**The Ultra Fast Flash Observatory (UFFO) in LOMOSOV a joint venture for GRB detection**

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LOMOSOV is a Russian space mission commemorative of the 100 anniversary of LOMOSOV. The total mass of the spacecraft is 300 Kg with a 100 Kg payload and an expected mission life time of 3 years.

The LOMOSOV payload is a composed by three instruments the UHECR, BDRG and UFFO. UHECR is a deployable telescope for high energetic particle interactions with Earth atmosphere and BDRG is a Gamma Ray detector for bust. Both are Russian design. In Figure 1 lower right corner is displayed the structure of LOMOSOV satellite. UFFO is displayed in blue colour ( lower right corner).

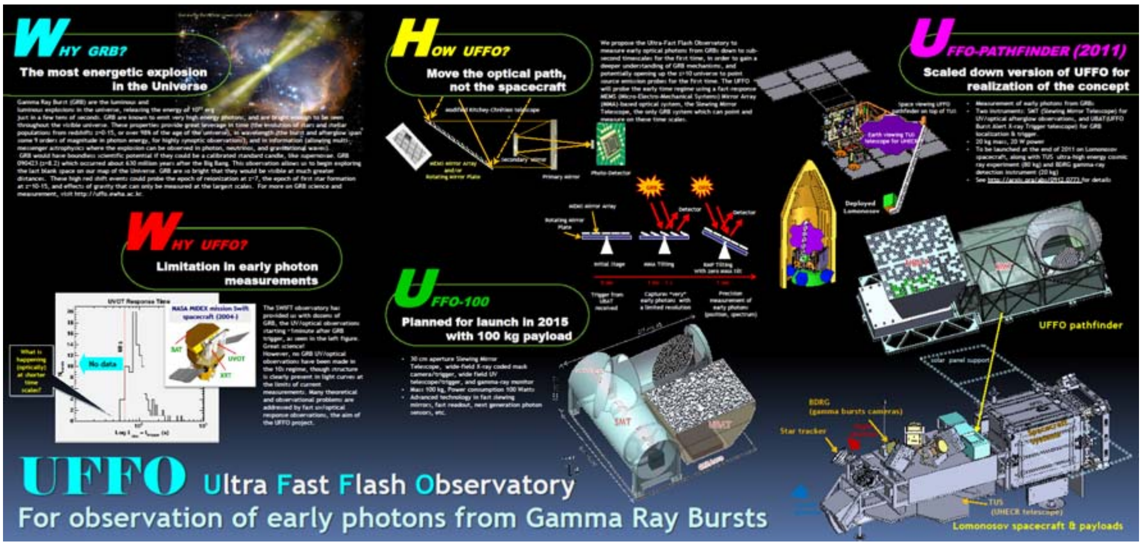


Figure 1.- UFFO Scientific goals and main subsystems: UBAT and SMT

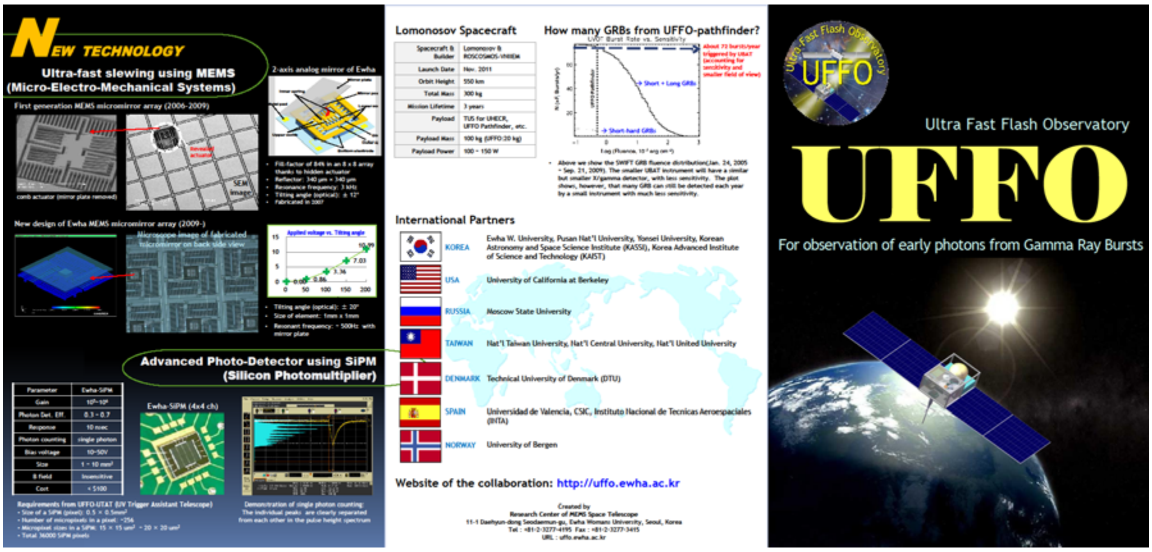


Figure 2.- STM micro mirror system, satellite envelopes and UFFO Consortium

The Ultra Fast Flash Observatory ( UFFO) is an instrument designed to measure **the optical GRB counterpart in the first second**. It is composed by two subsystems the Gamma ray detector (UBAT) and the optical telescope (SMT).

The relevance of UFFO scientific goal is obvious, to measure the optical GRB counterpart A.S.A.P. Up to now the best measurements using fast ground based robotic optical telescopes starts 2-5 min after the GRB detection. The reason for this delay is technical, it is necessary to trigger the system, open de window, pointing and start acquisition. The alternative of having both, optical telescopes and GRB detectors in a satellite do not improve so much the time gap. Once the GRB is triggered the optical telescope needs to move before start target acquisition. All of these operations require spacecraft control operations. Total time needed is very similar to the ground based telescopes, few minutes.

On UFFO, the key technology is the micro mirror system of the SMT. Once SMT is triggered by UFFO, the SMT focal plane assembly starts its deformation focussing the mirror in the field desired ( FOV 10 arc min) over a total FOV of 80ª. **It is not necessary any telescope or satellite motion.** See Figure 3 for details.

The technology of micro-electrical-mechanical-systems (MEMS) applied to micro-mirror arrays that can rapidly change their orientation to reflect light from any point in a given FOV to the mirror of an optical telescope is now available. The Ultra Fast Flash Observatory Pathfinder mission (UFFO) has been proposed by Prof I.H.Park, of Ewha W.Univ. Seoul, to enable the location of any GRB optical counterpart within a time resolution of seconds - or even less - compared to the best minimum times of > 1 min currently available with satellite-ground alert systems - the goal being to record the earliest possible history of a GRB optical afterglow.

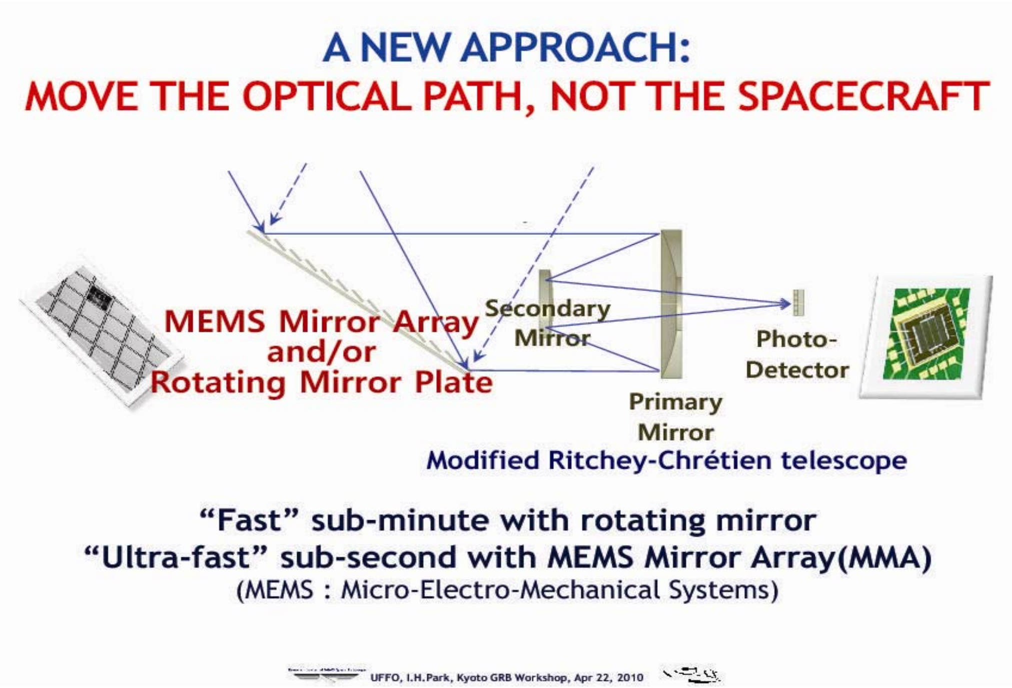


**Figure 3**.- Optical telescope technology

UBAT is the gamma ray detector on UFFO. Its technology is the classical coded aperture system coupled to a pixelated detector layer heritage from LEGRI, INTEGRAL and ASIM. Due to mass and geometrical envelopes resources allocated to UFFO, UBAt has a 200 cm2 detector area with a random mask 30 cm away.

The final decision on UBAT design was taken in a Consortium meeting held in Ganada in 4-6 October 2010. Work packages allocated to Spain and the full UFFO organization chart is displayed in Figure 4.

Spain took the full responsibility of UBAT design and main subsystems: Principal Investigator, Project manager, Imaging system, Triggering Protocols, Mechanical design and Thermal design. UBAT detectors and electronics are from the Korean group and AIVT activities belongs the Taiwan group.

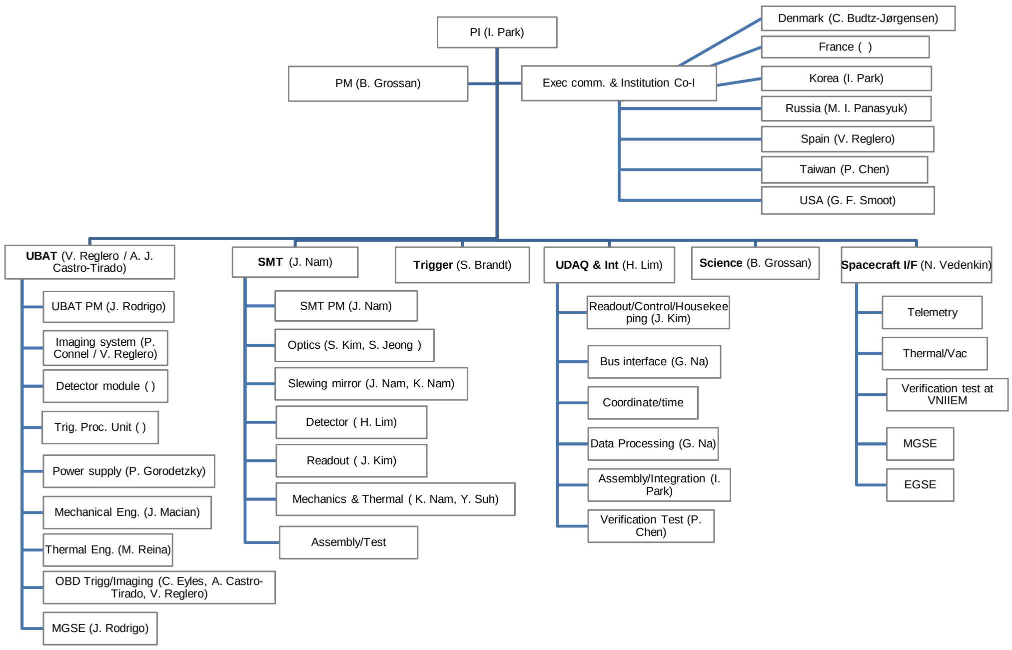


**Figure 4**.- UFFO Flow chart

The UBAT and UFFO schedules are “unrealistic”. STM by December the 1st 2010, QM by May 2011 and FM by September 2011. When we started in October, time allocated to the UBAT, mechanical, thermal, imaging system designs and STM manufacturing and delivery to Russia was 6 weeks.

The University of Valencia is studying the implementation of a small coded-mask “GRB location imager” UBAT, in the 15-200 keV energy range, using technology which is a further development of the MXGS imager - now approved for the ASIM mission to the ISS in 2014 - and will have a 160x160x5 mm CZT detector array, a 64x64 coded mask pattern with 5x5x1 mm Tungsten elements placed 25 cm from the detector to integrate incoming GRB photon counts continuously in real time.

When enough photon counts have been integrated [0.1-1.0-10.0 secs depending on GRB fluence] to make an unambiguous location estimate [~10 arcmin] a signal will be sent to the active mirror system of the UFFO optical telescope SMT to then focus within milliseconds upon the GRB optical afterglow [~17 arcmin resolution].

We present here the preliminary geometry and design of a UBAT imager with the results of the simulation of a GRB with a “mean wide band spectrum” [$\alpha = 0.95$, $\beta = 2.35$, E0 = 250.0 keV], a background of 2.0 cnts/cm2/sec [CXB, SAA, etc], integrated over 1.0 seconds - to show the back-projection SNR images obtained for a range of incoming GRB flux values [0.8 – 8.0 ph/cm2/sec] in the 15-200 keV energy range. The GRB is 20° off-axis. Initial results (shown right) suggest that for a 1.0 second integration time a GRB flux of at least 3.0 ph/cm2/sec

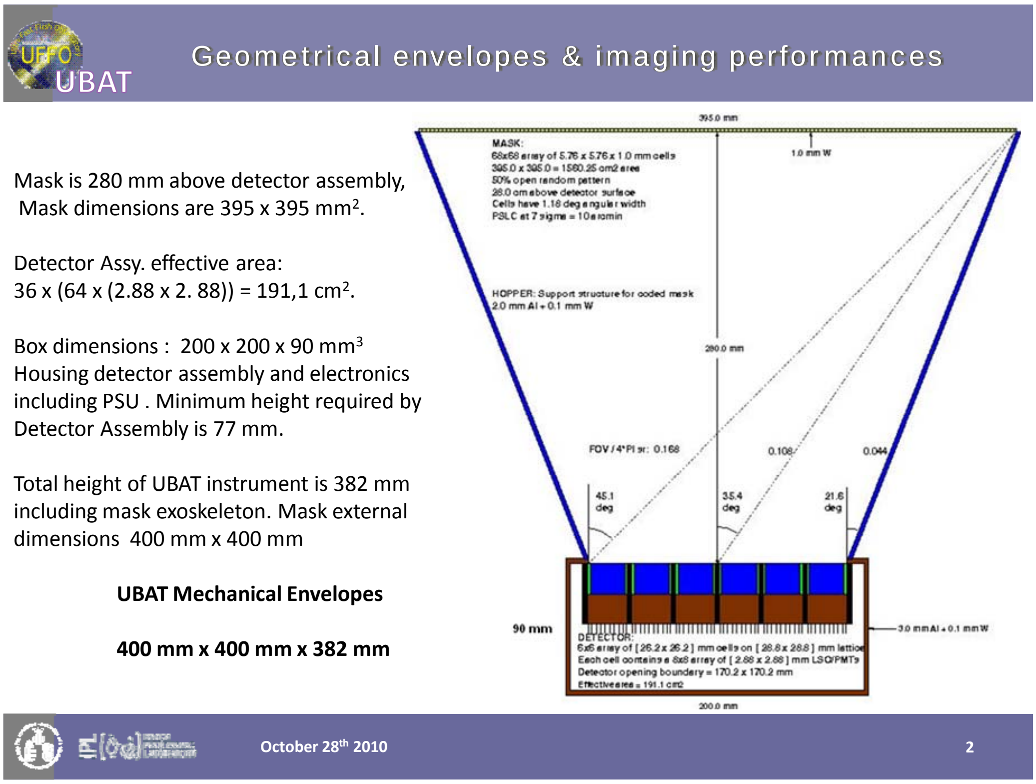


Figure 5.- UBAT Imaging system

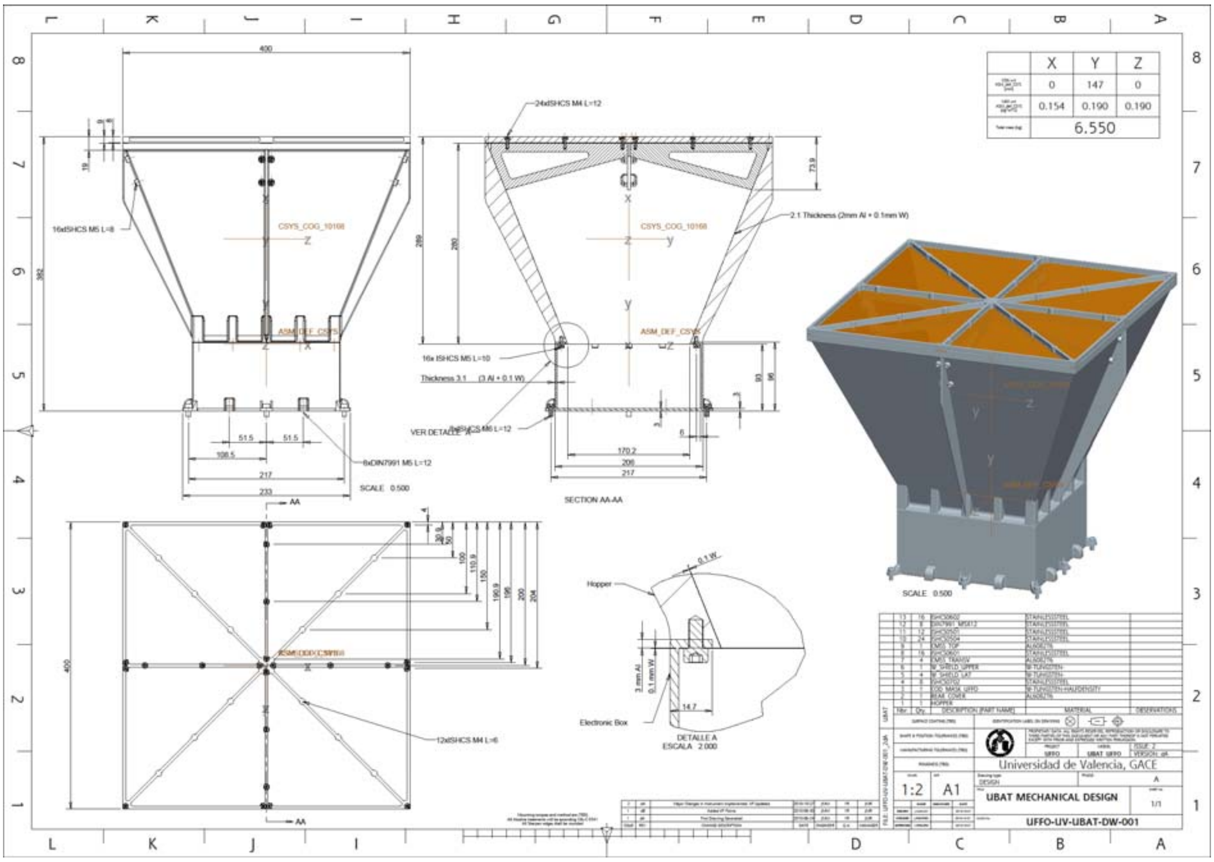


**Figure 6**.- UBAT main subsystems on top and UBAT detailed mechanical design.

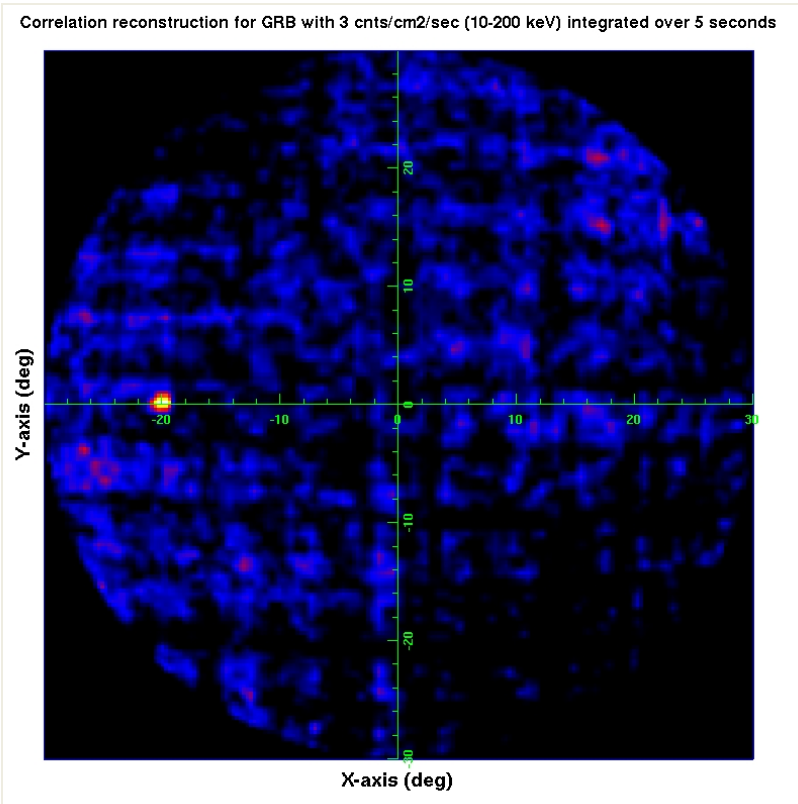


**Figure 7**.- UBAT imaging capabilities. First simulations.

In despite that the UBAT schedule was “Impossible” or “unrealistic” the UBAT STM was delivered to Russia on December 1st.

**Figure 8**.- Happy UBAT Mechanical engineer and Project manager, day before delivery to Russia, November $30^{th}$ 2010.

Ultra Fast UBAT development and delivery takes benefit from the existing ASIM project resources. UBAT is a “small” ASIM ( 1/5) using same technologies, model philosophy, parts and materials. The Team developing UBAT is the ASIM Team.

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