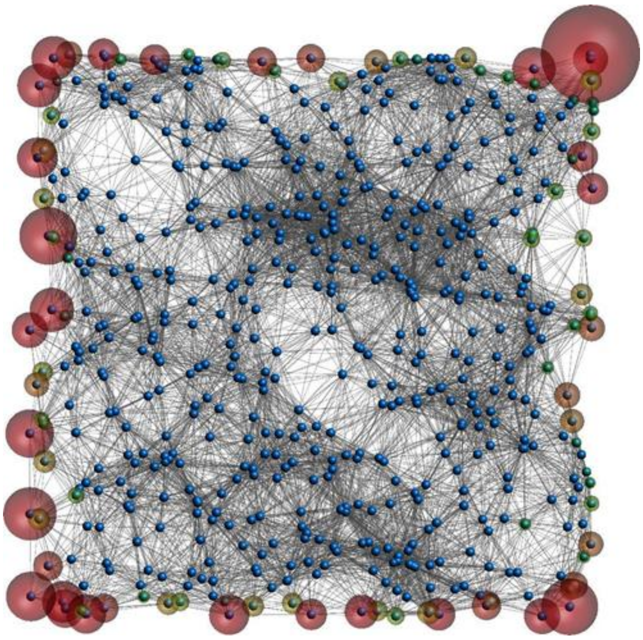
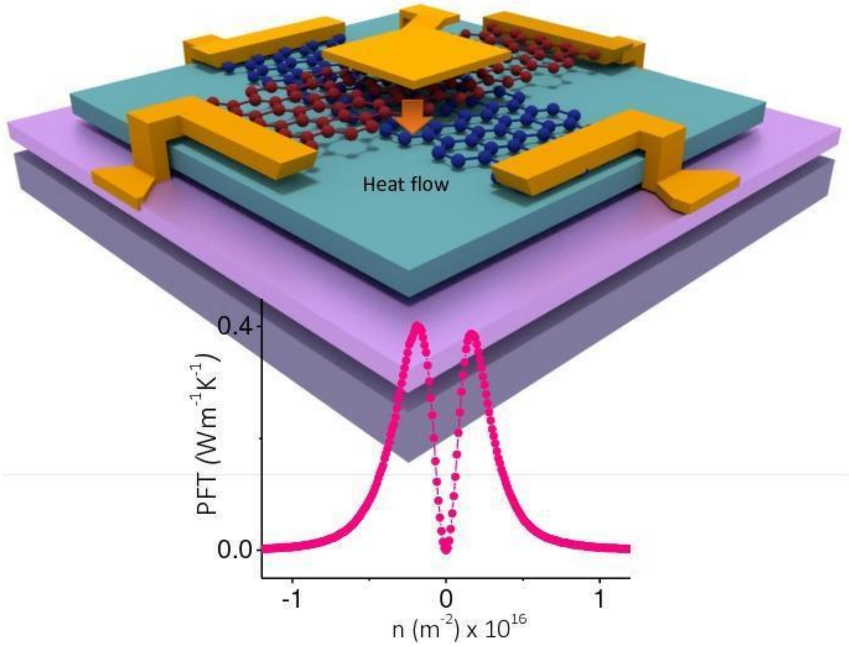
1. **Vijay Shenoy (PHY)**



Theoretical work establishes that topological insulators, materials which conduct only on the surface, can be realized in glassy (amorphous) materials. The image shows one such topological surface state in a model glass, where an electronic wavefunction lives on the edge of the sites that are arranged randomly.

Reference: A Agarwala, **VB Shenoy** (2017) Topological Insulators in Amorphous Systems. *Phys. Rev. Lett.* 118: 236402

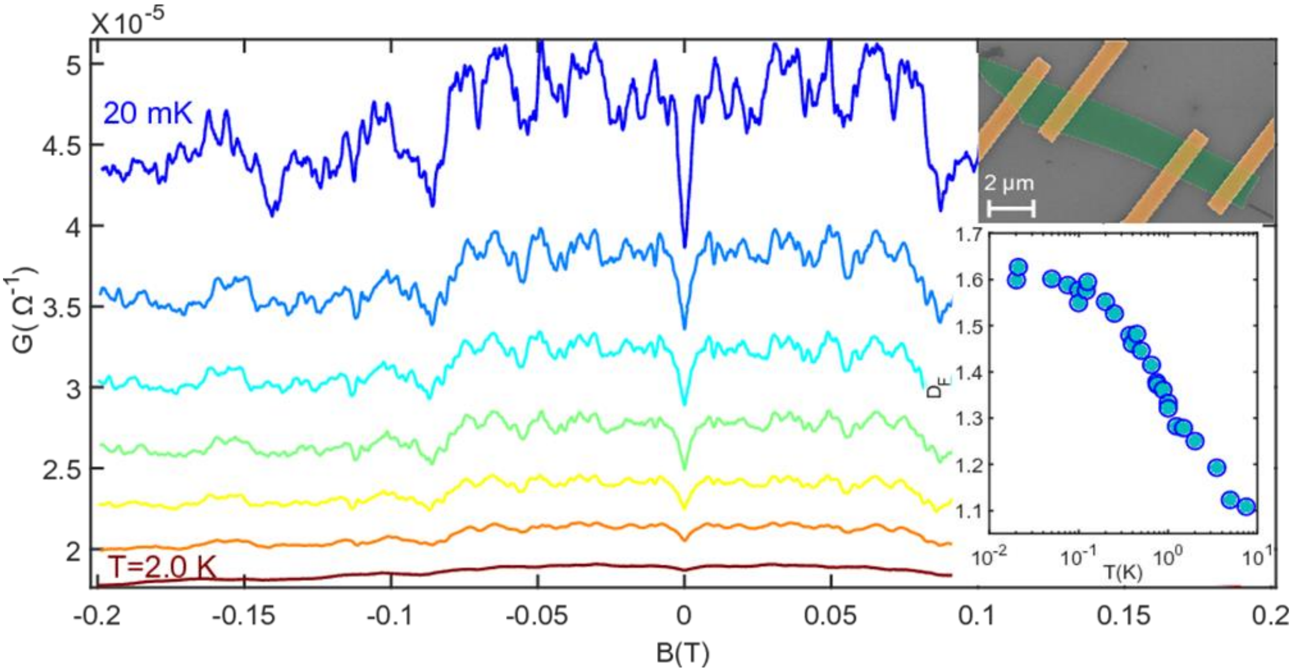
2. **Arindam Ghosh (PHY)**



Thermoelectricity at the atomic scale: The researchers have created a new class of thermoelectric device by placing two layers of graphene at a separation of 0.5 nanometres (the van der Waals distance). A temperature difference between the layers gives rise to several tens of microvolts of voltage difference and large power factor (PFT), making it the thinnest known thermoelectric system.

Reference: PS Mahapatra, K Sarkar, HR Krishnamurthy, S Mukerjee and **A Ghosh** (2017) Seebeck Coefficient of a Single van der Waals Junction in Twisted Bilayer Graphene. *Nano Letters*. 17(11):6822–6827

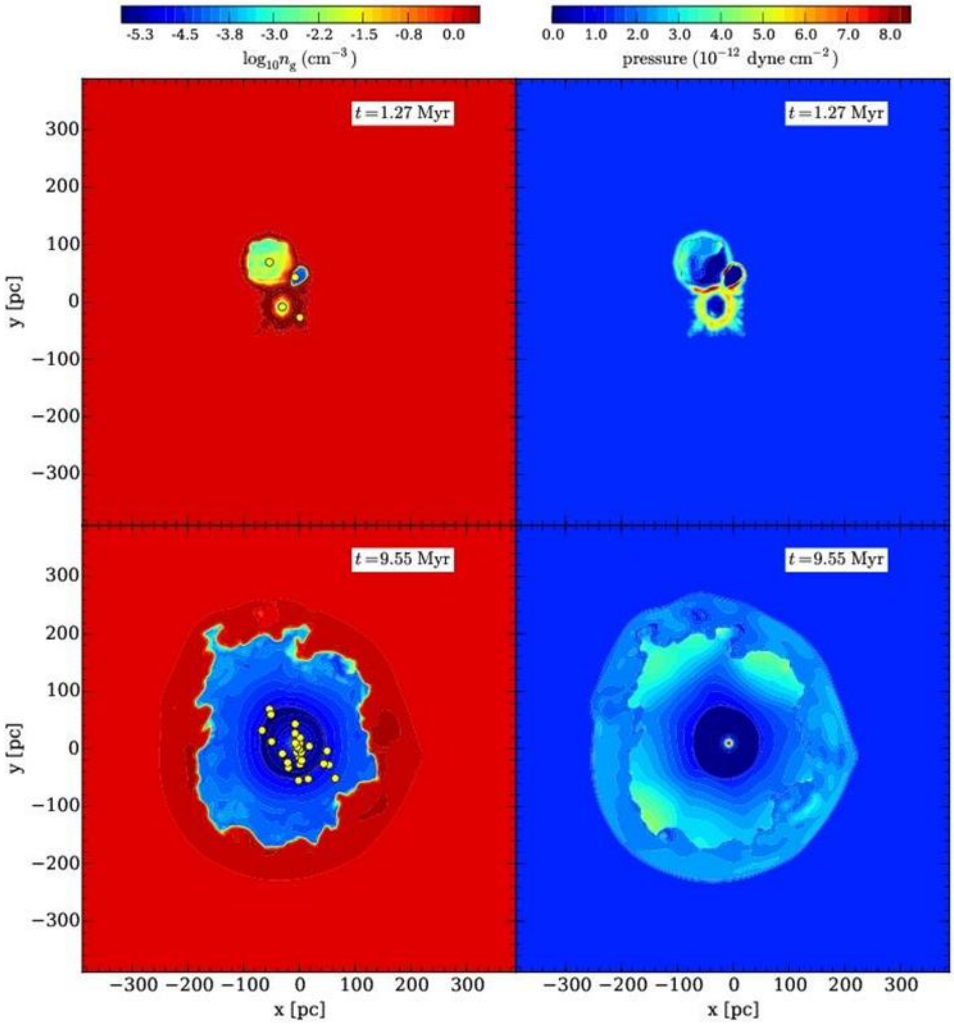
3. **Aveek Bid (PHY)**



This study reports the first observation of multifractality of electrical conductance at ultra-low temperature in single-layer graphene in the presence of a strong magnetic field. The figure shows plots of conductance of single-layer graphene device (shown in top-right corner) at different temperatures, while the bottom-right inset shows the temperature dependence of the fractal exponent.

Reference: KR Amin, SS Ray, N Pal, R Pandit, and **A Bid**. Exotic Multifractal Conductance Fluctuations in Graphene. *Communications Physics* (in Press)

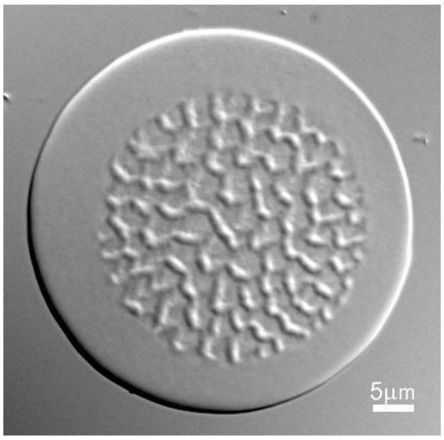
4. Prateek Sharma (PHY)



Gas density (left panels; log-scale) and pressure (right panels; linear scale) snapshots in the midplane of a 3D hydrodynamic simulation showing the transition of individual supernovae into a superbubble. The yellow circles in the left panels show the projected location of supernovae that have gone off till a given time. One can see the transition of isolated supernovae that fizzle out to a pressurized superbubble formed due to the overlap of supernovae.

Reference: N Yadav, D Mukherjee, **P Sharma**, BB Nath (2017) How Multiple Supernovae Overlap to Form Superbubbles. *Monthly Notices of Royal Astronomical Society*. 465:1720

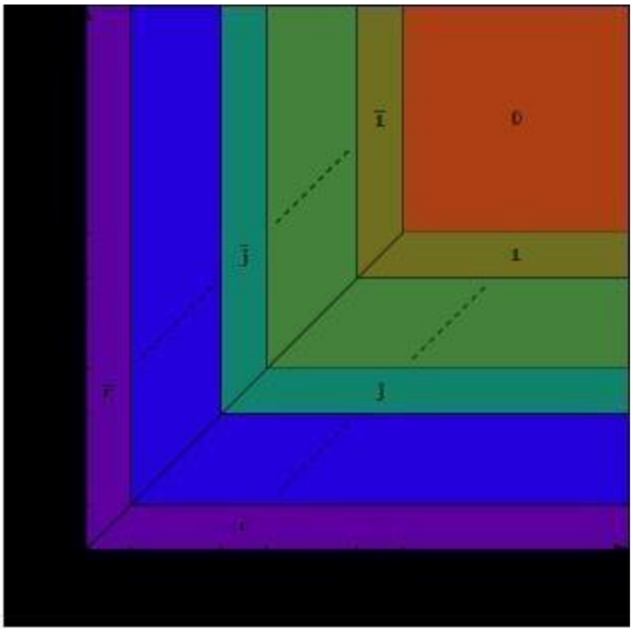
5. **Prerna Sharma (PHY)**



It is a major challenge to shape two-dimensional self-assembled monolayers at colloidal or molecular length scales. Unlike the usual strategies of externally applied confinement and differential strains, the authors demonstrate a novel pathway based on internal phase transition (crystallization) to induce curvature in colloidal membranes. The image shows a two-dimensional colloidal sheet of chiral rod-shaped particles undergoing spontaneous wrinkling during crystallization.

Reference: L Saikia, T Sarkar, M Thomas, VA Raghunathan, A Sain and **P Sharma** (2017) Curvature Instability of Chiral Colloidal Membranes on Crystallization. *Nature Communications* 8:1160

6. **Arvind Ayyer (MATH)**



The figure shows the exact phase diagram of a one-dimensional exclusion process with *r* species of positively and negatively charged particles in the presence of reservoirs and electric field in the nonequilibrium stationary state. The current of each species of particles is the same within each region of the phase diagram, and is distinct across different regions.

Reference: **A Ayyer** and D Roy (2017) The Exact Phase Diagram for a Class of Open Multispecies Asymmetric Exclusion Processes. Scientific Reports 7:13555

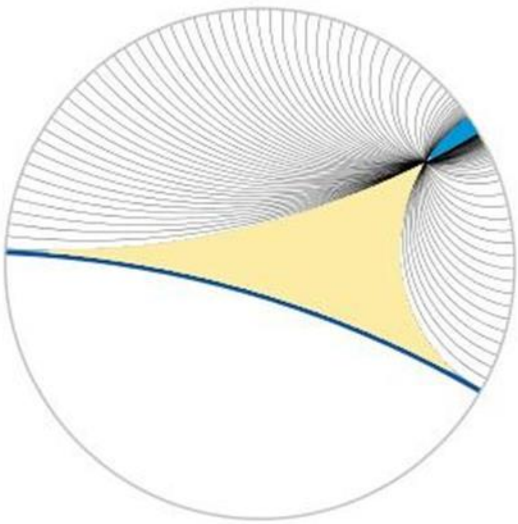
7. Abhishek Banerjee (Math)

$$\bar{B}_{\alpha,\mathcal{F}} := \bar{B}_\alpha \left| \frac{\hat{\mathcal{F}} \cap (\mathrm{mod}_\alpha - \mathbf{C})}{\mathrm{eff}_\alpha - \mathbf{C}} : \frac{\hat{\mathcal{F}} \cap (\mathrm{mod}_\alpha - \mathbf{C})}{\mathrm{eff}_\alpha - \mathbf{C}} \to \mathcal{F} \right.$$

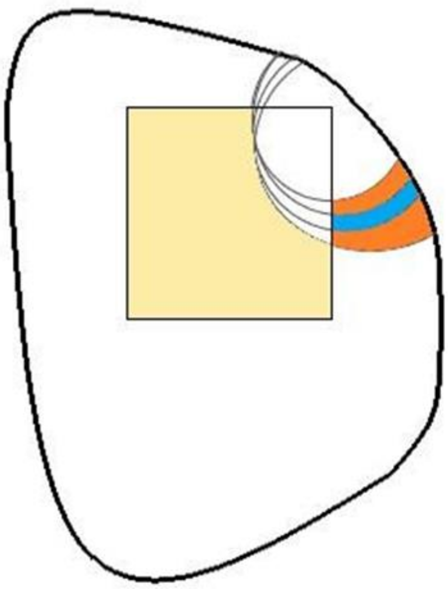
A secret key to understanding abelian categories, which has been somewhat hidden in the literature is the “Auslander-formula” which shows a way of putting every abelian category inside a “nice” abelian category. I showed that this formula is even more powerful than previously thought, because it also describes structure of certain subcategories inside the abelian category, known as torsion-free classes.

Reference: A Banerjee. On Auslander's Formula and Cohereditary Torsion Pairs. *Communications in Contemporary Mathematics* (In Press)

8. Gautam Bharali (MATH)



Disc model of *hyperbolic* geometry



Schematic of the *visibility* property

Although Goldilocks domains need not be negatively curved, they exhibit features of hyperbolic 2-space (illustration on the left). For instance, almost-geodesic paths—the analogue of light rays—between points close to the boundary bend sharply inward. This is at the root of powerful structural results which hold true for a wide range of domains in complex Euclidean space.

Reference: G Bharali and A Zimmer (2017) Goldilocks Domains, a Weak Notion of Visibility, and Applications. *Adv. Math.*, 310

9. **Soumya Das (MATH)**

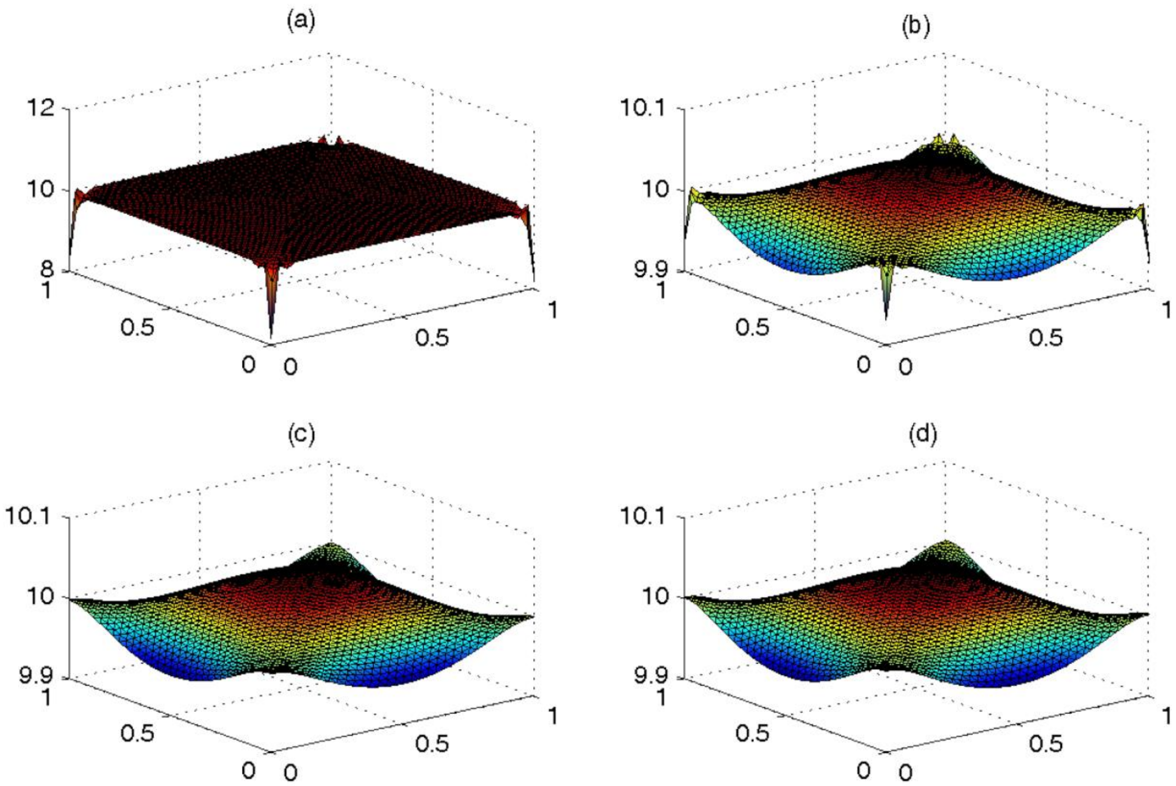
$a(F,T) \neq 0$ for infinitely many matrices T such that $\det(2T)$ is of the form $2^\alpha n$, where n is odd and square-free and $\alpha \in \{0,1,2,3\}$. More precisely, for all X large enough and any $\varepsilon > 0$ with α as above,

$$\#\{0 < n < X,\, n \text{ odd, square-free}, a(F,T) \neq 0, 2^\alpha n = \det(2T)\} \gg_{F,\varepsilon} X^{1-\varepsilon}.$$

This study is about determination of modular forms from their Fourier coefficients indexed by arithmetically interesting objects. The main result displayed is an example of this theme in the context of Hermitian modular forms of degree 2.

Reference: P Anamby, **S Das**. Distinguishing Hermitian Cusp Forms of Degree 2 by a Certain Subset of all Fourier Coefficients. *Publicacions Matemàtiques*. In Press.

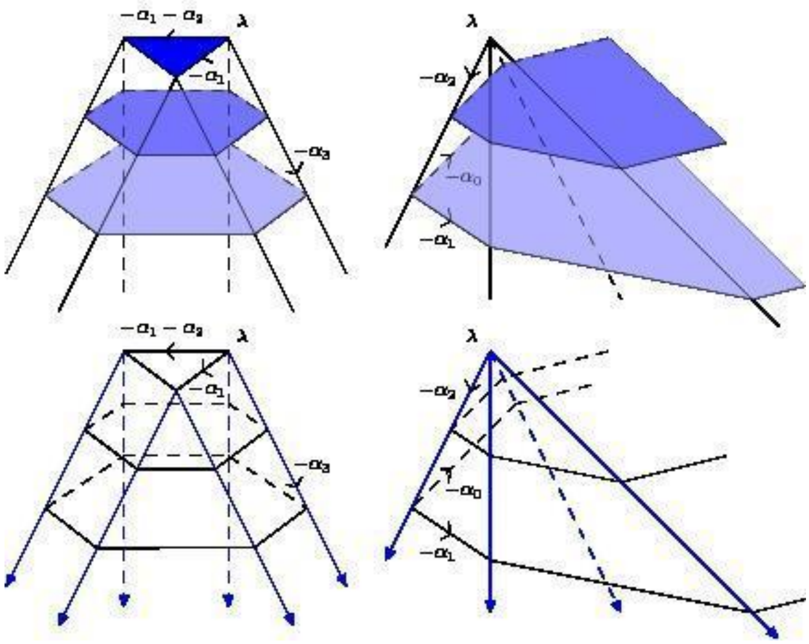
10. Thirupathi Gudi (MATH)



Energy space based Dirichlet boundarycontrol [Figures (c) and (d)] proposed by our group outperforms the standard $L2$-space based Dirichlet boundary control [Figures (a) and (b)]. The regularizing parameter considered is 0.001 in Figures (a) and (c) and is 0.00003 in Figures (b) and (d). The former method exhibits high stability over the latter.

Reference: S Chowdhury, **T Gudi** and AK Nandakumaran (2017) Error Bounds for a Dirichlet Boundary Control Problem Based on Energy Spaces. *Math. Comp*. 86: 1103-1126

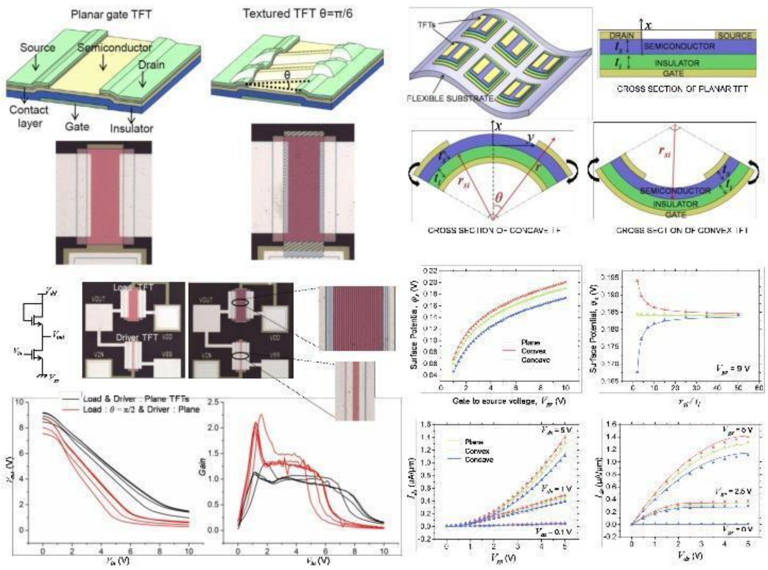
11. Apoorva Khare (MATH)



Highest weight modules (generated by a vacuum vector) are fundamental representations of semisimple, Kac-Moody, and Virasoro Lie algebras and quantum groups. The pictures describe the structure of the weights of general such modules over two Kac-Moody algebras, one each with finite and infinite integrability. The top row depicts “slices of weights”, and the bottom row their convex hulls.

Reference: G Dhillon and **A Khare** (2017) Faces of Highest Weight Modules and the Universal Weyl Polyhedron. *Advances in Mathematics*. 319: 111–152

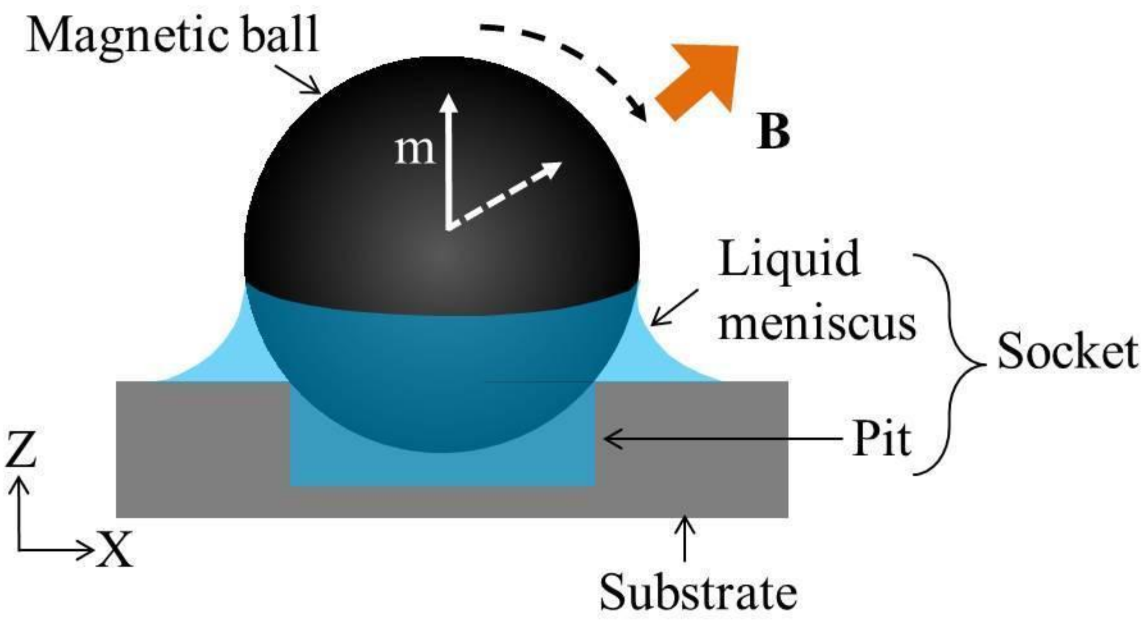
12. Sanjiv Sambandan (IAP)



Texturing the gate-insulator-semiconductor stack in thin-film transistors proves to be an interesting means of modulating the current-voltage characteristics. This implies that amplifier gain can be passively controlled without depending on aspect ratio scaling alone. For higher gain, this permits the use of low aspect ratio drivers thereby reducing the input Miller pole. The technology is relatively easy to implement within the scope of printed electronics.

Reference: A Nair, P Bhattacharya and **S Sambandan** (2017) Modulating Thin Film Transistor Characteristics by Texturing the Gate Metal. *Scientific Reports* 7 (1): 17932

13. GR Jayanth (IAP)



A novel active micro-scale ball and socket joint was designed, fabricated and evaluated for applications in microrobotics, micromanipulation and three-dimensional nanometrology. The ball is chosen to be a permanent-magnet micro-particle of spherical morphology whose orientation is controlled by external magnetic fields, while a micro-pit and a liquid meniscus together form the socket.

Reference: R Sri Muthu Mrinalini and **GR Jayanth** (2017) Design and Evaluation of an Active Micro-Scale Ball and Socket Joint. *J. Microelectromechanical Systems.* 26: 886

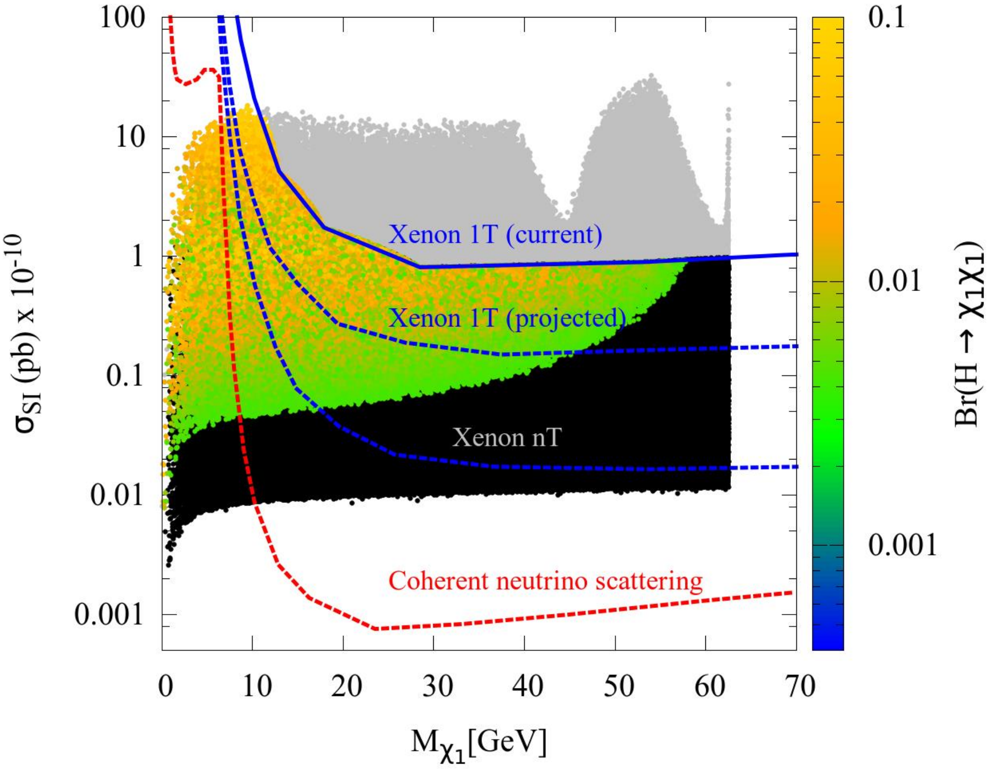
14. B Ananthanarayan (CHEP)

a) b)

The pion charge radius is determined from high precision data on the pion vector form factor from both time-like and space-like regions, using a novel formalism based on analyticity and unitarity. This figure shows statistical distributions of ⟨rπ2⟩ obtained using the Bern phase and one modulus measured by the BABAR experiment.

Reference: B Ananthanarayan, I Caprini, and D Das (2017) Electromagnetic Charge Radius of the Pion at High Precision. *Phys. Rev. Lett.* 119: 132002

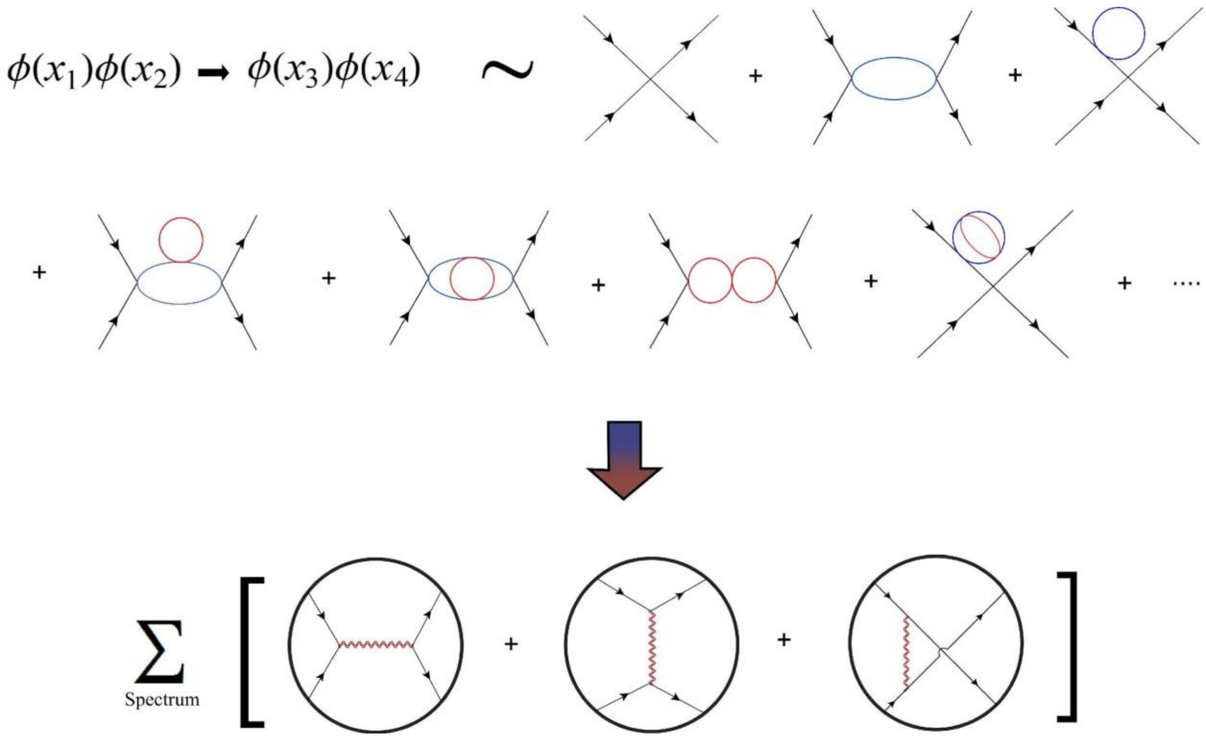
15. Rohini Godbole (CHEP)



Understanding the nature of the non-luminous dark matter (DM) in the universe is a foremost problem in particle physics. This work showed that the DM Direct Detection experiments under planning, and the study of 'invisible' Higgs decays in future electron positron colliders, can probe completely the case of the lightest supersymmetric particle as DM, covering both standard and nonstandard cosmology.

Reference: RK Barman, G Bélanger, B Bhattacherjee, **R Godbole**, G Mendiratta, and D Sengupta (2017) Invisible Decay of the Higgs Boson in the Context of a Thermal and Nonthermal Relic in MSSM. *Phys. Rev.* D 95: 095018

16. Aninda Sinha (CHEP)



The usual expansion in quantum field theory in terms of Feynman diagrams is tedious and leads to infinities. A new method, which is finite, uses a different basis in terms of a new set of diagrams. The method correctly reproduces old results and promises to produce new results which have never been computed using the Feynman diagram expansion.

Reference: P Dey, A Kaviraj, and **A Sinha** (2017) Mellin Space Bootstrap for Global Symmetry. *J. High Energ. Phys.* 2017: 19