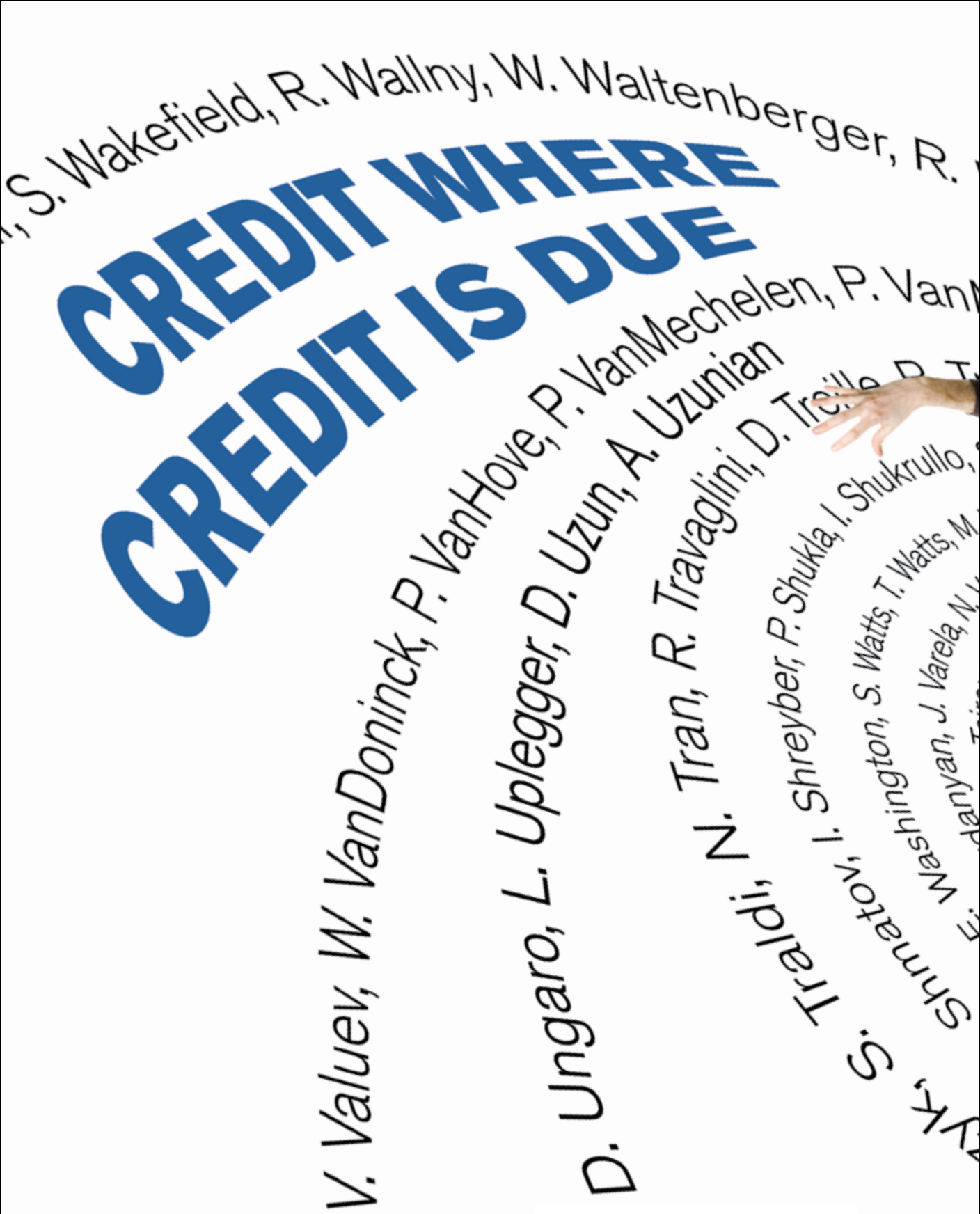

In the swirling sea of thousands of people who contribute to a major particle physics experiment, how can a young physicist pop to the surface and get noticed? An international committee offers ideas.


BY KATHRYN GRIM

Physicists around the world know the name Timo Aaltonen.

The Finnish graduate student has yet to complete his PhD. But since April 2007, members of the Collider Detector at Fermilab, or CDF, collaboration have credited almost all of their publications to "T. Aaltonen et al."

Particle physicists know that Aaltonen did not, in fact, write all of those papers. CDF publications list as authors every one of the collaboration members—all 602 of them—in alphabetical order. Before Aaltonen came along, the first author was "A. Abulencia."

The author list does not distinguish between the senior scientists who come up with ideas, the hardware specialists who helped design and build the machine and the grad students who put in long hours analyzing results. Some of those on the list might not have even read the paper because they are busy working on some other part of the experiment.

"I don't know anything about physics," Aaltonen jokes when people recognize him. "My boss only took me into the group to get someone from Helsinki as a first author." In fact, he studies *b*-jets in search of Higgs decays and spends most of his time processing raw data for physics groups in the collaboration.

In the early days of high-energy physics, researchers conducted experiments in small groups or even individually. Now they often work with much larger, more complex machines and detectors, in groups of collaborators that may number in the hundreds—or even thousands, in the case of the Large Hadron Collider, the 27-km particle accelerator situated at the border of Switzerland and France.

With the LHC experiments poised to produce papers that list as many as 3000 authors, a working group from the International Union of Pure and Applied Physics Commission on Particles and Fields has developed voluntary guidelines for crediting contributors fairly while maintaining the collaborative spirit.

The group called for collaborations to clarify their authorship rules and to find ways to publicly acknowledge the work of individual members through additional record-keeping or awards. It recommended they consider using two-tiered author lists to recognize those who made special contributions.

And it advised individuals to list on their curriculum vitae only the publications to which they made significant contributions.

The group does not expect current collaborations to adopt many of these recommendations, says current commission Chair Patty McBride of Fermilab's computing division.

"It's hard to impact a collaboration that's been around for 10 years," she says.

Instead, the group is more hopeful that scientists will consult the report when crafting policies for future experiments.

The shiniest apple in a crate of oranges

The current, decades-old system of including every collaboration member as an author was designed to give individuals an incentive to contribute to every aspect of the experiment. It helps large groups of people who may never meet face-to-face to feel like a team, says David Saxon, spokesman for the ZEUS collaboration in Hamburg.

"If you're not going to drink a beer with somebody, you're going to have to find other ways to promote cohesiveness in the collaboration," he says.

But to find out how each person added to the collective effort, outsiders have few clues. Contributors' names are buried in a list of authors that can run longer than the article itself.

Trends in university hiring have raised concern about the difficulty of standing out in such a large crowd.

Universities try to keep job candidate searches as narrow as possible, says Robert Wald, chair of the University of Chicago's physics department. "It would be very hard to compare a high-energy physics collider experimentalist with a condensed matter experimentalist," he says.

But some universities try to broaden their applicant pools, in part to reach larger numbers of women and members of minority groups, says Daniel Gauthier, chair of the physics department at Duke University.

Pitted against scientists in other disciplines for teaching positions, particle physicists find themselves at a disadvantage, as scientists in other fields often work in smaller groups and are more likely to land spots on author lists a line or two long.

Lost in a sea of authors, a young experimental physicist seeking a position or tenure at a university may have trouble proving his or her worth, says Gregor Herten, a physicist at Freiburg University in Germany and former chair of the IUPAP commission.

"When I was trying to promote a young person for a position, [the university] had to trust me," he says.

Kick-starting careers

Graduate students at the beginning of their careers have expressed the most dissatisfaction with the alphabetical author list. But a survey on authorship at an experiment at the SLAC National Accelerator Laboratory proved that they're not the only ones. Of 235 members of the BaBar collaboration who participated in the 2006 survey, 58 percent favored changing the alphabetical author list in some way. Of the 48 graduate students who replied to the survey, 73 percent were unhappy with the status quo.

Photo: Reidar Hahn, Fermilab

A list of all the people who contribute to a modern particle physics experiment from conception through design, construction, operation and data analysis can be very, very long.

Honorable mention

Standing out from the crowd can be difficult for researchers in large collaborations. The Commission on Particles and Fields of the International Union of Pure and Applied Physics has recommended seven ways to help highlight individual achievements.

Collaborations should:

- Write clear, publicly available rules regarding who is an eligible author for each publication.
- Release a public Web page with supporting notes and details about individual contributions for each publication.
- Publish scientific and technical notes written by small groups of authors.
- Keep a public record of ways members have contributed by taking responsibilities such as writing refereed internal notes, speaking at conferences and holding leadership positions inside the collaboration.
- Consider using a two-tiered author list to emphasize special contributions to publications without cutting out other contributors.

Collaboration members should:

- Include a list of "most relevant publications"—those to which they made the largest contributions—on their curriculum vitae, rather than simply listing all publications on which they are named as authors.

Organizations and collaborations should:

- Award more prizes for individual achievements in particle physics.

Some of the IUPAP commission's suggestions for addressing this concern were uncontroversial. For example, it's difficult to argue with the idea that collaborations should make authorship rules clear and public.

Many representatives of high-energy physics experiments who reviewed the report also liked the idea of keeping track of people who had held positions of authority inside the collaboration. The only problem is that no one can remember who did what over years or decades of research, says Dmitri Denisov, spokesman for Fermilab's DZero experiment, which started in 1984.

"We were looking forward," Denisov says. "We didn't keep detailed track of the past."

McBride says collaborations may be reluctant to take on additional record-keeping responsibilities in the future: "It's work to set up and maintain records and make them public."

Listing everyone in the collaboration as authors recognizes that without their help, there would be no experiment, says University of Cincinnati physics professor Kay Kinoshita, who works with the Belle collaboration, based in Japan. But small subgroups are usually responsible for writing the code, running the jobs, and making the plots necessary to produce papers.

"There's usually one person writing," Kinoshita says. "Like writing code, writing a cohesive piece of prose is very difficult to do with more than one person."

The people doing that writing are more often than not graduate students and postdoctoral researchers, says Gabriele Simi, a postdoc at the University of Maryland who works with the BaBar collaboration.

"The higher-level professors do a lot of the thinking and reviewing and the very important task of managing and choosing the right people for the right job," he says. "But in the end, they're not always the ones who do the analysis and the writing of the articles and the technical and service work."

Alternatives to alphabetical

The frustration of appearing as the 400th name on an alphabetic list after weeks or months of labor has fueled many a lunch-table venting session.

As a partial solution, the Belle collaboration uses a unique system to slim its author lists. Rather than including everyone automatically, it requires each potential author to opt in.

"I think there was a consensus that the collaboration members should at least be aware of papers," Kinoshita says. "People should have at least have read a paper, understood the result, and made some decision on whether they agree."

Kinoshita says she signs about two-thirds of the Belle papers, which come out at a rate of two or three per month. "If I have time to read a paper and think it's pretty good, I'm happy to sign," she says.

University of Warwick physicist Tim Gershon, who has also worked on Belle, says the rule changed attitudes toward publications. "I did find that it encouraged a very vibrant atmosphere within the collaboration in which the latest results were discussed," he says.

The collaboration also highlights a paper's main authors at the top of the list, as long as no one objects to the names proposed.

Lingering doubt

In the year before releasing its recommendations, the IUPAP commission's working group sought feedback from major collaborations. But some concerns remain.

Rob Roser, spokesperson for the CDF collaboration at Fermilab, says he worries that the

process of singling out those who have made the most important contributions is too subjective.

"We all have our own definition of what an ideal physicist is," Roser says. "I don't see why a person who made this final plot is more important than the person who made the detector the whole analysis was predicated on."

Researchers in the ATLAS collaboration at CERN's Large Hadron Collider fear that using two-tiered author lists would recognize physicists who perform analysis at the expense of those who are hardware-oriented, says ATLAS Deputy Spokesperson Steinar Stapnes. Many physicists and engineers have put in a decade of work at the LHC.

"It would be incredibly unfair to put in the front the people who have done the final steps of the analysis," Stapnes says. "They may not have even participated in the construction."

Others also worry that honoring some people over others through awards or abridged author lists might cause unhealthy competition, ZEUS physicist Saxon says.

"There's a danger of rivalry, people not sharing information," he says. "It can be destructive of the collaboration. As collaborations have got larger, the need to work hard on cohesion has increased."

Beyond the authors' list

As important as publications are, they are only one part of a physicist's credentials.

Particle physicists applying for tenure at Duke University need to demonstrate their contributions to publications during their time as faculty members, Gauthier says. But a typical particle physicist coming up for tenure might have 200 publications.

So Gauthier asks candidates to identify 10 publications for which they have played a primary role. According to the American Physical Society, a scientist must make several key contributions such as conceptualizing the project; collecting, analyzing, or interpreting the data; or writing the publication to be considered a primary author.

For his part, Aaltonen says he does not worry about author lists. "If I look for a job in physics," he says, "people know the story of the author list. If I look for a job outside the science community, then people are probably more interested in my hands-on experiences than in papers."

CDF's Roser says that most of the time what really counts is how candidates present themselves and what others say about them.

"Recommendations get you the interview. You get yourself the job," he says. "In the end the cream does rise to the top. People know who they are, and they figure out a way to be successful."

Even if they have to swim through an ocean of names to get there.