

# Publish or perish

## Getting into print

Michael  
Banks



*What happens when a scientist discovers something new and exciting? How do they manage to tell as many people as possible, and how can they be sure that someone else hasn't beaten them to it? Well one way, other than shouting it from the rooftops, which has passed the test of time is by writing and publishing research in scientific journals.*

*Since Sir Isaac Newton wrote his seminal work on gravity in the 1600s the method of scientific publishing in scientific journals has barely changed for hundreds of years but it is now starting to enter the digital age.*

### Scientific discovery

Experiments are always the most memorable and fun part about doing science. Who can forget dropping a small piece of potassium into water and noting how it menacingly fizzes around as it reacts with the liquid, or standing on a Van de Graaff generator and watching your hair stand on end. For a scientist, experiments are even more exciting when they have never been done before, giving the chance to learn something new about the world that no-one else knows.

Once a scientist discovers something new or of note to the community they will often write up their work and submit it to a scientific journal – a weekly or monthly book-like publication containing a series of research papers. These ‘papers’ usually have a certain structure (an example of which is on pages 10-11), which is not so different from the science reports that you write in class, and can be a few pages long, or hundreds. Journals are important to the scientific process. They contain a record of previous work, serving as a place where researchers go to see other results in their field and also to check that the work they are doing hasn't been done before.

Once a scientist's paper containing their new exciting results is sent to the journal it is then read by an editor (who may or may not be a scientist) who will give it a first inspection to see if it fits the scope of the journal, if the language is up to standard and if everything is submitted with the writing such as tables and graphs. The editor then submits the paper to two referees to judge the quality of the work and if it represents original research. Referees, much like in a football match, are neutral and should offer a balanced view of the paper. They then write a report to the editor who will decide – on the basis of the referee reports – if it will be accepted or rejected. Once this has been accepted it is then ready to be published.

**Science**, a prestigious scientific journal, has been published since 1883.

### Key words

publication  
paper  
abstract  
references

## Title, affiliation and abstract

The first page of a paper shows the title, the names and addresses of the authors, and the abstract. The abstract, around 150 – 200 words, presents what the researchers are looking for and what they found. It should be concise to contain all the relevant findings from the paper. If somebody wants to find out more they will then have to read the remaining sections.

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### New Journal of Physics

The open-access journal for physics

#### Spotch: visualizing cosmological simulations

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**Abstract.** We present a light and fast, publicly available, ray-tracer Spotch software tool which supports the effective visualization of cosmological

simulations data. We describe in order to deal with point-like particles ordering the particles as a function of the coordinates or other impressions are reached through properly calculating emission describe several scientific aspects. We emphasize how different results in terms of are available online.

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#### 1. Introduction

According to the standard theory of the Big Bang, our universe began as a singularity around 13.7 billion years ago. After its initial appearance, it was in a very dense, hot and homogeneous state to the expanded, cooled and formed the objects of our current universe. During its evolution, planets, stars, galaxies and structures that we observe today have formed as a result of various gravitational forces with a number of different physical processes (shock waves and turbulence), magnetic fields, star formation and supernova explosions). Cosmologists adopt numerical simulations as an effective tool for describing, investigating and understanding the evolution of such a complicated system within the framework of the expanding space-time of the universe. There are various numerical methods—grid- or particle-based—to perform such simulations. For a recent review on such numerical simulation methods within the cosmological context, see Dolag *et al.* (2008).

The resulting data is huge and complex and requires suitable and effective tools to be inspected and explored. Visualization represents the most immediate and intuitive way of analysing and exploring data and of understanding the results. Larger datasets require an enormous computational effort to be systematically studied and more and more complex and expensive algorithms to identify patterns and features. Visualization allows one to focus easily on subsamples and features of interest and to detect correlations and special characteristics of data. This is not a substitute for systematic analysis, but it is a fundamental support for accelerating and simplifying the cognitive process.

Visualization is also an effective instrument for introducing the general public, especially young people, to even the most complicated and innovative aspects and concepts of science.

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## Introduction

This section contains a brief introduction to the topic, explaining why it is important and summarising all the relevant past work that has been done in the area. The introduction provides an up-to-date analysis of the current state of the research field, and also provides a good indication for referees that the researchers know the topic well.

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## Method

Here the authors describe the experimental or theoretical methods used in this study. This section explains how the computational methods that were used to cluster and describe the data were implemented in the program and how the

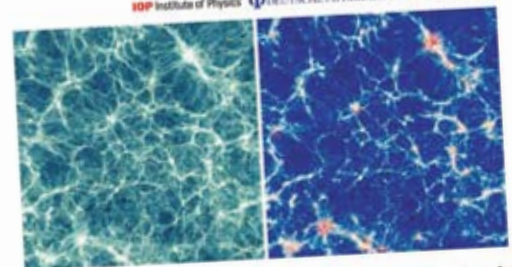


Figure 1. Map of a cosmological simulation box. The light would need nearly  $10^8$  years to cross the sidelength of the box and the slice thickness corresponds to  $\approx 50$  million lightyears<sup>11</sup>. The visualization has used a flat projection (i.e. the lightest structure formed in this cosmological simulation is on the right side of the simulation panel. Left side of the simulation panel.

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Figure 8. Sequence of ray-tracing a flight through a cosmological simulation. Here, the different components of the simulation are visualized. Stars in the disk, bulge and globular clusters are visualized as point sources. The colours of every gas and star particle has a vector array directly related to its velocity. The colours of the particles of the galaxy are added to the cosmological simulation in one shot, so that consistent movement of the galaxy is accomplished. A compressed version of the 4D Universe from <http://www.mpa-garching.mpg.de/galform/data.v>

#### Step 2: the EvolveGalaxy code

Giving a self-consistent numerical description of the galaxy dynamics, which is only marginally accomplished by the most advanced simulations. For our purposes, a simpler approach is sufficient implemented in the EvolveGalaxy code, according to the following assumptions:

- A typical galaxy rotation curve is used for making all the gas rotate, according to the differential rotation law. This results in a (no dynamics considered).
- The stars in the bulge and in the globular clusters rotate around with their own constant velocity, calculated in order to balance of the matter distributed inside the orbit.
- Equations of motion at the disk points are integrated using a simple method. Due to the kinematic approach and the amplification of

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## Analysis

Here, the results obtained from the method are presented and applied to a new problem. The scientists used their program to model galaxy evolution in the fourth dimension – time – and the evolution of the universe from the Big Bang to simulate how galaxies formed. The results can then be tested against theories of the Big Bang.

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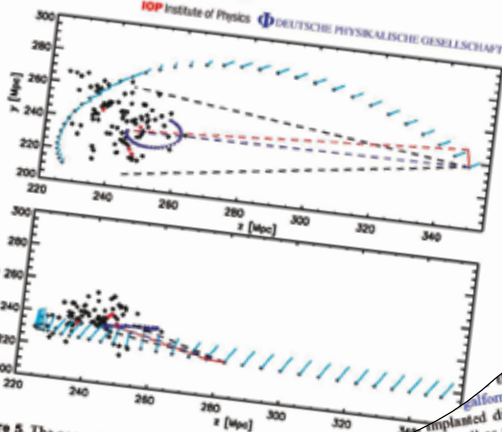


Figure 5. The geometrical setup of the camera path in two projections to the largest cosmological structure as well as the galaxy evolution. The dark blue plus symbols mark the position of the largest cosmological structure. For the first frame, the view vector for the right eye is marked by the black-dashed lines at an angle  $\psi$ . The red line marks the view vector for the left eye. The angle  $\beta = 6$  was used for visualization.

can be used to obtain its orthogonal part  $\vec{S}$ , with the view vector  $\vec{v}$ , which can be obtained by the

$$\cos(\alpha) = \frac{\vec{v} \cdot \vec{x}}{|\vec{v}| |\vec{x}|}$$

For stereoscopic projection, the same scene is re-calculated as follows. If we parameterize the position of the new camera position for the right eye  $\vec{C}$  can be

$$\vec{C} = \vec{z} + \frac{\vec{r}}{|\vec{r}|} \beta \frac{2\pi}{360} |\vec{v}|.$$

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first-order steps in numerical errors, the

## Method

The equipment used for the experiments is described, or if it is a theoretical paper as in this case, the ground mathematics is given. In an example, the authors describe a computer program they have written to visualise how galaxies or stars evolve. The researchers provide some background mathematics used in the computer program and how they implemented and tested it for performance.

# Catalyst

[www.sep.org.uk/catalyst](http://www.sep.org.uk/catalyst)

## Anatomy of a scientific paper

This paper by scientists in Germany and Italy was published in 2008 in the New Journal of Physics – a general physics journal published by the UK's Institute of Physics ([www.njp.org](http://www.njp.org)). The paper demonstrates a computer program to visualise how galaxies grow and behave. By performing such simulations it is possible to test theories that predict how they form and develop with time, and if possible to then compare it to experiments. Like this one, most papers have a similar structure containing an abstract, introduction, method, analysis and conclusion.

different fraction of the... process. Figure 8 shows the result... the 4D Universe movie can be obtained... <http://www.njp.org/data.via/index.shtml#movie1>. Note that... simulated directly within the cosmological simulation... as the position data were rendered at once. Here, all... of the cosmological structure.

## 5. Conclusions

Visualization is one of the most e dataset, understanding at a glance must be developed and exploited change according to the target audience. general public are being address requirements and different data suitable approach.

Furthermore, the software at time scientific datasets: the huge gigabytes of data at once, pro to be tuned to the data in order to memories and multiprocessor s such extraordinary data-process

In this paper, we have shi different applications in astron content production. For point adding the further advantage o both as a stand-alone applicat code.

Spetch was successf Planetarium. The movie has the universe, exploiting actu Therefore, it helps to give th the world on its largest scale

As a side product of the the-art cosmological simulat and thus start reaching a sta traditionally reflect the exte

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## Conclusions and References

This part extends the abstract by giving the importance of the work and summarising all the researchers' findings as well as what further work they intend to do. Most papers are built on previous work either by the authors or by others. This is given in the references where past work is documented. The references are an important part for the referees who will use them to judge how new the research is by looking at previous papers on the subject.



*Reading and writing are important scientific skills – but most scientists write their papers on a computer!*

## Submitting a paper

The process of submitting research to scientific journals has not differed for hundreds of years. Even the structure of a paper has been resistant to any change. However, some scientists lament the current voice of science, the very dry technical language that makes it impenetrable to outsiders.

Historically, papers were written in a more personal way. A paper in 1800 by the German-born British astronomer William Herschel (who discovered the planet Uranus) in one of the oldest scientific journals in the world the *Philosophical Transactions of the Royal Society* investigates the heating power generated by certain wavelengths (or colours) of light. Already in the introduction Herschel writes almost like he is thinking when describing how he came to investigate the heating effect by feeling a heating sensation whilst looking through one of his telescopes. Such personal ‘stories’ are missing in papers today, possibly at a loss to historians of science.

This type of language is evident in all parts of the paper. In describing the experiment in the method, Herschel writes, “No.2 and 3 were two excellent thermometers, which my esteemed friend Dr. Wilson late professor of astronomy at Glasgow, had lent me for the purpose.” Today, this would be replaced by “two thermometers were used...”.

## Internet impact

There are some advances that have come a long way since those days. In the 1800s only a handful of journals were around and even by the late 1800s dedicated journals in each of physics, biology and chemistry were rare. Libraries were also trusted upon to store big bound volumes of every journal on their shelves for people to read.

It is the advent of the internet that changed all that. Now there are thousands of journals in very specialised areas of science. As it is all on-line, no longer do scientists wander to the library but instead open their web browser when searching for new papers. With the internet also comes the possibility to add new functionality to papers. For example, the *New Journal of Physics* started to add films, so when you look at a paper on-line you get movies rather than still images – potentially enhancing your understanding. The next step could be to embed a video of scientists explaining and maybe showing how the work was performed – and finally put some personal stories back in science.

*Dr Michael Banks is news editor of Physics World magazine published by the Institute of Physics.*

### Look here!

More about how scientific papers are checked by referees before publication – the process of peer review:

[www.sep.org.uk/catalyst/articles/catalyst\\_18\\_1\\_334.pdf](http://www.sep.org.uk/catalyst/articles/catalyst_18_1_334.pdf)

*The full reference details of the paper shown on pages 10-11 are as follows:*

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