

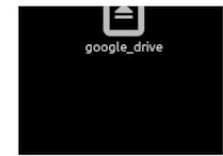
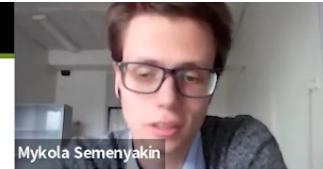
Title: Session 1 - Mykola Semenyakin

Speakers: Mykola Semenyakin

Collection: POSTDOC WELCOME 2022


Date: October 24, 2022 - 9:40 AM

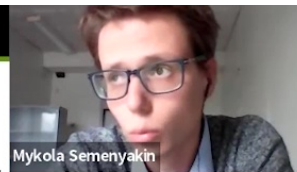
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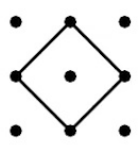
Cluster algebras, Seiberg-Witten integrability and topological string theory

Mykola Semenyakin

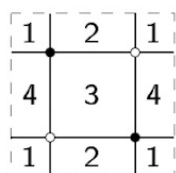
October 24, 2022 



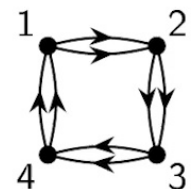
Newton polygon



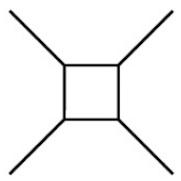
Bipartite graph on torus



"Cluster" quiver



Toric diagram



Topological strings theory & Seiberg-Witten theory

Discrete dynamics of A-cluster variables

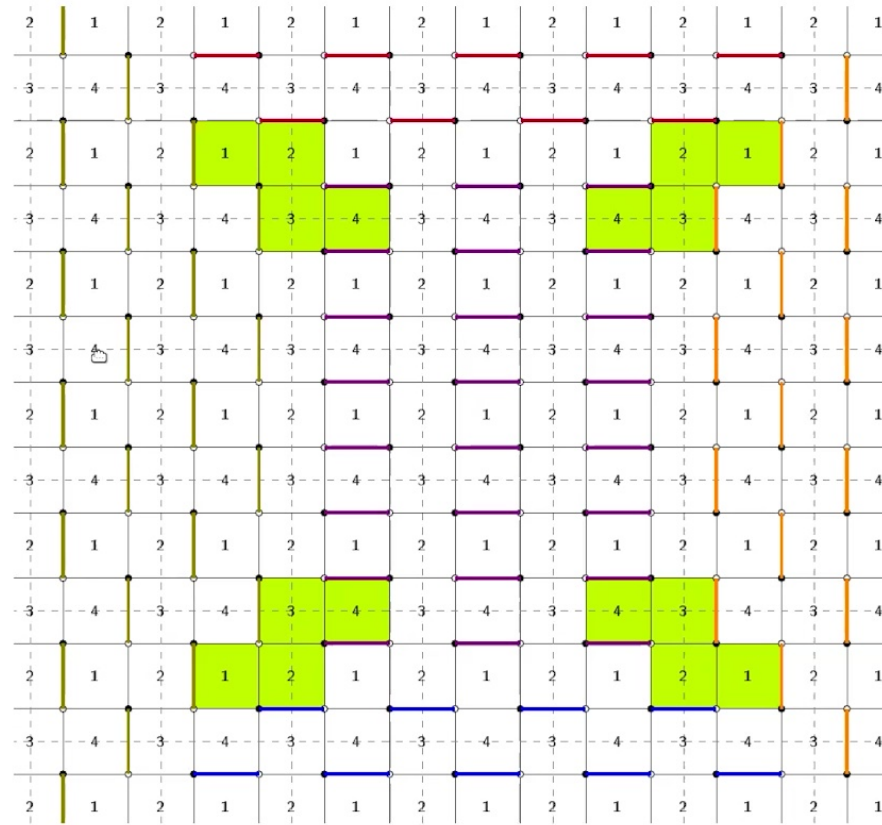
$$\tau_1 \bar{\tau}_1 = \tau_1^2 + Z^{1/2} \tau_3^2$$
$$\tau_3 \bar{\tau}_3 = \tau_3^2 + Z^{1/2} \tau_1^2$$



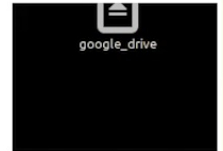
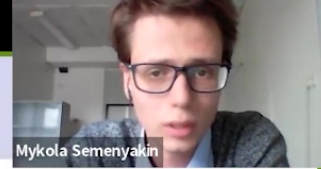
Solution by dual 5d Nekrasov functions

$$\mathcal{T}(u, s; q|Z) = \sum_{m \in \mathbb{Z}} s^m \mathcal{Z}(uq^{2m}; q, q^{-1}|Z)$$
$$\tau_1 = \mathcal{T}(u, s; q|Z), \tau_3 = is^{\frac{1}{2}} \mathcal{T}(uq, s; q|Z)$$

Dimers on bipartite lattices & boxcounting



Seiberg-Witten prepotential from WKB



$$\frac{\partial \mathcal{F}}{\partial a} = a_D, \quad a = \oint_A z \frac{dw}{2\pi i}, \quad a_D = \oint_B z \frac{dw}{2\pi i}$$

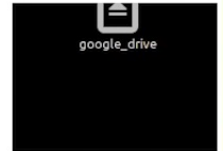
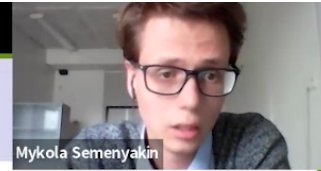
□

are solved by

$$\frac{1}{\varepsilon^2} \mathcal{F} \propto \log \det K(\tilde{T}_x, \tilde{T}_y) \propto \int \left(\frac{dp d\theta}{2\pi \varepsilon} \right)^2 \log \det K(e^{p_x + i\theta_x}, e^{p_y + i\theta_y})$$



What is next?



Algebra:

- ▶ Quantization of cluster algebras and refined topological strings. Toroidal algebra action & instanton R-matrix.
- ▶ Hamiltonian reductions in the cluster integrable systems.

Integrability & geometry:

- ▶ Double elliptic integrable systems as Hitchin systems. Analogy with "Higgs bundles", hyperkähler geometry.
- ▶ Seiberg-Witten prepotential beyond the Harnack locus. Wall crossing in the tropical limit. "Integrated" GKZ hypergeometric functions.

String theory:

- ▶ Kasteleyn operator, TS/ST correspondence and topological strings. Generalization to other geometries.