Schedule: Local Cohomology and its Applications

Venue: Room 114 , Mathematics Department

Registration: 8:00 - 8:45 AM, Friday, July 1.

	9:00–9:50	10:00–10:50	11:30–12:20	2:30–4:30
Fri, July 1	Lecture 1 Anurag	Lecture 2 Tony	Lecture 3 Krishna	Tutorial Clare, Manoj, Srikanth
Sat, July 2	Lecture 4 Tony	Lecture 5 Manoj	Lecture 6 Tony	Lecture 7 and Tutorial Krishna, Anurag, Clare
Sun, July 3 Free day				
Mon, July 4	Lecture 8 Tony	Lecture 9 Manoj	Lecture 10 Anurag	Tutorial Anurag, Clare, Manoj
Tue, July 5	Lecture 11 Srikanth	Lecture 12 Srikanth	Lecture 13 Krishna	Tutorial Clare, Anurag, Tony
Wed, July 6	Lecture 14 Krishna	Lecture 15 Krishna	Free	Free
Thu, July 7	Lecture 16 Manoj	Lecture 17 Manoj	Lecture 18 Anurag	Tutorial Clare, Krishna, Srikanth
Fri, July 8	Lecture 19 Anurag	Lecture 20 Srikanth	Lecture 21 Manoj	Tutorial Clare, Krishna, Tony
Sat, July 9	Lecture 22 Anurag	Lecture 23 Srikanth	Lecture 24 Srikanth	Tutorial Clare, Manoj, Krishna

Conference Schedule

	9:00–9:50	10:00–10:50	11:30–12:20	2:30–3:20	3:30-4:20
Mon, July 11	Mehta	Trivedi	Nayak	Lyubeznik	Brenner
Tue, July 12	Blickle	Brenner	Sastry	Verma	

Workshop

Participants will arrive on 30th June, a Thursday. The workshop runs from 1st July through the afternoon of 9th July (the following Saturday). A tentative plan for the twenty-four lectures is as follows:

1. Basic notions: algebraic sets, dimension theory, regular rings. (Anurag)
2. Injective modules I: structure theorem. (Tony)
3. Injective modules II: Matlis duality. (Krishna)
4. Resolutions and derived functors. (Tony)
5. Depth: Koszul complex, regular sequences, Čech complex. (Manoj)
6. Local cohomology: torsion functor, direct limit of Ext and Koszul. (Tony)
7. Regular rings: global dimension, Auslander-Buchsbaum. (Krishna)
8. Cohomological dimension: depth, nonvanishing theorem. (Tony)
9. Arithmetic rank. (Manoj)
10. Cohen-Macaulay rings. (Anurag)
11. Gorenstein rings. (Srikanth)
12. Local duality. (Srikanth)
13. Sheaf cohomology. (Krishna)
14. Projective varieties: local cohomology and sheaf cohomology. (Krishna)
15. Hartshorne-Lichtenbaum vanishing theorem. (Krishna)
16. Connectedness: Mayer-Vietoris sequence, punctured spectra. (Manoj)
17. Finiteness properties: Hartshorne's example, associated primes. (Manoj)
18. D-modules: Weyl algebra, holonomic modules. (Anurag)
19. Finiteness properties using D-modules. (Anurag)
20. Frobenius action on local cohomology. (Srikanth)
21. Lyubeznik's vanishing theorem, dependence on characteristic. (Manoj)
22. Ideals of minors of generic matrices. (Anurag)
23. Big Cohen-Macaulay algebras: the Huneke-Lyubeznik theorem. (Srikanth)
24. Parafactoriality: Samuel's conjecture via local cohomology. (Srikanth)

Conference

Manuel Blickle, Universität Mainz
Cartier Modules and applications to local cohomology

We will introduce the notion of a Cartier module, i.e., a finitely generated module with a right action of the Frobenius, and give an elementary proof of a crucial finiteness result they enjoy. Then some applications to finiteness results of local cohomology modules are derived.

Holger Brenner, Universität Osnabrück
Local cohomology and ideal closure operations I, II

Several ideal closure operations can be studied by looking at the forcing algebras of the given data. The behaviour of local cohomology under this construction defines solid closure, which is tight closure in positive characteristic. In the graded case, the forcing algebra yields also a torsor of the syzygy bundle on the corresponding projective variety.

With this translation, one obtains results in tight closure theory by applying cohomological-geometric methods as well as interesting examples of bundles and their torsors. In particular, we will report on weird behaviour of local cohomology for arithmetic and geometric deformations.

Gennady Lyubeznik, University of Minnesota
Holonomic D-modules, a characteristic-free approach

Holonomic D-modules have been studied in characteristic zero for several decades now. In characteristic $p > 0$ there has been no comparable theory. Recently V. Bavula has given a characteristic-free definition of holonomicity and shown that in characteristic zero it coincides with the usual notion. We will discuss some developments resulting from this approach, including applications to local cohomology.

Vikram Mehta, TIFR Mumbai
The strong Harder-Narasimhan filtration for vector bundles in characteristic p

In characteristic p, the strong Harder-Narasimhan filtration plays a very important role. In this talk, we shall give a simpler proof of this result, which was first proved by Langer.

Suresh Nayak, Chennai Math Institute
To be announced

To be announced

Pramath Sastry, Chennai Math Institute
Differential operators and duality on formal schemes

Given a reasonable map of schemes (separated, finite type), there is a natural interpretation of the ring of relative differential operators on the source of the map in terms of Grothendieck duality for formal schemes (developed by Alonso, Jeremias and Lipman) involving the diagonal of the map. The description gives a natural right D-module structure on certain Cousin complexes on the source of the map, generalizing and giving a natural interpretation of an old result of Yekutieli. This is joint work with Suresh Nayak.

Vijaylaxmi Trivedi, TIFR Mumbai
Frobenius pull backs of vector bundles in higher dimensions

We prove that for a smooth projective variety X of arbitrary dimension and for a vector bundle E over X, the Harder-Narasimhan filtration of a Frobenius pull back of E is a refinement of the Frobenius pull-back of the Harder-Narasimhan filtration of E, provided there is a lower bound on the characteristic p (in terms of rank of E and the slope of the destabilising sheaf of the cotangent bundle of X). We also recall some examples, due to Raynaud and Monsky, to show that some lower bound on p is necessary. We also give a bound on the instability degree of the Frobenius pull back of E in terms of the instability degree of E and well defined invariants of X and E.

Jugal Verma, IIT Bombay
Normal Hilbert polynomial of ideals

Let I be an $\mathfrak{m}$-primary ideal of a local ring $(R, \mathfrak{m})$. The normal Hilbert function of I is the function $\overline{H}_I(n) = \lambda(R/(I^n)^*)$, where $*$ denotes the integral closure of I, and λ denotes the length of a module. Rees showed that the normal Hilbert function $\overline{H}_I(n)$ is a polynomial for all large n if R is analytically unramified.

The coefficients of the normal Hilbert polynomial carry information about the local ring such as its regularity and pseudo-rationality. The interest in the normal Hilbert polynomial was revived by a conjecture of Vasconcelos about the positivity of its first coefficient. We will survey some old and new results about this fascinating topic and point out connections with local cohomology and Ehrhart polynomials of polytopes.