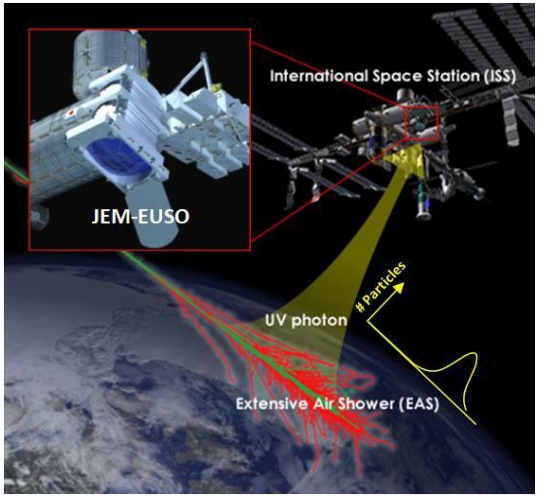
The JEM-EUSO time synchronization system

V. Scotti[1,2], G. Osteria[1] on behalf of the JEM EUSO collaboration

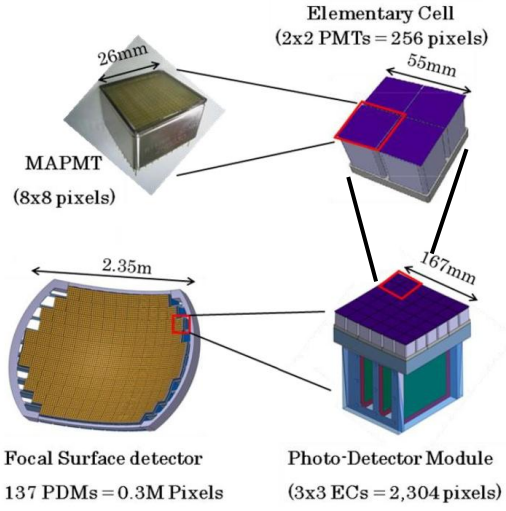
[1] INFN, Sezione di Napoli, Italy [2] Dipartimento di Scienze Fisiche, Università degli Studi di Napoli "Federico II"

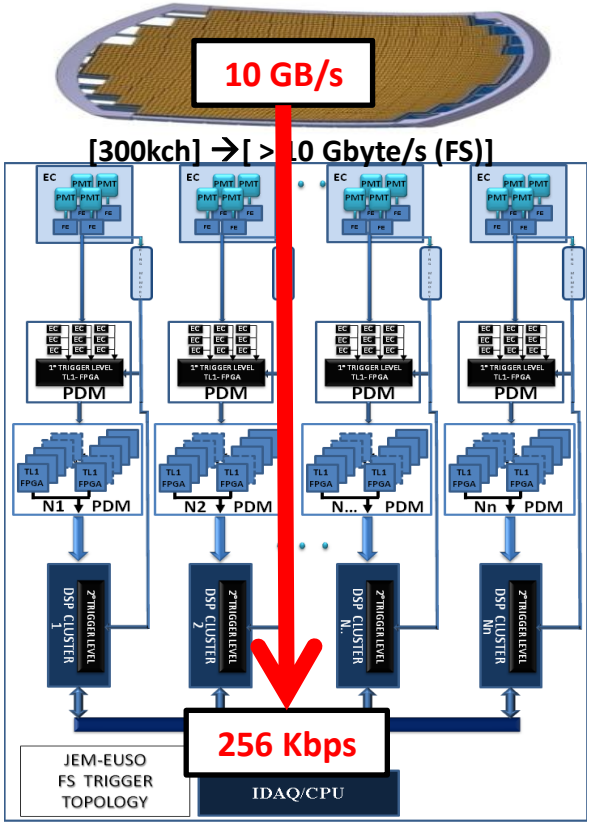


The Extreme Universe Space Observatory on Japanese Experiment Module will observe fluorescence and Cherenkov photons generated by Extensive Air Showers created by Ultra High Energy Cosmic Rays.

Objectives:

- astronomy through the particle channel above 10^{20}eV
- identify sources by arrival direction analysis
- measure the energy spectra from the individual sources





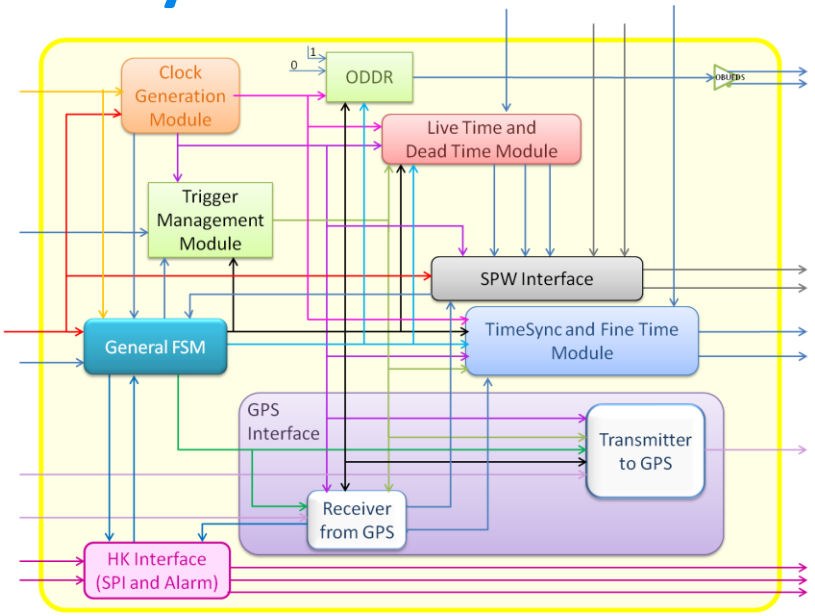
- 5300 PMT → ~ $3 \cdot 10^5$ channels
- 5300 FE ASIC & ~ 300 FPGA
- Strongly parallel & hierarchical structure

→ Also the clock distribution network has a hierarchical structure

Gate Time Unit = basic time unit for data acquisition and readout

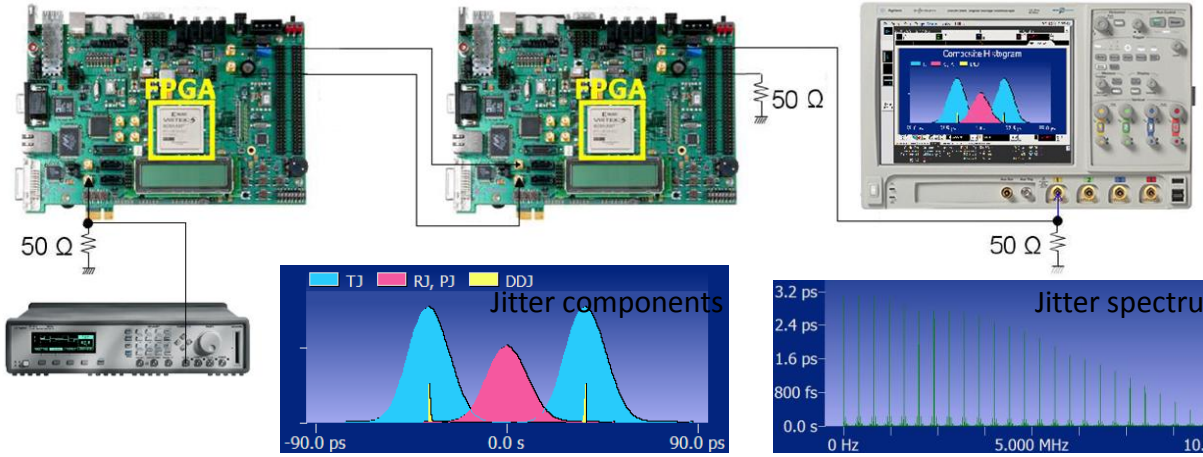
The time synchronization system

1. Generates and distributes system clock (40 MHz), GTU clock (400 KHz) and the Time-Sync to all the devices of the FS
2. Provides for time synchronization of the event and measures the arrival time of the particles on a scale of few µs
3. Interfaces with the JEM EUSO GPS system
4. Manages the trigger signals: receives CCB 2nd level trigger signals and forwards to CCBs any triggers coming from CPU
5. Measures live-time and dead-time



After the implementation on a Virtex-5 FPGA, we carried on:

- Interfaces with GPS test
- Space-Wire and SPI protocol tests
- Jitter measurement through the CLK-Board and after an additional level of boards



Next step: we are developing the CLK-Board for two pathfinder missions planned for 2013: EUSO-BALLOON and a prototype that will be installed in the TA site.