ICTS String Seminar

Title	:	When is the CFT attached to a target space variety rational?
Speaker	:	Abhiram Kidambi (Max Planck Institute for Mathematics in the Sciences, Germany)
Date	:	Wednesday, 11 June 2025
Time	:	3:00 PM (IST)

Abstract : Rational CFTs (RCFTs, following Moore-Seiberg [3] and Kapustin-Orlov [4]) represent the simplest kind of solvable CFTs in which all correlation functions are expressible as finite sums of holomorphic and anti-holomorphic functions. They are also tied intricately with the study of BPS partitions in string compactification - RCFTs can be conjecturally interpreted as a heterotic string dual of attractor points in Type II string compactification. However, when one thinks of CFTs with a specific target space (abelian variety, or even more generic algebraic varieties like K3 surfaces and CY threefolds), it is an interesting question to ask if whether rationality of the CFT picks out specific target spaces, and vice-versa - if the target space satisfies certain properties, is the CFT rational? Such an undertaking was initially considered by G.Moore [1] for the case of elliptic curves who showed that CFTs with elliptic curve target spaces are rational when the elliptic curve admits complex multiplication (CM) and the mirror curve is also CM, and both curves have isomorphic CM fields. An equivalent lattice theoretic undertaking was done by K. Wendland [2] for higher dimensional abelian varieties (T^4, …), for c = 2 cases by Hosono-Yau-Lian-Oguiso [5]. Gukov-Vafa [6] conjectured, following [1] that a similar setting also holds for CY-3 folds.

In this talk, based on [A], [B] (w/ Taizan Watari and M. Okada), we revisit the Gukov-Vafa conjecture. In an attempt to formalize the conjecture, one sees that the Gukov-Vafa conjecture is false even for the case of abelian varieties. The talk will focus on a formal description of rational CFTs with abelian variety target space and their characterisation.

If time permits, which I am sure it won't, or if interest exists, which I hope it will, I will go over the generalisation of this to algebraic varieties including self-mirror CY3, WIP towards non-self mirror CY3, reconstruction of RCFTs from Hodge datum, as well a view of this problem from L-functions attached to the target space variety.

Note: As a warm up for the actual seminar, I will also give a lightning review session on "complex multiplication for physicists" for 30 minutes sometime before the start of the actual seminar. We will deal only with the analytic aspects of CM in this talk so I will only give a review of that.

References:
[1] Arithmetic and attractors, hep-th/9807087 [hep-th]
[2] Moduli spaces of unitary conformal field theories
[3] Lectures on RCFT (Not the original paper but a good overview)
[4] Vertex algebras, mirror symmetry, and D-branes: The Case of complex tori, hep-th/0010293 [hep-th]
[5] Classification of c = 2 rational conformal field theories via the Gauss product, hep-th/0211230 [hep-th]
[6] Rational conformal field theories and complex multiplication, hep-th/0203213 [hep-th]
Talk is based on:
[A] Towards Hodge Theoretic Characterizations of 2d Rational SCFTs, 2205.10299 [hep-th]
[B] Notes on Characterizations of 2d Rational SCFTs: Algebraicity, Mirror Symmetry, and Complex Multiplication, 2408.00861 [hep-th]
For warm up session:
Appendix A in [B] above (This is a topic tailored distillation of [WU2] below)
[WU1] Complex Multiplication by James Milne (Sections 1-3, Section 5 if you want to see the big picture)
[WU2] Abelian Varieties with Complex Multiplication and Modular Functions by Goro Shimura

Venue	:	Emmy Noether Seminar Room
		Zoom Link: https://icts-res-in.zoom.us/j/88092766911?pwd=R3ZrVk9yeW96ZmQ4ZG9KRzVhenRKZz09
		Meeting ID: 880 9276 6911
		Passcode: 232322