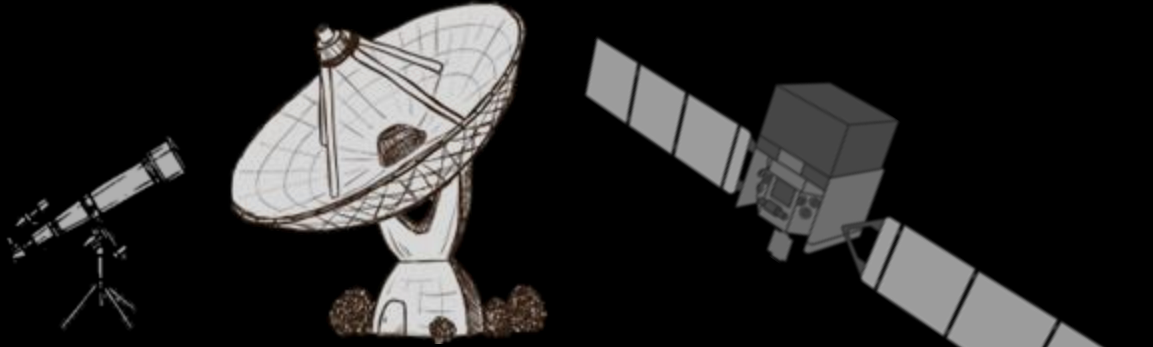


Zwaartekrachtsgolven

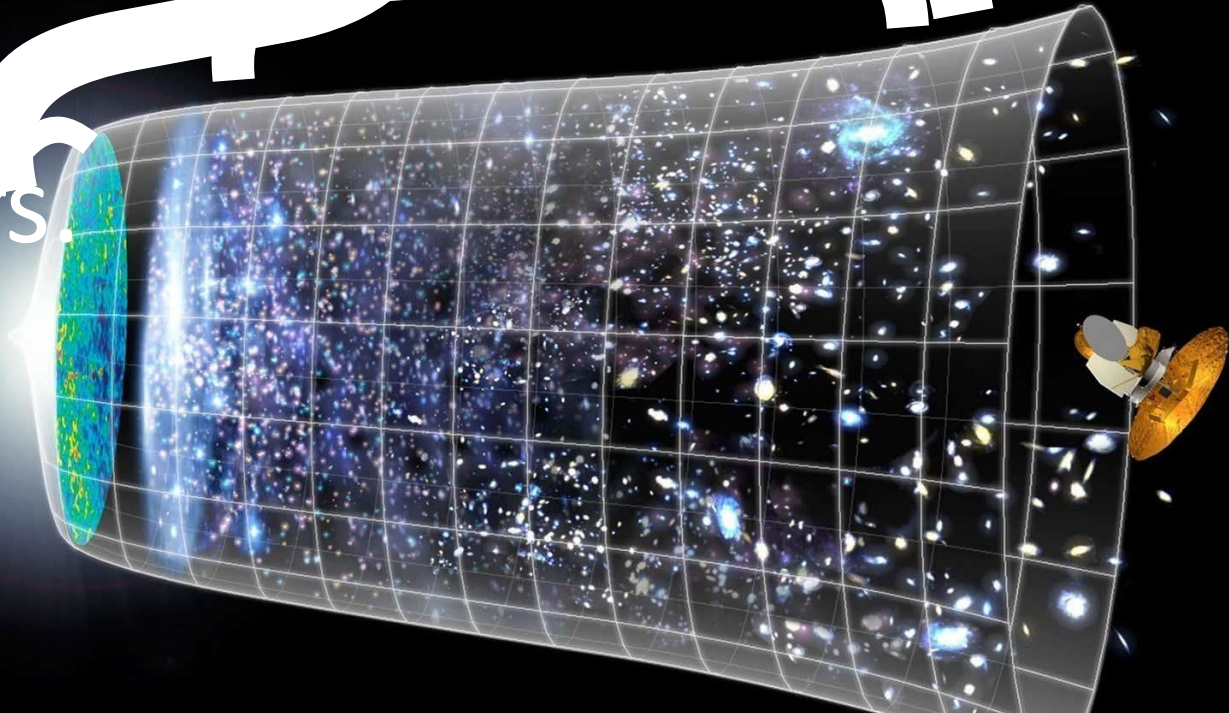
de meest precieze lengte meting ooit

Joris van Heijningen
HOVO op Nikhef | 17.02.2025

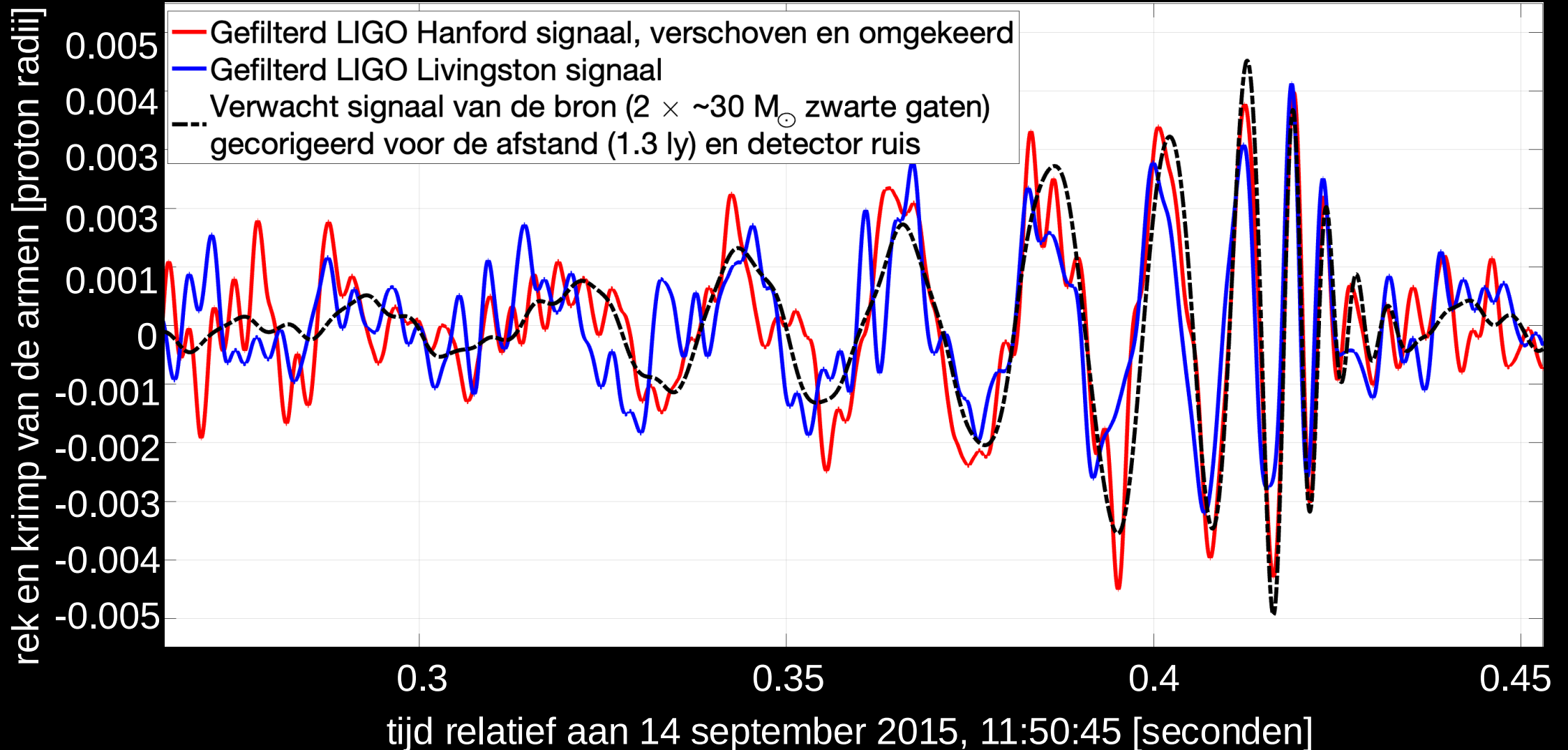


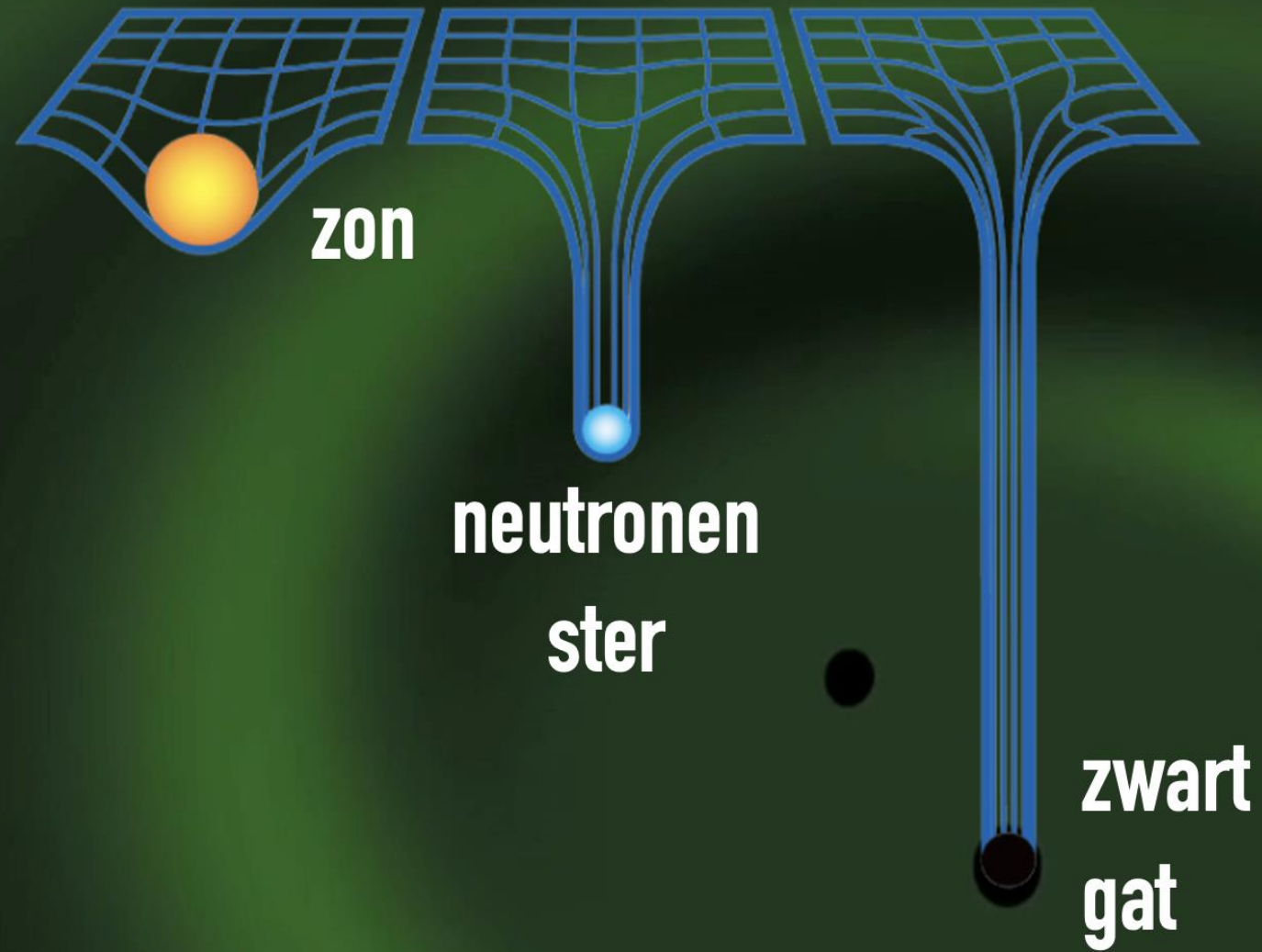
Horen met elektrische antennes en telescopieën.

Simuleren met
deeltjes boters.

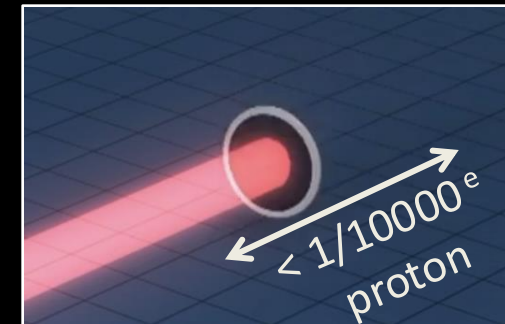
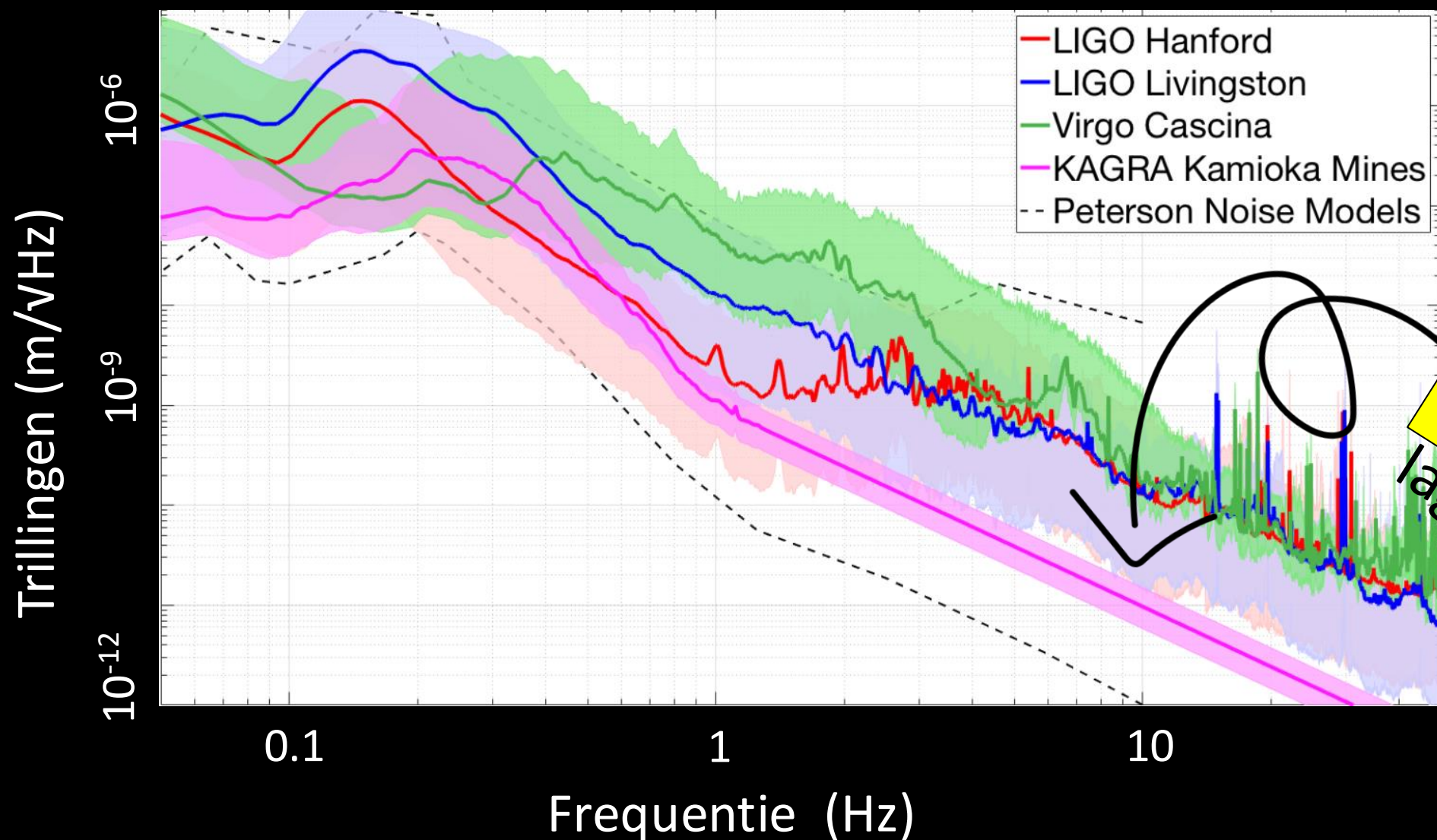


Wat hoorden wij?



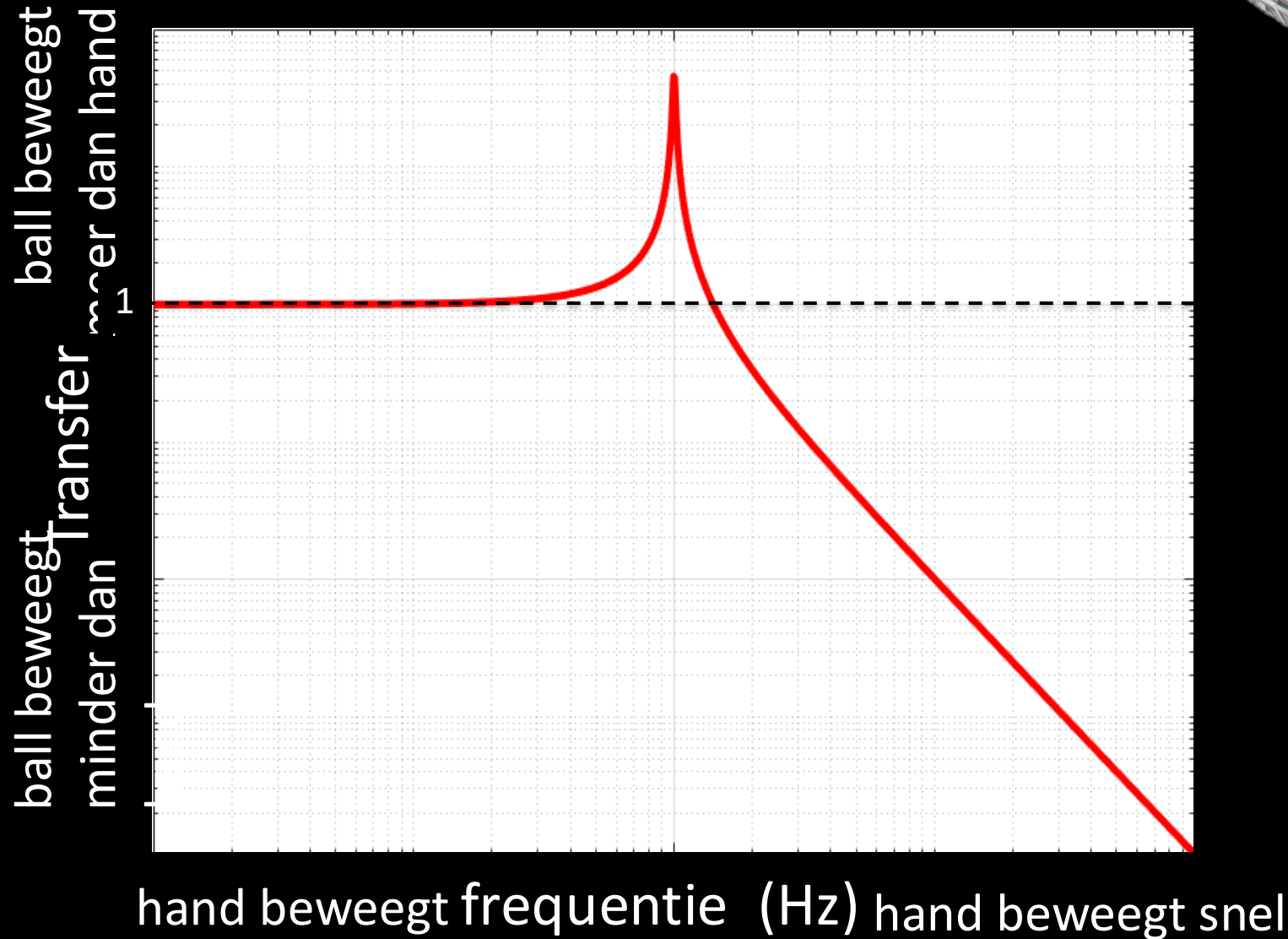


De aarde trilt. Altijd.



moet een factor
10.000.000.000

Ontkoppelen van de aarde

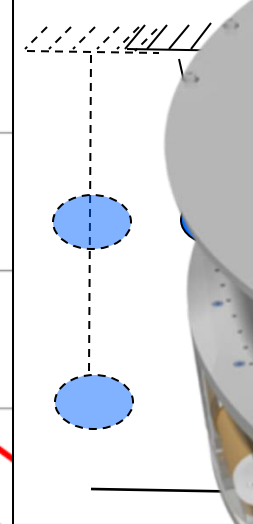
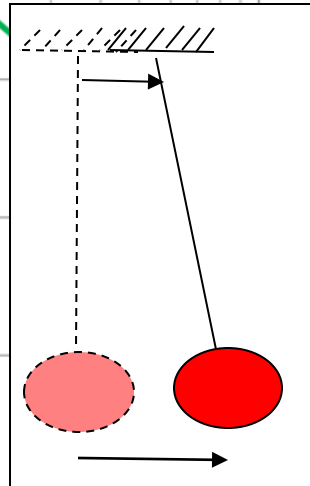


Een ketting van mechanische filters

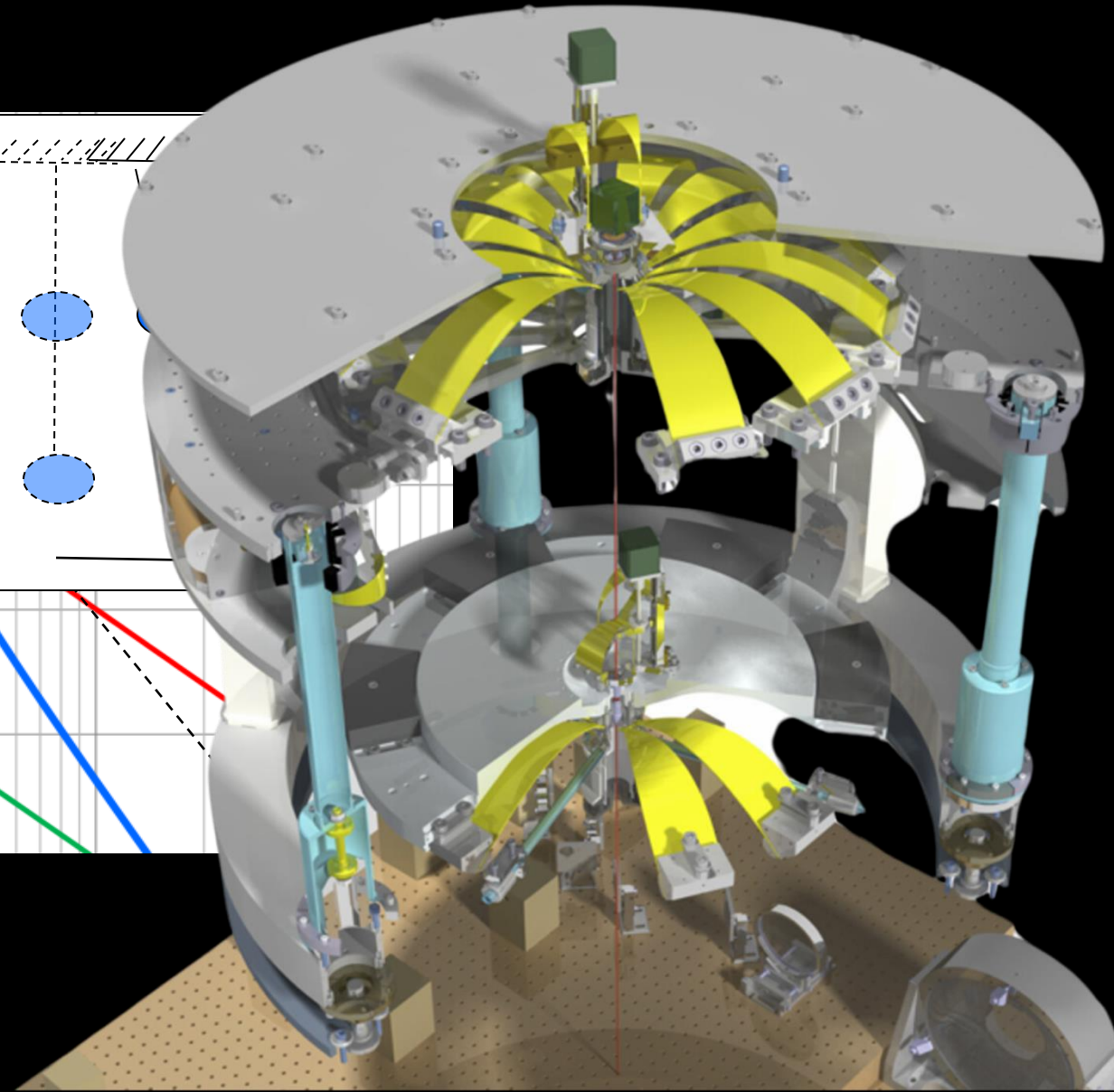
Transfer



Robin Cornelissen



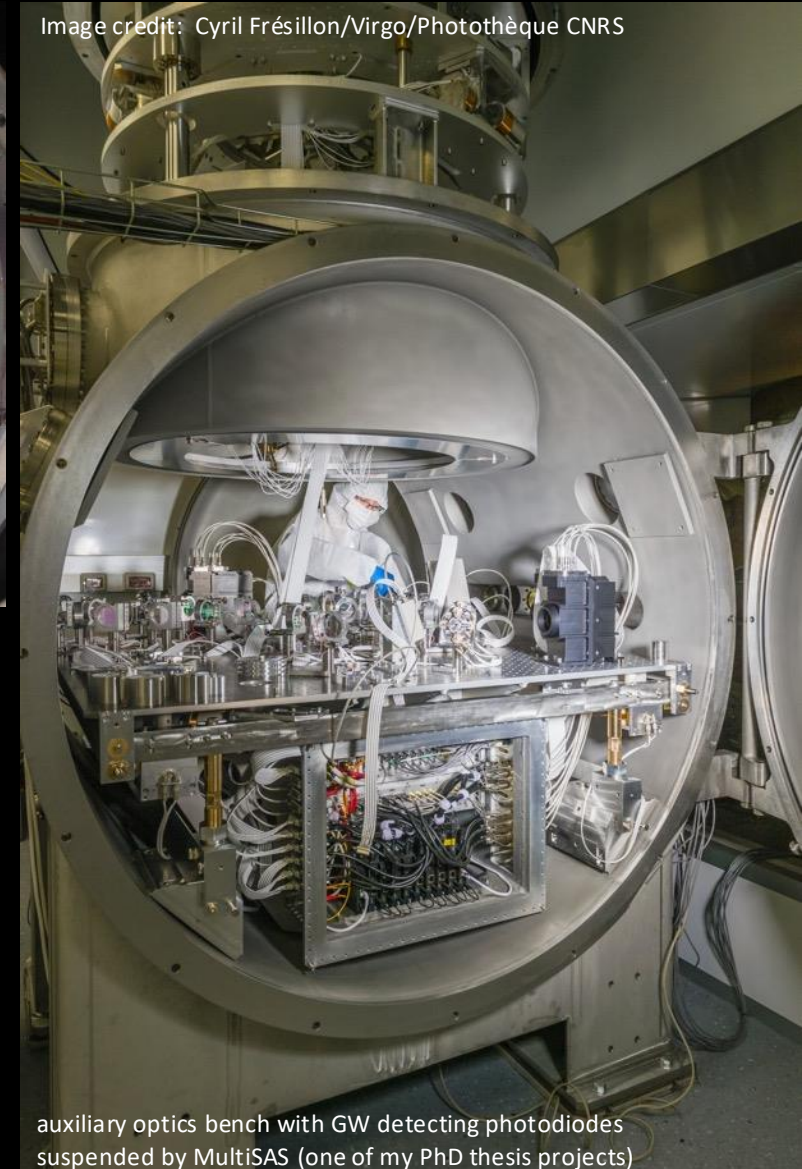
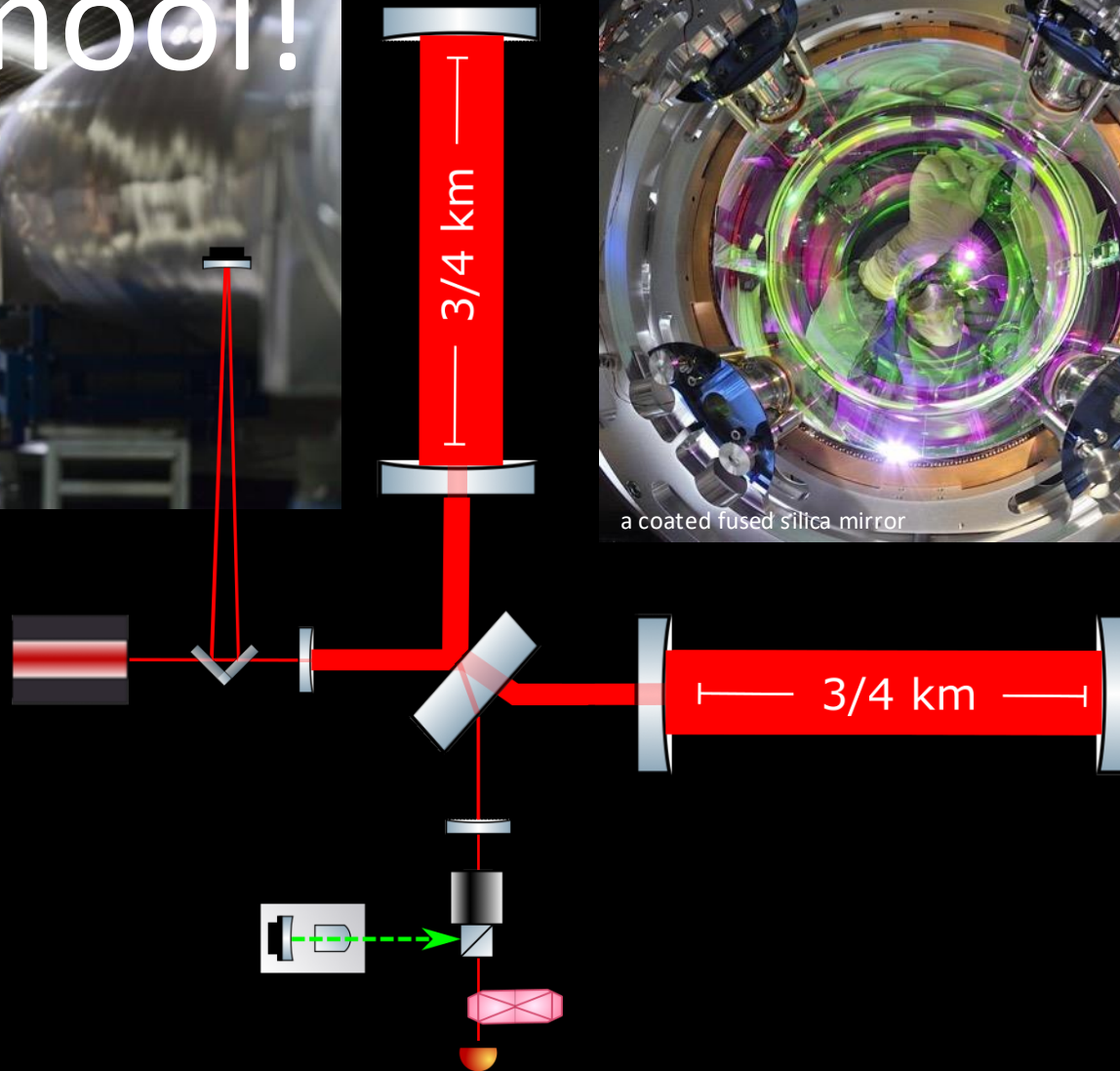
Frequentie (Hz)





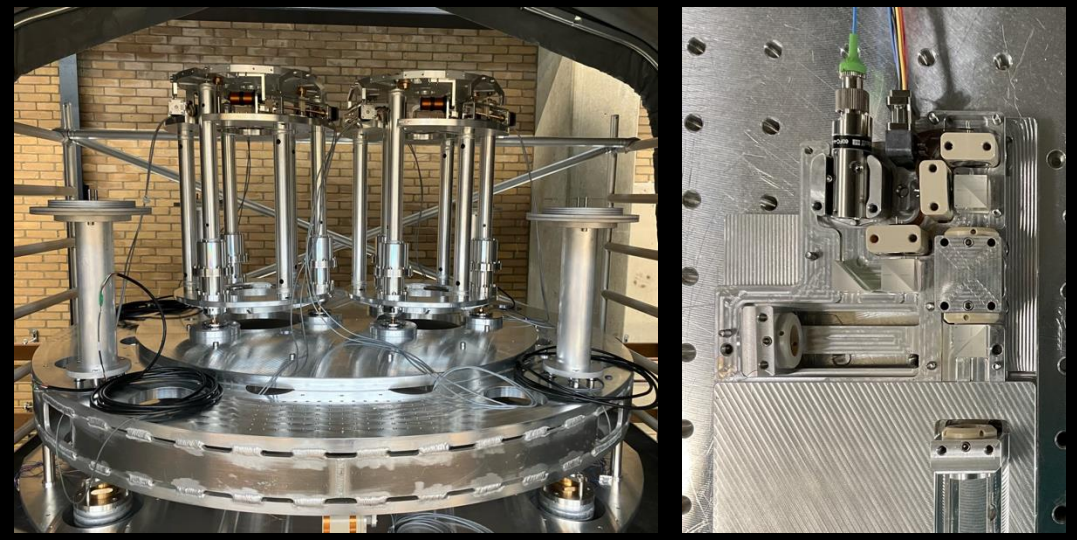
De europese detector Virgo.

Zwaartekrachtsgolfdetectoren



Nikhef speelt een grote rol in...

Isolatie en sensing



Optische simulatie

```

import finesse
finesse.configure(plotting=True)

kat = finesse.Model()
kat.parse(
    """
    # Add a Laser named L0 with a power of 1
    l L0 P=1

    # Space attaching L0 <=> m1 with length d
    s s0 L0.p1 m1.p1

    # Input mirror of cavity.
    m m1 R=0.99 T=0.01

    # Intra-cavity space with length of 1 m.
    s CAV m1.p2 m2.p1 L=1

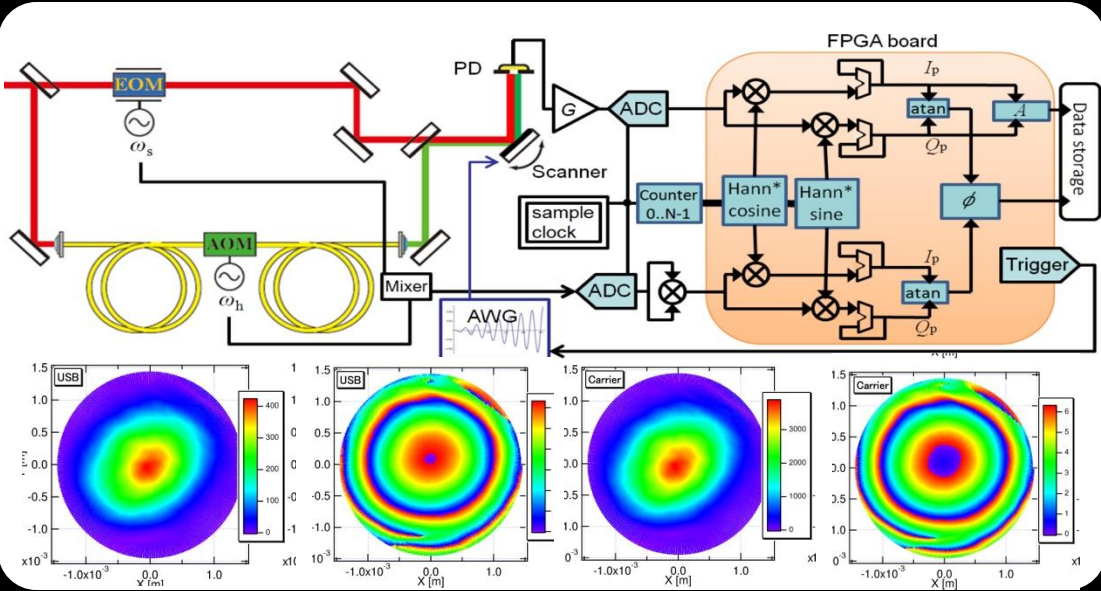
    # End mirror of cavity.
    m m2 R=0.991 T=0.009

    # Power detectors on reflection, circulation and transmission.
    pd refl m1.p1.o
    pd circ m2.p1.i
    pd trns m2.p2.o
    """
)
        
```

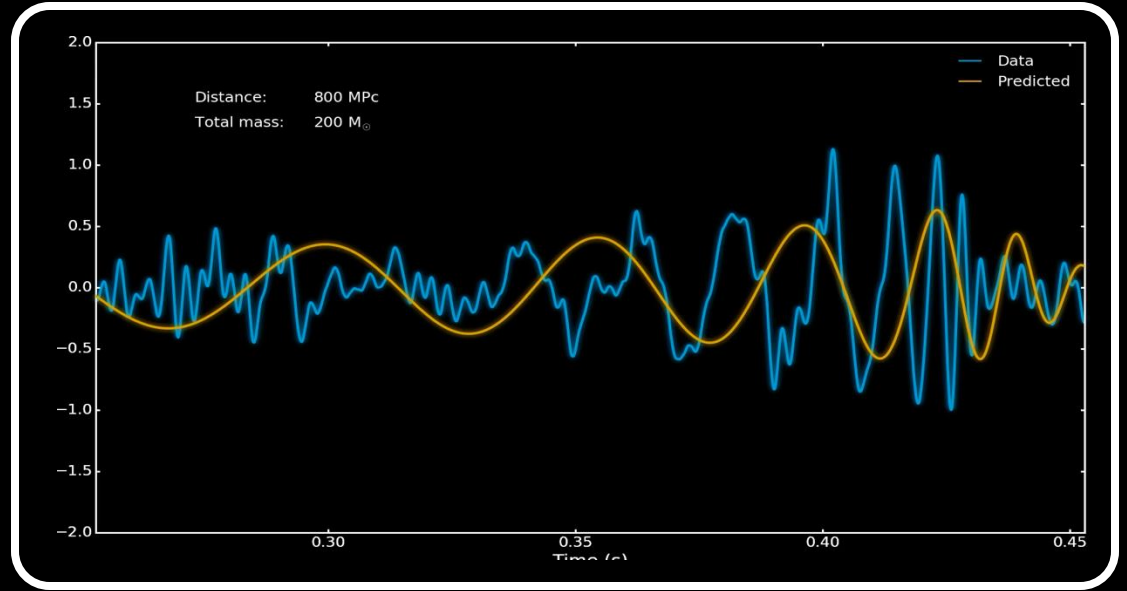
Finesse

(software gebruikt door ZG community, nu ontwikkeld op Nikhef)

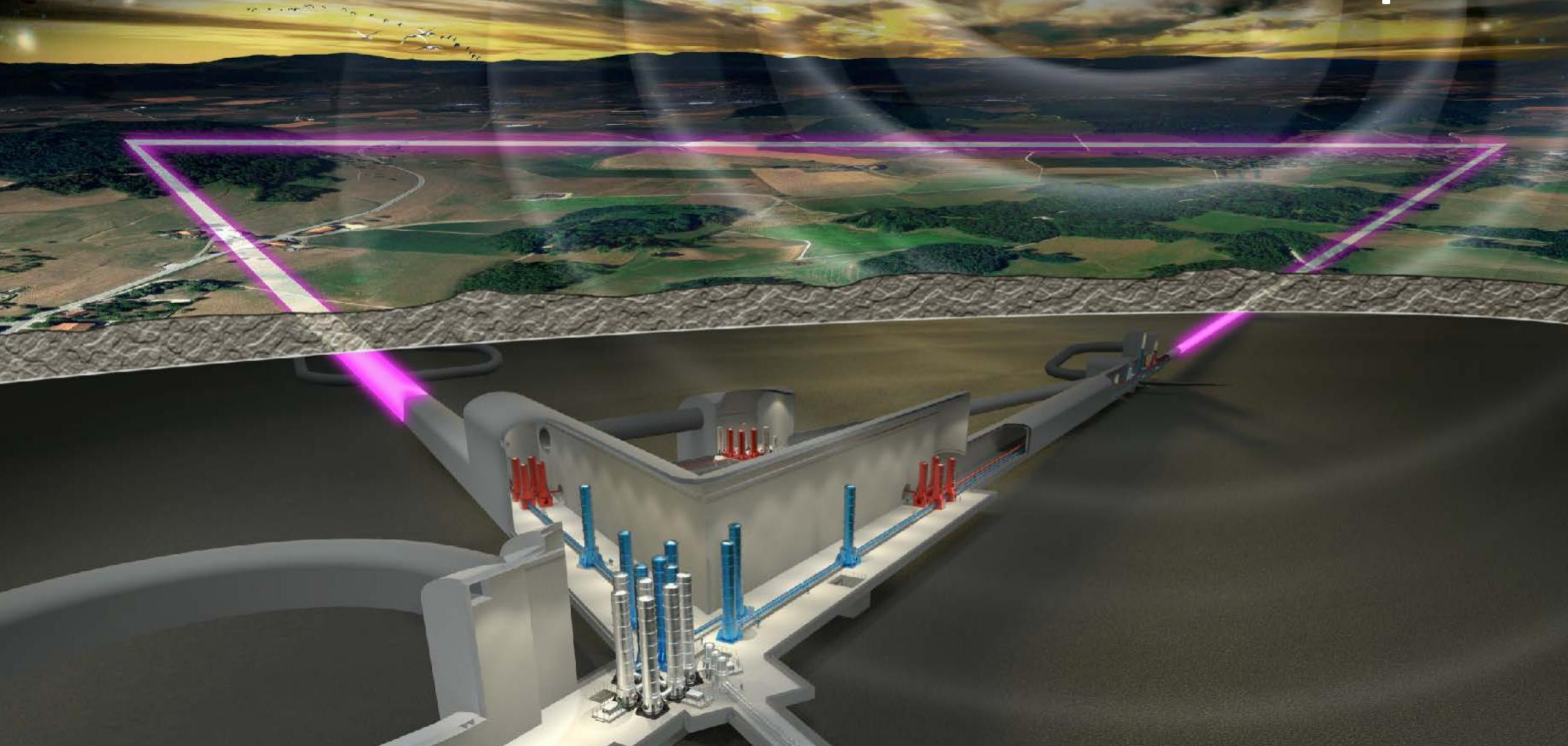
Golfvront sensing



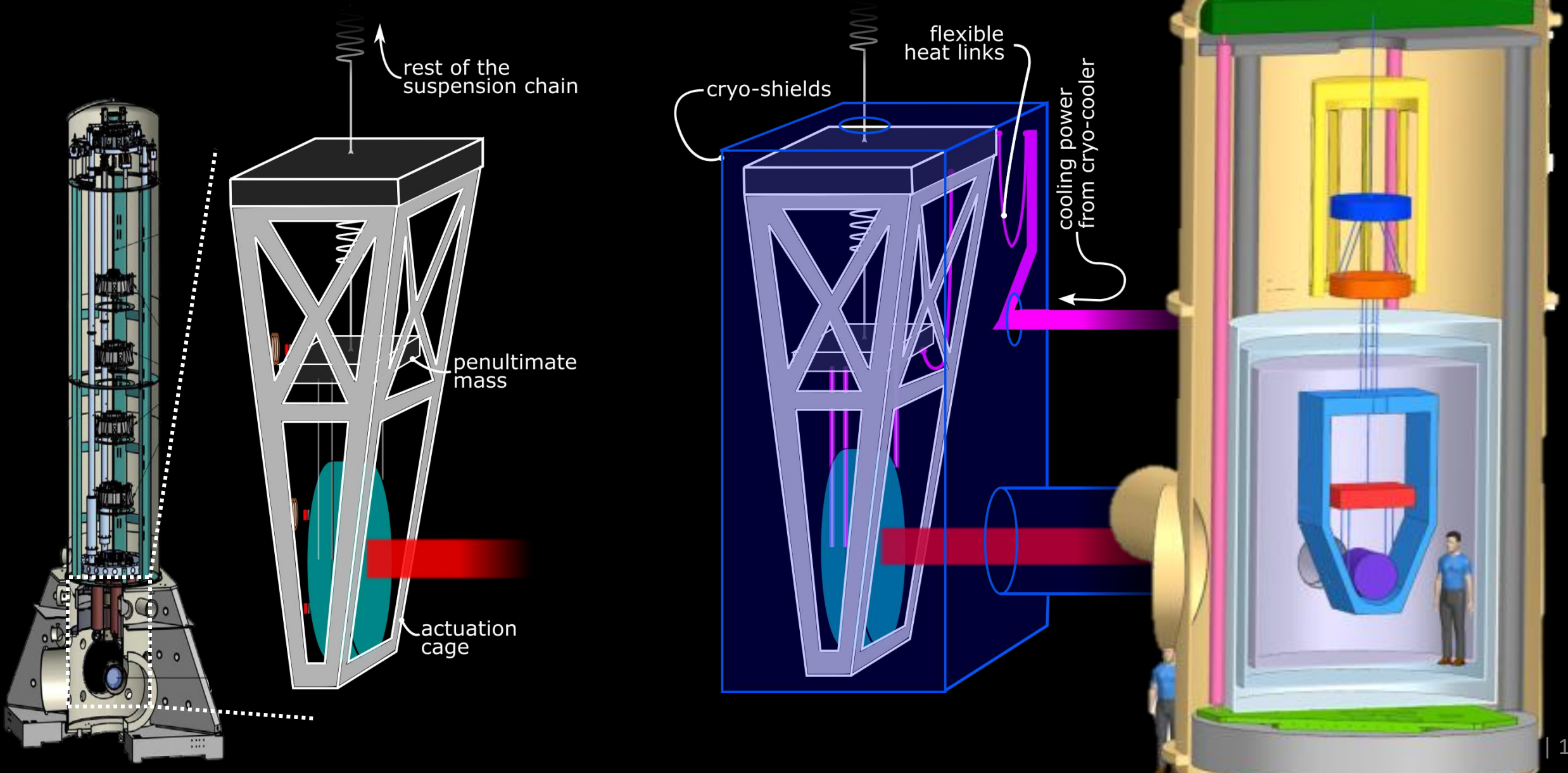
Golfvorm modelleren



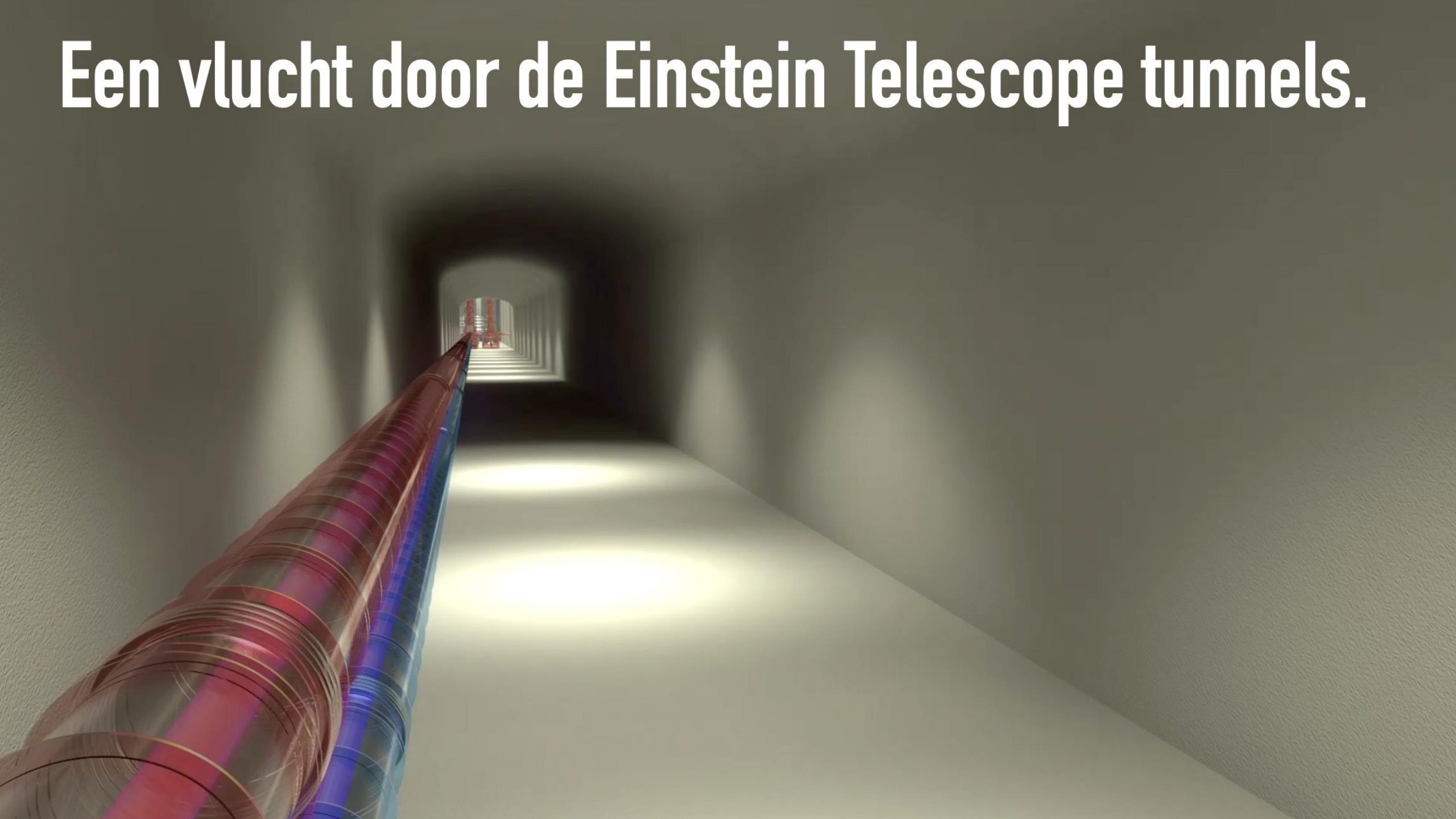
...en de toekomst: Einstein Telescope



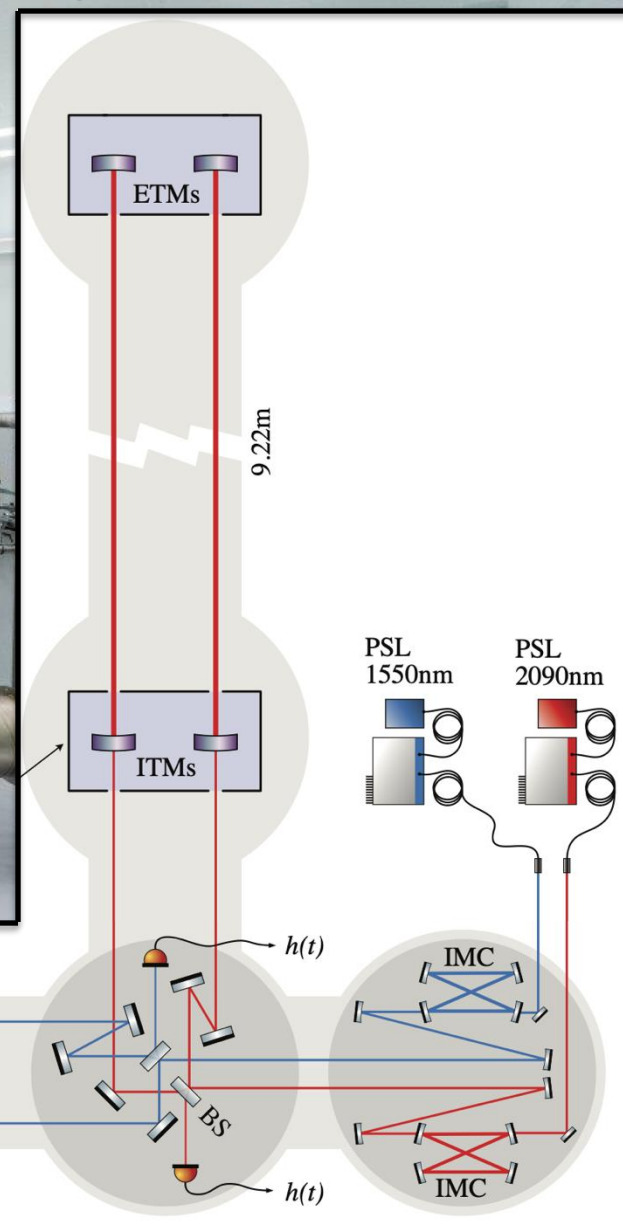
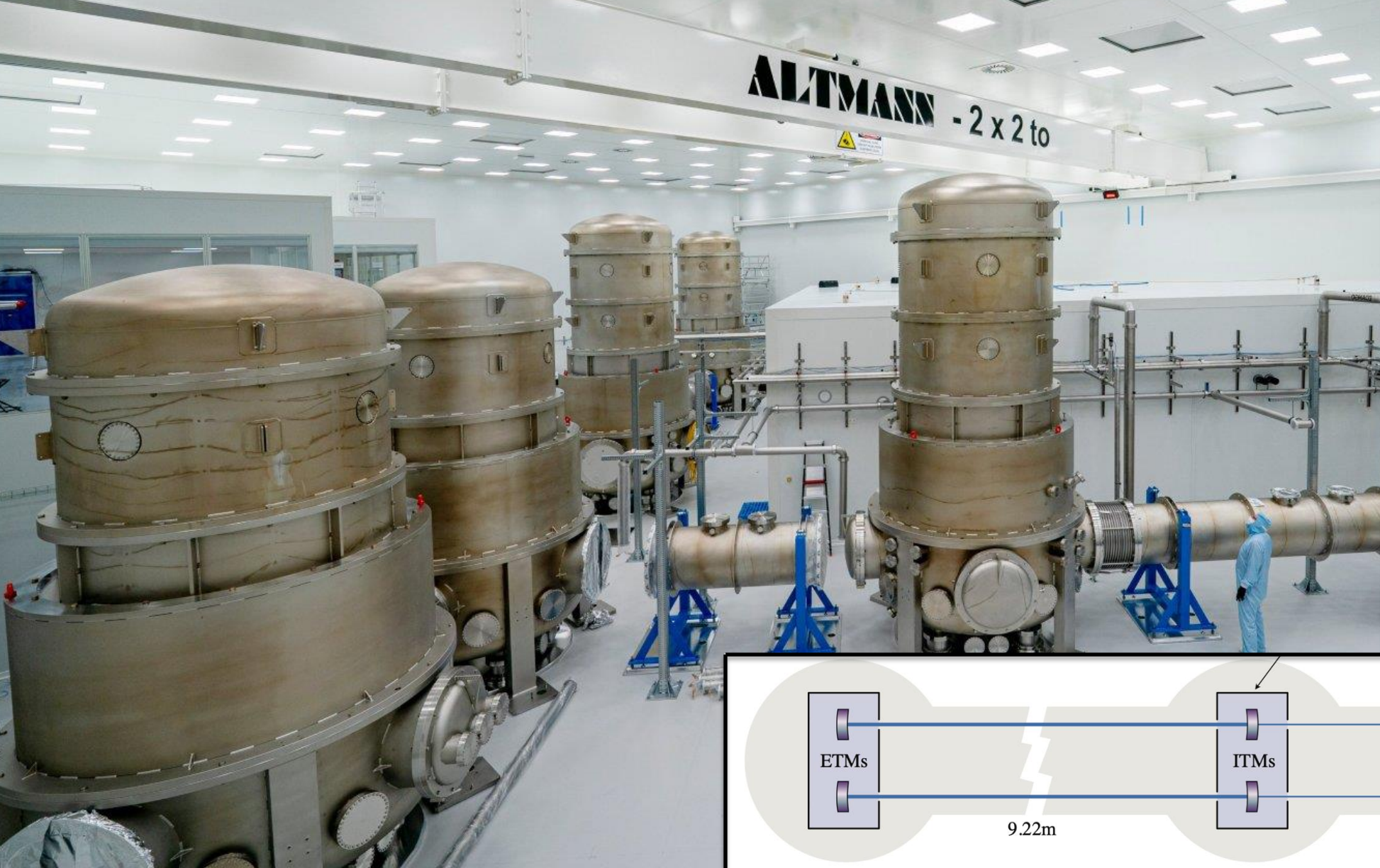
Spiegels koelen is moeilijk.



Een vlucht door de Einstein Telescope tunnels.



R&D voor de Einstein Telescope in Ma



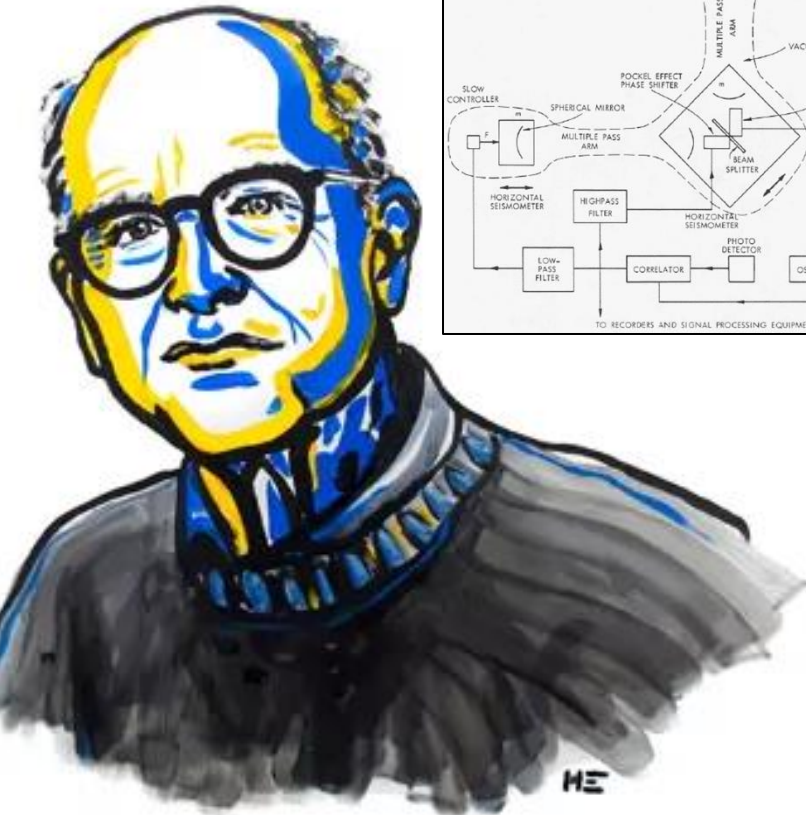
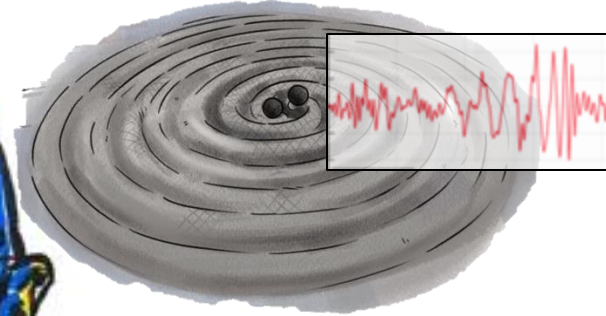
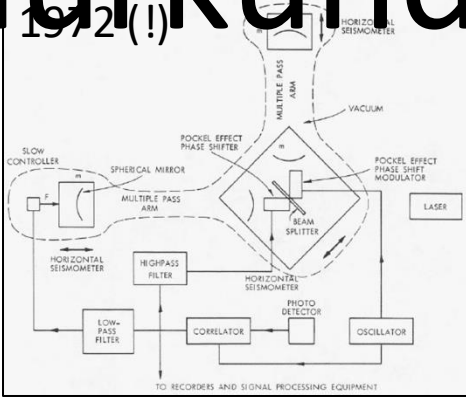


Dank u
voor
uw
aandacht

De 2017 nobel prijs van de

“voor beslissend werk aan de LIGO detector en de eerste detectie van zwaartekrachtsgolven”

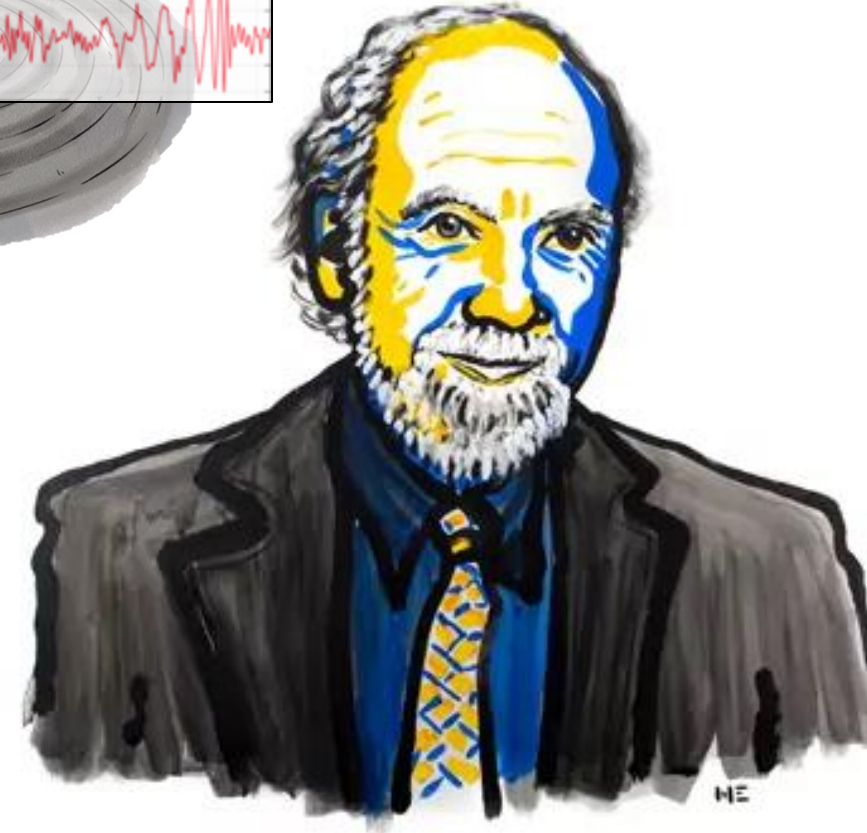
natuurkunde



Rainer Weiss (MIT)
Knutselaar



Kip S. Thorne (Caltech)
Denker



Barry C. Barrish (Caltech)
Leider