

# Questions and Replies related to the ET at Nikhef

*In this document the questions related to the ET brought up on the flip-chart at the VISTA meeting, as well as additional email directed to the WAR, have been summarized by the WAR (black font) and answered by the GW group and Nikhef management (blue font). The goal of this document is to have these questions answered and shared before the staff meeting to facilitate a fruitful meeting where everyone is aware and up to date on ET related issues.*

## Money questions:

If a new institute is made it is clear that additional funding from NWO would need to be available for this new institute as base funding. However if ET stays as part of Nikhef that means base-funding from Nikhef needs to go to ET too, so does that mean that the other programs at Nikhef have reduced base-funding available?

The ET observatory (independent of where it is going to be built) will be operated by its own legal entity (e.g. a ERIC, or like EGO operates Virgo), i.e. ET will not be operated by Nikhef.

Nikhef will be one of many (!) research institutes that contribute to ET, similar to how Nikhef contributes right now hardware to the Virgo observatory, or how Nikhef contributes to the different CERN experiments.

Maybe also worthwhile to state that we believe at the scale of a project like ET the funding is not a zero-sum game. (note that the 42+870 MEuro for ET come from the research, development & innovation pillar of the national growth fund and not from existing research budgets). There is some sense that fundamental research in Europe might come under pressure in the coming years. While there are no guarantees, having a local flagship project like ET might help to protect funding locally (also for non-GW science).

Does the ET produce a risk for exploiting activities at CERN?

In terms of funding, to the best of our knowledge we can answer this question with a clear “No”. Funding for CERN is bound by governmental agreements based on our Gross Domestic Product. Those agreements are not touched by negotiations for other European projects. Note that CERN is funded by our ministry OCW, not NWO.

In terms of funding received from open competition it is worth stating that there is always some competition in this case, so the addition of ET to the mix should not be any additional risk.

## Organisational questions:

Could you please work out scenarios for the impact on Nikhef (strategy) dependent on the location in which ET will be built, e.g. Limburg, Sardinia or Gorlitz. In particular;

- If ET comes to Limburg does Maastricht get its own institute focussing on and running ET? And what happens to the GW groups that aren't ET in that case?

As mentioned above, we anticipate and work hard towards ET becoming its own international legal entity (aka ‘headquarter’ if you like), which operates the ET observatory. This legal entity would likely have its statutory seat in Maastricht, but would neither be Nikhef or University of Maastricht, it is a new ‘organisation’ with a different purpose than Nikhef or an university. All ET groups in the NL, including Nikhef, Maastricht etc. would contribute to ET in a similar way as we have been doing in the CERN experiments or in Virgo (for the past ~10 years). Note that it is very likely that more Dutch institutes, besides the Nikhef partnership, become member of this new entity, e.g. Technical Universities and Astronomy institutes.

Maybe as an example let's look at the Pisa INFN GW group when it was decided that Virgo would be constructed near Pisa: This Pisa INFN group is nowadays one of about 140 research groups in Virgo, on par with all other Virgo groups,

like INFN Rome, Firenze, Padua, or Nikhef or Utrecht or Maastricht, while the Virgo observatory is run by an especially established legal entity, i.e. "EGO".

- Please expand on whether nikhef would join/maintain other groups, aka what happens to EGO, what if people want to do cosmics observatory?

It is expected that ET will take some time after construction to reach design sensitivity. During that period the current GW observatories are expected to run to help with sky-localisation etc. Once ET significantly outperforms Virgo, it makes scientifically no more sense to operate Virgo.

Currently, Cosmic Explorer is in the design phase (not a funded project!) and several Nikhef members are also in personal capacity part of Cosmic Explorer, to steer ET and Cosmic explorer towards optimal collaboration within a future network of third generation GW observatories. There is no intention for Nikhef to formally join Cosmic Explorer and/or to take on any hardware or subsystem responsibilities in CE.

- What would be the percentage of participation of Nikhef if ET goes to one of the other locations? And what is our preference if it's not coming to NL?

We believe that to first order the contribution to ET by the Nikhef partnership will not depend on the final ET location. Note that the dominant part for the costs of the construction of ET are the underground tunnelling and vacuum system, will have to be provided by the participating governments; not by Nikhef nor does Nikhef have any expertise in these fields. The scientific instrumentation part, e.g. lasers, suspension systems and mirrors are comparable to one of the LHC experiments. The aim for Nikhef is either case to contribute with instrumentation and science exploitation and to cover NL contributions via standard NWO avenues, i.e. Roadmap GWI and ENW-G calls.

The integration of the GW and HEP communities is currently clearly not ideal. Is the goal to bring them together or split?

Whereas it is true that the GW community of Nikhef does not always manage to join all other activities at Nikhef, it is certainly not the intention to split.

While it can be discussed whether the traditional Nikhef group structure with "theory", "R+D" and "HEP detectors" might not be equally well developed/suited for Nikhef's GW programme, there are many efforts to bring the synergies between HEP and GW to fruition: The Maastricht group was initiated with both HEP (i.e. LHCb) and APP (i.e. GW) researchers to stimulate research beyond the discipline silos. The BND schools have recently been partly revamped in order to strengthen in particular GW. In addition to the GW + ALICE connection at UU, UU researchers have also been exploring the possibility of detecting ultra-light particle dark matter through its effects on black holes that would be visible in gravitational waves (connection with GRAPPA). Similarly, they have looked for the signature of "dark photons" in binary black hole inspiral. Similarly one could think of, for example, looking into using GW as an avenue to dark matter detection.

Any suggestions for additional activities and measures to bring together GW and HEP will be very welcome.

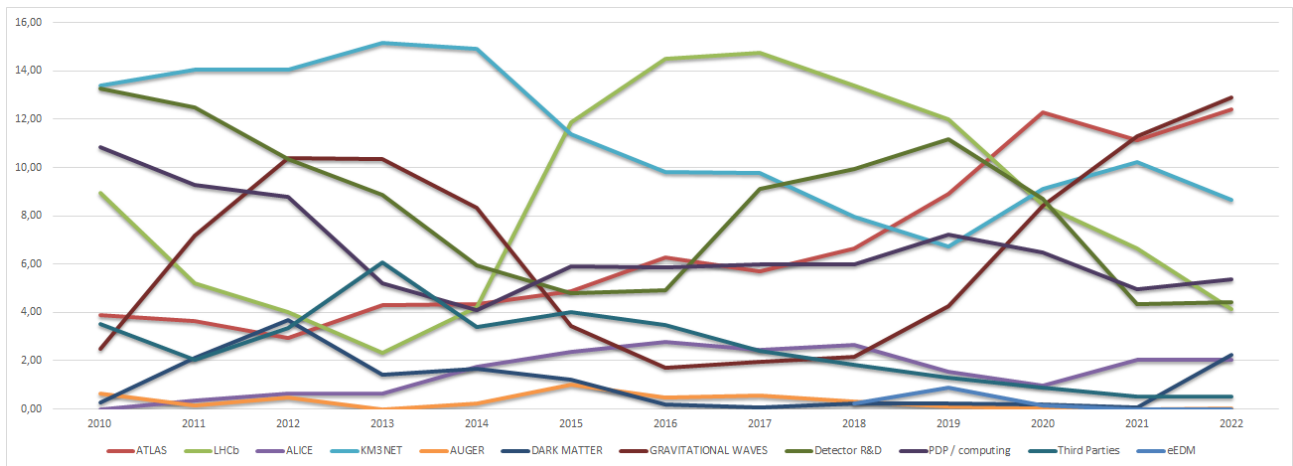
Are there any other physics or astronomy communities that should be involved in these discussions about the ET, and in particular the GW strategy in Europe, which are not involved now?

Indeed it would be good to have the discussions with different communities, including astronomers (e.g. NOVA recently started discussions on synergies between GW instrumentation and optical infrared efforts of NOVA, Nikhef is also part of the SRON roadmap on LISA on instrumentation overlap between LISA and ET) and other fundamental physics groups. Note that the CAN is the body to discuss (and advise) GW science aspects between the Nikhef and the astronomy communities.

[Impact on other programmes questions;](#)

What would be the impact on Nikhef engineering/workshop capability? Should we introduce a cap per group at Nikhef on the use of the engineering/workshop capabilities of Nikhef?

We believe the strength of Nikhef (one of its crown-jewels!) are the technical departments. As the plot below shows there have been huge variations of the technical person power for the different experiments over time. This is a natural process following the different life and upgrade cycles of the various experiments. The Nikhef strategy and other planning instruments are aimed to give the total Nikhef efforts the biggest possible 'punch'. This is not (and should not be seen as) a competition between HEP and APP, but rather we should cherish Nikhef's amazing capacity and the flexibility to do the best for both, HEP and APP. We worry that any caps or fixed percentages will reduce Nikhef's impact.



What would the effect of building the ET mean for the future collider projects?

Nothing. From the perspective of the Nikhef strategy these are two independent events.

In the previous strategy there was a 50/50 split written for high energy particle physics (colliders) and astroparticle physics. What is the envisioned split within Nikhef explicitly separating GW for this strategy document?

The mentioned 50-50 split between HEP and APP (including GW) is still both the current reality and also the intent for the next Strategy period.

#### Environmental questions;

What is the plan to compensate for the climate impact of ET. Not only during construction and running, but also considering the windmill park envisioned for this spot now can't be built in the original proposed time-frame.

Sustainability is a very explicit attention point, in particular for the construction phase of ET. Several activities/studies/projects/proposals are ongoing or being planned to gain more insight.

The windmill issues and their effects on the operation of ET are being investigated. Strictly speaking, building of windmills in the ET search area is for the time being suspended, not ruled out in the longer term.

#### Summary question:

I do not retire in 15 years. To have a secure scientific career with adequate funding, should I join ET now?

Nikhef offers a broad portfolio of fantastic science opportunities. Here it is best to go with the same advice most of us give to our students: Determine what your personal main science driver/motivation is and then go for it! 110% Independent of whether it is HEP, GW or any other topic.

Please explain the way the mission budget is divided at CERN, where well funded groups from open competition usually get a reduced/no money from the mission budget while groups without success in the open competition get a little bit extra at each time. This way the strategy of Nikhef holds.

The director of Nikhef has set aside a portion of Nikhef's (NWO-I's) base funding (or mission funding) to be devoted to the appointment of PhD students and postdocs in those research lines, that are less successful (or less 'lucky') in obtaining external funding for such positions. This funding, currently in the order of 3 to 5 positions per year, is of course not enough to compensate for total loss of external funding, but at least helps a bit. This mission budget is available for *all* research lines at Nikhef (LHC experiments, astroparticle physics, theory, R&D alike), at the discretion of the director.