Technische
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What Does Cherenkov`s OMA Look Like?

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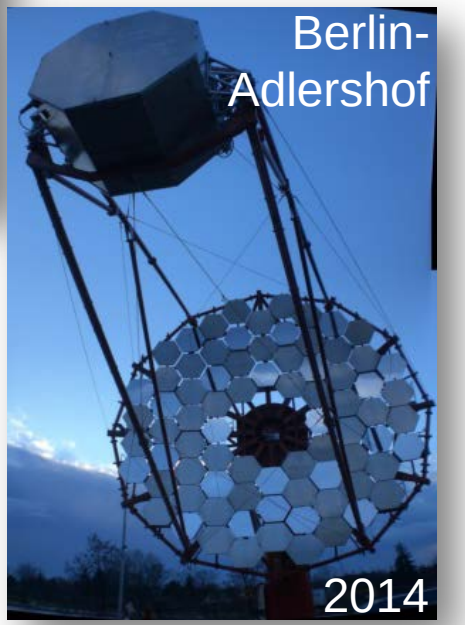
InnoTesting 2015, Feb. 20th, Wildau

What Does Cherenkov`s OMA Look Like?

- Pawel Cherenkov
- Cherenkov-Telescope
- OMA – Operational Modal Analysis
  - Eigenfrequencies
  - Modal Damping
  - Mode Shapes

https://de.wikipedia.org/wiki/Pawel_Alexejewitsch_Tscherenkow#mediaviewer/File:Cerenkov.jpg, 20141209

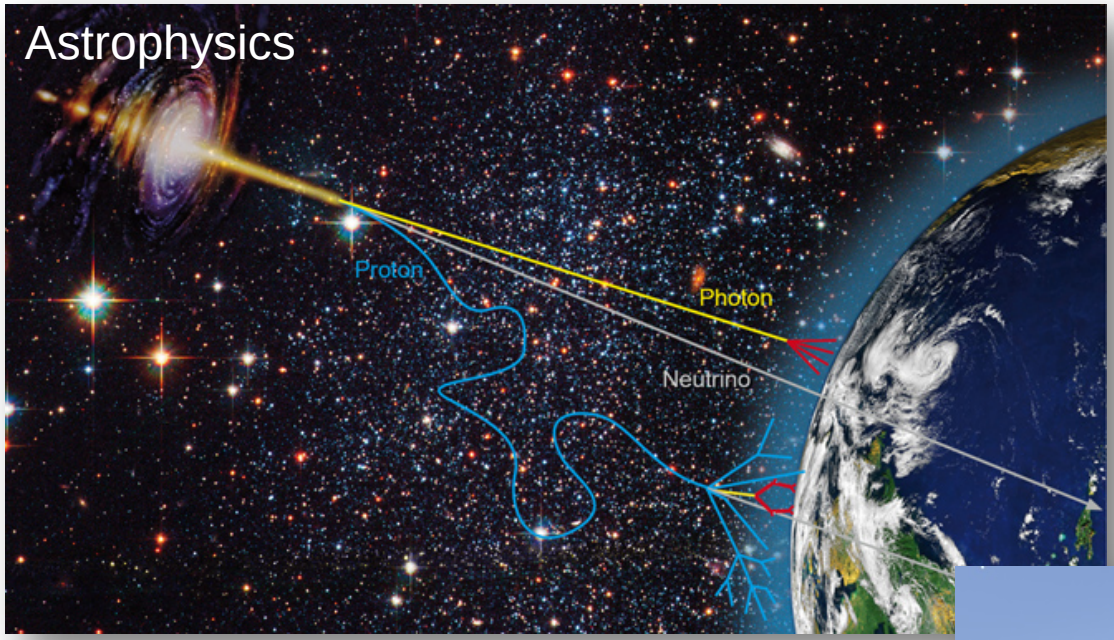


Mode	Mode Shape	Eigenfrequency in Hz		Damping in %
		FEA	OMA	OMA
1	Telescope-Head-Yaw	1,549	0,778	6,917
2	Telescope-Head-Pitch	2,052	1,135	11,243
3	Telescope-Head-Roll	2,765	2,293	0,975

Agenda

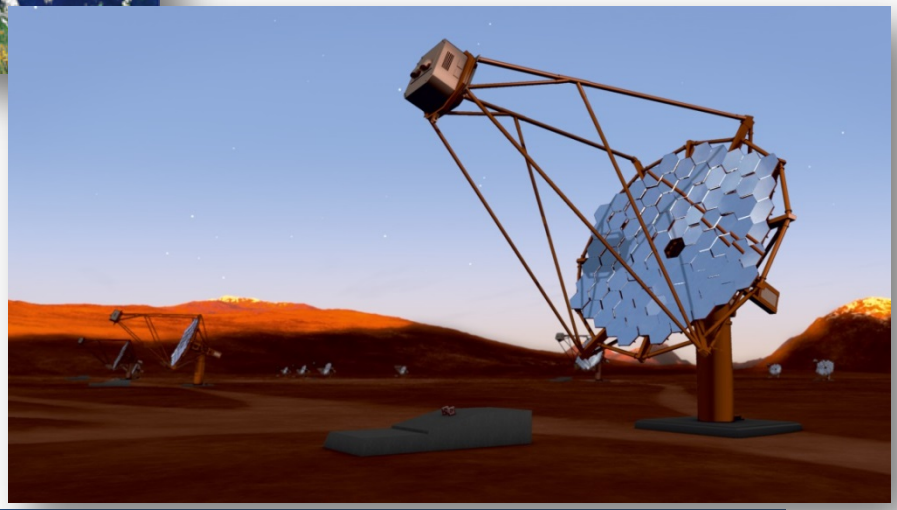
- Background/ Project
- Condition Monitoring
- Modal Analysis/ Operational Modal Analysis
- Measurement Setup
- Cherenkov‘s OMA

Project



Source:
https://astro.desy.de/sites2009/site_astro/content/e63733/astro-web-titel_eng.jpg

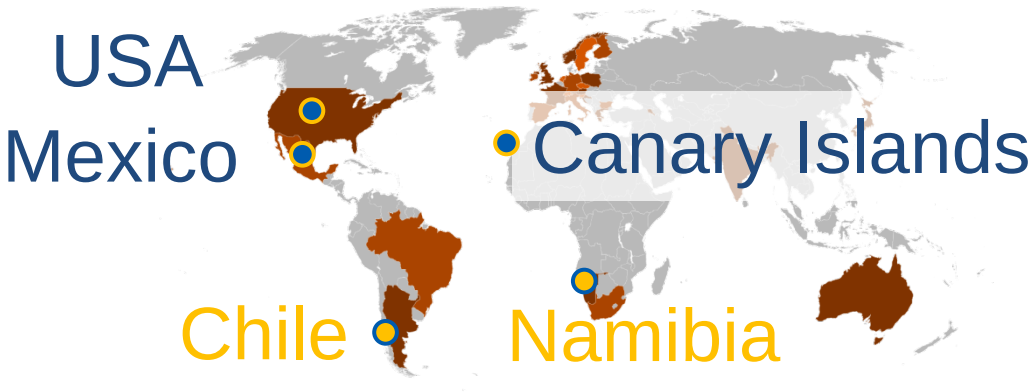
Source:
http://astro.desy.de/sites2009/site_astro/content/e104979/e105782/e111632/e126607/e156827/column-objekt156837/img/ArraywithMSTinfront_eng.jpg



Cooperation

- Deutsche Elektronen-Synchrotron DESY Zeuthen (Helmholtz Association of German Research Centres)
- Young Scientist Research Group for Structural Dynamics Optimization (ESF+Brbg.)
- Monitoring: Structure + Drive System

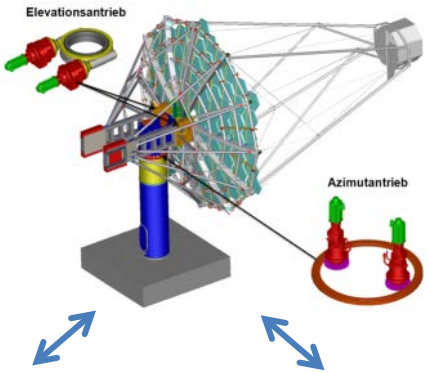
Background: Cherenkov Telescope Array (CTA)



Source: https://en.wikipedia.org/wiki/File:CTA-Consortium_Countries_of_Member_Institutes.svg, modified

Source: https://portal.cta-observatory.org/SiteAssets/Pages/Home/CTA_array_sm.jpg

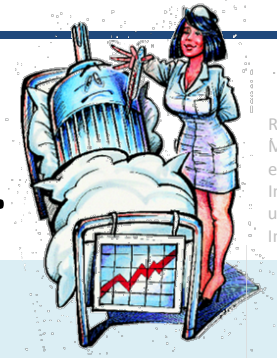
Monitoring



Structure
- Load
- Connections
- Cracks
- …

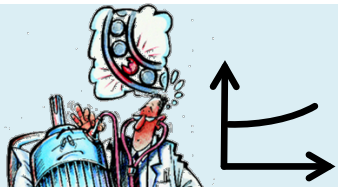
Drive
- Gears
- Bearing
- …

Condition…

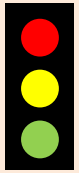


Rüdiger Proff (Prüftechnik Condition Monitoring GmbH): Mobile schwingungsbasierte Maschinendiagnose als elementarer Bestandteil der zustandsorientierten Instandhaltung - Konzepte, Messtechnik, praktische Beispiele und Nutzenstiftung. Netzwerksitzung Märkisches Netzwerk Instandhaltung in Iserlohn am 29.1.2009

Monitoring
- Acquire measurement data
- Trend analysis



Diagnostics
- Utilizes measurement data
- Detect and evaluate damages



Prognostics
- Utilizes measurement data AND models
- Forecast of remaining lifetime

- Machines – Condition Monitoring
- Structures – Structural Health Monitoring

Monitoring

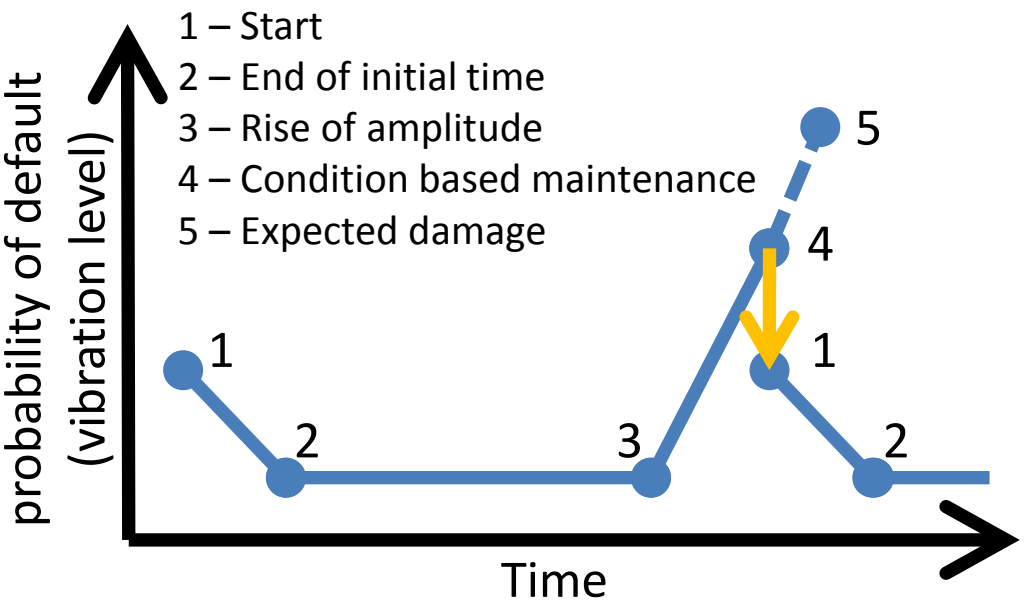
Alternatives: use until break down; preventive maintenance

Advantages: condition based maintenance possible

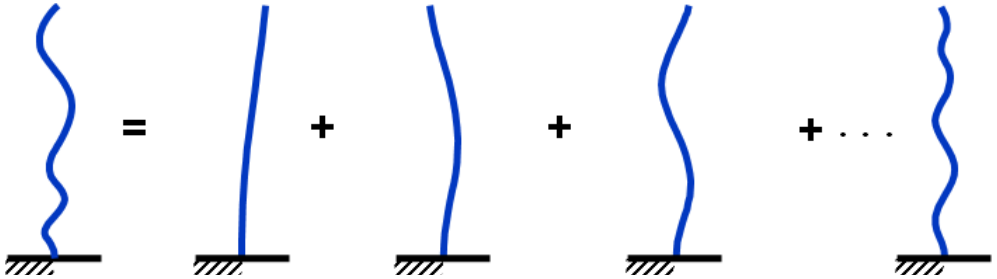
- Use full life time of components
- Unnecessary dismantling is avoided
- Consequential damages are mostly excluded
- Prognosis is possible

Disadvantages: Costs

- Planning
- Sensors
- Measurements
- Analysis



Modal Analysis



P. Andersen: Hatch / SVS Meeting, 20130115

Modal Analysis

! ? !

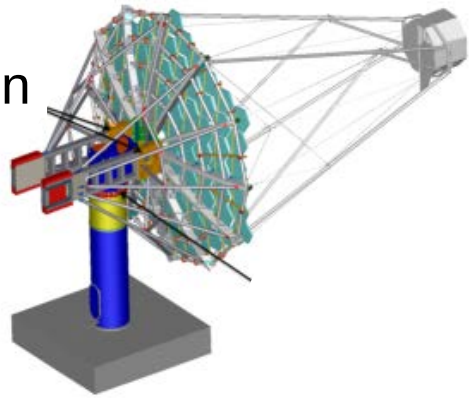
Answer= Structure x Excitation

↓

Frequency Response Function

Mathematics ↓ Model

- Eigenfrequencies
- Modal Damping
- Mode shapes



Operational Modal Analysis (OMA)

! ?

Answer → Structure ~~x Excitation~~

Mathematics
Statistics

↓

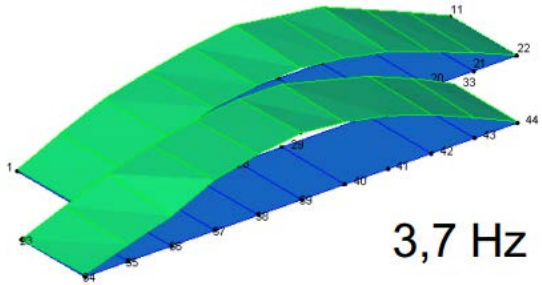
- Eigenfrequencies
- Modal Damping
- Mode shapes

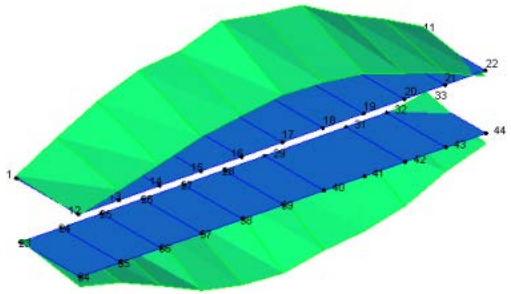
Operational Modal Analysis (OMA)

- Think!
- Simulation (e.g. Finite Element Analysis)
- Define measurement grid and parameter
- Measurement
- Analysis incl. Validation
- Eigenfrequencies, Damping, Mode Shapes
- Evaluation of results

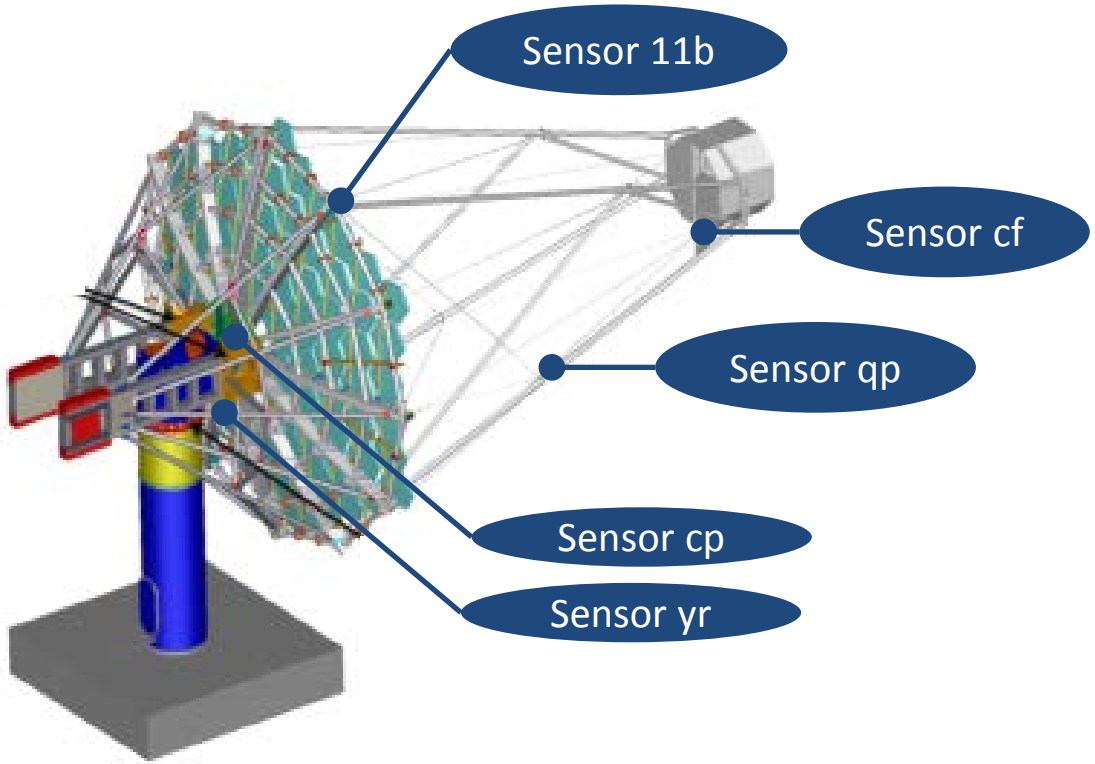
→ Condition monitoring

P. Andersen: Hatch / SVS Meeting, 20130115



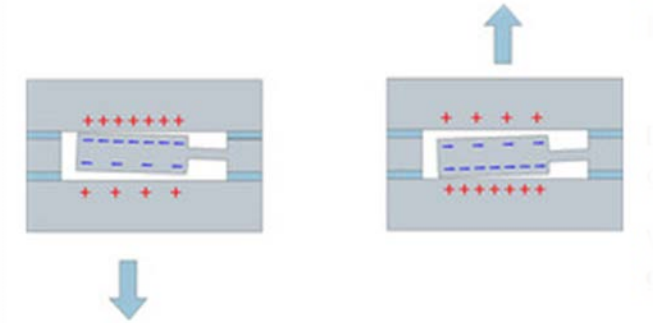


Cherenkov-OMA Setup

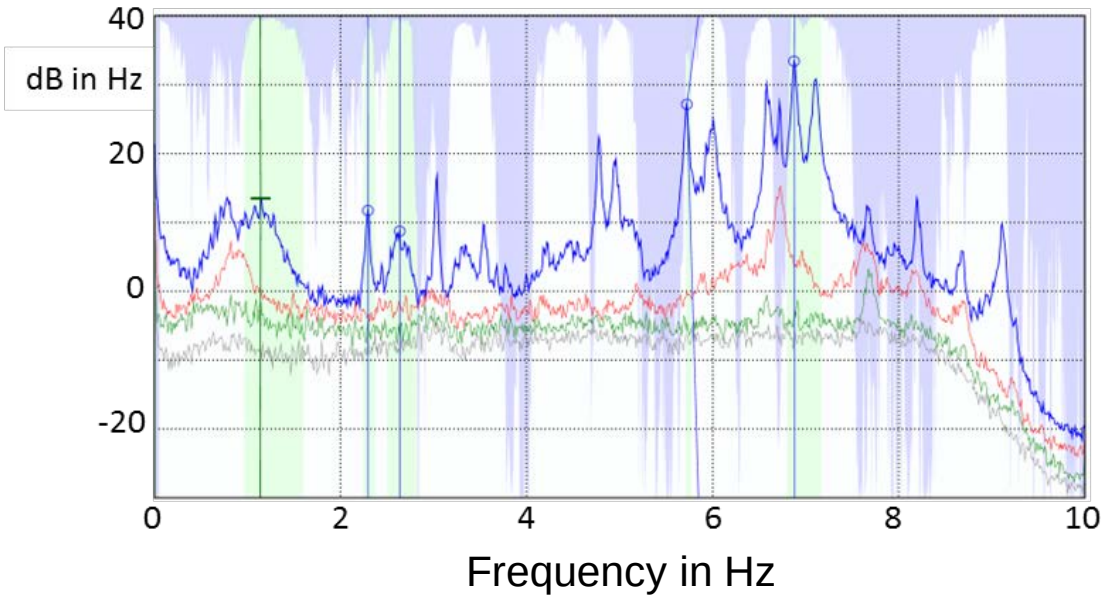


Five 2-axis sensors

Sensors - capacitive



Cherenkov‘s OMA: Results



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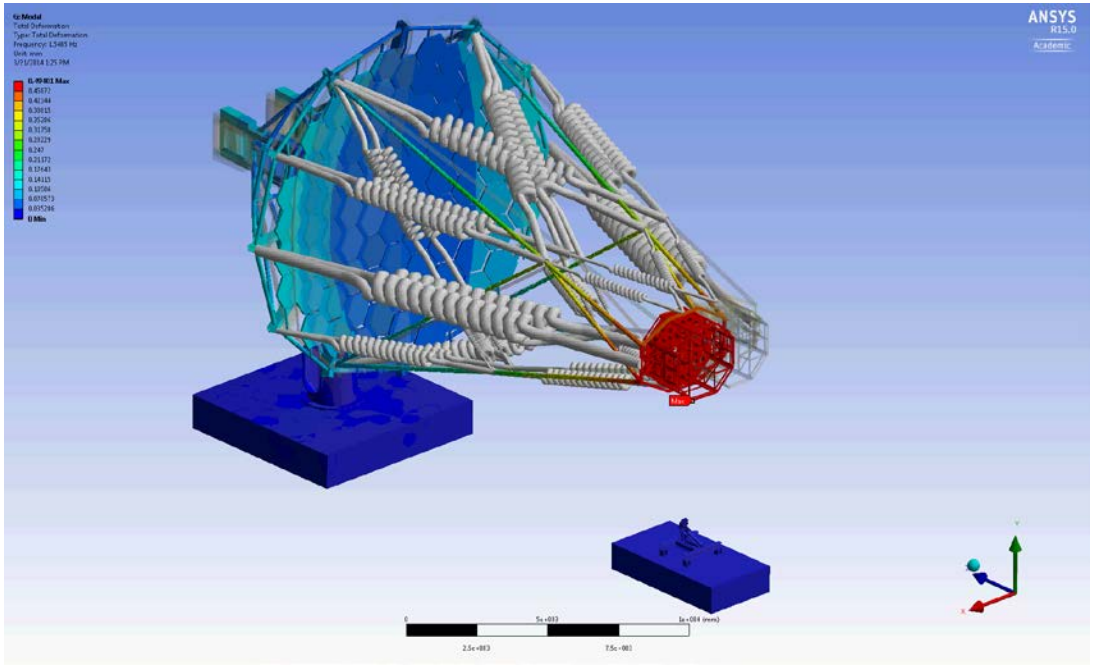
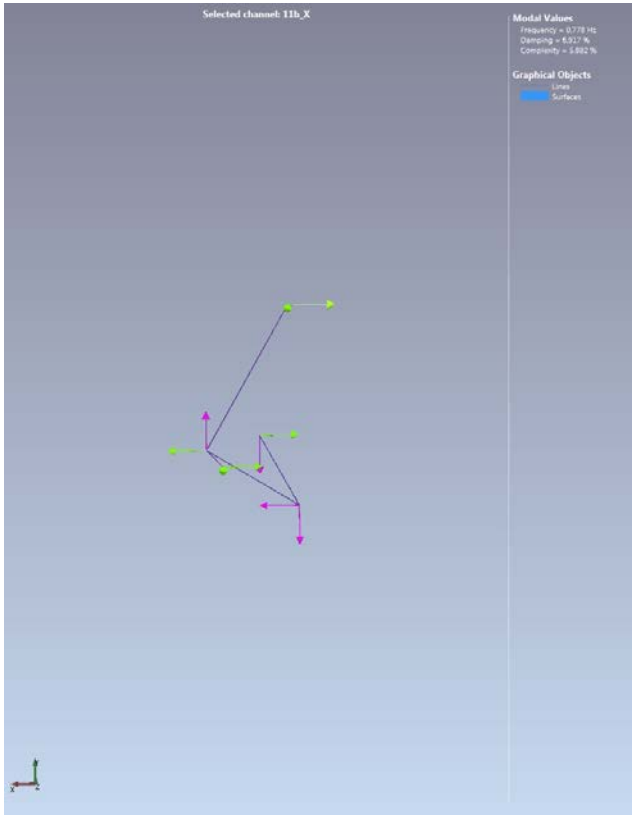
Mode 1: Yaw

FEA

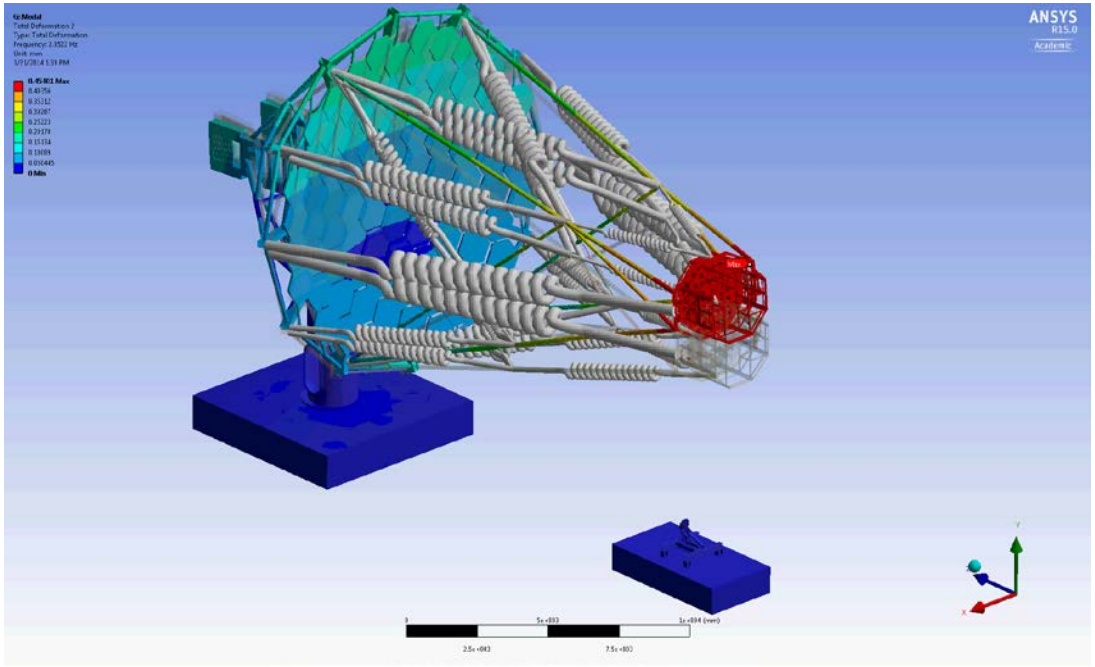


OMA

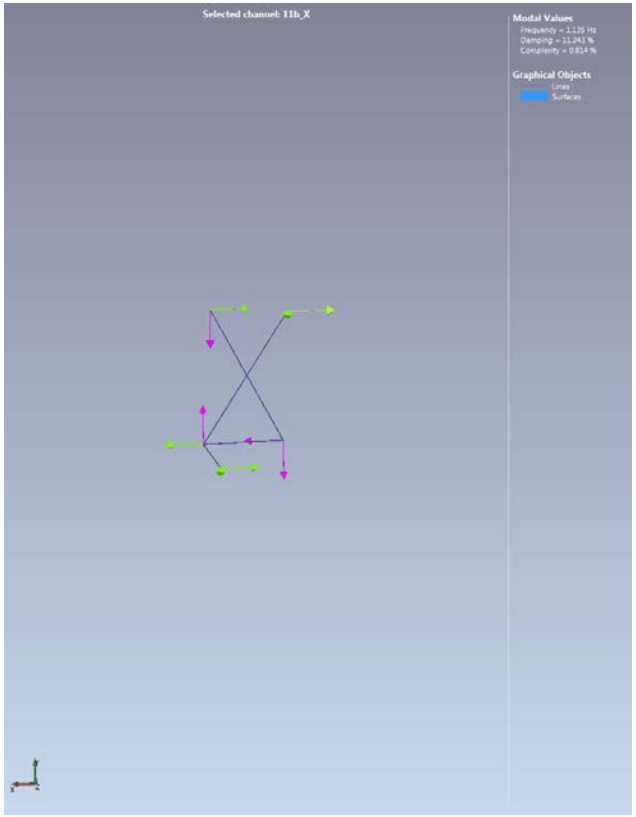


Mode 2: Pitch

FEA

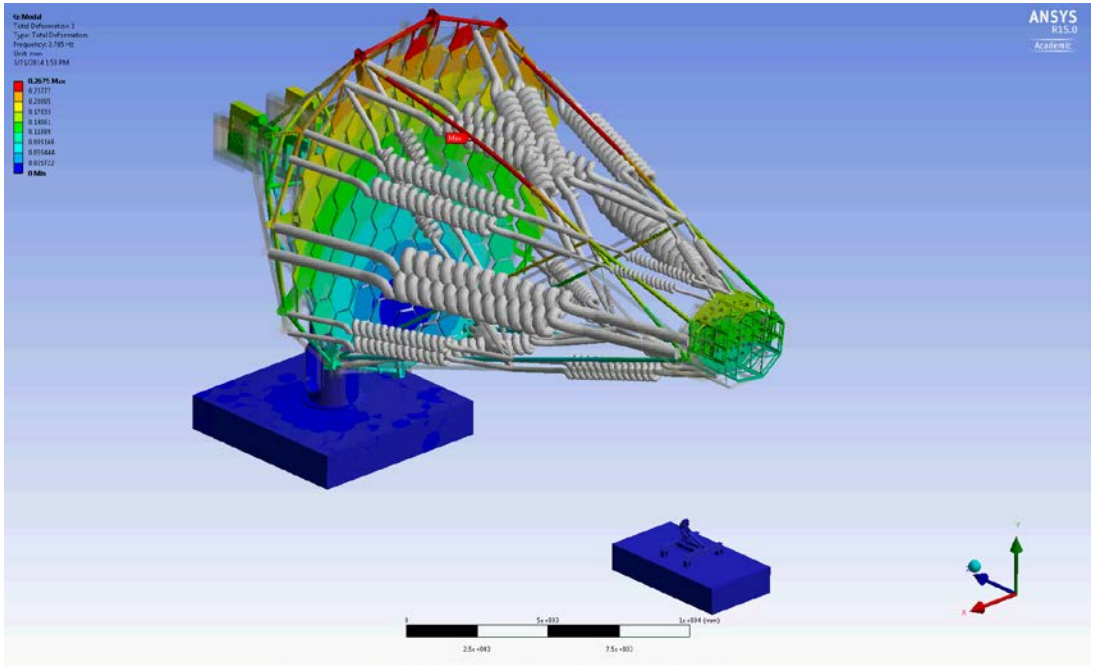


OMA

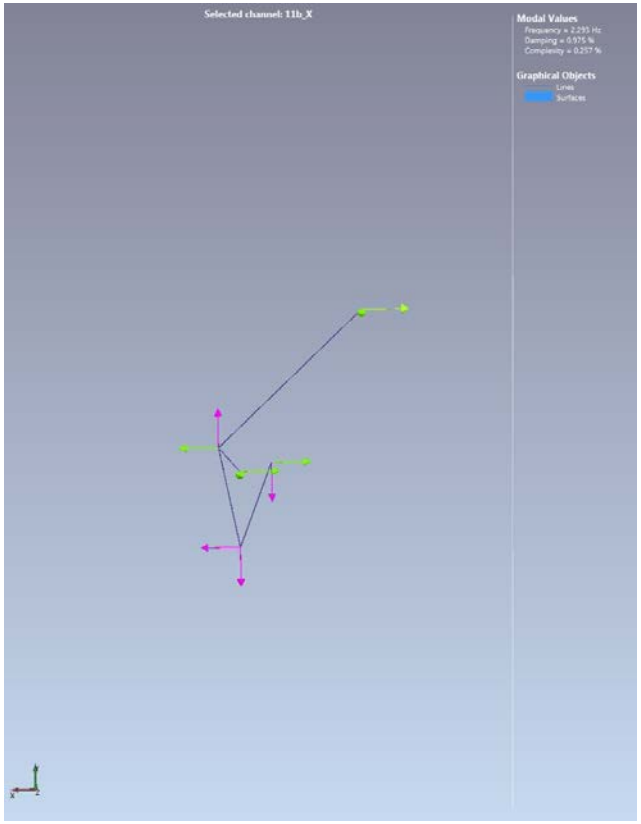


Mode 3: Roll

FEA



OMA



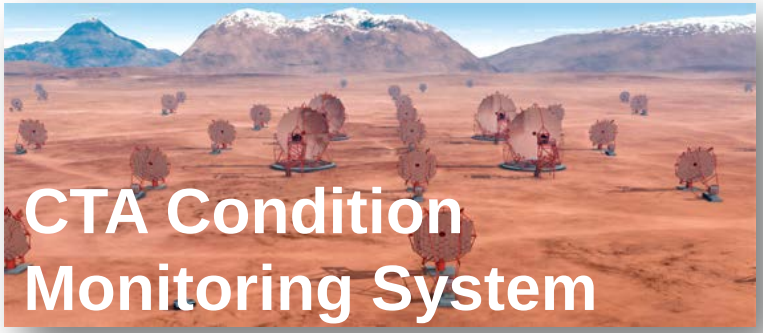
Further Work

FE-Model Update

Continuous Measurements

Establish data base

Analysis



Trends
Alarm values
Condition index

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Europäischer Sozialfonds

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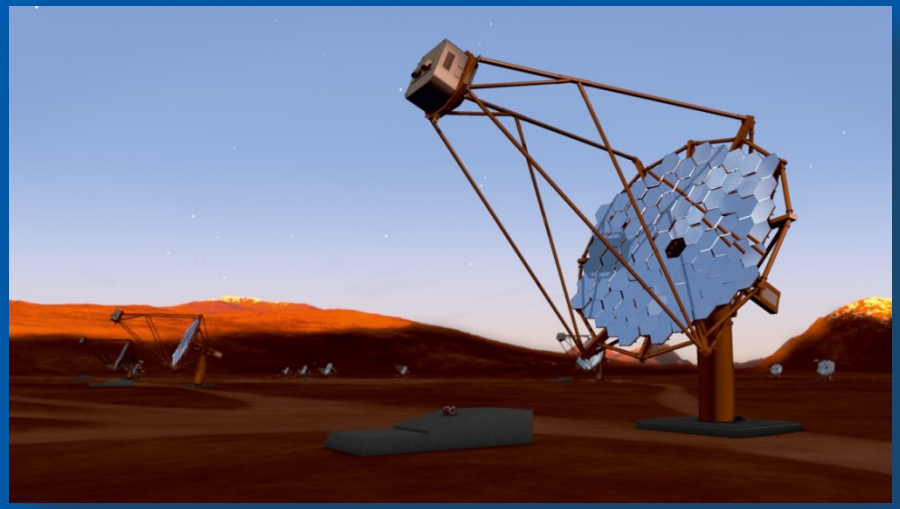
WILDAU



Thank you for your attention.