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

Splotch: visualizing cosmological simulations

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Abstract. We present a light and fast, publicly available, ray-tracer Splotch software tool which supports the effective visualization of cosmological simulations data. We descri
order to deal with point-li
ordering the particles as a fu
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impressions are reached thr
properly calculating emissio
describe several scientific a
We emphasize how differe
different results in terms of
are available online.

[3] Author to whom any correspondence should be a

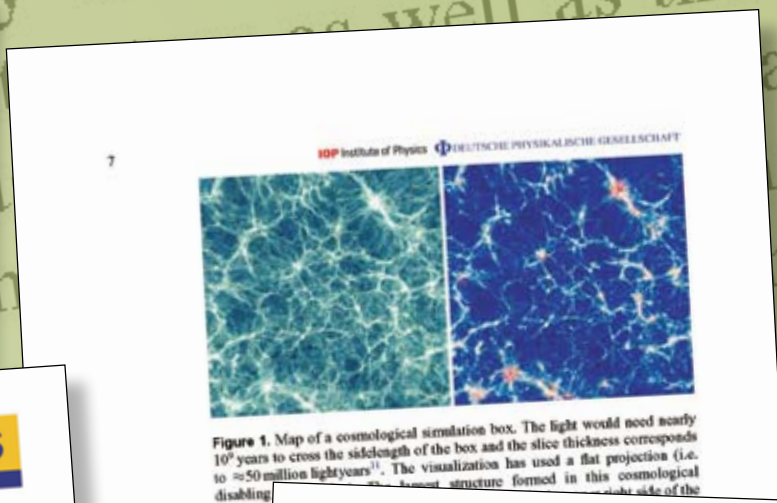

Figure 1. Map of a cosmological simulation box. The light would need nearly 10^9 years to cross the sidelength of the box and the slice thickness corresponds to ≈50 million lightyears[31]. The visualization has used a flat projection (i.e. disabling
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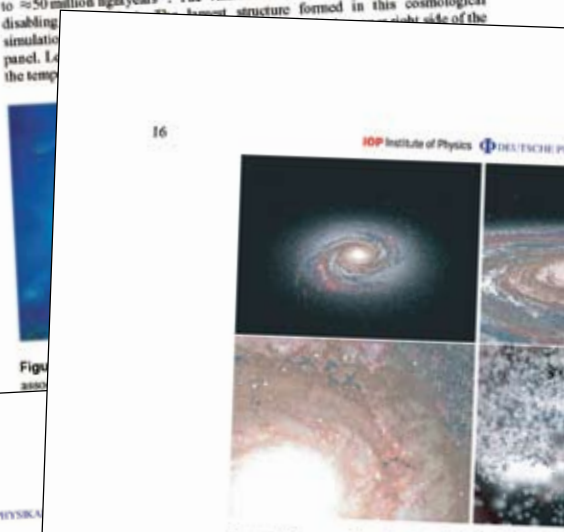
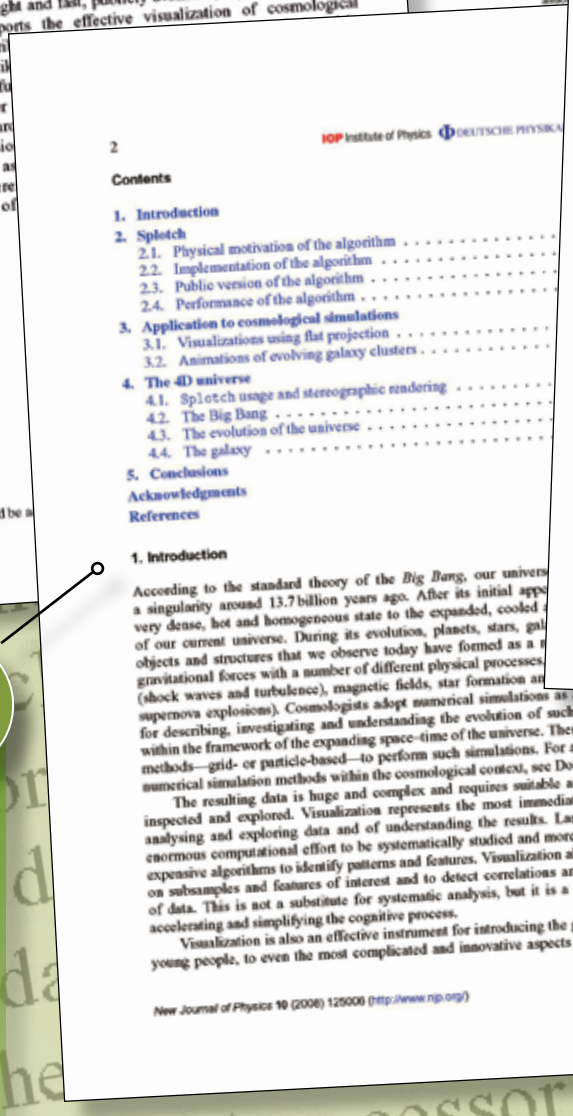


Figure 8. Sequence of ray-tracing a flight through a reco
into the cosmological simulation. Here, the different co
stars in the disk, bulge and globular clusters are visua
every gas and star particle has a vector array directly
which is used instead of the colour look-up table. The re
the colours composed from a real, optical observation
particles of the galaxy are added to the cosmological
in one shot, so that consistent movement of the galax
accomplished. A compressed version of the *4D Univer*
from http://www.mpa-garching.mpg.de/galform/data_

Step 2: the *EvolveGalaxy* code

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

- A typical galaxy rotation curve is used for making all the gas
rotate, according to the differential rotation law. This results in
(no dynamics considered).
- The stars in the bulge and in the globular clusters rotate aro
with their own constant velocity, calculated in order to balanc
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



Contents

1. Introduction

According to the standard theory of the *Big Bang*, our univers
a singularity around 13.7 billion years ago. After its initial appe
very dense, hot and homogeneous state to the expanded, cooled
of our current universe. During its evolution, planets, stars, ga
objects and structures that we observe today have formed as a r
gravitational forces with a number of different physical processes
(shock waves and turbulence), magnetic fields, star formation a
supernova explosions). Cosmologists adopt numerical simulations as an effective
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.

2

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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www.sep.org.uk/catalyst

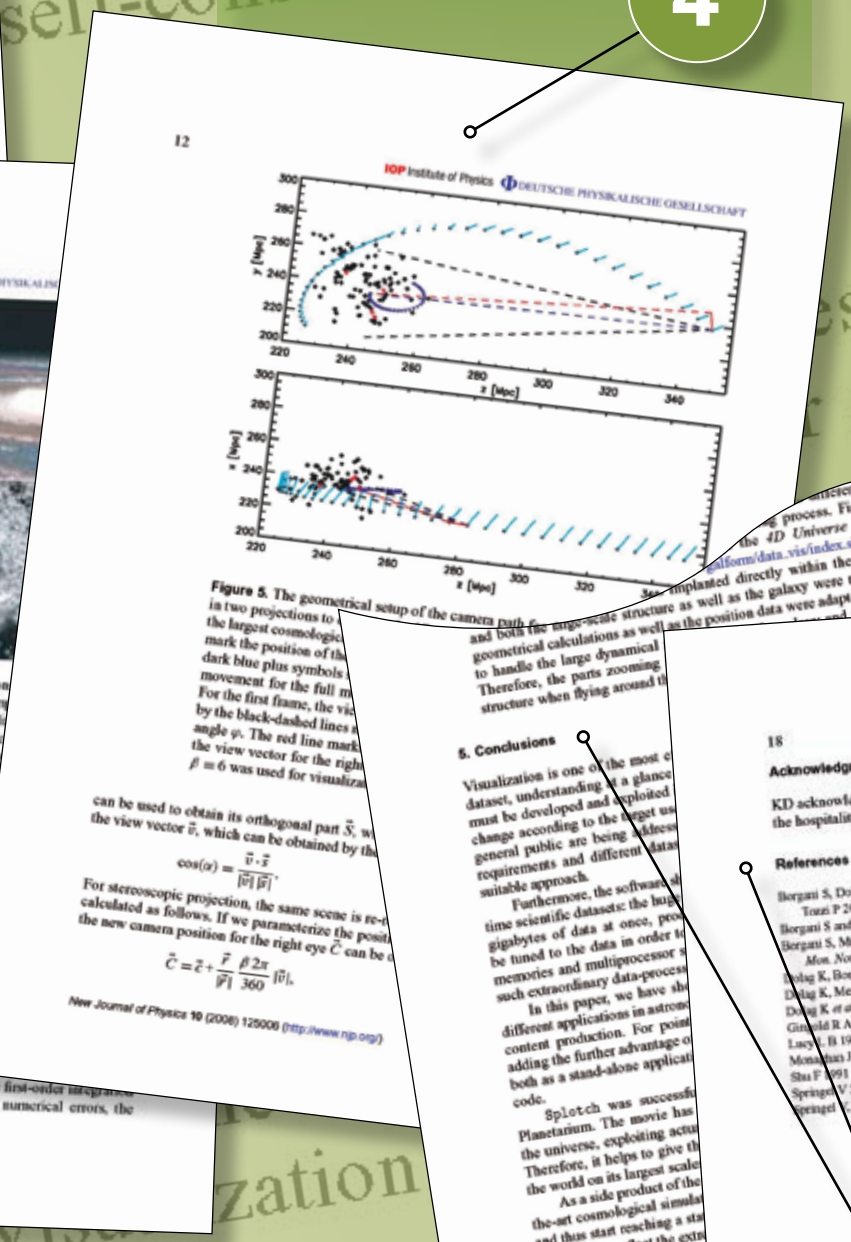
Analysis

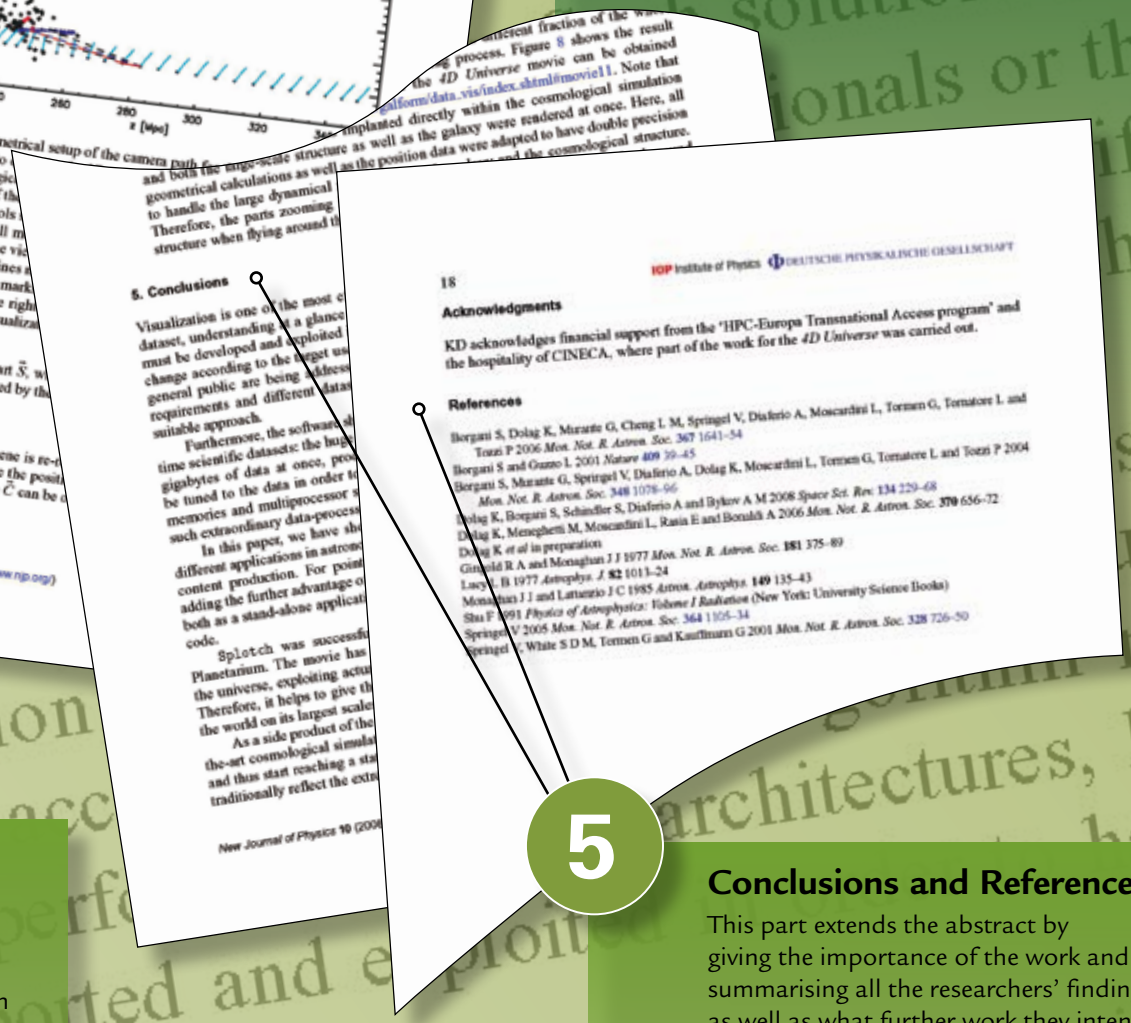
Here, the results obtained from the method are presented and applied to a new problem. The scientists used their program to model galaxy evolution in the fourth dimension – time – and the evolution of the universe from the Big Bang to simulate how galaxies formed. The results can then be tested against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

4

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). 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.





5

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 thee 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.

hod

he equipment used for the ments is described, or if it a tical paper as in this case, the round mathematics is given. In ample, the authors describe a uter program they have written an visualise how galaxies or rs of evolve. The researchers be some background matics used in the computer am and how they implemented sted it for performance.

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

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

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We are grateful to the authors and to the publishers, Institute of Physics Publishing, for giving their permission to use the paper in this way.