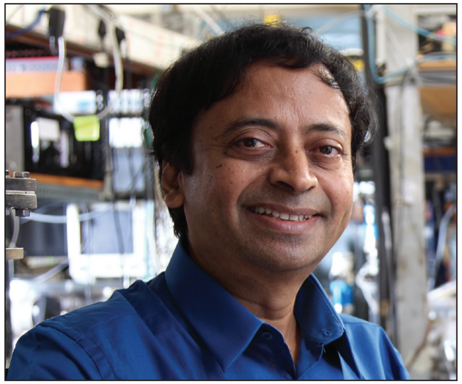


"Experimental science needs a lot of motivation, a can-do spirit, and passion. It needs a tremendous amount of patience and it needs an ability to interface with lots of things. And the biggest thing is persistence. If you don't do good experimental science, there is no good technology."

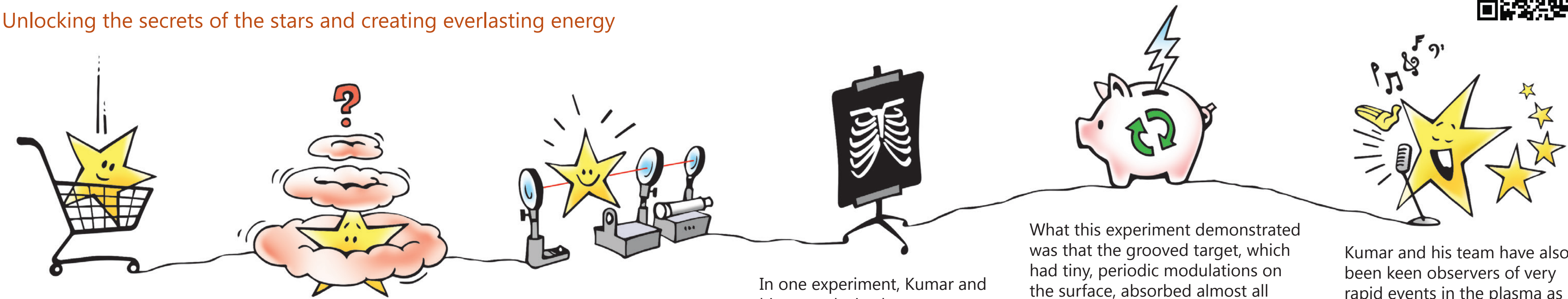
G. Ravindra Kumar

Senior Professor, Department of Nuclear and Atomic Physics, Tata Institute of Fundamental Research, Mumbai

- B.E. (Hons) in Mechanical Engineering from Birla Institute of Technology and Science, Pilani
- M.Sc. (Hons) in Physics from Birla Institute of Technology and Science, Pilani
- Ph.D. in Physics from Indian Institute of Technology, Kanpur

Prof. G. Ravindra Kumar is being recognized for his pioneering experimental contributions to the physics of high intensity laser matter interactions that probe matter at extreme densities and temperature. His results have significant implications for laboratory testing of astrophysical scenarios like supernova explosions and high energy particle production.

Unlocking the secrets of the stars and creating everlasting energy



Ever since the first laser was built in 1960 by Theodore H. Maiman, it has been used to spectacular effect in many fields. It has been used to create extreme temperatures, pressures and energy densities in the lab. Imagine we want to figure out what goes on inside a star; or witness what goes on inside a supernova explosion. Clearly we can't physically go anywhere near a star. So what's the next best thing? We bring the stars down to us! And unlocking the secrets of the stars could possibly lead to the discovery of a source of clean and everlasting energy.

These are the exciting mysteries that Prof. G. Ravindra Kumar and his coworkers are trying to find answers to, at UPHILL (Ultra-short Laser Pulse High Intensity Laser Laboratory), TIFR. While working towards a perpetual and clean energy source, Kumar has been figuring out fundamental physics that may explain what goes on during the turbulently spectacular births and deaths of stars.

Kumar works on these scientific questions using lasers and plasma. Plasma is the fourth state of matter and Kumar studies it at high energy densities that are created when ultra-short laser pulses interact with different types of targets. He and his team have created in their laboratory, conditions somewhat similar to those in stars. These are essentially hot, dense plasmas that in turn emit visible light, x-rays, gamma rays, electrons and highly charged ions.

In one experiment, Kumar and his team devised two targets. One was a gold-coated grating (grooved) target and the other a gold-coated smooth target. They hit these targets with ultra-short laser pulses which last as little a time as tens of a millionth of a billionth of a second. The light which was absorbed by these targets generated 'hot' electrons in the plasma and these in turn emitted hard x-rays. These electron and x-ray pulses could be applied in medical therapies and in the still evolving experiments on particle acceleration.

What this experiment demonstrated was that the grooved target, which had tiny, periodic modulations on the surface, absorbed almost all the laser energy unlike the smooth target which at best absorbed only half the energy, reflecting the other half. This enhanced absorption by the grating target provides a possible path to reduce energy wastage due to laser reflection in the process of laser fusion. This becomes especially crucial in the global quest for a clean and everlasting source of energy. Kumar's work has clearly established that tiny (nano and micro) wiggles and bumps on the surface are great enhancers of light coupling to the solid. The x-ray brilliance of a nanostructure aided plasma is enhanced manyfold, promoting applications in imaging, therapies and other technology.

Kumar and his team have also been keen observers of very rapid events in the plasma as they unfold. Recently, they used ultrashort laser pulses to 'see' into the magnetic field of the laser produced plasma and find an analogue to the way the Sun's magnetic field evolves into turbulence. This is now hailed as the first direct observation of such turbulence 'as it happens'. And their latest discovery (in 2015) showcases sound waves in the laser produced plasma which are a hundred million times shriller than the highest pitch audible to the human ear! They once again look to the heavens and posit that a supernova can possibly sing at such a pitch.