

# THE UNIVERSE EXPLORED BY HERSCHEL – WELCOME

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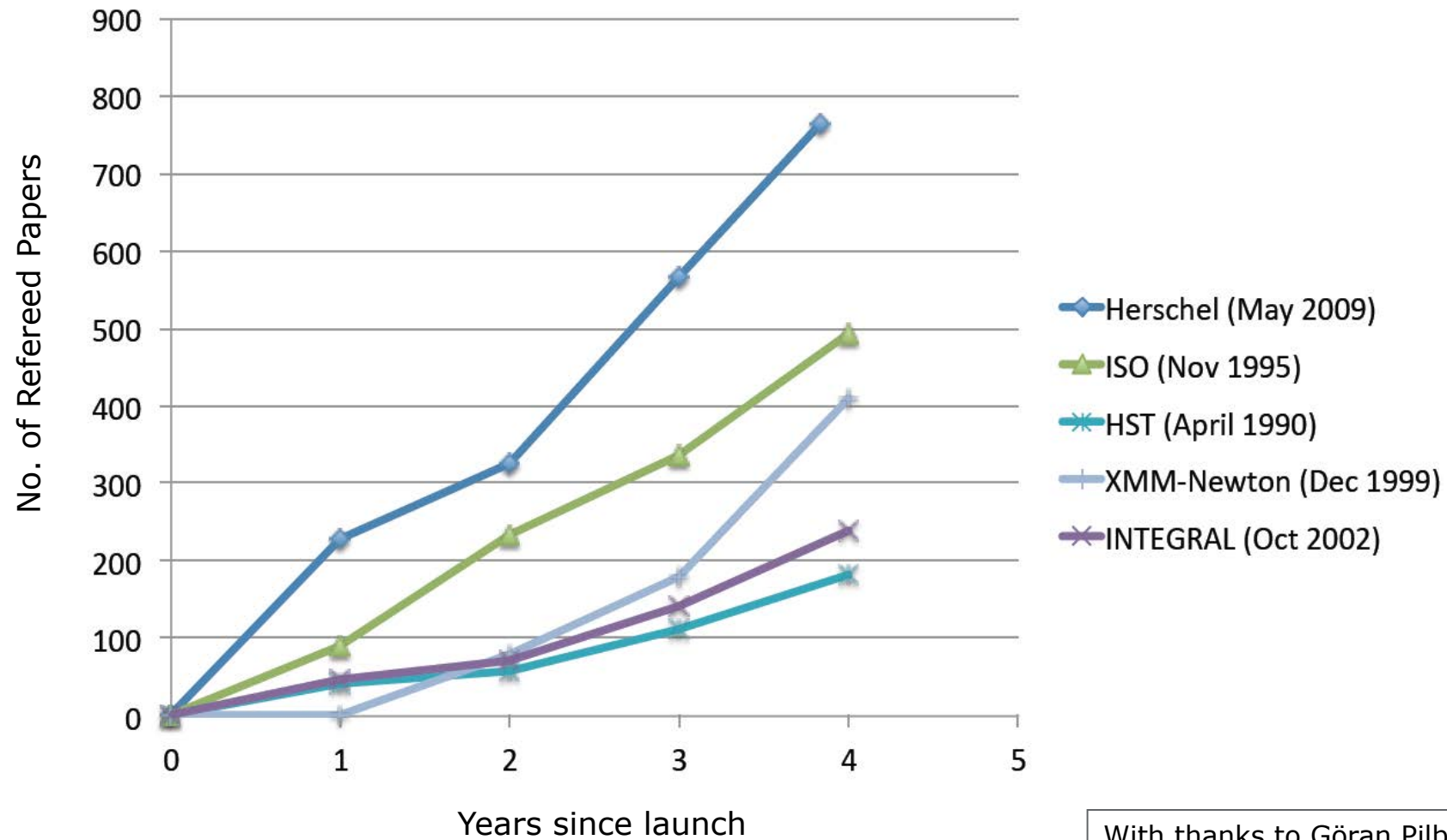
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- On behalf of D/SRE, welcome to four very full days of intensive scientific presentations, discussion and debate!
- 102 talks, around 200 posters covering 5 broad science themes. >350 attendees!
- Reflects the high scientific interest in the mission and the quality of the science coming from Herschel.
- Herschel is already one of the most successful ESA Science Mission with almost 800 refereed papers.

# SCIENCE PRODUCTIVITY

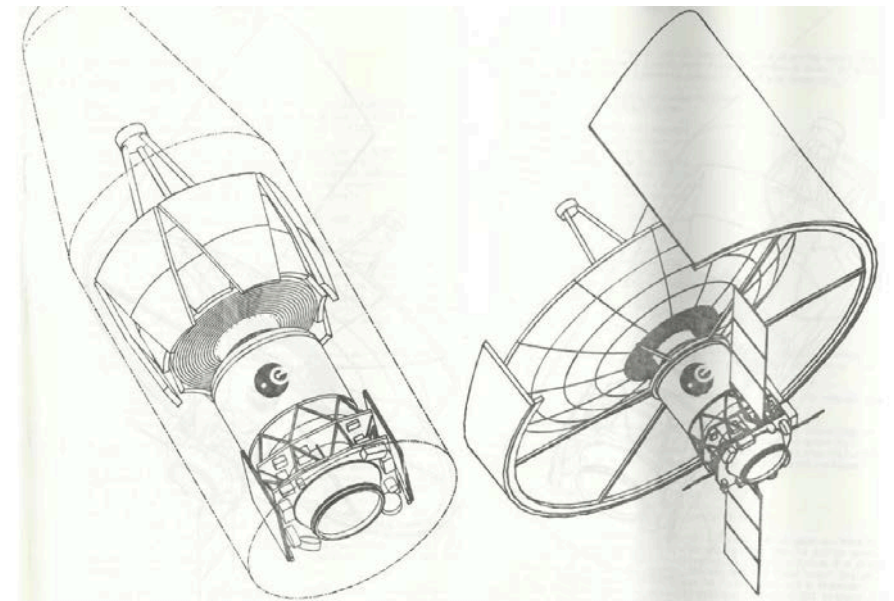


With thanks to Göran Pilbratt

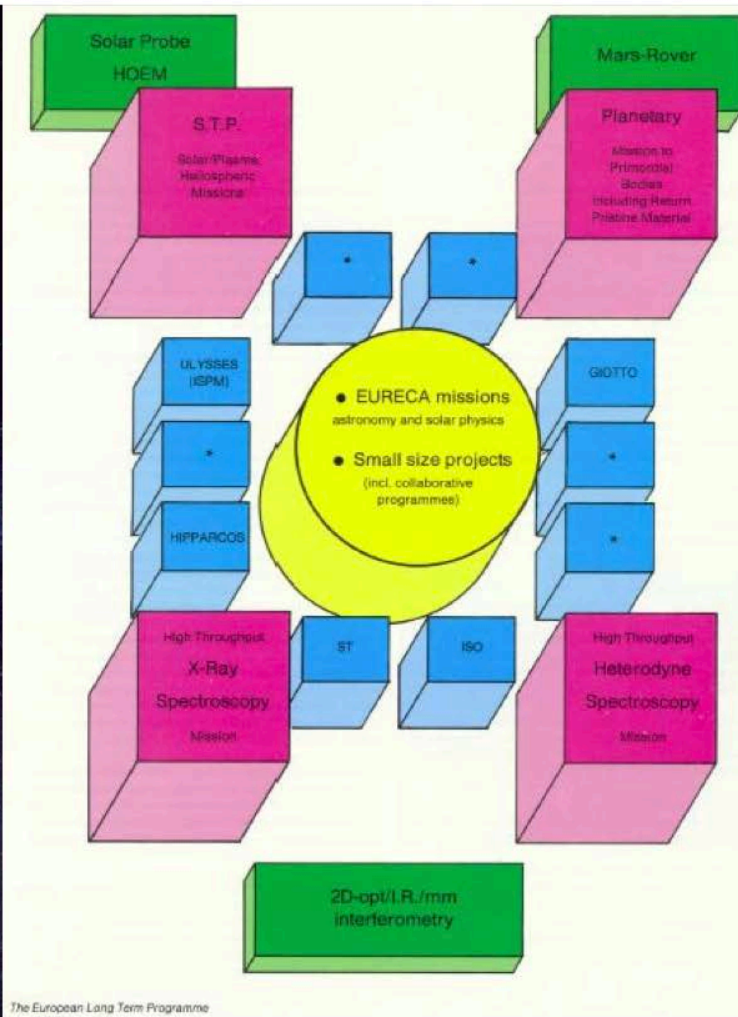
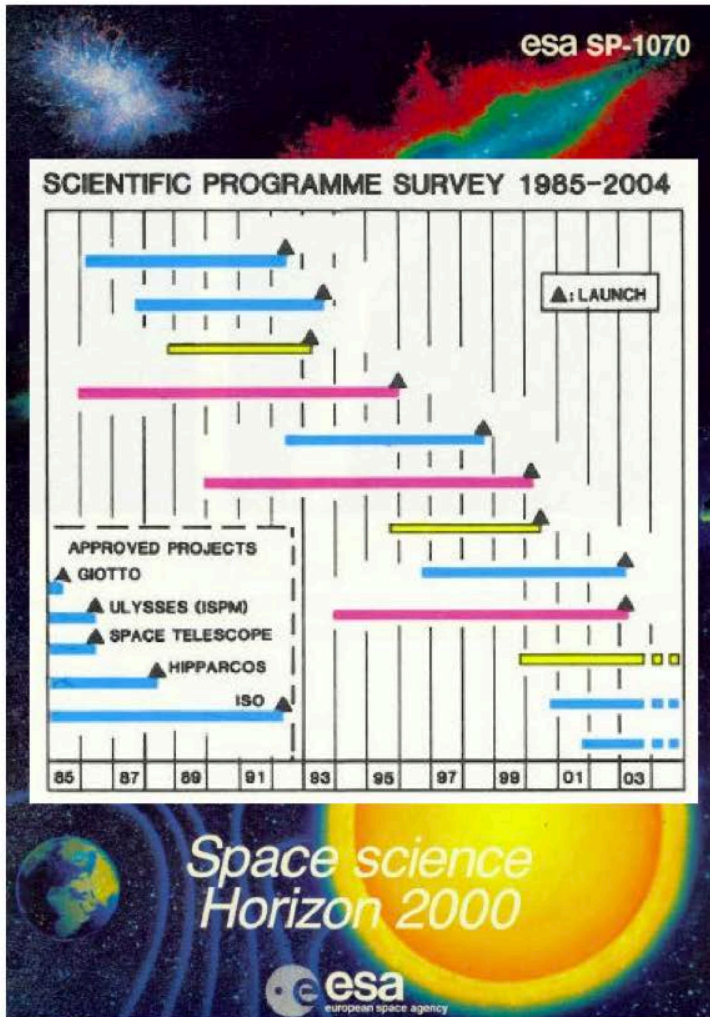
# THE START OF HERSCHEL



- However, we are observing the Herschel Universe from a privileged time - 4.5 years after launch.
- It has taken over 30 years of effort to get to where we are today. Herschel, originally called FIRST, was proposed to ESA in November 1982
- The proposal was for a telescope with a 8 m diameter deployable mirror.
- 3 instruments (down to 100 microns)
  - Multiband Imaging Photometer
  - High Resolution F-P Spectrometer
  - Superheterodyne Spectrometer with  $\lambda/\Delta\lambda \sim 10^6$
- Science focussed on molecular clouds, nearby galaxies, cosmology and solar system studies.



# HORIZON 2000 – DEC 1984

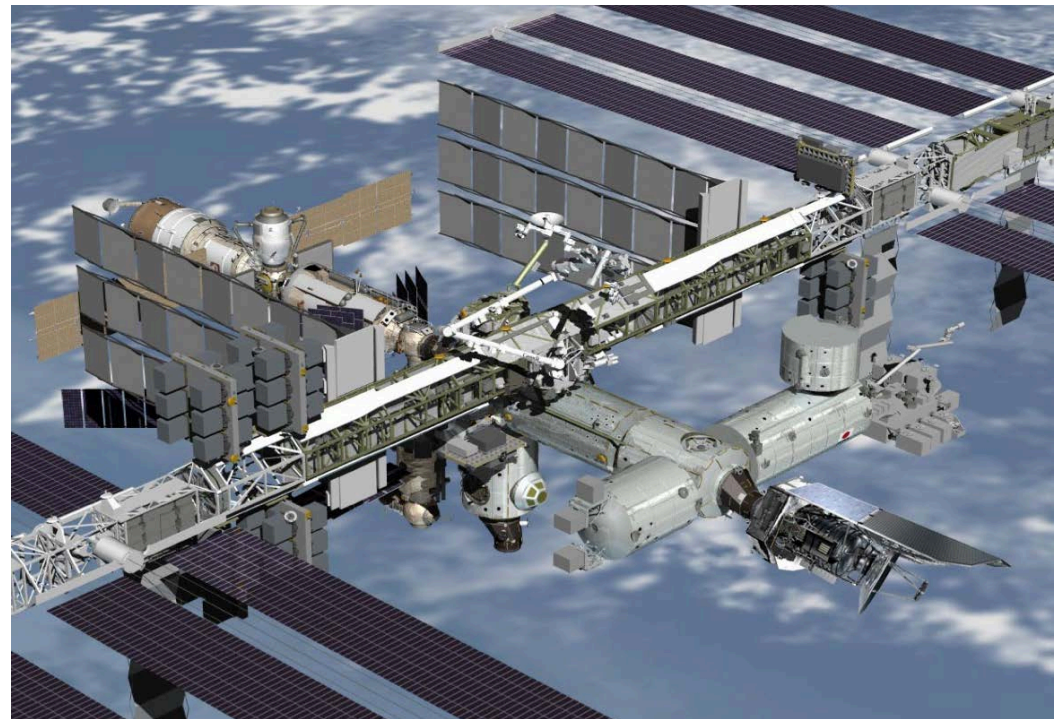


# IT HAS TAKEN A LONG TIME!

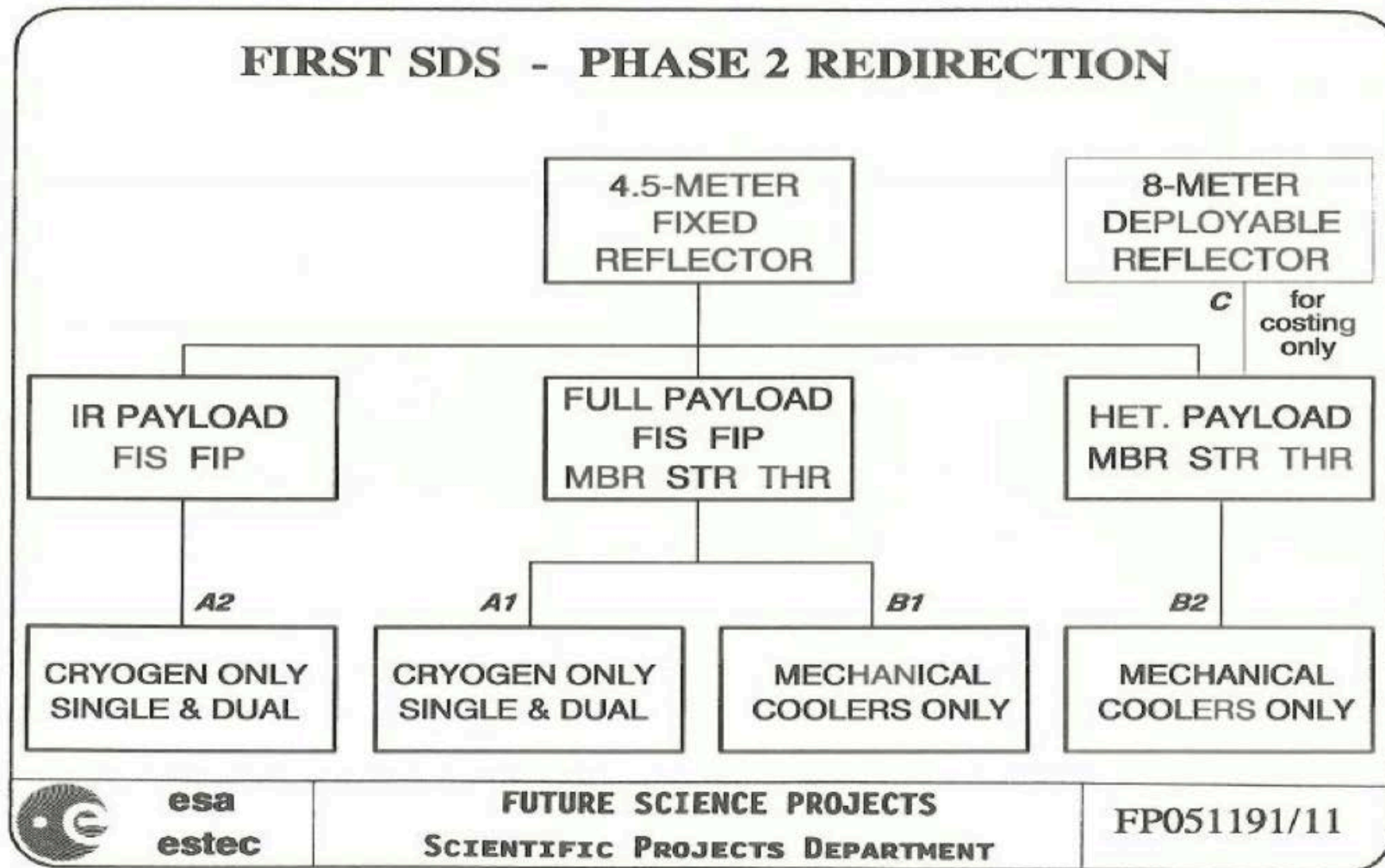


- FIRST flirted with the Space Station:

“The need for cryogenics is the obvious limitation to the lifetime of such an observatory, and thus the possibility to refill (or exchange) liquid helium tanks by servicing in space is one way to get 10 to 15 years lifetime”.



# SYSTEM DEFINITION STUDY IN EARLY 1990's



## FIRST IN THE 1990's



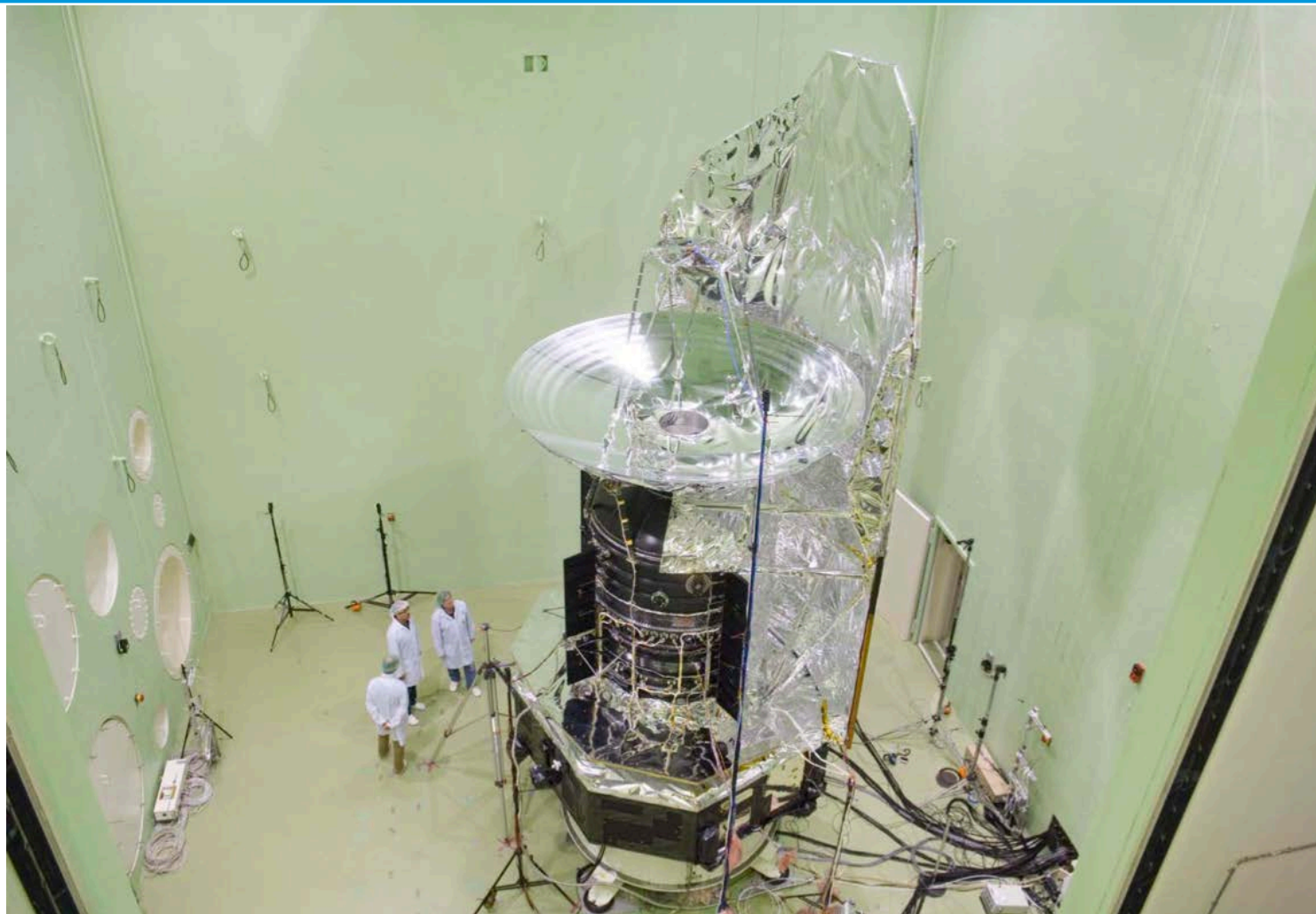
- FIRST was competing with Rosetta for the CS3 launch opportunity
- Various studies to try and reduce costs, whilst maintaining the capabilities of a Cornerstone mission.
- In September 1993, the Definition Study report was published (red book) and FIRST was selected at CS4. (However, FIRST then was a very different mission to Herschel, 3 m telescope, no cryostat....)
- Then came the FIRST/Planck merger proposal. Ideas developed in 1996-97. First step was a dual launch. Then a common spacecraft was proposed – shared observing time! Outrage in the community!
- The then Director of Science, Roger Bonnet, gave the welcome address at the “Promise of FIRST” meeting in Toledo, December 2000. Following a suggestion made by Göran Pilbratt, FIRST was renamed to be the Herschel Space Observatory.



# HERSCHEL IN THE 2000's



Herschel in the  
acoustic chamber  
in June 2008



- What I find fascinating is that many of the ideas pioneered by Herschel live on:
  - The use of the Herschel mirror technology to be actively cooled in the JAXA led SPICA mission – see talk by Nakagawa-san.
  - The use of a deployable optics in the Russian led Radioastron and Millimetron missions.
  - Autonomous spacecraft servicing with missions such as the DARPA Orbital Express STP-1 Mission

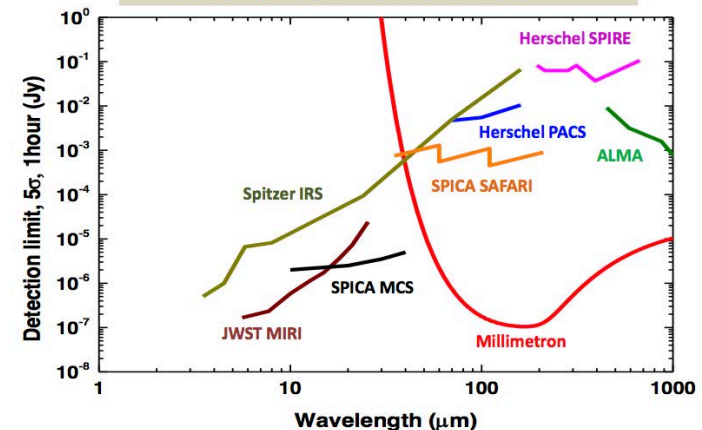
# THE ORIGINAL FIRST CONCEPT LIVES ON!



- Millimetron: Approved project of the Russian Space Agency.
- 10 m class cryogenically cooled ( $<10$  K) telescope operating in the FIR, submm and mm.
- VLBI and single dish observations from L2.
- Target launch date of 2019/2020.
- Lifetime of 10 years (cryo  $>3$  years)



Predicted Photometric Performance of the Millimetron  
( $\varnothing$  10m (10 $\mu$ m), NEP =  $10^{-19}$  W/vHz, T= 4.5K)



- It is not too early to start thinking about the successor to Herschel in the ESA programme.
- There was 25 years between the beginnings of Herschel and the launch.
- ESA recently solicited science themes for the L2 and L3 launches in 2028 and 2034 – which is not so different a delay as Herschel!
- See the L2/L3 white paper “Subarcsec far-infrared space observatory: a science imperative”.
- Very challenging! 3 mission designs were proposed for further study, should the theme be selected.

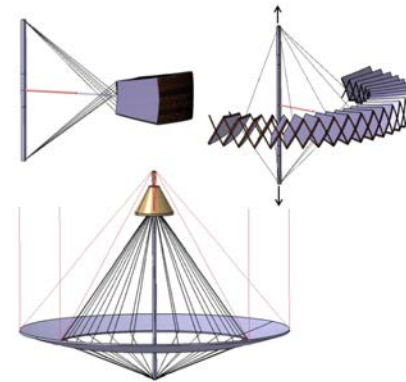


Figure 5: TALC deployment (clockwise). At top left the mirror segments are still stowed, but have been pushed away from the central mast, which extends, deploying the whole structure. Red lines indicate the optical path to the instrument platform (figure from A. Bonnet).

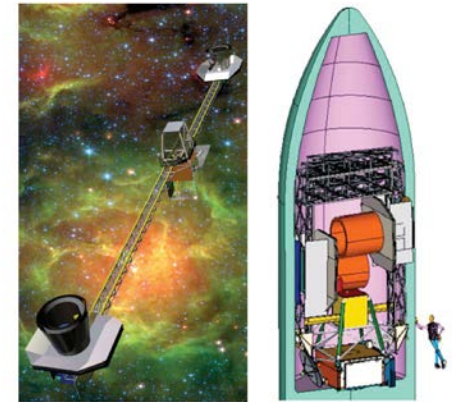


Figure 6: The FIRIT concept. Left: spacecraft concept design; right: the stowed configuration in both showing how the 1 m-class primary mirror design would fit into the medium fairing Ariane 5.

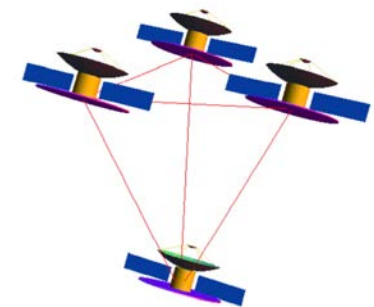


Figure 7: A schematic view of the free-flying ESPRIT interferometer (figure from A. Baryshev).

With thanks to Marc Sauvage