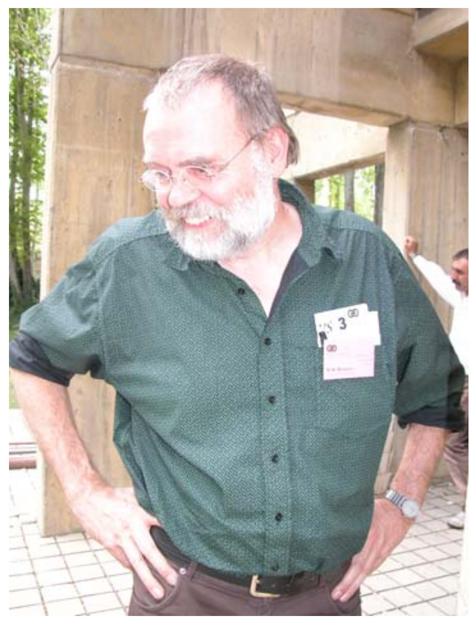
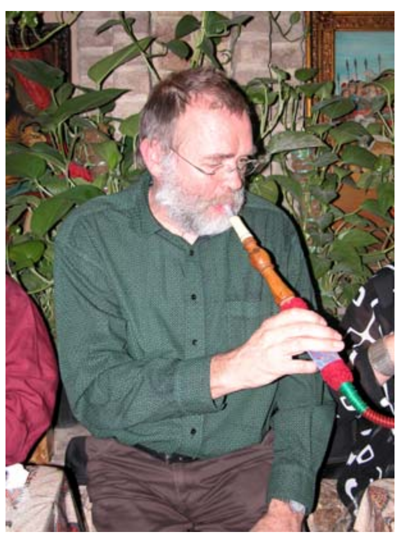
IPM
Institute for Studies in Theoretical Physics and Mathematics
DAILY NEWS
Sunday, April 22, 2007, Second Issue

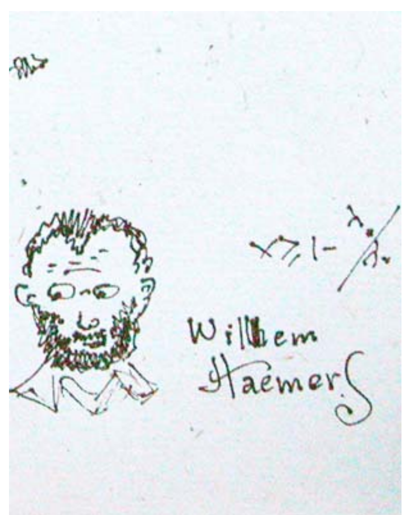
A Champion ☺

Willem Haemers is the only combinatorialist that has participated in all three Combinatorics Workshops of IPM.

Some Reminiscences of Willem:







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Poincare' Conjecture

At the University of Wisconsin in Madison we were treated recently with a lecture by Professor Gang Tian of Princeton University on the biggest recent news in mathematics, namely the ***Proof of the Poincare' Conjecture***.

The lecture started out with the quote ``Solving good problems have played a significant role in mathematical research." This is true, in particular, in combinatorics and graph theory e.g. the 4-color conjecture, the perfect graph conjecture, Euler's conjecture on orthogonal latin squares, and existence of t-designs, come to mind. Tian went on to say that Hilbert's 23 problems posed at the ICM in Paris in 1900 played a crucial role in 20th century mathematics. He described how problems become more famous as they resist more and more difficult attempts at solution (think of the 4 color conjecture and the perfect graph conjecture) and how they are used as standards for testing new ideas. In the tradition of Hilbert, in 2000 the Clay Mathematics Institute identified 7 important and central problems of mathematics and offered $1 million for the solution of each of them; one of these problems is the Poincare' conjecture.

The conjecture known as the Poincare' conjecture was proposed by Poincare' in 1904 and concerned a characterization of the simplest of all 3-dimensional shapes, the 3-dimensional sphere. It asserts (informally) that a 3-dimensional space with the property that every closed curve in it can be shrunk to a point is topologically equivalent to a 3-dimensional sphere.

Just as the 2-dimensional sphere (the boundary of a ball) is obtained by taking the union of two disks and gluing them together at their boundaries (1-dimensional spheres), the 3-dimensional sphere is obtained by taking the union of two balls and gluing them together at their boundaries (2-dimensional spheres). This can't be done in 3 dimensions and the 3-dimensional sphere lives in 4-dimensional space. The Poincare' conjecture was attacked by direct topological means for 100 years without much success.

According to Tian, in the final analysis all topological attacks on the Poincare's conjecture involve trying to show that the 3-dimensional shape in question is obtained by gluing together two 3-dimensional balls in this way.

Attempts to solve the Poincare' conjecture led to many advances in the study of other 3-dimensional spaces but not the sphere. It was generalized by Stephen Smale in 1960 to all dimensions and solved by him in dimensions at least 5. Tian then went on to describe a remarkable sequence of events all of which led to a Fields Medal. First Smale got a Fields Medal for his work.

John Milnor in 1956 provided a counterexample of a closely related problem in dimension at least 7 (Fields medal); Michael Freedman solved the analogue of the Poincare' conjecture in 1982 (Fields Medal); in 1982 Simon Donaldson solved a related problem in dimension 4 (Fields Medal); around 1980 Bill Thurston generalized the Poincare' conjecture to a conjecture about all 3-dimensional spaces--the geometrization conjecture (Fields Medal); in 2003 G. Perelman solved the Poincare's conjecture (Fields Medal but he declined to accept it).

The methods used by Perelman were those not of topology but of differential geometry and differential equations, more precisely the Ricci flow for Riemannian metrics. Perelman's insight was how to deal with singularities arising in the Ricci flow and then continuing the flow for all time. In 2002-03 Perelman posted 3 preprints which sketched a proof of Thurston's geometrization conjecture. In April of 2003 he visited MIT and gave 20 one-hour lectures explaining his proof. Now, as a service to the mathematical community, John Morgan, also of Princeton University, and Gang Tian have written a book whose goal was to make the proof of the Poincare' conjecture more accessible.

Richard A. Brualdi

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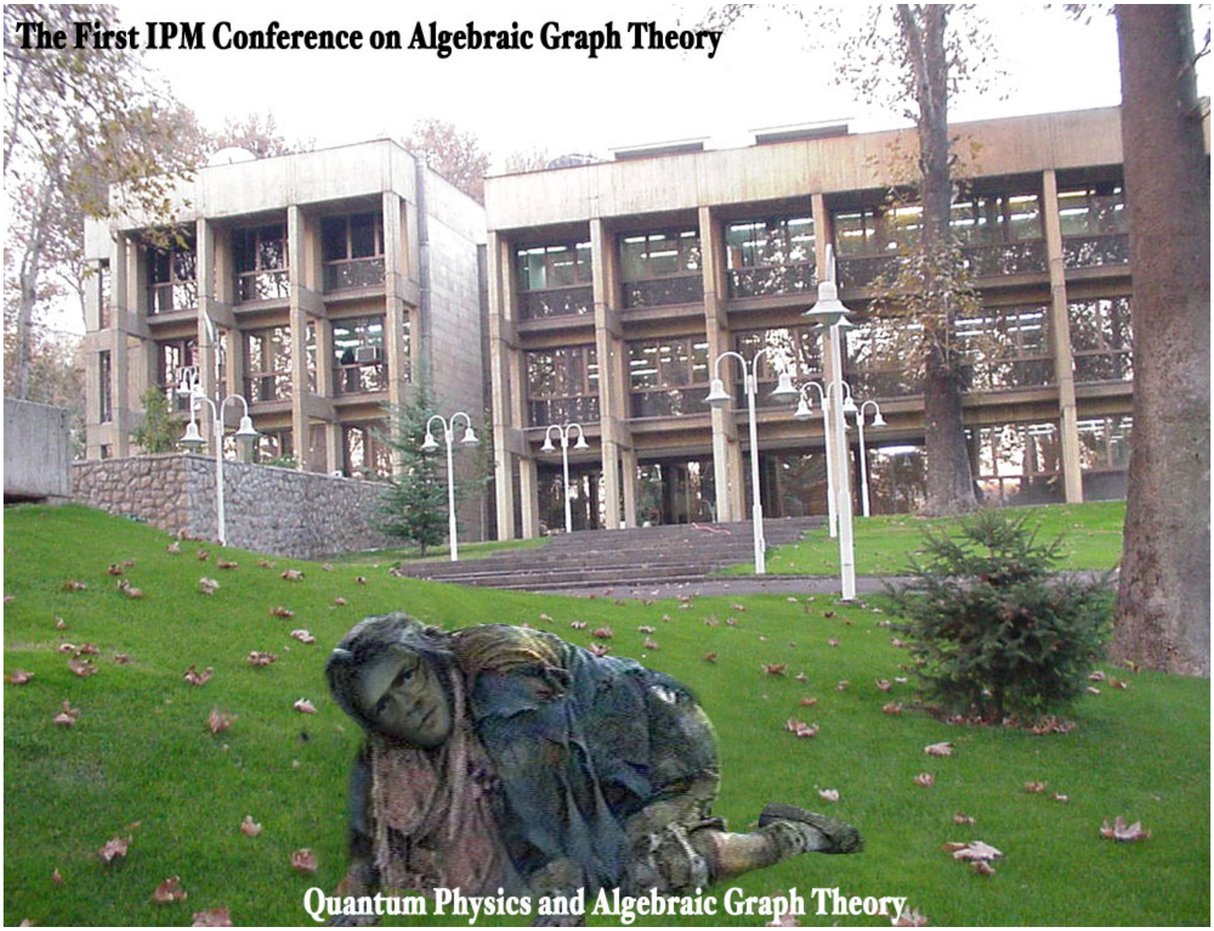

Daily Program

9:00-10:00	10:00-10:30	10:30-11:00	11:00-12:00	12:00-14:00
R. Brualdi (1)	A. Rahnamai Barghi	Coffee Break	Ch. Godsil (1)	 Lunch
14:00-14:30	14:30-15:00	15:00-15:30	15:30-16:30	16:30-17:00
D. Kiani	M. Mohammad-Noori	Coffee Break	E. Konstantinova	F. Ramezani

Chairman of the morning session: Peter Rowlinson
Chairman of the afternoon session: Jack Koolen

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Two E-mails to read

- Dear Sam

  I am at the IPM in Tehran for the Algebraic Graph Theory Conference. I was delighted to see that Reza dedicated this conference to you on the occasion of your 70th birthday. Congratulations! I only wish that you were here too. As usual the conference organization is super, and the people here are wonderful. And the weather couldn't be better.

  Best wishes

  Richard

- Dear Richard,

  Thanks for the email. I am glad that you are enjoying the visit at IPM. Reza has been and has always been kind to me and I am sorry that I could not be there to attend the conference and see you all there. A big loss for me.

  As actor John Barrymore said: "A man is not old until regrets take the place of dreams "

  Regards,

  -Sam

  S. Hedayat

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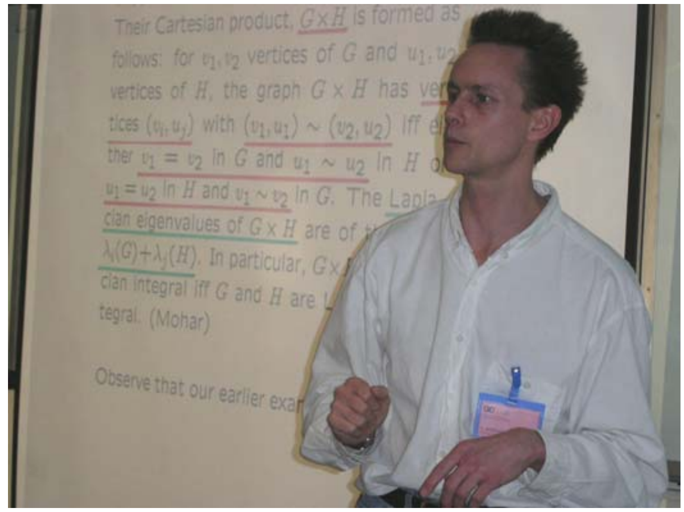
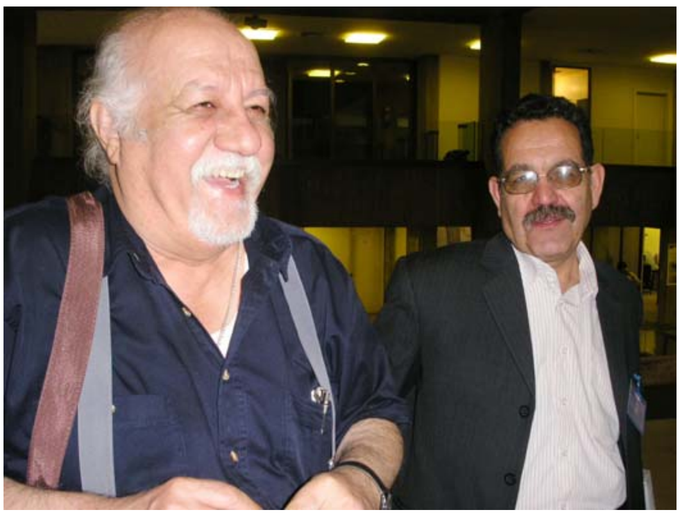


Their Cartesian product, G×H is formed as
follows: for v1, v2 vertices of G and u1, u2
vertices of H, the graph G × H has ve
tices (vi, uj) with (v1, u1) ~ (v2, u2) iff ei
ther v1 = v2 in G and u1 ~ u2 in H o
u1 = u2 in H and v1 ~ v2 in G. The Lapla
cian eigenvalues of G × H are of t
λi(G)+λj(H). In particular, G×
cian integral iff G and H are L
tegral. (Mohar)
Observe that our earlier exa



f = hom(.,H) with |V(H)| ≤ c
⇔
∀k : M(f,k) is positive semidefinite
and has rank ≤ c^k
edman - L - Schrijver
Enough to assume
M(f,0) has rank 1
M(f,2) has finite ra