

Event processing in X-IFU detector onboard Athena



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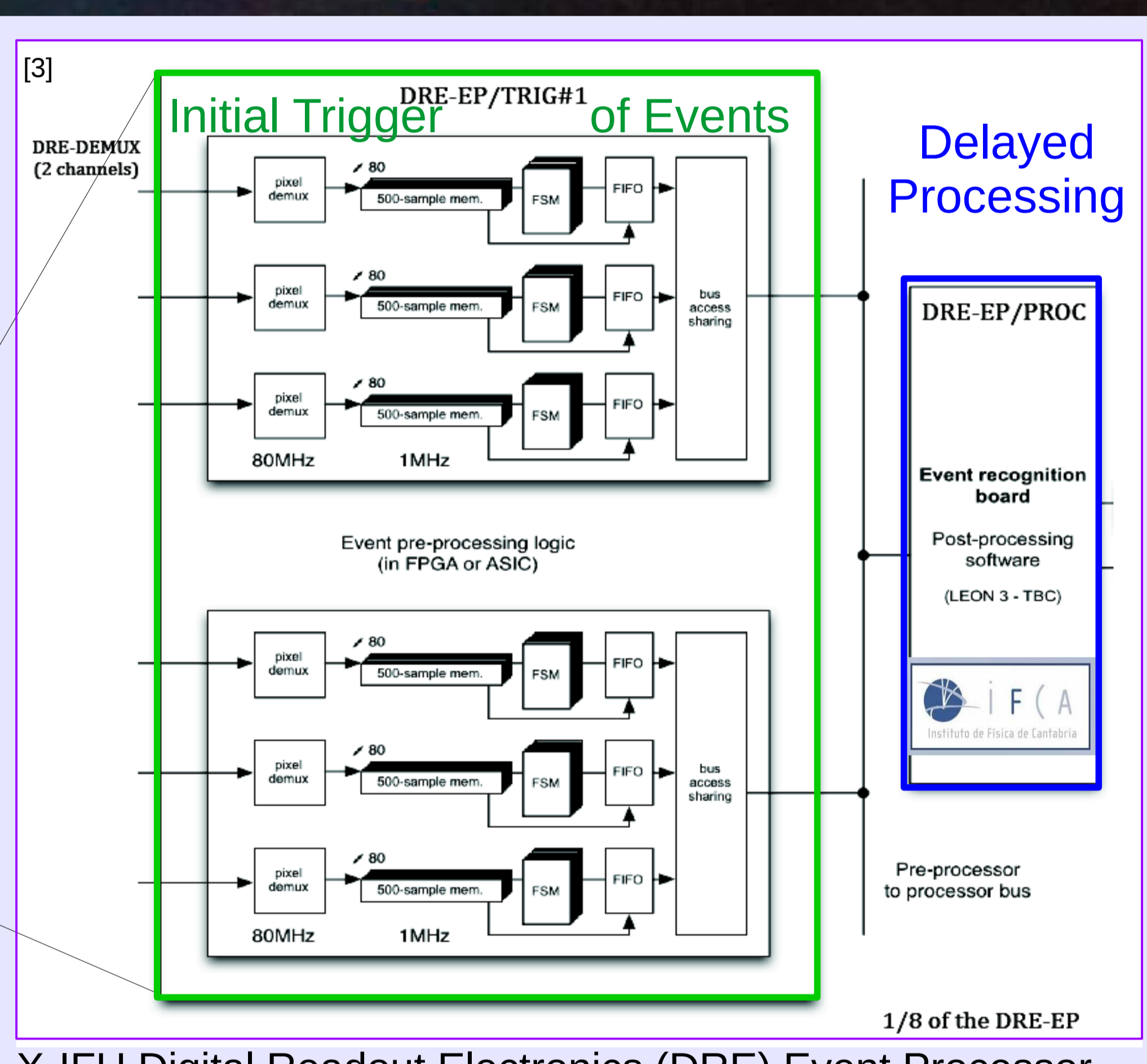
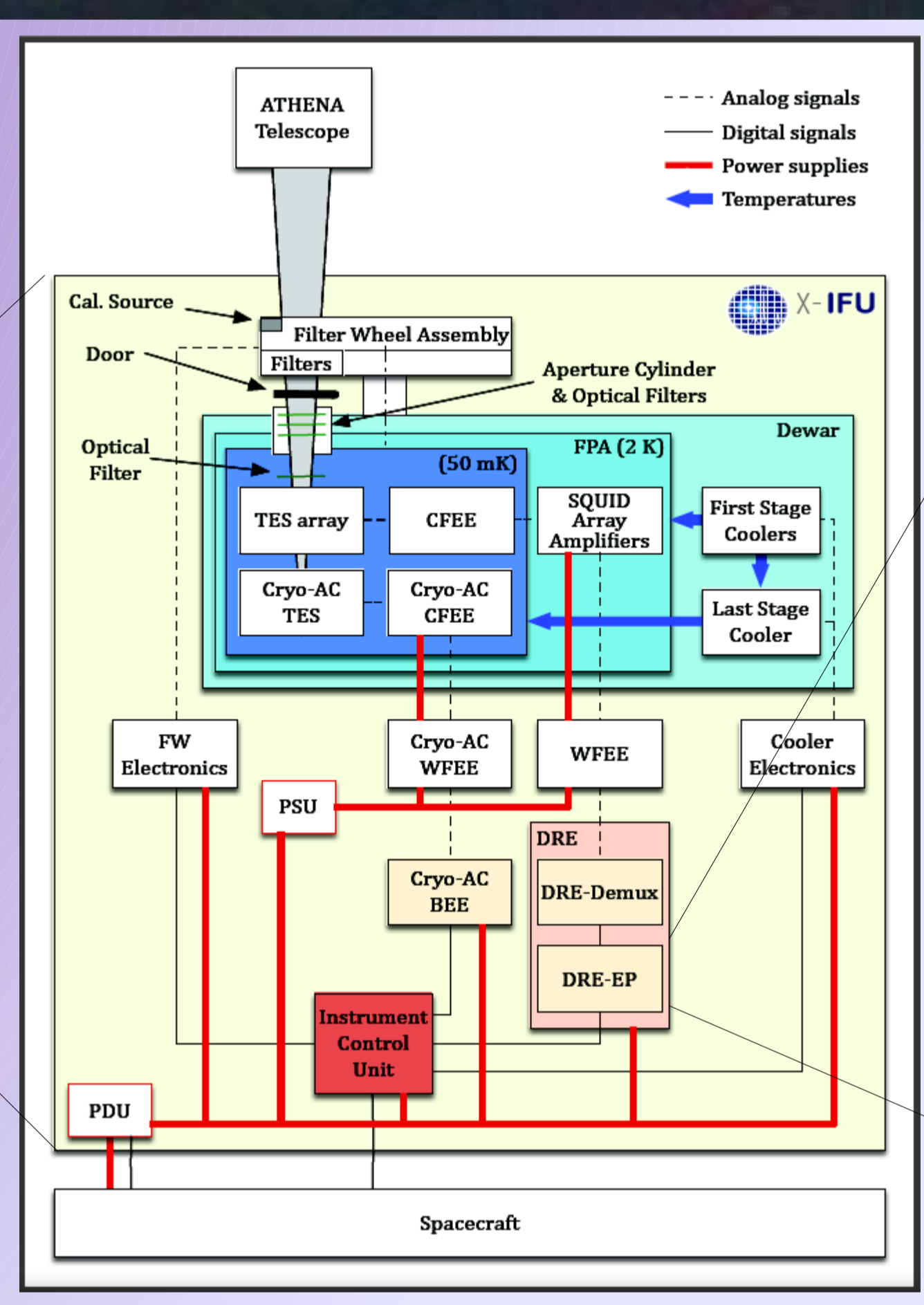
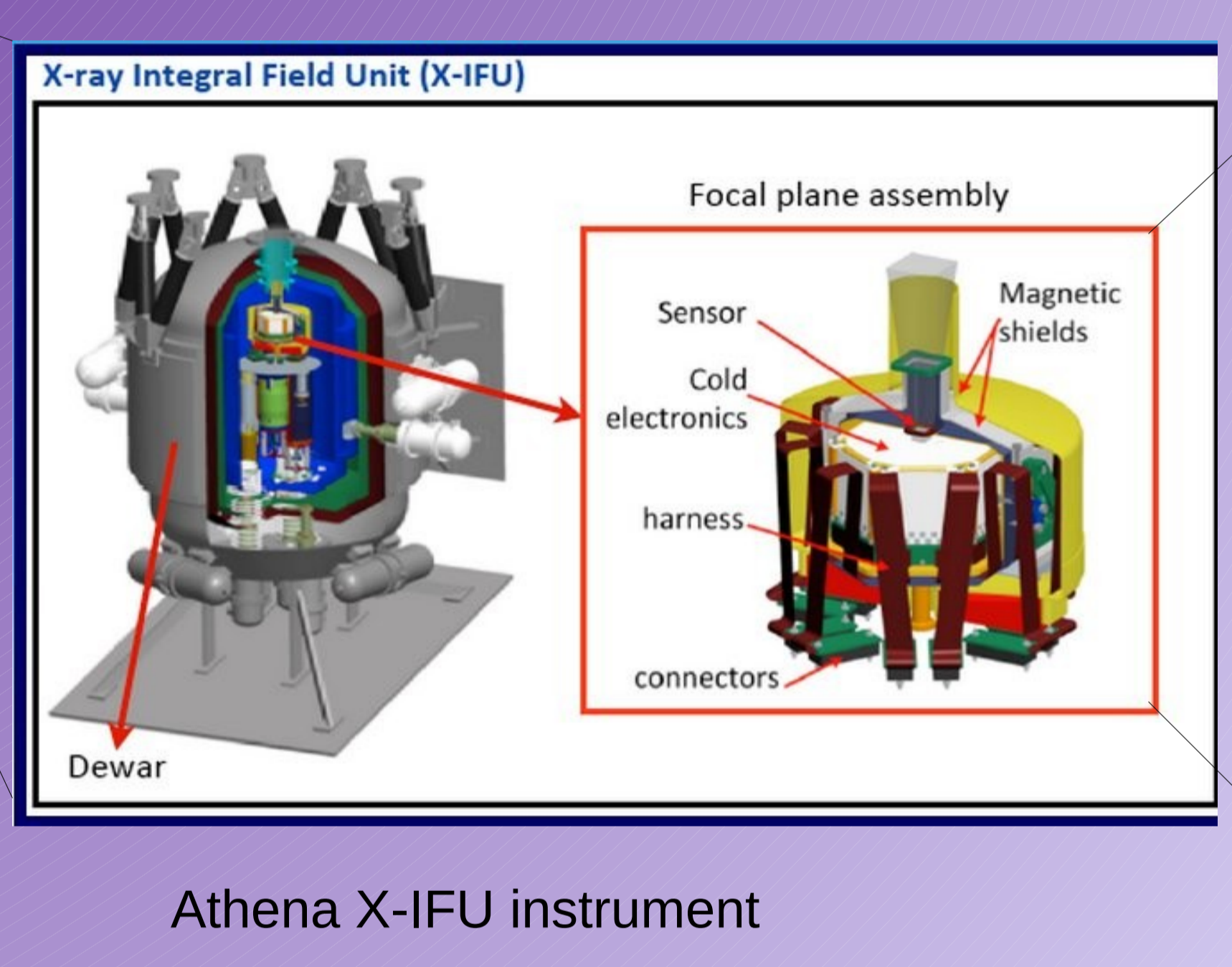
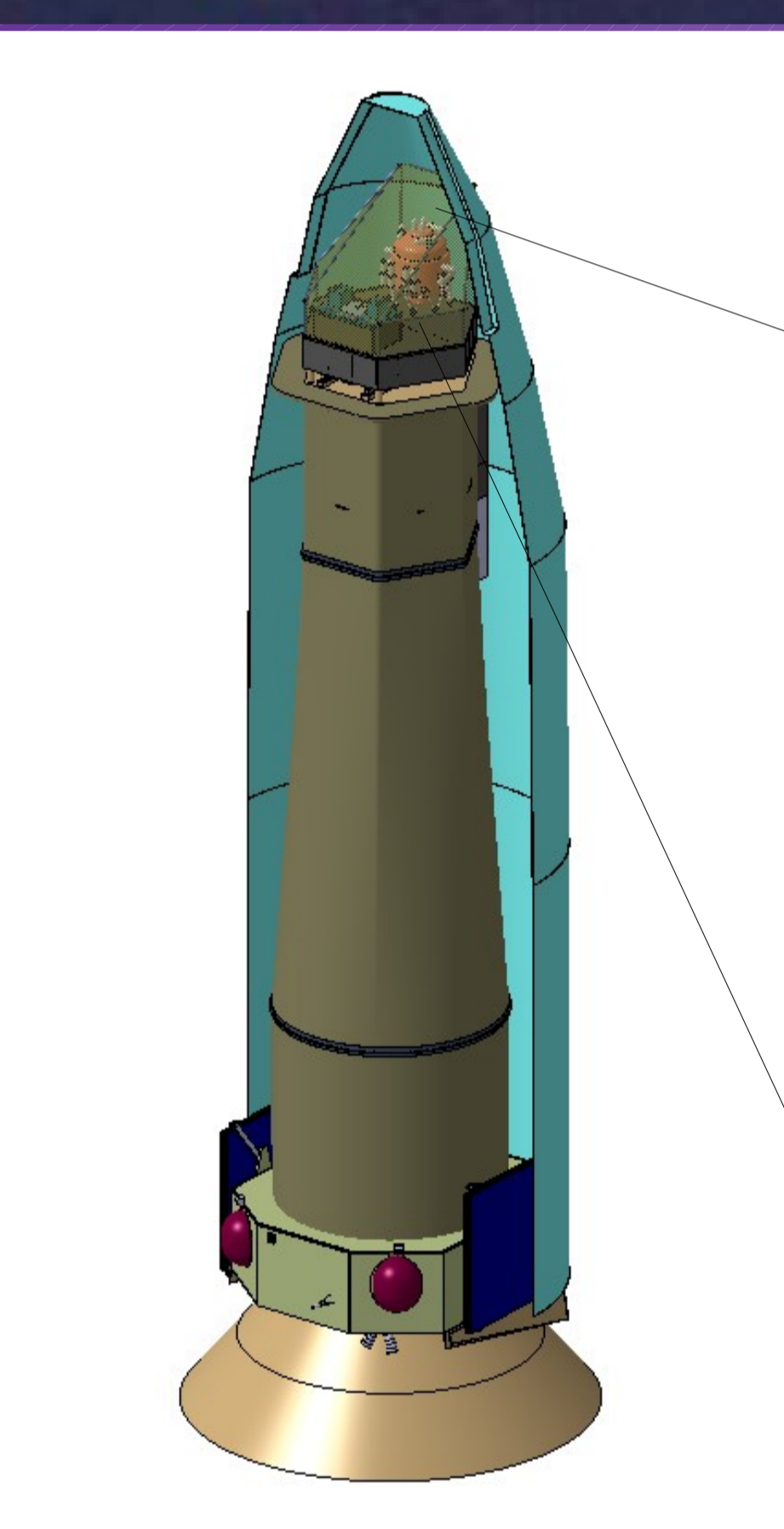
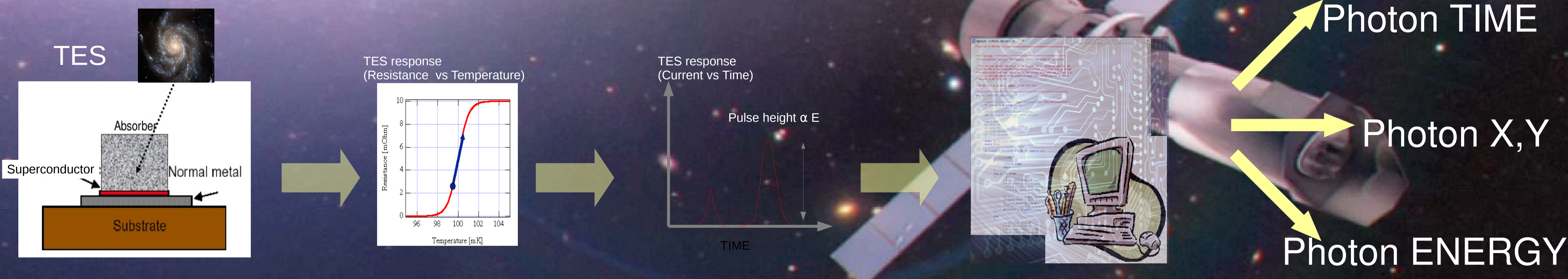
New Astronomy: The current and forthcoming research lines in X-ray astronomy (black holes, accretion physics, hot cosmic plasmas, large bound structures) will require unprecedented spectral resolution with imaging capabilities.

New Mission: In June 2014, the X-ray observatory ATHENA^[1] was selected by ESA to implement the science theme "The Hot and Energetic Universe" as the second large-class mission.

New Detectors: The X-IFU^[2] (X-ray Integral Field Unit) onboard ATHENA is a calorimeter based on Transition Edge Sensor (TES) technologies, able to provide high spectral resolution (2.5 eV @ 6 keV)

New processing: These new detectors require a different approach for the event detection: they must detect the electrical pulses that are the response to an abrupt change in resistance in the device, caused by the absorption of an X-ray photon.

Let's see how to process this...!



Satellite design (courtesy Astrium)

DRE-EP/PROC
 Event recognition Board
 Post-processing Software
 (LEON 3 - TBC)
 Instituto de Física de Cantabria
 [4,5,6]



Filters the data stream and computes a first derivative to detect the events. A running sum filter is used to find the closest pulse template from a library. The derivative of the template is removed from the derivative of the input signal to identify the small events.

Assigns a grade to the detected events based on the time interval between consecutive events:
 - high resolution (2.5 eV)
 - medium resolution (3.5 eV)
 - low resolution (tens of eV)

Determine energy of high and mid-resolution events using optimal filter^[3] methods once instrument has been calibrated

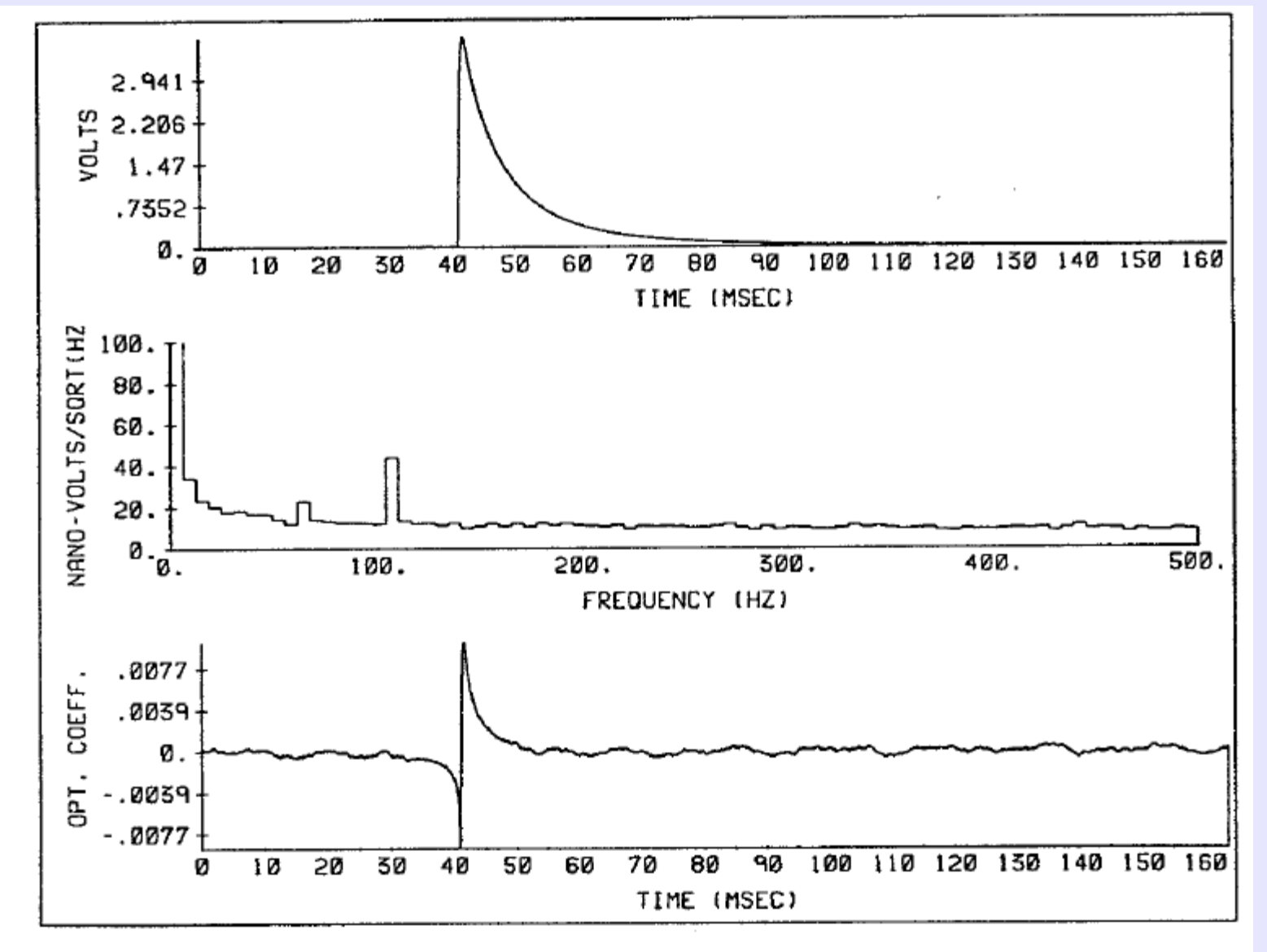
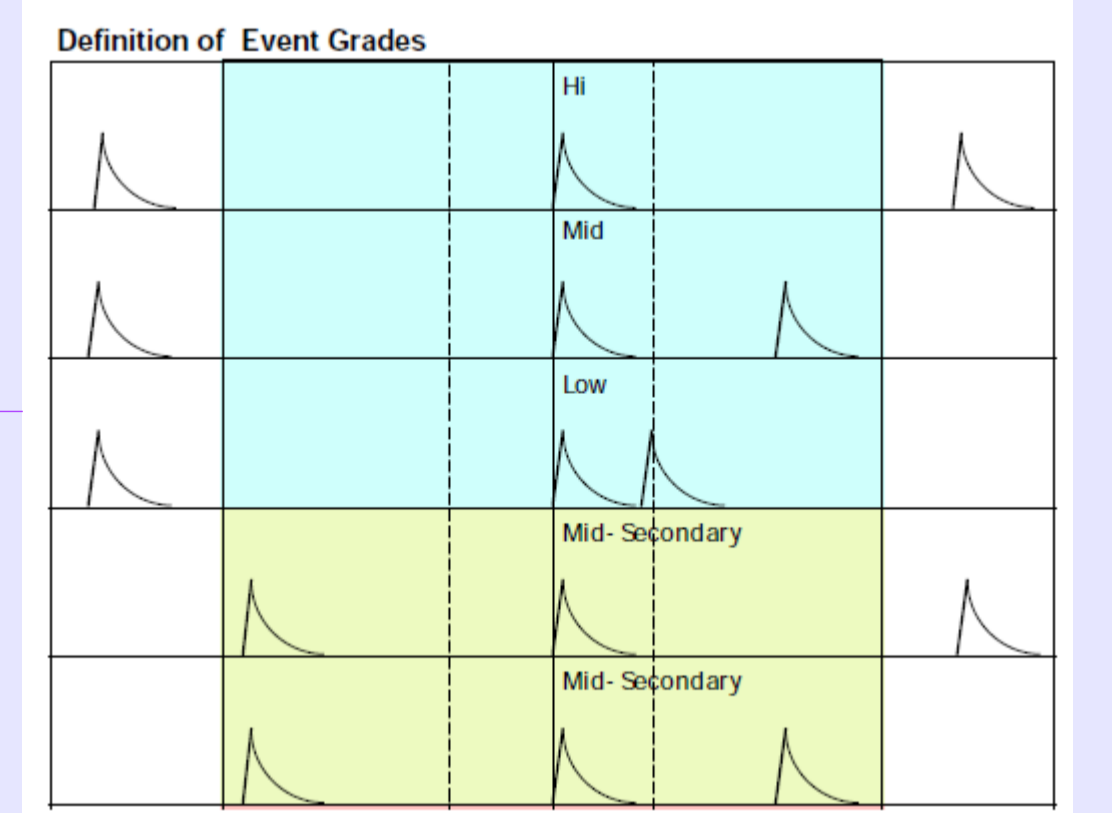
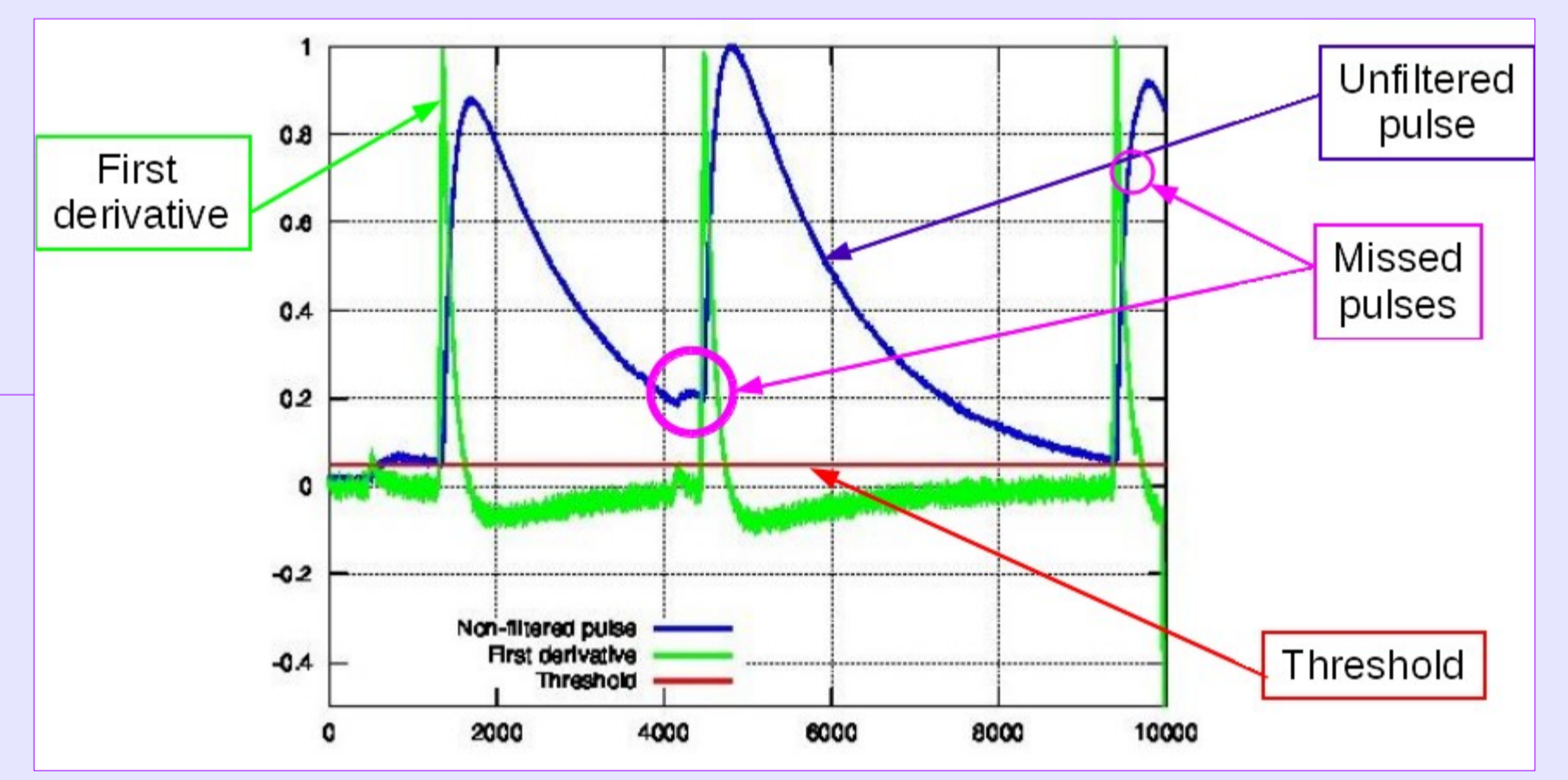
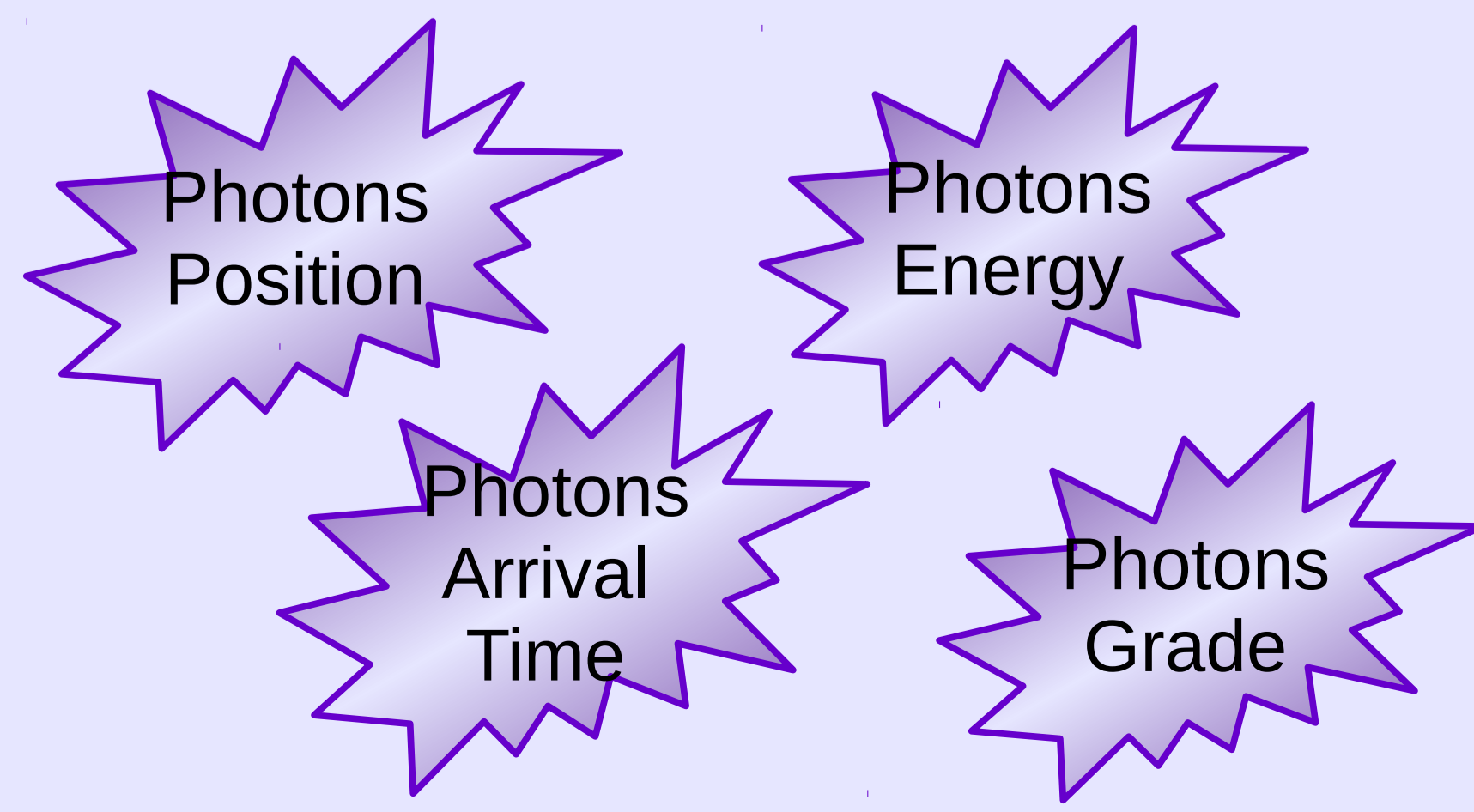


Fig. 1 Plots showing (top to bottom) average pulse shape, power spectrum of the noise, and the optimal filtering template. [7]



References & Acknowledgements
 [1] Athena Team, ATHENA Mission Proposal <http://www.the-athena-x-ray-observatory.eu/>
 [2] Barret et al. 2013, arXiv:1308.6784v1
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 [7] Szymkowiak A.E. et al. 1993, JLTP, Vol. 93, Nos 3/4
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