# Fifteenth Annual Workshop in Geometric Topology

## June 11-13, 1998

### Hosted by Brigham Young University
### Held at Park City, UT USA

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**Homology Manifolds**
Steven C. Ferry
*(State University of New York at Binghamton )*

Day 1: Do an application of controlled surgery – probably the construction of two different topological manifolds which admit cell-like maps to the same compactum.

Day 2: Talk about the controlled algebra that goes into the theory and how it gives cycles in L-homology theory. Basically, I want to say what the cycles in L-homology theory are and what the boundary map is.

Day 3: Prove that every ANR homology manifold has a DDP resolution. This should also give some insight into our construction of nonresolvable homology manifolds.

steve@math.binghamton.edu

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**Twisted Face Pairings**
James W. Cannon
*(Brigham Young University )*

A mechanical process is given for the construction of interesting 3-manifolds.

cannon@byu.edu

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## Fundamental Groups of Locally Complicated Spaces
### Greg Conner
### (*BYU* )

The speaker will discuss results concerning fundamental groups of spaces which are locally complicated. In particular, we will focus on a recent result of Conner and Lamoreaux which shows that the fundamental group of a locally path connected , connected subset of the plane is free if and only if it is countable if and only if the underlying set has a universal cover. Also discussed will be an earlier result of Cannon and Conner which proves a similar result for one dimensional separable metric spaces.

*This work represents the result of joint research with James W. Cannon and Jack W. Lamoreaux.*

conner@math.byu.edu

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## Abelain 2-groups and Approximate Fibrations
### R. J. Daverman
### (*University of Tennessee* )

A closed n-manifold N is a codimension-2 fibrator if it automatically induces approximate fibrations, in the following sense: given a closed map p from an (n+2)-manifold M onto a (metric) space B such that each preimage under p is a copy of N , up to shape, p is an approximate fibration. The mail result, which answers a question posed by N. Chinen, expands the extensive list of known codimension-2 fibrators. Theorem: All closed n-manifolds N whose fundamental groups are Abelian 2-groups are codimension-2 fibrators. This constrasts neatly with recently developed examples of nonfibrators N having cyclic fundamental groups of odd order. In addition, the role of finite torsion is clarified by another result. Theorem: If G is a finitely generated, residually finite group such that G/G' is cyclic of order d yet the order of no element of G divides d , then G is hyperhopfian. Hence, every closed n-amnifold having findamental group isomorphic to G is a codimension-2 fibrator.

*This work represents the results of joint research with Yongkuk Kim.*

daverman@novell.math.utk.edu

## Generic partial two-point sets are extendable

Jan J. Dijkstra

(*The University of Alabama*)

It is shown that under ZFC almost all planar compacta that meet every line in at most two points are subsets of sets that meet every line in exactly two points. This result was previously obtained by the author jointly with K. Kunen and J. van Mill under the assumption that Martin's Axiom is valid.

jdijkstr@ualvm.ua.edu

## Additive subgroups in Banach spaces that are homotopically trivial

Tadeusz Dobrowolski

(*Pittsburg State University*)

tdobrowo@mail.pittstate.edu

## On coarse dimension

Alex Dranishnikov

(*University of Florida*)

The concept of dimension in the coarse category is very important in the coarse approach to the Novikov type conjectures. We compare three notions of dimensions: Gromov's asymptotic dimension $as\dim$, dimension defined in terms of extensions of mappings to coarse spheres $\dim^c$ and covering dimension the Higson corona. The Higson corona is a functor $\nu Coarse \to Compacta$ defined for arbitrary metric spaces. We show that $\dim^c X = \dim \nu X$ and $as\dim X = \dim \nu X$ if $as\dim X$ is finite.

dranish@math.ufl.edu

## Decomposition spaces, then and now. Part II

Robert D. Edwards

*( UCLA )*

rde@math.ucla.edu

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## Z-compactifications of ANRs
Craig R. Guilbault
*( University of Wisconsin-Milwaukee )*

A closed subset $A$ of a compact ANR $X$ is a $Z$-set if for every open set $U$ of $X$, the inclusion of $U - A$ into $U$ is a homotopy equivalence. For example, if $M$ is a manifold with boundary, then bdry$(M)$ is a $Z$-set in $M$.

If $Y$ is a non-compact ANR, a $Z$-compactification of $Y$ is a compact ANR, $Y^*$, containing $Y$ as an open subset and having the property that $Y^* - Y$ is a $Z$-set in $Y^*$.

In 1976, Chapman and Siebenmann gave a beautiful characterization of those Hilbert cube manifolds which may be $Z$-compactified. In their paper, they asked whether their conditions, when applied to an arbitrary locally compact ANR, guarantee the existence of a $Z$-compactification. Combining their results with a theorem of R.D. Edwards, one arrives at the equivalent question: If $Y$ is a locally compact ANR and $Y \times Q$ is $Z$-compactifiable ($Q$ denotes the Hilbert cube), must $Y$ be $Z$-compactifiable? We will discuss this problem.

craigg@uwm.edu

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## Ghastly Generalized Manifolds with the Plentiful 2-Manifolds Property
Denise M. Halverson
*( University of Tennessee at Knoxville )*

A space X has the plentiful 2-manifolds property if each path $\alpha : I \to X$ can be approximated by a path $\alpha' : I \to X$ such that $\alpha'(I) \subset N \subset X$ where N is a 2-manifold.

The construction of resolvable generalized n-manifold, $n \geq 5$, with the plentiful 2-manifolds property, but with no embedded k-cells for some given $k$ such that $2 < k < \frac{n+1}{2}$, will be discussed. The product of such generalized manifolds with a line is a manifold. This class of generalized n-manifolds enlarges the class of generalized manifolds known to be $n + 1$ manifold factors.

deniseh.math.utk.edu

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# Hyperbolic manifolds as codimension-1 and -2 complements
## Dubravko Ivanšić
### ( *University of Oklahoma* )

We consider the question of when a finite-volume hyperbolic $(n+1)$-manifold $M$ may be embedded as a complement of a closed codimension-$k$ submanifold $A$ inside a closed $(n + 1)$-manifold $N$. We show that if this is possible, then every flat manifold $E$ corresponding to an end of $M$ is either an $S^0$ or $S^1$-bundle, giving that $k$ is either 1 or 2. We give a criterion in terms of the fundamental group when $E$ is an $S^1$ bundle, which is used to tell when $M$ is a codimension-2 complement. Furthermore, we show that there are at most finitely many 4-manifolds $M$ so that $M = S^4 - \{\text{tori} \cup \text{Klein bottles}\}$. If $M$ is a codimension-1 complement, we show that the universal cover of $N$ is $rnp$ and, with an additional assumption, there are only finitely many choices for $N$ in dimensions $n = 2, 3$.

divansic@aardvark.ucs.ou.edu

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# The Mardešić Factorization Theorem for Extension Theory and C-Separation
## Leonard R. Rubin
### ( *University of Oklahoma* )

## Abstract

We shall prove a type of Mardešić factorization theorem for extension theory over an arbitrary stratum of CW-complexes in the class of arbitrary compact Hausdorff spaces. The stratum notion allows one to define strong countability (e.g., strong countable-dimension) for any type of extension (and hence any dimension) theory and our result provides that the space through which the factorization occurs will have the same strong countability property as the original one had. Taking into consideration the class of compact Hausdorff spaces, this result extends all previous ones of its type. Our factorization theorem will simultaneously include factorization for weak infinite-dimensionality and for Property C, that is, for C-spaces.

A corollary to our result will be that for any weight $\alpha$ and any finitely homotopy dominated CW-complex $K$, there exists a Hausdorff compactum $X$ with weight $wX \leq \alpha$ and which is universal for the property $X\tau K$ and weight $\leq \alpha$. The condition $X\tau K$ means that for every closed subset $A$ of $X$ and every map $f : A \to K$, there exists a map $F : X \to K$ which is an extension of $f$. The universality means that for every compact Hausdorff space $Y$ whose weight is $\leq \alpha$ and for which $Y\tau K$ is true, there is an embedding of $Y$ into $X$.

We shall show, on the other hand, that there exists a CW-complex $S$ which is not finitely homotopy dominated but which has the property that for each weight $\alpha$, there exists a Hausdorff compactum which is universal for the property $X\tau S$ and weight $\leq \alpha$.

*This work represents the result of joint research with Michael Levin and Philip J. Schapiro.*

LRUBIN@OU.EDU

## Disjoint Spines in Newman Contractible Manifolds
### Manuel (Bud) Sanders
### ( *University of Tennessee* )

A compact polyhedron $K$ in the interior of a PL manifold $M$ is said to be a **spine** of $M$ if $M$ collapses to $K$. The manifold $M$ has **disjoint spines** provided that it collapses (independently) to two disjoint polyhedra in its interior. The question arises as to which contractible manifolds have a pair of disjoint spines.

A technique of M.H.A. Newman provides contractible manifolds which are not balls. A Newman contractible manifold is constructed as the closure of the complement of a regular neighborhood of a finite, acyclic, simplicial complex $K$ in $S^n$ with $\pi_1(K) \neq \{1\}$ for large enough $n$. When well-defined, it is denoted $New(K, n)$. C. Guilbault has shown that if $K$ is any finite, non-simply connected, acyclic $k$-complex then $New(K, n)$ has disjoint spines provided $n > 4k$ thereby providing examples in dimensions $n \geq 9$. Some results concerning disjoint spines in lower dimensional Newman contractible manifolds will be discussed.

sandersm@math.utk.edu

## Geometric simple connectivity and open 3-manifolds
## 3-manifolds
### T. L. Thickstun
### ( *Southwest Texas State University* )

A noncompact polyhedron is said to be "geometrically simply connected" (gsc) if it's exhausted by compact simply connected polyhedra. We demonstrate that, among open contractible 3-manifolds containing no fake 3-balls, only euclidean 3-space is proper homotopy equivalent to a gsc polyhedron.

tt04@swt.edu