

# Faculty News

The Faculty of Science, No. 3, 2008



Stockholm  
University

## "Wrong" calculations and straight curves

By turning the arithmetical operations around, tropical geometry has become a hot branch within mathematics. The Department of Mathematics is involved in the exploration of this exciting new field. There are applications outside of mathematics within everything from nanotechnology to genetics.

Today, tropical geometry turns up in several branches of mathematics. That the field is bringing together scientists from both algebraic geometry, combinatorics, and theoretical physics is due to the fact that it can help to translate mathematical problems between different subjects. At the Department of Mathematics, Mikael Passare is leading a group of researchers who are studying this and other areas.

"Unlike more established branches of mathematics, tropical geometry has not been developed for several hundred years. There is something of a pioneering spirit within the field, which is attracting considerable interest amongst researchers. Many periodical articles and conferences have been devoted to tropical geometry over the past decade," he says.

One of the pioneers was the Brazilian mathematician Imre Simon, hence the strange addition of 'tropical' in the name of the field. The basic idea is just to use two new operations. In the case of tropical addition, the sum of two numbers is equal to the greater of the two numbers, while tropical multiplication on the other hand is like normal addition. Slightly surprisingly, it follows that  $1 \oplus 1 = 1$  and  $1 \otimes 1 = 2$ . The circle around the arithmetical symbol indicates that tropical arithmetic is involved.

"The point behind redefining the arithmetical operations is that certain mathematical problems become easier to treat with tropical calculations."

Mikael Passare illustrates this by noting that  $(x \oplus y)^2 = x^2 \oplus y^2$ , unlike the more complicated squaring rule in normal arithmetic. The geometry that is associated with tropical mathematics also often results in simpler solutions to problems than ordinary geometry. Curves for tropical functions are also made up of straight-line sections.

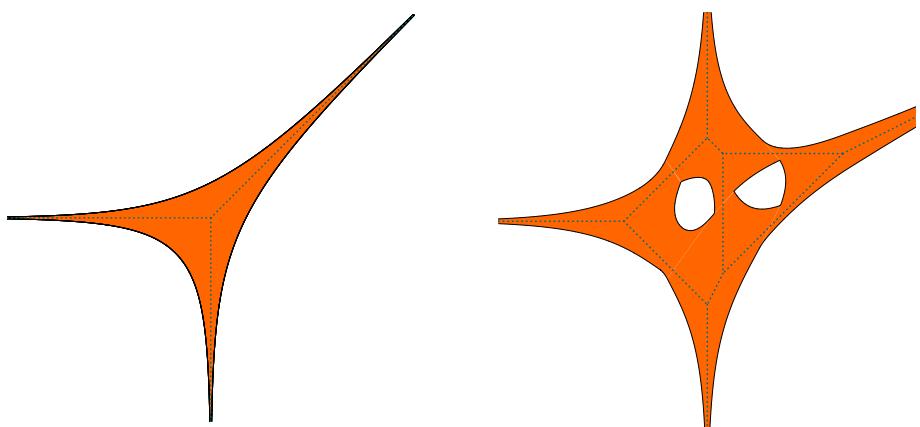
Mikael Passare is spreading knowledge concerning the new field by travelling and teaching around the world. This autumn, he is also contributing an article to the American Mathematical Society's periodical for popular findings concerning mathematics with an article on 'amoebae'. Amoebae can be seen as geometric descriptions in a logarithmic coordinate system of functions where the variables  $x$  and  $y$  are allowed to take complex numbers as values. The link to tropical geometry lies in the anatomy of the amoeba-like shapes – unlike

biological amoebae, they have straight "spines" which are made up of tropical curves.

Tropical geometry and amoebae are exciting new fields for mathematicians to explore, but they are also beginning to have applications outside the field.

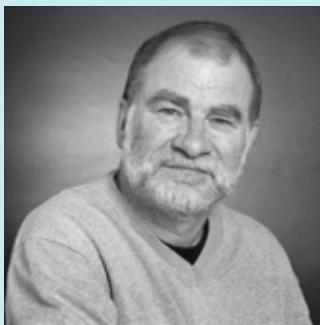
"Amoebae turn up for example within statistical mechanics as regards the way in which materials are built up at the nano-level. One tends to think that a crystal should have sharp corners, but the atoms near the corners easily become detached, so that in practice the corners are slightly rounded. Recently, theoretical physicists showed that the rounded area around a corner is actually made up of an amoeba – while the ideal sharp edges of the crystal correspond to the straight tropical lines inside the amoebae."

Another application that Mikael Passare mentions is Computational Biology. Here, tropical geometry can be of use in computing the distance between different organisms or genes and illustrating the relationship as a phylogenetic tree.



The amoebae for the polynomials  $1+x+y$  and  $1+5xy+y^2-x^3+3x^2y-x^2y^2$ . Note the blue-marked "spines" inside the amoebae, which are tropical curves.

# The Dean's Discourse



A new academic year - again!

So, the new term is under way with new students and new expectations. As usual, it has been exciting to see how many of those who were accepted on the autumn courses actually turn up and register.

A general comment is that the situation differs considerably within the faculty but that most courses still have places for more students, in some cases there are far too few registered. Overall however more new students have registered than during the previous autumn, partly as a result of more Master's degree students. Although it is difficult for many departments with the low student numbers, we should probably give the new 3+2 system another couple of years before we evaluate it. It is also pleasing that we have recently been told that more courses offered by the faculty within the framework of the Government action 'Lärarlyftet' will be financed.

Within research and doctoral studies, the Government's action concerning increased resources is pleasing news. It is still not yet clear how much of the promised resources will be allocated firstly to the University of Stockholm and then secondly to our faculty in particular. However, I would like to clarify even at this early stage that the new resources will only partially be used for a general increase. Discussions are under way to identify specific areas for directed funding to raise the level of quality further.

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# News from the faculty

## After the PhD degree – A survey of persons receiving the PhD degree 1997-2006

A new report from the Faculty of Science shows that most being awarded the PhD degree at the faculty get a job in a field relevant to their education within a year or two. A questionnaire was sent out to all the 983 persons being awarded the PhD degree at the Faculty of Science during the period 1997-2006. The report can be obtained from [felicia.markus@science.su.se](mailto:felicia.markus@science.su.se)

## Welcome day for PhD students

A welcome day will be held on 22 October 2008 for new PhD students at the Faculty of Science. The Dean Stefan Nordlund and the Deans of the Sections will welcome the new students to the faculty.

## Naturens Hus nominated for the Swedish National Encyclopaedia's Knowledge Award 2008

Naturens Hus ("The House of Nature") is a sub-department of Vetenskapens hus ("The House of Science") and offers teaching in the bio- and environmental sciences in the Bergius Botanic Garden. Naturens Hus is one of three nominated for the Swedish National Encyclopaedia's Knowledge Award 2008 within the public sector category. More information on the award and Naturens Hus can be found at [www.kunskapspriset.se](http://www.kunskapspriset.se) and [www.bergianska.se](http://www.bergianska.se)

## Successful start for new LHC particle accelerator

The morning of 10 September saw the start-up of the gigantic LHC (Large Hadron Collider) particle accelerator at the CERN facility in Switzerland. The facility is the world's largest laboratory for high energy physics. A number of scientists at Stockholm University have key roles within this international research project.

## Respiration Day 23 October

Staff in the faculty will be welcomed to Respiration Day – a day for strategic thinking concerning student recruitment at the Faculty of Science. The date for this is 23 October, when we will start with lunch at AlbaNova. More information can be found at [www.science.su.se](http://www.science.su.se)

## New staff at the Faculty Office

Since the spring, Mikael Stenberg has been working on employment issues and senior lecturer matters. Information Officer Per Nordström started on 11 August and is working on student recruitment and as web editor. Sven Widerberg is the faculty's new controller and will take up his position on 6 October. During the autumn, Monika Stolarska will work on the follow-up of finance and basic training, among other things. We would like to extend a warm welcome to the new staff at the Faculty Office!



## Registration for the Science Seminar Series

Students must now register for the mandatory Science Seminar Series on the faculty's website, [www.science.su.se](http://www.science.su.se).