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## The goal

Persistent Homology for more than one scale parameter

- Density and scale (e.g. metric space with a function)
- Time-varying persistence
- RGB value of images

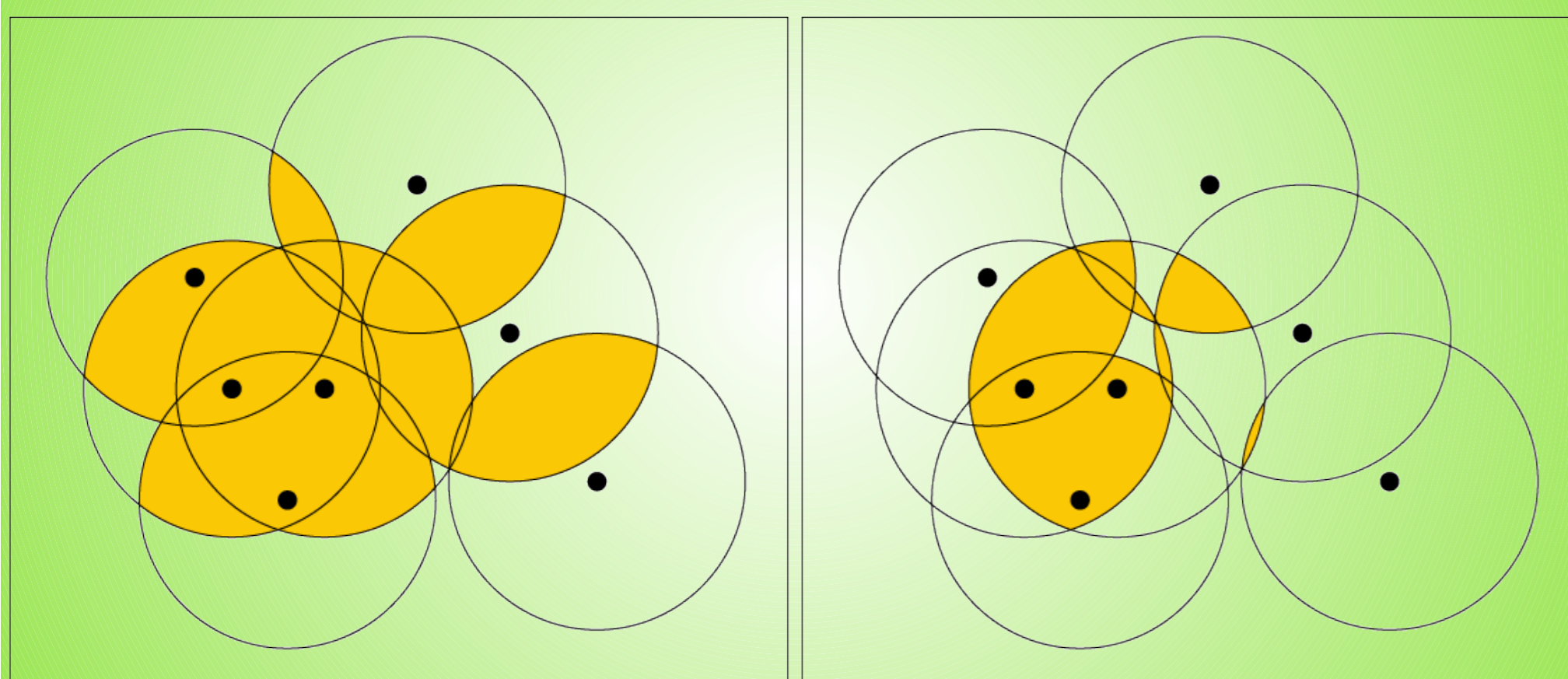
## State of the art

- „There is no persistence diagram“
- Some problems hard (e.g., interleaving distance)
- Others feasible (e.g., Matching distance, decomposition)
- Mostly prototypical implementations

**Three contributions** to the algorithmic pipeline for multi-parameter TDA with **fast implementations**

### Complexification

Turn data into a multi-filtered complex



Corbet, K., Lesnick, Osang (submitted):  
Cell complex for the multi-cover filtration

### Compression

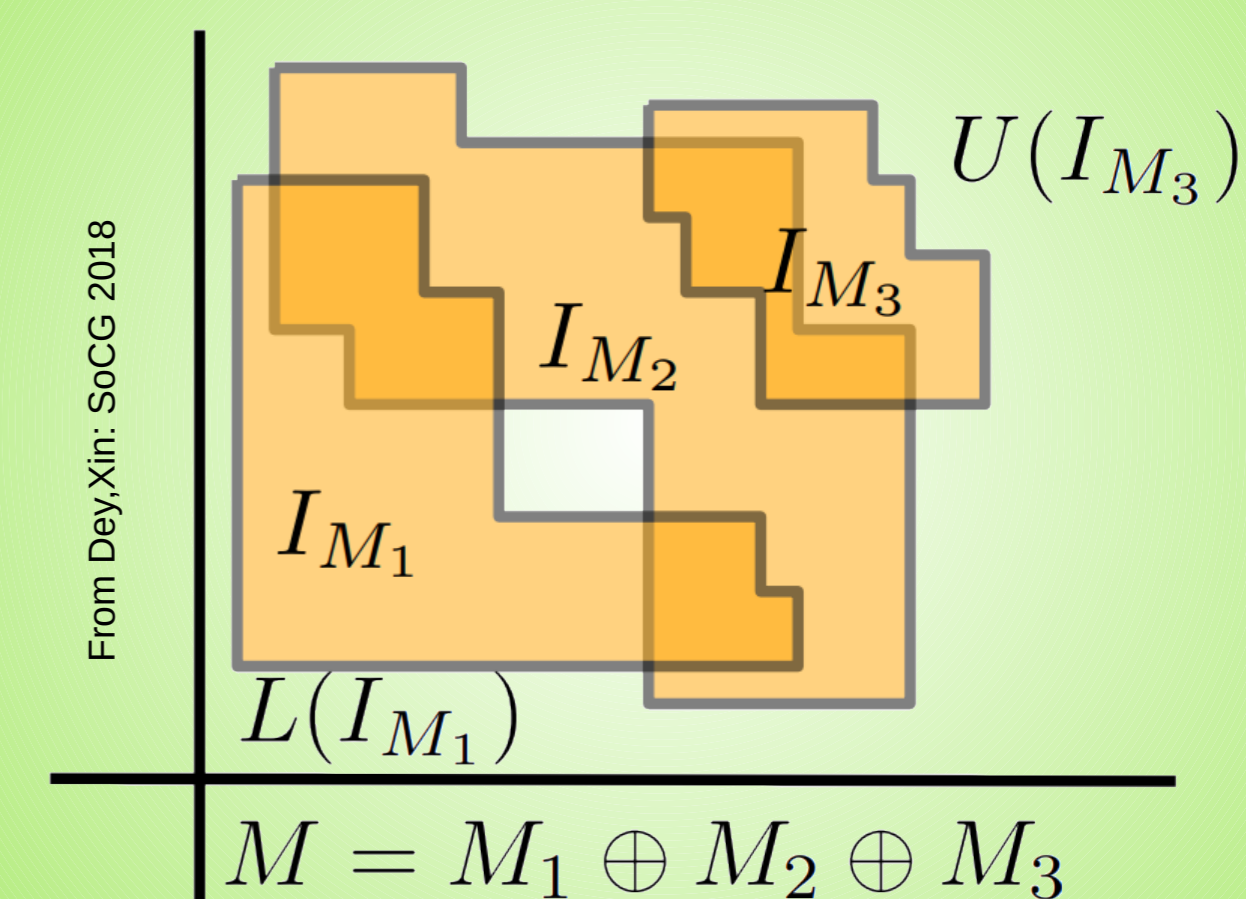
Reduce the size of multi-filtration

instance	before	after	time
func-Rips	28MB	4.3KB	1.25
multi-cover	3.3MB	258KB	0.22
points-on-sphere	3.4MB	8.2KB	0.17
delaunay-dim-1	20MB	147KB	0.92

K., Rolle (ALENEX 2021):  
Fast minimal presentations (mpfree)

### Comprehension

Gain understanding of data set



Dey, K. (in preparation):  
Fast decomposition via matrix reduction

**Next task:** Use algorithmic pipeline for multi-parameter data analysis