

Euclid Needs

for Space and Ground Segments

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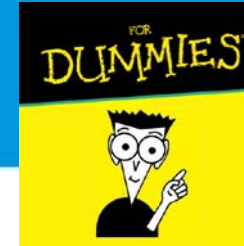
- Euclid is a telescope
- Investigates two mysterious elements shaping the universe
- The information will have a profound effect on the physics models and law, as general relativity
- These two mysterious elements got mysterious names

DARK Matter

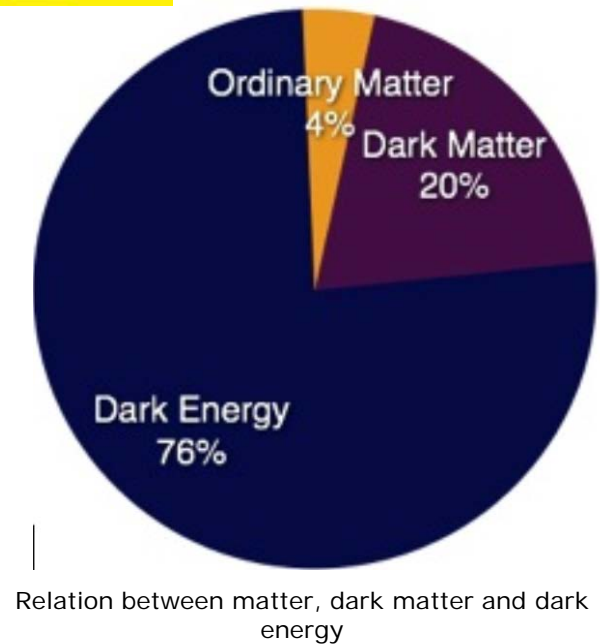
DARK Energy

Bit more of details

Cosmology for dummies



- The **concordance** model is a cosmological model based on general relativity
- It explains well many strange aspects of the universe:
 - How the light elements have been formed
 - The uniformity of the background radiation v.s. the dis-uniformity of the universe
 - The observation that the expansion of the universe accelerated few billions years ago.
- The model includes a **inert matter that generate gravity** but that does interact in any other way with the rest of the matter
- The model includes a **repulsive force** causing the accelerated expansion of the universe.



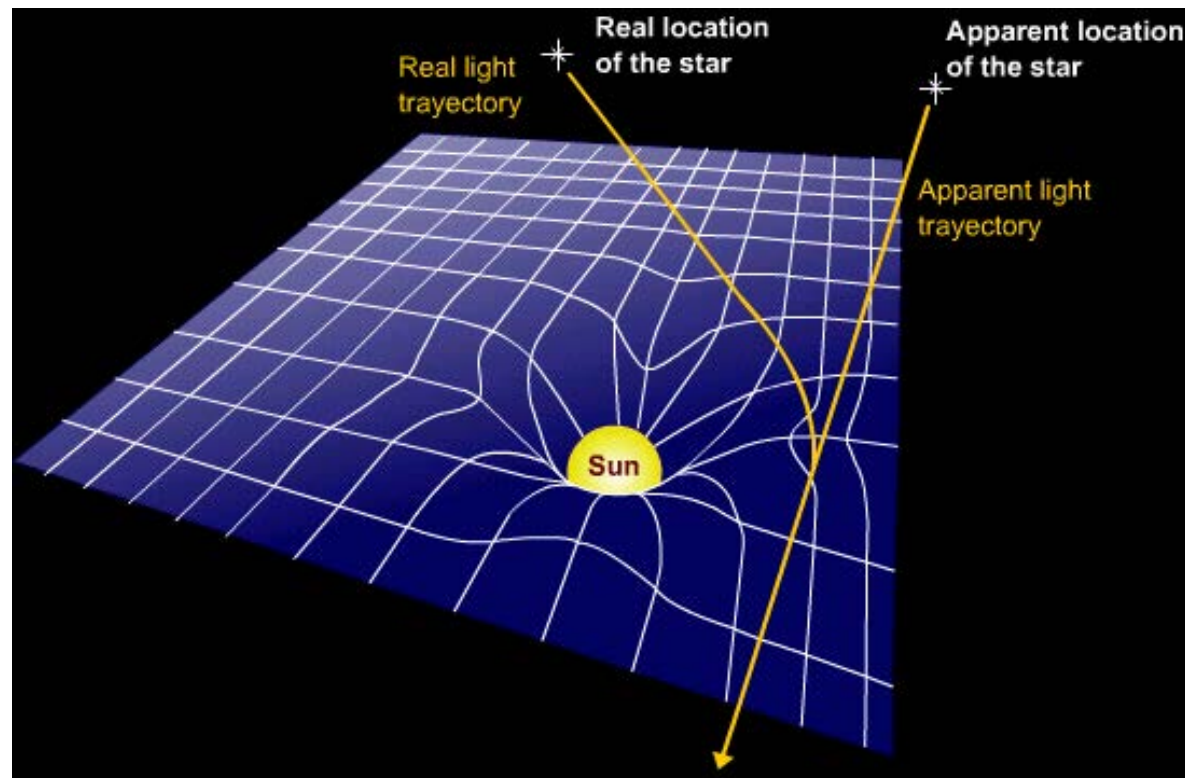
The universe is made for 96% of something we do not know what it is and how it works

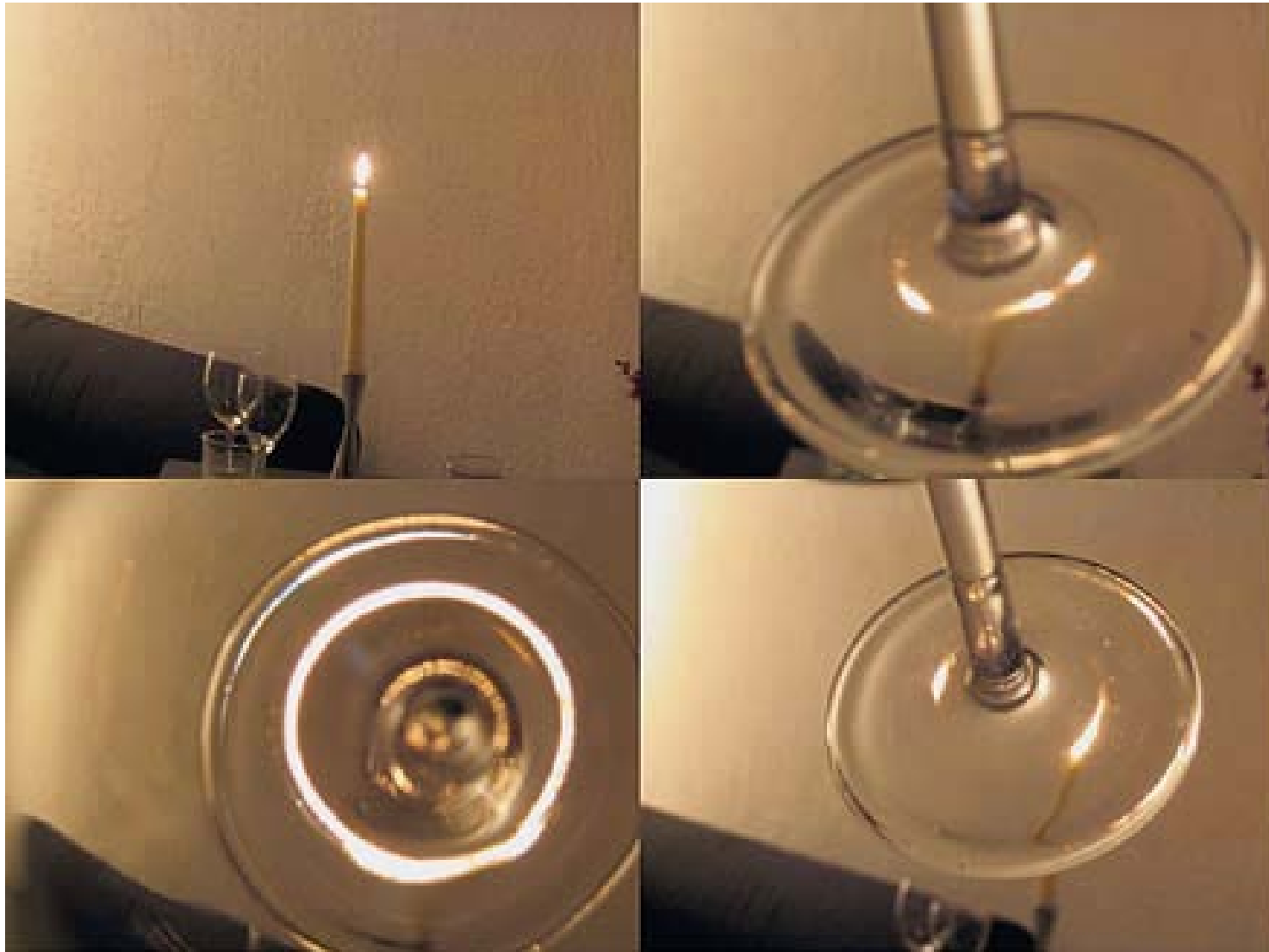
Weak Lensing

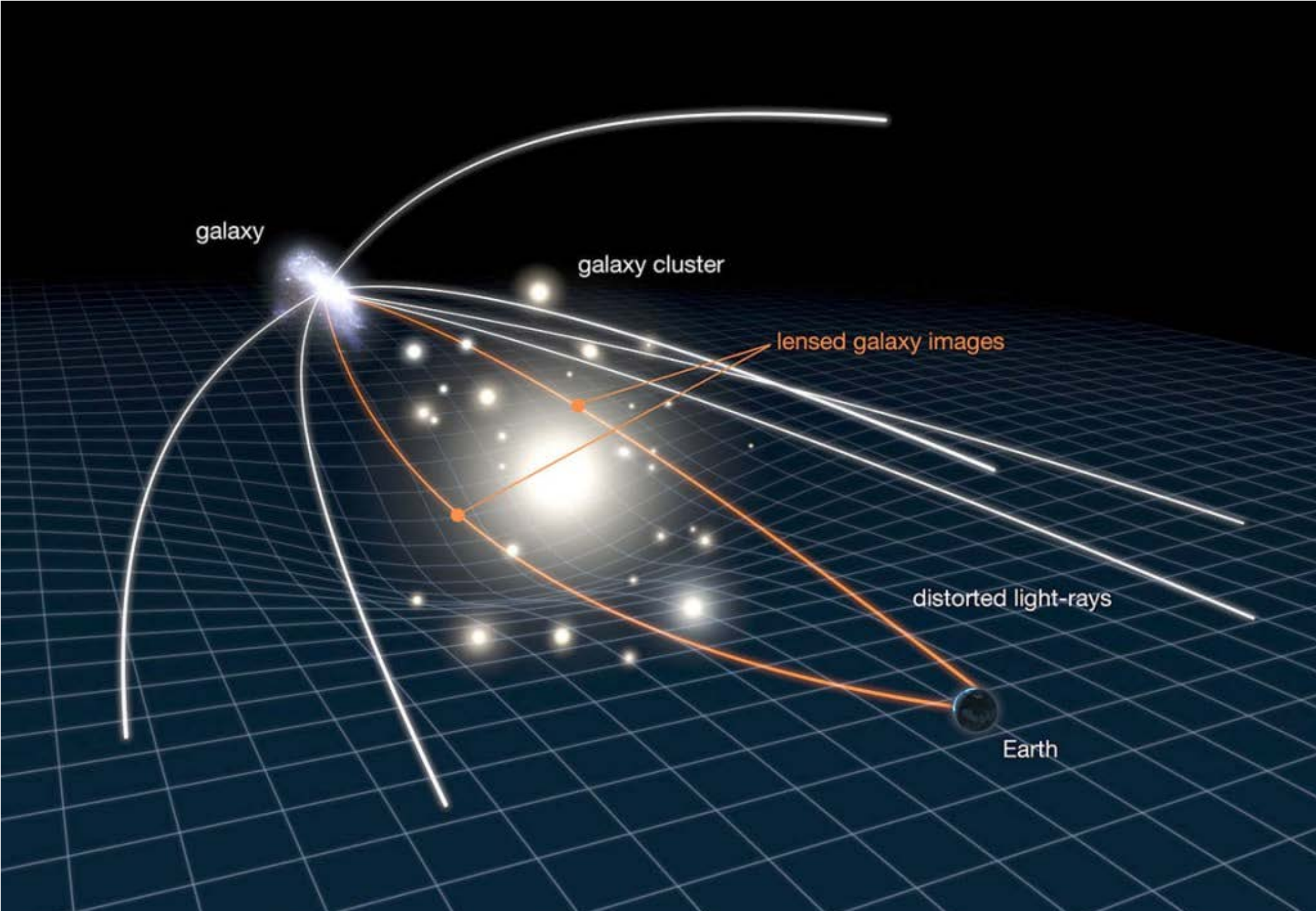
Image distortion caused by
Dark matter

Baryonic Acoustic Oscillations

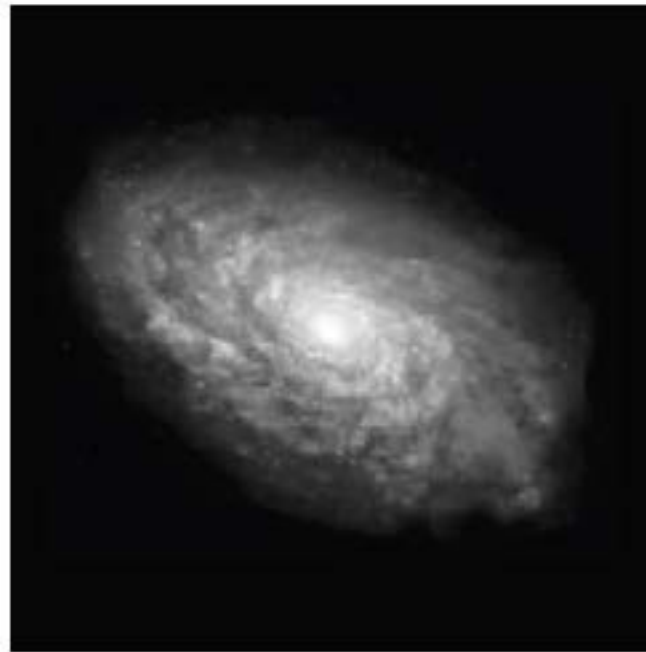
How matter and galaxies cluster
Together compared to CMB





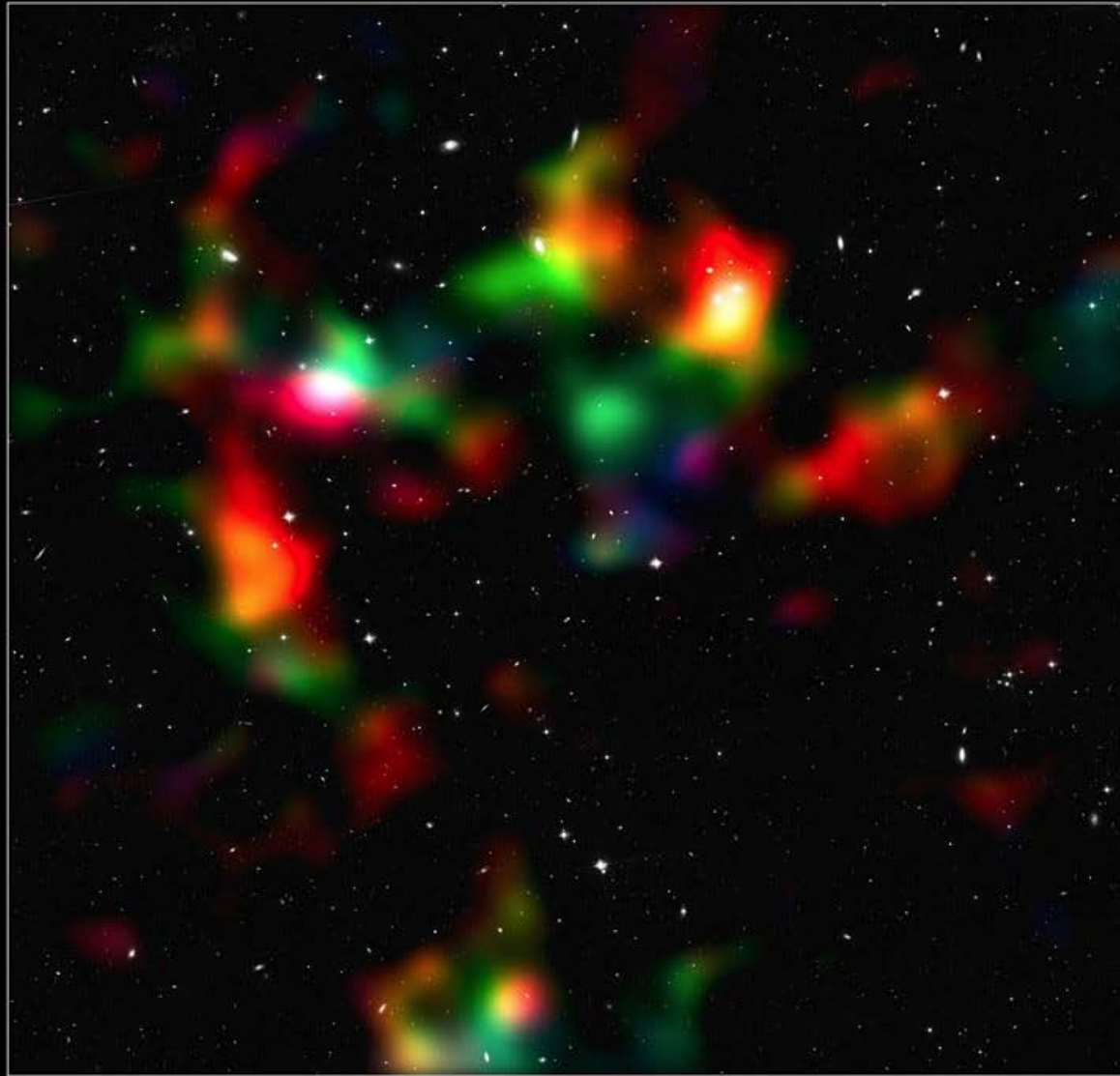






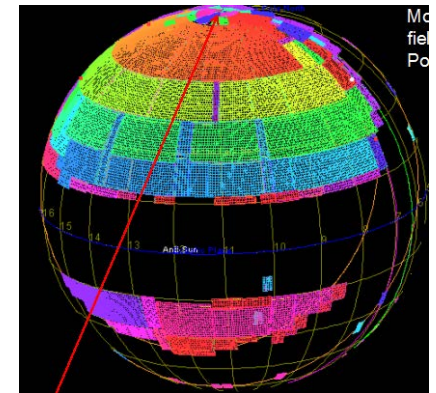
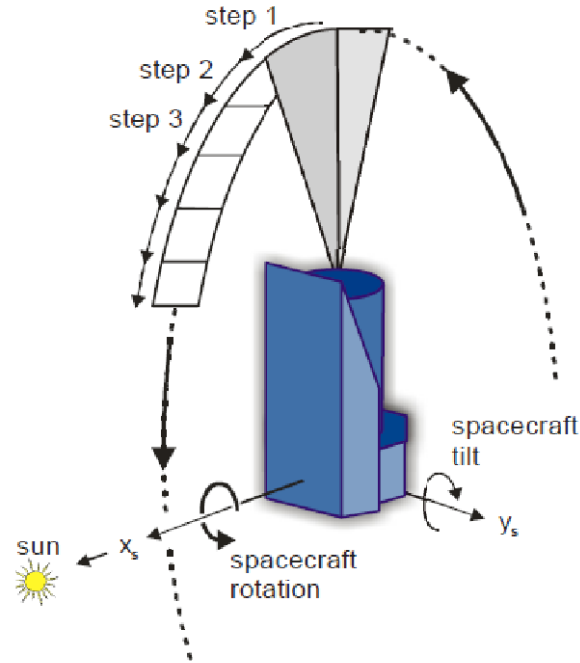
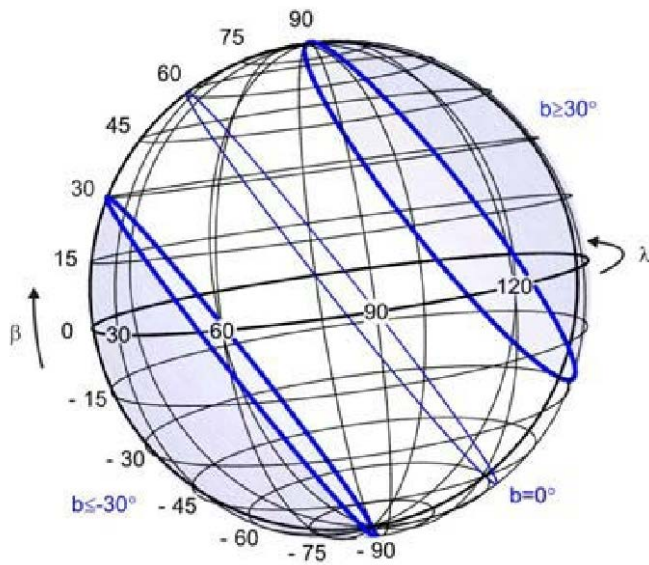
Dark Matter

HEIC 1005

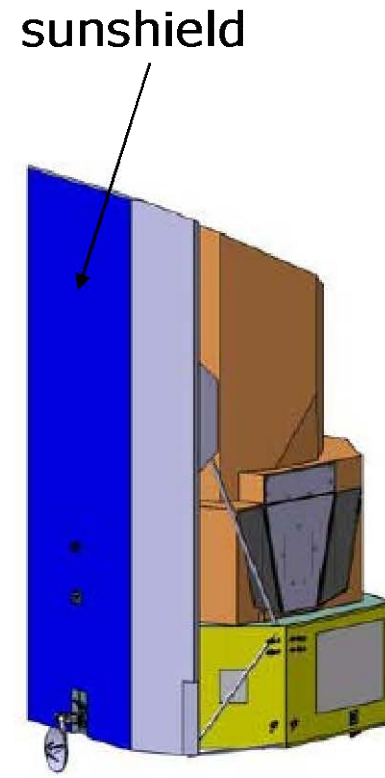
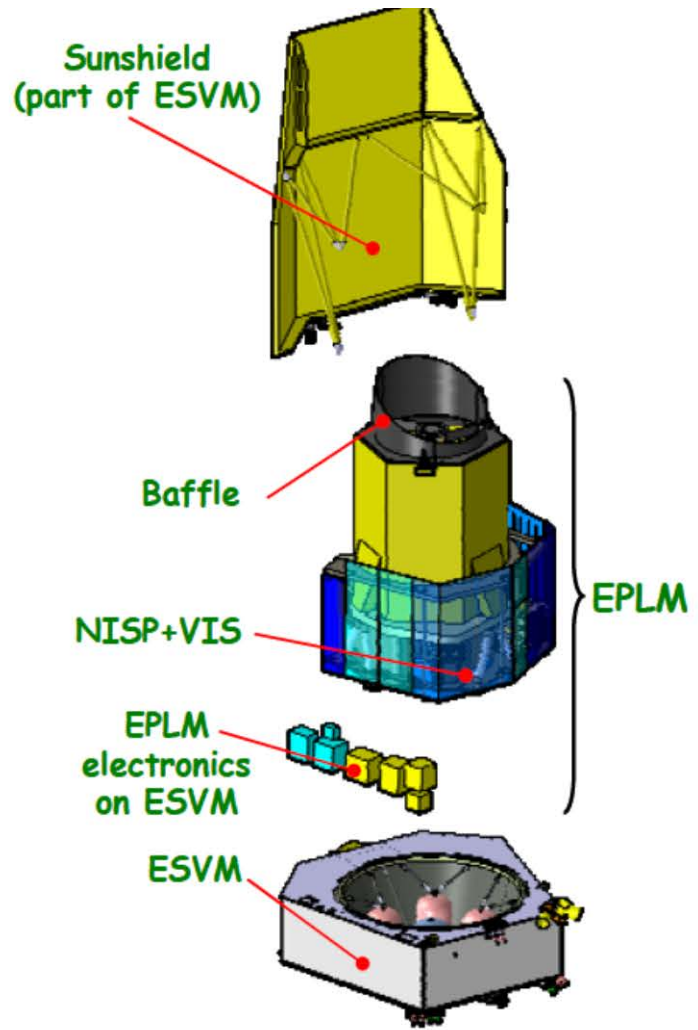
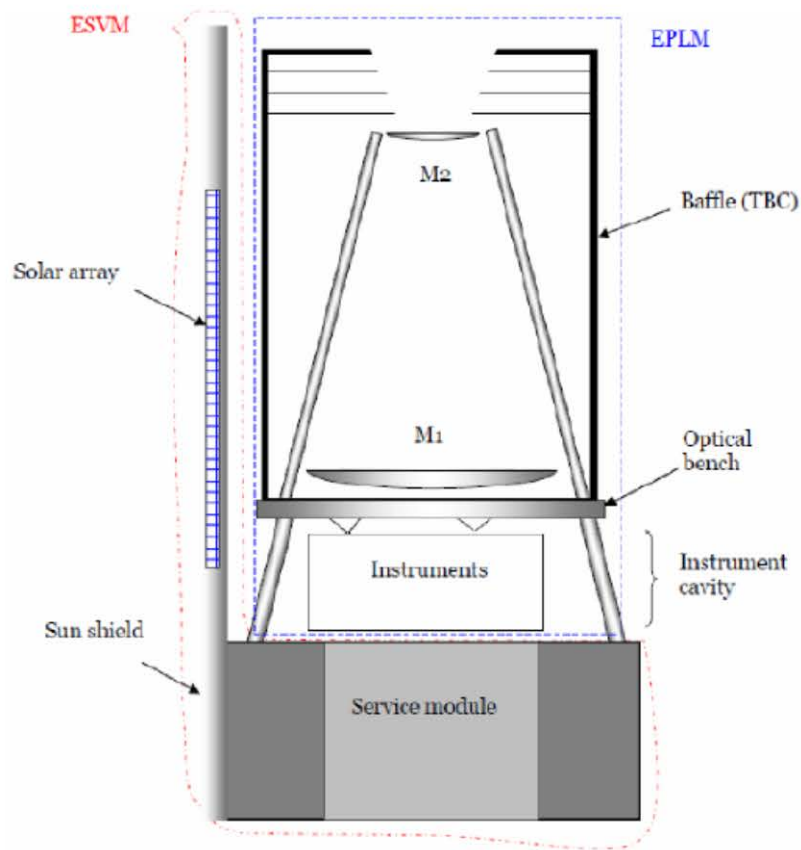


**ACS /
ground-based**

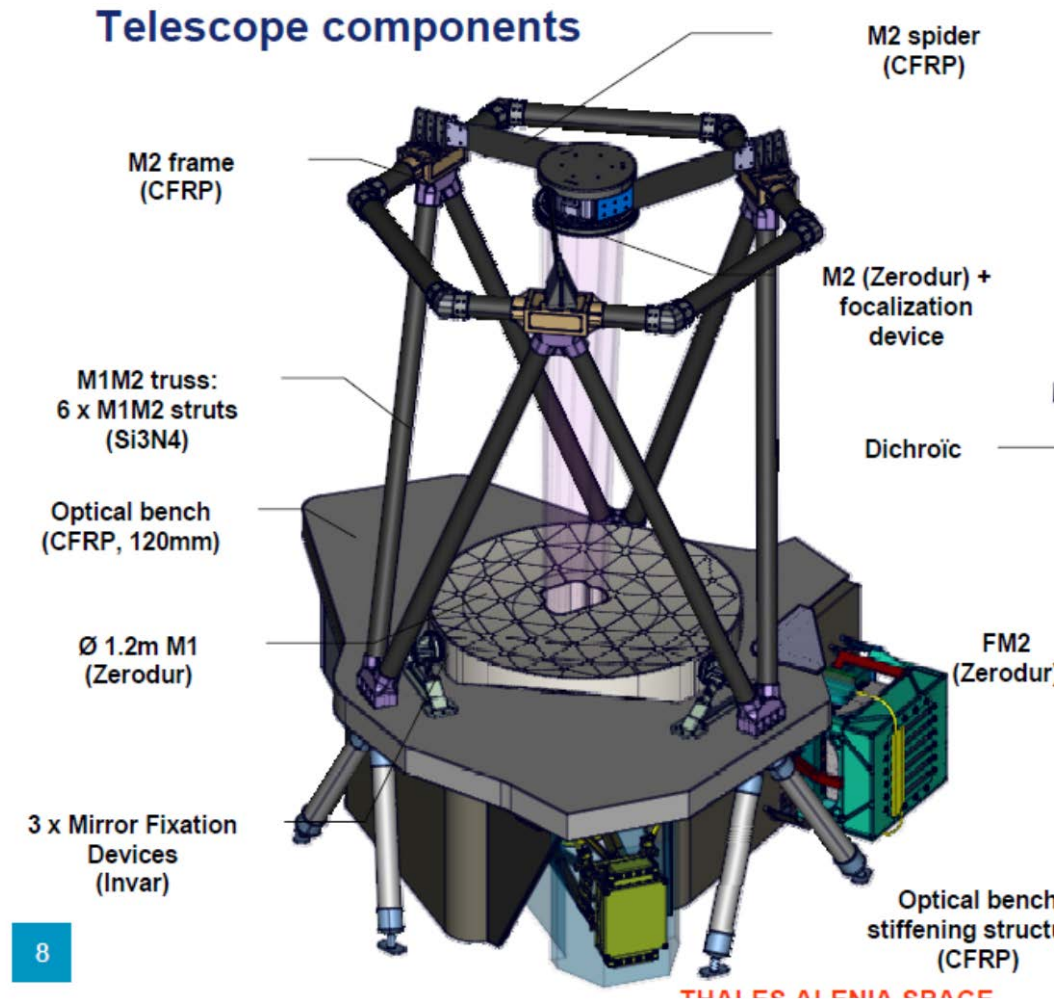
- Euclid is fundamentally a very accurate telescope capable of taking images of galaxy and galaxies cluster in the visible and near infra-red portion of the spectra
- It will survey most of the portion of the sky not obscured by our galaxy star, taking accurate images of all galaxies for 6 years
- Euclid will take images of 1.5 billion galaxies
- Spectroscopy of 50 million galaxies



Spacecraft overview



European Space Agency



- The survey area is divided in small tiles of 0.54 deg^2
- A total of 15.000 deg^2 need to be surveyed
- Euclid takes 4 images for each tile, each of them slightly shifted
- For each tile Euclid takes

- 4 Visible images
- 4x3 Infrared images
- 4 spectra



428 Gbit/day



216 Gbit/day

+ Margin

850 Gbit/day



Equivalent to 10 DVD
discs every day



- Euclid can operate without ground contact for up to 3 days

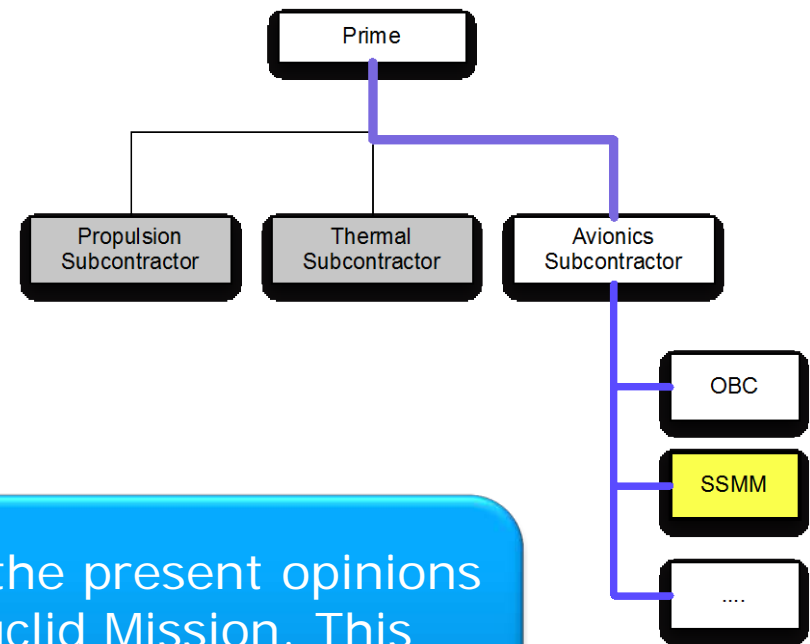
2.5 Tera bit storage on board

- Every 24 hrs ground download the scientific data for a total 3.5 hours to download

75 Mbps downlink

- The whole mission concept rely on the mass memory. The data volume and traffic makes impractical any other architecture
- Mass Memory reliability reflects directly onto the mission reliability

- The function and capabilities of the SSMM for Euclid can not be specified
- There are two layers of contract between ESA and the contractor
- It is discussed at the moment up to which level we have to express detailed wishes from ESA
- Architecture can be quite impacted from the ESA approach, therefore we act carefully



The content of this presentation reflect the present opinions and discussions within ESA for the Euclid Mission. This presentation is not a specification and it shall not be taken as reference for the future Euclid Requirements

- The large amount of data requires the organization into **files**
- The RF link in K band is subject to high interferences, in particular water in rain drops can seriously affect the link
- We will have intermittent transmission in bad weather, and we need a mechanism for **retransmission**
- CFDP the accepted standard for reliable file transmission, ESA and the European industry have developed sufficient know-how in the past years.
- **CCSDS CFDP** is therefore selected as the Euclid standard for file transmission.

➤ SSMM capabilities

- Store in files unformatted data
 - the data stream of the instruments (On-Board)
 - The data stream from ground
 - OBCP
 - SW Images
 - SW Patches
 - TC Files
- A file system is maintained (flat or hierarchical)
- Minimal Set of Commands
 - Open/Close/Read/Write Files
 - Delete/Rename Files
 - Initiate/Pause/Stop transmissio
 - Create/Delete Directories (Optional)
- Handle contemporary transmission of 2 files
- Handle both files and packet stores (Optional)

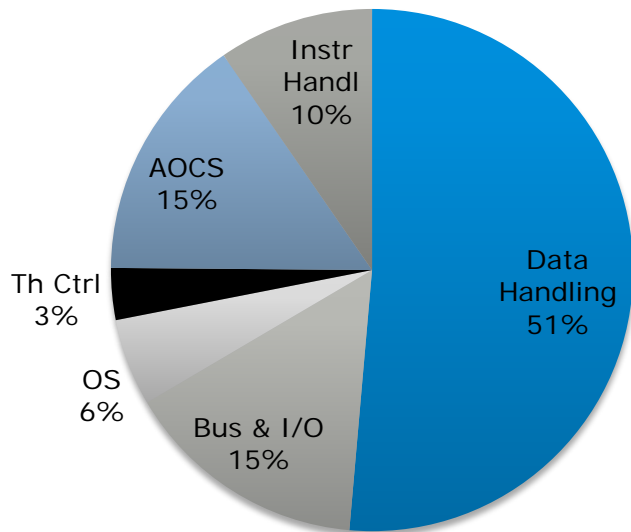
➤ CFDP capability

- Class II downlink
- Class I uplink (OPTIONAL)
- Deferred NAK

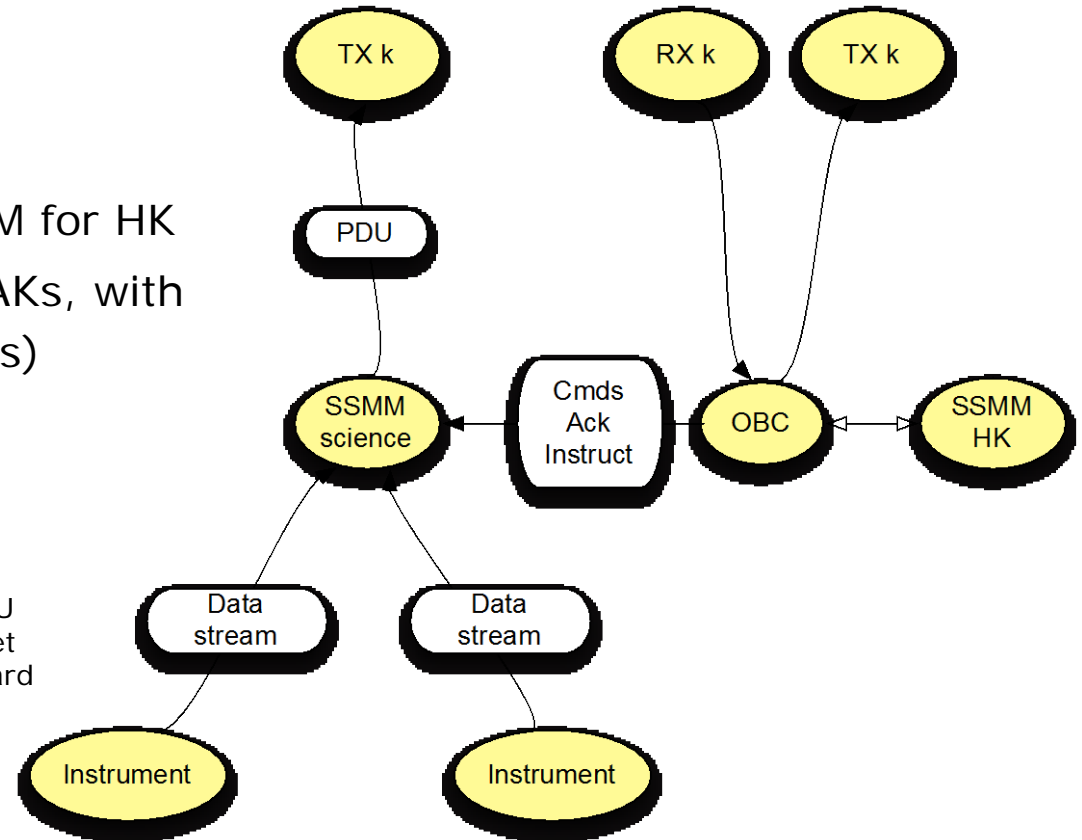
Conceptual View

Moderate SSMM capabilities

- Moderate SSMM capabilities
 - All TC traffic goes to OBC
 - OBC configure the SSMM
 - OBC redirect NAKs to SSMM
 - OBC has a separate internal SSMM for HK
- Increase OBC load depending from NAKs, with no added value (OBC just shuffle NAKs)

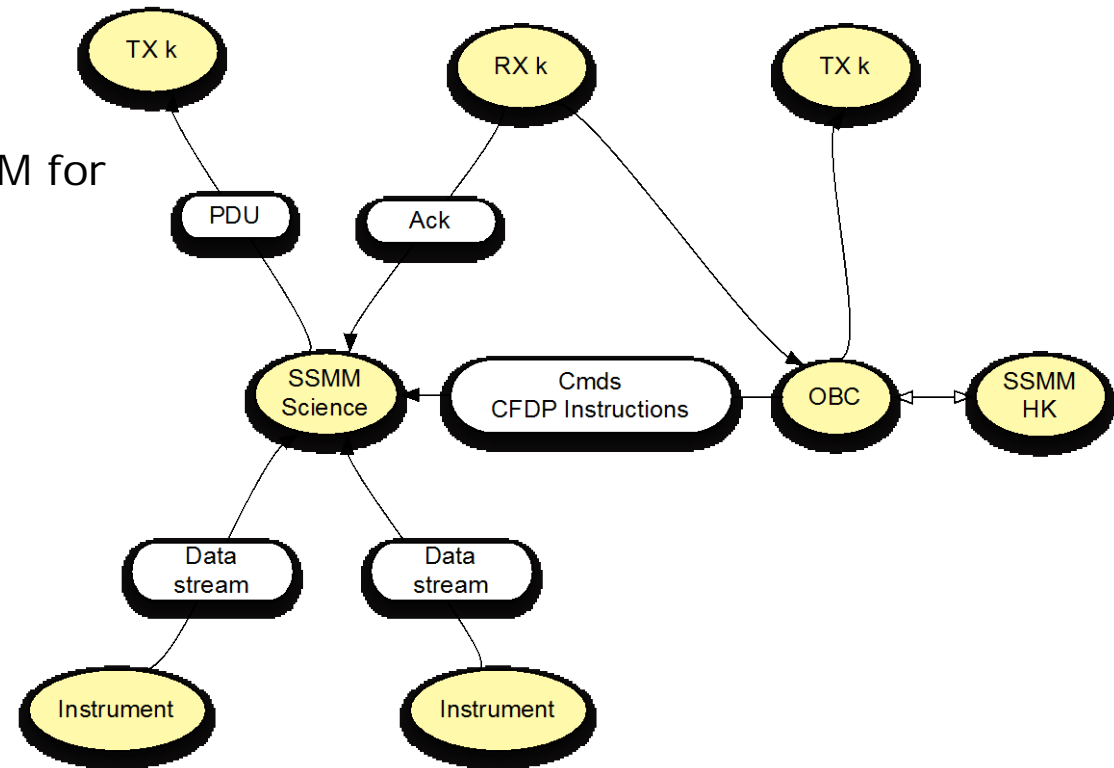


Typical CPU load budget for On-Board Computer



Conceptual View Improved SSMM

- Improved SSMM capabilities
 - SSMM receives TCs addressed to it and handle NAK directly
 - OBC configure the SSMM
 - OBC has a separate internal SSMM for HK
- OBC load is decreased



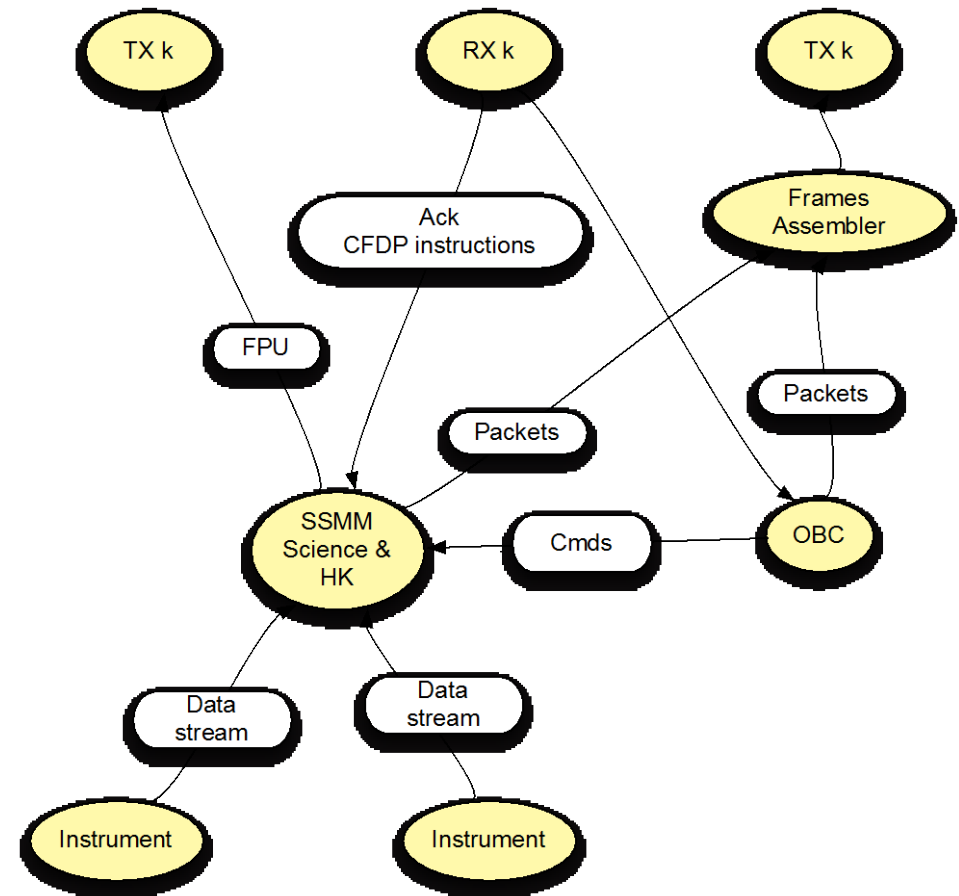
➤ Premium SSMM

- SSMM receive file transfer commands directly from ground
- SSMM store HK from the OBC and transmit them upon request to a different output
- OBC open and close files, synchronizing instruments with platform operations and write HK

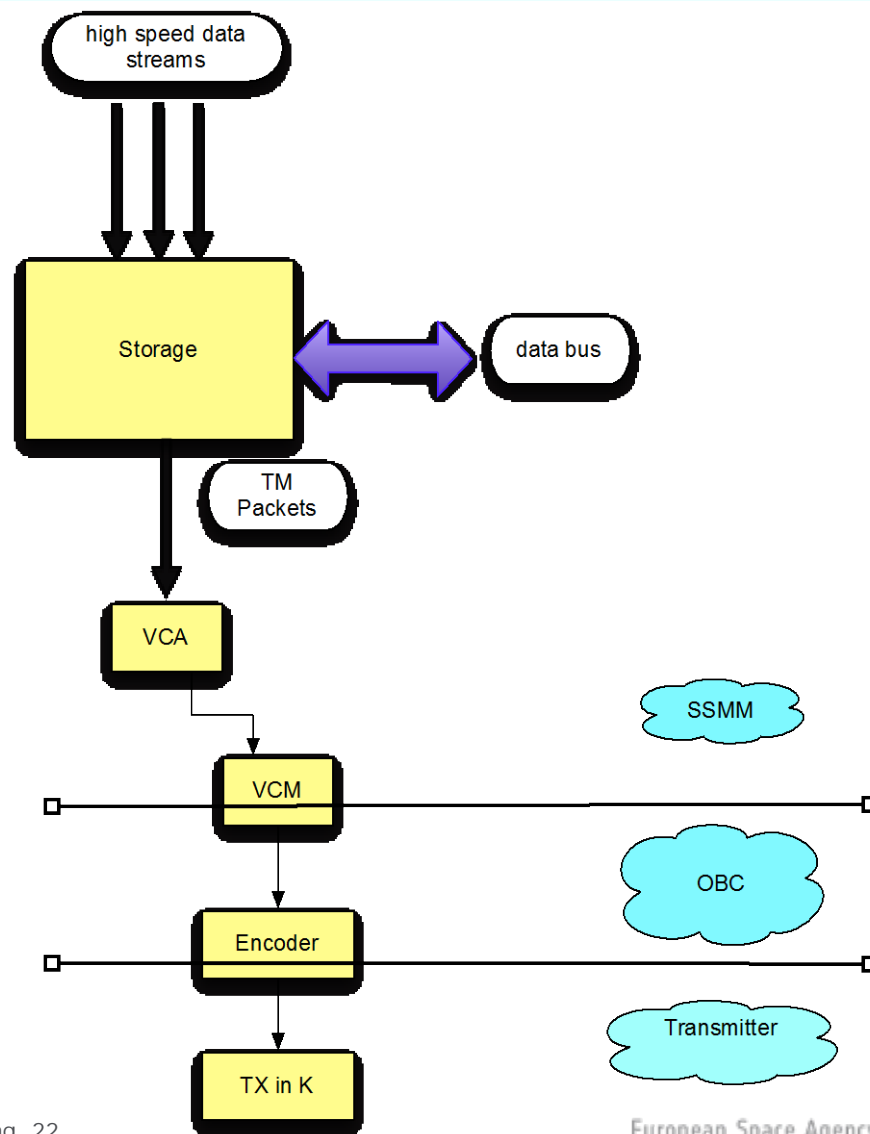
➤ Minimal involvement of OBC, good for CPU and SW costs

➤ SSMM becomes a neat self-standing unit with the complete file managing and HK

➤ SSMM gets even more complicated ☹



➤ Allocation of functionalities is to be determined





Launch 2020



- SSMM function can be extended to fit the paradigm of hard disk
- All TM could go directly into the SSMM
- OBC boots a minimal capability SW and load the executable image from MM
- Several images can be stored onto the SSMM and ground can select which should be used
 - Different part of the mission with different SWs (very attractive)
- Tasks images can be stored into the mass memory and executed on needs
- More extensive usage of scripting languages (OBCP on steroids)

