

The Weizmann Institute of Science  
Faculty of Mathematics and Computer Science

The Chaim Leib Pekeris Memorial Lecture  
Dolfi and Lola Ebner Auditorium  
on Thursday, March 7, 2013  
at 16:00  
Refreshments at 15:45

Ingrid Daubechies  
Duke University

will speak on

### **Art + : intersections of art and mathematics.**

The encounters of art and mathematics are manifold. This talk will showcase a few ways in which mathematical tools and insights are assisting art historians and art conservators.

At the end of WWII, a tragic allied bombing mistake reduced the Eremitani church in Padua to rubble, together with its world-famous frescoes by Mantegna and other renaissance artists. Thousands of fragments, the majority of which measured only tens of square centimeters, and representing a total surface area of less than 1% of the original, were all that remained. They were collected and preserved by Italian art historians, praying (without much hope) that one day it might be possible to resurrect the frescoes. In the 1990s their prayer was answered: Massimo Fornasier, then a mathematics graduate student, developed an approach to put together the very fragmentary puzzle.

Vincent Van Gogh, always short of cash, often reused old canvases, applying first a new lead-white ground layer on top of them, and then covering it with a newer painting. Many of the bottom layers of these palimpsest paintings were studies, not necessarily of great interest. One small painting from his Paris period, a study of some grasses and wildflowers in bloom, covered the portrait of a peasant woman, possibly from his earlier Nuenen period, in which Van Gogh had been experimenting with how to render color while using only a very dark palette. On moving from the Netherlands to France he left these studies behind, in his parents' home; soon he would change his style radically.

Earlier, he had sent one of the Nuenen portraits to his brother Theo in Paris, describing it in the accompanying letter as an example in which he felt he had come close to achieving what he was looking for. The letter has survived; no corresponding painting had been found among Theo's possessions.

Maybe the portrait underneath the *Blades of Grass* was the missing painting? Using new techniques from materials science (X-ray fluorescence), Joris Dik and Koen Janssen produced a digitized version of *Lady-6-mm-under* (as we dubbed her, irreverently), with a materials analysis for each pixel, which could be translated back to pigment information. The resulting much more precise picture, confirmed the guess, but it was still very patchy. By modern image analysis techniques, a team of undergraduate and graduate students in mathematics and electrical engineering managed to significantly enhance the picture.

The lead-white ground layer of paintings on canvas absorbs X-rays very well; on the other hand, the grounding automatically is slightly thicker in the "valleys" between the threads than on top of each thread itself. X-rays can thus give a very detailed picture of the canvas of such paintings, even when the canvas itself can no longer be seen because art conservators have applied additional canvas to the back of the painting to stabilize it. Based on these X-ray canvas pictures, irregularities in the weave patterns can be identified and documented, making it possible to group several paintings by the same artist as cut from the same cloth. This technique, pioneered by Rick Johnson, has in some cases given a decisive vote as to the authenticity of some works of art that had been called in question.