Basilisk: what's up?

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BGUM 2019

Thanks!

- Sponsors



  ∂'Alembert

  Centre National de la Recherche Scientifique (CNRS)

  Sorbonne Université

  IFP Energies Nouvelles

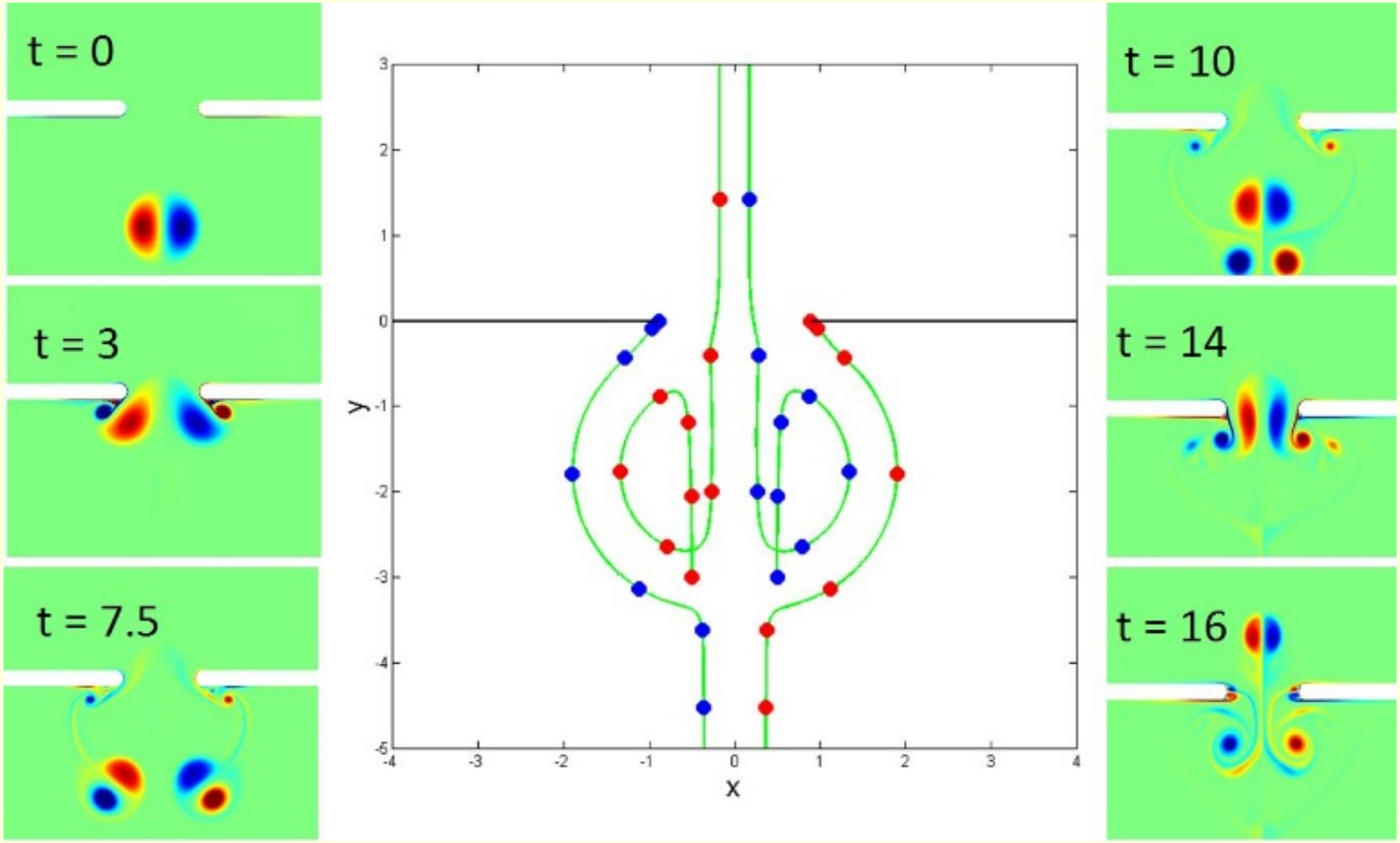
  Peugeot SA

- Jose, Sandrine, Olivier, Simona, the students and the university staff

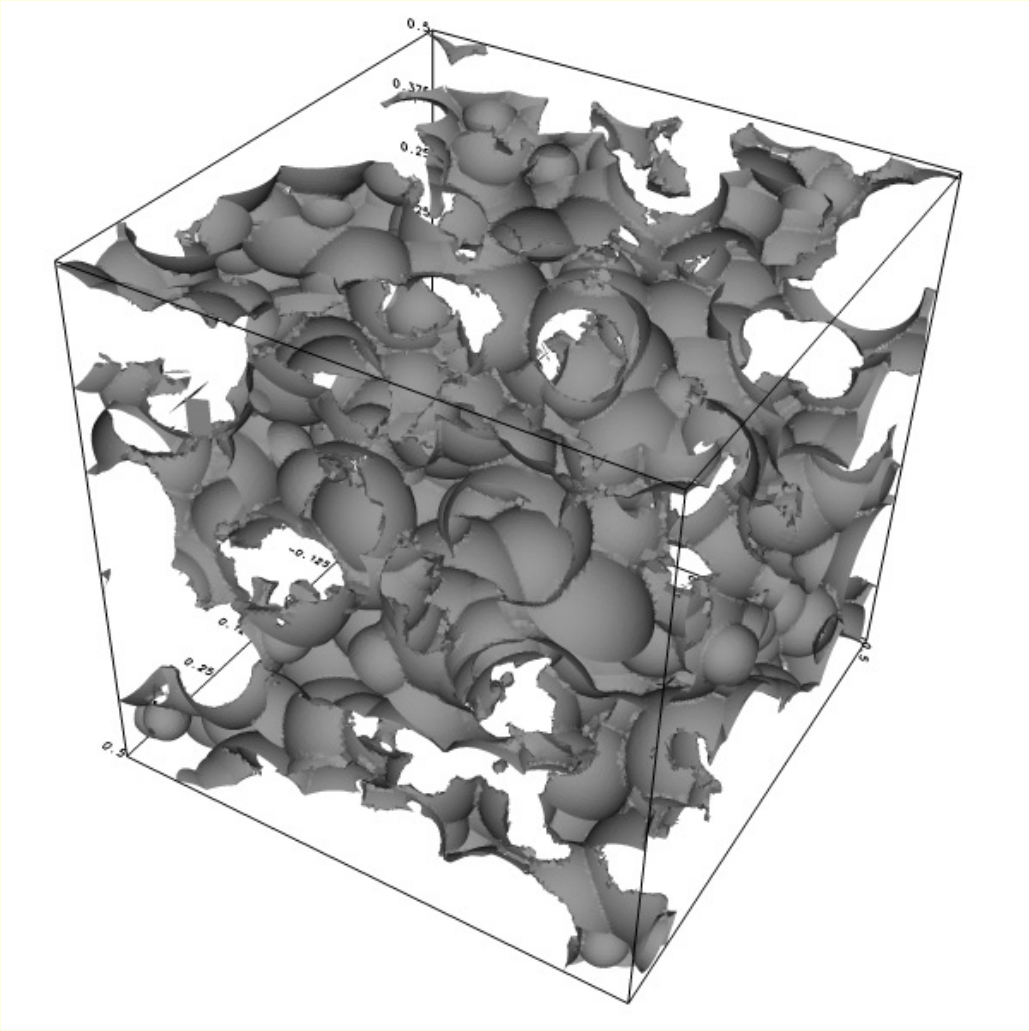
New features 2018–2019

- 320 patches, $+25634 - 5688 = +19946$ lines
- Patch contributors: Bruno Deremble, Alexis Berny, Donna Calhoun, Emily Lane, Frederik Brasz, Jose Lopez-Herrera, Quentin Magdelaine, Wojciech Aniszewski

- Embedded boundaries

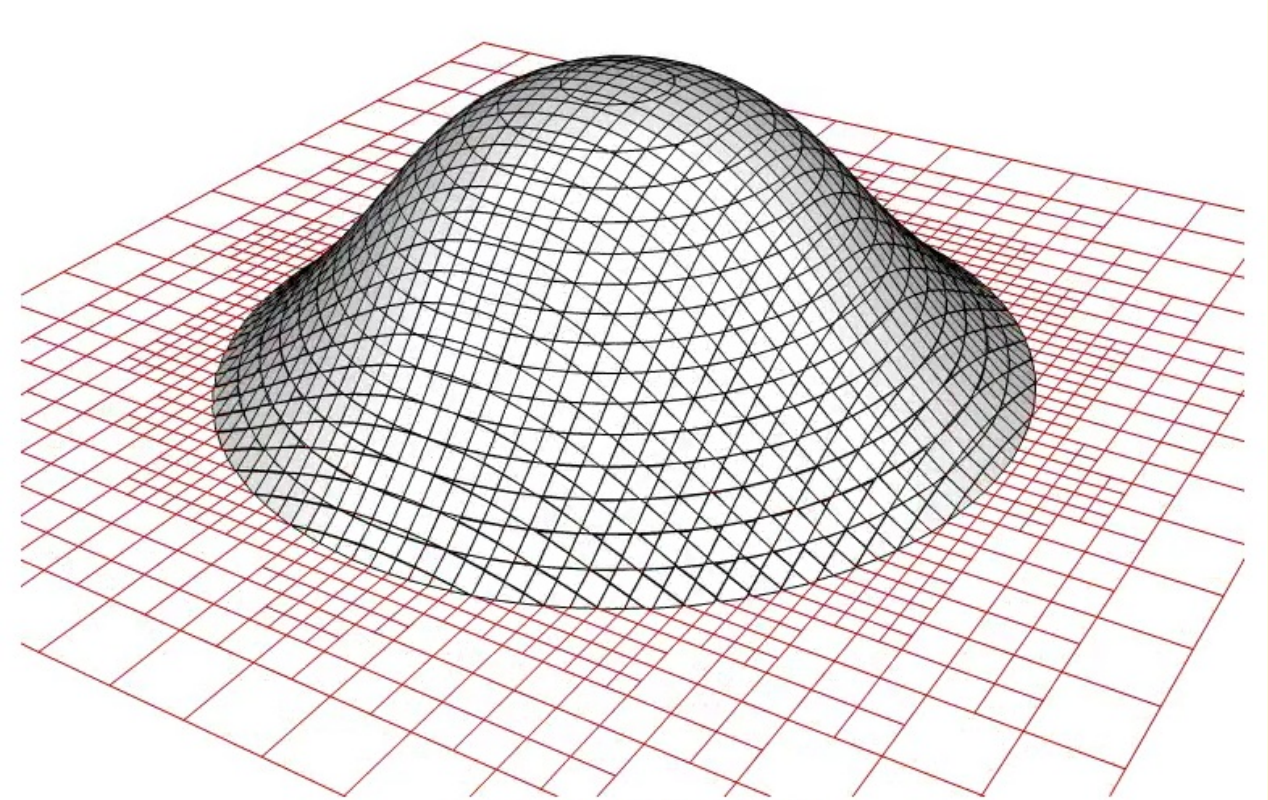


From sandbox/Antoonvh/rebound2.c



From src/examples/porous3D.c

- Contact angles



Relaxation toward a 30° contact angle.

From src/test/sessile3D.c

- Axisymmetric Navier-Stokes with swirl: axisymmetric streamfunction

$$\partial_x u_x + \partial_y u_y + \frac{u_y}{y} = 0$$

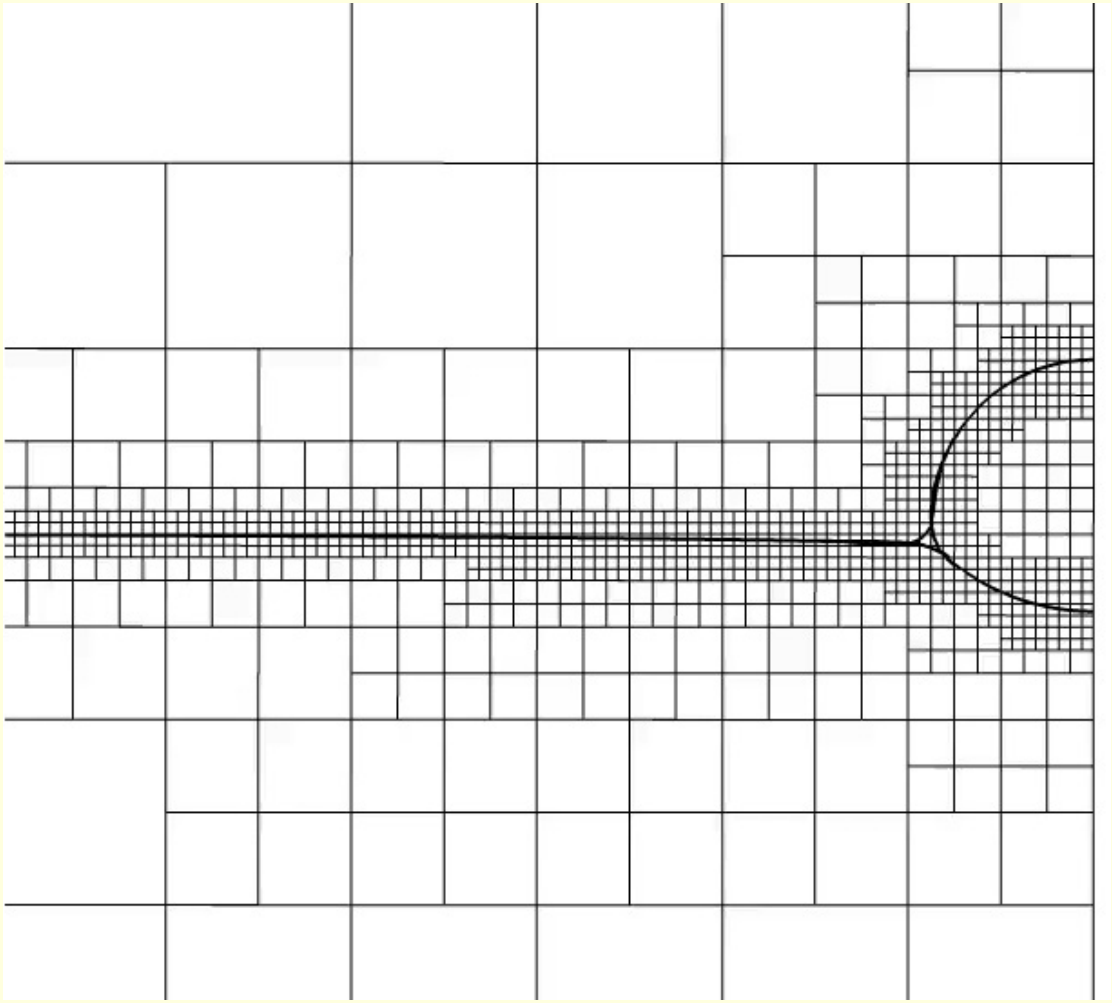
$$\partial_t u_x + u_x \partial_x u_x + u_y \partial_y u_x = -\frac{1}{\rho} \partial_x p + \frac{1}{\rho\, y} \nabla \cdot (2\, \mu\, y\, \nabla \mathbf{D}_x)$$

$$\partial_t u_y + u_x \partial_x u_y + u_y \partial_y u_y - \frac{w^2}{y} = -\frac{1}{\rho} \partial_y p + \frac{1}{\rho\, y} \left(\nabla \cdot (2\, \mu\, y\, \nabla \mathbf{D}_y) - 2\, \mu \frac{u_y}{y} \right)$$

$$\partial_t w + u_x \partial_x w + u_y \partial_y w + \frac{u_y w}{y} = \frac{1}{\rho\, y} \left[\nabla \cdot (\mu\, y\, \nabla\, w) - w \left(\frac{\mu}{y} + \partial_y \mu \right) \right]$$

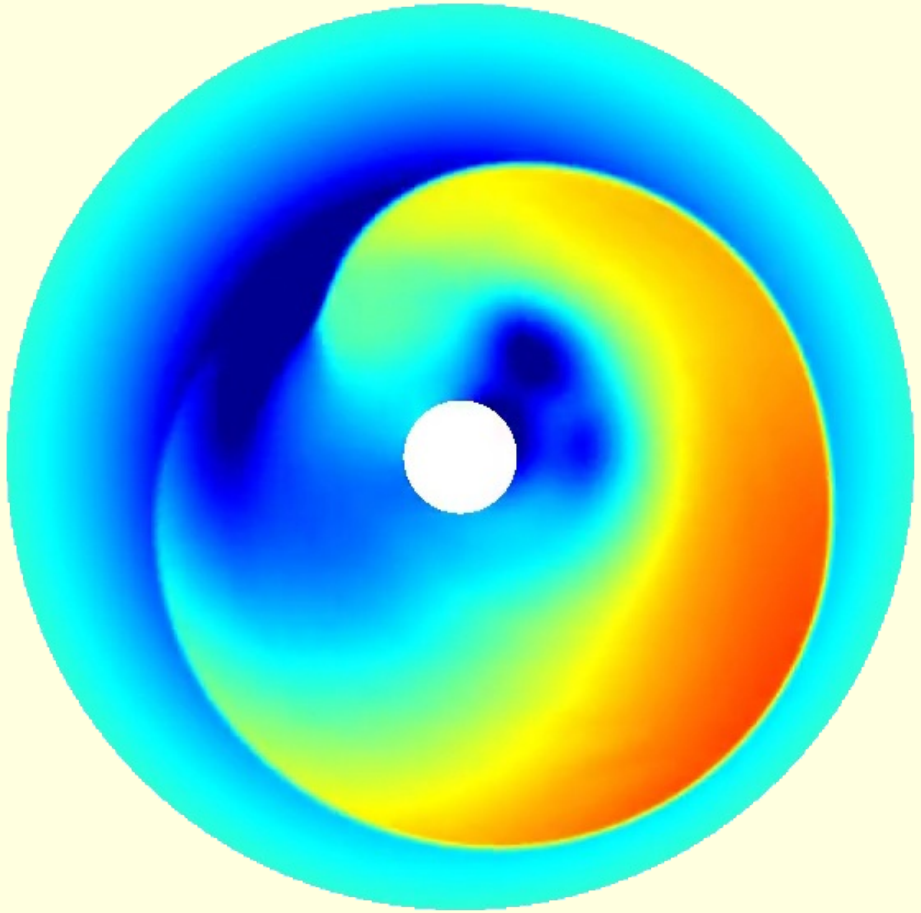
`src/navier-stokes/swirl.h`

- Multiple phases / multiple surface tensions



From sandbox/ray/Three_Phase/oil_lens.c

- Radial/cylindrical coordinates (for Saint-Venant)



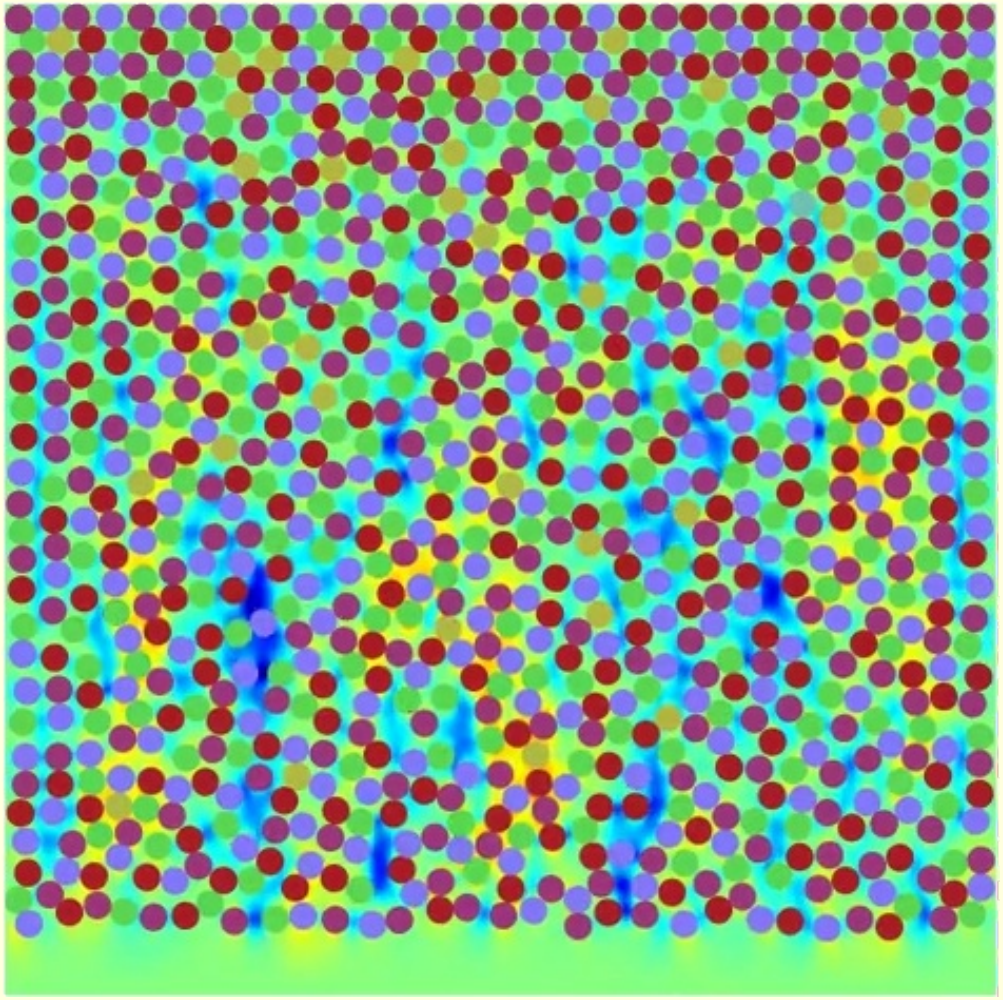
Standing accretion shock instability (src/examples/swasi.c)

- Momentum-conserving two-phase flows (breaking wave examples this afternoon) and three-phase flows (Nelson tomorrow)
- Viscoelastic solver (Oldroyd-B, FeneP etc...) Jose Lopez-Herrera

  src/log-conform.h
- Bview improvements: filled VOF display, isolines, min/max autoscale, labels, coordinate mapping
- CADNA support
- New website engine, local web page generation

Work in progress

- Phase change / evaporation (Quentin)
- Compressible two-phase flow (Daniel)
- Moving solids (Can, UBC): using Lagrangian penalization
- Moving solids (Arthur, UBC): using embedded boundaries
- Phase change / solidification / melting (Alexandre): using embedded boundaries and levelset $\rightarrow$ multidomain solvers
- Phase-field (Stéphane Z.)
- Integration of higher-order schemes (Rajarshi's PhD)
- CLAWPACK scheme for conservation laws (Donna Calhoun)
- Non-coalescing emulsions (Mani's PhD)



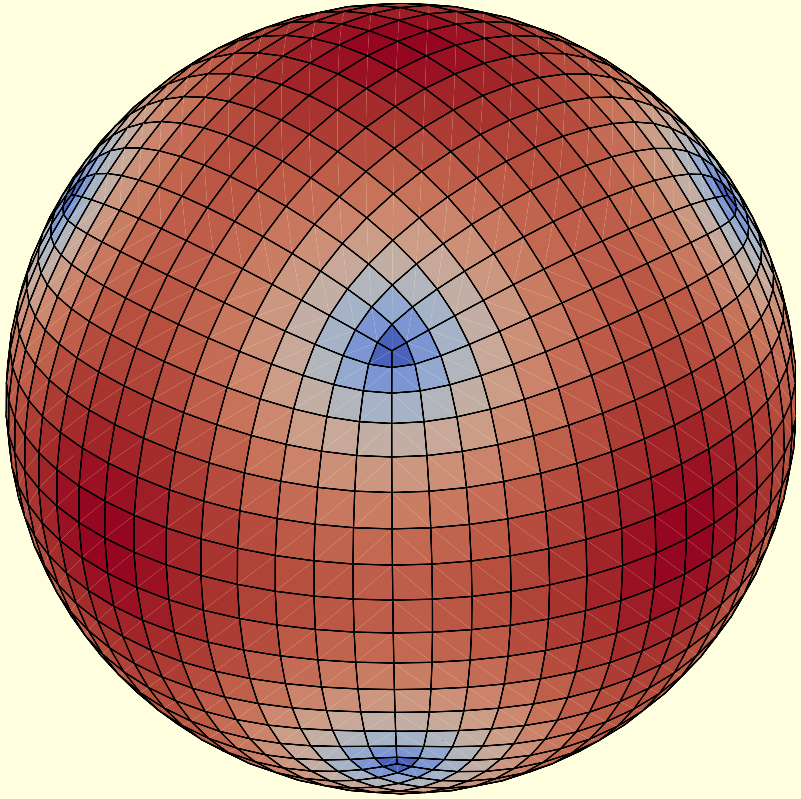
DNS of 1024 sedimenting oil droplets in water

Short-term development priorities

- Embedded boundaries + multiphase
- MPI-parallel STL geometries $\rightarrow$ New MPI-parallel "particule" data structure
- `mask()` will go... and be replaced (to some degree) by "multi-box" topologies (à la Gerris)
- Improved low-level memory handling
- Curvilinear coordinates
- Generic multilayer grids (e.g. Bruno's talk this morning)
- Re-implementation of `adapt_wavelet()`
- Improved documentation / workshops
- Automatic boundary conditions (since 2016...)

Future plans (from BGUM 2017)

- Periodic boundary conditions and more general topologies e.g. cubed sphere (for geophysical fluid dynamics)



"Multi-boxes" but more flexible than Gerris (2:1 box connections)

- Multi-layer non-hydrostatic "generalised Saint-Venant" model:

  Saint-Venant $\rightarrow$ multilayer Saint-Venant $\rightarrow$ free-surface Navier–Stokes
- Conservative Serre–Green–Naghdi model (Clamond et al. 2016)
- Contact angles (using the integral formulation) (done but not using the integral formulation)
- Generalised fluid/solid solver using e.g. the "reference map" method of Kamrin & Nave (2009)

Important non-technical issues

- Merging sandbox contributions

  delegate code review

  "public consultation" on what to merge

  a badly-managed case: W. Hayek's GPU code
- Attribution / authorship
- Communication

Some statistics

328 members in basilisk-fr google group (up from 197 in 2017)

Published papers or PhD manuscripts: `basilisk.fr/Bibliography`

2019

Manpreet Singh, Palas Kumar Farsoiya, and Ratul Dasgupta. Test cases for comparison of two interfacial solvers. *International Journal of Multiphase Flow*, 2019.

2018

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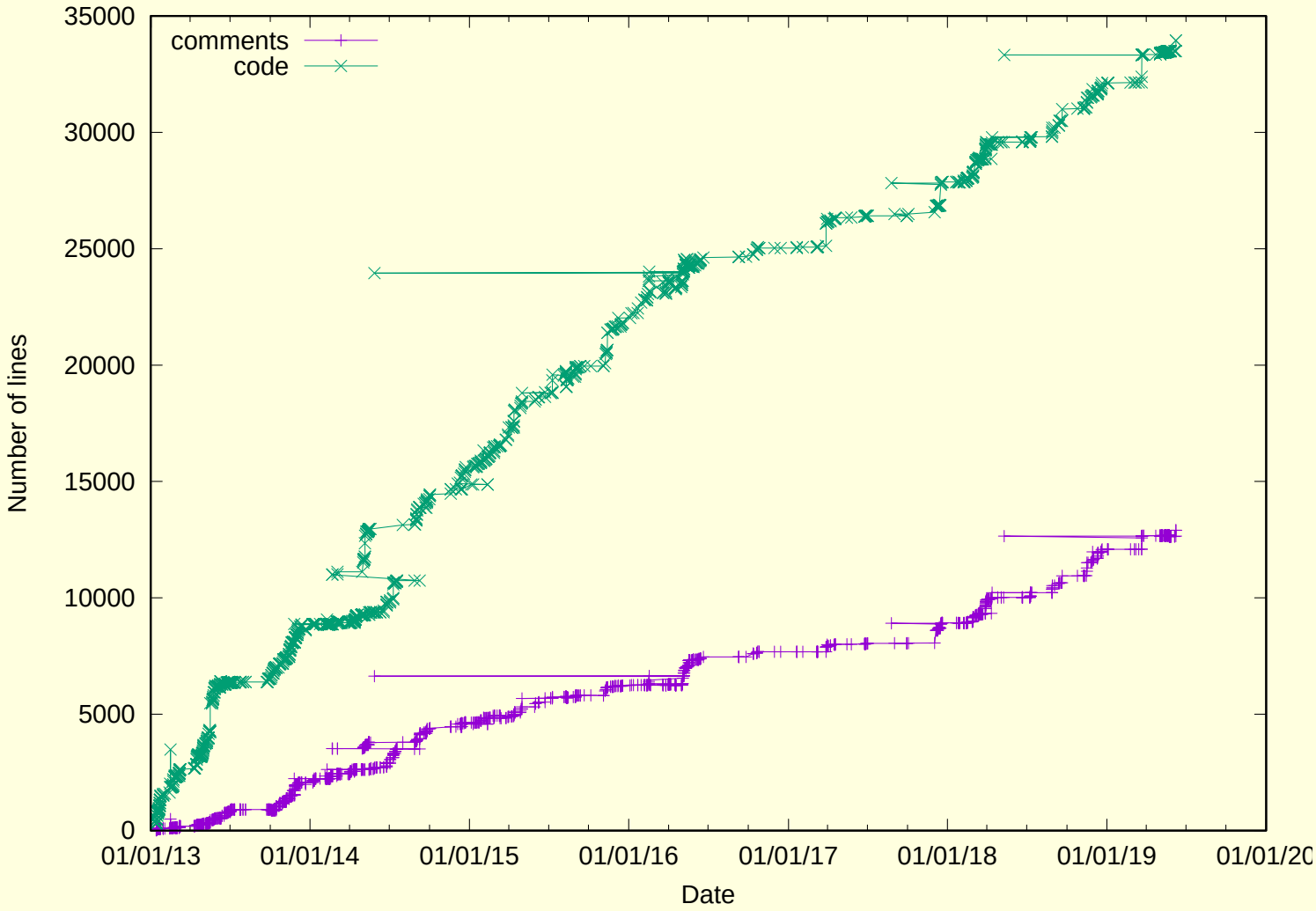
Andres Castillo-Castellanos. *Turbulent convection in Rayleigh-Bénard cells with modified boundary conditions*. PhD thesis, UPMC - Université Pierre et Marie Curie - Paris 6, 2017.

Lines of code



Number of patches