INFOMAT

September 2006

Kjære leser!

Da er vi i gang med høstsemesteret og nye studentkull strømmer til våre universiteter og høgskoler. La oss håpe at mange finner veien til realfagsstudiene og at de blir der. Norge er i ferd med å få et kraftig underskudd på realister. Ikke bare er det mangel på gode realfagslærere rundt omkring i landet, men industrien gir mer og mer uttrykk for at den ikke finner den nødvendige realfagskompetansen i Norge. Det er absolutt på sin plass å minne om at denne utviklingen ikke kommer som noen overraskelse, den er snarere beskrevet i detalj i fagmiljøene allerede for 10 år siden. Den politiske viljen til virkelig å gjøre noe med det har imidlertid ikke vært til stede.

I sommer ble den internasjonale matematikerkongressen avviklet i Madrid. Som kjent samles kongressen bare hvert 4. år, med India som neste vertsnasjon. Høydepunktet på kongressen er utdelingen av IMUs priser, med Fields-medaljen som den det er knyttet størst spenning til. Les mer om det i dette nummeret av INFOMAT.

hilsen Arne B.

PERELMAN ”DECLINED TO ACCEPT”

Det som vakte mest oppsikt under Den Internasjonale Matematikerkongressen i Madrid var utvilsomt Fields-medalje-vinner Grigory Perelmans fravær. Hans bevis for Poincaré-formodningen er nå i ferd med å bli universelt akseptert og siden Perelman akkurat klarer aldersgrensa på 40 år, var han en selvskreven kandidat. Men så ville han altså ikke motta medaljen, uansett hvor mye presidenten i IMU, Sir John Ball prøvde å overtale han til å komme. Vi registrerer hans beslutning og regner med at han har gode grunner for sitt valg. Han vil uansett for alltid bli stående som den som beviste formodningen. Men i dette ”sirkus Perelman” må vi ikke glemme de tre andre Fields-medaljistene og vinneren av Nevanlinna-prisen. På bildet over er de avbildet sammen med Kong Juan Carlos som sto for den offisielle overrekkelsen. Wendelin Werner, Terence Tao, Andrei Okounkov og Jon Kleinberg er alle fremragende matematikere som på alle måter fortjener sine medaljer. INFOMAT bringer i dette nummeret presentasjoner av arbeidene til to av prisvinnerene, Grigory Perelman og Andrei Okounkov. Presentasjonene har vi lånt fra IMU og burde være tilgjengelige for et bredt publikum. Presentasjoner av de andre vinnerene kommer i neste nummer.

INFOMAT kommer ut med 11 nummer i året og gis ut av Norsk Matematisk Forening. Deadline for september-utgaven er 10. oktober kl. 2400. Stoff til INFOMAT sendes til

infomat at math.ntnu.no

Foreningen har hjemmeside http://www.matematikkforeningen.no/INFOMAT
Ansvarlig redaktør er Arne B. Sletsjøe, Universitetet i Oslo.

NYTT FRA INSTITUTTENE

Nye doktorgrader:
Mats Molberg disputerte 2. juni. Hans avhandling har tittelen *Etale equivalence relations and free group actions on zero-dimensional spaces.*

Sivilingeniør **Håvard Berland** disputerte 14. september med avhandlingen *Lie Group and Exponential Integrators: Theory, Implementation, and Applications.*

Nyansettelser:
David Cohen, Geneve, Sveits, ansettes som postdoc for ett år på EU-prosjektet GALA fra 1. oktober.

Utmerkelser:
BIT-prisen for 2006 er tildelt førsteamanuensis **Espen Robstad Jakobsen**. Prisen deles ut til yngre nordiske forskere for beste artikkel i journalen *BIT Numerical Mathematics.*

Utnevnelser:
Professor **Helge Holden**, som nå er sekretær i European Mathematical Society (EMS), vil fra 1. januar 2007 være visepresident i EMS.

Nyansettelser:
Odin Gramstad og **Andrea Hoffman** er ansatt som stipendiater fra 1. august, Odin i mekanikk og Andrea i algebraisk geometri.

Opptakstall:
Antall nye mastergradsstudenter tatt opp i høst er 34 fordelt med 21 på *Anvendt matematikk, mekanikk og numerisk fysikk*, 6 på *Matematikk* og 7 på *Modellering og dataanalyse.*

Nye sentermedlemmer:
Stipendiat **Peter Rippis** er ansatt fra 6. september, tilknyttet Snorre Christiansens EURYI-prosjekt.

Utlysninger:
Senteret har 1-2 postdocstillinger ledige og utlyst for tiden. Søknadsfrist er 29.september, se www.cma.uio.no

Langtidsgjester:
4.9 - 28.2(07): **Boris Andreianov**, Universite de Franche-Comte, Besancon, France
1.9 - 31.10: **Carl Lindberg**, Chalmers University, Gøteborg, Sweden
14.8 - 25.9: Professor ***Michael Taksar,*** University of Missouri, USA
1.8 - 31.10: PhD-student **Christina Erlwein**, Brunel University West London, UK
1.6 - 31.12: Professor **Tarmo Soomere**, CENS, Estonia

Arrangementer:
29. september: Matematikk & økonomidagen
4-5. oktober: Nordisk PhD-skole i stokastisk analyse / matematisk finans.

Ledig stilling:
Ledig førsteamanuensis-stilling, søknadsfrist 30. september. (*http://www.mi.uib.no/adm/stillinger/*)
Med denne stillingen ønsker instituttet å styrke sin forskningsaktivitet og veilederkapasitet, primært innen algebra/algebraisk geometri eller algebraisk topologi. Det er en fordel om søkernes forskning passer sammen med den eksisterende virksomheten ved instituttet innen disse feltene.

(Illustrasjon til Nettavisens artikkel om mangelen på realister i Norge.)
Foto: Scanpix

Matematisk kalender

2006
September:
18.-20. Etterutdanningskonferanse for lærere som underviser matematikk i lærerutdanningen, Dømmesmoen, HiA
28.-30. Årsmøte, Norsk Matematikkråd, Stavanger
29. Matematikk & økonomi-dagen, CMA, Oslo
Oktober:
4.-5. Nordisk PhD-skole i stokastisk analyse/ matematisk finans, CMA, Oslo
2007
Januar:
4.-7. Ski og Matematikk
Mai:
22. Abelpris-utdeling
August:
5.-10. Abelsymposiet, Oslo
2009
Juni:
8.-11. Den Nordiske Matematikerkonferansen, Oslo

ETTERUTDANNINGSKONFERANSE FOR MATEMATIKKLÆRERUTDANNERE, 18.–20. september 2006

HiA vil ta opp igjen tradisjonen med en "årlige" etterutdanningskonferanse for matematikklærerutdannere. Konferansen vil bli holdt på Dømmesmoen ved Grimstad fra 18. til 20. september, arrangert av HiA og HiT i fellesskap. To av hovedtemaene for konferansen vil være begynneropplæring og matematikkvansker.

ÅRSMØTE I NORSK MATEMATIKKRÅD, 28.-30.september 2006

Norsk Matematikkråd avholder årsmøte i Stavanger 28.-30. september 2006. På programmet står vanlige årsmøtesaker, som vedtektsendringer, arbeidsprogram, etc. I tillegg blir det mer faglige/ fagpolitiske innlegg:
Kristian Seip: Lennart Carleson, vinner av Abelprisen 2006
Anne-Berit Fuglestad: Hva er digital kompetanse?
Jan Terje Kvaløy: TBA (om overgang fra høgskole til universitet ved UiS)
Svein H. Torkildsen: En modell for tidevann
Harald Solbakken: Symbolregnende kalkulatorer i videregående skole.

INFOMAT vil i neste nummer gi en litt bredere presentasjon av Norsk Matematikkråd.

CMA-WORKSHOP, 29. september 2006

Den 13. Workshop i Matematikk og Økonomi holdes på CMA, Oslo 29. september. Årets tema er *Mathematical Finance and Insurance.*

KONFERANSEN FOR MATEMATIKKSTUDENTER I NORGE (KoMiN), 3.-5. november 2006

Den første konferansen for stipendiater og studenter i matematikk fra hele Norge avholdes ved NTNU 3.-5. november 2006. Konferansen vil bestå av foredrag fra alle grener av matematikk og en bedriftspresentasjon.

SKI OG MATEMATIKK 2007, 4.–7. januar 2007

Det årvisse arangementet *Ski og Matematikk* vil gå av stabelen på Rondablikk Høyfjellshotell 4/1 – 7/1 2007.
Priser:

Pr.person/enkeltrom	KR. 2.350:-
Pr.person/dobbeltrom .(deltager)	KR. 2.050:-
Pris for samboer/ektefelle	KR. 1.560:-
Pr.barn under 15 år / x-seng	KR. 250:-

Påmelding til Dag Normann via e-post
dnormann@math.uio.no
Det vil etterhvert bli opprettet en hjemmeside med program og deltagerliste.

NOTISER

KONFERANSEN FOR MATEMATIKKSTUDENTER I NORGE (KoMiN)

NTNU, Trondheim, 3.-5. november 2006
Linjeforeningen Nabla, sammen med noen studenter og stipendiater har tatt initativ til å starte opp en årlig konferanse for matematikkstudenter i Norge. Første konferansen vil bli holdt ved NTNU i Trondheim helgen 3.-5. november i år. Målgruppen for konferansen er stipendiater og studenter i matematikk fra hele Norge. Vi håper med dette å knytte kontakter på tvers av universitetene og presentere spennende matematikk. Konferansen vil bestå av foredrag fra alle grener av matematikk og en bedriftspresentasjon. Det vil legges stor vekt på det sosiale. Fullstendig program vil være ferdig i løpet av september, og sendes da ut til de matematiske institutt rundt om i Norge.
Ta gjerne kontakt med stipendiat Marte Hatlo dersom dere ønsker mer informasjon: *hatlo@math.ntnu.no*.

STJERNØ-UTVALGET HAR STARTET SITT ARBEID

I disse dager starter Stjernø-utvalget (Utvalg for høyere utdanning) sitt arbeid. De skal ha ferdig sin innstilling innen 31. desember 2007. Muligens vil dette så danne grunnlag for en Stortingsmelding og senere vedtak. Hvis en ønsker å være med å utforme punktene utvalget skal arbeide med er det beste å forsøke å få inn synspunktene under denne prosessen, og ikke etter at meldingen er skrevet.
Utvalget: http://odin.dep.no/kd/norsk/aktuelt/nyheter/070021-210049/dok-bn.html , Mandat: http://odin.dep.no/filarkiv/281792/Utvalg_for_hoyere_utdanning_mandat.pdf

INSTITUT MITTAG-LEFFLER 2009/2010

"Calls for proposal" for året 2009/2010 er nå tilgjengelig på *http://www.mittag-leffler.se proposals.html*
Institut Mittag-Leffler feirer 90-års jubileum i år. Dagen markeres med et mini-symposium 9-10. november, se *http://www.mittag-leffler.se/program/90years/*

NY LOGO FOR IMU

The International Mathematical Union has adopted the new logo above, as announced on 22 August 2006 at the opening ceremony of the International Congress of Mathematicians in Madrid. It was the winner of an international competition announced by the IMU in 2004.The logo was designed by John Sullivan, Professor of Mathematical Visualization at the Technical University of Berlin.

The logo design is based on the Borromean rings, a famous topological link of three components. The rings have the surprising property that if any one component is removed, the other two can fall apart (while all three together remain linked). This so-called Brunnian property has led the rings to be used over many centuries in many cultures as a symbol of interconnectedness, or of strength in unity. Although the Borromean rings are most often drawn as if made from three round circles, such a construction is mathematically impossible. The IMU logo instead uses the tight shape of the Borromean rings, as would be obtained by tying them in rope pulled as tight as possible. Mathematically, this is the length-minimizing configuration of the link subject to the constraint that unit-diameter tubes around the three components stay disjoint. This problem and its solution are described in the paper Criticality for the Gehring Link Problem by J.Cantarella, J.Fu, R.Kusner, J.Sullivan, N.Wrinkle, to appear in Geometry and Topology, 2006, and available at arXiv.org/math/0402212.

Merk likheten med NMFs logo! (red. anmerkning)

GENERALFORSAMLING I IMU

Helge Holden, NTNU

Generalforsamlingen i den internasjonale matematikkunionen (IMU) ble avholdt i Santiago de Compostela weekenden før den internasjonale matematikerkongressen i Madrid. Den norske delegasjonen bestod av Erling Størmer (UiO) og Helge Holden (NTNU). I tillegg var Ragni Piene (UiO) tilstede som medlem av styret i IMU.

IMU er det høyeste organet for matematikk globalt, men har kanskje noe overraskende ikke mer enn 67 medlemsland, mens f.eks. FN og Det internasjonale fri-idrettsforbundet hver har rundt 200. Av europeiske land er de fleste land naturlig nok med, men f.eks. ikke Albania. I Afrika er det mange land som ikke er med. Medlemsskap er delt opp i grupper, og enkelt sagt er det slik at jo mer man betaler, jo flere delegater får man. Norge befinner seg i gruppe II, sammen med bl.a. Danmark og Finland, mens f.eks. Sverige og Sveits er i gruppe IV. USA, UK, Russland, Kina, Israel, Frankrike, Canada, Tyskland, Italia og Japan er i den høyeste gruppen, gruppe V. Medlemsskap i IMU er organisert gjennom nasjonale tilslutningsorganisasjoner. I Norge er det Det Norske Videnskaps-Akademiet, som igjen har etablert en Nasjonalkomité for matematikk.

Med generalforsamling bare hvert fjerde år blir det naturlig nok mange forutsigbare og kanskje ikke så spennende saker på sakskartet, med rapporter fra ulike komitéer for aktivitene siden forrige generalforsamling. Men IMU fyller flere viktige funksjoner. Mest synlig er kanskje bestemmelse av plassering av ICM'er. Det ble bestemt at den neste ICM i 2010 skal være i Hyderabad i India. Videre gjør IMU et viktig arbeid for å styrke matematikkens stilling i utviklingsland.

Det var også valg til styreverv i IMU. Som ny president etter Sir John Ball ble László Lovász (fra Budapest, Ungarn og Microsoft Research, Seattle, USA), og som tidligere har sittet i Abelkomitéen, valgt. Videre ble Z.-M. Ma (Kina) og Claudio Procesi (Italia; medlem av Abelkomitéen) valgt som visepresidenter, og Martin Grötschel (Berlin) valgt som ny sekretær. Gledelig for Norge ble Ragni Piene gjenvalgt som styremedlem, og IMU planlegger å legge et styremøte i Oslo i forbindelse med Abelfeiringen i 2007. Forøvrig ble den første vinneren av Ramanujanprisen (som er støttet fra Abelfondet), brasilianeren Marcelo Viana, også innvalgt i styret.

For meg er noe av det viktigste IMU gjør for tiden, anstrengelsene for å etablere et *World Digital Mathematical Library.* Som jeg har beskrevet i INFOMAT tidligere er visjonen om å ha all matematisk litteratur fra Euklid til Perelman tilgjengelig på din datamaskin absolutt teknisk og finansielt realiserbart. Men det krever koordinert innsats, bestemmelse av standarder for digitalisering osv. Det største hinderet er copyrightproblematikken. IMU arbeider, som the European Mathematical Society, aktivt for å realisere denne visjonen, og det er godt håp at vi skal nærmere oss målet, iallfall asymptotisk.

IMU har etablert *The Electronic World Directory of Mathematicians* som erstatning for den trykte versjonen som eksisterte før. Alle matematikere oppfordres til å registrere seg der. Gjør det du også! Det gjøres lett fra web-siden *www.mathunion.org/ewdm*.

Abelprisen har gitt Norge mye oppmerksomhet og en god posisjonering internasjonalt. Med den gode utviklingen norsk matematikk er inni, burde Norge, kanskje sammen med Danmark og Finland, søke om å bli plassert i gruppe III; en ting å tenke på før den neste generalforsamling i 2010 i India.

FIELDS-MEDALJEVINNER GRIGORY PERELMAN

"For his contributions to geometry and his revolutionary insights into the analytical and geometric structure of the Ricci flow"

The name of Grigory Perelman is practically a household word among the scientifically interested public. His work from 2002-2003 brought groundbreaking insights into the study of evolution equations and their singularities. Most significantly, his results provide a way of resolving two outstanding problems in topology: the Poincaré Conjecture and the Thurston Geometrization Conjecture. As of the summer of 2006, the mathematical community is still in the process of checking his work to ensure that it is entirely correct and that the conjectures have been proved. After more than three years of intense scrutiny, top experts have encountered no serious problems in the work.

For decades the Poincaré Conjecture has been considered one of the most important problems in mathematics. The conjecture received increased attention from the general public when it was named as one of the seven Millennium Prize Problems established by the Clay Mathematics Institute in 2000. The institute has pledged to award a prize of one-million US dollars for the solution of each problem. The work of Perelman on the Poincaré Conjecture is the first serious contender for one of these prizes.

The Poincaré Conjecture arises in topology, which studies fundamental properties of shapes that remain unchanged when the shapes are deformed---that is, stretched, warped, or molded, but not torn. A simple example of such a shape is the 2-sphere, which is the 2-dimensional surface of a ball in 3-dimensional space. Another way to visualize the 2-sphere is to take a disk lying in the 2-dimensional plane and identify the disk's boundary points to a single point; this point can be thought of as the north pole of the 2-sphere. Although globally the 2-sphere looks very different from the plane, every point on the sphere sits in a region that looks like the plane. This property of looking locally like the plane is the defining property of a 2- dimensional manifold, or 2-manifold. Another example of a 2-manifold is the "torus", which is the surface of a doughnut. Although locally the 2-sphere and the torus look the same, globally their topologies are distinct: Without tearing a hole in the 2-sphere, there is no way to deform it into the torus. Here is another way of seeing this distinction. Consider a loop lying on the 2-sphere. No matter where it is situated on the 2-sphere, the loop can be shrunk down to a point, with the shrinking done entirely within the sphere. Now imagine a loop lying on the torus: If the loop goes around the hole, the loop cannot be shrunk to a point. If loops can be shrunk to a point in a manifold, the manifold is called "simply connected". The 2-sphere is simply connected, while the torus is not. The analogue of the Poincaré Conjecture in 2 dimensions would be the assertion that any simply connected 2-manifold of finite size can be deformed into the 2-sphere, and this assertion is correct.

Henri Poincaré.

It is natural then to ask, What can be said about non-simply-connected 2-manifolds? It turns out that they can all be classified according to the number of holes: They are all deformations of the torus, or of the double-torus (with 2 holes), or of the triple torus (the surface of a pretzel), etc. (One actually needs two other technical assumptions in this discussion, compactness and orientability.) Geometry offers another way of classifying 2-manifolds. When one views manifolds topologically, there is no notion of measured distance. Endowing a manifold with a metric provides a way of measuring distance between points in the manifold and leads to the geometric notion of curvature. 2-manifolds can be classified by their geometry: A 2-manifold with positive curvature can be deformed into a 2-sphere; one with zero curvature can be deformed into a torus; and one with negative curvature can be deformed into a torus with more than one hole.

The Poincaré Conjecture, which originated with the French mathematician Henri Poincaré in 1904, concerns 3-dimensional manifolds, or 3-manifolds. A basic example of a 3-manifold is the 3-sphere: In analogy with the 2-sphere, one obtains the 3-sphere by taking a ball in 3-dimensions and identifying its boundary points to a single point. (Just as 3-dimensional space is the most natural home for the 2-sphere, the most natural home for the 3-sphere is 4-dimensional space---which of course is harder to visualize.) Can every simply connected 3-manifold be deformed into the 3-sphere? The Poincaré Conjecture asserts that the answer to this question is yes. Just as with 2- manifolds, one could also hope for a classification of 3-manifolds. In the 1970s, Fields Medalist William Thurston made a new conjecture, which came to be called the Thurston Geometrization Conjecture and which gives a way to classify all 3-manifolds. The Thurston Geometrization Conjecture provides a sweeping vision of 3-manifolds and actually includes the Poincaré Conjecture as a special case. Thurston proposed that, in a way analogous to the case of 2-manifolds, 3-manifolds can be classified using geometry. But the analogy does not extend very far: 3-manifolds are much more diverse and complex than 2-manifolds. Thurston identified and analyzed 8 geometric structures and conjectured that they provide a means for classifying 3-manifolds. His work revolutionized the study of geometry and topology. The 8 geometric structures were intensively investigated, and the Geometrization Conjecture was verified in many cases; Thurston himself proved it for a large class of manifolds. But hopes for a proof of the conjecture in full generality remained unfulfilled.

In 1982, Richard Hamilton identified a particular evolution equation, which he called the Ricci flow, as the key to resolving the Poincaré and Thurston Geometrization Conjectures. The Ricci flow is similar to the heat equation, which describes how heat flows from the hot part of an object to the cold part, eventually homogenizing the temperature to be uniform throughout the object. Hamilton's idea was to use the Ricci flow to homogenize the geometry of 3-manifolds to show that their geometry fits into Thurston's classification. Over more than twenty years, Hamilton and other geometric analysts made great progress in understanding the Ricci flow. But they were stymied in figuring out how to handle "singularities", which are regions where the geometry, instead of getting homogenized, suddenly exhibits uncontrolled changes.

That was where things stood when Perelman's work burst onto the scene. In a series of papers posted on a preprint archive starting in late 2002, Perelman established ground-breaking results about the Ricci flow and its singularities. He provided new ways of analyzing the structure of the singularities and showed how they relate to the topology of the manifolds. Perelman broke the impasse in the program that Hamilton had established and validated the vision of using the Ricci flow to prove the Poincaré and Thurston Geometrization Conjectures. Although Perelman's work appears to provide a definitive endpoint in proving the conjectures, his contributions do not stop there. The techniques Perelman introduced for handling singularities in the Ricci flow have generated great excitement in geometric analysis and are beginning to be deployed to solve other problems in that area. Perelman's combination of deep insights and technical brilliance mark him as an outstanding mathematician. In illuminating a path towards answering two fundamental questions in 3-dimensional topology, he has had a profound impact on mathematics.

BIOGRAPHICAL SKETCH

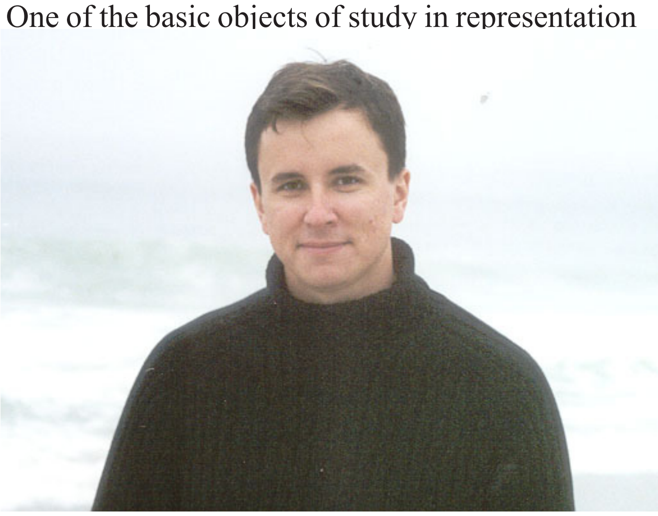
Grigory Perelman was born in 1966 in what was then the Soviet Union. He received his doctorate from St. Petersburg State University. During the 1990s he spent time in the United States, including as a Miller Fellow at the University of California, Berkeley. He was for some years a researcher in the St. Petersburg Department of the Steklov Institute of Mathematics. In 1994, he was an invited speaker at the International Congress of Mathematicians in Zurich.

FIELDS-MEDALJEVINNER ANDREI OKOUNKOV

”*For his contributions bridging probability, representation theory and algebraic geometry*”

The work of Andrei Okounkov has revealed profound new connections between different areas of mathematics and has brought new insights into problems arising in physics. Although his work is difficult to classify because it touches on such a variety of areas, two clear themes are the use of notions of randomness and of classical ideas from representation theory. This combination has proven powerful in attacking problems from algebraic geometry and statistical mechanics.

One of the basic objects of study in representation



theory is the ”symmetric group”, whose elements are permutations of objects. For example, if the objects are the letters {C, G, J, M, N, O, Q, Z}, then a permutation is an ordering of the letters, such as GOQZMNJC or JZOQCGNM. The number of possible permutations grows quickly as the number of objects grows; for 8 objects, there are already 40,320 different permutations. If we consider an abstract set of n objects, then the ”symmetric group on n letters” is the collection of all the different permutations of those n objects, together with rules for combining the permutations. Representation theory allows one to study the symmetric group by representing it by other mathematical objects that provide insights into the group's salient features. The representation theory of the symmetric group is a well developed subfield that has important uses within mathematics itself and also in other scientific areas, such as quantum mechanics. It turns out that, for the symmetric group on n letters, the building blocks for all of its representations are indexed by the ”partitions” of n. A partition of a number n is just a sequence of positive numbers that add up to n; for example 2 + 3 + 3 +4 + 12 is a partition of 24. Through the language of partitions, representation theory connects to another branch of mathematics called ”combinatorics”, which is the study of objects that have discrete, distinct parts. Many continuous phenomena in mathematics are related by virtue of having a common discrete substructure, which then raises combinatorial questions. Continuous phenomena can also be discretized, making them amenable to the methods of combinatorics. Partitions are among the most basic combinatorial objects, and their study goes back at least to the 18th century. Randomness enters into combinatorics when one considers very large combinatorial objects, such as the set of all partitions of a very large number. If one thinks of partitioning a number as randomly cutting it up into smaller numbers, one can ask, What is the probability of obtaining a particular partition? Questions of a similar nature arise in representation theory of large symmetric groups. Such links between probability and representation theory were considered by mathematicians in Russia during the 1970s and 1980s. The key to finding just the right tool from probability theory suited to this question derives from viewing partitions as representations of the symmetric group. A Russian who studied at Moscow State University, Andrei Okounkov absorbed this viewpoint and has deployed it with spectacular success to attack a wide range of problems. One of his early outstanding results concerns ”random matrices”, which have been extensively studied in physics. A random matrix is a square array of numbers in which each number is chosen at random. Each random matrix has associated with it a set of characteristic numbers called the ”eigenvalues” of the matrix. Starting in the 1950s, physicists studied the statistical properties of eigenvalues of random matrices to gain insight into the problem of the prediction and distribution of energy levels of nuclei. In recent years, random matrices have received renewed attention by mathematicians and physicists. Okounkov has used ideas from quantum field theory to prove a surprising connection between random matrices and increasing subsequences in permutations of numbers. An increasing subsequence is just what it sounds like: For example, in a permutation of the numbers from 1 up to 8, say 71452638, two increasing subsequences are 14568 and 1238. There is a way to arrange these increasing subsequences into a hierarchy: the longest subsequence, followed by the second-longest, the third-longest, and so forth, down to the shortest. Okounkov proved that, for very large n, the sequence of largest eigenvalues of an n-by-n random matrix behaves, from the probabilistic point of view, in the same way as the lengths of the longest increasing subsequences in permutations of the numbers from 1 to n. In his proof, Okounkov took a strikingly original approach by reformulating the question in a completely different context, namely, as a comparison of two different descriptions of a random surface. This work established a connection to algebraic geometry, providing a seed for some of his later work in that subject. Random surfaces also arise in Okounkov's work in statistical mechanics. If one heats, say, a cubical crystal from a low temperature, one finds that the corners of the cube are eaten away as the crystal "melts". The geometry of this melting process can be visualized by imagining a corner to consist of a bunch of tiny blocks. The melting of the crystal corresponds to removing blocks at random. Thinking of the partitioning of the crystal into tiny blocks as analogous to partitioning integers, Okounkov brought his signature methods to bear on the analysis of the random surfaces that arise. In joint work with Richard Kenyon, Okounkov proved the surprising result that the melted part of the crystal, when projected onto two dimensions, has a very distinctive shape and is always encircled by an algebraic curve---that is, a curve that can be defined by polynomial equations. The connection with real algebraic geometry is quite unexpected. Over the past several years, Okounkov has, together with Rahul Pandharipande and other collaborators, written a long series of papers on questions in enumerative algebraic geometry, an area with a long history that in recent years has been enriched by the exchange of ideas between mathematicians and physicists. A standard way of studying algebraic curves is to vary the coefficients in the polynomial equations that define the curves and then impose conditions---for example, that the curves pass through a specific collection of points. With too few conditions, the collection of curves remains infinite; with too many, the collection is empty. But with the right balance of conditions, one obtains a finite collection of curves. The problem of "counting curves" in this way---a longstanding problem in algebraic geometry that also arose in string theory---is the main concern of enumerative geometry. Okounkov and his collaborators have made substantial contributions to enumerative geometry, bringing in ideas from physics and deploying a wide range of tools from algebra, combinatorics, and geometry. Okounkov's ongoing research in this area represents a marvelous interplay of ideas from mathematics and physics.

Biographical Sketch:

Andrei Okounkov was born in 1969 in Moscow. He received his doctorate in mathematics from Moscow State University in 1995. He is a professor of mathematics at Princeton University. He has also held positions at the Russian Academy of Sciences, the Institute for Advanced Study in Princeton, the University of Chicago, and the University of California, Berkeley. His distinctions include a Sloan Research Fellowship (2000), a Packard Fellowship (2001), and the European Mathematical Society Prize (2004).