

The French Blue diamond : how spectroscopy reveals an unsuspected masterpiece

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In December 2007, we discovered an unknown lead cast of the "French Blue" diamond, the largest known blue diamond known so far (69 carats), mined originally in India (as the "Tavernier Blue" diamond, weighing 115,4 carats). Alas, the diamond was stolen in 1792 and the diamond has never resurfaced. Also, no accurate drawings of that diamond were kept in royal inventories. Twenty years later, an oval dark blue diamond appears in London (only 45,5 carats). This diamond - now called "Hope" - will quickly be suspected to be the "French Blue" diamond recut to hide its identity. By comparing the recovered lead cast with the "Hope" confirms for the first time that the "Hope" is a modern avatar of the "French Blue".

The "French Blue" diamond could then be reconstructed in virtual reality based on (1) the mesh of the lead cast and (2) the optical spectroscopy spectrum measured on the "Hope" diamond, kindly provided by Jeffrey Post, curator at the SI. The Diamcalc software is able to display complex light effects involved in diamond, including reflection, refraction and light dispersion as a function of the refractive index. But, to test and validate this software, we first studied the "Hope" diamond. Using ab-initio methods, we assumed a supercell of 63 atoms of carbon arranged as in diamond in which one atom was replaced by boron and structurally and energetically relaxed. Using first principles, we computed thanks to the OCEAN package kindly provided by John R. Rehr and his Univ. of Washington team, ab-initio calculations of the optical absorption spectrum of a diamond structure doped with boron. The computed UV-VIS-NIR spectrum shows a transmission window into the blue region and high absorbance in the red-NIR region, confirming the steel-blue color origin of blue diamonds from India.

Based on that spectroscopic information, we then recreated virtually the "French Blue" diamond. The optical analysis of this diamond shows that the gem was in fact light sky blue. The lapidarist, Jean Pittan (ca.1617-1676), created a set of facets either below or above the critical angle of diamond (26°). This arrangement of facets contributed to darken the diamond so that the recut gem was apparently dark blue. He set the diamond into gold that promoted the appearance of a central "soleil royal" inside the diamond (another optical illusion), suggesting the diamond to be cut at the image of the sun-king, Louis XIV of France. We will detail the other numerous scientific and technical aspects of the "French Blue" diamond and how skillful was the lapidarist who created it. It is unfortunate that the diamond was recut at sometime before 1812 as the original cut of the diamond was a masterpiece of linear optics.