1. Local cohomology at Snowbird

- Check in: Sunday, June 19
- ***Saturday, June 25 is free***
- Conference: Tuesday, June 28 – Thursday, June 30
- Check out: Friday, July 1
- Schedule of introductory talks:

	June 20	June 21	June 22	June 23	June 24	June 26	June 27
7:00–8:30	*Breakfast*	*Breakfast*	*Breakfast*	*Breakfast*	*Breakfast*	*Breakfast*	*Breakfast*
9:00–10:00	Lecture	Lecture	Lecture	Lecture	Lecture	Lecture	Lecture
10:30–11:30	Lecture	Lecture	Lecture	Lecture	Lecture	Lecture	Lecture
11:30–1:30	*Lunch*	*Lunch*	*Lunch*	*Lunch*	*Lunch*	*Lunch*	*Lunch*
1:30–2:30	Lecture	Lecture	Lecture	Lecture	Lecture	Lecture	Lecture
3:00–4:00	Problems	Lecture	Problems	Lecture	Problems	Lecture	Problems
5:30–7:00	*Dinner*	*Dinner*	*Dinner*	*Dinner*	*Dinner*	*Dinner*	*Dinner*

- Speakers for the introductory lectures:

SI	Srikanth Iyengar, 6,8,15,18
GL	Graham Leuschke, 3,5,7,12
AL	Anton Leykin, 4,13,17,23
CM	Claudia Miller, 10,14,21
EM	Ezra Miller, 16,20,24
AS	Anurag Singh, 1,9,22
UW	Uli Walther, 2,11,19

2. Introductory lectures at Snowbird: Tentative plan

(1) (**AS**) Review of Krull dimension and basic properties, systems of parameters, regular rings, algebraic sets, Nullstellensatz and basic notions from algebraic geometry.

(2) (**UW**) Review of algebraic topology, simplicial/singular homology, long exact sequences of a pair of spaces and a triple of groups, manifolds, global sections functor on a circle, Čech and Mayer-Vietoris principle, sheaves, exponential sequence, de Rham sequence on $\mathbb{C}^*$.

(3) (**GL**) Review of free, flat, projective, and injective modules, projective and injective resolutions, Tor, Ext, derived functors. Modules over $(R, \mathfrak{m})$ with DCC are precisely submodules of E^n for some n. Proof that $R = \mathrm{Hom}_R(E, E)$ for complete local rings, Matlis duality. (Write-up on injectives and Matlis duality provided to students as preparatory material.)

(4) (**AL**) Gröbner bases, weights, term orders, initial ideal, associated graded, Buchberger, staircase pictures, Hilbert functions, flat deformations, constructive ideal and module theory.

(5) (**GL**) Tensor products of complexes, Koszul and Čech complexes, regular sequences and depth, direct limits.

(6) (**SI**) Local cohomology: definitions as (a) derived functor of $\mathfrak{a}$-torsion functor, (b) as direct limit of Ext modules, (c) as direct limit of Koszul cohomology, and (d) as cohomology of a Čech complex, some proofs of equivalences.
(7) (**GL**) Proof of Hilbert Syzygy Theorem using earlier results on Koszul-complex, measuring depth using Ext, sketch of Auslander-Buchsbaum formula.
(8) (**SI**) Long exact sequence of local cohomology, depth-measuring via local cohomology, applications of local cohomology to number of defining equations and related questions on set-theoretic complete intersections, arithmetic rank.
(9) (**AS**) Cohen-Macaulay rings, definition and characterisation as rings with unique nonzero $H^i_{\mathfrak{m}}(R)$, motivation and examples from invariant theory and from intersection theory.
(10) (**CM**) Gorenstein rings, examples, $H^d_{\mathfrak{m}}(R) = E_R(K)$ for Gorenstein local rings, local duality over Gorenstein rings, $H^i_{\mathfrak{m}}(M)$ has DCC for M finitely generated over $(R, \mathfrak{m})$.
(11) (**UW**) Grothendieck vanishing, first look at cohomological dimension, proof that $\operatorname{cd}(\mathfrak{m}, M) = \dim M$ for M finitely generated over $(R, \mathfrak{m})$, local cohomology and direct limits.
(12) (**GL**) Connections with theory of schemes and with sheaf cohomology, local cohomology as cohomology with support.
(13) (**AL**) Graded modules and sheaves on projective space, graded local cohomology and cohomology of $\mathbb{P}^n$, perhaps also of graded hypersurface, a-invariants.
(14) (**CM**) Hartshorne-Lichtenbaum vanishing theorem: sketch of the proof.
(15) (**SI**) Mayer-Vietoris sequence, and applications of local cohomology to connectedness theorems for algebraic varieties, Hartshorne example of 2 planes, monomial ideals, Faltings, Grothendieck-Bertini, Fulton-Hansen connectedness theorem.
(16) (**EM**) Simplicial complexes, Stanley-Reisner rings, polytopes, upper bound theorem.
(17) (**AL**) Weyl algebra, action on Čech complex, $(0, 1)$-filtration, characteristic variety, holonomicity, Lyubeznik in characteristic zero.
(18) (**SI**) Differentials and differential forms, canonical module, Serre-Grothendieck duality.
(19) (**UW**) de Rham complex, the sheaves of differentials on projective plane, Čech – de Rham complex, hypercohomology, de Rham isomorphism, affine and projective examples, Alexander duality.
(20) (**EM**) Semigroup rings, invariants, local cohomology of semigroup rings, case of normal rings, Hartshorne's example with infinite Bass number.
(21) (**CM**) Flatness of Frobenius and Kunz's theorem, Frobenius action on local cohomology, vanishing theorem of Peskine-Szpiro, associated primes of local cohomology: summary of results of Huneke-Sharp in positive characteristic, and Lyubeznik in characteristic zero.
(22) (**AS**) Lyubeznik's characteristic $p > 0$ duality theorem, examples of Hochster (minors) and of Hartshorne-Speiser illustrating the dependence of local cohomology on characteristic. Examples of infinitely many associated primes.
(23) (**AL**) Holonomicity stable under localization, Bernstein-Sato polynomials, roots $\leftrightarrow$ generators, example of algorithm.
(24) (**EM**) LC and GKZ: roots of a quadric as hypergeometric functions, torus action and $H_A(\beta)$ definition, rank, Cohen-Macaulay rings and no jumps, 0134 by picture, MMW theorem.