

# Report on the outcomes of a Short-Term Scientific Mission<sup>1</sup>

Action number: CA20111

Grantee name: Thorsten Altenkirch

## **Details of the STSM**

Title: Concurrency in cubical type theory

Start and end date: 31/08/2024 to 06/09/2024

## **Description of the work carried out during the STSM**

Description of the activities carried out during the STSM. Any deviations from the initial working plan shall also be described in this section.

*(max. 500 words)*

We explored the definition of inductive datatypes in cubical type theory based on container theory. This is an essential requirement to model more advanced definitions. In particular we investigated the role of distributive laws in this setting using the insight that Sigma universes correspond to monadic containers. We also discussed a recent publication by Tarmo Uustalu about concurrent monads with shared state and its relation to the research described above

Exploiting a mini-workshop in bifroest we re also able to discuss the relationship of combinatorial species and containers and the challenges when formalising combinatorial arguments. I presented the concepts of Homotopy Type Theory to an audience of computer scientists and Mathematicians. In Reykjavik I gave a talk about "Dependently typed Python".

## **Description of the STSM main achievements and planned follow-up activities**

<sup>1</sup> This report is submitted by the grantee to the Action MC for approval and for claiming payment of the awarded grant. The Grant Awarding Coordinator coordinates the evaluation of this report on behalf of the Action MC and instructs the GH for payment of the Grant.

Description and assessment of whether the STSM achieved its planned goals and expected outcomes, including specific contribution to Action objective and deliverables, or publications resulting from the STSM. Agreed plans for future follow-up collaborations shall also be described in this section.

*(max. 500 words)*

*The STSM certainly achieved some planned and unplanned objectives. We identified some requirements to modelling structures relevant for concurrency and initiated a novel approach to investigating them. We will continue this approach and hopefully jointly publish about this topic in the future.*

*The unplanned opportunities are also important for the general goals of the action, in particular the formal development of combinatorial arguments while not specifically targeted by the STSM is certainly in the scope of the action. We initiated discussions with several Mathematicians in Iceland and UK which may bear fruits in the future.*