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

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| Crossings | Knots | | |
|---|---|---|---|
| 3 | $3_1$ | | |
| 4 | $4_1$ | | |
| 5 | $5_1$ | $5_2$ | |
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Table: The census of knots up to 6 crossings

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Table: The census of knots up to 6 crossings

For orientable cusped hyperbolic manifolds: replace crossings with tetrahedra.

| Tetrahedra | Orientable cusped hyperbolic 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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Table: Timeline of census of orientable cusped hyperbolic manifolds

| Tetrahedra | Name convention | Year | Contributer(s) |
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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

| Step | Candidates | Discarded | Eligible |
|---|---|---|---|
| Candidate generation | 8,373,308 | 0 | 0 |

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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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  - $\{\text{orientability}, H_1 = \pi_1^{ab}, S_2^{ab}(\pi_1), \ldots, S_{11}^{ab}(\pi_1)\}$

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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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### 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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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.

### Corollary

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

**Dunfield, 2019**

There are precisely 205,822 exceptional Dehn fillings on 1-cusped hyperbolic 3-manifolds triangulable by no more than 9 tetrahedra.

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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 $b_1(M) = 1$,

$$x(M) = \frac{1}{2} \deg \tau_{2,\rho}(M)$$

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- The above equality holds for all the computed ones

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- The above include *almost all* homological spheres with systole $\geq 0.163$ obtainable in this way (did not deduplicate)

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The only one in the orientable cusped census up to 10-tet.

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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 $\rightarrow$ Research $\rightarrow$ Projects $\rightarrow$ snappy_10_tets