

## **Nobel Prize in Physics 2004**



**David J. Gross**



**H. David Politzer**



**Frank Wilczek**

The Nobel Prize in Physics 2004 was awarded jointly to David J. Gross, H. David Politzer and Frank Wilczek "for the discovery of asymptotic freedom in the theory of the strong interaction".

### **Information about winners:**

**David J. Gross**

Kavli Institute for Theoretical Physics, University of California, Santa Barbara, USA,

**H. David Politzer**

California Institute of Technology (Caltech), Pasadena, USA, and

**Frank Wilczek**

Massachusetts Institute of Technology (MIT), Cambridge, USA.

### **RESEARCH INFORMATION:**

#### **A 'colourful' discovery in the world of quarks**

What are the smallest building blocks in Nature? How do these particles build up everything we see around us? What forces act in Nature and how do they actually function?

**Call for research and Review articles publication: [ijsidonlineinfo@gmail.com](mailto:ijsidonlineinfo@gmail.com)**

This year's Nobel Prize in Physics deals with these fundamental questions, problems that occupied physicists throughout the 20th century and still challenge both theoreticians and experimentalists working at the major particle accelerators.

David Gross, David Politzer and Frank Wilczek have made an important theoretical discovery concerning the strong force, or the 'colour force' as it is also called. The strong force is the one that is dominant in the atomic nucleus, acting between the quarks inside the proton and the neutron. What this year's Laureates discovered was something that, at first sight, seemed completely contradictory. The interpretation of their mathematical result was that the closer the quarks are to each other, the *weaker* is the 'colour charge'. When the quarks are really close to each other, the force is so weak that they behave almost as free particles. This phenomenon is called "asymptotic freedom". The converse is true when the quarks move apart: the force becomes stronger when the distance increases. This property may be compared to a rubber band. The more the band is stretched, the stronger the force.

This discovery was expressed in 1973 in an elegant mathematical framework that led to a completely new theory, *Quantum Chromodynamics*, QCD. This theory was an important contribution to the Standard Model, the theory that describes all physics connected with the electromagnetic force (which acts between charged particles), the weak force (which is important for the sun's energy production) and the strong force (which acts between quarks). With the aid of QCD physicists can at last explain why quarks only behave as free particles at extremely high energies. In the proton and the neutron they always occur in triplets.

Thanks to their discovery, David Gross, David Politzer and Frank Wilczek have brought physics one step closer to fulfilling a grand dream, to formulate a unified theory comprising gravity as well – a theory for everything.

***For more details please visit:***

[http://www.nobelprize.org/nobel\\_prizes/physics/laureates/2004/popular.html](http://www.nobelprize.org/nobel_prizes/physics/laureates/2004/popular.html)

**Call for research and Review articles publication: [ijsidonlineinfo@gmail.com](mailto:ijsidonlineinfo@gmail.com)**