Reviving and extending *Pgsphere*

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- About Pgsphere
- Pgsphere revival
- Extending Pgsphere with MOC

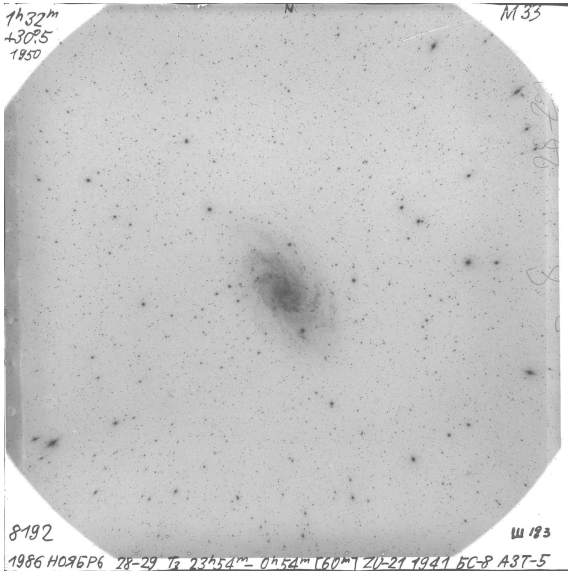
About Pgsphere

- **Pgsphere???**

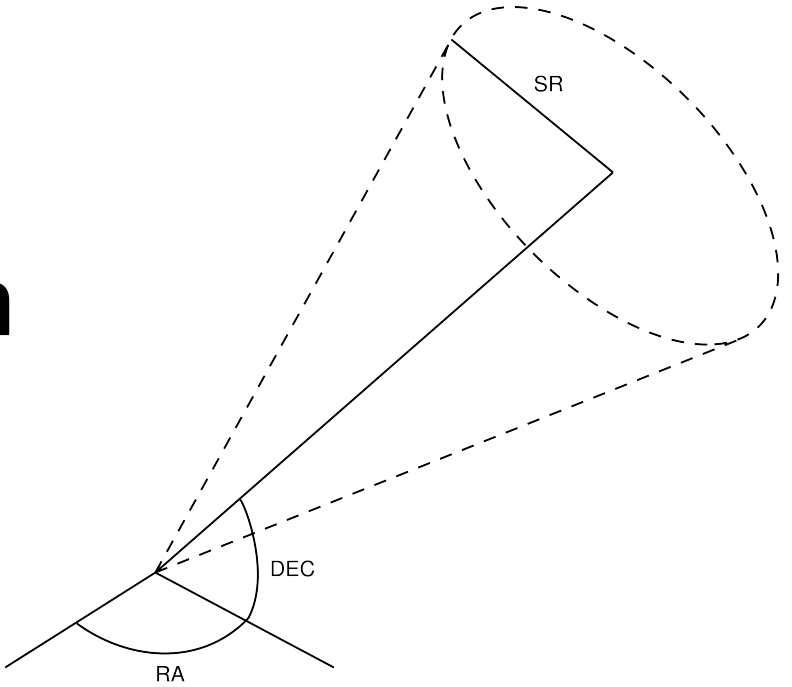
About Pgsphere

- Exotic back-end stuff?
- PostgreSQL server extension: new SQL data types, functions, indexes
- SQL data types: “spherical points” (right ascension, declination),
  “spherical lines, polygons, ellipses, paths”,
  spherical transformations (rotations)

VO Usage of Pgsphere



X-match



VO Usage of Pgsphere

Database indexes of spherical coordinates for:

- **Cone search**
- **Cross-match**
- **Images (e. g., digitised astronomical plates)**

Pervasive use in astronomical community

- **Alternatives (Q3C, H3C) exist for part of Pgsphere's functionality**
- **Not just VO data centres**

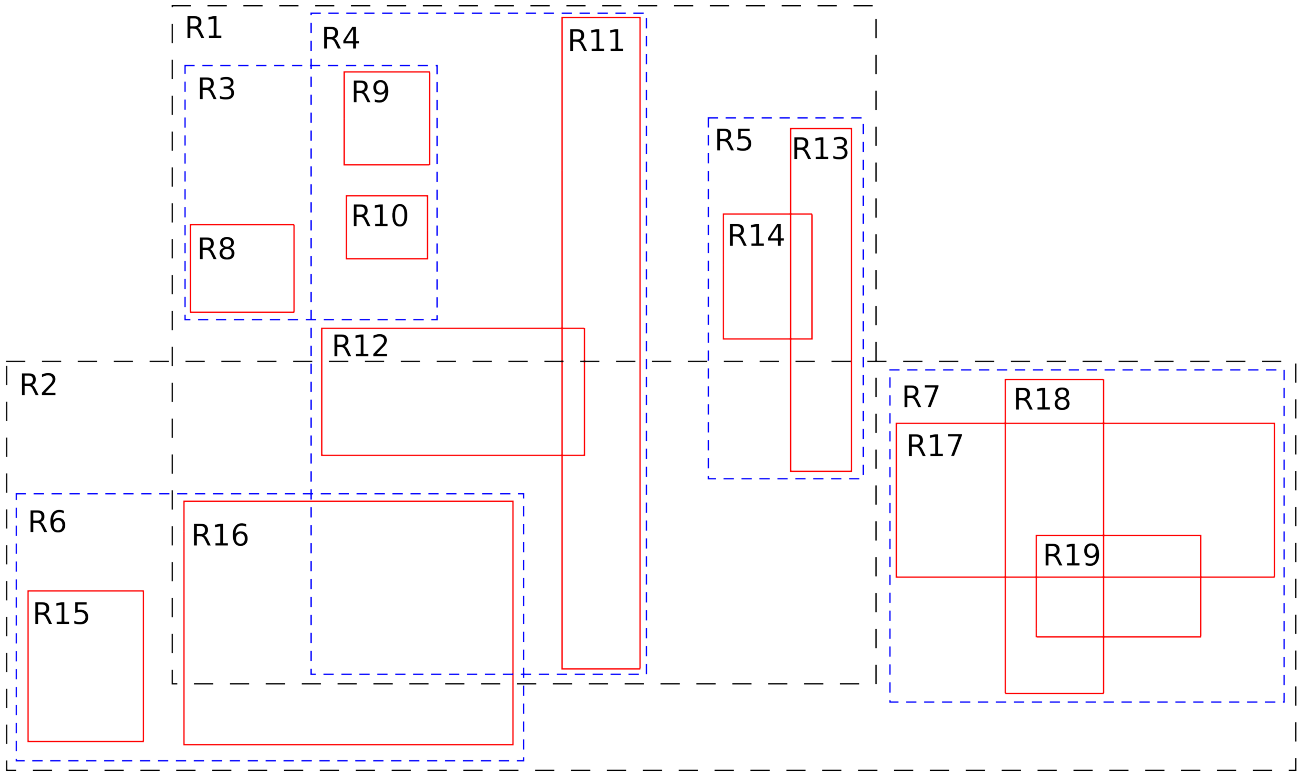
Pgsphere internals

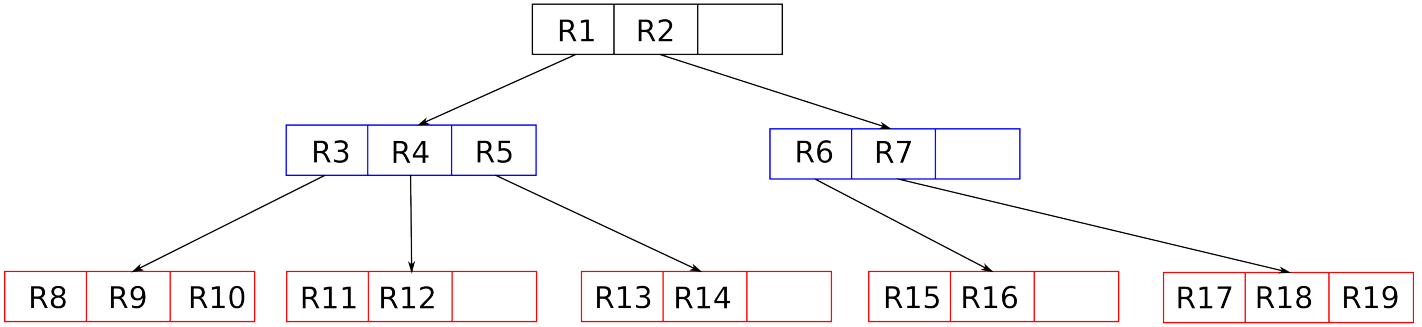
Database indexes of spherical coordinates for, e. g.:

- Cone search
- Cross-match
- Images (e. g., digitised astronomical plates)

Pgsphere internals

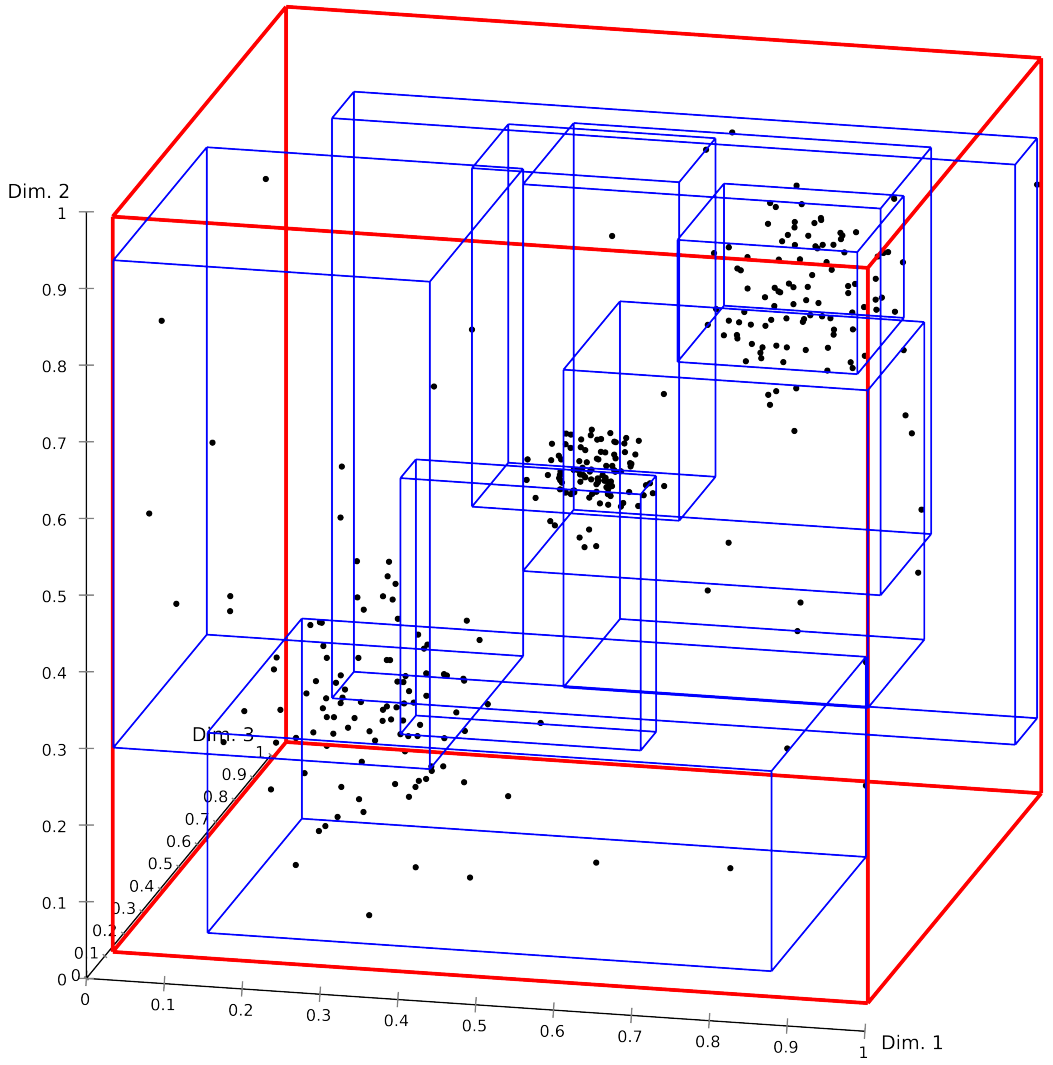
R-tree





Pgsphere internals

Index:
3D R-tree
on unit sphere



Pgsphere development history

Janko Richter

Teodor Sigaev Oleg Bartunov

Igor Chilingarian

State of Pgsphere: June 2015

- Patches required to build on PostgreSQL 9.2+ (09/2012)
- Maybe problems when building on Macintosh
- Open bugs on `http://pgfoundry.org/projects/pgsphere`
- Test suite does not pass (even hangs on current Linux distributions)
- Pre-PostgreSQL 8.2 syntax for SQL “contains” operators
- Improved R-tree indexing: `https://github.com/akorotkov/pgsphere`
- Several bug fixes at various places

State of Pgsphere: now

https://github.com/mnullmei/pgsphere

- *Add. branch* `fixes-1-1-1` **with portability and stability fixes for latest release**
- **All known open bugs fixed (plus several others)**
- **Test suite: works, some extensions, easier to use**
- **Addition of new-style SQL “contains” operators**
- **Included improved R-tree indexing of Alexander Korotkov and Oleg Bartunov**
- **Some fixes to numerical stability**
- **Several documentation fixes**
- **Maintenance efforts also on** `https://github.com/akorotkov/pgsphere`

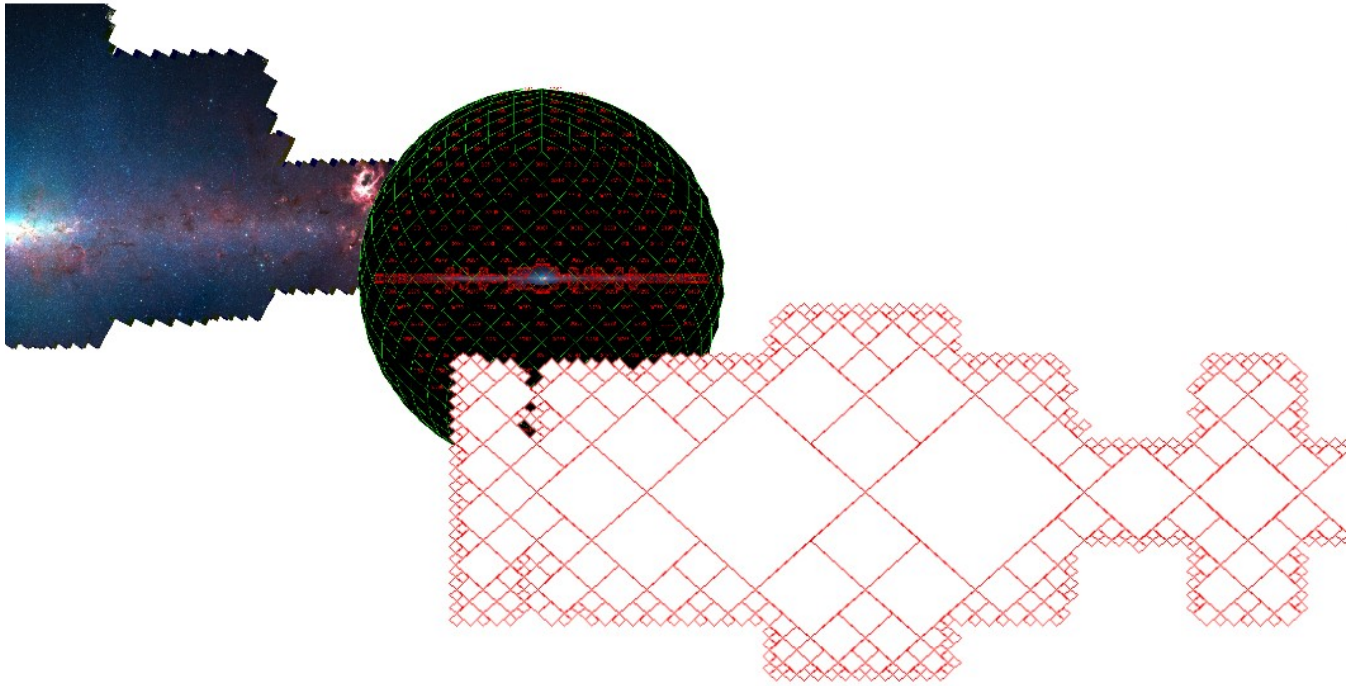
State of Pgsphere: remaining goals

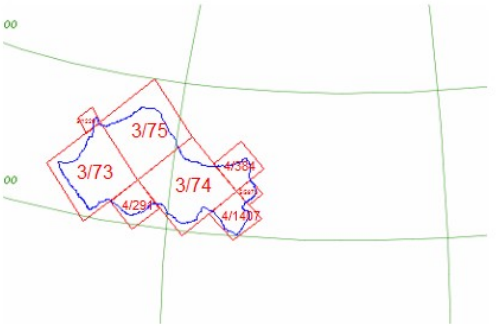
- Coordination of official release (maybe on pgfoundry.org)
- More fixes to numerical stability
- Increasing numerical precision (presently, cut-off at 0.2 m arcsec)
- Modernising the code; add PostgreSQL “server extension” patch
- Overhaul of documentation
- Official packages for Debian Linux (and thereby, Ubuntu)
- Extending Pgsphere with …..

Extending Pgsphere with MOC

MOC = Multi-order coverage (HEALPix Multi-Order Coverage map)

- Concise mapping of one catalog's coverage of the sphere





- Coverage made up from discrete elements
- Make MOC a first-class SQL data type **ALL DESIGN PHASE below...**

MOC in PostgreSQL / Pgsphere: goals

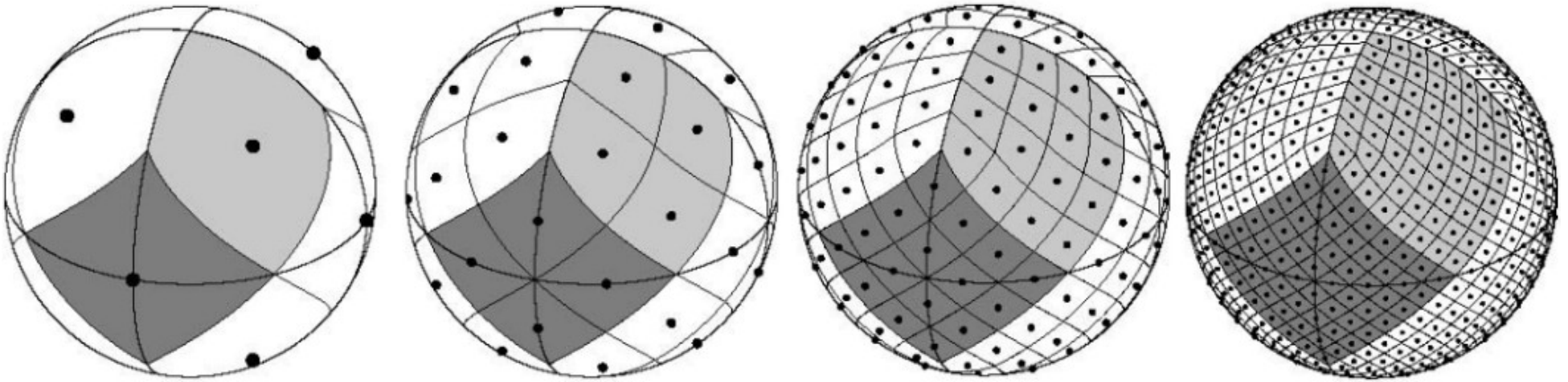
MOC as indexable SQL data type

- I/O to / from files
- Create one MOC from table column or query
- Specify your own MOC and search over all catalogs of a data center:

  SELECT name FROM catalogs WHERE my_moc <@ catalogs.moc ;

MOC: discretisation

- **Based on HEALPix**

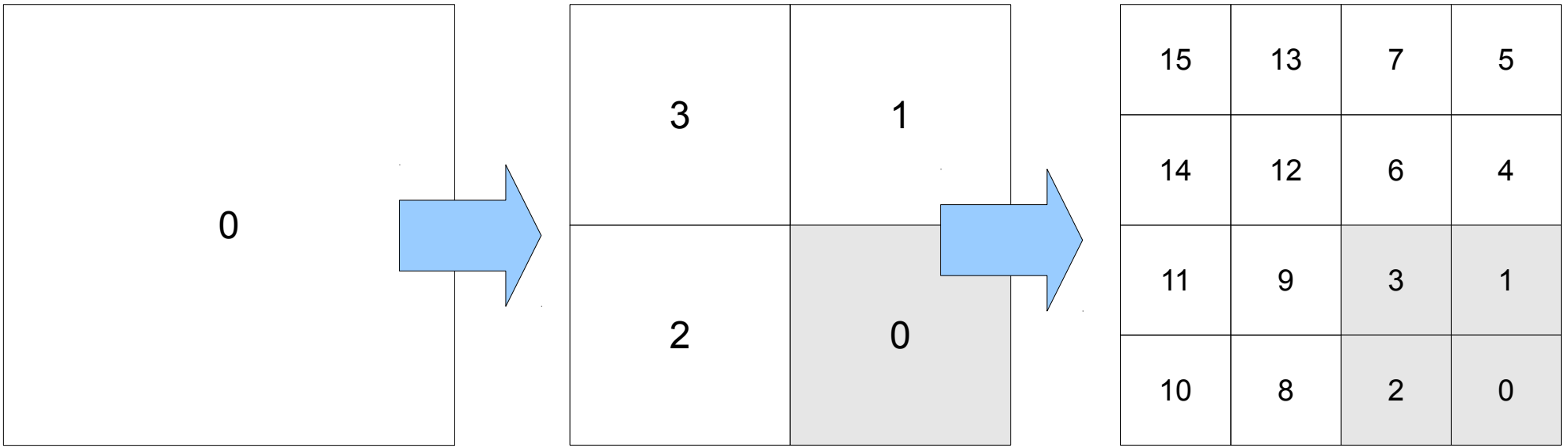


- **Start with 12 diamonds**
- **Subdivide by fours**

MOC: internal data structure for PostgreSQL

- List of ranges of HEALPix element numbers

  … at finest discretisation level



- Works because of nested numbering of HEALPix elements

MOC: indexing

- **R-trees of questionable use (too many overlaps...)**
- **Proper PostgreSQL index implementation is quite involved**
- **Feasible surrogate as first step:**
  - use a (global) SQL table like this:

RANGES OF NUMBERS OF HEALPIX ELEMENTS	SETS OF MOC IDs
range0	{ id7, id11 }
range1	{ id2, id108, id109 }
range2	{ id108, id732, id11030 }
...	...

- **MOC IDs: probably SHA1**

Your involvement

- **Download, use & test:**
  `https://github.com/mnullmei/pgsphere`
  `https://github.com/akorotkov/pgsphere`
- **Send in bug reports**
- **Send in test cases**
- **Send in patches**
- **Send in feature requests :-)**