



TNO innovation for life

Space & Science





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Innovation Area Space

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1972



Spectro-
photometer S59
on ESRO's
TD-1A satellite

1983



GOME / GOME 2
on ERS-2 / METOP

1995



DAX
on IRAS

2002



Sciamachy
on Envisat

2004



OMI
on EOS-AURA

2006



Darwin



VLT



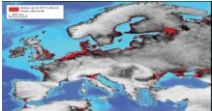
Star Separator



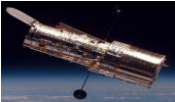
Delay Lines



E-ELT



InSAR PSI
Terrafirma 2003+
PSIC4 2003+



Hubble



3

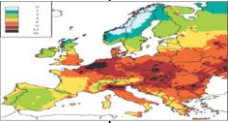
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2007



HERSCHEL HIFI

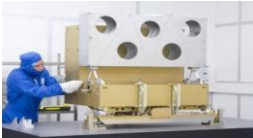


Atmospheric Chemistry
LOTOS-EUROS 2007+
Aerosol OSSE 2008+

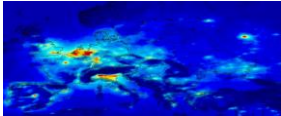
2010



LISA

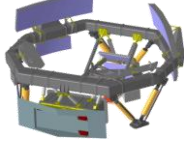


GAIA AFMA



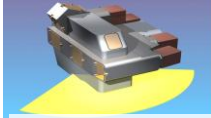
OMI data

2012



GAIA Basic Angle Monitoring

2014



Sentinel 5 precursor



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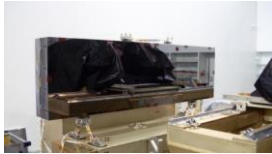
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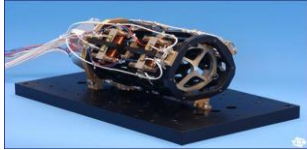
Metrology, interferometry, OGSE, mechanisms, sensors



GAIA Basic Angle Monitoring:
picometer stability



GAIA scan system: stroke 22 mrad; resolution < 3 nanorad



DARWIN: sub-nanometer positioning



E-ELT nanoactuator: 1.4 nm resolution



E-ELT M1 support



E-ELT M1 support



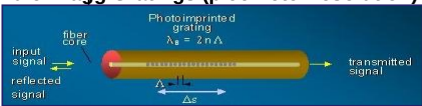
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Metrology, interferometry, OGSE, mechanisms, sensors

Fibre Bragg Gratings (picometer resolution)



Photoimprinted grating
 $\lambda_s = 2n\Lambda$
 $\Delta\lambda$

input signal
reflected signal
transmitted signal

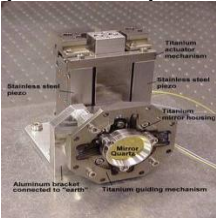


Displacement
FBG1
FBG2
FBG3
FBG4

Comparison with conventional methods



Read out: FBG(I);
traditional (r)



Tip/tilt: Stroke 1 degree;
Resolution < 0.1 μ rad



0.5 μ rad stability over one week



Diagnostics for fusion



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Metrology, interferometry, OGSE, mechanisms, sensors

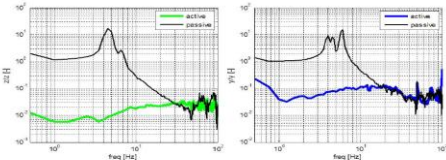
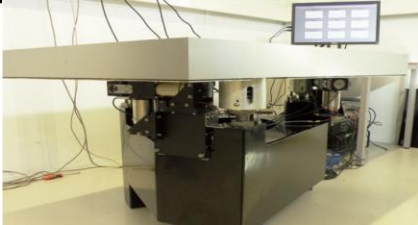
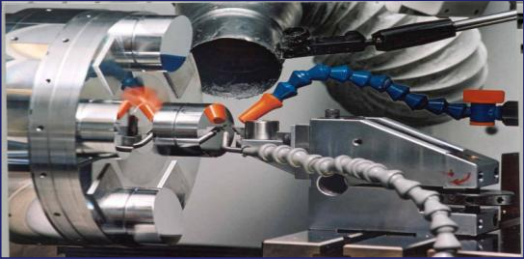


Figure 5. Reduction of transmission by Rollrite system in vertical (left) and one horizontal (right) direction. The black line represents the transmission of the passive table, the colored lines (green and blue) are the reduced transmission.

Active vibration isolation down to sub-nanometer level



Computer controlled diamond turning



Nanometer metrology



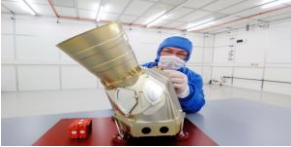
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Facilities





The **Van Leeuwenhoek Laboratory (VLL)** in Delft is one of the largest nanotechnology research facilities in Europe.



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Some of our partners and Customers





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Thank you for your attention