

Recent activities using Distributed Acoustic Sensing at DESY

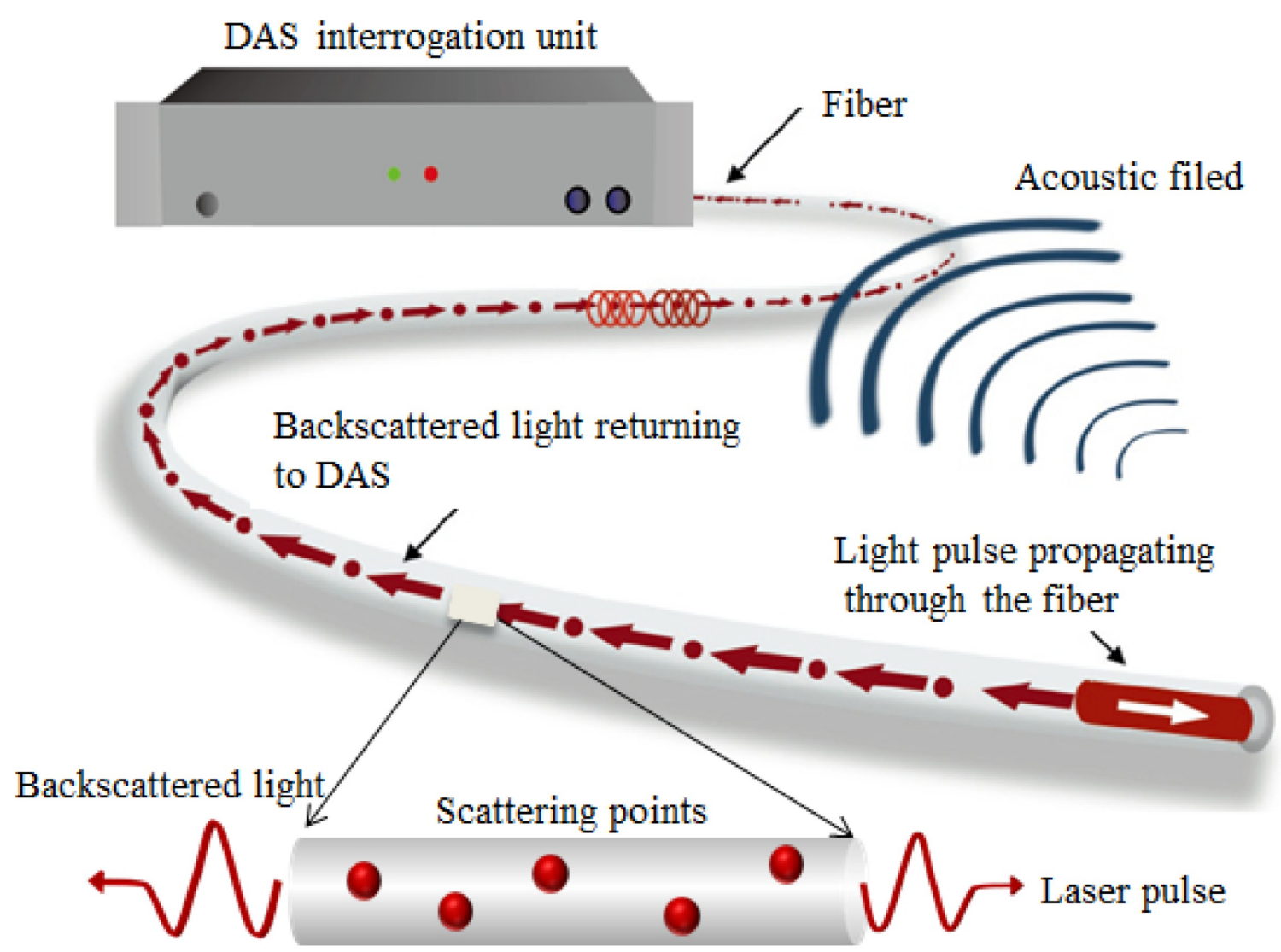
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<https://wave-hamburg.eu/>



Distributed Acoustic Sensing (DAS)

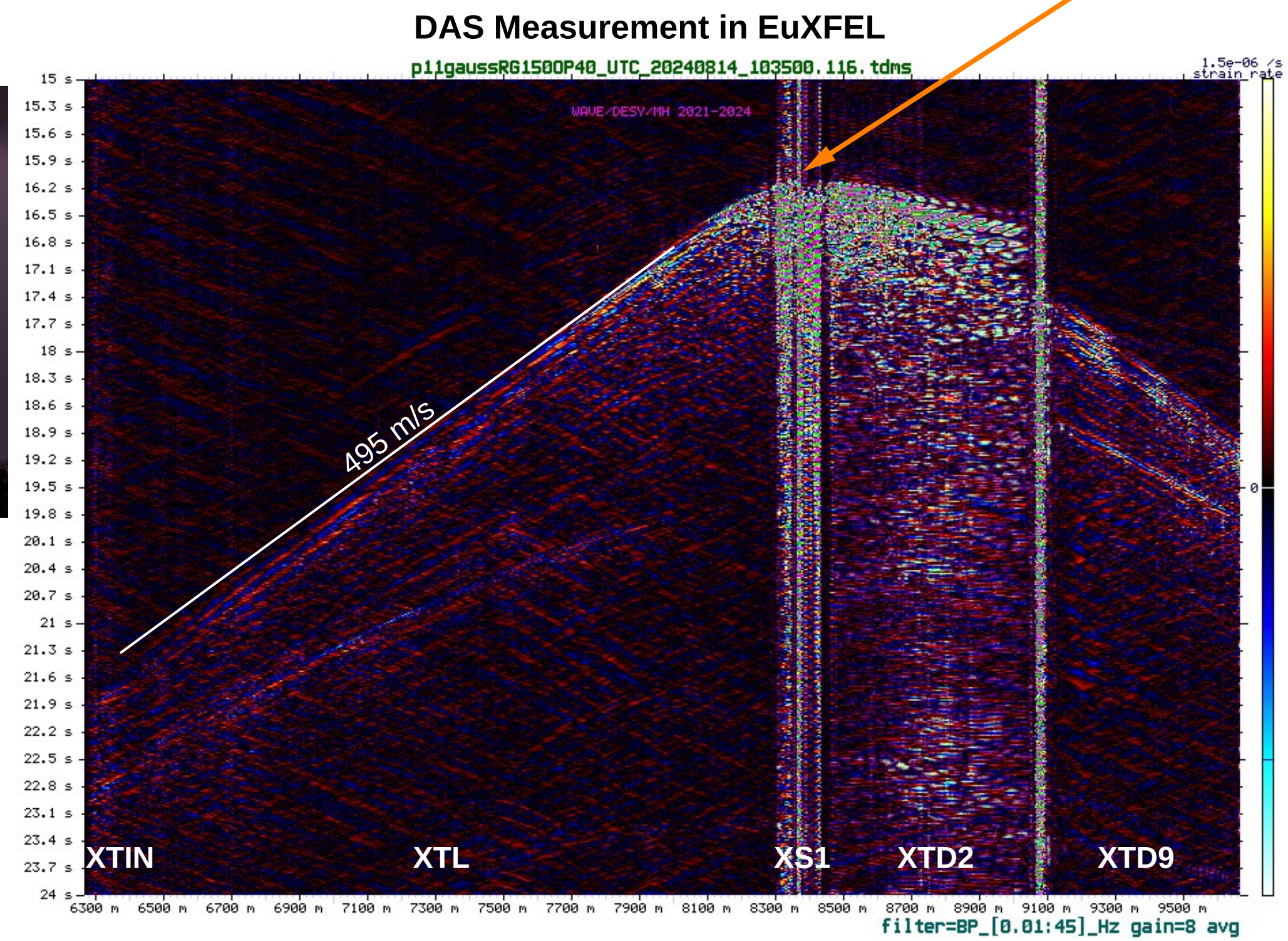
1. Interrogator sends laser pulse into optical fibre
 2. Laser pulse is back-scattered throughout the fibre (Rayleigh Backscattering)
 3. The returning signal is sampled at high frequency (GHz).
- The phase of the returning signal is proportional to the strain of the fibre along 10 metres.
 - The delay of the returning signal determines the location along the fibre.



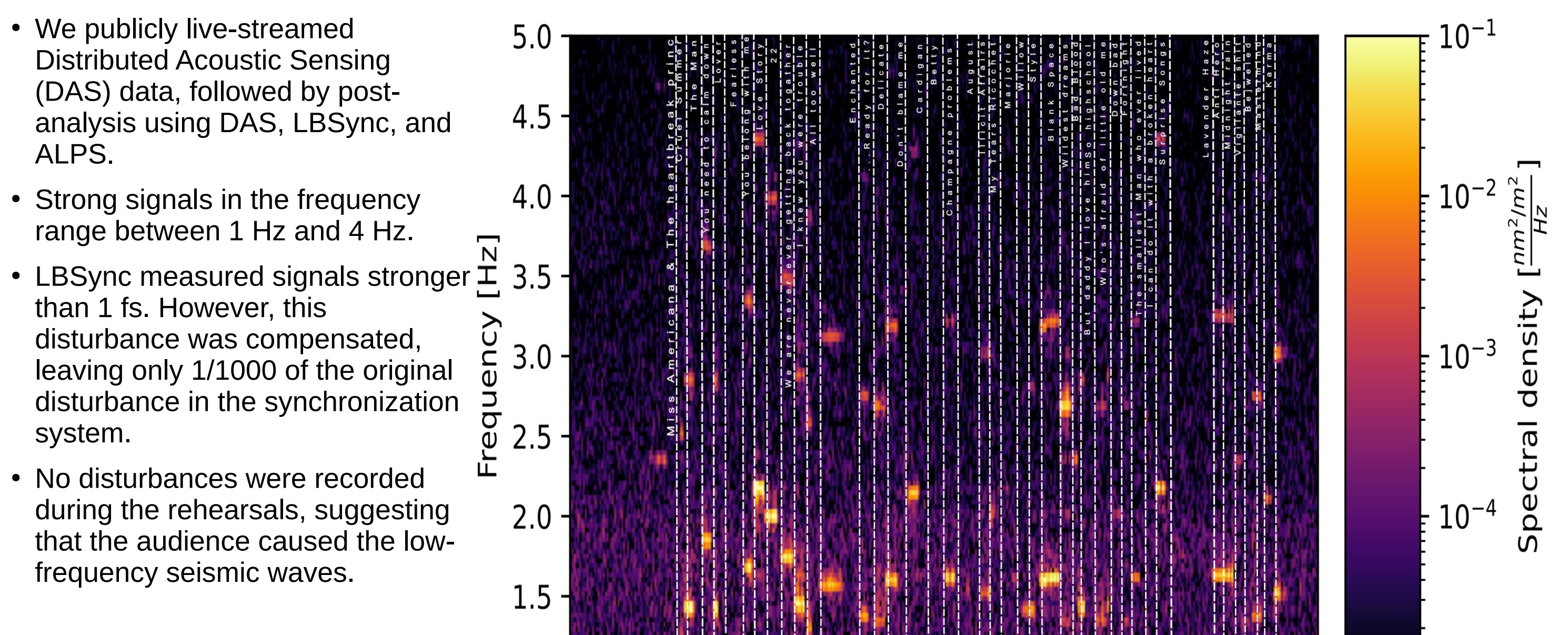
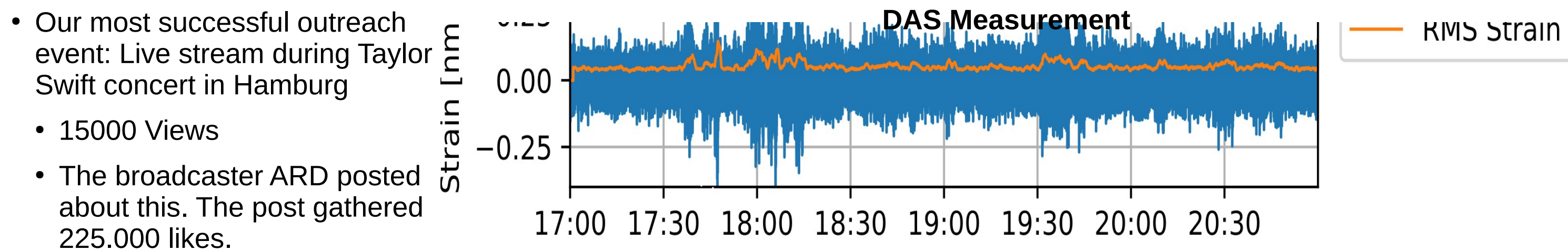
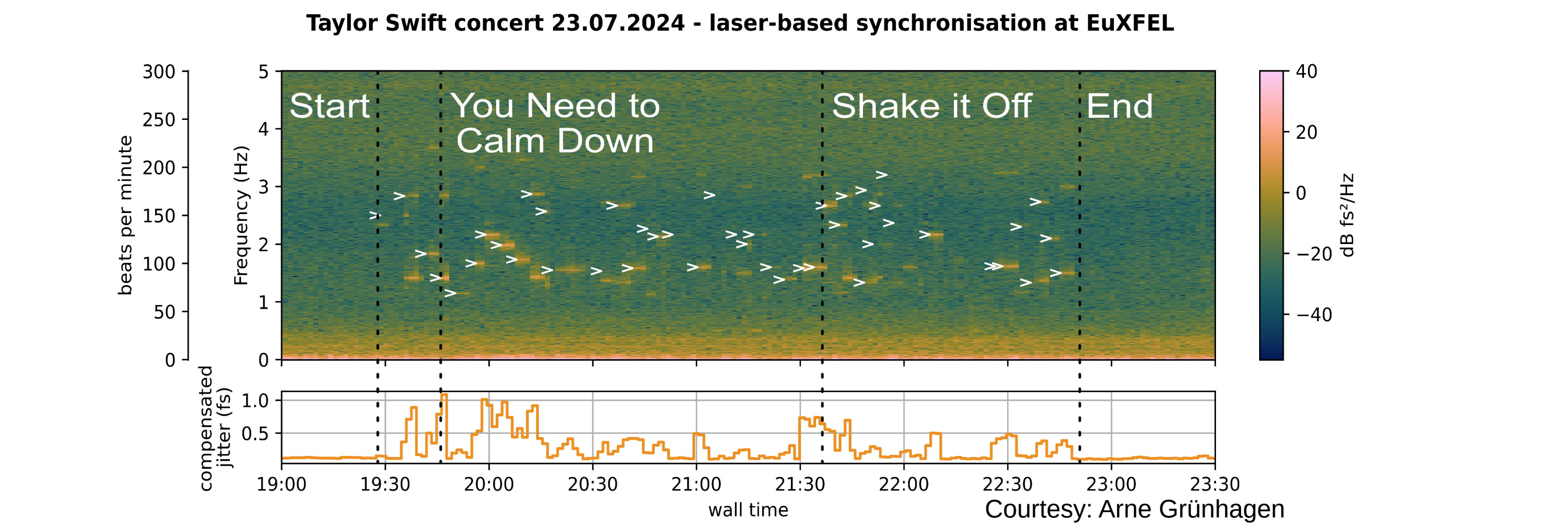
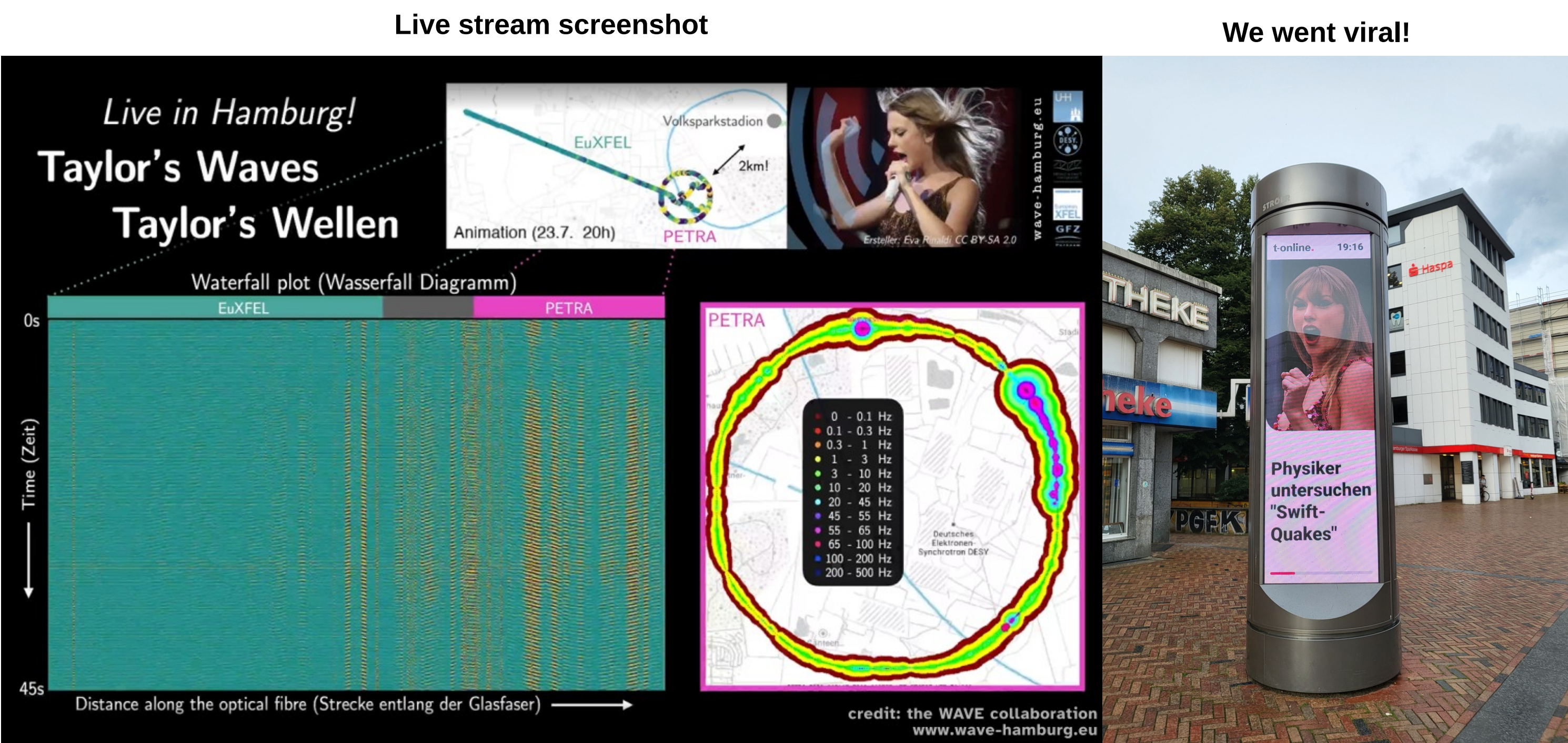
Lightning strike at the European XFEL XS1 building



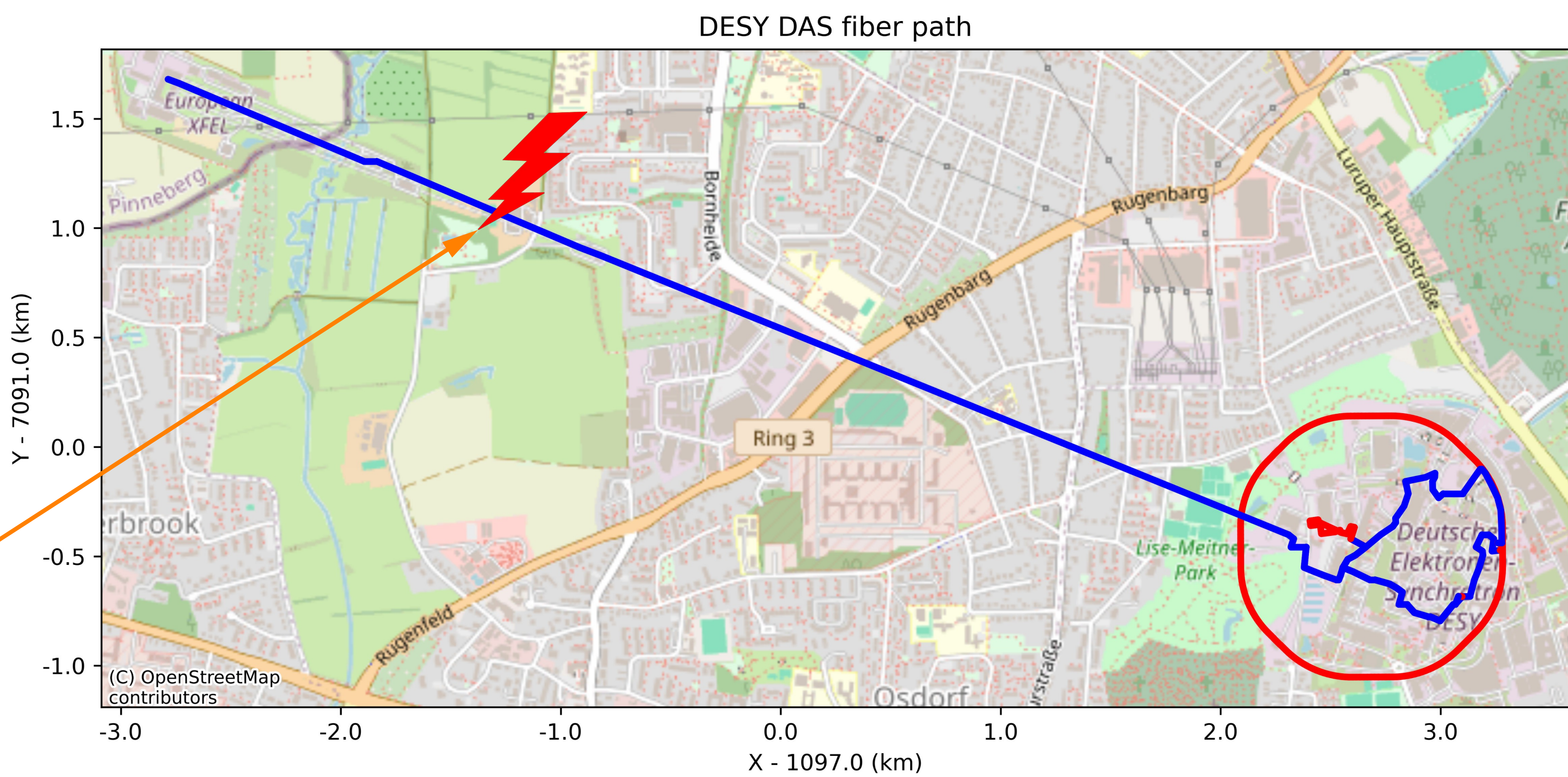
Phase velocity of 495 m/s suggests, that the wave is a shallow surface wave travelling through the soil



Taylor Swift outreach live stream

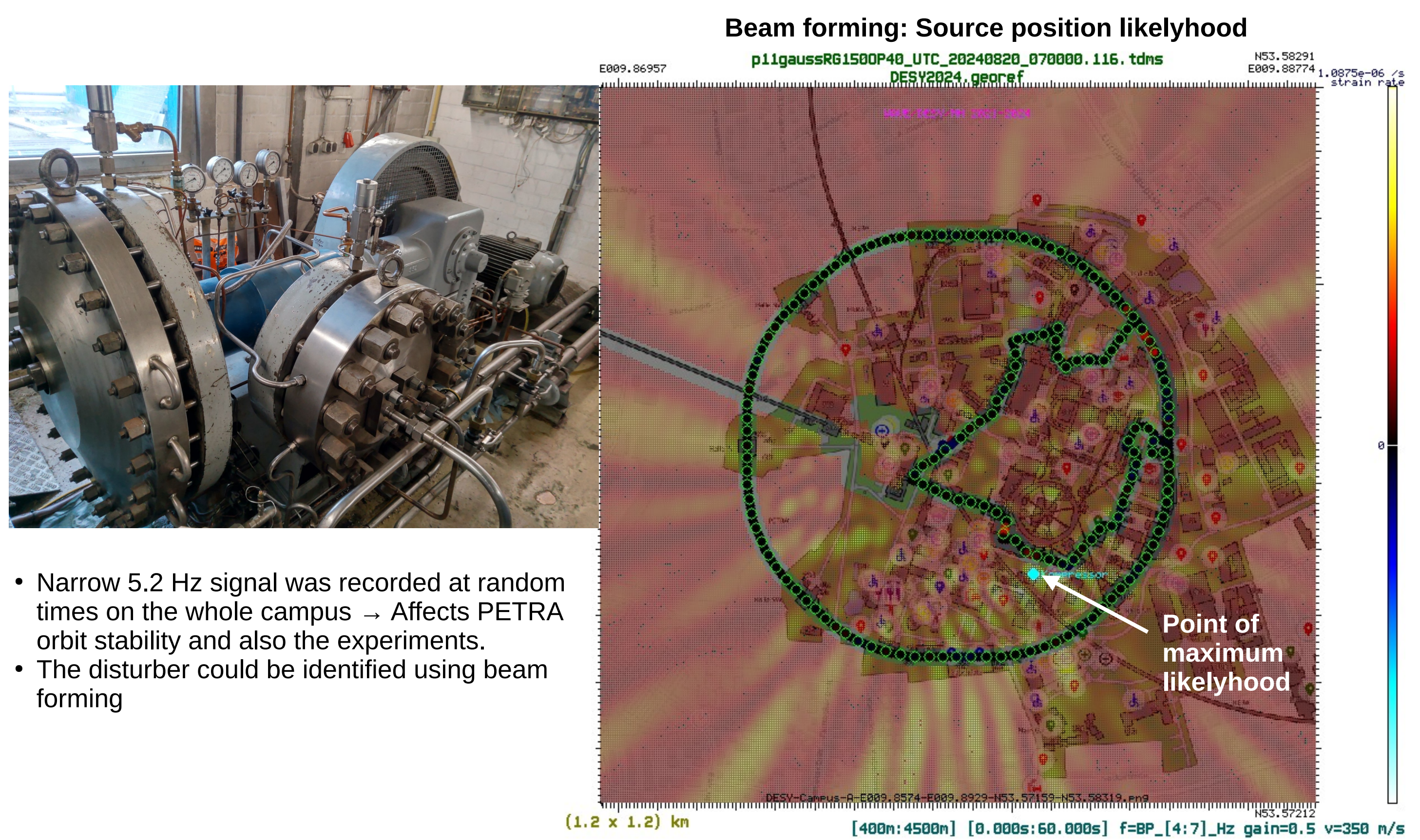


DAS on the DESY campus



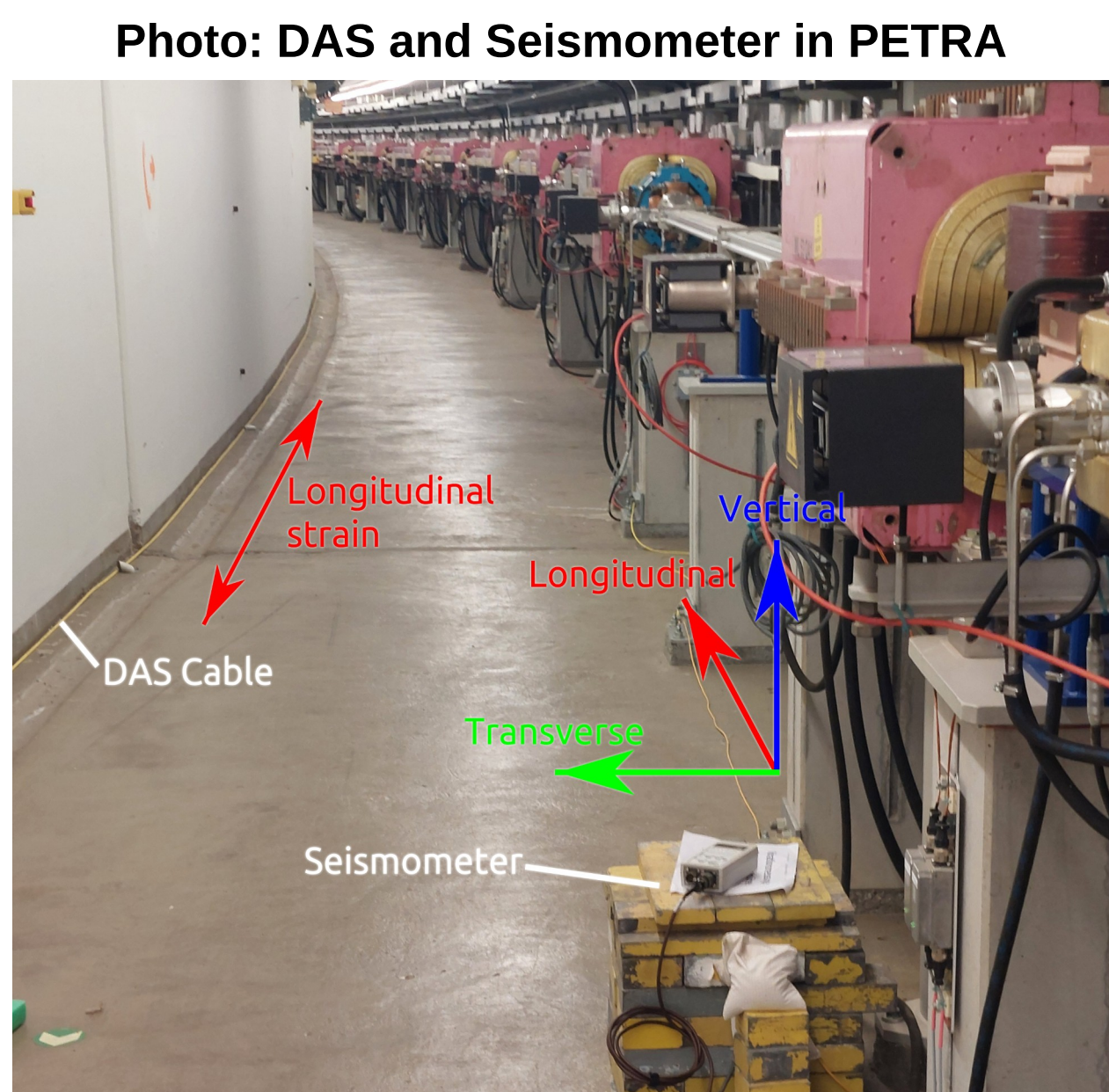
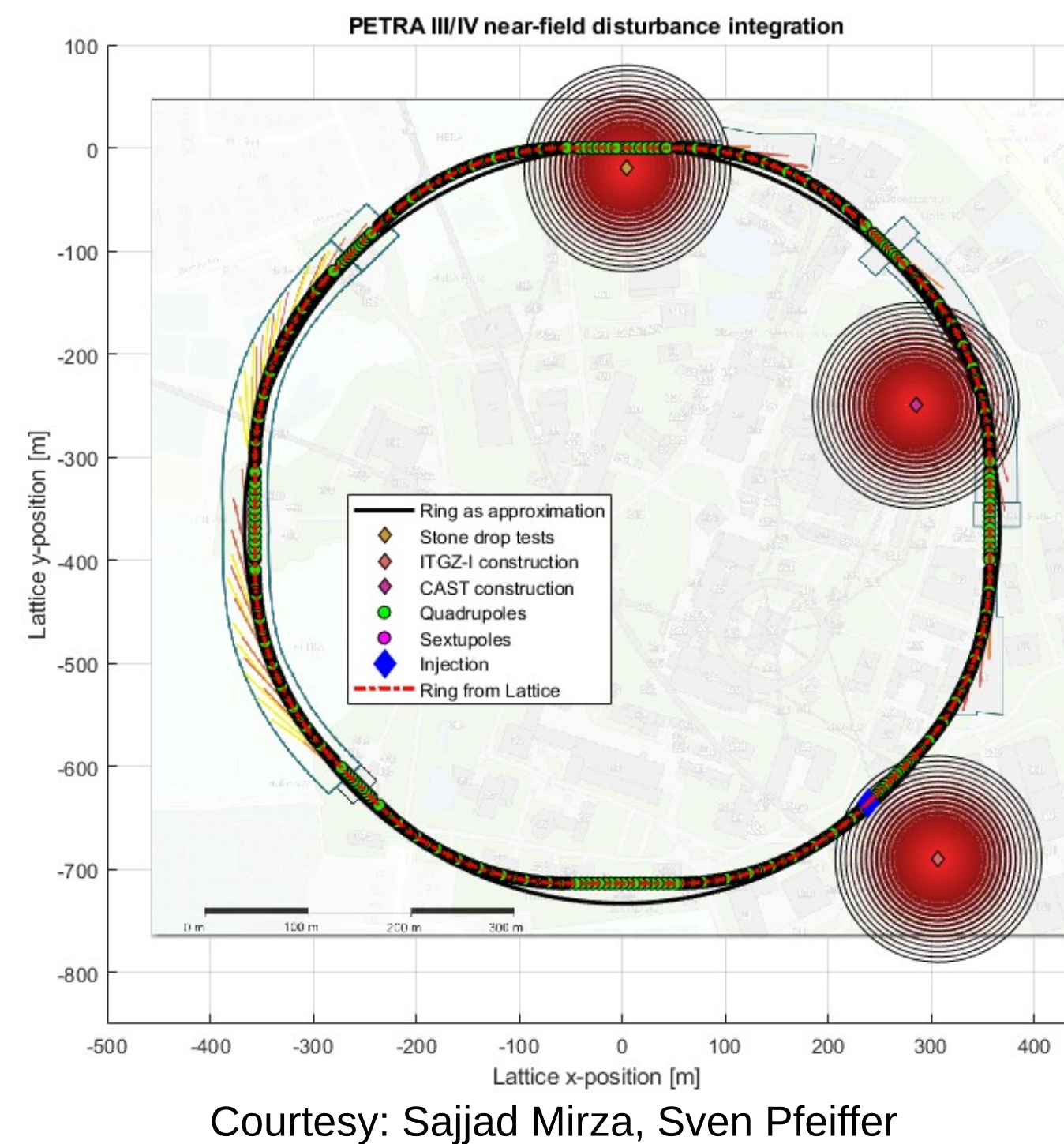
Since 2021 the WAVE-collaboration (<https://wave-hamburg.eu>) has deployed a long fiber path using existing and newly installed fiber cable to use DAS for detecting seismic and acoustic signals along the fiber with a spatial resolution of 1 meter and a sample frequency of 1 kHz. A single interrogator serves a fiber path of 15 km length. It captures 2.3 TB of data per day which can be visualized in real-time on <https://dasweb.desy.de>.

Localization of 5 Hz signal (Heliumcompressor)



PETRA IV orbit stability with DAS

Orbit stability in the PETRA III light source plays an important role for its upgrade to PETRA IV. The PETRA tunnel is made of individual segments that move against each other, caused by seismic and acoustic waves.



- DAS measures strain along the beam direction
- Seismometer measures velocity along three axes. Velocity can be integrated to displacement.
- For the orbit stability the displacement in the transverse direction matters.
- We try to use DAS to develop a ground motion model for PETRA IV.

