The PENCIL CODE Newsletter

Issue 2022/1

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Contents

1 Sign up for PCUM22

As already advertised in the previous newsletter, this year’s PENCIL CODE User Meeting (PCUM22) will be held at the Indian Institute of Astrophysics (IIA), Bangalore, India. The timing has meanwhile been fixed to be May 4–10, expect for the weekend in between. Thus, we have Wednesday (May 4) to Friday (May 6) together with Monday (May 9) and Tuesday (May 10) of the following week. This was done to enable participation from those who have other obligations in one of the two weeks. Please sign up asap on `https://www.iiap.res.in/pcum2022/` (see Figure 1)

Before, during, and after the PCUM, we use Slack to communicate about questions that might arise.

2 Steering committee meeting

The latest steering committee meeting was held on March 17, 2022. As usual, the minutes can be found on: `https://www.nordita.org/~brandenb/pencil-code/PCSC/minutes/`. As a new PENCIL CODE owner, Jennifer Schober from Lausanne has been nominated. Thus, altogether, we have now 19 owners; see the updated list on `https://www.nordita.org/~brandenb/pencil-code/PCSC/ToR/ToR.pdf`.

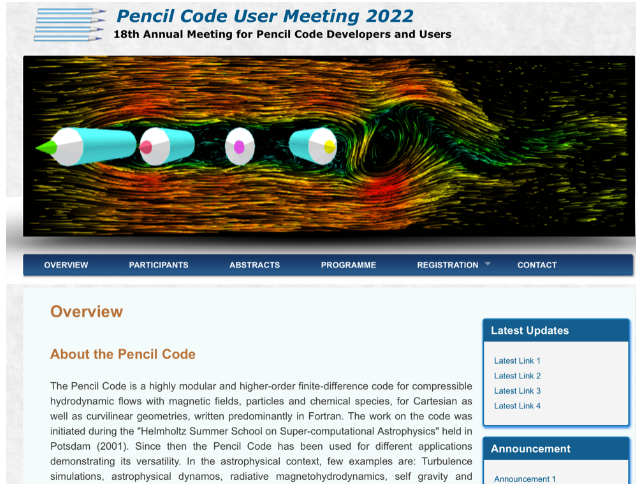


Figure 1: PCUM22 homepage. Sign up on `https://www.iiap.res.in/pcum2022/`

3 Office hours now Thursdays

To optimize the participation, we have now moved the PENCIL CODE office hours to the second Thursday of the month at 13:00 CEST; see `https://www.nordita.org/~brandenb/pencil-code/office_hours/`. The next event will be on April 7. The zoom address is `https://stockholmuniversity.zoom.us/j/69160607217`. These events provide great opportunities for brainstorming with others about code-related issues, and also for demonstrating some new developments. To improve efficiency, an agenda will be defined at the beginning of the meeting, and related proposals are welcome to be sent in beforehand. See you then.

4 Science & code developments

4.1 Mass hyperdiffusion

Mass hyperdiffusion, which is an artificial damping term sometimes invoked in the continuity equation, was no longer in effect since a revision of `2018-10-22 11:59:32 +0200` in density.f90. Wlad has fixed this with his commit of `2022-03-21 02:38:56 +0100`. Between these revisions, the code was calculating but not adding hyperdiffusion to the rhs. Affected people, who used `diffrho_hyper3` $\neq 0$, would have noticed that it didn't make any difference whether this coefficient was 1e-30 or 1e+30. The problem was only in the density module, so hyperviscosity, hyperresistivity, hyperconductivity, as well as upwinding, were not affected. The Pencil developers have unveiled the sequence of events: In the same week the bug was introduced in, the autotest was also being cleaned of variables that had underflow. Unfortunately, along with those, variables that uncovered the error were also removed. Since the remaining differences were small, they were thought to be due different compiler versions, so the reference data files were eventually updated.

Solutions to avoid such problems in the future will be discussed at PCUM22. It will be useful to spend more time in investigating the sensitivity and specificity of any single auto-test! We are all extremely sorry that the bug was not caught soon enough, and apologize to those, especially students, who have been affected by it.

4.2 r-slices

r-slices (spherical slices in Cartesian grids) are now available for most of the variables defined for slices in general. The remaining ones will be added upon request.

4.3 Interaction with "foreign" codes

The Pencil Code contains now essential elements of an MPI-interface to other ("foreign") codes. The code coupling follows the MPMD (multiple program, multiple data) paradigm of parallel computing. As a first application, the transfer of a velocity field, being simulated by the foreign code, as a kinematic flow was implemented, for use in test methods. It would be activated by specifying `kinematic_flow='from-foreign-snap'` and setting `tag_foreign` in `run_pars` to a positive value. Further, the script `run.csh` needs to be executed in the way `run.csh <scheduler parameters> <path to foreign executable> [<parameters of foreign code>]`. Here, `<scheduler parameters>` is typically an option specifying the number of processes for the foreign code. `tag_foreign` must also be used in the foreign code for the MPI interface. (Note that the scheduler `srun` might not work as it may not fully adhere to the MPI standard. `mpirun` does work, though.) This solution is partly specific for cooperation between the MHD code EULAG (`https://www.astro.umontreal.ca/~paulchar/grps/eulag-mhd.html`) and the Pencil Code, but can easily be extended to other codes. Proposals for other code partners, in particular such which would extend the physics scope of the Pencil Code, are welcome. A sample is under construction; see `pencil-code/samples/Pencil-MagIC`.

4.4 Resetting code modifications

As explained during the Pencil Code User Meeting 2020 (see also newsletter 2021/3), we can do multiple special modules. This implies that statements containing `special` must be differentiated, and hence `make` replaces `special` by the respective file name. Everything is automatic and safe, but, to avoid excess differences when checking in new changes to one of the modules, it is convenient to reset the mentioned changes from `make` before check-in; see `pencil-code/utils/axel/pc_mkspecial.sh` from an email by Matthias to Axel.

5 Rädler memorial lectures

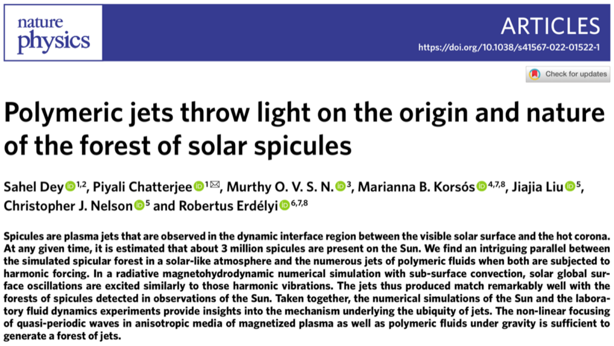
On 23 June, a series of lectures will be held at the AIP in Potsdam in memory of the life and work of K.-H. Rädler. The speakers include Manfred Schüssler, Günther Rüdiger, Joachim Trümper, Axel Brandenburg, Anvar Shukurov, Frank Stefani, Klaus Strassmeier, and Matthias Rheinhardt. This is a whole day event open to anybody interested. Inquiries can be sent to Oliver Gressel `<ogressel@aip.de>`, who knows more.

6 Preprints on Slack

When you have a new preprint related to work with the Pencil Code, please register it also on Slack under `pencil-papers`. We normally find most of the papers later anyway, but some we don't, especially if you forgot to acknowledge the Pencil Code!

7 Nature Physics paper now out

In the Pencil Code Newsletter 2020/3, we reported under item 6 about the work of Sahel Dey and Piyali Chatterjee from the Indian Institute of Astrophysics in Bengaluru and collaborators about their first spicule formation in a three dimensional radiative MHD simulations. Their paper is now published; see **?** in Nature Physics; see Figure 2. The study tries to identify


nature physics

ARTICLES

https://doi.org/10.1038/s41567-022-01522-1

Check for updates

Polymeric jets throw light on the origin and nature of the forest of solar spicules

Sahel Dey[1,2], Piyali Chatterjee[1], Murthy O. V. S. N.[3], Marianna B. Korsós[4,7,8], Jiajia Liu[5], Christopher J. Nelson[5] and Robertus Erdélyi[6,7,8]

Spicules are plasma jets that are observed in the dynamic interface region between the visible solar surface and the hot corona. At any given time, it is estimated that about 3 million spicules are present on the Sun. We find an intriguing parallel between the simulated spicular forest in a solar-like atmosphere and the numerous jets of polymeric fluids when both are subjected to harmonic forcing. In a radiative magnetohydrodynamic numerical simulation with sub-surface convection, solar global surface oscillations are excited similarly to those harmonic vibrations. The jets thus produced match remarkably well with the forests of spicules detected in observations of the Sun. Taken together, the numerical simulations of the Sun and the laboratory fluid dynamics experiments provide insights into the mechanism underlying the ubiquity of jets. The non-linear focusing of quasi-periodic waves in anisotropic media of magnetized plasma as well as polymeric fluids under gravity is sufficient to generate a forest of jets.

Figure 2: Nature Physics paper by ?.

the minimal set of ingredients and is able to do this by making an impressive comparison with non-Newtonian viscoelastic fluids, which are known to share similarities with hydromagnetic fluids.

8 Papers since December 2021

As usual, we look here at new papers that make use of the Pencil Code. Since the last newsletter of December 7, three new papers have appeared on the arXiv, and 12 others, some of which were just preprints and have now been published. We list both here, 15 altogether. A browsable ADS list of all Pencil Code papers can be found on: `https://ui.adsabs.harvard.edu/user/libraries/iGR7N570Sy6AlhDMQRTe_A`. If something is missing in those entries, you can also include it yourself in: `https://github.com/pencil-code/pencil-code/blob/master/doc/citations/ref.bib`, or otherwise just email brandenb@nordita.org. A compiled version of this file is available as `https://github.com/pencil-code/website/blob/master/doc/citations.pdf`, where we also list a total of now 102 code comparison papers in the last section "Code comparison & reference". Those are not included in our list below, nor among the now total number of 630 research papers that use the Pencil Code.

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