Weather Sentinel

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Joint Scientific Space Mission Chinese Academy of Science (CAS) - European Space Agency (ESA)

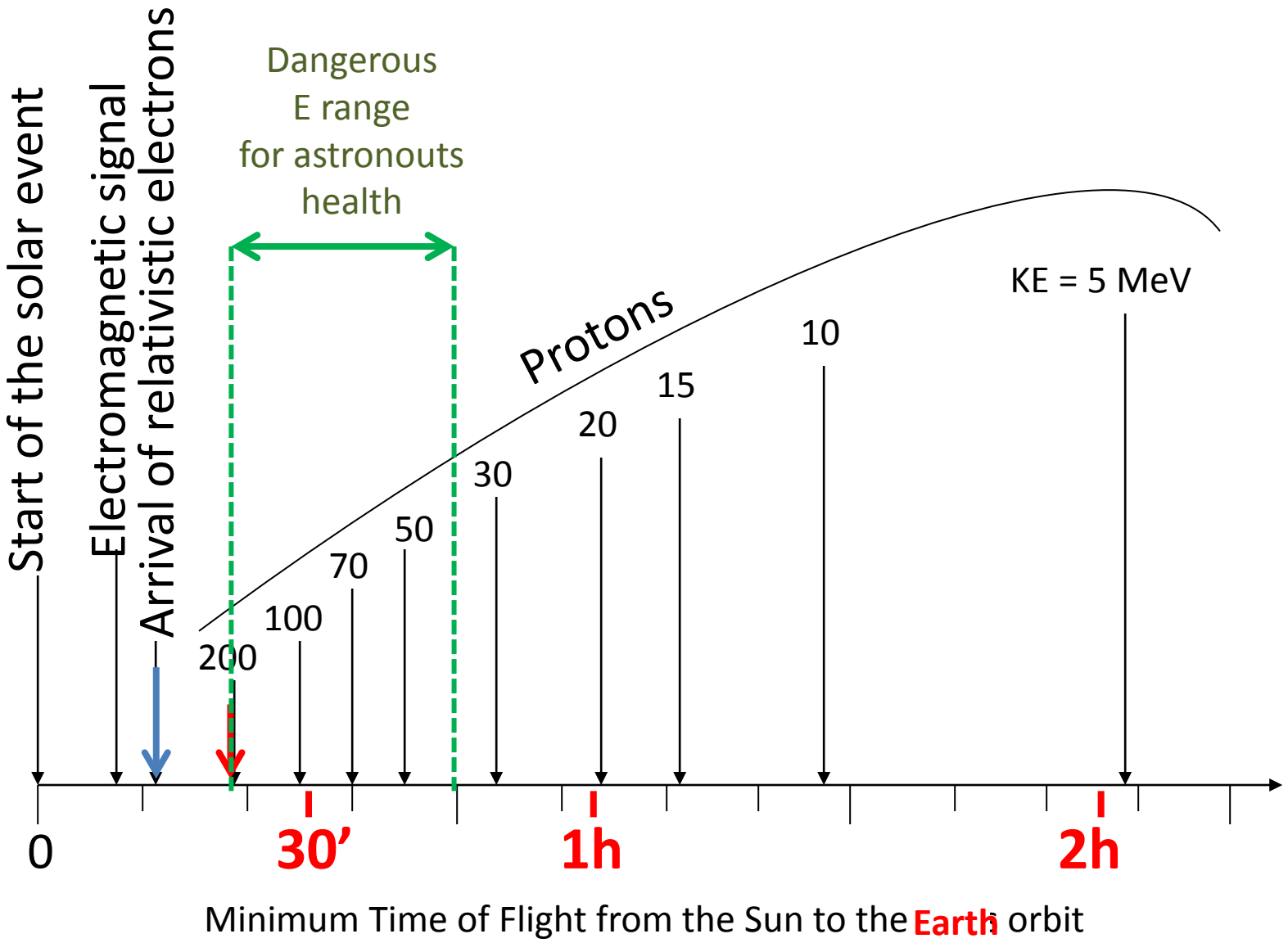
Science objectives

Main science objective:
understanding emission and transmission through heliosphere
of energetic particles in correspondence of different kinds of SEEs,
by measuring energy spectra and the angular distributions,
of the energetic tail of SEEs (electrons, protons, ions and neutrons),
and their time evolution,
continuously and on a long period of time, possibly a full solar cycle

In particular:
knowledge of evolution in time of the angular distribution as a function of energy of electrons and protons in the CME type of events, the most energetic and high fluence SEEs.

maximum importance for the future manned exploration of the solar system:

"knowledge of the arrival direction of the energetic electrons allows the spacecraft to take countermeasures against the shortly arriving, by the same direction, protons and ions".


Start of the solar event
Electromagnetic signal
Arrival of relativistic electrons
Dangerous
E range
for astronouts
health
Protons
KE = 5 MeV
10
15
20
30
50
70
100
200
0
30’
1h
2h
Minimum Time of Flight from the Sun to the Earth orbit

The Instruments

Main instrument:

SPhERA

- ***Arrival angle*** of the charged particle (by coincidence of pixels of two concentric spheres)
- ***Energy*** of the charged particle (by ToF between the two pixels)

PAMELA and AMS heritage

Possible complementary instruments:

INTERACTOR

- ***neutron energy*** (by position of the neutron interaction + angle, amplitude and time of the recoiling proton in the SPhERA instrument)

SUNSPOT MAP

- time evolution in several bands (UV+optics) (by filters + CCD image)

RADIATION DOSIMETRY

- time evolution in diamond detectors (by two dosimeters)

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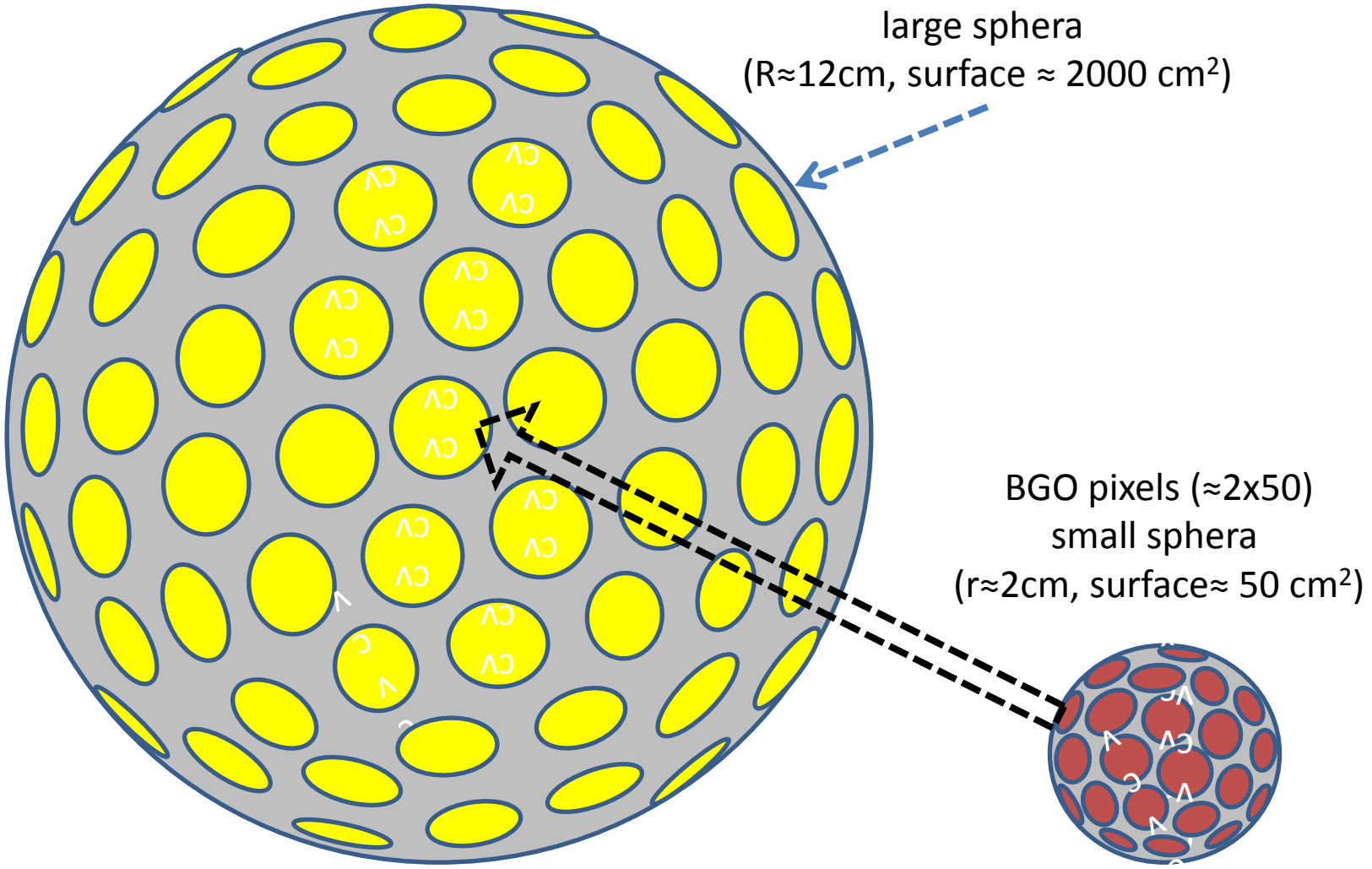
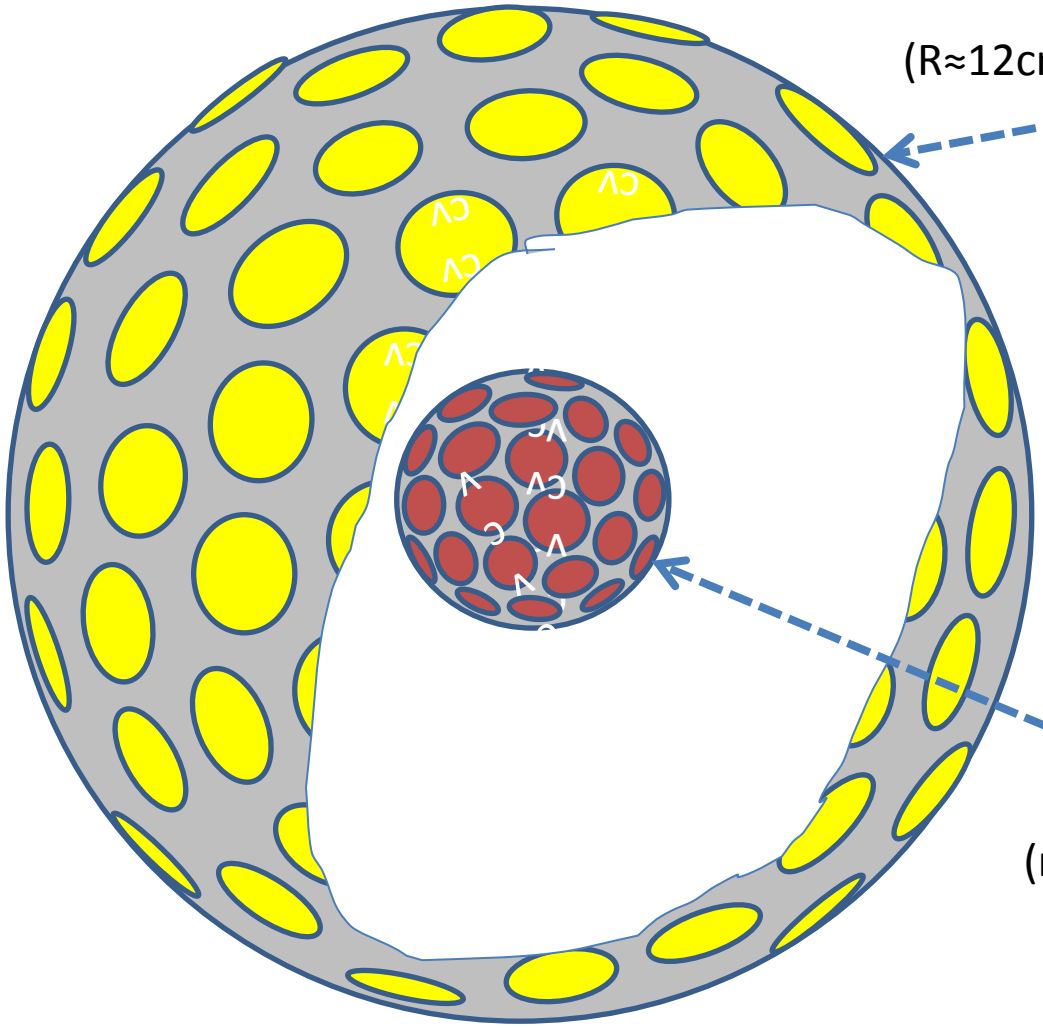
SPhERA sensors

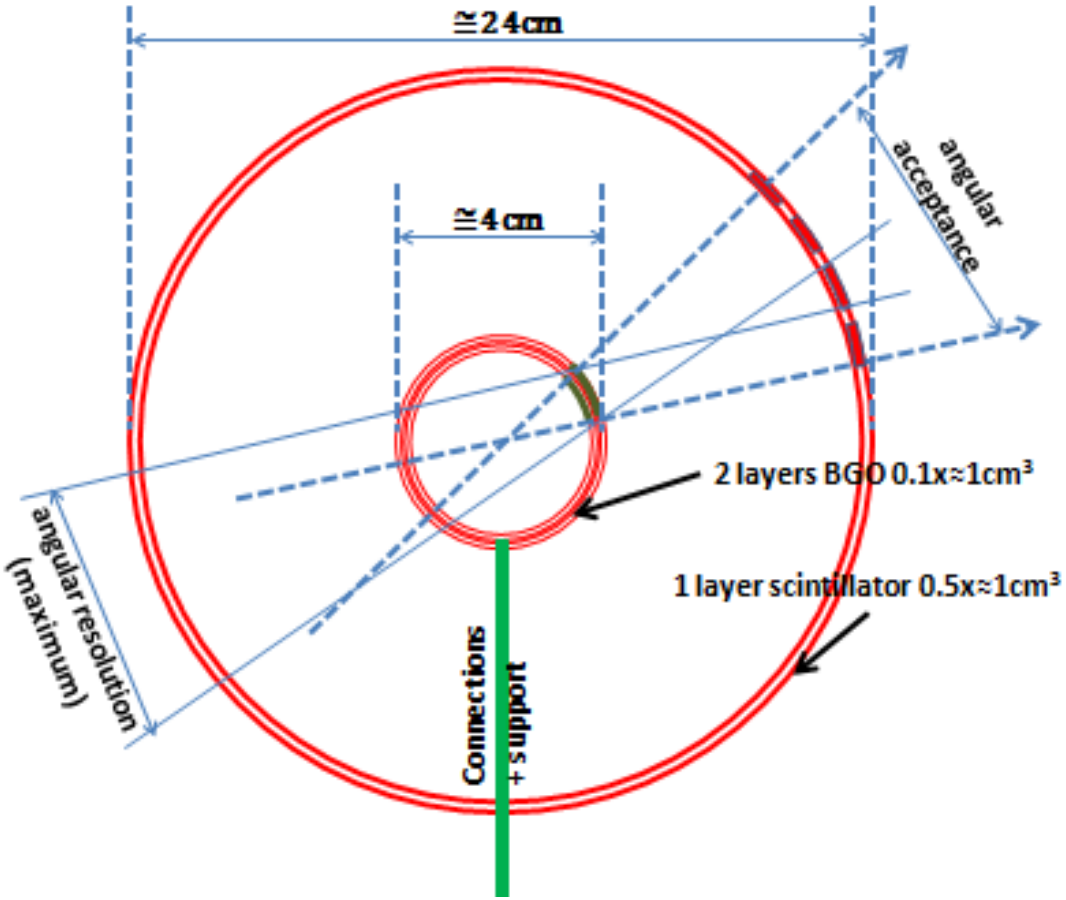


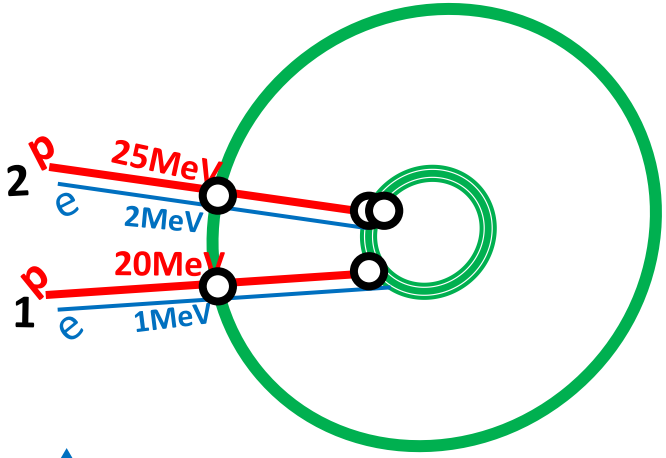


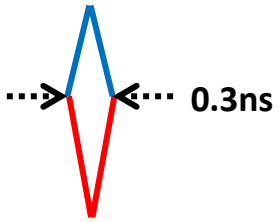
scintillator pixels (≈1000)
large sphera
(R≈12cm, surface ≈ 2000 cm^2)

BGO pixels (≈2x50)
small sphera
(r≈2cm, surface≈ 50 cm^2)

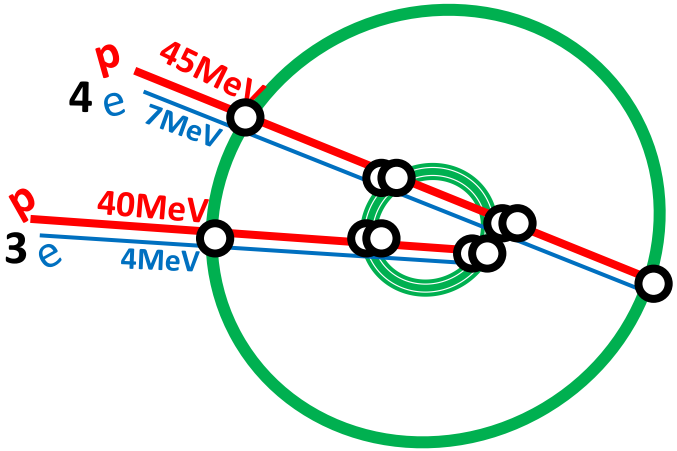
SPhERA sensors

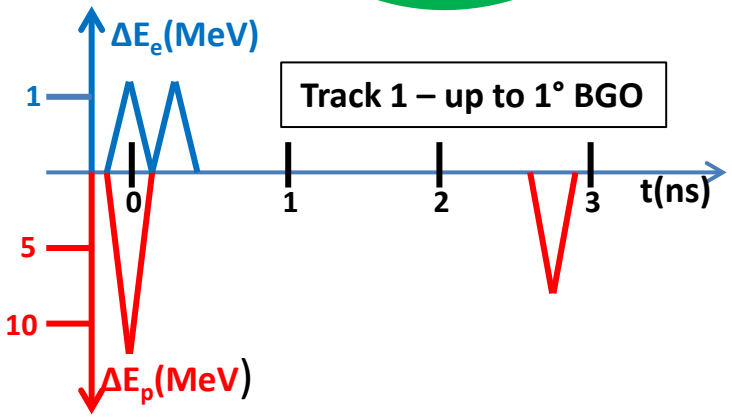


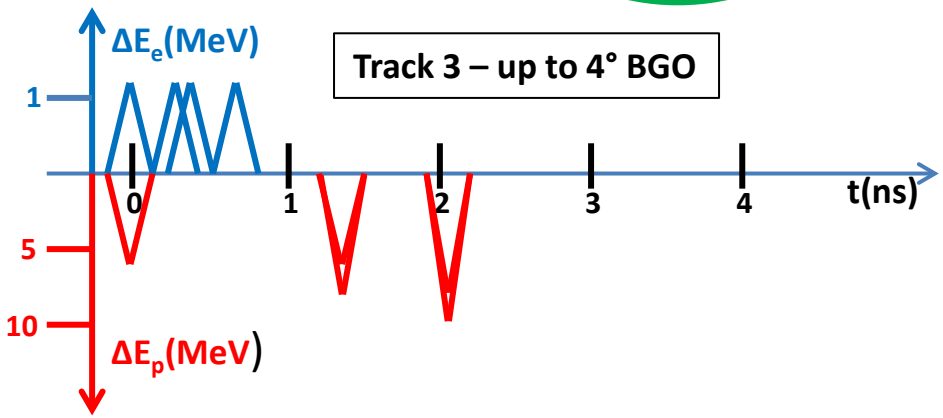


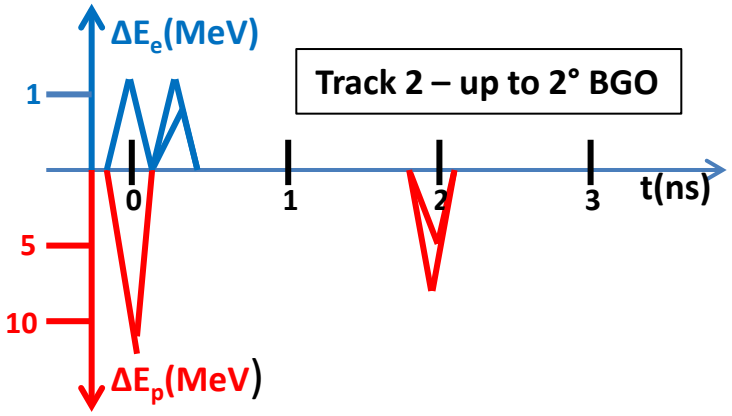


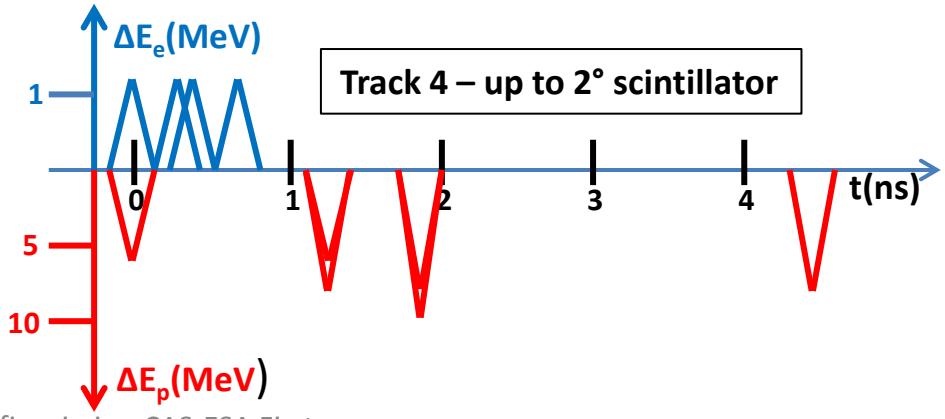
Time resolution





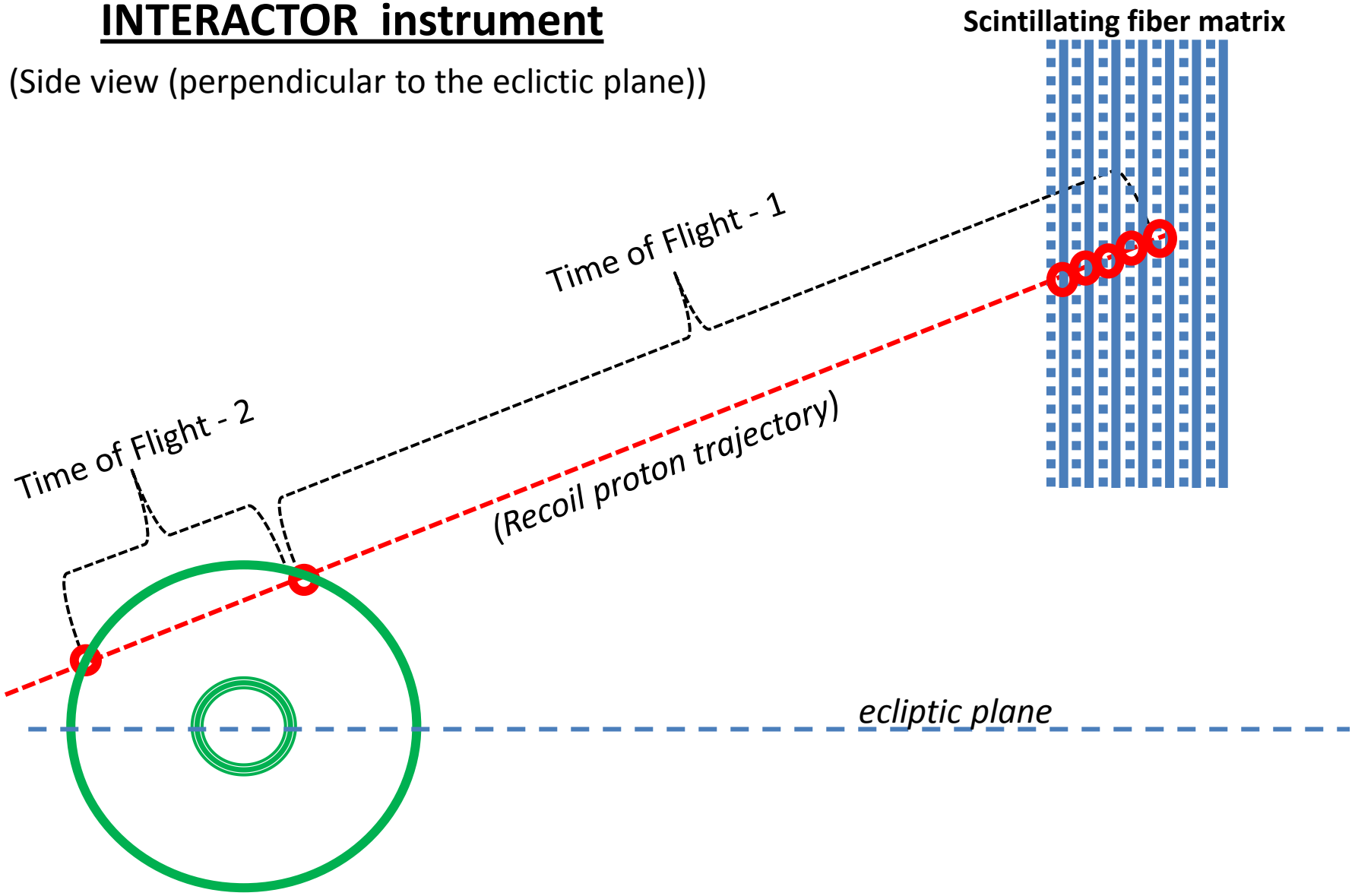






INTERACTOR instrument

(Side view (perpendicular to the eclictic plane))



Main parameters of the instruments:

SPhERA	Mass of the sensors	3kg
	Number of channels	4k
	Power consumption	10W
	Mass of the electronics	5kg
INTERACTOR	Mass of the sensors:	20kg
	Number of channels	50k
	Power consumption	10W
	Mass of the electronics	5kg

Total:
≈30kg
20W

SUNSPOT MAP few kg + few W

RADIATION DOSIMETRY few kg + few W

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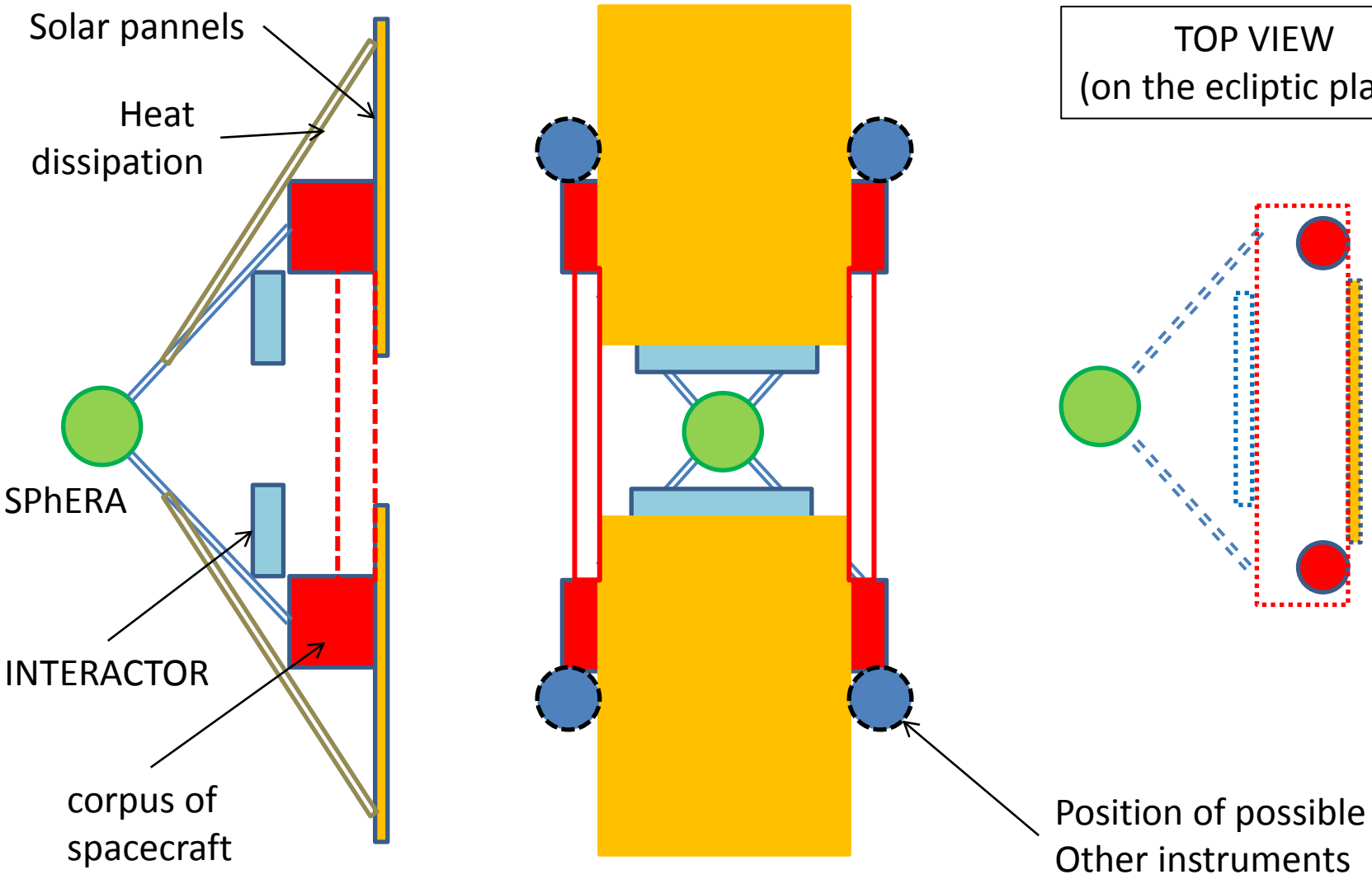
≤ 20kg
≤20W

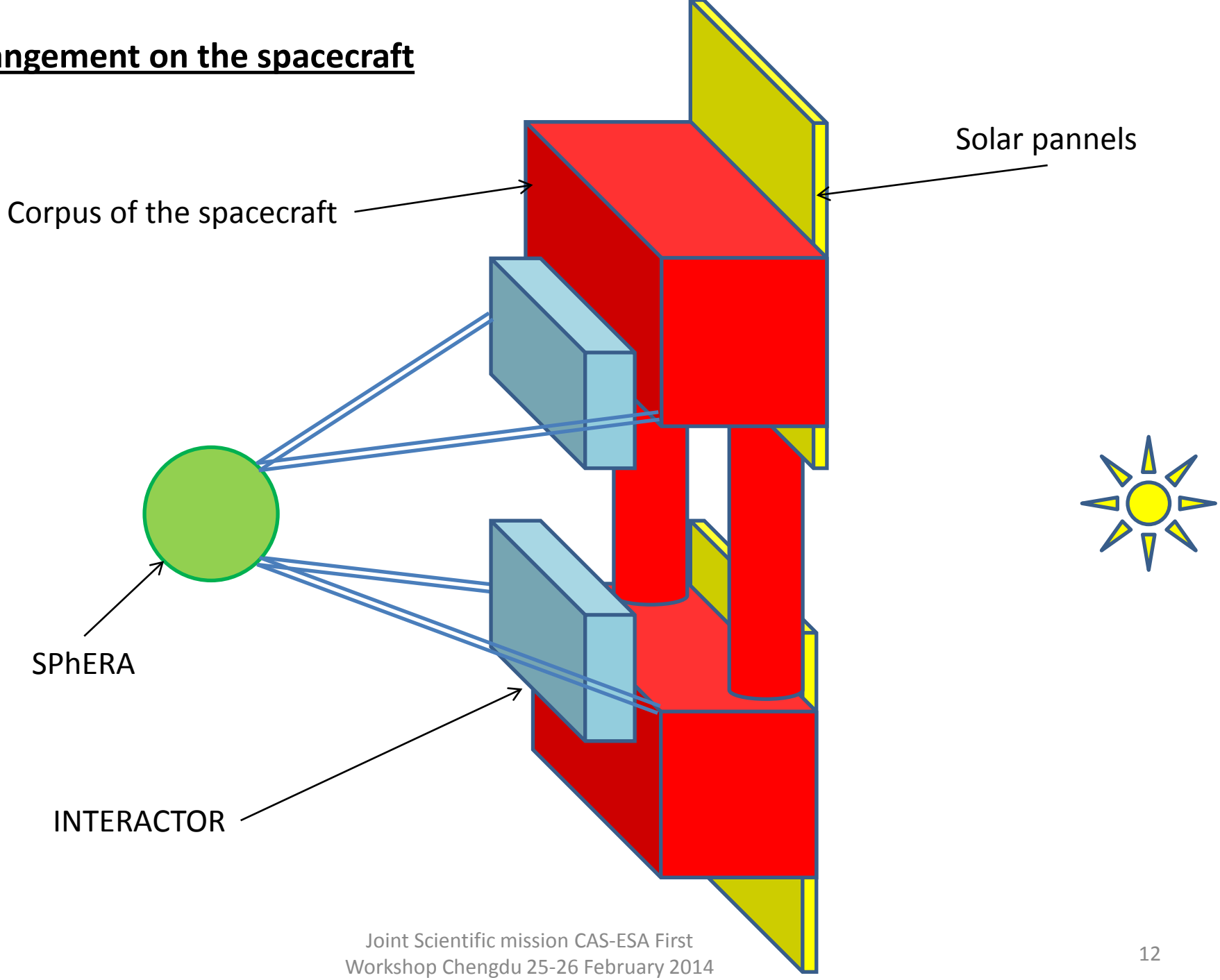
SIDE VIEW

FRONT VIEW

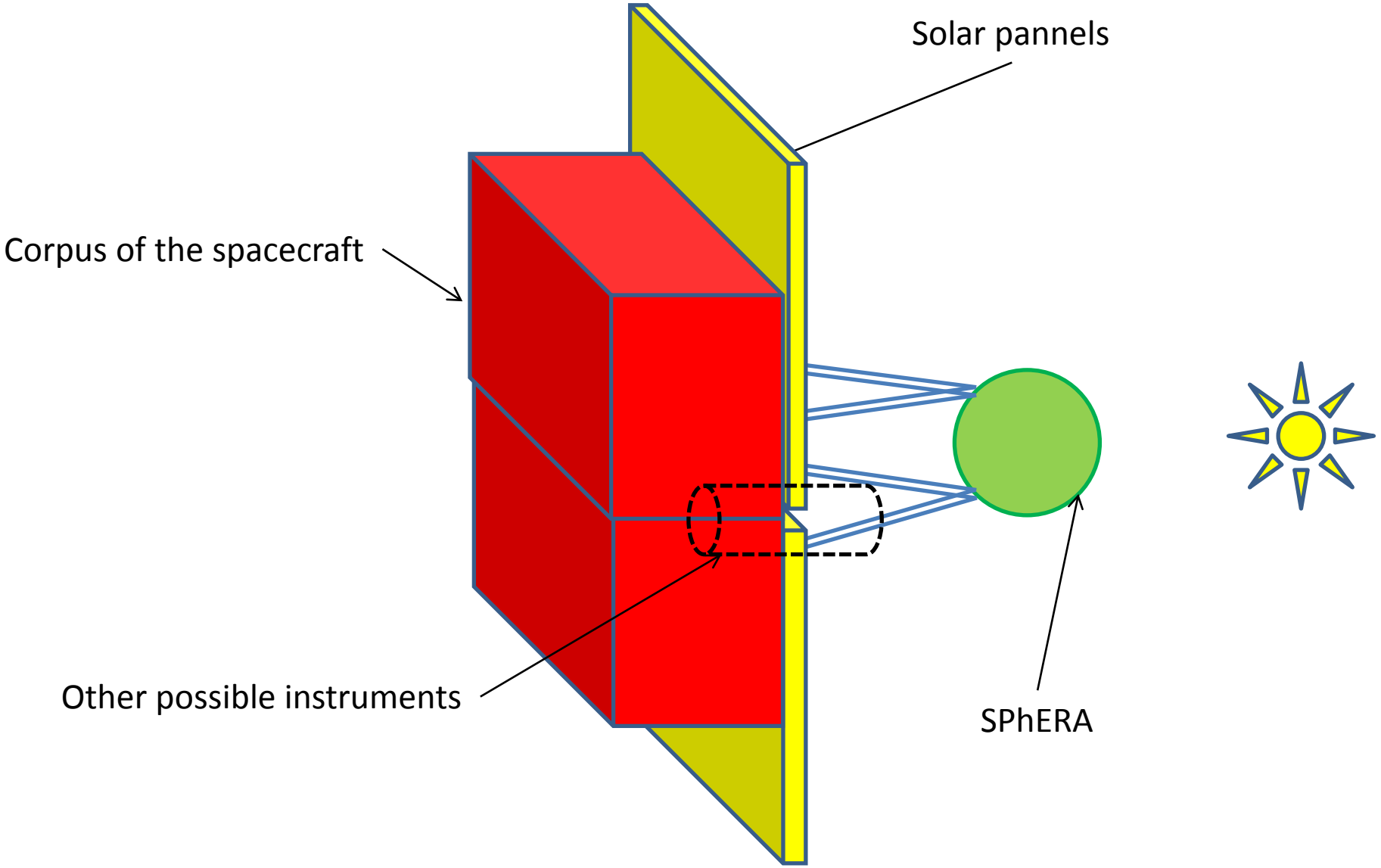
TOP VIEW
(on the ecliptic plane)



Arrangement on the spacecraft



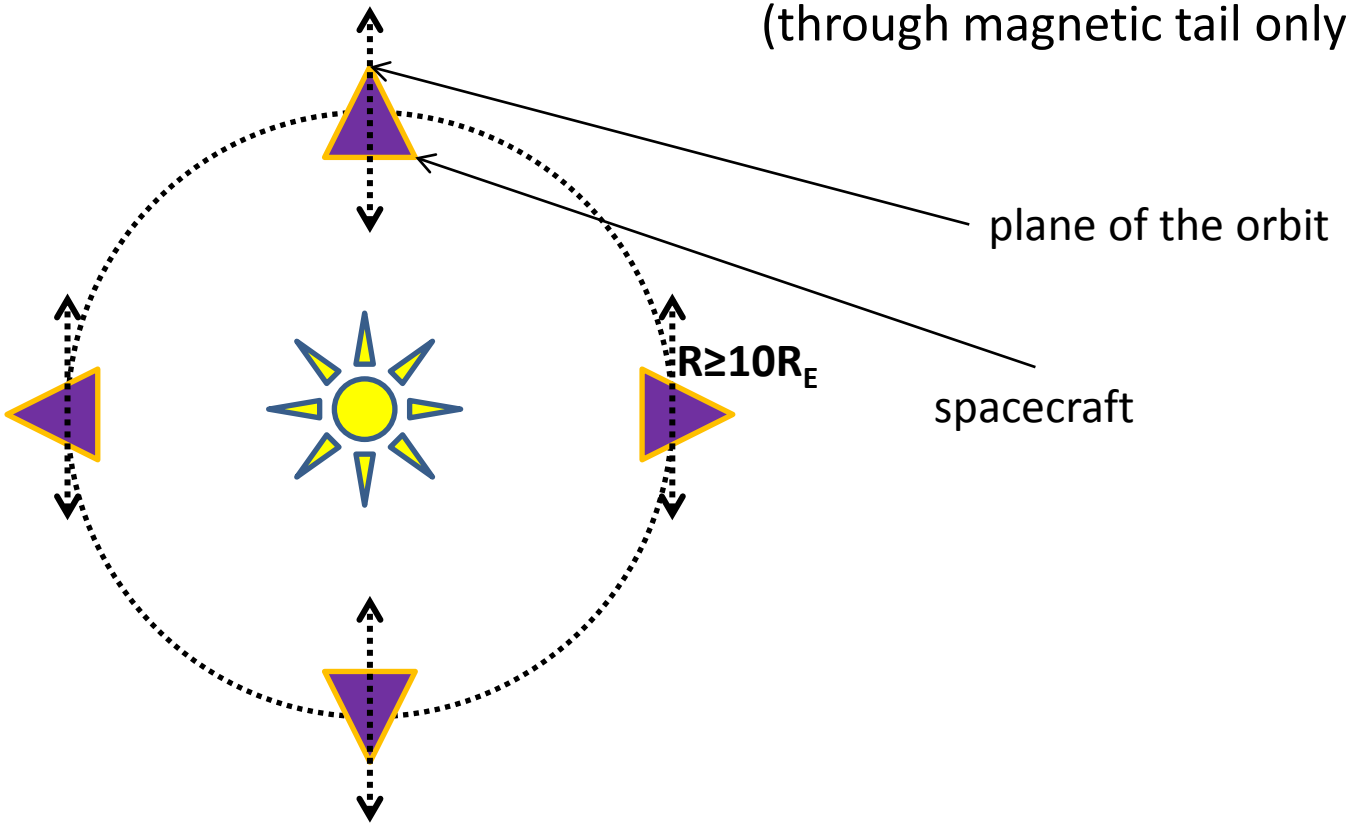
Arrangement on the spacecraft (without detection of neutrons)



Suggested locations in space

(a) – 'Sun soriented' spacecraft in very high Earth orbit

Very High Earth Orbit, plane fixed in space
'Looking to Sun' attitude of the spacecraft
Orbit fully outside the terrestrial magnetic field
(through magnetic tail only for few % of time)



preferred location in space

(b) -- Earth-Sun L1

Orbit around L1

Spacecraft attitude: looking to Sun

Time interval to alarm Earth: several minutes

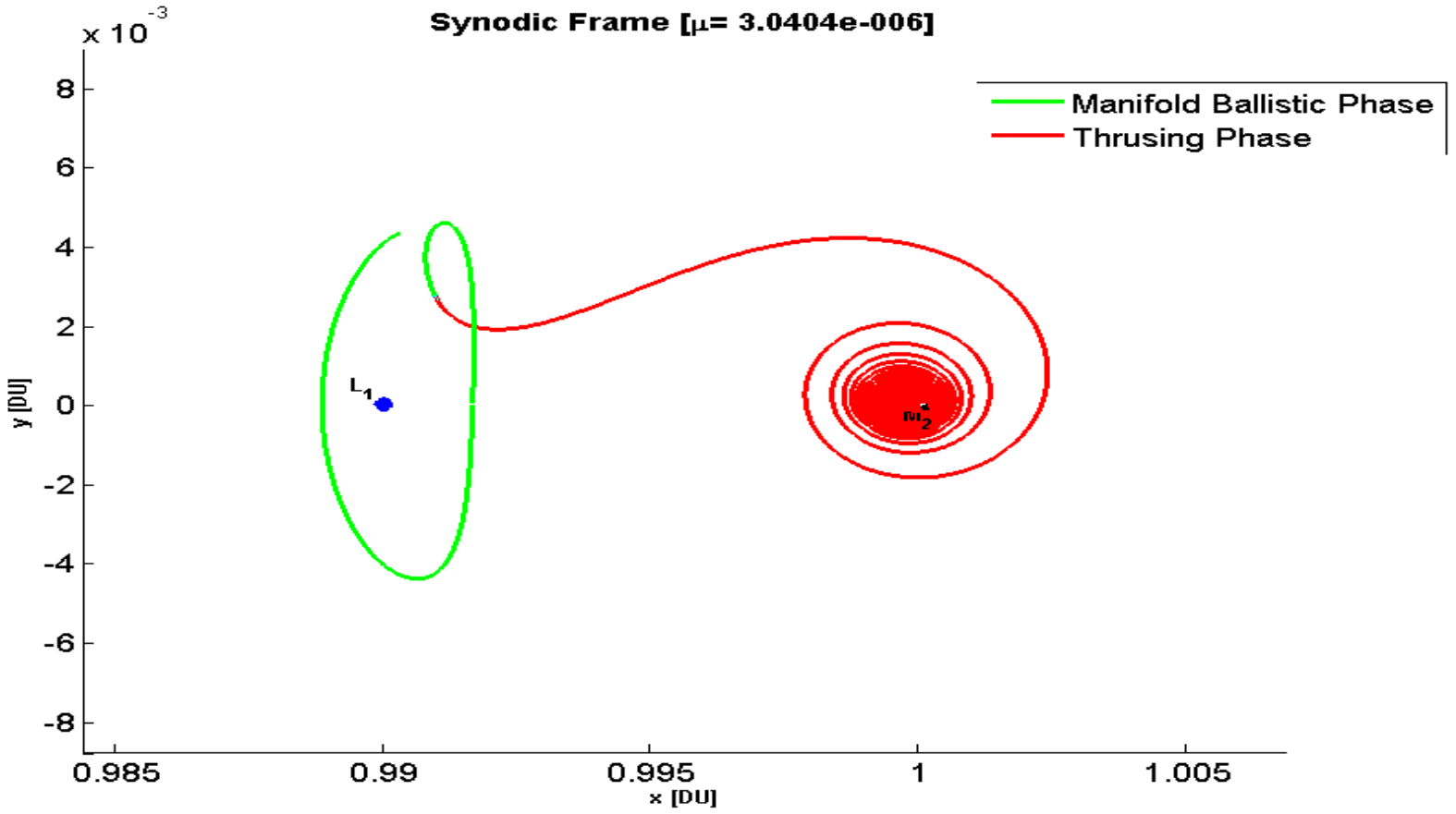
-- Chemical fuel: about 60% of the total mass!

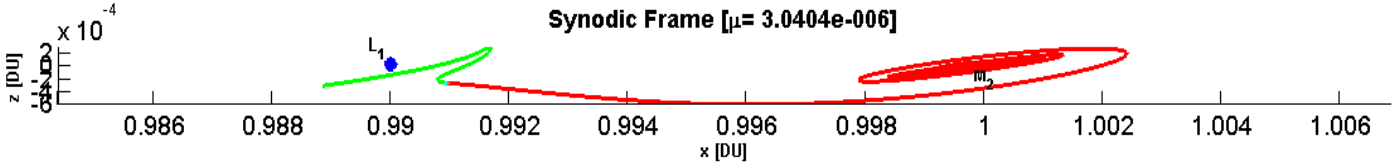
-- Ion thrusters:

fuel (Xe) 25% of the total mass

with one Hall effect Truster HT400 (ALTA-Space)

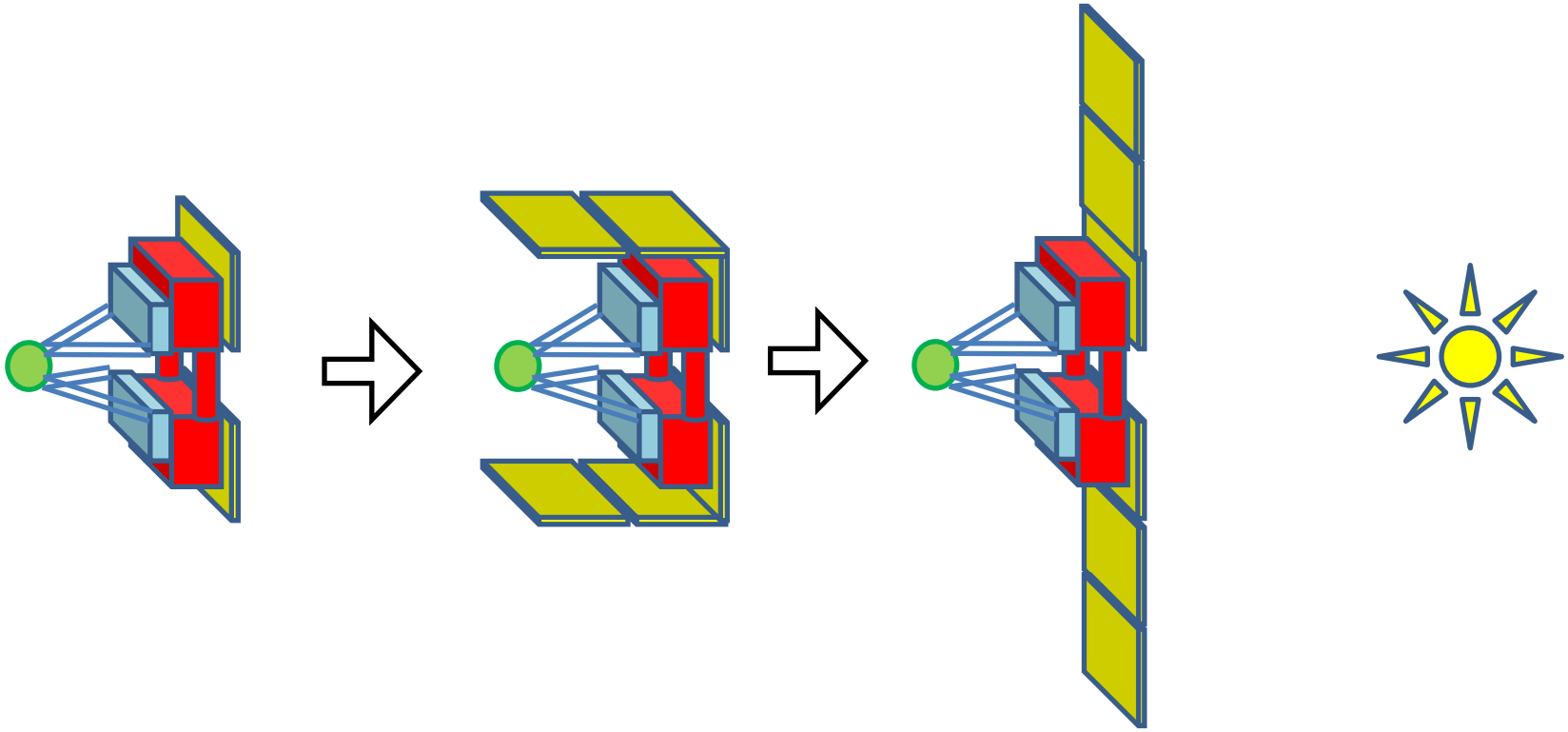
→ spiraling + ballistic insertion (10+7 months)





for each HT400 thruster needed 500W

→ several m^2 of solar pannels



Thanks for the attention