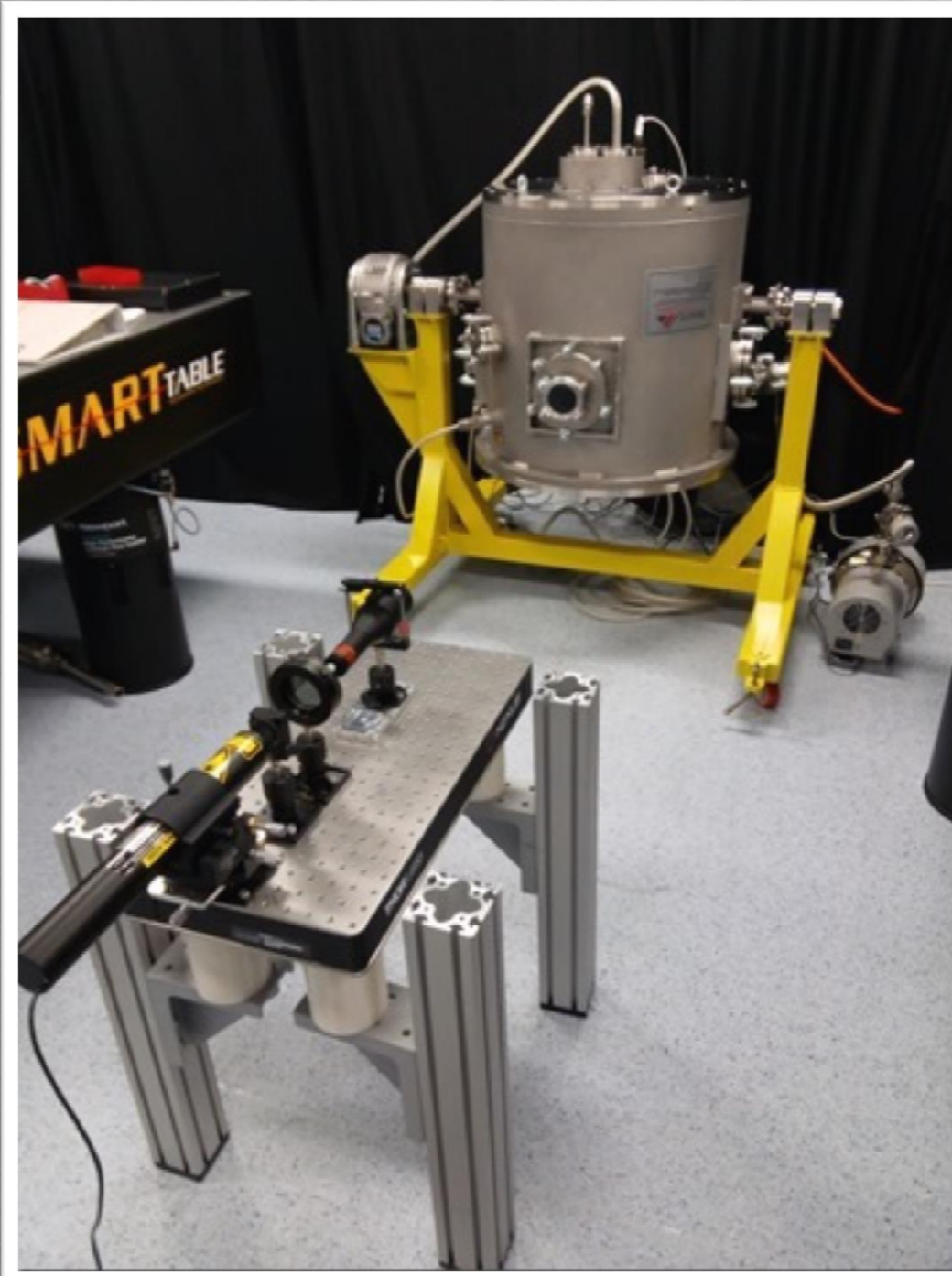




# The IMax+/SCIP cameras



# COTS implies tests...



# *Solar Orbiter (2008-2020) : PHI:* **Polarimetric and Helioseismic Imager**



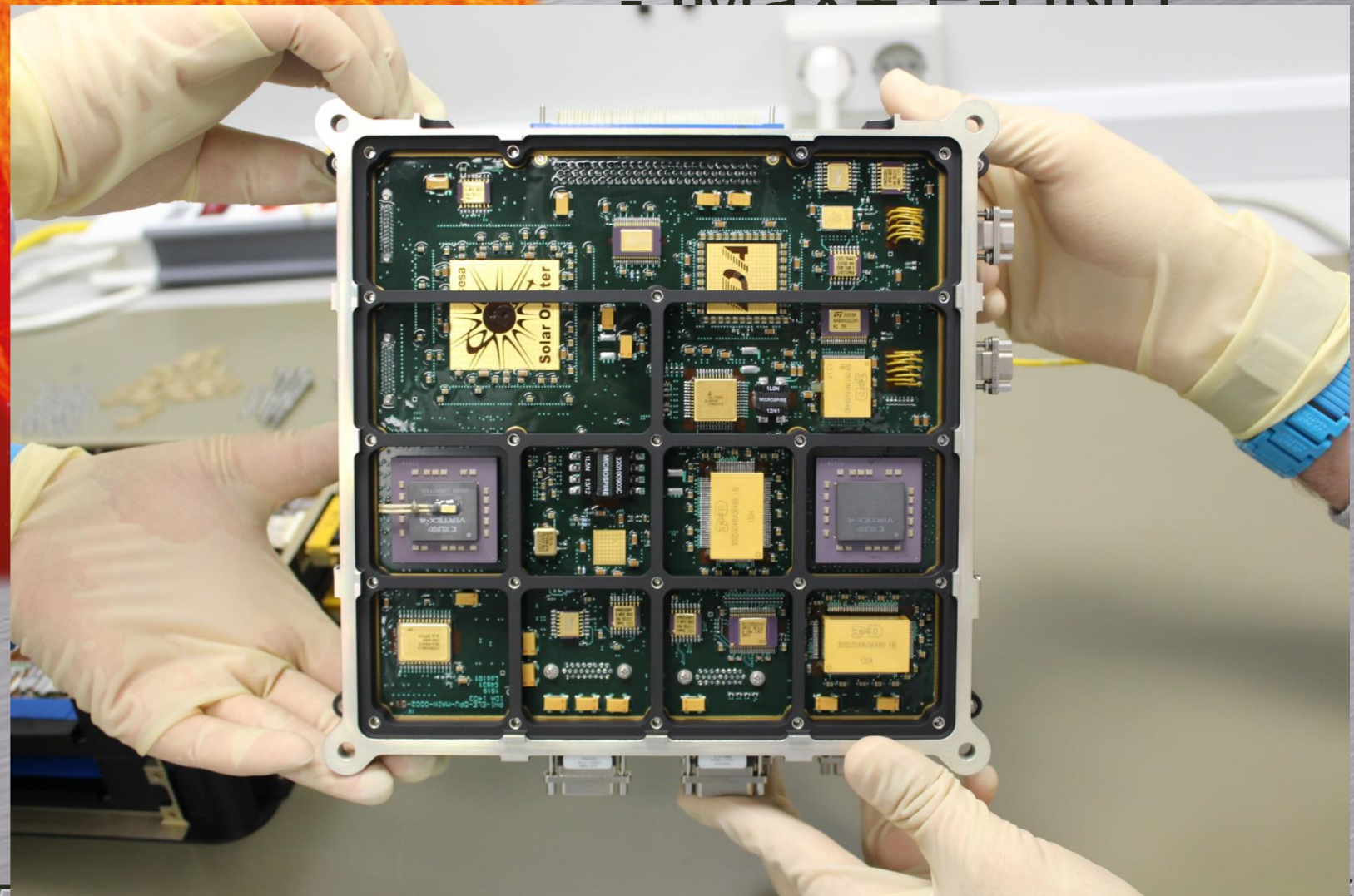
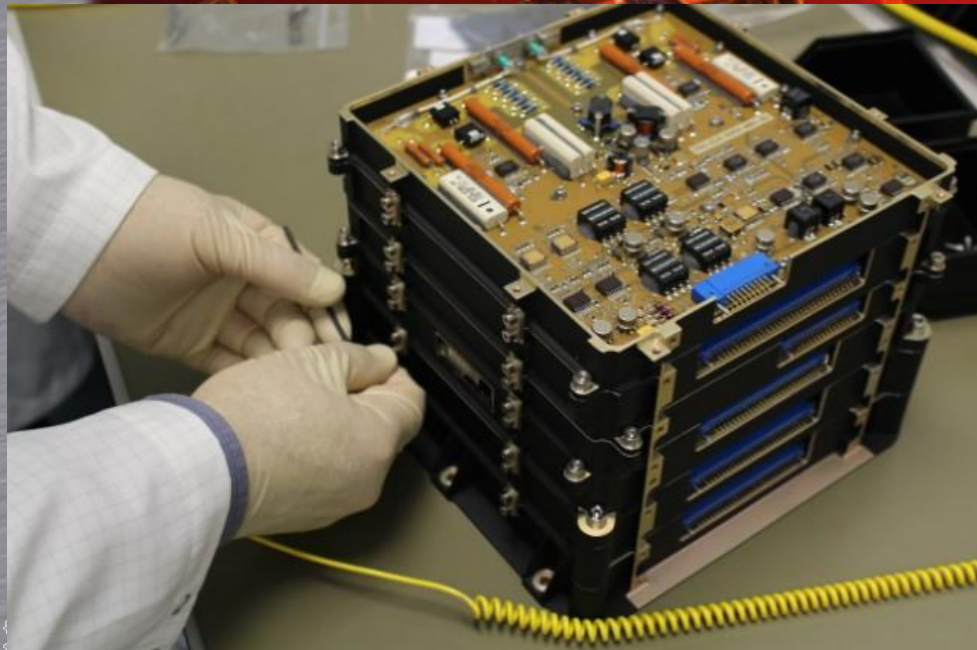
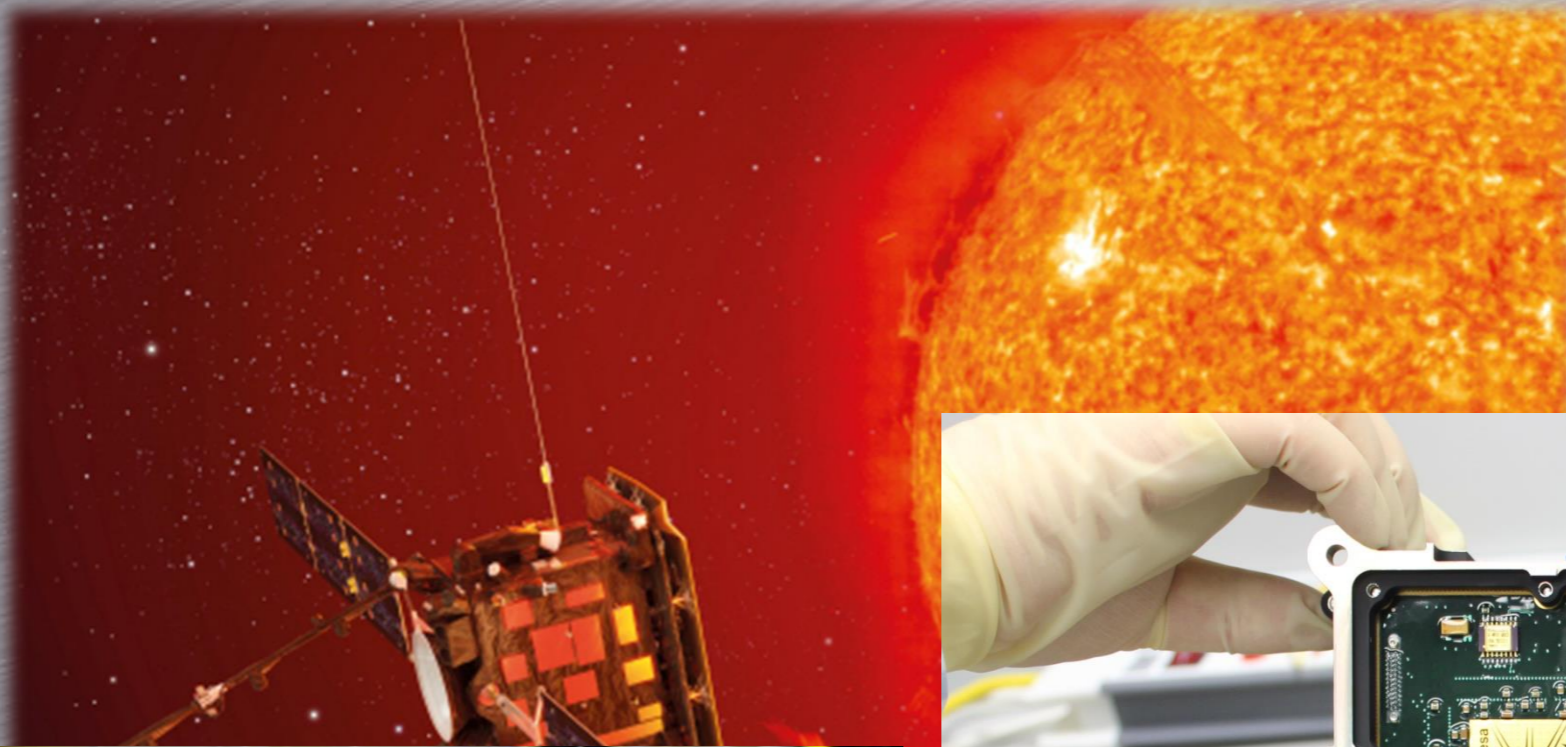
- PHI E-UNIT  
6 kg and 33W

- IMaX+ E-UNIT  
25 kg and 190W

# Solar Orbiter (2008-2020) : PHI: Polarimetric and Helioseismic Imager

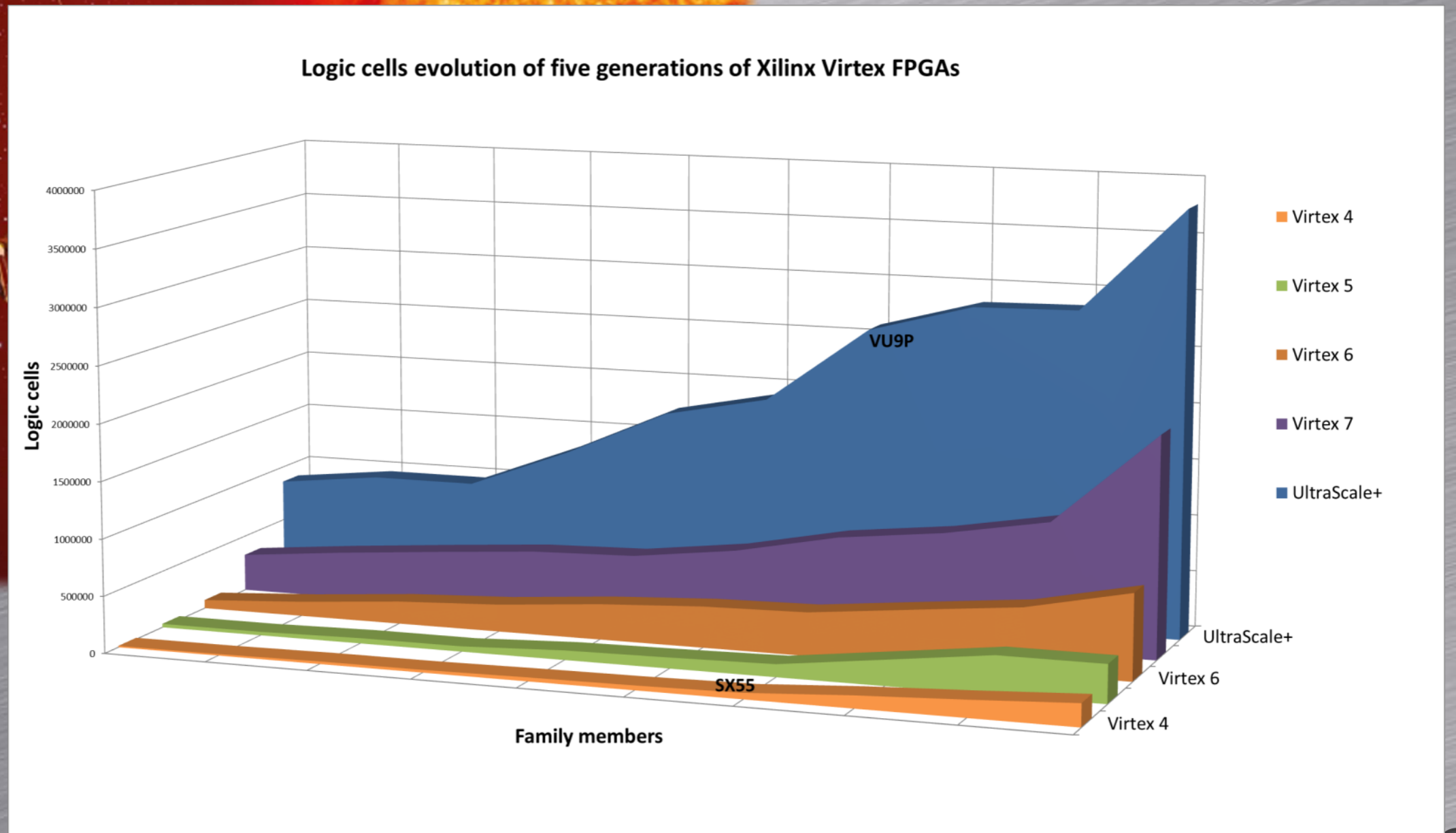
- PHI E-UNIT  
6 kg and 33W

- IMaX + E-UNIT



# Solar Orbiter (2008-2020) : PHI: Polarimetric and Helioseismic Imager

PHI E-UNIT  
6 kg and 33W



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# Conclusions

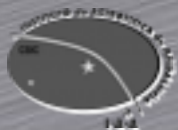
- Presented our COTS-based instruments
  - Provides opportunity to test tech.
- During 10 years: 3 balloon launches and one promise of satellite launch...
  - Faster development.
- A balloon-borne mission 50 times less of budget!!
- Provided training for engineering teams.
- Excellent and revolutionary science.
  - 130 papers Q1 (80 % using IMax+) ...



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- End of the presentation



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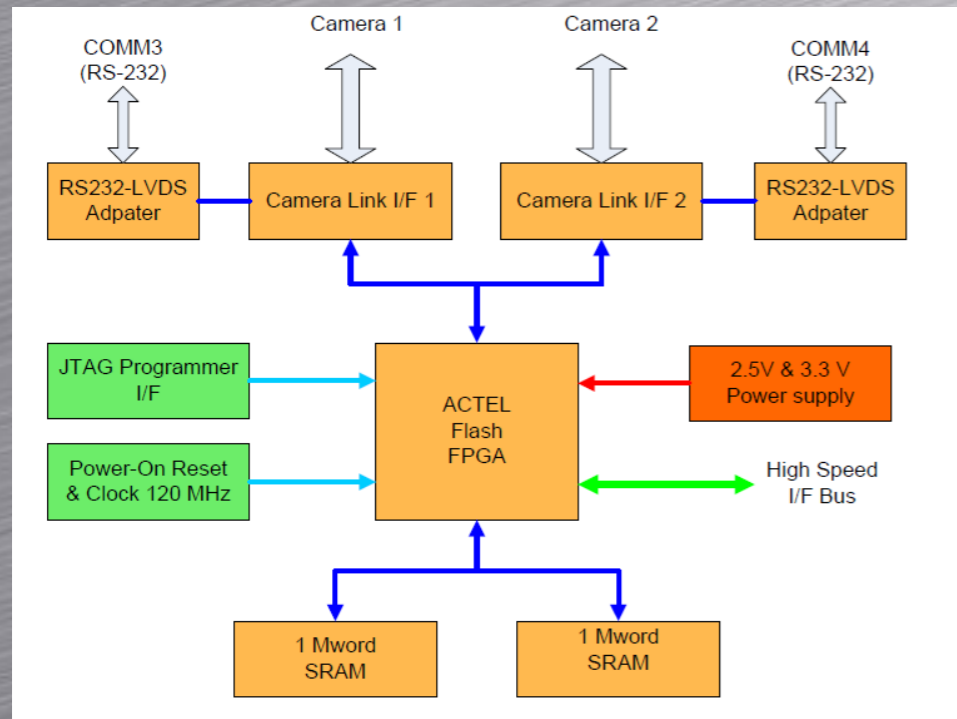
**SPG**



# The SCIP CSW: Jetson TX2 development board



# The old IMax hardware: Data Processing Unit



I/F board block diagram

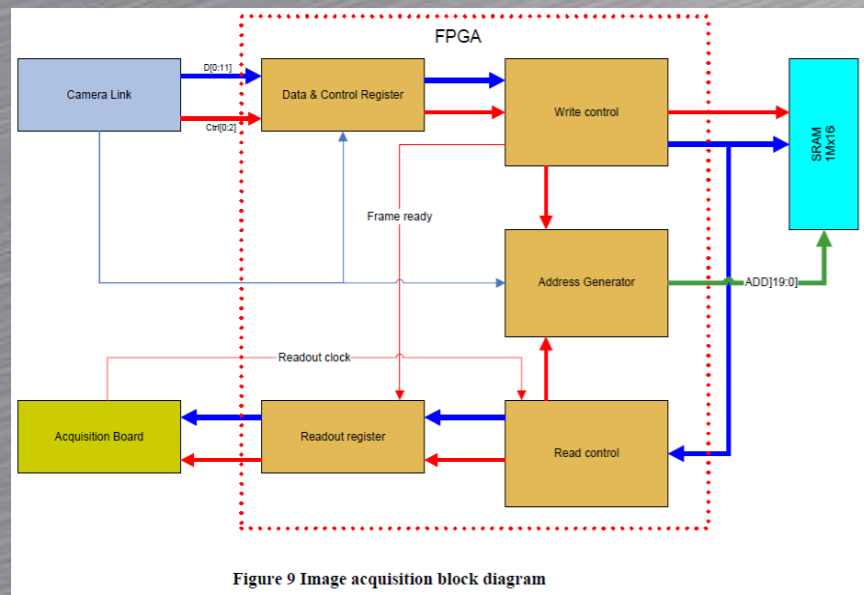
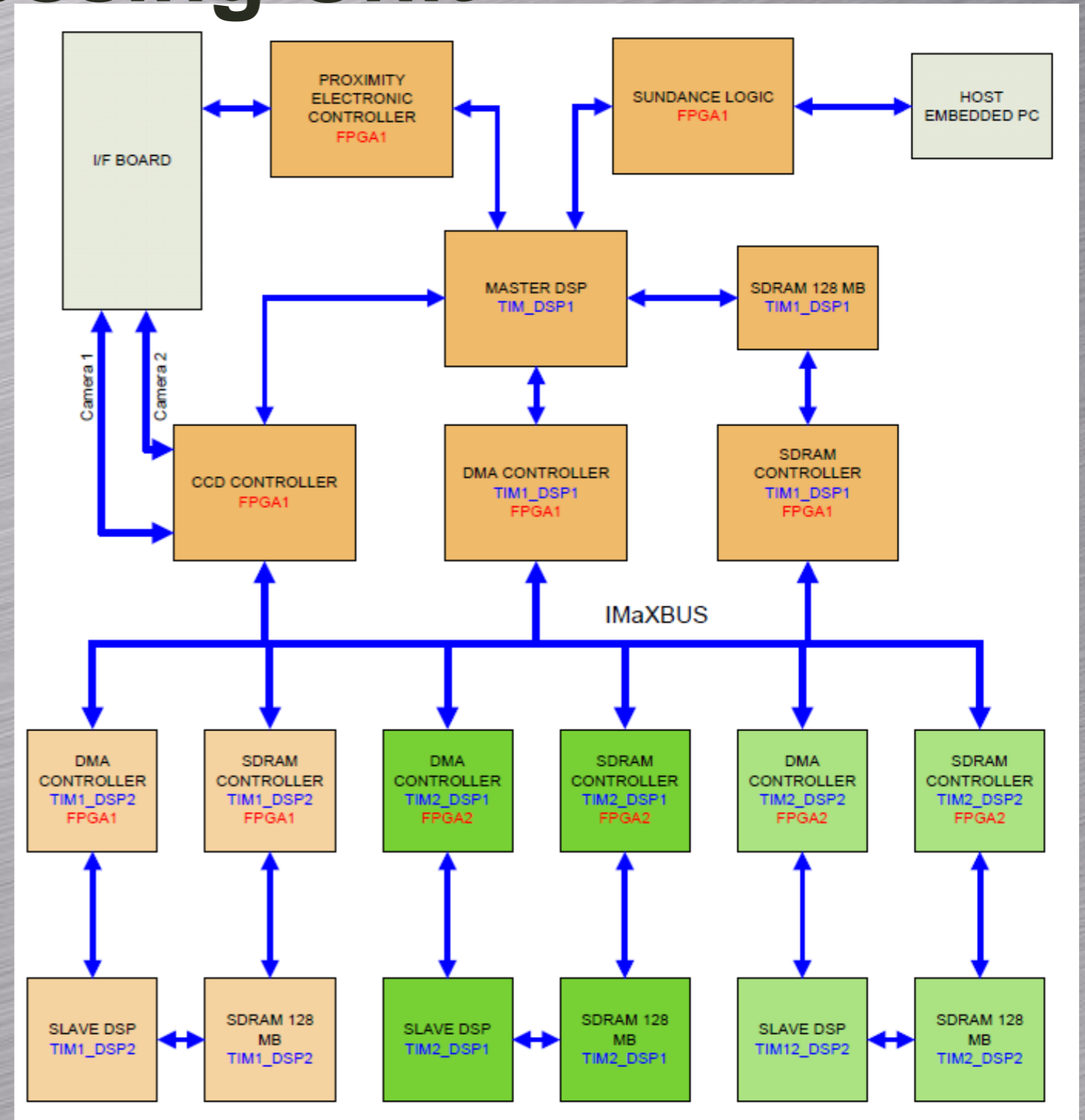


Figure 9 Image acquisition block diagram



The DSP-FPGA based acquisition

25<sup>th</sup> Feb. 2019, OBDP 2019 system

