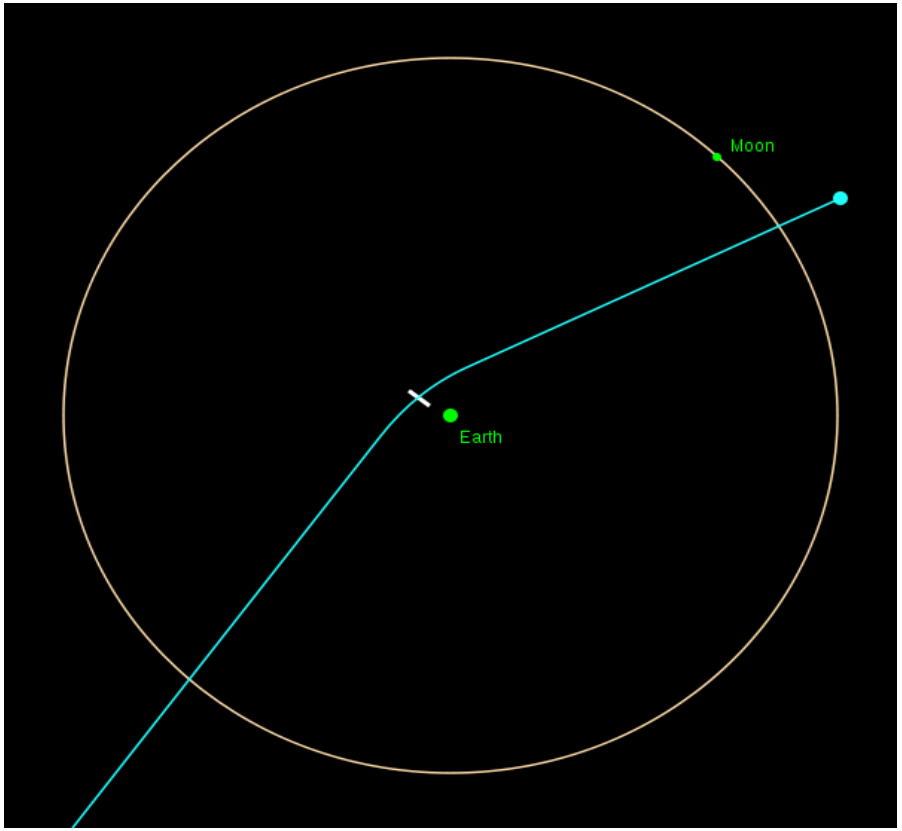
APOPHIS Express

A UNIQUE OPPORTUNITY FOR VISITING APOPHIS IN 2029



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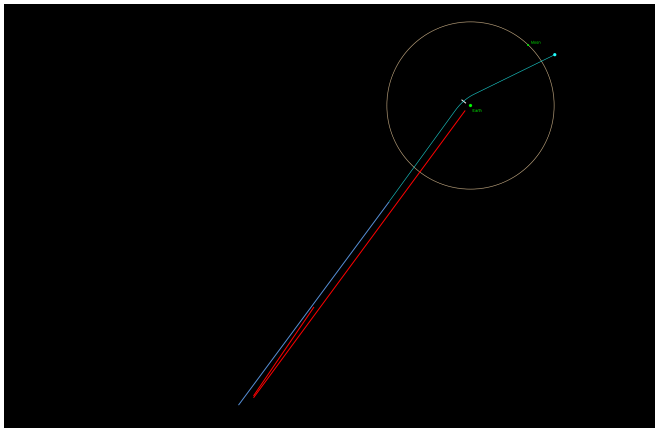
APOPHIS Express Outline

. Interception and rendez-vous with APOPHIS on its incoming leg, a few days before its flyby

. Launch in March 2029 on a highly eccentric orbit with an apogee between 1 and 2 Million kilometers



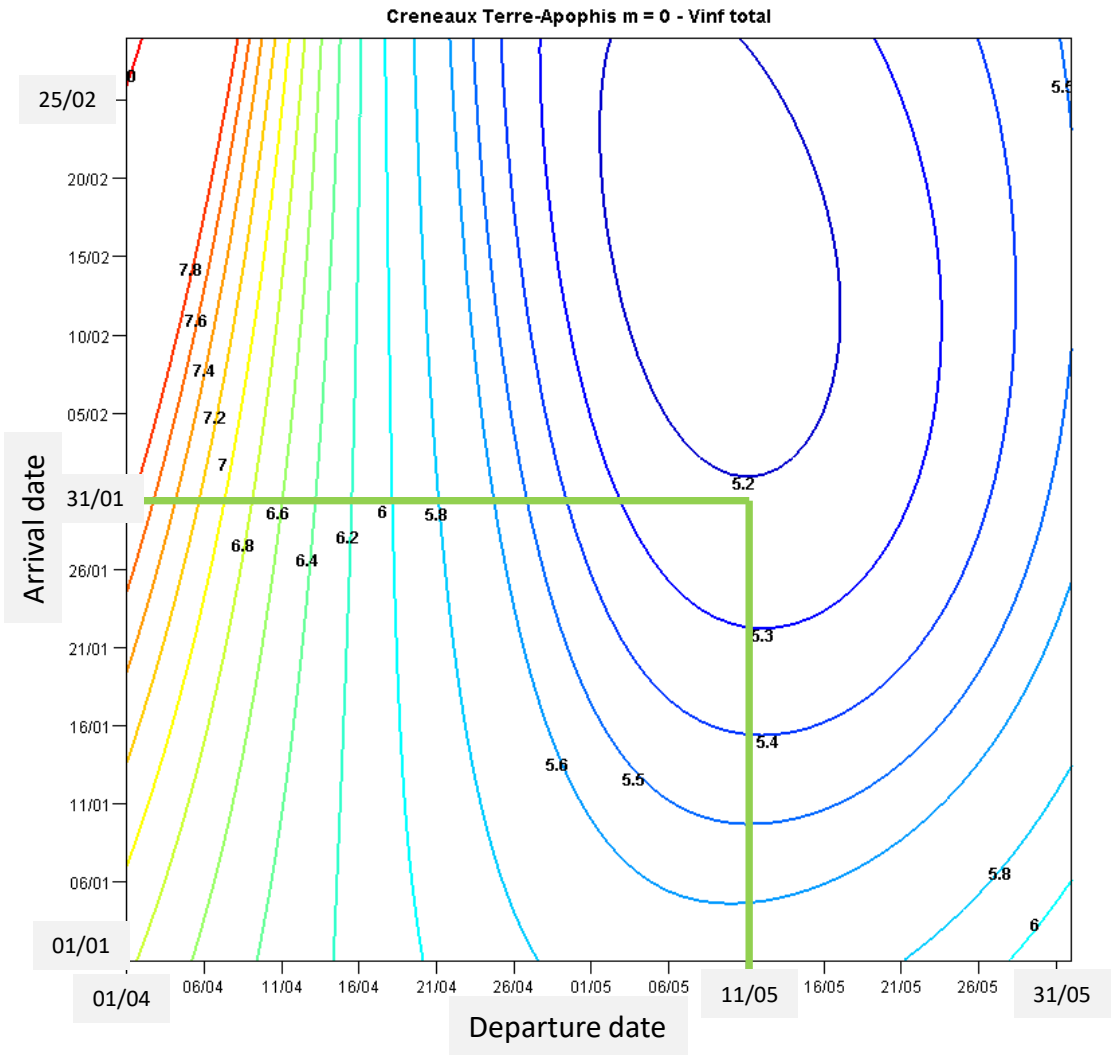
. Delivery of a set of modules for

- rendez-vous with APOPHIS (Apogee Kick Module)
- close navigation, observation and command of the other modules (Service Module)
- APOPHIS orbiter
- lander
- Return Capsule

. Main mission advantages:

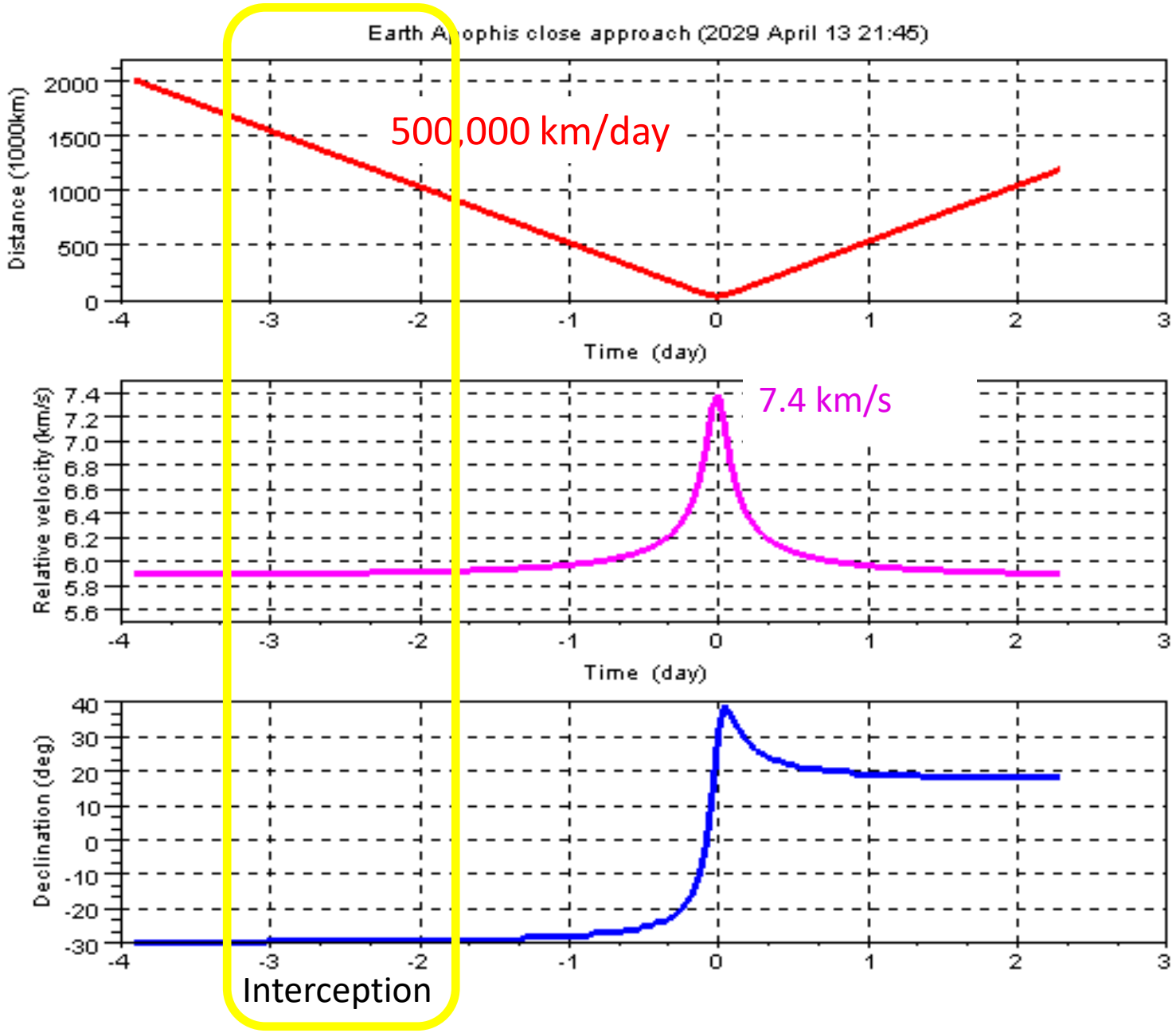
- short duration
- late departure
- system requirements similar to Sun-Earth L1/L2 missions instead of interplanetary missions

Standard Mission Scenario

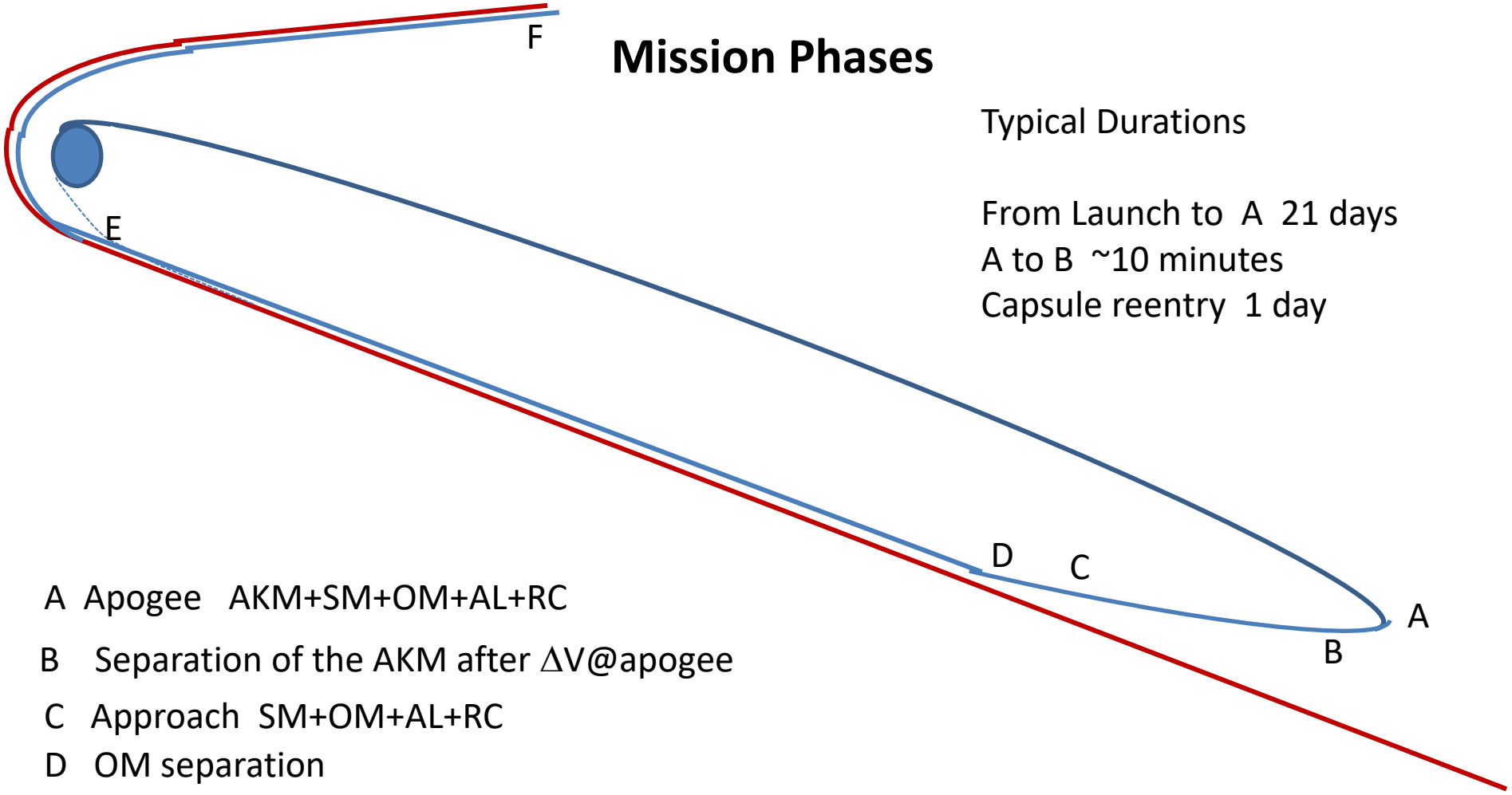


- Launch in May 2028 at the latest (V_{inf}<3.7 Km/s)
- Arrival on APOPHIS in February 2029 (V_{inf}<1.6 km/s)
- Total ΔV <5.2 km/s
- 2 months for precursor activities before the close pass

Proposed Scenario



Mission Phases



Typical Durations

From Launch to A 21 days
A to B ~10 minutes
Capsule reentry 1 day

A Apogee AKM+SM+OM+AL+RC

B Separation of the AKM after ΔV@apogee

C Approach SM+OM+AL+RC

D OM separation

E AL (+RC) separation

F Mission end

APOPHIS trajectory

Launch Options (based on publically available data)

Launcher	Delivery capacity @ 1 Mkm	Gross mass after AKM separation	Estimated allocation (2) for instrumentation
Soyuz-Fregat	2000kg	296kg	56kg
AR 62	2500	320	60
AR5 ECA	6200	920	174
AR64	7500	1060	201
AR64-VINCI (1)	7500	1370	260

All masses in kg

(1) AKM Specific Impulse 435s except for AR64-VINCI (465s)

(2) Based on HERA mass budget (19% of the total mass available for the scientific P/L

ref https://www.cosmos.esa.int/documents/336356/1601091/SMPAG_HERA_Carnelli.pdf/f8d427cf-5ec7-95c0-1265-3fe95f89d880

Conclusions

The short duration and short distance of the systems have positive effects on operation costs

Late launch has positive impact on the decision making process

It can benefit from other space missions and ground observations

Large public interest expected due to the fast sequence of events in the last 2 days before the flyby

Scientific objectives, payload and modules to be defined in coherence with the expected other missions (SMPAG?) and in adequation with the selected launcher