Until about two centuries ago, the only available artificial light sources were based on burning fuels like oil, wax, coal, gas or wood. While this provided some ways to live and move around during the night, it was not until the development of the electrically powered incandescent lamp that bright artificial light became available.

There has been very little improvement in the design and efficiency of these artificial light sources for a long time: Incandescent lamps are inherently inefficient, and convert only about 2% of the electrical power into visible light; the rest is lost as heat. Only in the 1930s, the first fluorescent tubes were developed, showing a much better efficiency and a much longer lifetime. The problem of their fragility and large size was partly solved in the 1980s by the development of compact fluorescent lamps. The latter could directly replace incandescent lamps while keeping the advantages of long lifetime and relatively high efficiency.

In the meantime, other light sources, some having a very high efficiency, became available, such as sodium lamps and mercury discharge lamps. These lamps are ubiquitous in street lighting, but are hardly useful indoors, since they have very bad color rendering properties. Light emitting diodes (LEDs), which were the first solid state light sources, were invented in 1927, but only in 1962, the first working LEDs were introduced. Even then, these were very inefficient, could only provide a single color, and were solely used for numerical displays and indicators.

Strangely enough, it has been the invention of efficient blue LEDs in 1994 - for which 3 Japanese scientists received the Nobel prize in physics in 2014 - which has led to a revolution in the lighting industry. LEDs are inherently monochromatic, but any short wavelength light, such as blue or violet, can be converted into the other visible colors green and red using luminescent materials.

After a brief historical introduction, this presentation will give an overview of the wavelength conversion process for blue LEDs. In addition, we will discuss the colors needed to make up nice white light and the maximum efficiency that can ultimately be obtained in such white LEDs.

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