

The Einstein Telescope: progress report

J.R. Cudell
ULiège, Feb. 4th, 2019

The full advanced GW Network (>2024)



2nd generation
~500 events/year

Advanced LIGO
Hanford, 4 km



GEO600

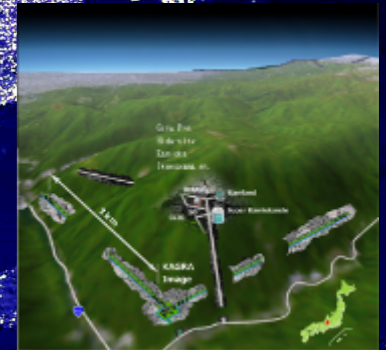


Advanced LIGO
Livingston
4 km



Advanced Virgo
3 km

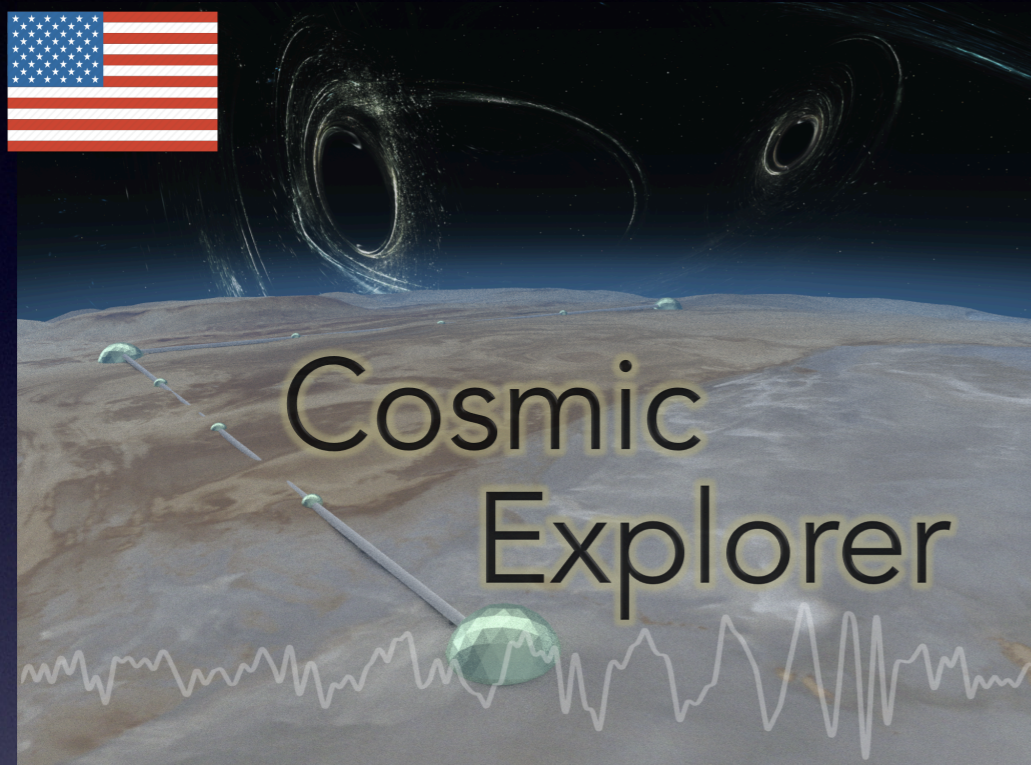
(Advanced LIGO
INDIA, 4 km)



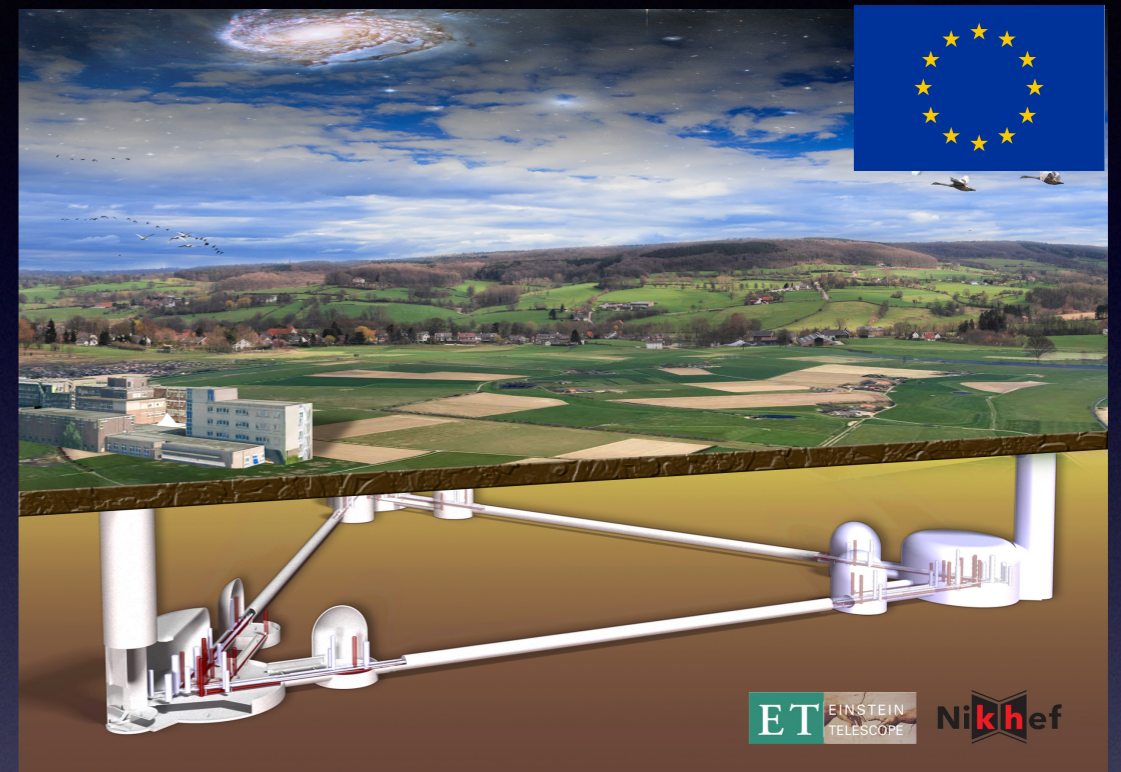
KAGRA, 3km

from H. Lück's talk at January Liège workshop

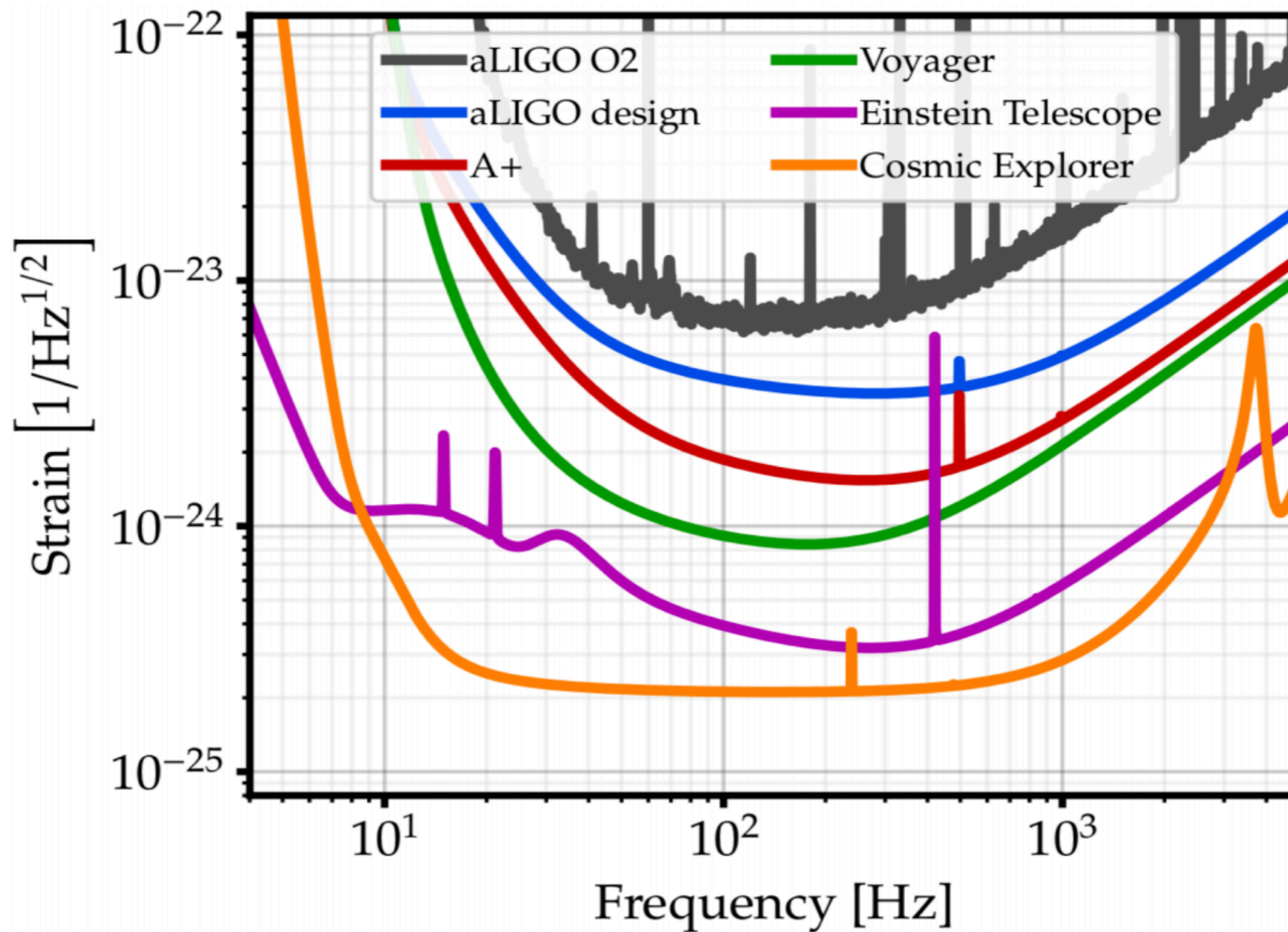
3G detectors



2x40 km
above ground



3x10 km
300 m underground
cryogenic



10⁵ to 10⁶ events/year

from J. Mills et al., arXiv:1708.00806v1 [gr-qc] 2 Aug 2017

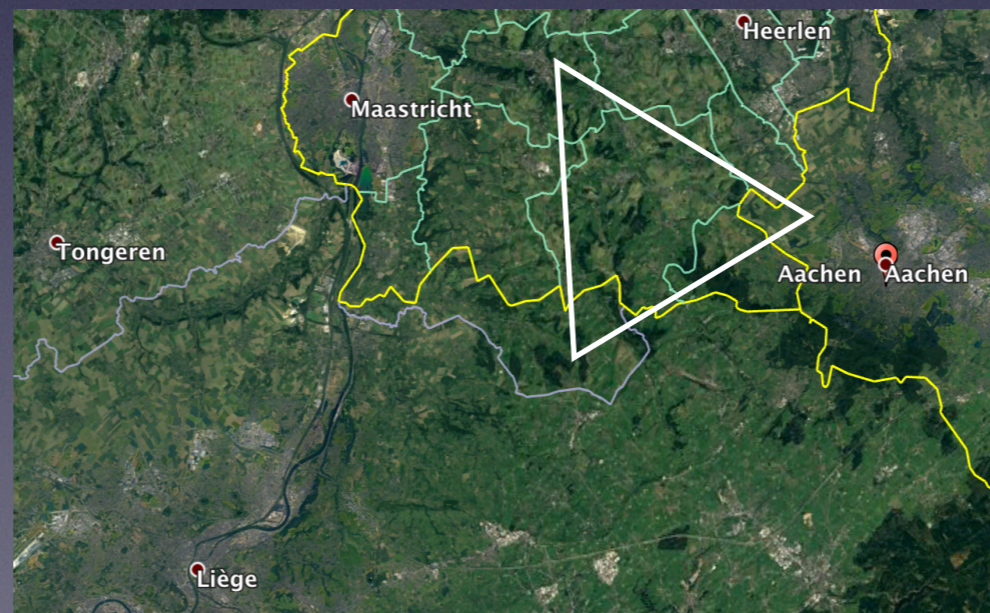
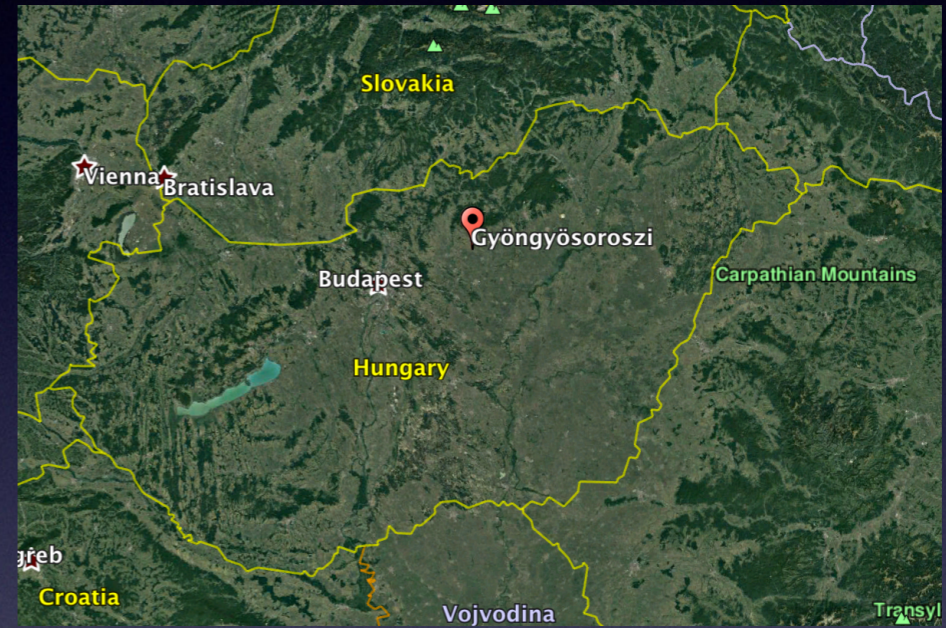
- 10 km → longer wavelength → lower frequencies and longer inspirals
- cryogeny to reduce thermal noise at low frequency
- bigger number of reflections, higher power (3 MW)
- 100000 events/year - up to $z=7$ (galaxy formation)

Where to put it?

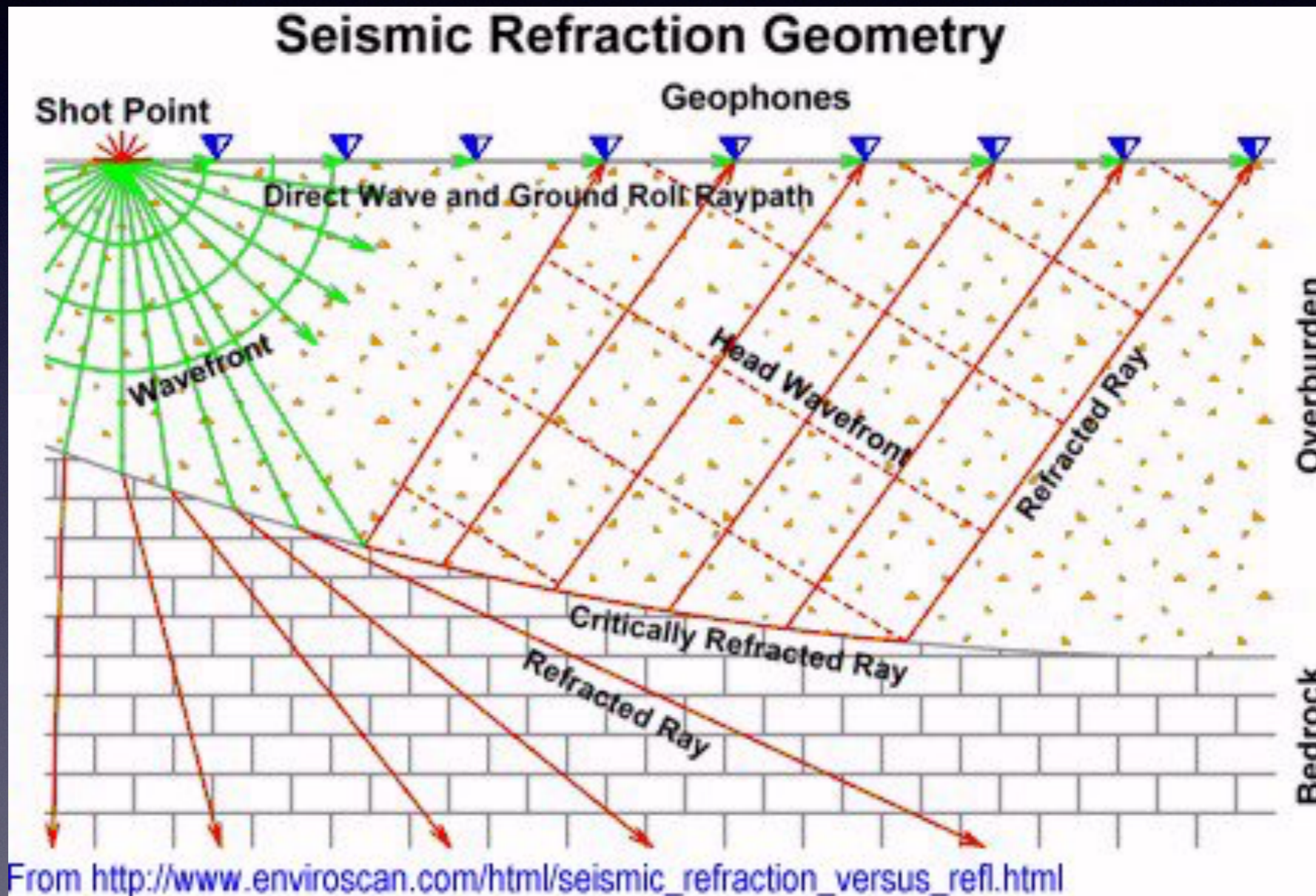
Seismic noise for ET

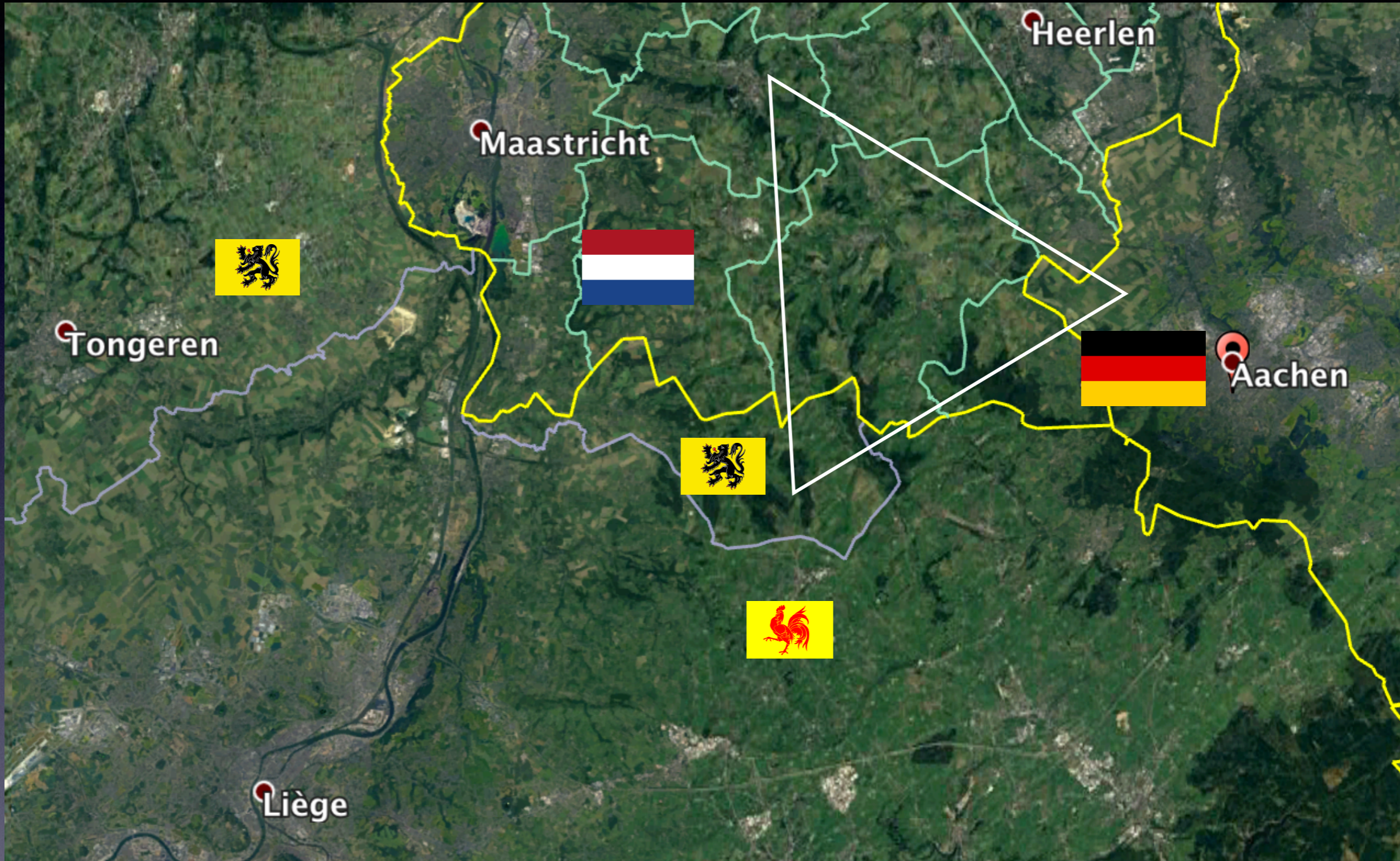


Best candidates



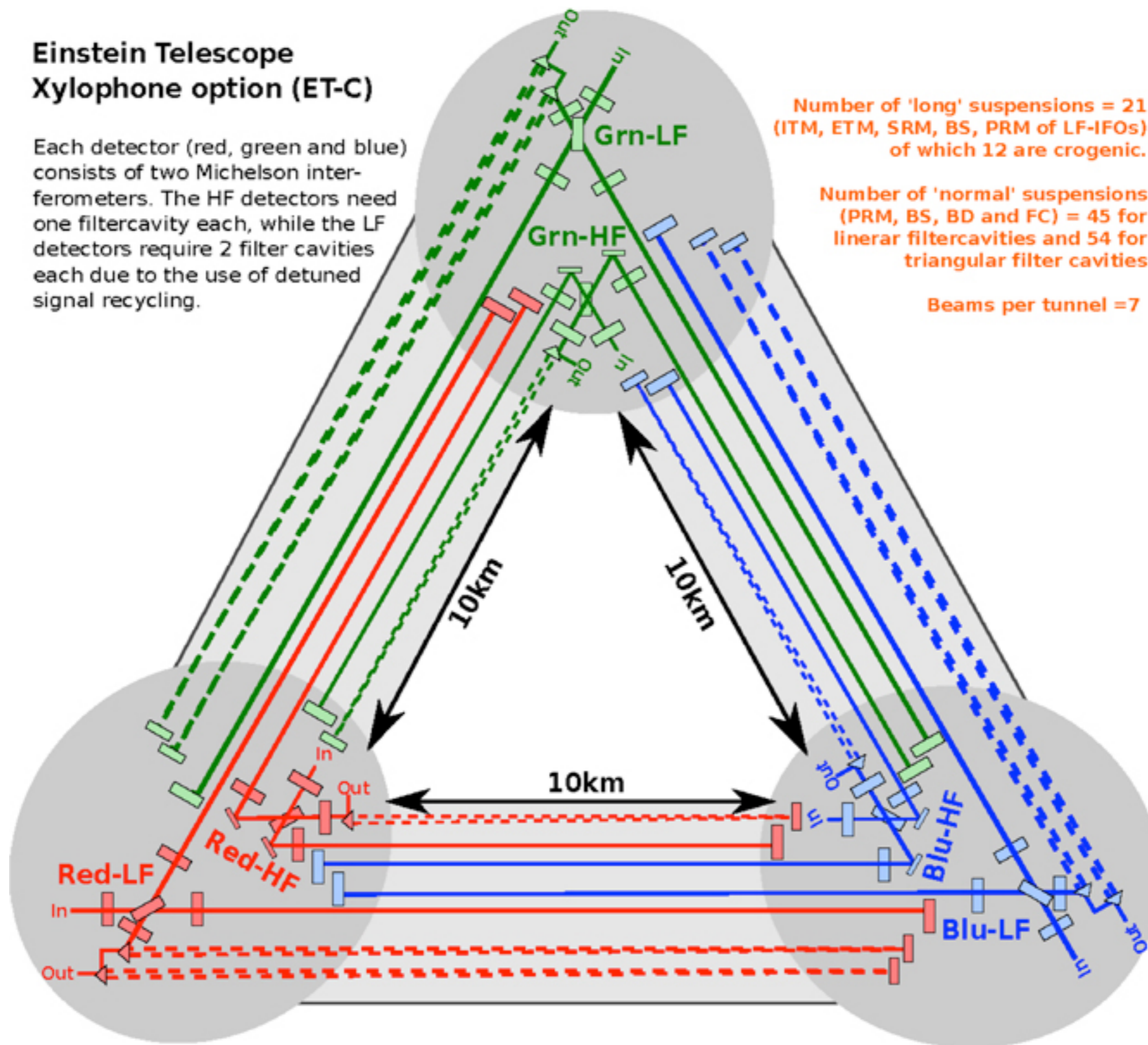
sound refraction in geophysics

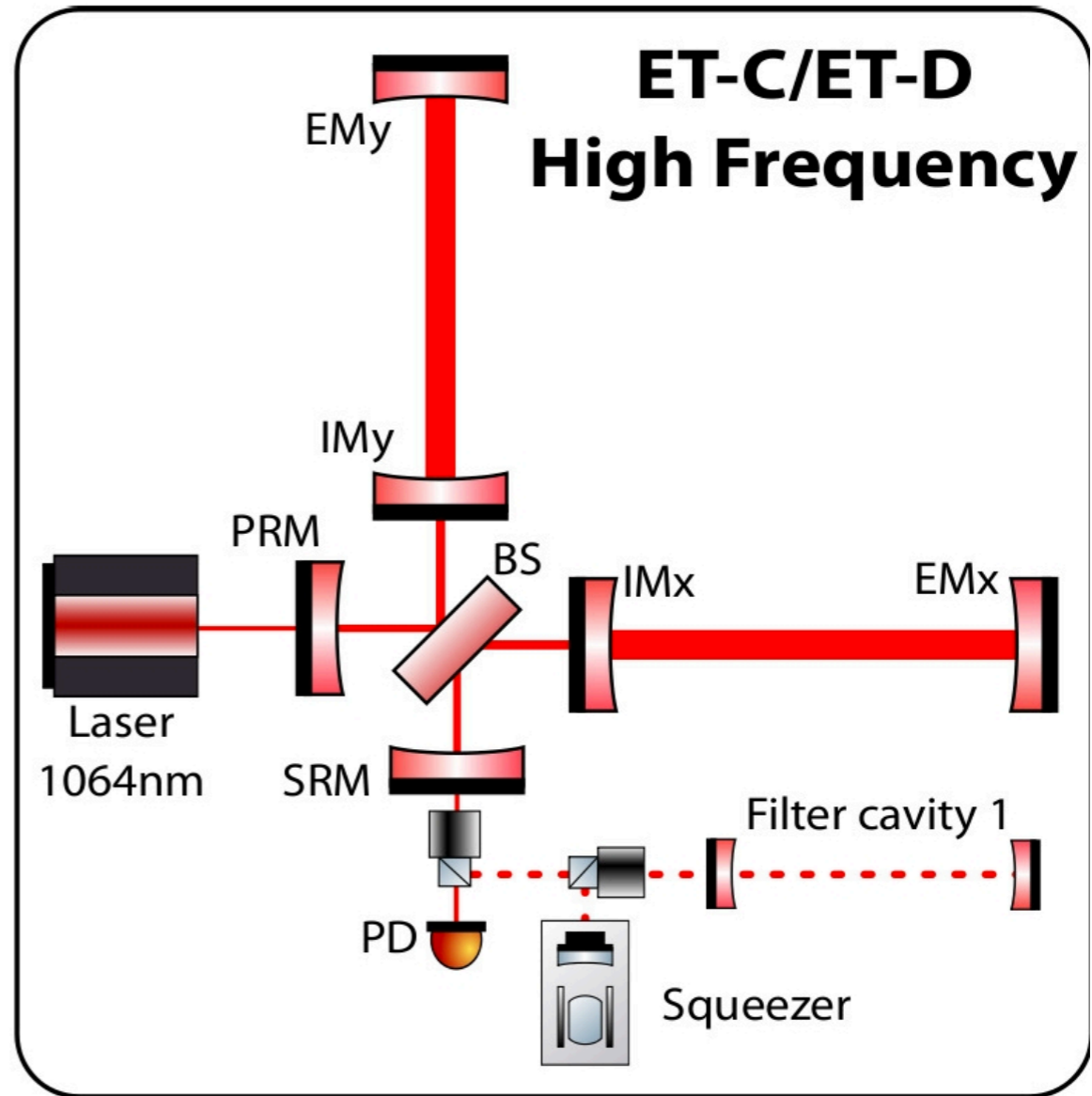
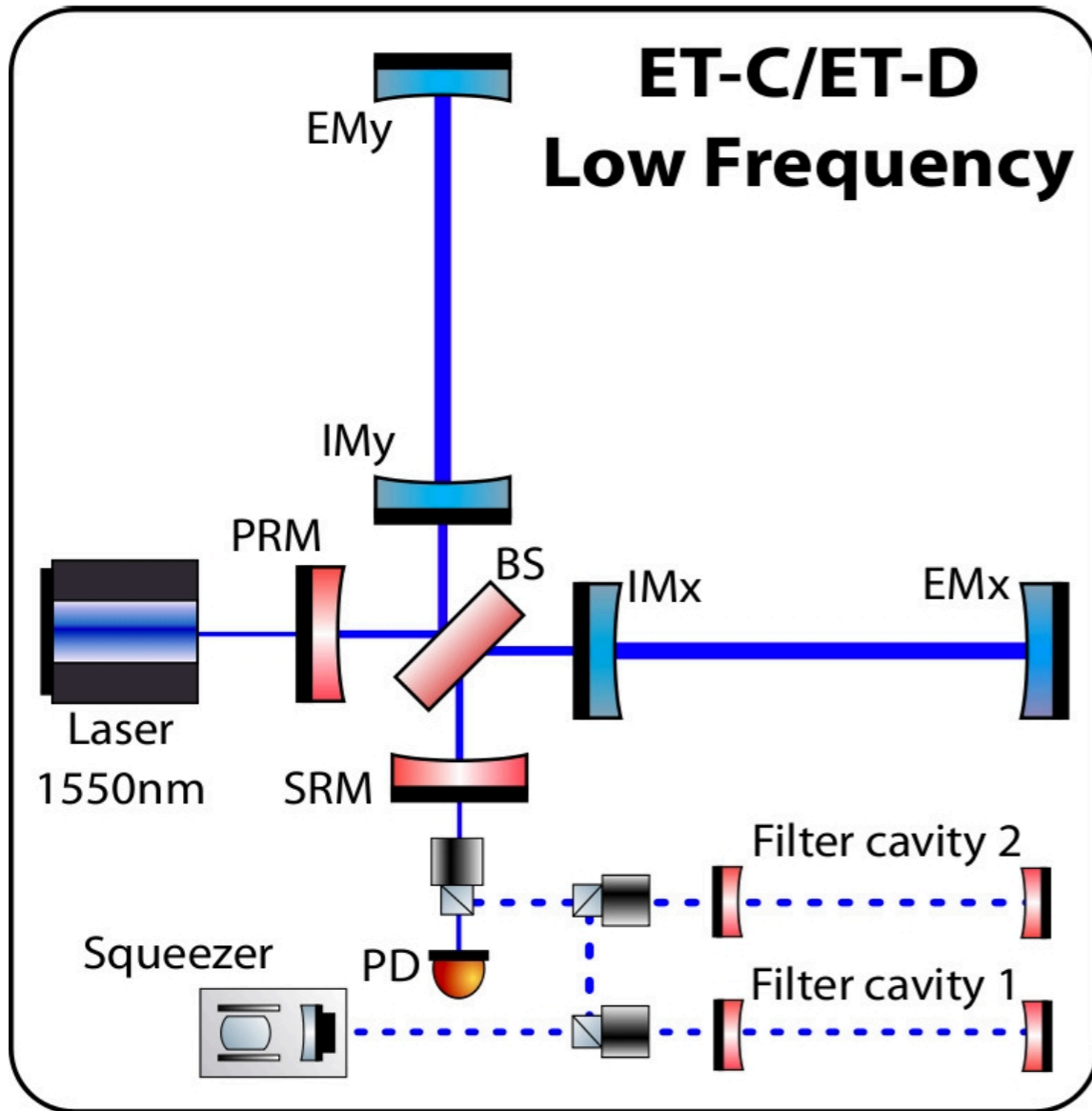




Einstein Telescope Xylophone option (ET-C)

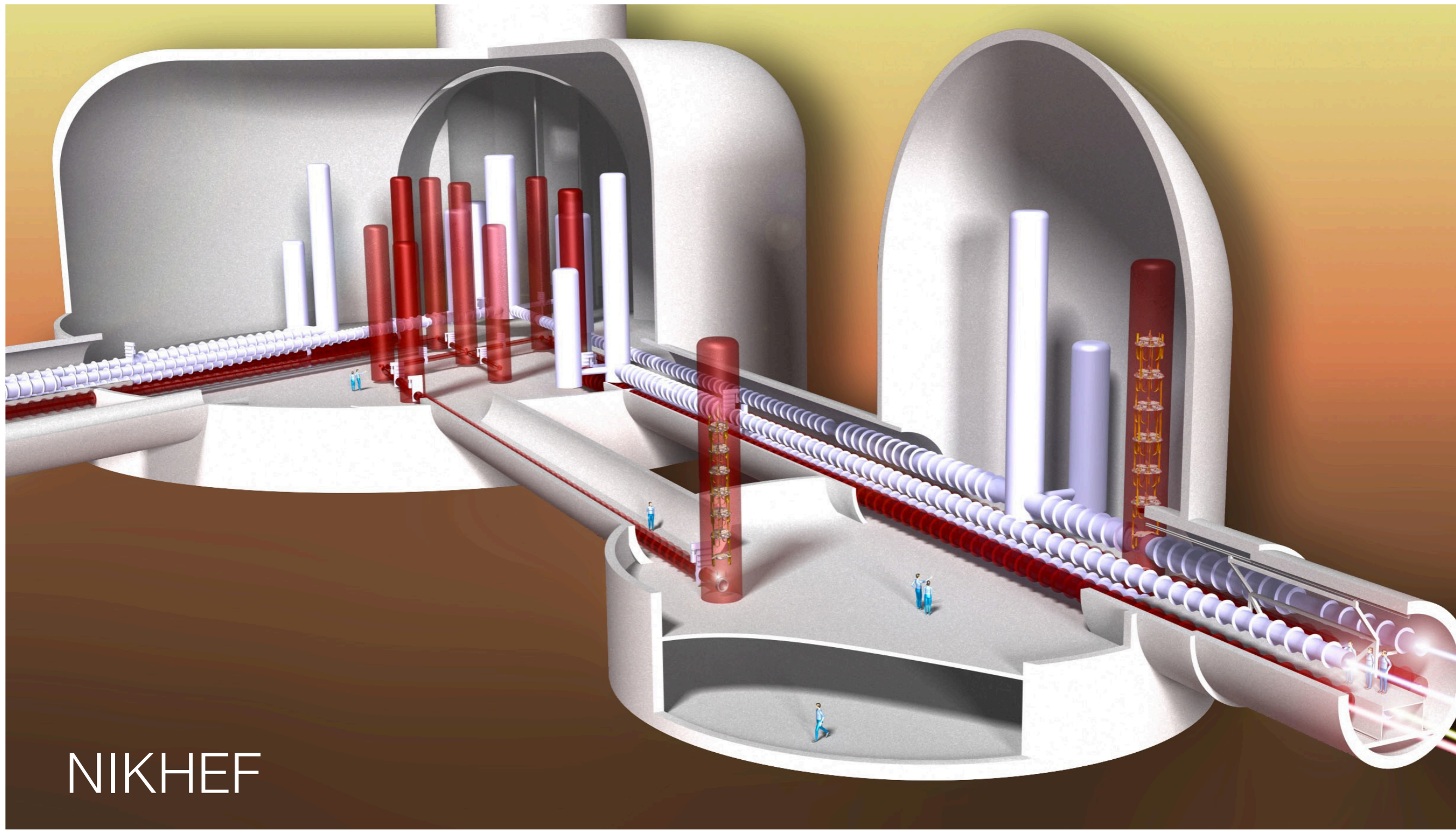
Each detector (red, green and blue) consists of two Michelson interferometers. The HF detectors need one filtercavity each, while the LF detectors require 2 filter cavities each due to the use of detuned signal recycling.





Optical element, Fused Silica, room temperature	Optical element, Silicon, cryogenic	Laser beam 1550nm Laser beam 1064nm squeezed light beam
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Lower-energy cryogenic interferometer for low-f band



NIKHEF

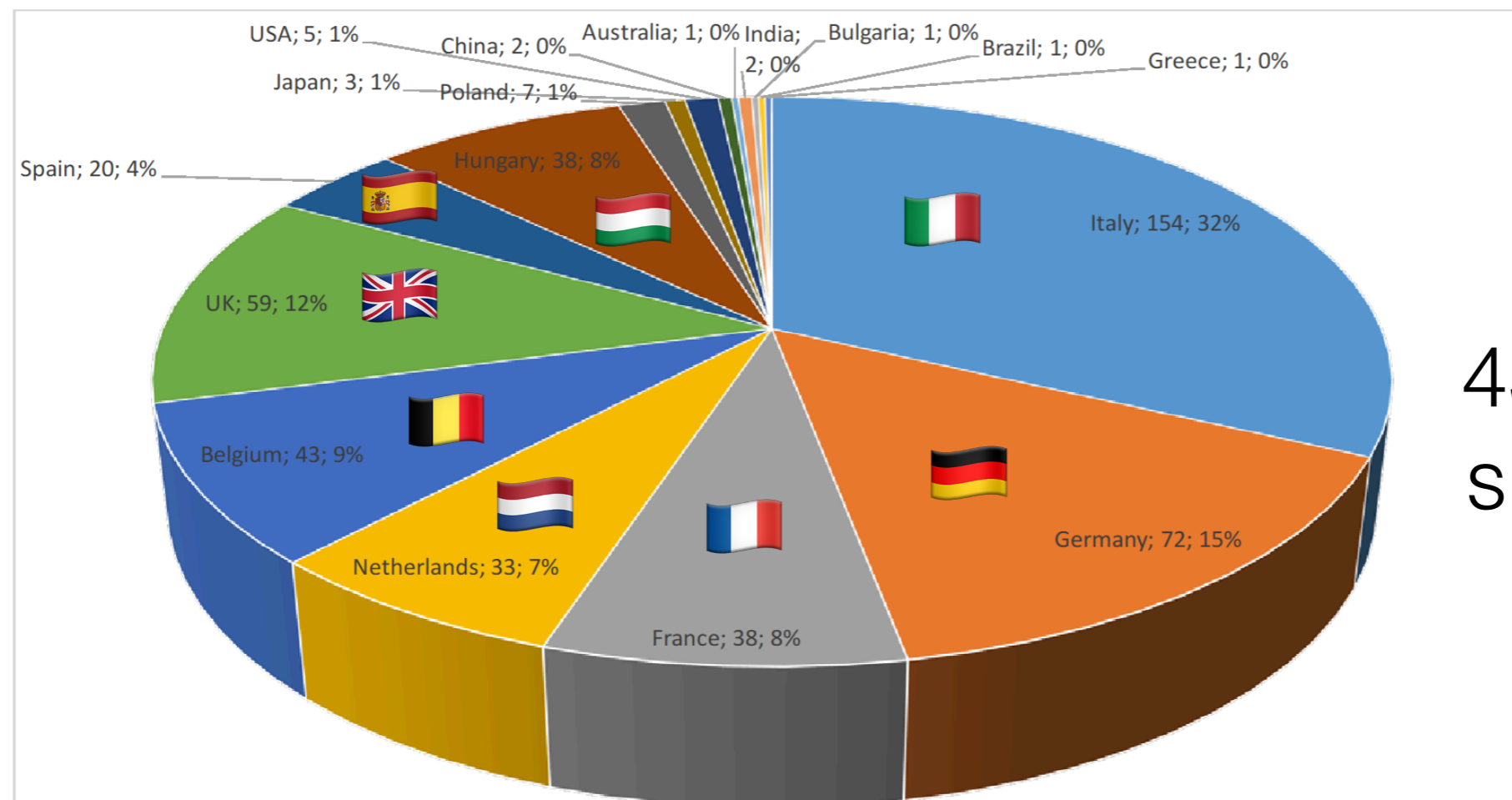
1-2 G€

ET Letter of intent signatories

Einstein Telescope (ET) Letter of Intent (LOI) signatures

This document reports the signatures of the ET LOI collected by the online system at the date 03/06/2018 18:09:00. Please, note that some of the subscribers declared to belong to more than one country; this info is stored in the database, but the output is created selecting just one of the two or more selection.

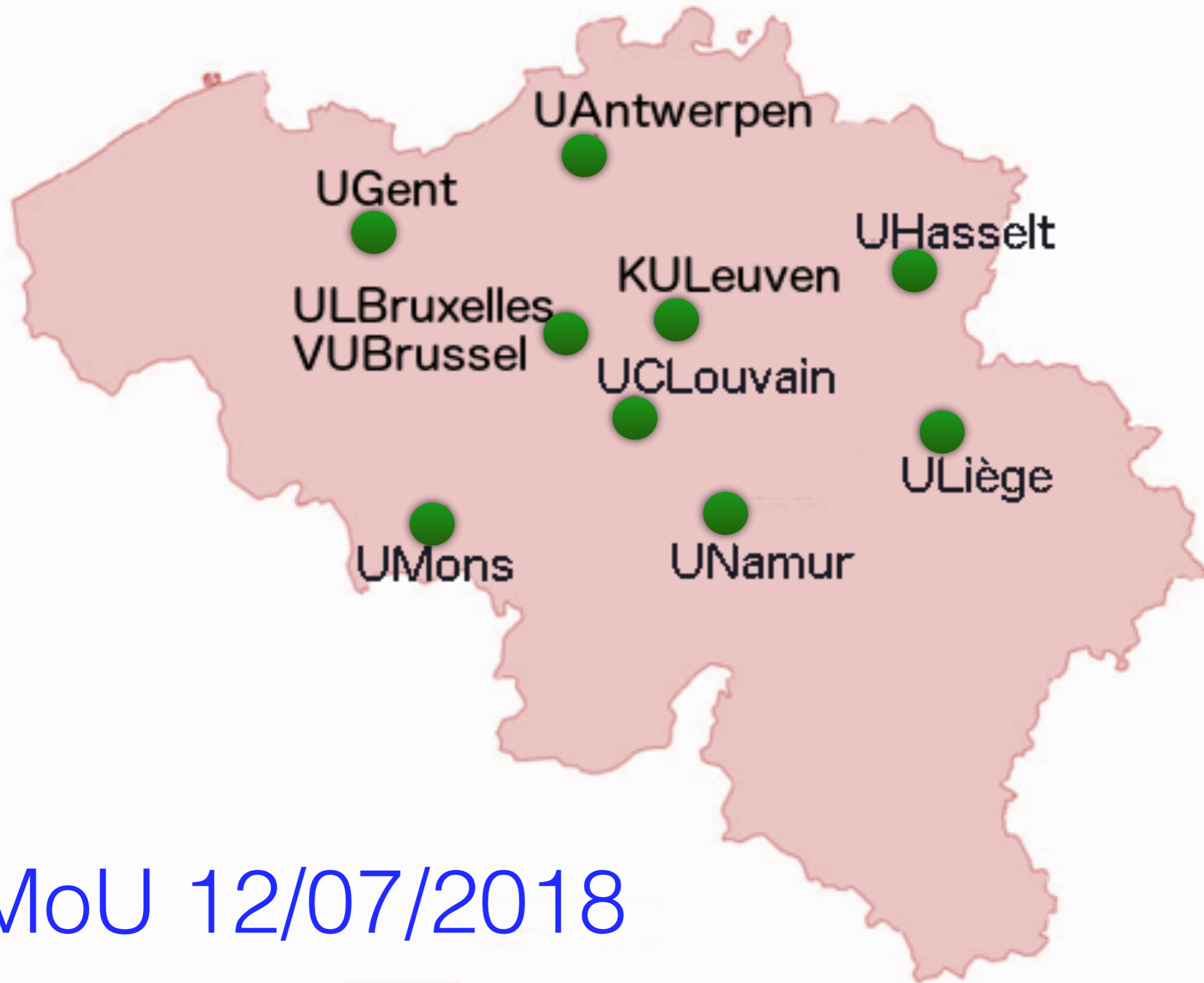
Currently there are 480 valid signatures.



43 Belgian signatures

LOI BELGIAN SIGNATORIES (43)

Geert	Degrande	KULeuven
Thomas	Hertog	KULeuven
Michael	Kraft	KULeuven
Filip	Tavernier	KULeuven
Nick	van Remortel	UAntwerpen
Giacomo	Bruno	UCLouvain
Sebastien	Clesse	UCLouvain
Marco	Drewes	UCLouvain
Vincent	Lemaitre	UCLouvain
Krzysztof	Piotrkowski	UCLouvain
Chris	Ringeval	UCLouvain
Dirk	Ryckbosch	Ugent
Guoying	Zhao	ULB
Geoffrey	Compere	ULB
Arnaud	Deraemaeker	ULB
Stéphane	Detournay	ULB
Johan	Gyselinck	ULB
Stephane	Goriely	ULB
Alain	Jorissen	ULB
Gauthier	Lafruit	ULB
Laura	Lopez Honorez	ULB
Michel	Tytgat	ULB
Jennifer	Watchi	ULB
Christophe	Collette	ULiege&ULB
★ Atri	Bhattacharya	ULiege
★ Jean-René	Cudell	ULiege
Alain	Dassargues	ULiege
★ Michael	De Becker	ULiege
Christophe	Geuzaine	ULiege
★ Eric	Gosset	ULiege
Hans-Balder	Havenith	ULiege
★ Damien	Hutsemékers	ULiege
★ Jerome	Loicq	ULiege
Gilles	Louppe	ULiege
John	Martin	ULiege
★ Yael	Naze	ULiege
Frederic	Nguyen	ULiege
★ Gregor	Rauw	ULiege
★ Pierre	ROCHUS	ULiege&CSL
Ben	Craps	VUB
Alexandre	SEVRIN	VUB

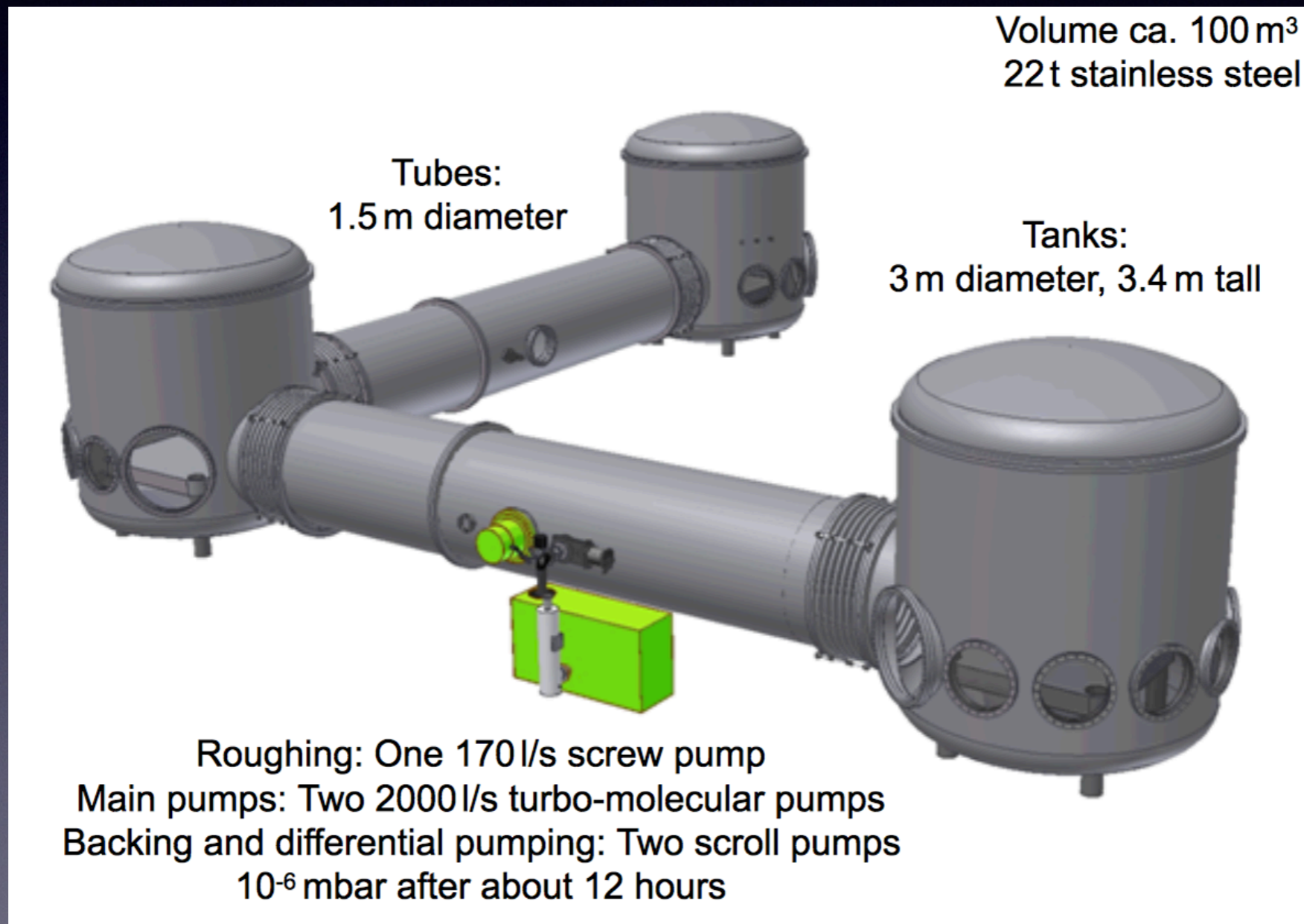


MoU 12/07/2018

Roadmap

- Submission of an ESFRI (European Strategy Forum on Research Infrastructures) proposal in April 2020 with possible sites (and funding - commitment of host countries > 0.6 - 1.2 G€).
- Decision 2021
- Final decision on the site early 2022
- Construction starts 2022
- Scientific operation starts 2031

ET pathfinder



Interests

- Test mirrors (Si for cryogenic, SiO₂ for HF)
- Test the idea to cool the HF Si to 120 K
- Test suspensions
- Test cryogeny
- etc.

Funding: INTERREG

- Vlaanderen-Nederland: 1st stage approved
- Euregio Meuse-Rhein: submitted last November

INTERREG V: Vlaanderen – Nederland

approved



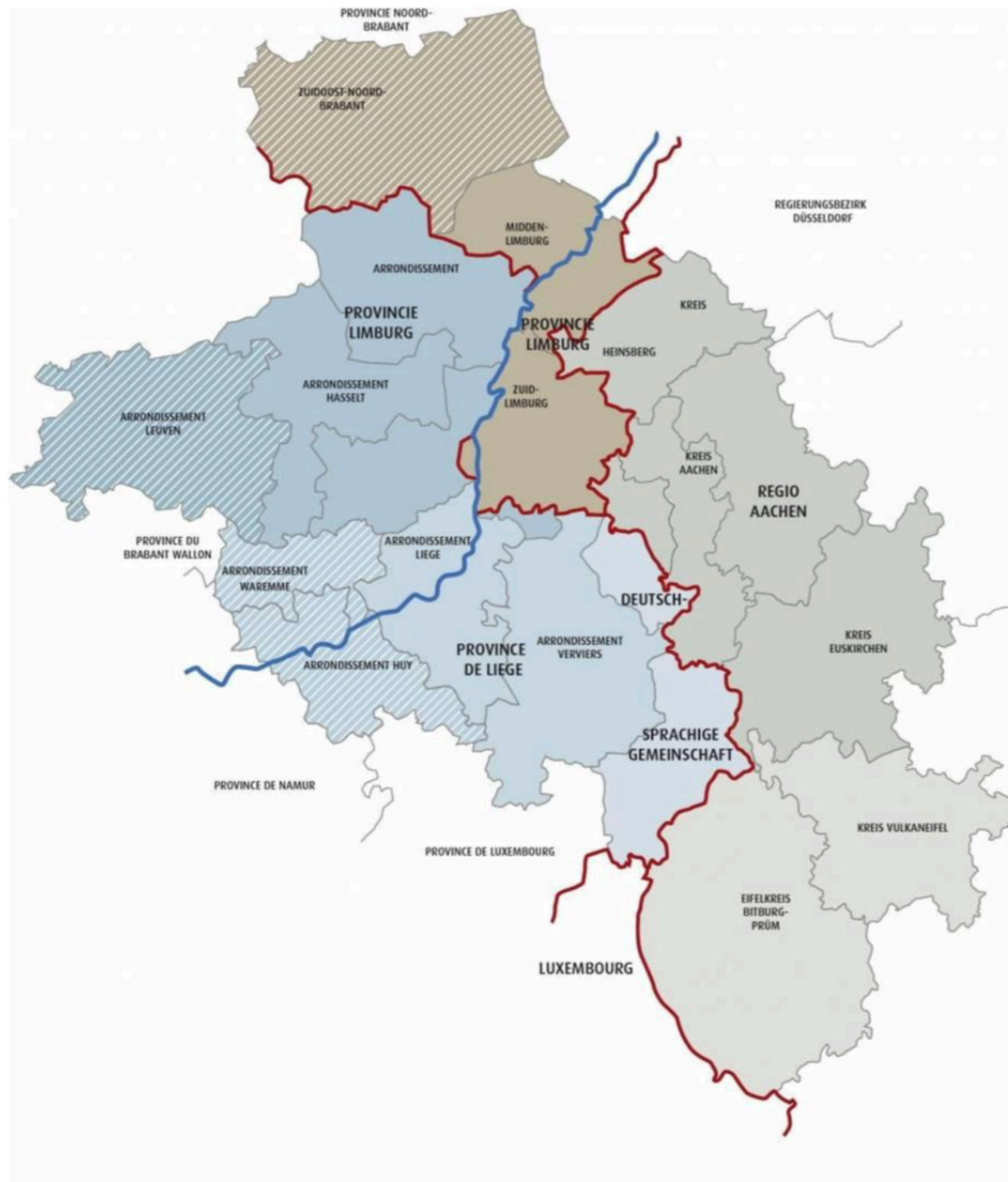
Partners:

- University of Leuven
- university of Ghent
- University of Antwerp
- Nikhef
- Maastricht University (UM)
- Eindhoven U. of Technology (TU / e)

Satellite :

- University of Liège
- Vrije Universiteit Brussel
- Universiteit Hasselt
- Fraunhofer Institute for Laser Technology (ILT), Aachen)
- Rheinisch-Westfälische Technische Hochschule (RWTH), Aachen

INTERREG V: Maas - Rhin



submitted

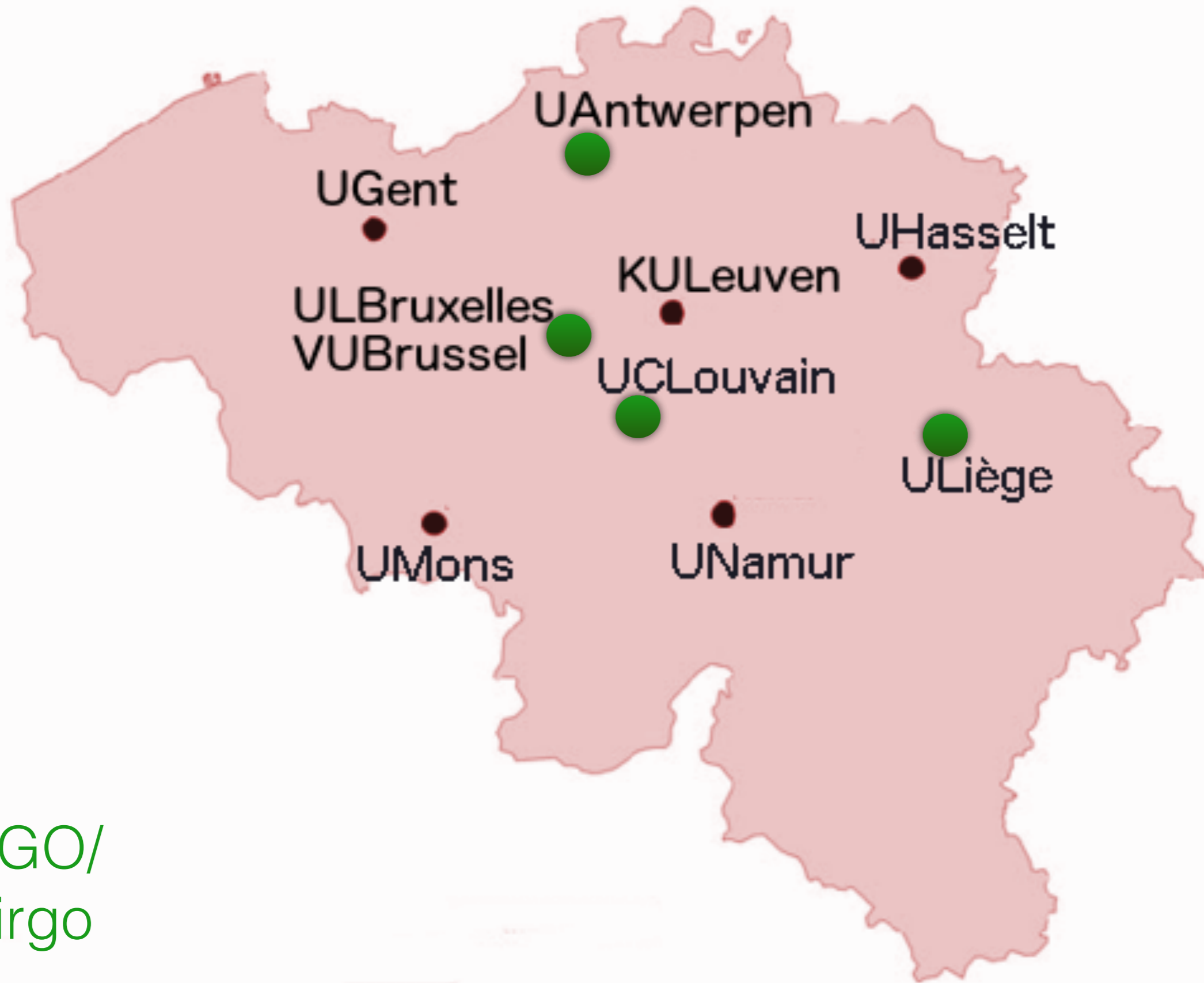
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- University of Liège

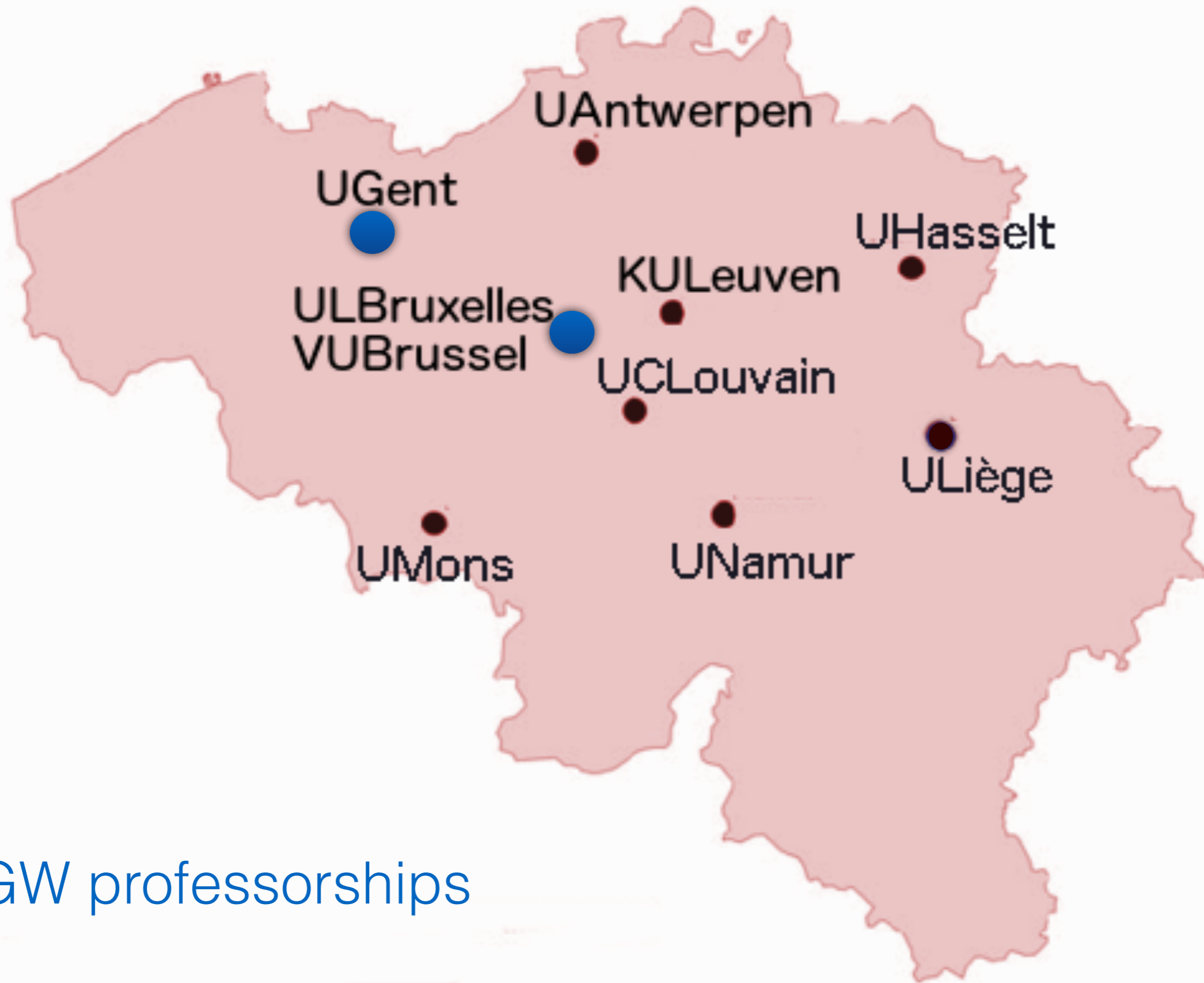
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- university of Ghent
- University of Antwerp

Further GW developments in Belgium



LIGO/
Virgo



GW professorships

Emergence of a new field

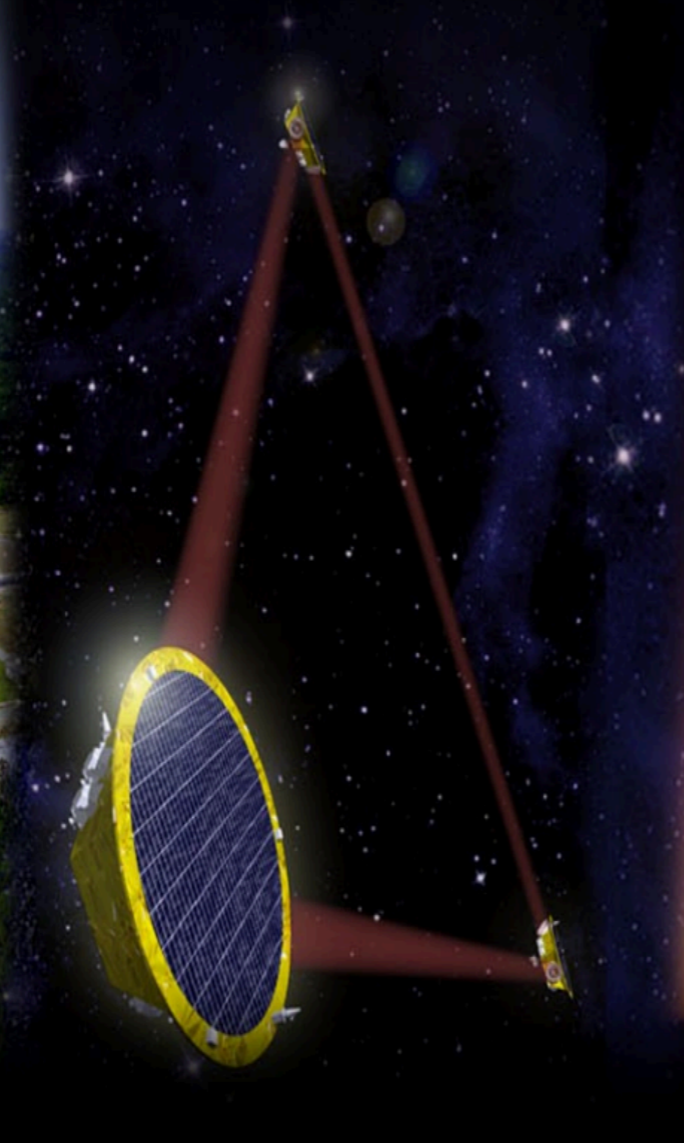
Milliseconds

LIGO/Virgo



Minutes
to Hours

LISA



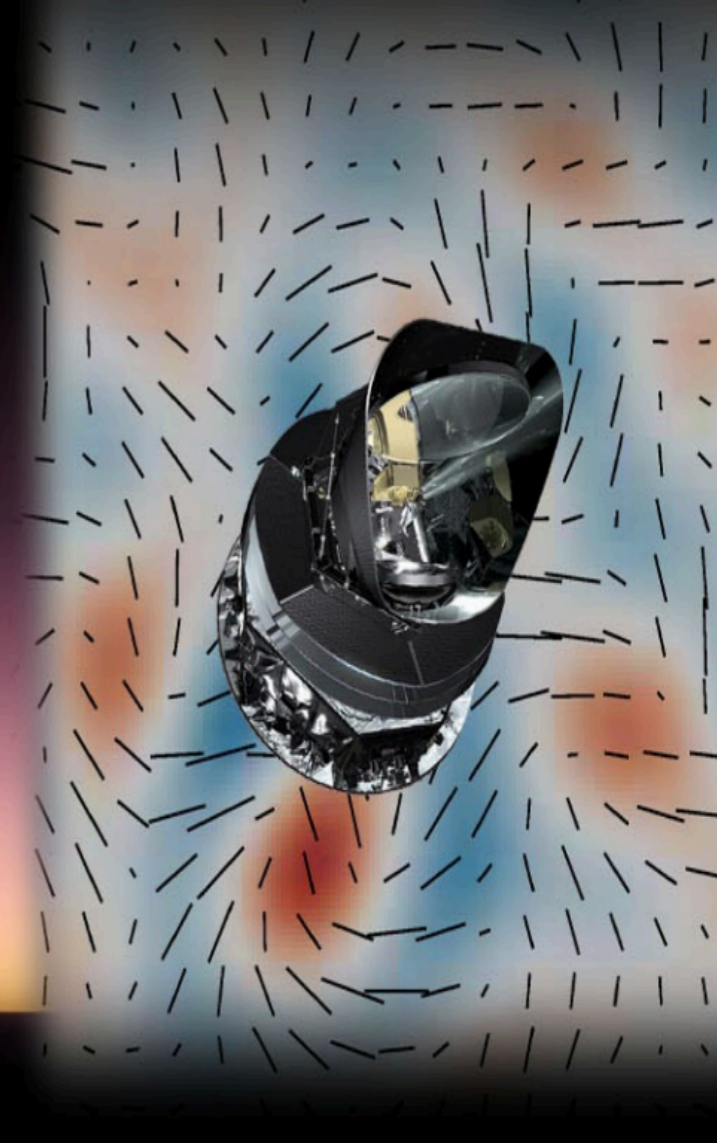
Years
to Decades

Pulsar Timing Array



Billions
of Years

Cosmology Probes



Join in!

- <http://www.et-gw.eu/index.php/letter-of-intent>