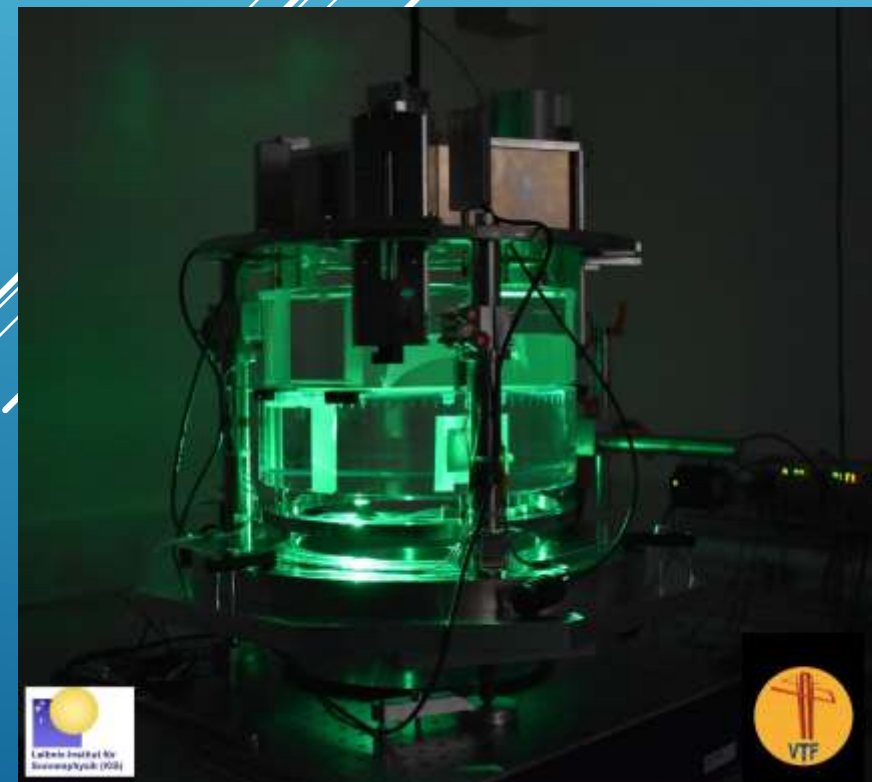


VISIBLE TUNABLE FILTER (VTF) INSTRUMENT FOR DK1 SOLAR TELESCOPE (4M)

Petri Kehusmaa, VTF Projektipäällikkö

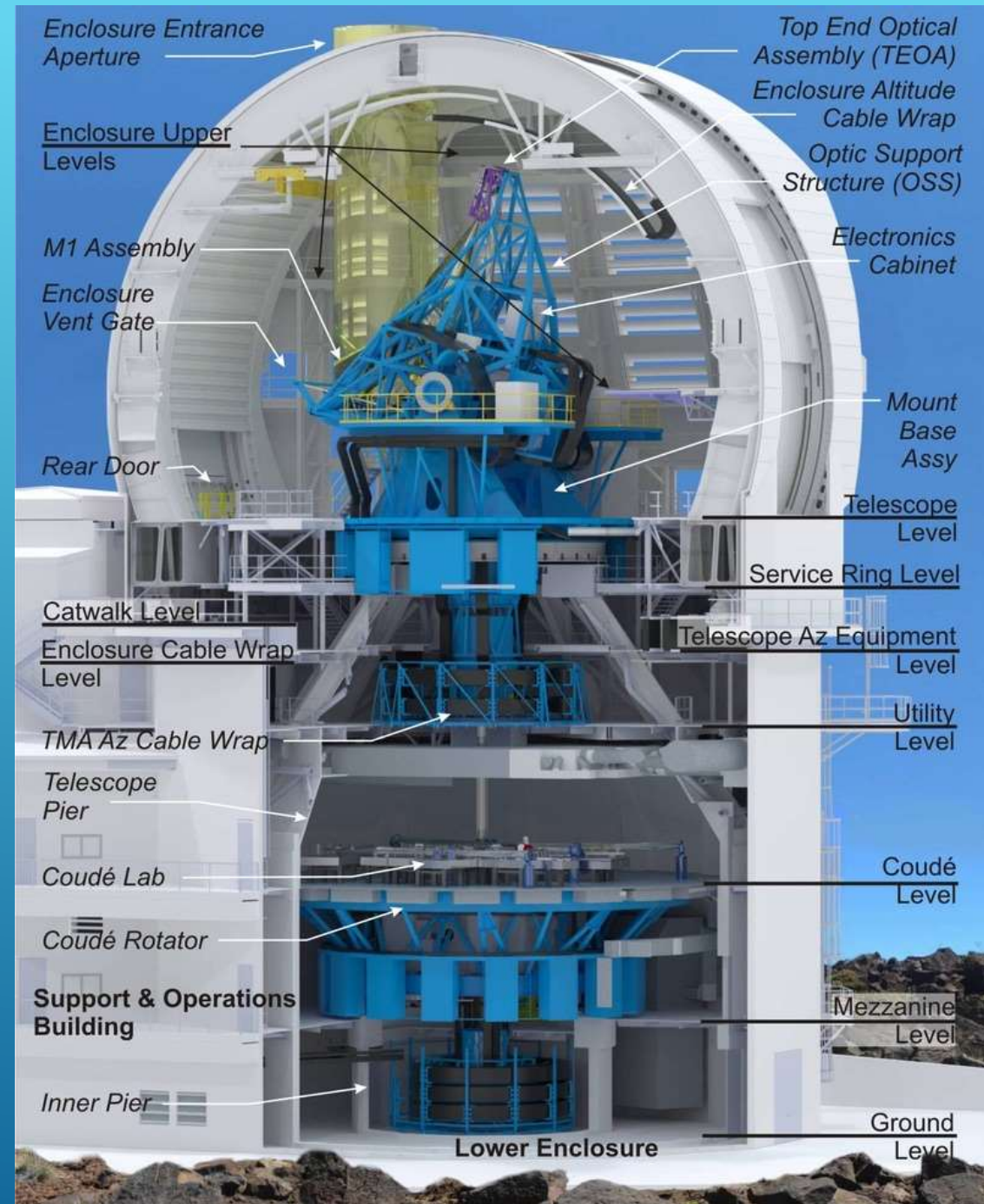
Leibniz-Institute for Solar Physics

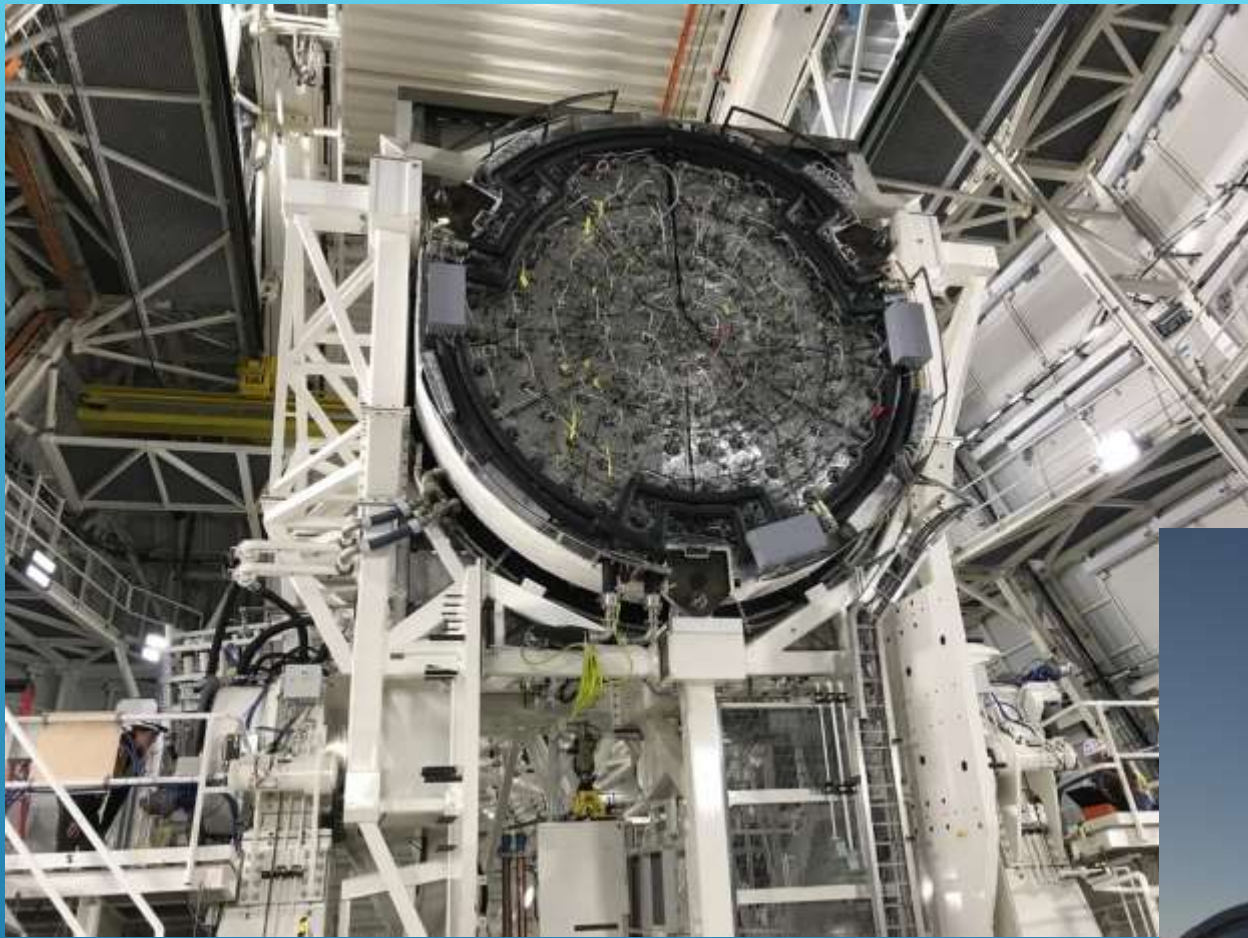
Laitapäivät 2023



- ▶ Maailman suurin aurinkoteleskooppi
- ▶ Sijaitsee Mauin saarella Hawajilla
- ▶ Observatorio 3000m korkeudella
- ▶ 4 m pääpeili, vain 75mm paksu!
- ▶ Energia polttopisteessä $2,5 \text{ MW/m}^2$.
- ▶ Tehokas jäähdytys tarpeen!

TILAJAA DKIST, USA





DKIST, MAUI

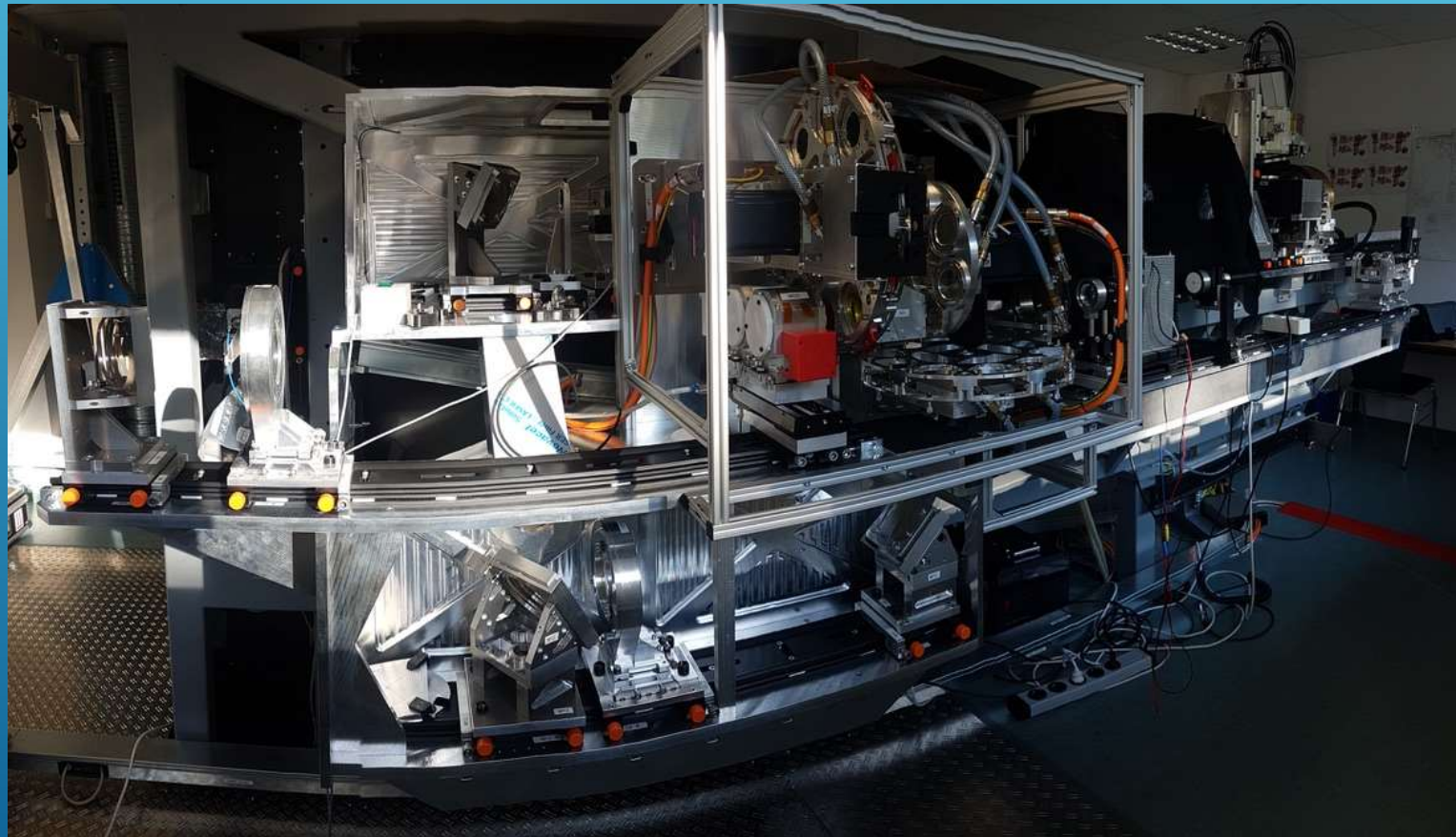


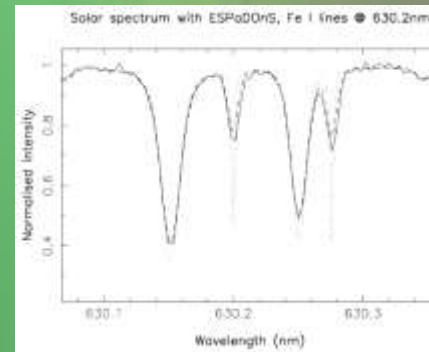
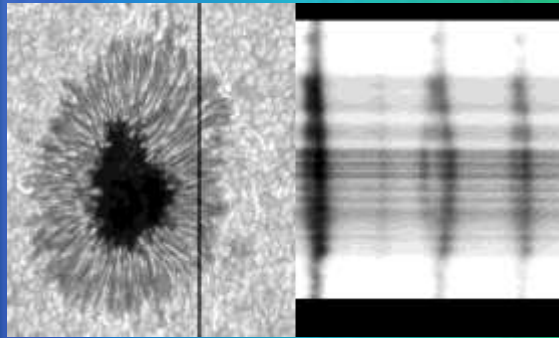
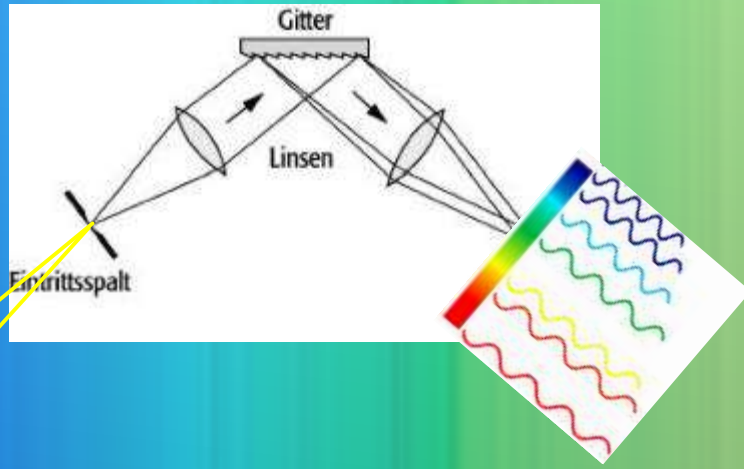
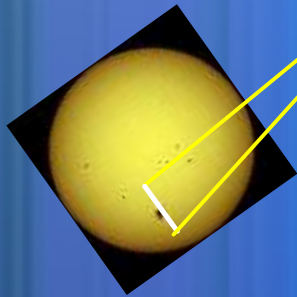


DKIST COUDE LAB

- ▶ Maailman suurin ja tehokkain spektropolarimetri
- ▶ Havaintoja auringon fotos- ja kromosfääristä sekä magneettikentistä

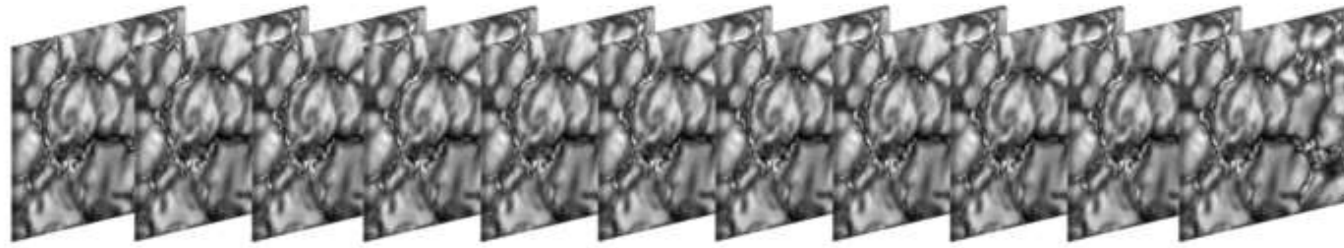
MIKÄ VTF ON?



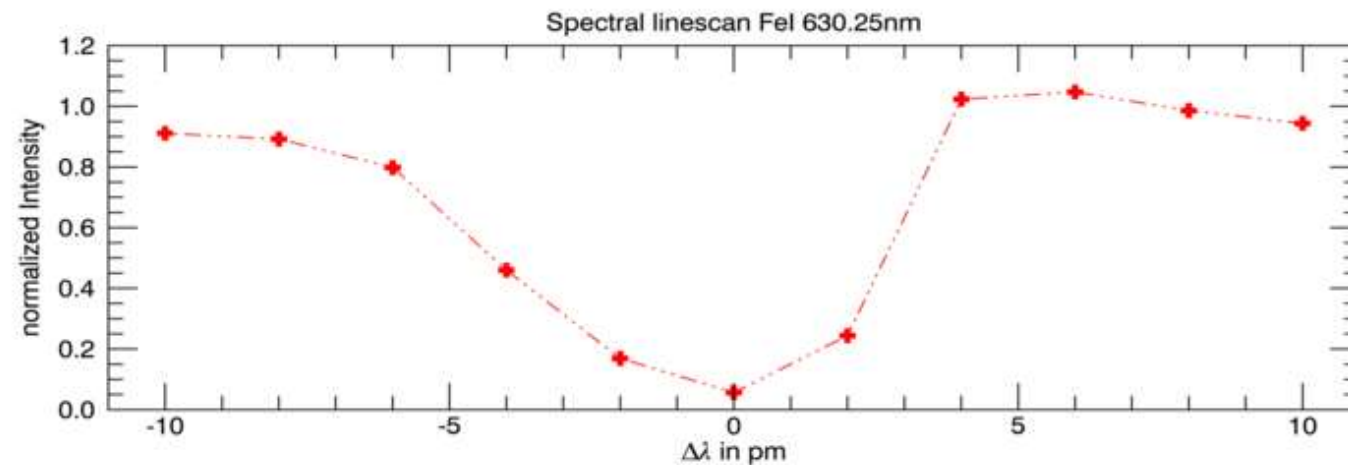
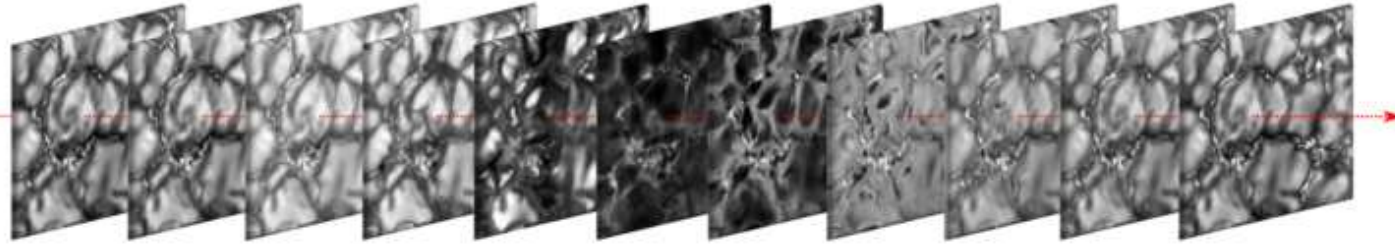


NORMAALI SPEKTROSKOOPPI

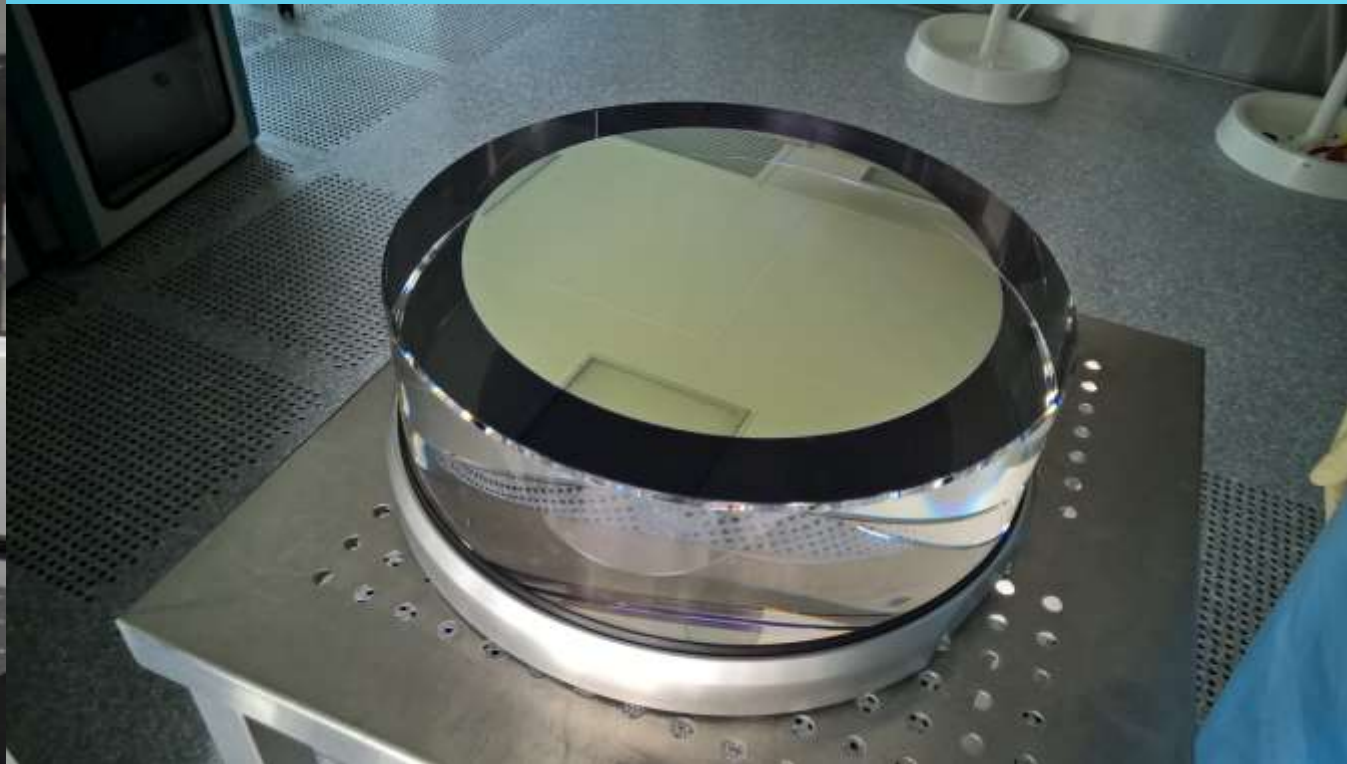
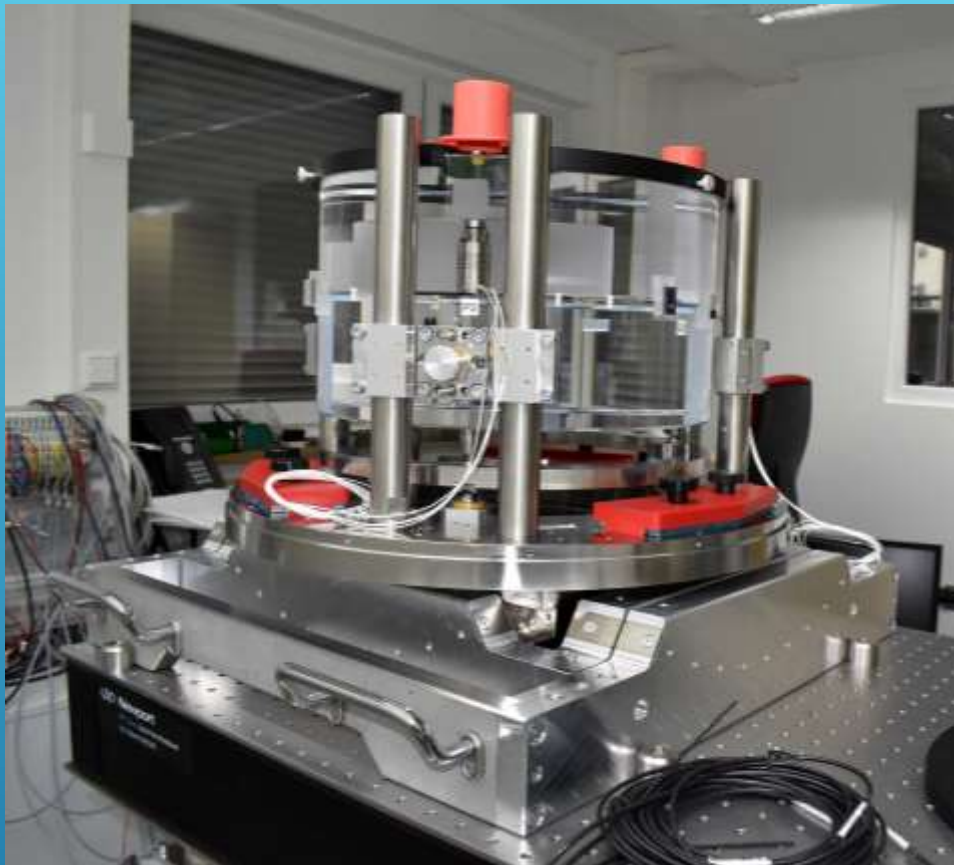
BB



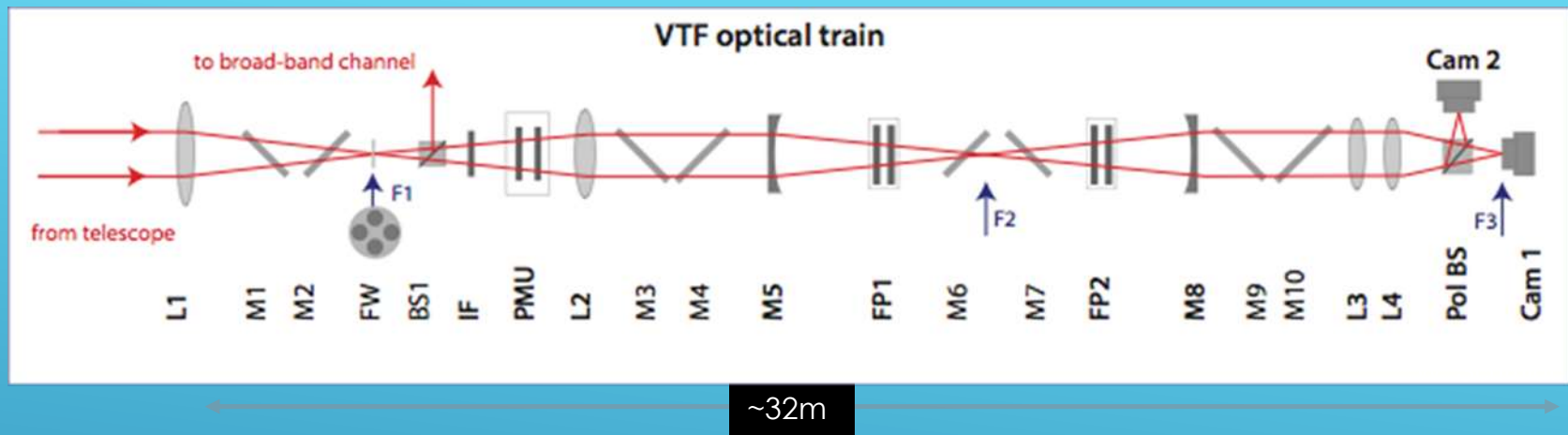
NB



VTF: SÄÄDETTÄVÄ 2-ULOTTEINEN SPEKTROSKOOPPI JA POLARIMETRI



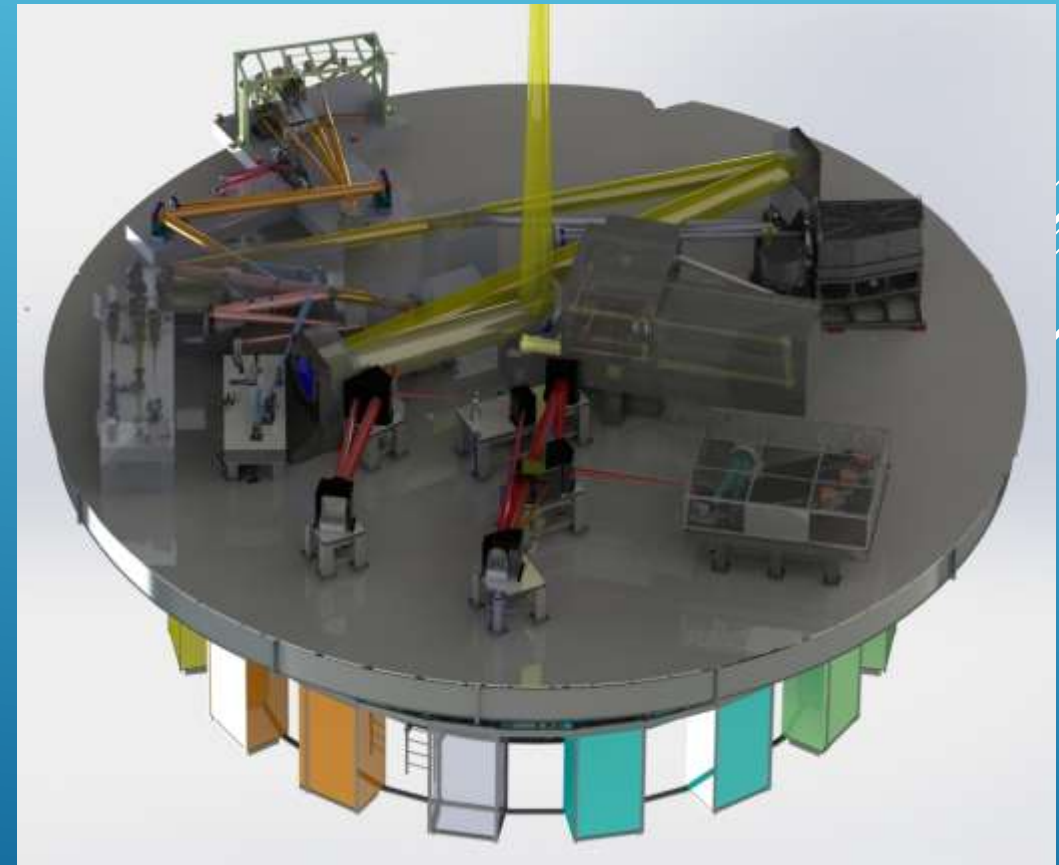
VTF PERUSTUU FABRY-PÉROT
ETALONIIN (2 KPL)



VTF:N OPTINEN RAKENNE

- ▶ Yksi viidestä DKIST instrumentista
- ▶ 5m korkea ja painaa 4300kg
- ▶ Suurin FPI
- ▶ Arvo n. €12m
- ▶ Projekti aloitettiin v 2012
- ▶ Asennus 01/2024-

VTF TOTEUTUS



VTF Observational Characteristics

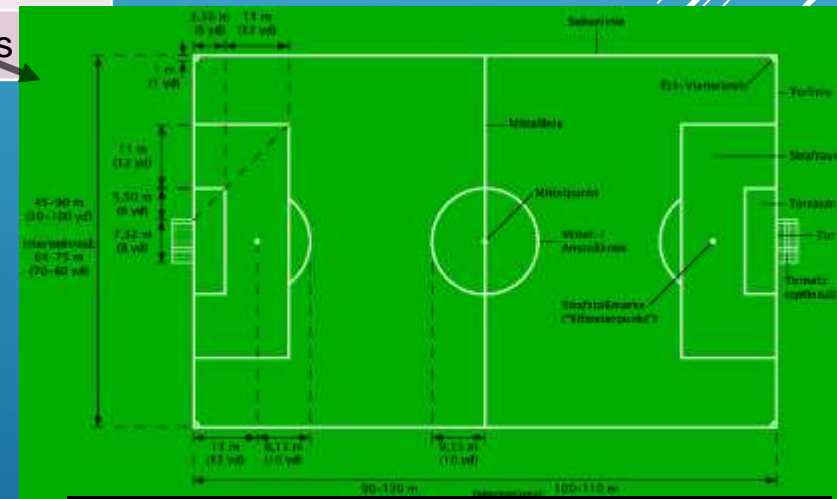
Field of view	60x60 arcsec	F-ratio, Etalon size
Spectral resolution	6 pm (60 mÅ)	F-ratio, Finesse
Spatial resolution	0,028 arcsec (20km)	diff. limit @ 600 nm
Spectral range	520 – 870 nm	Coating

VTF Etalon Design Characteristics

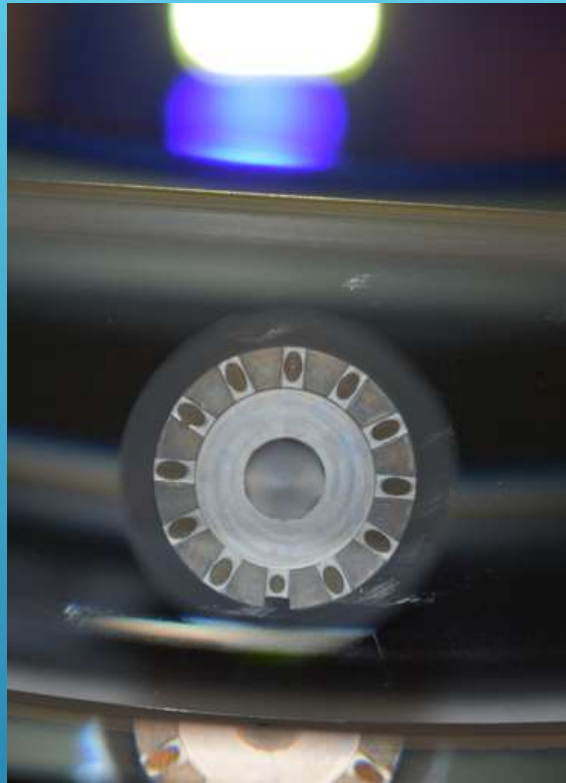
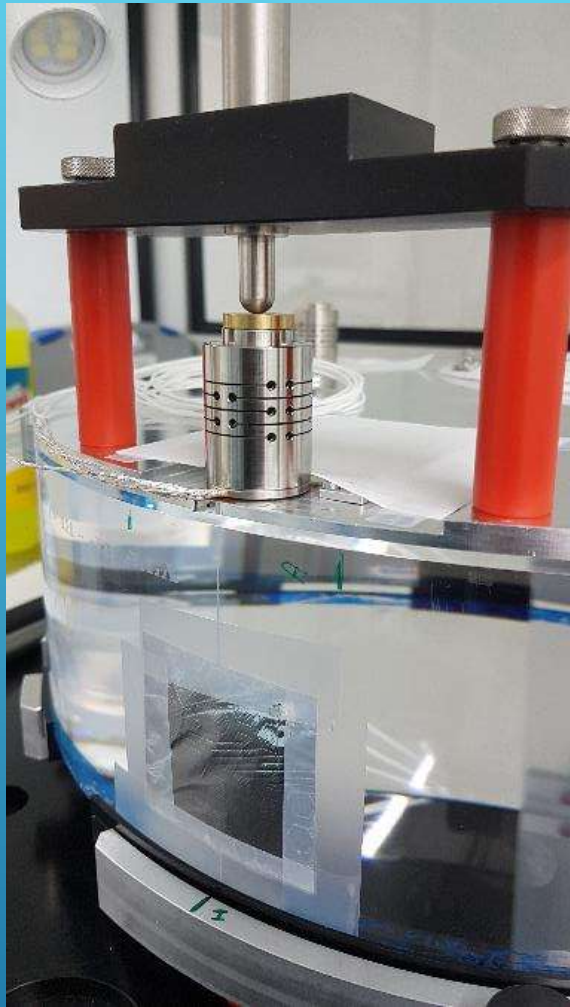
Clear aperture (CA)	250 mm	350mm total
Cavity variation on scales <1mm (micro roughness)	≤ 0.4 nm RMS	Plate polishing; coating
Cavity error on scales >1mm (figure error)	≤ 3 nm RMS (goal: 1nm RMS)	Plate figure error of coated and mounted plates
Scanning precision	+/- 150 pm	Max. error over 1h
Scanning range	1,2 μm	Plus range for adjustments



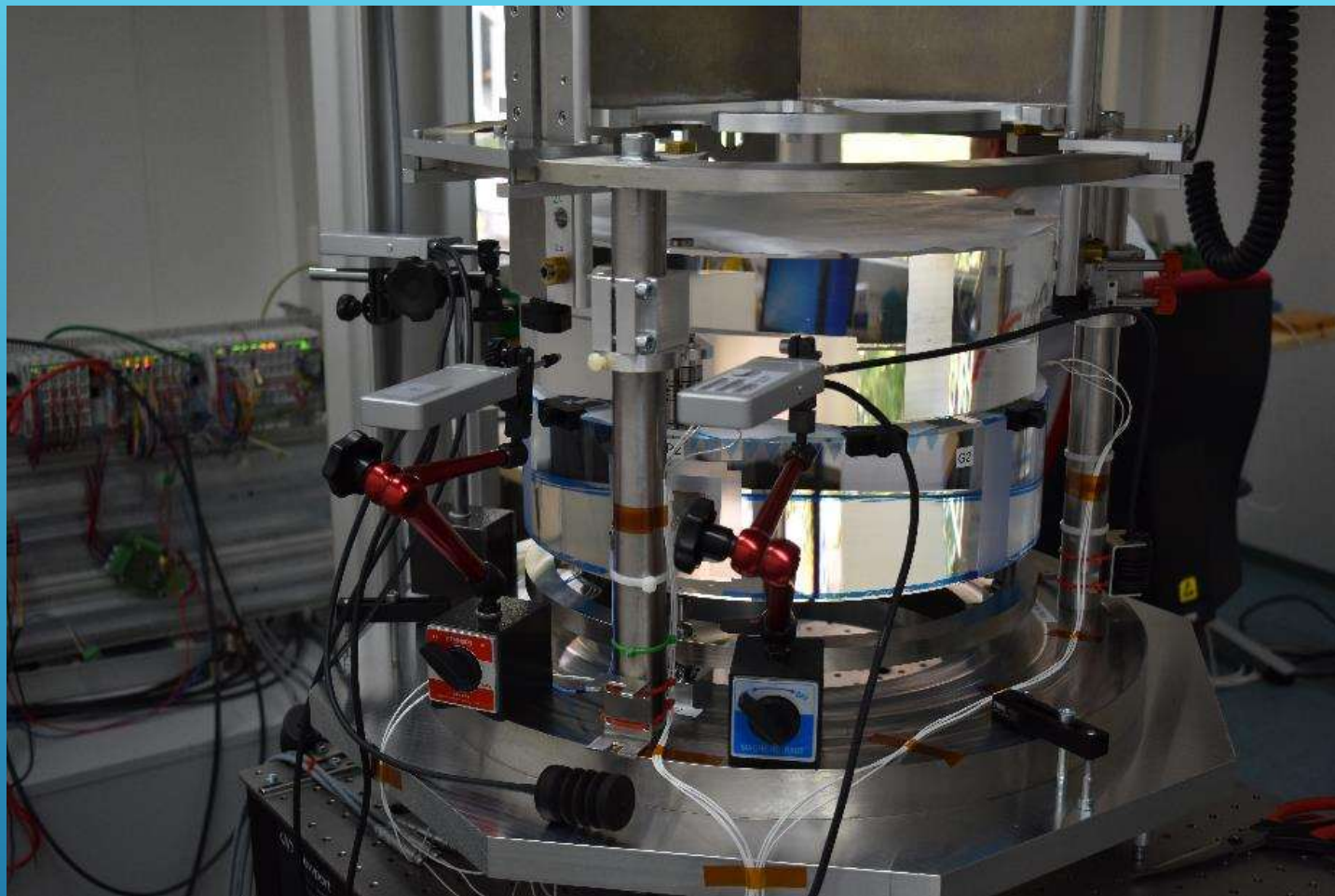
VTF NUMEROINA



Allowed variation of grass height on a soccer field:
~1,5μm RMS



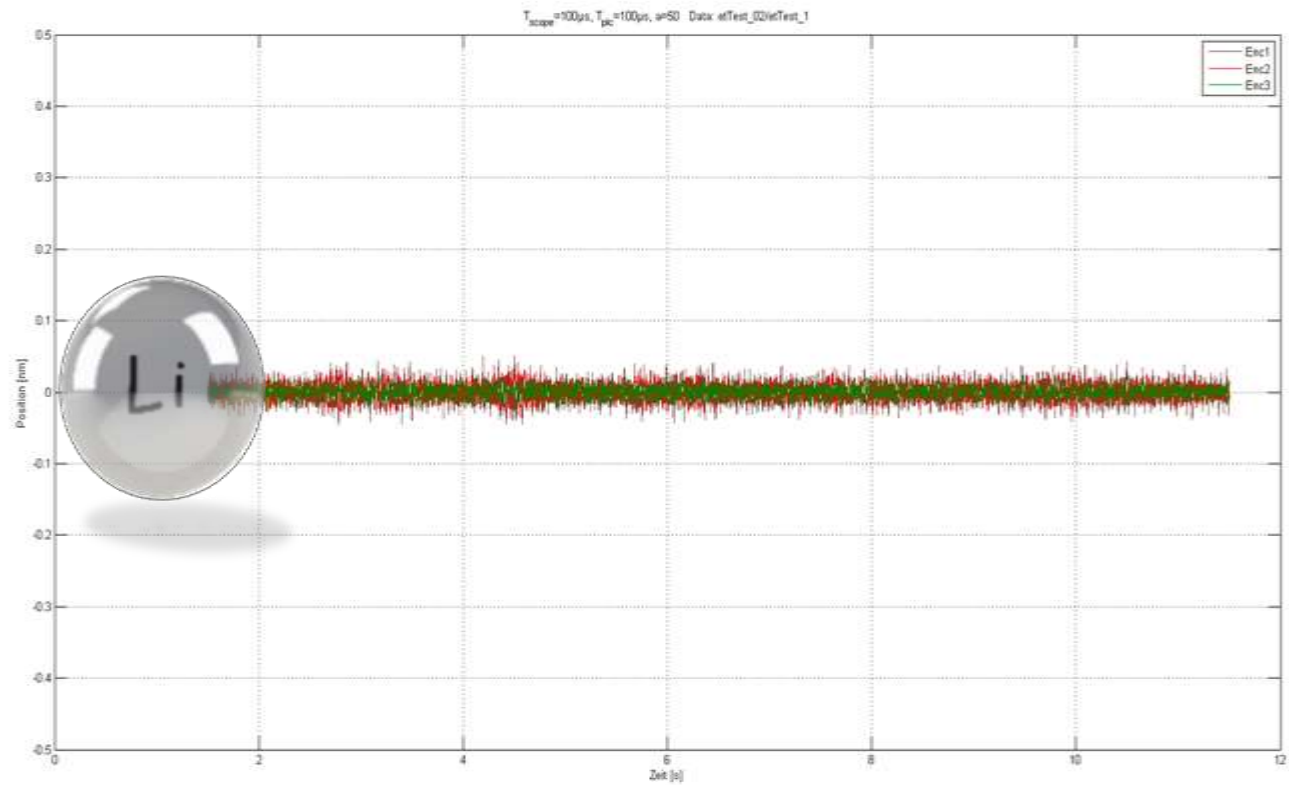
PIEZO-AKTUATORIT



ETALON RAKO $0,55\text{MM} \pm 0,5\text{MM}$

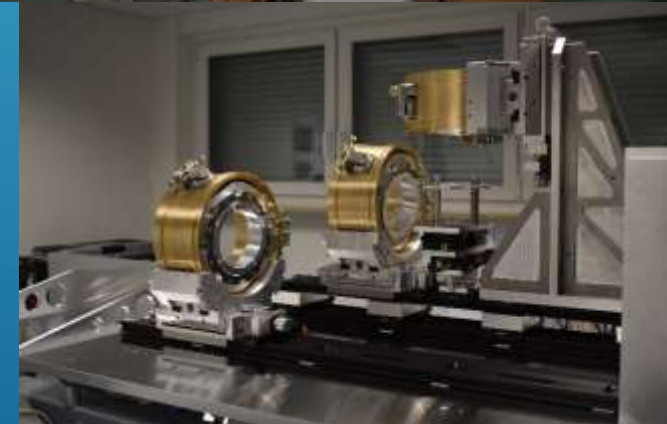


Position; Scale: 0,1nm



ETALONIN SÄÄTÖ

- ▶ 39 yksikköä
- ▶ 272 säädettävää akselia, joista 25 moottoroitua
- ▶ 1430 piirrustusta
- ▶ 2150 valmistettavaa osaa



OPTOMEKANIikka



ETALON LABRA

- ▶ Etalonin testit loppusuoralla
- ▶ Mekaaniset- ja optiset-osat pääosin valmiit
- ▶ Kuljetuslaatikot miltei kaikki valmiit (+ 2 x 22ft merikonttia)
- ▶ DKIST tulee hyväksymistestamaan instrumentin Saksaan 07/2023
- ▶ Instrumentti puretaan moduleihin ja pakataan
- ▶ Osat lähetetään konteissa Hawajille (+ ilmarahhti)
- ▶ Laivakuljetus kestää n. 2kk
- ▶ Hawajilla rahti + kuljetuskalusto puhdistetaan (2 vkoa) → kontit kuljetetaan Haleakalan huipulle odottamaan asennusta
- ▶ VTF:n asennus 01/2024 ->

PROJEKTIN VAIHEET 2023

KIITOS!

