

The emergence of space and time in string theory in higher dimensions

Faculty Research Grant Closing Report

Rolf Schimmrigk

1. *Description of grant-supported activity.*

I spent the bulk of the summer of 2007 doing research at IUSB as well as at the Kavli Institute for Theoretical Physics in Santa Barbara, where I also attended a conference. I continued to work with Monika Lynker on a project on arithmetic methods in the context of special Fano varieties, constructing arithmetic geometric modular forms that we were able to identify with modular forms constructed from the string worldsheet via Hecke indefinite modular forms. This project also involves IUSB student Savan Kharel. We were able to finish this project and submitted a paper that is currently in press and will appear in 2008. Monika and I also continued working on a new project in which we aim to extend our methods to families of varieties. We spent a lot of time understanding the mathematics involved and have continued to work on programming the necessary machine computations. We have made crucial progress in that we now have a working code which allows us to analyze in detail a certain family of surfaces with which we want to test our ideas.

2. *Were you able to complete the project? Describe any difficulty you had.*

The projects I'm working on are part of an extended multi-year long program. As such they will not be finished in a short period of time. We were, however, able to complete our project concerning the arithmetic of special Fano varieties in the context of mirror symmetry. The paper containing these results is currently in press. I have also finished and published a paper concerned with arithmetic mirror symmetry in the context of elliptic curves.

The p -adic program to consider families of string compactifications turned out to be more difficult and time-consuming than we expected. However, we were able to come up with a working code and have now entered the second phase of this project where we apply the techniques we learned in concrete examples.

3. *Did, or will, the project result in a specific product - a manuscript, etc? If so, describe and indicate the state of development.*

Our work so far has resulted in two publications:

1. *A modularity test for elliptic arithmetic mirror symmetry*
R. Schimmrigk, Phys. Lett. **B655** (2007) 84
2. *Arithmetic aspects of mirrors of rigid Calabi-Yau manifolds*,
S. Kharel, M. Lynker and R. Schimmrigk, in press (to appear in 2008)

Currently, I have another paper in the final stages of preparation

1. *Emergent spacetime from modular motives* R. Schimmrigk, in preparation, to be submitted in 2008

The 'Calabi-Yau family' project that Monika and I have been working on should lead to a publication in the not too distant future.