

This is my personal impression  
of the current situation

Not meant for distribution!

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26 February 2025

This is an informal meeting for mathematicians about

Symmetry theme

NWA route

Building blocks of matter  
and Foundations of space and time

## Why are we having this meeting?

There will soon be a new ORC call  
(Onderzoek op Routes door Consortia  
Research along Routes by Consortia)

I hope with one of the themes being

“new types of symmetry”

“nieuwe vormen van symmetrie”

- 6.75M€ for **one** inter/multi/trans disciplinary consortium
- expected number of proposals per theme: **1-3**

## My role

Increase participation of mathematics in the route

I will not be part of any consortium in this route

## Rough time line

- Early March: NWO publishes call (then we know whether theme is in or not)
- Collaborative workshops: likely 14 April and 8 May
- Deadline for submitting proposal expected February 2026

The route management will not form the consortium, but we will help where we can.

## Why the symmetry theme?

Route board (<https://www.nwa-fundamenten.nl/who/>) decided to go for this theme since

- connects to original questions
- easy to imagine for societal partners
- new science
- interdisciplinary connections

I collected some input from mathematics community

NWO was positive but the programme committee also wanted more visible transdisciplinarity

## Symmetry theme text

“new types of symmetry”

“nieuwe vormen van symmetrie”

In mathematics and the natural sciences, symmetries play a key role. .... The framework of this call is formed by four pillars

Two scientific, two societal (connecting to art and education)

**It is not:** anything symmetric

# Symmetry theme text

## Pillar 1: Generalized symmetry:

In theoretical physics, there is particular attention to higher-order forms of symmetry. These play a role not only in string theory, for example, but also in high-energy particle physics and (the classification of) condensed forms of matter. These developments have a close relationship with **mathematical research into topological phase transitions and category theory**. More generally, the relationship between algebra, geometry and symmetry, the so-called Langlands program, is one of the great challenges in mathematics where important progress has recently been made, with new perspectives towards **both number theory** and quantum field theory. These developments can have important consequences for effective descriptions, from particle, quantum and soft-matter physics to hydrodynamics. Recent advances in semiconductor technology, for example, are also based on symmetry insights (topological insulators, robust quantum computers).



# Symmetry theme text

## Pillar 2: Quasi symmetry:

Symmetry often has imperfections. Such **near-, hidden or partial symmetry is nevertheless crucial as an organizing principle for the effective description of behavior, and the classification of, a wide diversity of natural phenomena.** The study of broken symmetry, spontaneous or as a result of disturbances, has important applications from particle physics to turbulence in fluids and gases. For instance, symmetry violation has proven to be a powerful way to uncover new physics of fundamental particles and their interactions. The **mathematical structure and description of quasi-crystals** is another important challenge in this context. More generally, there have been new insights into **dynamically generated (near-) symmetry in many-particle systems such as liquid crystals and large networks, both from mathematics** and the 'soft-matter' community. The latter is also closely related to studies of fractal (scaling) symmetries, which are ubiquitous in living nature; think of the repeating curls of a fern or recurring patterns in alveoli.

## Consortium building

I think it would be wise for the mathematics community to **self-organize** for the consortium

- Which “new types of symmetry” research questions should be answered in mathematics? By whom?
- Then connect to form interdisciplinary consortium, in particular with physics
- This route focuses on fundamental questions!
- Think about outreach & societal partners (arts, schools)
- Do not duplicate existing big consortia (XL, Emergence)
- Involve younger researchers & gender balance!

## Consortium building

- invest time
- go to collaborative workshops
- don't be shy, take the lead
- be willing to compromise and share
- don't take it personally
- communicate
- do it together
- use experience in Emergence theme
- self-organize and coordinate

# Questions

