Saturn LD

Patented by L. A. M. J. DeBergh 1996, made by LD Games, Belgium.
(plastic, 4.5 inches by 7/8 inch thick;
one the bar it says "SATURN 2x4 colors",
and on the other side of the bar is says "LD Games Belgium Patented C 1994")

Each side of the ring has 16 discs, where each of the 64 disc sides are colored with one of 14 colors. The goal is to have exactly 4 colors showing on each side (arranged in 4 sets of 4) for a total of 8 *visible* colors, where the remaining 6 colors are *hidden*. This puzzles is really a pencil and paper problem of determining which of the 14 colors are the 8 visible colors (see the next page); for the white body puzzle above they are:

Visible: yellow, pink, magenta, purple, light green, green, blue, gray

Hidden: white, orange, red, light blue, brown, black

(The black body is the same except that brown is visible and gray is hidden.)

Once the 8 visible colors have been determined, solving the puzzle is very easy. The bar across the center in the photos above, which the directions refer to as the "switch", is in the solved position that prevents the puzzle from being mixed up. Rotating the switch along its axis 90 degrees exposes a track on both sides. The first two positions on each side can each be used to temporarily park one or two discs, and the third position on the track allows a disc to pass from one side of the track to the other. Rotating the switch 180 degrees allows one to exchange discs from top to bottom or flip a disc:

To solve:

1. Flip all discs that have a hidden color showing.
2. If a color is showing on 5 discs (all colors are on at most 5 sides), find the disc that does not have a hidden color on the reverse side and flip that one.
3. Exchange discs one or two at a time until only four colors show on each side.
4. Rearrange the colors on each side into any desired pattern (e.g., 4 groups of 4).

Determining the 8 Visible Colors

Flip each disc to make a list of 32 color pairs that are comprised by the discs (see the next page). The number of times each color occurs is:

5	white
5	yellow
5	orange
5	purple
5	red
5	light blue
5	green
5	black

4	pink
4	magenta
4	blue
4	light green
4	brown
4	grey

We refer to the colors that appear only 4 times as the *sparse* colors. The puzzle is not so simple as the 6 sparse colors are the 6 hidden colors.

A key observation is that If a sparse color is hidden, then all colors that appear on the opposite side of a disc with that sparse color must be visible. To determine which are the visible colors, we can employ some simple deductions. This is for the white body puzzle; similar logic for the black body with brown and gray reversed:

1. There are two discs that have a sparse color on both sides, (brown, gray) and (brown, pink). It turns out that brown is hidden and gray and pink are visible (if we had guessed incorrectly and chosen brown as visible, then in the following steps one quickly reaches a contradiction where there is a color that can be neither visible or hidden).
2. Brown is also paired with green and yellow, so at this point we know that 4 of the visible colors are gray, pink, green, and yellow.
3. By checking our list of 64 pairs, we see that blue is paired with 4 additional colors (red, black, light blue, and white) and so if blue was hidden, that would add 4 more visible colors, making a complete set of eight. But this cannot be possible, because now light green, for example, cannot be visible (because that would make 9 visible colors) and cannot be hidden (because light green is paired with orange which is not one of these 8). Hence blue must be the 5th visible color.
4. Similar to step 3, light green must be the 6th visible color.
5. Similar to steps 3 and 4, magenta must be the 7th visible color.
6. Similar to steps 3, 4, and 5, purple must be the 8th visible color.

Jaap's Page gives a similar solution (that motivated this one).

Tabulation Of The Disc Colors

Here is a tabulation, listed in alphabetical order, of the disc colors that appear in the two puzzles show in the photos on the first page. Although both have the same numbers of each color, the pairings are not the same:

White Body
black, blue
black, gray
black, pink
black, purple
black, yellow
blue, light blue
blue, red
blue, white
brown, green
brown, gray
brown, pink
brown, yellow
gray, red
gray, white
green, light blue
green, light green
green, orange
green, white
light blue, light green
light blue, magenta
light green, orange
light green, red
light blue, yellow
magenta, orange
magenta, white
magenta, yellow
orange, pink
orange, purple
pink, purple
purple, red
purple, white
red, yellow

Black Body
black, blue
black, brown
black, magenta
black, pink
black, purple
blue, light blue
blue, red
blue, white
brown, gray
brown, red
brown, white
gray, green
gray, pink
green, white
gray, yellow
green, light blue
green, light green
green, orange
light blue, light green
light blue, magenta
light blue, yellow
light green, orange
light green, red
magenta, orange
magenta, yellow
orange, pink
orange, purple
pink, purple
purple, red
purple, white
red, yellow
yellow, white

Further Reading

Jaap's Page, from: http://www.jaapsch.net/puzzles/saturnld.htm

DeBergh WO Patent, from: http://www.wipo.int - patent no. WO 96/08296