Scientific Report – visit to Hamburg December 2011

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1 Purpose of the visit

The main purpose of the visit was to initiate a project in logarithmic conformal field theory (CFT), making use of a categorical construction due to Lyubashenko to construct candidates for correlators in certain generalised spaces of conformal blocks. Beyond that, part of the purpose was also to discuss recent developments and ongoing projects with the faculty, postdocs, students and visitors at the Mathematics department of the University of Hamburg.

For reasons beyond my control, the intended project could not be started at this time. Instead, as described below, another project concerning uniqueness of rational CFT with defect lines was started, and furthermore significant work was carried out on yet another project in collaboration with another visitor to Hamburg.

2 Work carried out during the visit

I will divide the description of the work carried out during the visit in three parts.

Uniqueness of rational CFT with defect lines Together with prof. Ingo Runkel I initiated a project to investigate the uniqueness of rational CFT with defect lines. More precisely, the "TFT approach to RCFT" (as developed mainly by J. Fuchs, I. Runkel, and C. Schweigert, with contributions also by G. Felder, J. Fröhlich, J. Fjelstad and others) is not only capable of constructing conventional rational CFT correlators with bulk and boundary field insertions, but also allows the construction of correlators with so-called 'topological defect lines', tensionless interfaces separating possibly different CFT's on a given world sheet. In the conventional case, it was shown in [FjFRS] that every rational CFT is indeed covered by the topological field theory (TFT) approach, thereby providing a kind of uniqueness result. The aim of this project is to extend this uniqueness result to the case when we also allow correlators with topological defect lines.

The work carried out on this project, not having been discussed prior to my visit, mainly took the form of black board discussions (during some of which a PhD student, Sebastian Novak, also participated). We came up with a strategy, generalising that of [FjFRS], which ought to be sufficient to carry the project out. Furthermore, we identified what we perceive to be crucial intermediate results on which this strategy hinges, and spent some time deriving these.

Factorisation and fundamental world sheets in the presence of defect lines Together with prof. Jürgen Fuchs and PhD student Carl Stigner from Karlstad University, I am since some time back working on extending the notions of factorisation (or sewing constraints), modular covariance, and fundamental correlators, to rational CFT in the presence of topological defect lines. Since my visit to Hamburg partially overlapped with a visit by Jürgen Fuchs, some of the time was devoted to this project. More precisely, we were at the time concentrating on a precise definition of world sheets with defects, its consequences for the generalised notion of modular covariance and fundamental correlators, and technical issues in the proofs of these properties.

Discussions with other people A non-negligible part of my visit was spent discussing various Mathematical issues related to CFT and TFT with faculty, students, postdocs and other visitors. In particular I will mention discussions with Sebastian Novak concerning 2D TFT on surfaces with spin structure; with Martin Mombelli concerning representation categories of finite dimensional Hopf algebras and in particular the Brauer-Picard group of such categories; and with Gregor Masbaum concerning a certain decomposition of modular categories occurring in an approach to 3D TFT, in particular the nature of a factor in this decomposition with so-called Lee-Yang fusion rules.

3 Main results obtained

Uniqueness of rational CFT with defect lines Since this project is still in an early stage, the results obtained are therefore also of a preliminary nature. I judge that the main result obtained here is a strategy for showing uniqueness of RCFT with defects, in terms of a small number of generating world sheets and relations among these generators obtained from factorisation properties and modular covariance.

Factorisation and fundamental world sheets in the presence of defect lines The main results here were the consequences of a precise definition of world sheets with defects. More precisely, strict proofs of certain world sheets being fundamental in that they determine all other correlators, and of a certain covariance property of correlators under the action of homeomorphisms of (topological) world sheets.

4 Future collaboration with host institution

I expect that the project initiated with prof. Ingo Runkel, Department of Mathematics, University of Hamburg, will continue throughout 2012.

5 Projected publications

There will be one article together with Jürgen Fuchs and Carl Stigner on factorisation and fundamental correlators in the presence of defect lines, appearing as a preprint before the end of February 2012. In addition I expect one article together with (at least) Ingo Runkel in the uniqueness project either late 2012 or early 2013.

References

[FjFRS] J. Fjelstad, J. Fuchs, I. Runkel, C. Schweigert, *Uniqueness of open/closed rational CFT with given algebra of open states*, Adv.. Theor. Math. Phys. **12** (2008)