

Low-Frequency Impact

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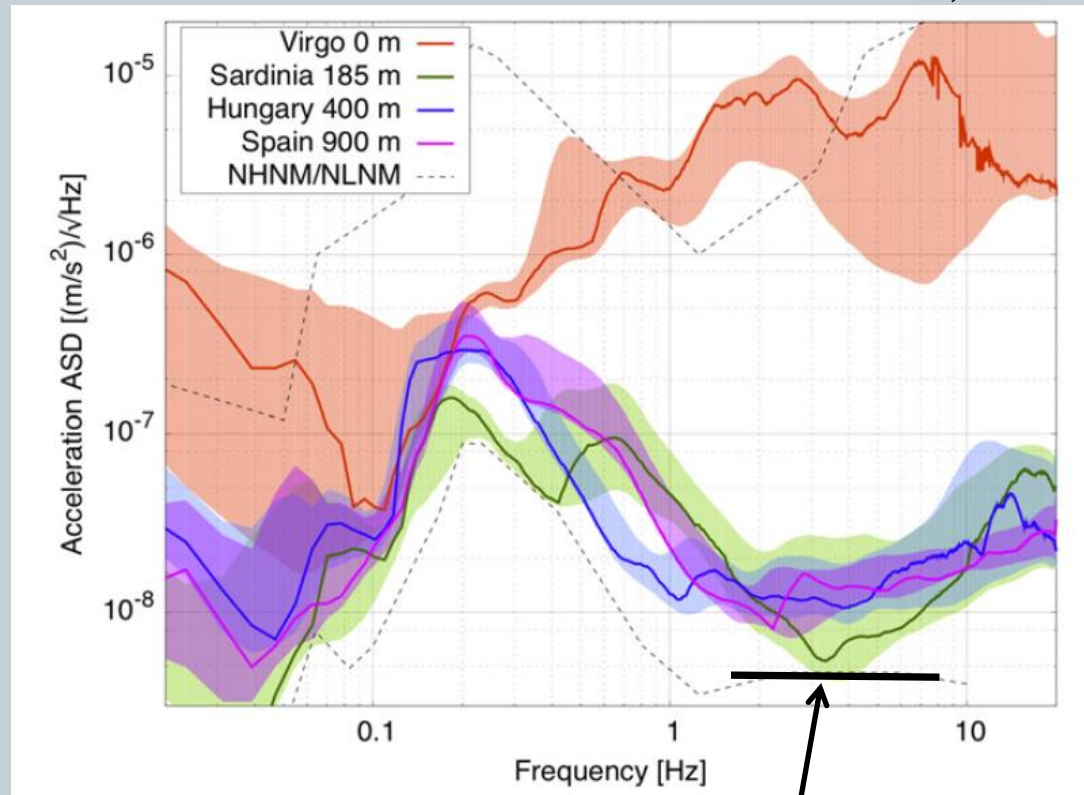
JAN HARMS & JENNE DRIGGERS

GWADW 2016

Underground Seismic Spectra

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Beker et al, 2012



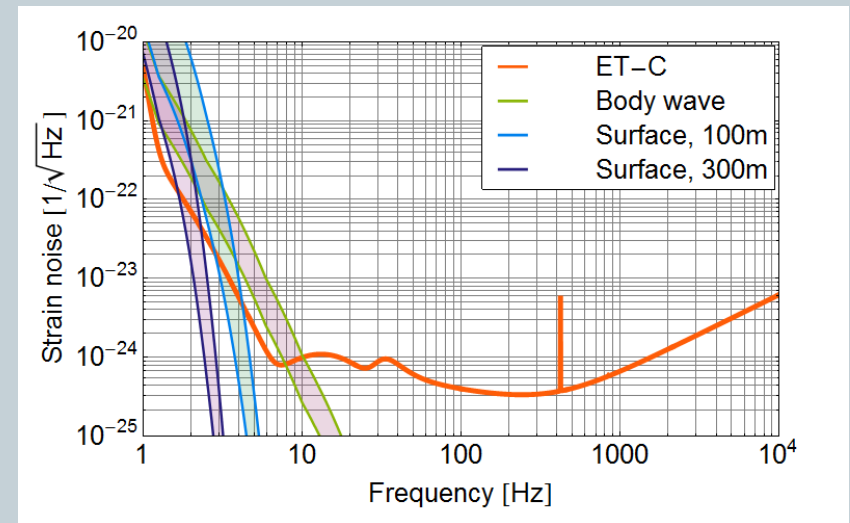
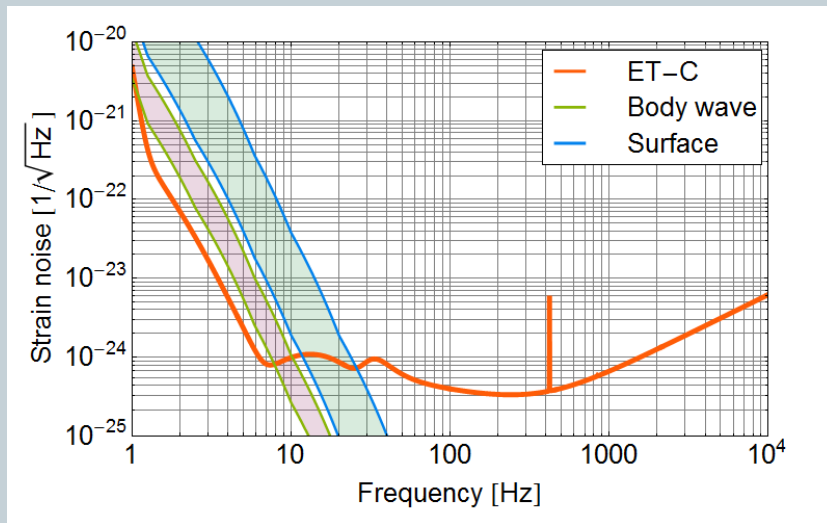
Requirement ET
(conservative: underground displacement dominated by compressional waves)

Seismic NN

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Seismic NN in a surface detector

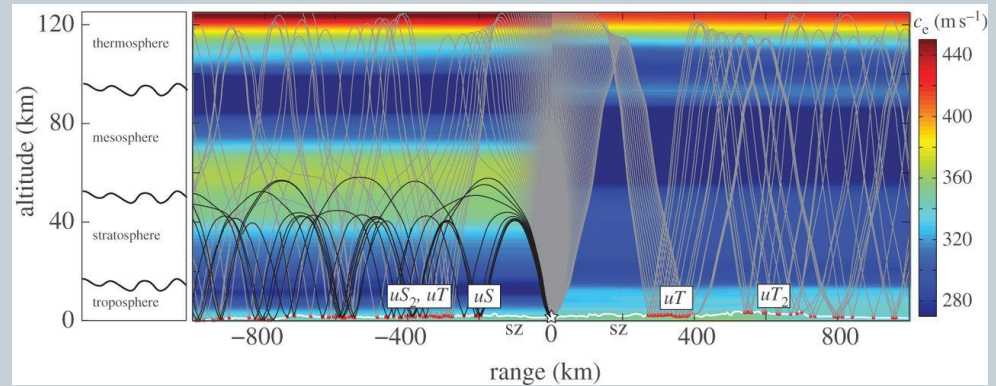
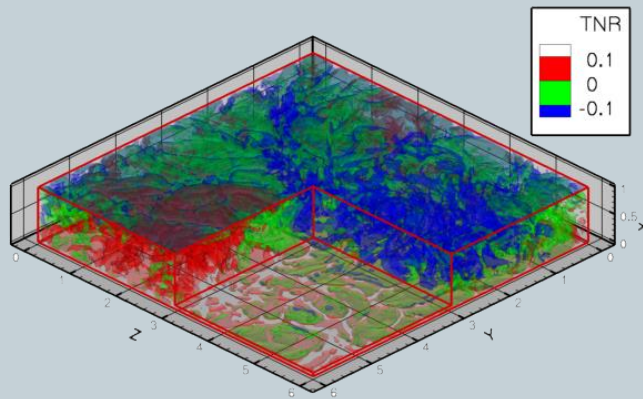
Seismic NN in an underground detector



- Seismic models: Body wave: 3x – 12x LNM, Surface: 50x – 1000x LNM
- Rayleigh dispersion model: 1.5km/s @ 1Hz → 300m/s @ 10Hz
- Includes contributions from cavity-wall displacement
- Homogeneous half space (except for Rayleigh dispersion)

Modelling Atmospheric NN

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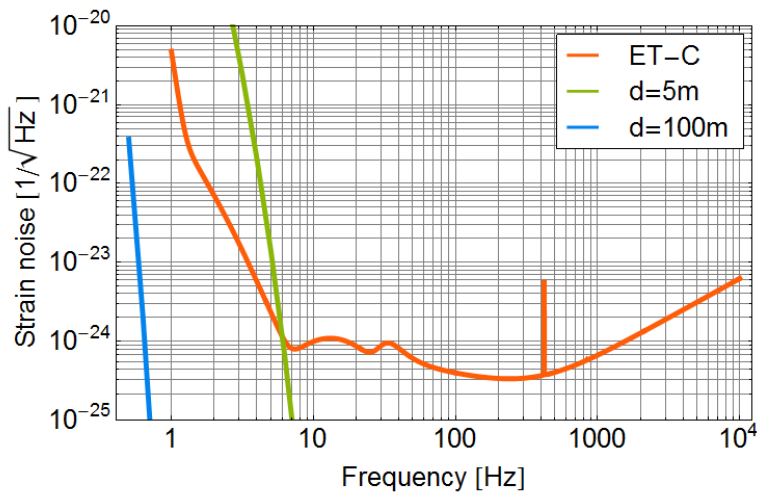
- **Atmospheric NN**

- (So far poorly modelled) quasi-static temperature perturbations advected along (so far poorly modeled) streamlines
- Sound propagation inside atmosphere and laboratory buildings (scattering not yet simulated)

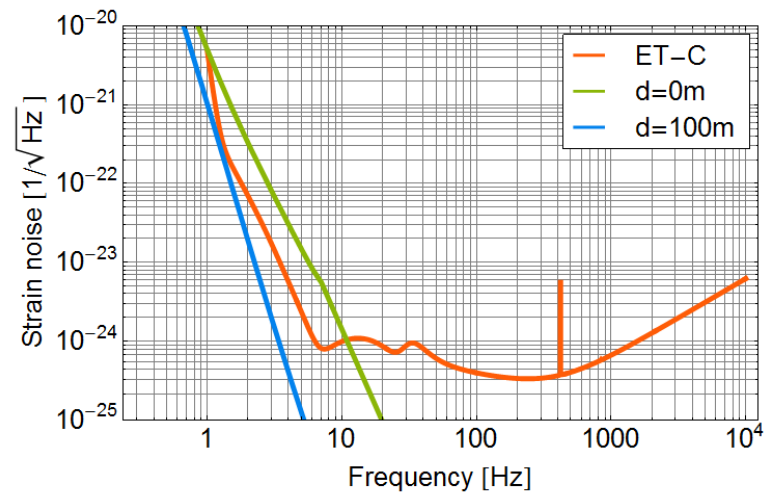
Atmospheric NN

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Temperature NN Uniform air flow, $v=20\text{m/s}$



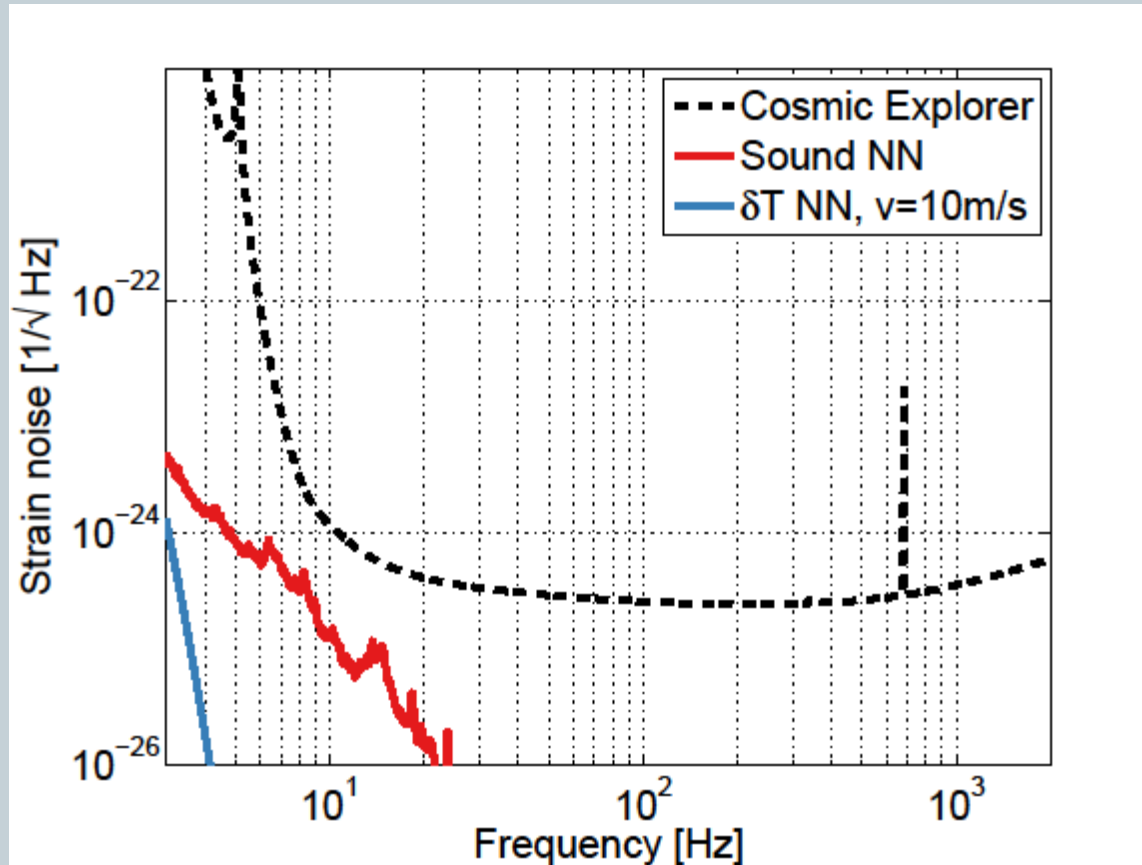
Infrasound NN



- Atmospheric NN limits sensitivity of ET-type detectors if built at the surface
- Going underground very efficiently suppresses atmospheric NN
- Atmospheric NN will be extremely challenging to cancel

Cosmic Explorer

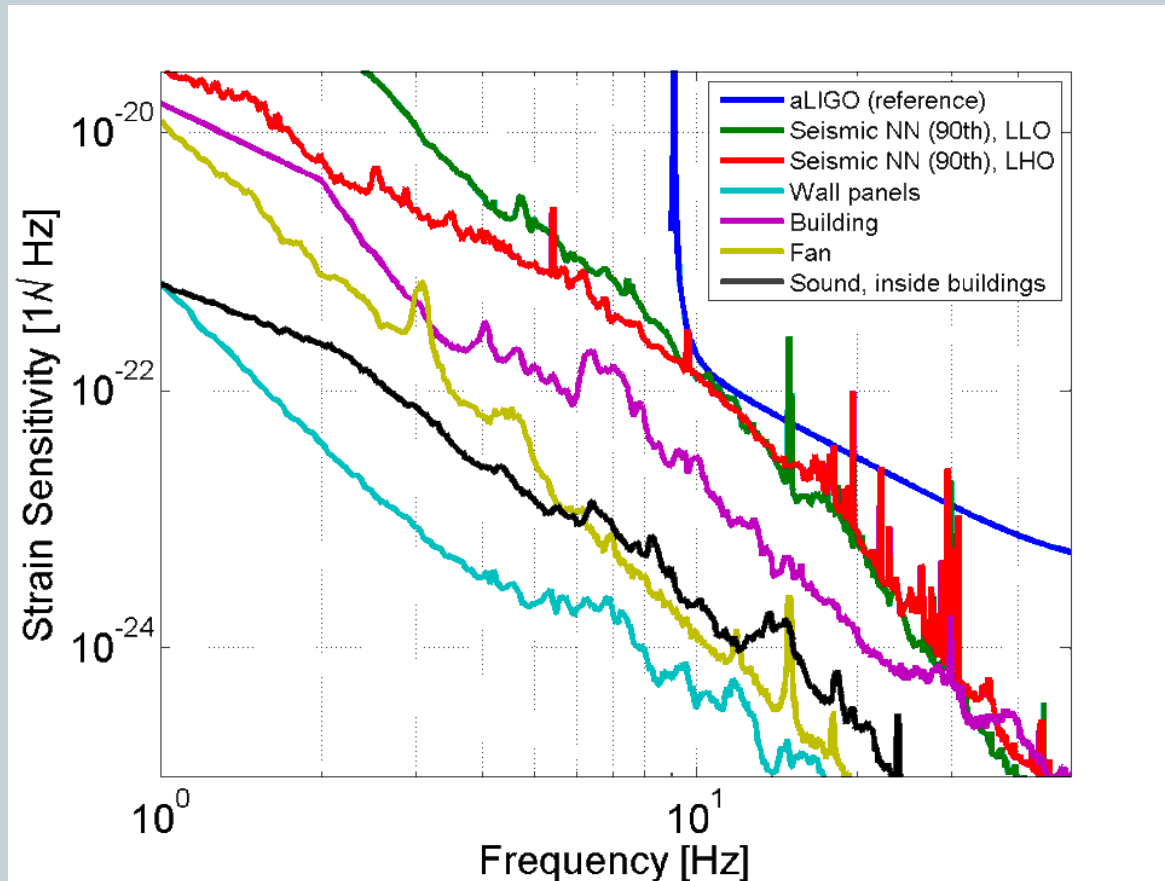
6



NN in Advanced LIGO

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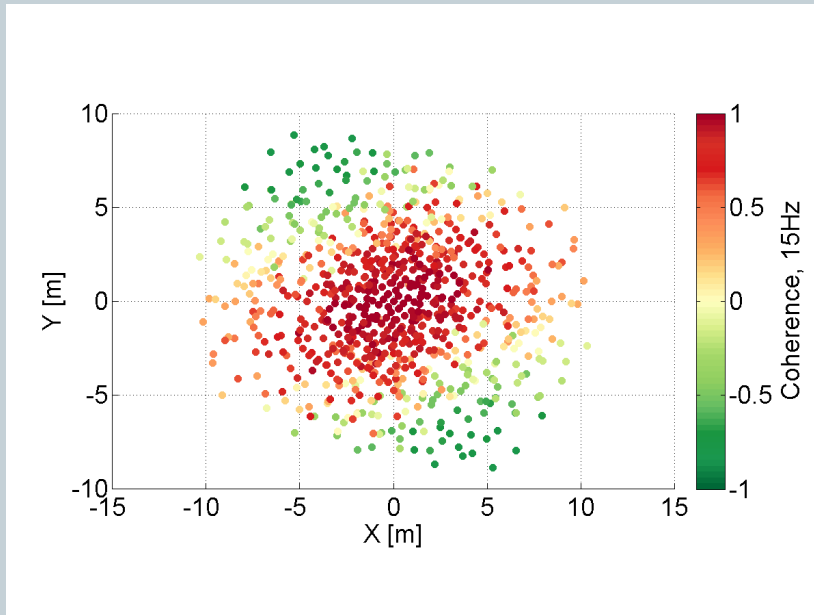
Driggers et al, 2012



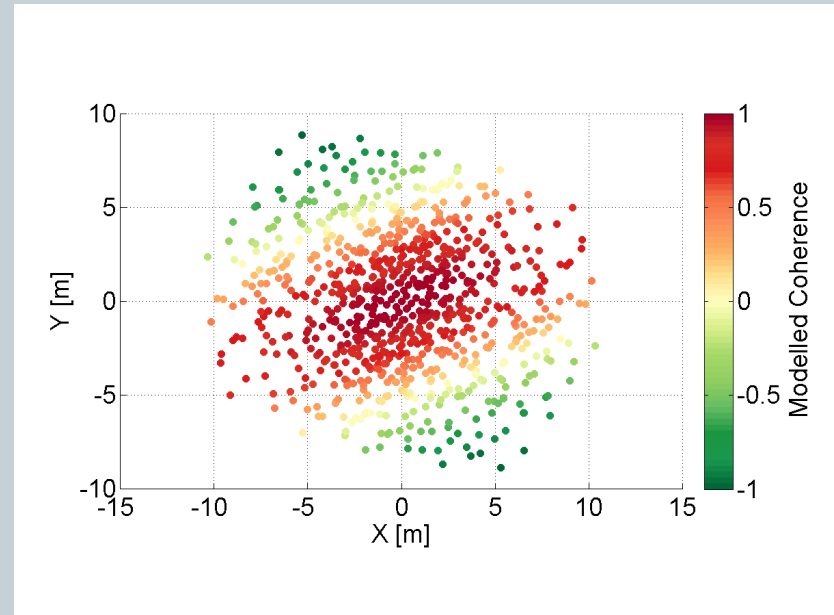
LIGO Hanford Measurements (2012)

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Observation



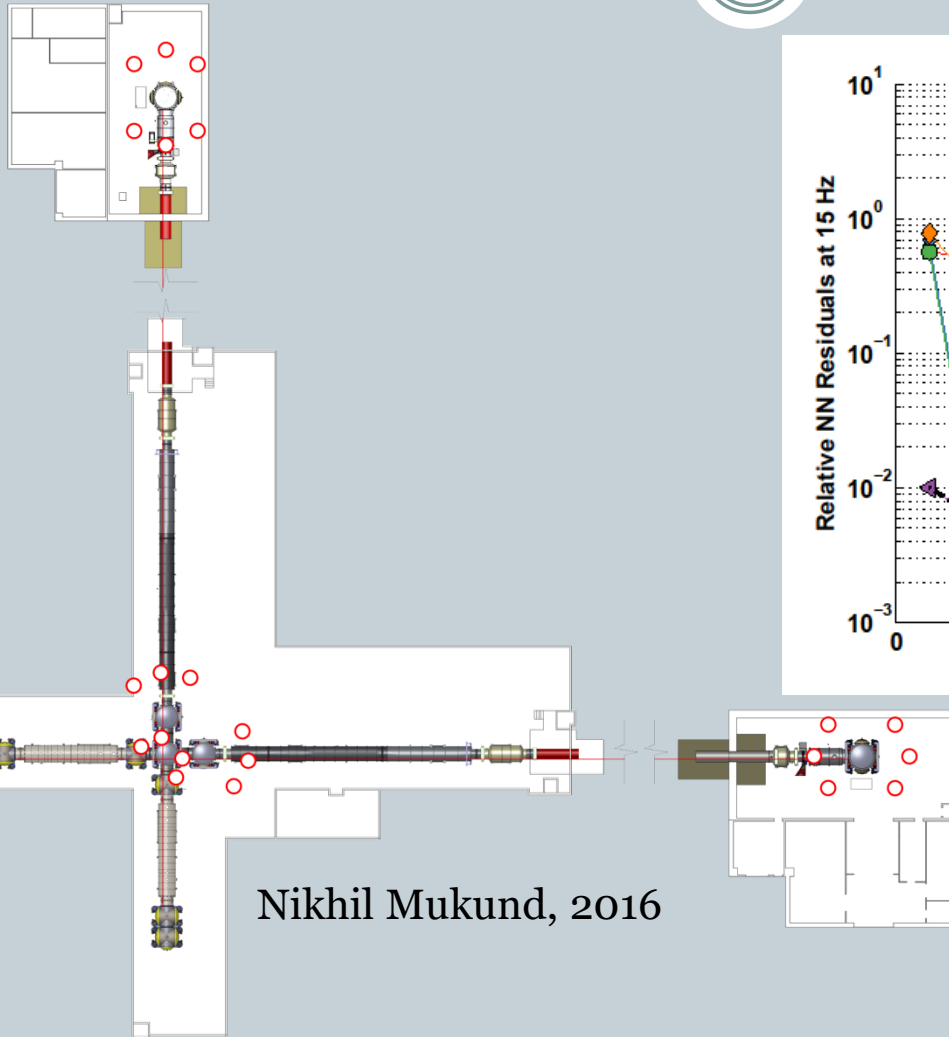
Plane-wave model



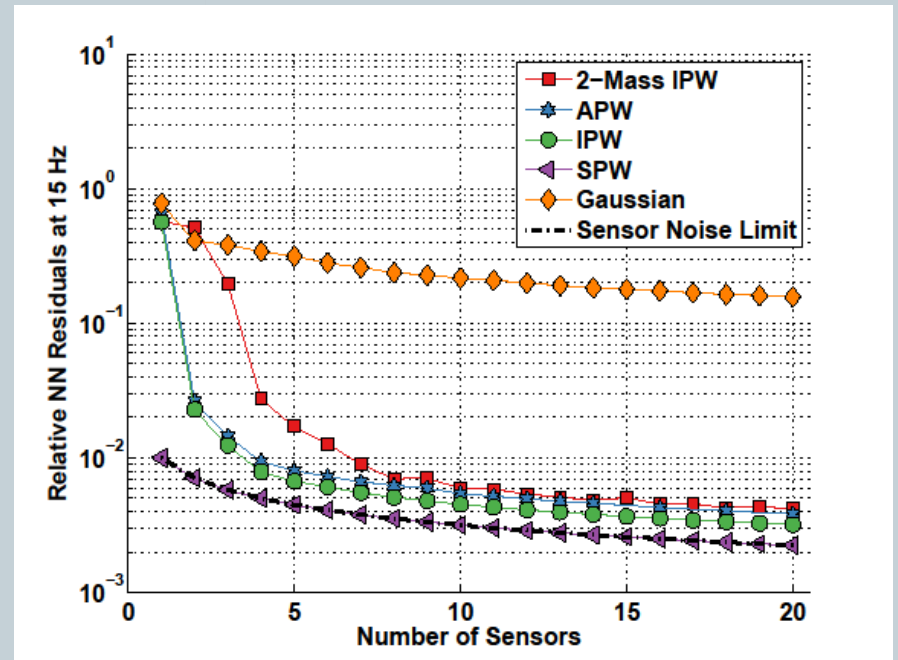
- Anisotropic, plane-wave model gives qualitatively good match with observation
- Mismatch is not minor. It demonstrates inhomogeneity of the seismic field, due to local seismic sources

NN Cancellation

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Nikhil Mukund, 2016



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ANTENNA INTERFEROMETRICA PER ONDE GRAVITAZIONALI

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PROGETTO ESECUTIVO DEL SECONDO LOTTO DI OPERE CIVILI
(CADERNA PIREN)

ECO CONSULTING INGENIERIA S.r.l.
(società specializzata in progetti, studi, direzione lavori, direzione generale)
Dir. Ing. Francesco MIREU – coordinatore progettista
Dir. Ing. Roberto MIREU – coordinatore generale
Dir. Ing. Francesco MIREU – coordinatore generale
Dir. Arch. Federico SAMBO – progettista

**EDIFICIO TERMINALE
BRACCIO NORD
SEZIONI**

ARCH. FEDERICO SAMBO
(società specializzata in studi, direzione lavori, direzione generale)
Dir. Arch. Federico SAMBO – progettista

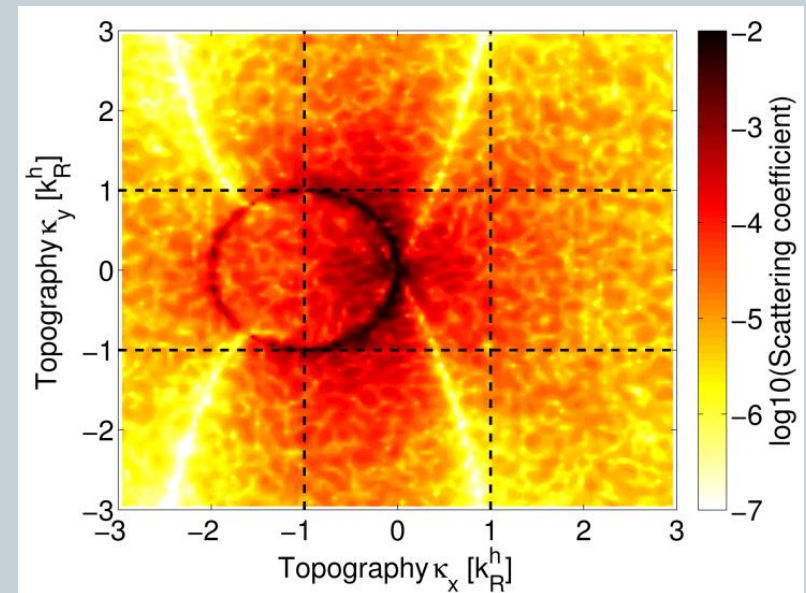
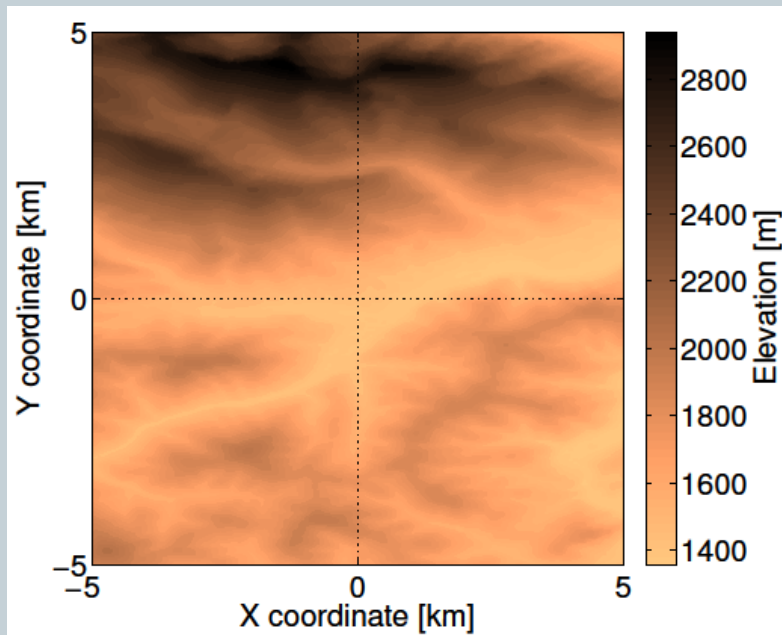
Progettista	Edificatore	All. 1.2.1
Coordinatore	Rappresentante	

Rappresentante Temperature:

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Topographic Scattering

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Class. Quantum Grav. **29** (2012) 075004

- So far, calculations of topographic scattering only carried out in Born approximation
- Measurements with Sweetwater array confirm that seismic correlations are complicated in regions with rough topography

Constraints on Observatory Designs

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- **Surface**
 - Wind noise – Few meters underground or aerodynamically shaped buildings?
 - Strong seismic noise from local sources – Improve design of laboratory infrastructure?
 - How much digging required for 40km arms?
- **Stick ends into mountains**
 - Strong mitigation of atmospheric NN
 - Detrimental effects on seismic NN cancellation (necessarily complex topography)
- **Underground**
 - Detector infrastructure – How to avoid elevated underground seismic noise?

