

Talking physics in

From “blogs” to “wikis”, the Web is now more than a mere repository of information. **Martin Griffiths** investigates how this new interactivity is affecting the way physicists communicate and access information

Scientific publishing, like so many other aspects of human life, has been transformed by the Web. Almost all journals can now be read online and papers downloaded at the click of a mouse without ever having to visit a library. Indeed, the traditional commercial publishing model is being challenged by open-access preprint servers like *arXiv.org*, which – as a survey carried out for this special issue of *Physics World* reveals – is used by almost everyone in the physics community to access the latest research.

But while online access to papers is certainly convenient, and also makes scientific information more easily accessible to the developing world, it is little more than the digital equivalent of retrieving a paper from a traditional library. In other words, the information flow is still one way. Now, however, the Web is evolving. The next generation of the Web – a set of applications bundled under the loosely defined term “Web 2.0” –

90% of physicists say they use journal websites or *arXiv.org* as their primary source of scientific papers

encourages people not just to use the Web as a reference source but also to interact with it.

Web 2.0 is all about making it easier for people to create and share content, ranging from digital photos of their cats to entries in user-edited encyclopedias. And it is undoubtedly big business, as demonstrated by News Corporation’s recent acquisition of the “social networking” site *MySpace* for \$580m and by Google’s \$1.6bn purchase of video-sharing site *YouTube*.

Given that the first incarnation of the Web was developed by researchers at CERN to aid their research, you might expect Web 2.0 to have a similarly revolutionary impact on the way physicists communicate and access information. For instance, some researchers are starting to use websites such as “blogs” and “wikis” in their professional lives. But as our survey reveals, rather than being the vanguard of these developments, this time round, physicists may be getting left behind.

Battles in the blogosphere

By far the most widespread manifestation of user-generated content on the Web is “blogging”. A blog (short for “web log”) is essentially an online diary, fea-



turing regular entries, or “posts”, by one person or a small group. Anyone reading the blog can add a written comment on a post, creating lively debates between the denizens of the so-called blogosphere. Since the term was first coined in 1997, blogs have become an Internet phenomenon – 60 million are now listed in the blog directory *Technorati*. With so many people voicing their opinions, the content is often banal. But blogs

the social Web



see their blog as a form of public outreach, providing plain English explanations of the latest physics stories; and others use blogs as a forum to debunk bad science reporting in the media. (A new column in *Physics World* looking at popular physics blogs begins this month on page 41.)

In the *Quantum Diaries* project, 33 physicists blogged about their life and work to celebrate World Year of Physics in 2005; and 40 more scientists run blogs as part of the popular *ScienceBlogs* portal. If it seems like too much of an effort to keep track of so many frequently updated webpages, the “aggregator” site *Mixed States* compiles the recent updates from all of the major physics blogs in one place.

While some may see them as vanity projects, physics blogs are starting to have a real impact on the way researchers communicate. For instance, several papers have already been published on *arXiv.org* that cite blog entries, demonstrating that blogs are becoming a bona fide channel for scientific communication. Meanwhile, a debate about string theory that began in the blogosphere has recently been thrust into the spotlight, being widely reported in science magazines and picked up by national newspapers.

The most outspoken critic of string theory, Columbia University mathematician Peter Woit, has used his blog *Not Even Wrong* to point out that string theory does not

10% of respondents to *Physics World's* survey say that the library is their main source of papers

make predictions that can be tested by experiment, and that the status granted to the theory as the most promising approach to reconciling quantum physics with gravity diverts resources away from other alternatives.

His blog has sparked a fierce, and sometimes unexpectedly personal, debate, both in the comments posted on *Not Even Wrong* and on string theorists' blogs such as Luboš Motl's *Reference Frame* and Clifford Johnson's *Asymptotia*. Such slanging matches may not be typical of the level of discussion in physics departments, and cause one to wonder how much of the debate depends on the easy anonymity that such online forums offer. But, for better or worse, blogs have opened up a new form of discourse in physics that can – as it is carried out in such a public fashion – be propelled into a broader context in a way that a discussion at a conference, say, would not have been.

In fact, the media attention generated by the “string wars” has already claimed one blogger as a casualty. Christine Dantas, a Brazilian physicist, regularly discussed the problem of quantum gravity in her blog *Background Independence*. Then in November she closed the blog down, explaining on an online forum

have also been lauded as a new form of “citizen journalism”, for example providing us with eyewitness accounts of dramatic events such as 9/11.

Several science magazines and academic journals have set up blogs, featuring rolling reports from conferences or updates on the latest science news. In addition, many professional physicists have blogs of their own. Some discuss research at an academic level; some

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Physicists on Web 2.0

“Nothing beats *Wikipedia* for a brief overview or the definition of a technical term.”

Robert Helling, Jacobs University Bremen, Germany



“Generally, I don’t trust the physics I read in blogs at all, and I don’t think it was a good idea to put trackbacks connecting them to *arXiv.org*.”

Lee Smolin, Perimeter Institute in Canada

“Physics blogs play a role in teaching young researchers about the field but I’d never use them as a research tool.”

Nick Evans, University of Southampton

“Since *arXiv.org* works very well, it might be possible to imagine some sort of self-correcting peer-review system à la *Wikipedia*, although this would require scientists to set aside their research time to suggest corrections to papers.”

Paul Cook, Scuola Normale Superiore di Pisa, Italy



“The idea that everything will go online and we will have the ‘paperless office’ is like the promise of fusion – always some time in the future.”

Frank Close, Oxford University

“Physics blogs will explode in popularity, but rather than replacing science publishing, they will be used for informal communications between researchers, and as a way to interact with the public.”

Sean Carroll, California Institute of Technology

“There are a bunch of string-theory-oriented blogs out there, but I’m fairly disgusted with their antics at the moment, so I’m not currently reading them.”

Chad Orzel, Union College, New York



“I don’t trust *Wikipedia* very much. I’ve followed the way the ‘nanotechnology’ article has evolved, and it doesn’t give me a lot of confidence in the wisdom of crowds.”

Richard Jones, Sheffield University

“No. I’m 47.”

Gary Hinshaw, NASA’s Astrophysics Science Division, when asked whether he uses “social tagging” sites like *Connotea*

that the media coverage of the string wars had made her uncomfortable, especially after her blog was mentioned in a Brazilian physics journal. “I am a quiet person, and wish to go back to my quiet life, to my quiet readings and studies,” she wrote.

In this case, however, has the very nature of blogging inflated obscure disagreements between small groups of physicists into something that looks like a “holy war”? The intricacies of quantum gravity have no impact on the work of the vast majority of physicists, but they occupy a disproportionate amount of the discussion in the physics blogosphere. Some have compared the blog community to an “echo chamber”,

where people tend to write about things they have seen on other blogs. For instance, Sabine Hossenfelder, co-author of the blog *Backreaction*, says that viewing the string debate through the eyes of blogs is “like putting magnifying glasses on a spot on your nose and then getting obsessed about it”.

Taking a step back from such passionate debates, blogs are also influencing the careers of the physicists who write them, though it remains to be seen whether blogs are perceived as a positive example of outreach work or a waste of time that would be better spent on research. California Institute of Technology cosmologist Sean Carroll, who contributes to the most popular physics blog *Cosmic Variance*, has certainly raised his profile through blogging. He is now seen by the mainstream media as someone who they can rely on for accessible explanations of difficult science (see page 14).

But how many physicists actually read or contribute to blogs? While 16 of the 60 respondents to our survey

80% of physicists who say they read physics blogs also write one of their own

said they do read physics blogs, all but three of these are the very same people who also write blogs of their own. The *Mixed States* site lists about 100 physics blogs, which is a drop in the ocean of a worldwide community of hundreds of thousands of physicists. Indeed, most of our survey respondents were either unaware of the existence of physics blogs or said that they do not trust the content of them. “I ignore blogs completely,” says theoretical particle physicist Frank Close from Oxford University. “I wouldn’t read what someone posts on a notice board outside my local newsagent and putting it on the Web doesn’t make it any more official.”

Wikifying the Web

Trust is a recurring issue in the online world. A few years ago the idea that one of the most-consulted sources of information in the world would be an online encyclopedia that can be modified by anyone who uses it would have seemed ridiculous. But that is exactly what has happened with *Wikipedia*, probably the most well known of the Web 2.0 sites. As it has turned out, the self-correction that is built in to the system has worked pretty well – barring occasional controversies, erroneous modifications are usually quickly corrected by another user. Indeed, a study carried out by *Nature* in 2005 suggested that, for science, *Wikipedia* is almost as accurate as the *Encyclopaedia Britannica*, with the average *Wikipedia* entry containing around four inaccuracies to *Britannica*’s three.

From the Big Bang to quantum computing, there is a wealth of physics information on *Wikipedia*, though detail is sparse on more obscure topics. According to our survey, most physicists now seem happy to use *Wikipedia* as a quick reference; indeed, 75% of our respondents say they consult *Wikipedia* for physics information. The level of trust physicists have in the encyclopedia varies markedly, however, though all agree that anything crucial should be cross-checked with the original source. Harvard string theorist Motl

thinks that the quality of articles in *Wikipedia* is high, “especially in sufficiently general topics that have been edited, verified and refined by a large number of editors”. But some remain unconvinced. “I wouldn’t dream of reading *Wikipedia* for physics,” says Nobel laureate Philip Anderson. “Nor would I trust it if I did.”

In fact, *Wikipedia* is the most successful example of the general concept of a user-editable webpage, or “wiki”, which is being put to use by physicists for other purposes. In a large collaboration, a wiki can be a great way to get round the problem of disseminating tacit knowledge and “tricks of the trade”, especially when collaborators are spread over the world and cannot take part in coffee-room discussions. Such wikis already exist in experimental-particle-physics collaborations like CDF at Fermilab and ATLAS at CERN, for example, and are gradually evolving into comprehensive repositories of information about these experiments.

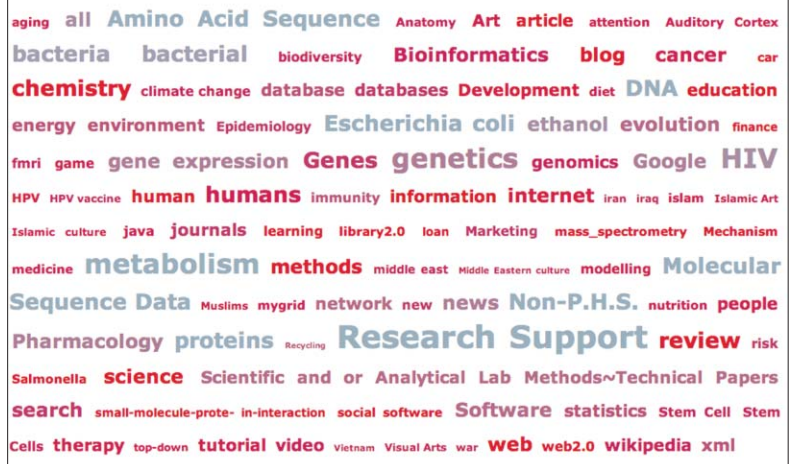
“I can well imagine that blogs and wikis will become the framework for brainstorming and discussing ideas,” says Gordon Watts of the University of Washington in Seattle. “It may even end up in some cases that ideas are fully formed on blogs and never make it into a preprint, let alone peer review.” In fact, some have suggested that a framework based on blogs and wikis could be the basis of a new type of peer review. In this model, a paper under review would be posted on a public webpage where comments could be appended. The text of the paper itself might even become a wiki that could be edited.

A precursor of this idea was the decision by the administrators of *arXiv.org* to allow “trackbacks” to papers posted on its server. Trackbacks are a crucial feature of Web 2.0. While the original “hyperlinks” of the Web are one-way, simply pointing from one site to another, trackbacks are a means of notifying a webpage that another webpage has added a link to it. In the case of *arXiv.org*, if a physicist writes about a particular paper in their blog and sends a trackback request, that blog entry is then automatically included on the paper’s page.

Such a combination of *arXiv* preprints and blog comments has already proved fruitful. For example, physicists Robert Alicki, Daniel Lidar and Paolo Zanardi produced a revised version of their paper on quantum error correction (arXiv.org/abs/quant-ph/0506201) in the light of discussions on Dave Bacon’s blog *The Quantum Pontiff*. Bacon, who works on quantum computing at the University of Washington, was naturally delighted. “This is now my favourite comment on an *arXiv* paper,” he posted to his blog.

However, such a system is not without its problems. Discussions on physics blogs are often derailed by crackpots promoting their own off-the-wall theories or political opinions. In an attempt to keep such distracting elements out of *arXiv*’s system, all trackbacks are moderated by its eight-member physics advisory board. But this raises its own questions, such as who should and should not be allowed to add a trackback. Last

2% of physicists have used “social tagging” sites such as *Connotea* to search for scientific papers



Cloud of knowledge “Social tagging” is a form of classification in which users categorize objects – photos, websites, scientific papers – by freely choosing a set of “tags”. For example, you might tag a photo with the words “family”, “holiday” and “Spain”. It is then possible to search using the tags that other users have added. This is in contrast to a strict “top-down” classification system like the Dewey decimal system for books. A “tag cloud” represents the most popular tags by displaying the words in different sizes depending on how often they are used. The tag cloud shown here is taken from the *Connotea* site, which allows users to tag scientific papers.

year, for example, Woit was told that he would be excluded from the system because he did not meet *arXiv*’s definition of an “active researcher”. Hotly disputing what he saw as a slur on his reputation, Woit accused Jacques Distler, a string theorist who sits on the advisory board, of bearing a personal grudge against him. He remains excluded.

Socializing online

Despite being at the forefront of the development of the Web in the 1990s, physicists have been slow to embrace some of the innovations offered by Web 2.0. “Social tagging”, for example, is a form of classification by users that is widely used in sites such as the photo-sharing forum *flickr*. Users choose “tags” to describe their photos – “me”, “London”, “red” and so on – and

75% of respondents use *Wikipedia* for physics information. However, only 5% regularly contribute to the online encyclopedia

can then search on not only their own tags, but also those of millions of other users. This “bottom-up” form of classification can also be used for scientific information. Indeed, the sites *Connotea* and *CiteULike* were set up specifically to apply social tagging to scientific papers.

The idea is that when you find a useful paper online, you save it in your account and add tags describing the content of the paper. If this was just a way for individuals to manage their references, it would not be terribly exciting. The innovative aspect of sites like *Connotea* is the social side: you can see what other users are saving and search their tags to look for new papers on a topic of your choice. However, biologists seem to have adopted the concept much more eagerly than physicists – with “genetics” and “metabolism” being among the most popular tags on *Connotea* (see figure above) – and only one of the respondents to our survey has so far used such sites.

Linking up with the social Web

Blogs by professional physicists are becoming increasingly popular. Those mentioned in the article include the following.

- *Asymptotia* (asymptotia.com)
- *Backreaction* (backreaction.blogspot.com)
- *Cosmic Variance* (cosmicvariance.com)
- *Not Even Wrong* (www.math.columbia.edu/~woit/wordpress)
- *The Quantum Pontiff* (dabacon.org/pontiff)
- *Reference Frame* (mottls.blogspot.com)

Many others can be found at the physics blog “aggregator” *Mixed States* (mixedstates.something similar.com), or at the *ScienceBlogs* portal (scienceblogs.com). *Technorati* is a comprehensive directory of all blogs (technorati.com). The sites *CiteULike* (citeulike.org) and *Connotea* (connotea.org) allow scientists to store and search for information about papers using “social tagging”. Jennifer Golbeck’s research on trust in social networks can be found at trust.mindswap.org and Michio Kaku’s *MySpace* page at www.myspace.com/mkaku.

In the wider world, there is no doubt about the most popular Web 2.0 destination. *MySpace* is a “social networking” site that allows each of its users – a staggering 120 million, mostly teenagers – to produce a personal homepage with photos and details of their likes and dislikes. The page also prominently displays how many “friends” the user has on the site, and friends can add comments to each other’s pages, creating something of an online popularity contest. This might seem an unlikely place to find a physicist, but that would be reckoning without string theorist Michio Kaku, author of

popular-science books *Hyperspace* and *Parallel Worlds*. Kaku, who lists himself as married/straight/non-smoker/non-drinker, has accumulated an impressive 2725 friends on his page.

There could, however, be a more serious use of social networks for physicists. Jennifer Golbeck, a computer scientist at the University of Maryland, has found that a social network like *MySpace* contains useful information about who knows whom and how much people trust each of their contacts. Golbeck is working on algorithms to use this information to tell you how much you should trust someone you do not know, based on their position in your social network. This trust measure could then be used by scientists and collaborations. For example, you might allow access to an early version of a paper only to people whose trust rating is above a certain threshold.

It is clear that a brave new world of blogs and trackbacks, wiki peer review, social tagging and trust networks awaits physicists who dare to venture into Web 2.0. But while physicists are happy to publish and download papers online, there is a certain pining for print. “Undeniably, the Web offers several important advantages,” says 85-year-old Nobel laureate Jack Steinberger, “but it also has some unfortunate drawbacks, and I am nostalgic for the good old days when publishing something was a more serious event in our lives than putting something on the Web.” Perhaps Web 2.0 will not fully make its mark on physics until the *MySpace* generation hits the labs.

Next month in Physics World

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