

# The complete census of orientable cusped hyperbolic 3-manifolds, up to 10 tetrahedra

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October 2025

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**1** Introduction

**2** Extending the census to 10 tetrahedra

**3** Applications

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## 1 Introduction

## 2 Extending the census to 10 tetrahedra

## 3 Applications

Crossings	Knots		
3	$3_1$		
4	$4_1$		
5	$5_1$	$5_2$	
6	$6_1$	$6_2$	$6_3$

Table: The census of knots up to 6 crossings

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minimal number of crossings in planar diagrams of knots

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minimal number of tetrahedra in triangulations of manifolds

Tetrahedra	Orientable cusped hyperbolic 3-manifolds				
2	m003	m004			
3	m006	m007	m009	m010	m011
	m015	m016	m017	m019	

**Table:** The census of orientable cusped hyperbolic manifolds up to 3 tetrahedra

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### Burton, 2014

There are precisely 75,956 cusped hyperbolic 3-manifolds triangulable by no more than 9 tetrahedra.

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- 3 Deduplicate the eligible candidates

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Total	8,373,308	7,468,856	904,452

# Deduplication: Group by canonical triangulations computed with SnapPea/SnapPy

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With verified computation, the canonical triangulation produced is a complete invariant of cusped hyperbolic 3-manifolds.

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L. 2025

There are precisely 150,730 orientable cusped hyperbolic 3-manifolds triangulable by a minimal of 10 tetrahedra.

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## Census of exceptional Dehn fillings

### Exceptional Dehn filling

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Let  $M$  be a 1-cusped hyperbolic 3-manifold. If a slope  $(p, q)$  has length larger than 6, then  $M(p, q)$  is hyperbolic.

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### Corollary

There are only finitely many exceptional Dehn fillings on a 1-cusped hyperbolic 3-manifold.

## Dunfield, 2019

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(In progress) Classification of each filling & Verify conjectures

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Conjecture (Dunfield-Friedl-Jackson, 2024)

For any cusped hyperbolic 3-manifold  $M$  with  $b_1(M) = 1$ ,

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- Equality holds for all the computed ones

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The only one in the orientable cusped census up to 10-tet.  
In particular, it is the smallest among all.



The 10-tetrahedra census is available for installation on GitHub.



Figure: QR code to the GitHub repository

Alternatively:

shana-y-li.github.io → Research → Projects → snappy\_10\_tets