The innovative particle tracker for the HEPD space experiment onboard the CSES-02 satellite

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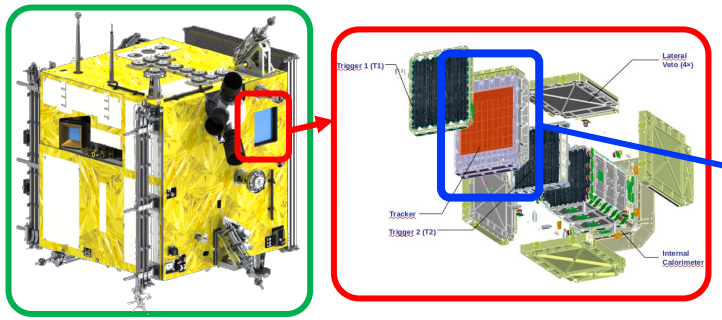
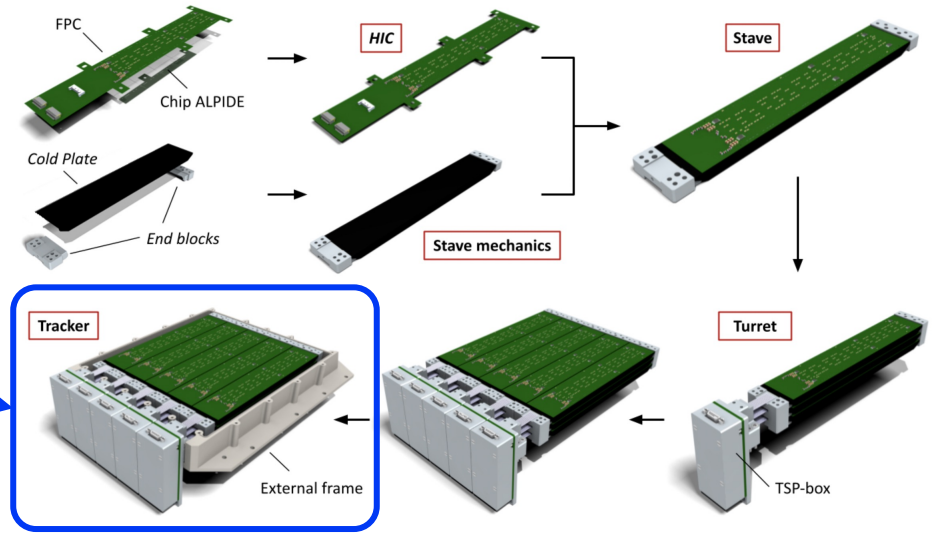
CSES-02 is the second satellite of a constellation devoted to Earth remote sensing (launch in 2022)
Among payloads, the High-Energy Particle Detector (HEPD) has been designed by the Limadou Collabroation to measure 3-100 MeV electrons and 30-200 MeV/Z nuclei



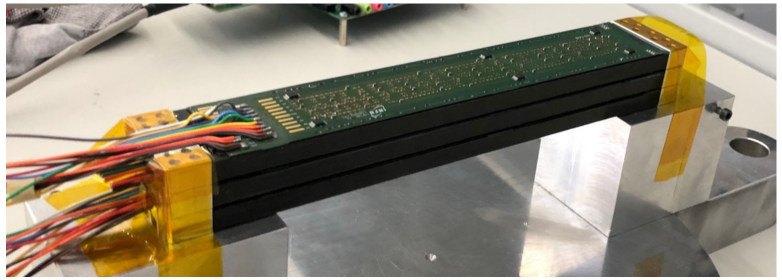


The particle tracker of HEPD-02 will be the **first space-borne instrument to use Monolithic Active Pixel Sensors (MAPS).** The ALPIDE chip has been chosen, after good performance and high reliability proved for the ALICE experiment at CERN.
The tracker is made of 5 independent turrets (interfaced to the payload with the Tracker-Splitter (TSP) board. Each turret is made of three staves, with Hybrid Integrated Circuits (HIC) glued onto Aluminum/CFRP mechanics. The HIC is made of 10 ALPIDE chips glued and bonded onto a Flexible PCB (FPC).
3 active planes, 675 cm^2 active area in total, 150 sensors, 80 Mpixels

Very promising technology when compared to past space-missions:

Experiment	Year	Technology	Pitch [µm]	Res. [µm]	Surface [m^2]	Power [W]	p. density [mW/cm^2]	Life Span [yr]
FERMI-LAT	2008	1side µstrip	228		74	160	0.2	ongoing
DAMPE	2015	1side µstrip	121	70	7	90	1.3	ongoing
PAMELA	2006	2side µstrip	50(p) 67(n)	3	0.13	63	48	11
AMS-02	2011	2side µstrip	110(p) 208(n)	10(p) 30(n)	6.4	734	12	ongoing
HEPD-01	2018	2side µstrip	182	50	0.088	10	11	ongoing
HEPD-02	**2022**	**MAPS**	**28**	**3**	**0.068**	**10.5**	**15**	-

Thanks to MAPS technology, the HEPD-02 tracker will exploit innovative features like **in-flight calibration with charge injection** and **online fast tracking** with possible **in-flight data selection**.
If future technological improvements are considered, it becomes apparent that MAPS will be an important option for mid and large-size astroparticle experiments.



The **MAPS technology** for the HEDP-02 tracker has been **fully qualified for space applications**, successfully passing radiation hardness tests, electrical tests, mechanical and thermal stress tests (picture: turret ready for vibration tests)