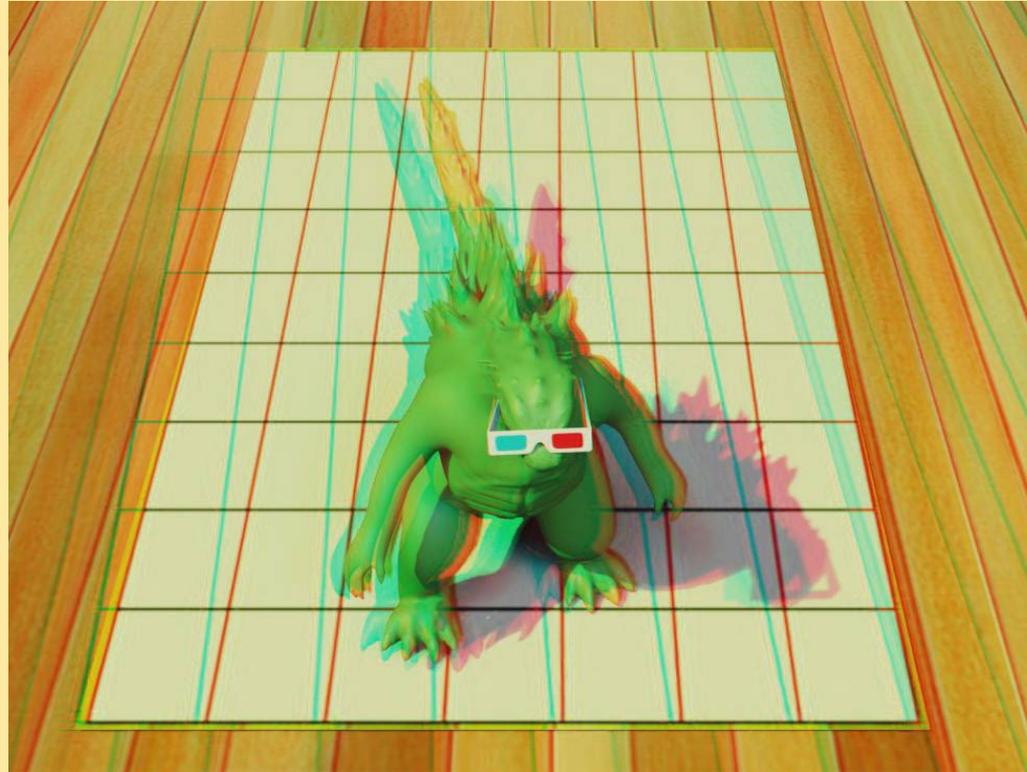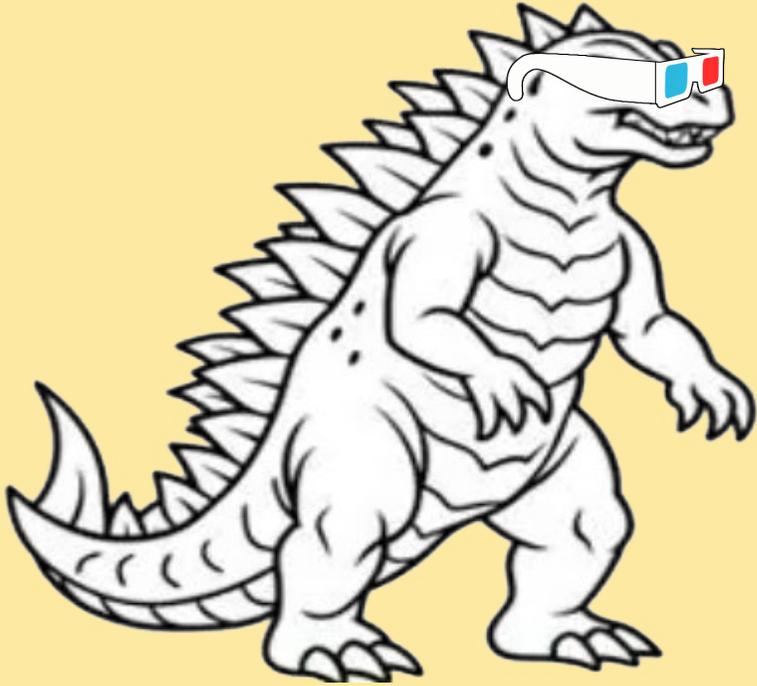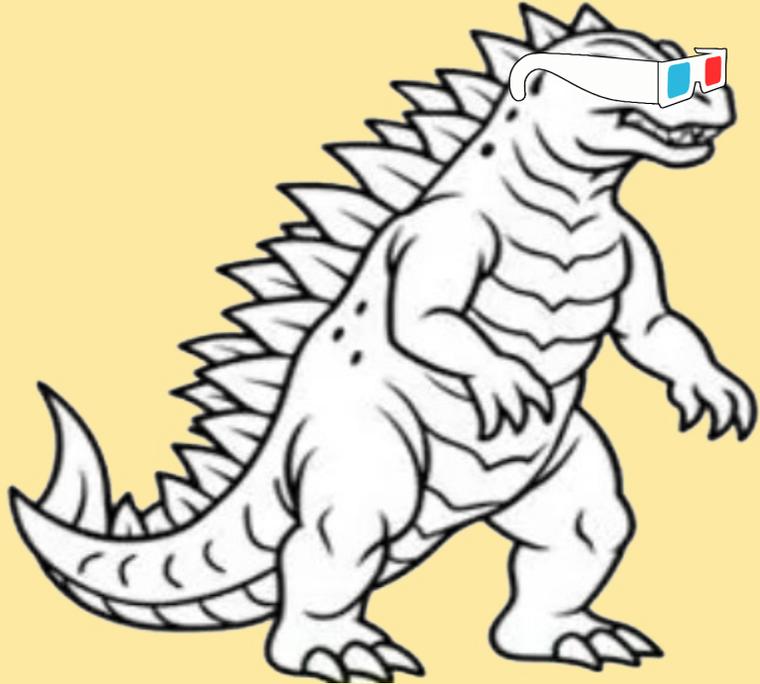# Phantograms or "Pop-up" Anaglyphs

Jay Horowitz
Presented to the Ohio Stereo Photographic Society, Feb. 3, 2026
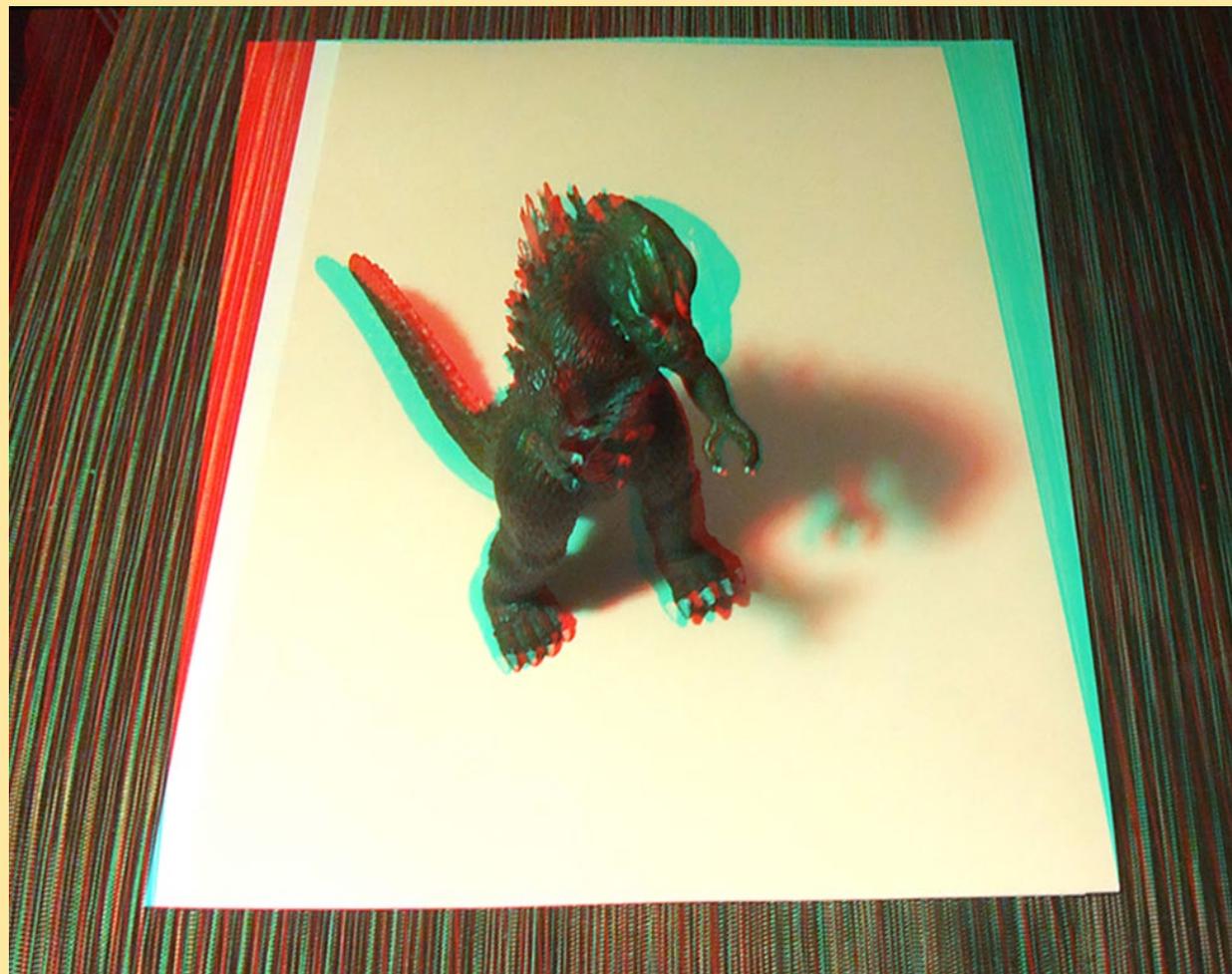
Presentation Outline

- The Popup Phantogram Illusion
- Understanding The illusion
- Creating the Phantogram
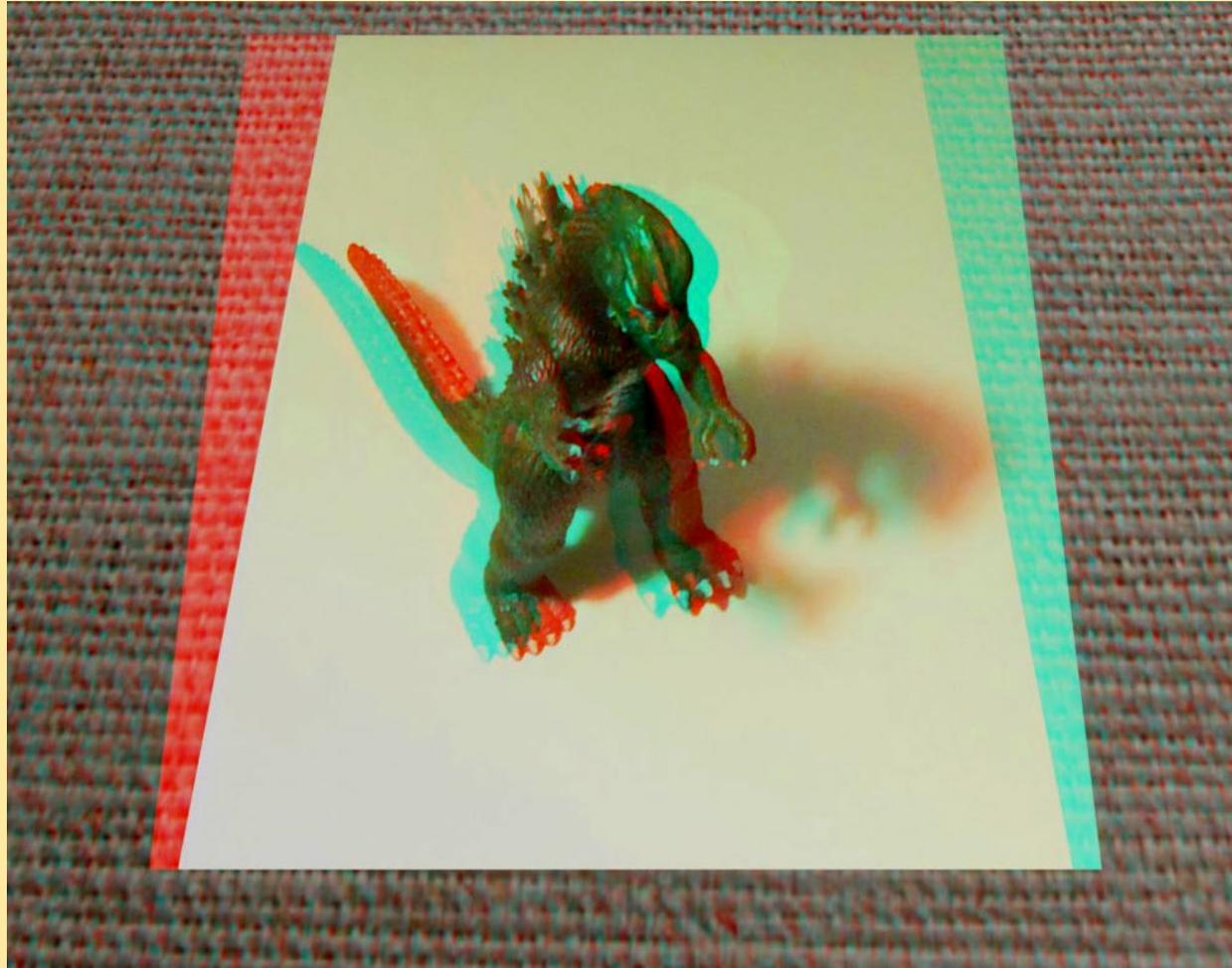- Printing the Phantogram

Presentation Outline

- **The Popup Phantogram Illusion**
- Understanding The illusion
- Creating the Phantogram
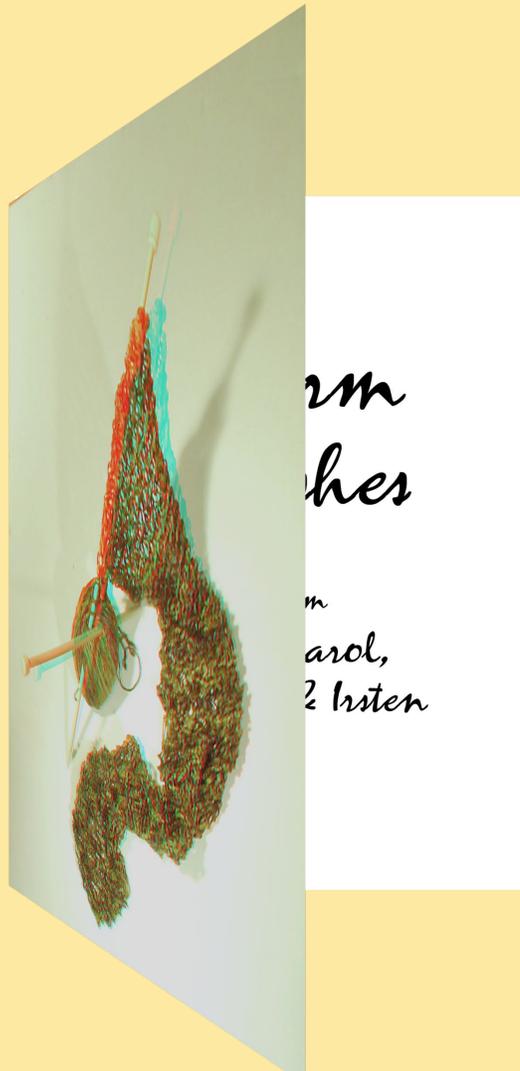- Printing the Phantogram

'Actual' Scene taken by Fuji W3 at 45-degree angle

Phantogram, flat on table, viewed at 45-degree

My first 3D Xmas Card (2005) was a Phantogram

Card Front was phantogram
of Carol's knitting

The card as viewed

Another 3D Xmas Card (2006) Phantogram

ow!

eetings from

Carol,

& Irsten

Card Front was phantogram
of home-made candles

The card as viewed

Fun with Phantograms

I made my 'birder' sister a phantogram of a robin's nest that fell from one of our trees
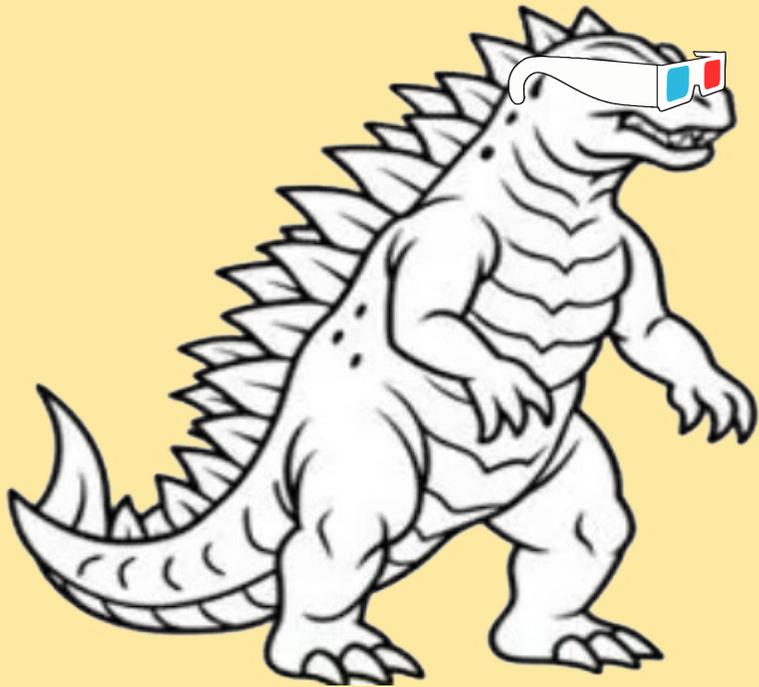
When you place an 'Candy Robin Egg' on the Phantogram it looks like it's in the nest!

Phantograms don't just have to Pop-UP, they can Pop-OUT

At NASA, I created a Phantogram mural of a proposed crew module. When looked at from the end of the room, the solar panels appeared to stick out.
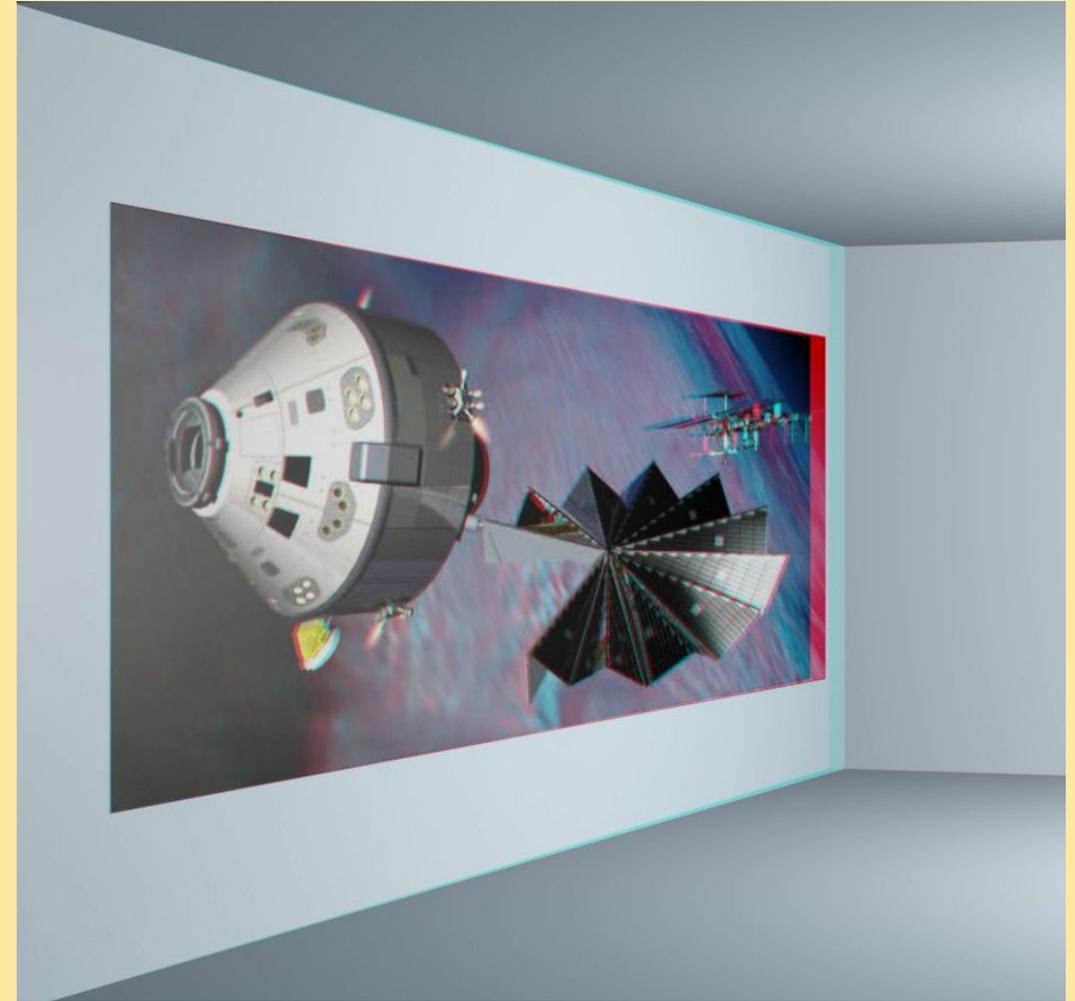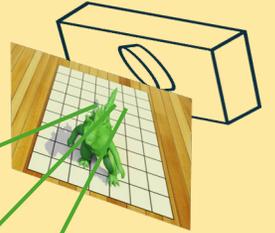
Presentation Outline

How Phantograms Work
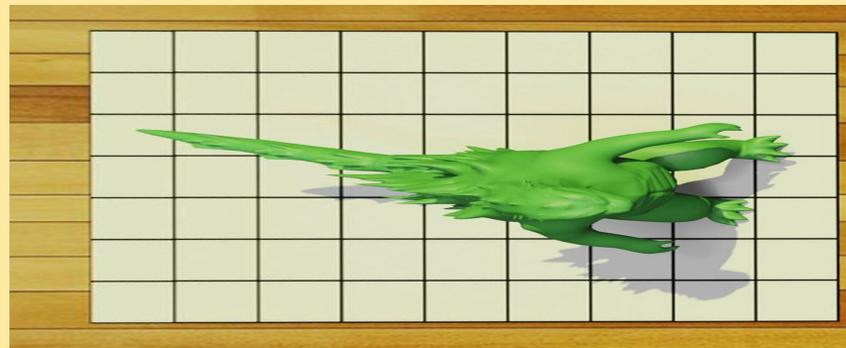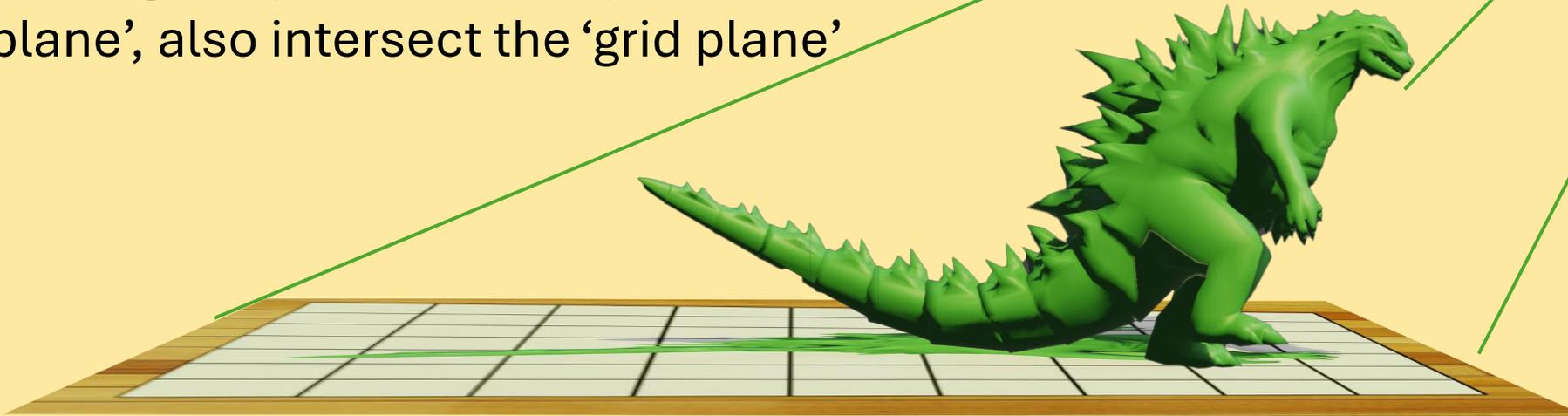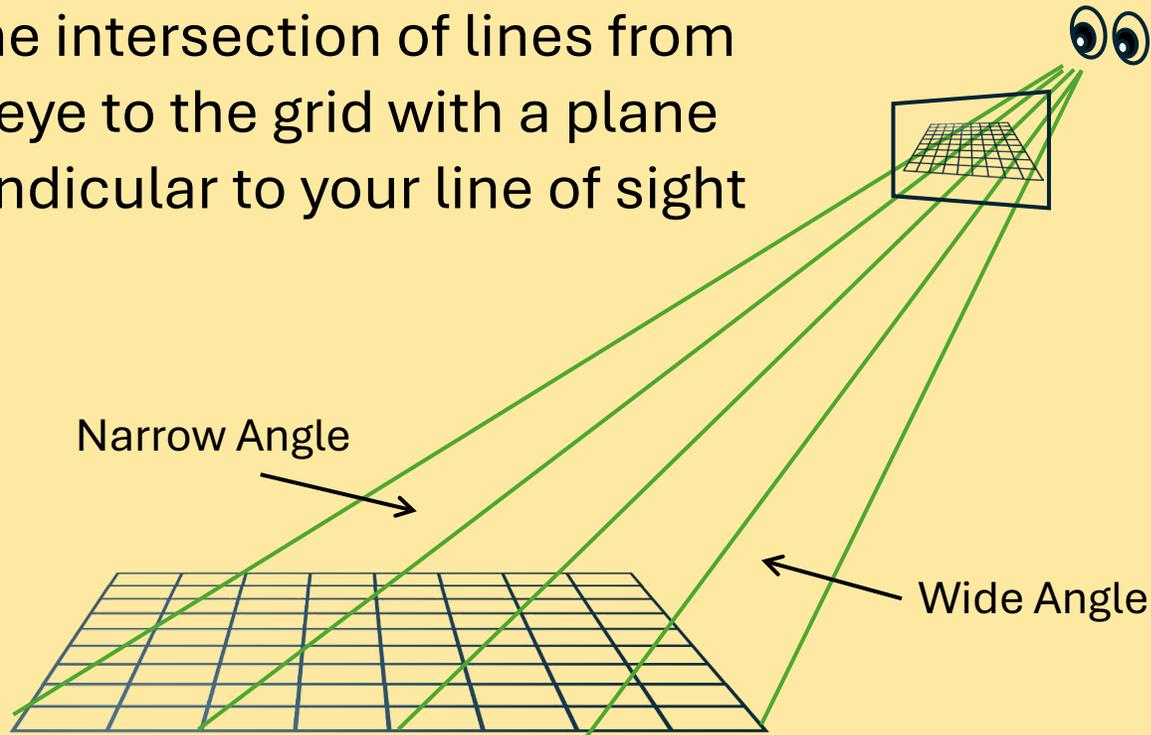
Consider taking a picture of an object on a grid.

The set of light rays from the object to the 'film plane', also intersect the 'grid plane'
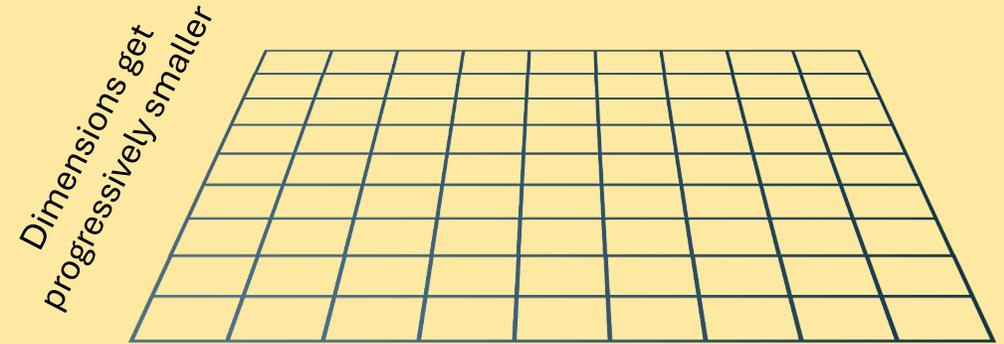
Camera Image

Grid Plane Image 'Phantogram'

The Camera View is a 'perspective' view of the scene

It is the intersection of lines from your eye to the grid with a plane perpendicular to your line of sight
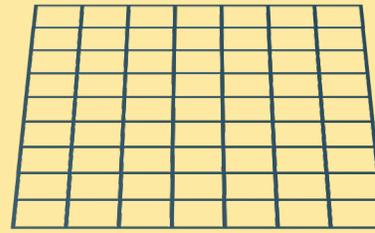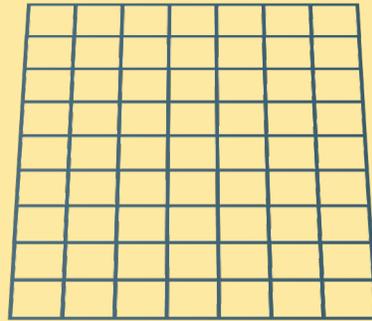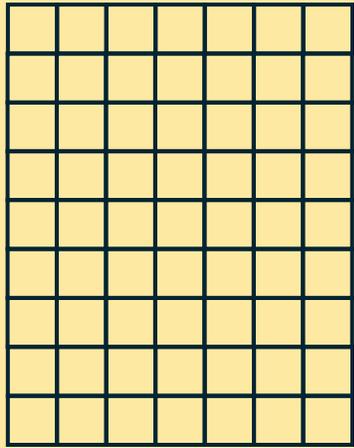
Narrow Angle

Wide Angle

The distant grid squares form a smaller angle and appear smaller

Dimensions get progressively smaller

The geometry of the perspective view is not a simple resizing of the image

An image can be mathematically manipulated to simulate a perspective view at any angle
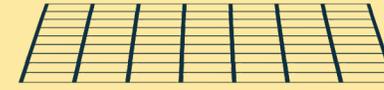
View angle w.r.t. plane

90°   75°   60°   20°   2°

The "Perspective Transformation" is not merely resizing of dimensions, but is based on the viewing geometry. Here's the formulas.
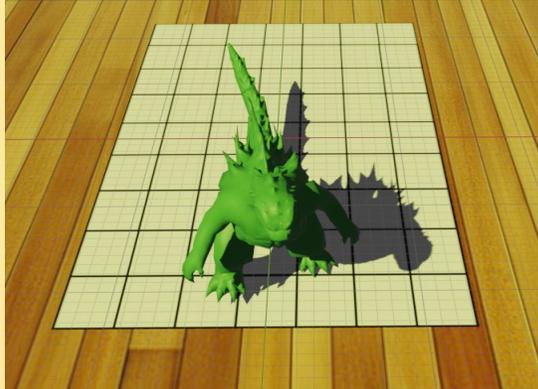
$$
\begin{bmatrix} \mathbf{d}_x \\ \mathbf{d}_y \\ \mathbf{d}_z \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & \cos(\theta_x) & \sin(\theta_x) \\ 0 & -\sin(\theta_x) & \cos(\theta_x) \end{bmatrix} \begin{bmatrix} \cos(\theta_y) & 0 & -\sin(\theta_y) \\ 0 & 1 & 0 \\ \sin(\theta_y) & 0 & \cos(\theta_y) \end{bmatrix} \begin{bmatrix} \cos(\theta_z) & \sin(\theta_z) & 0 \\ -\sin(\theta_z) & \cos(\theta_z) & 0 \\ 0 & 0 & 1 \end{bmatrix} \left(\begin{bmatrix} \mathbf{a}_x \\ \mathbf{a}_y \\ \mathbf{a}_z \end{bmatrix} - \begin{bmatrix} \mathbf{c}_x \\ \mathbf{c}_y \\ \mathbf{c}_z \end{bmatrix} \right)
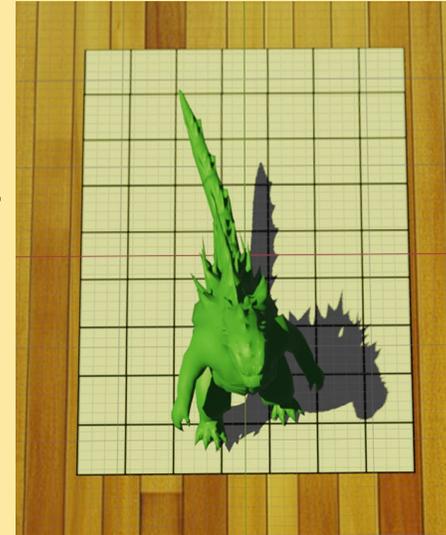$$

Don't worry, SPM has it built in.

Oh, and the process is reversible, which is the key to creating Phantograms!

The Phantogram process explained in 2D
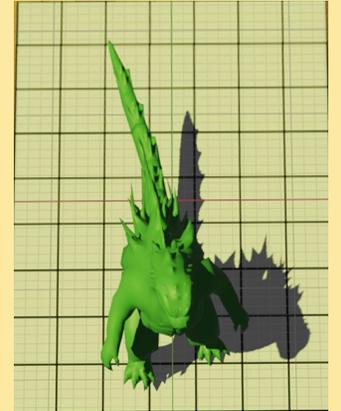
1. Take a picture at 45-deg angle of a rectangular plane.
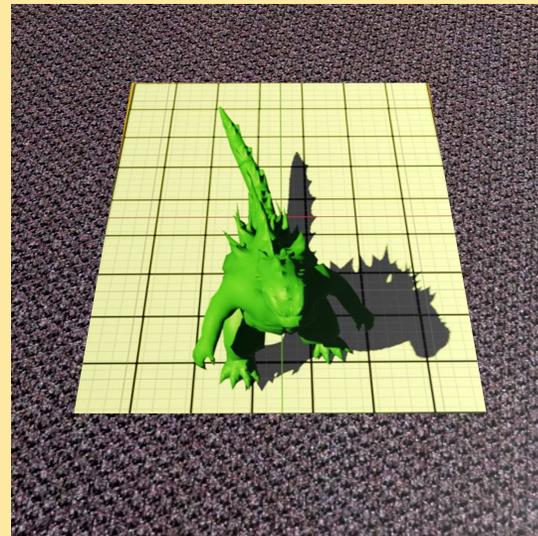

2. 'Reverse perspective' transform it by 45 degrees.
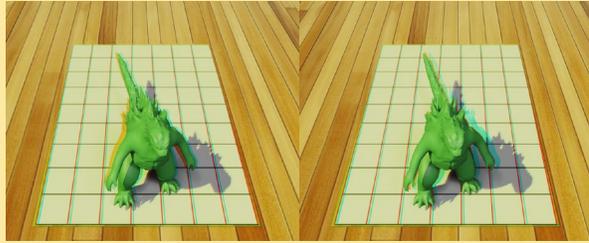

3. Crop and print the image.

4. Put the image on a flat surface and view it from 45 degrees.

You're basically just doing a transform/un-transform. First mathematically, and then physically.

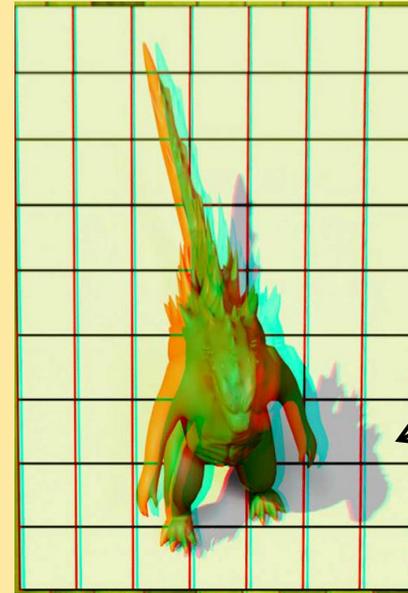Any object in the image, goes along for the ride.

The Phantogram process for 3D
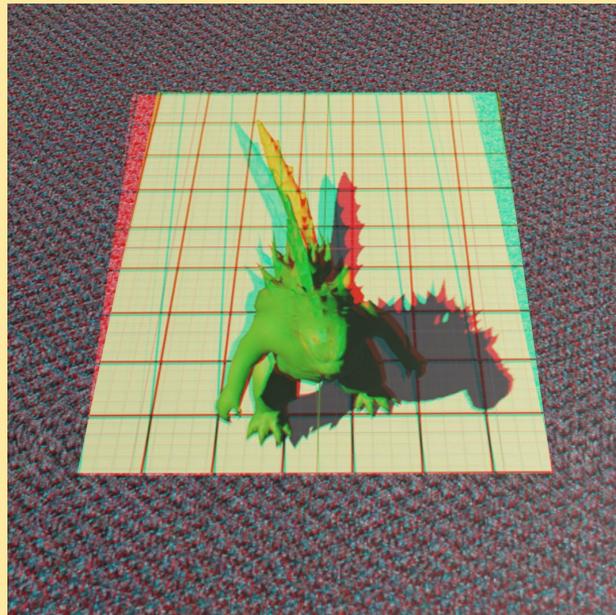

1. Take a picture at 45-deg angle

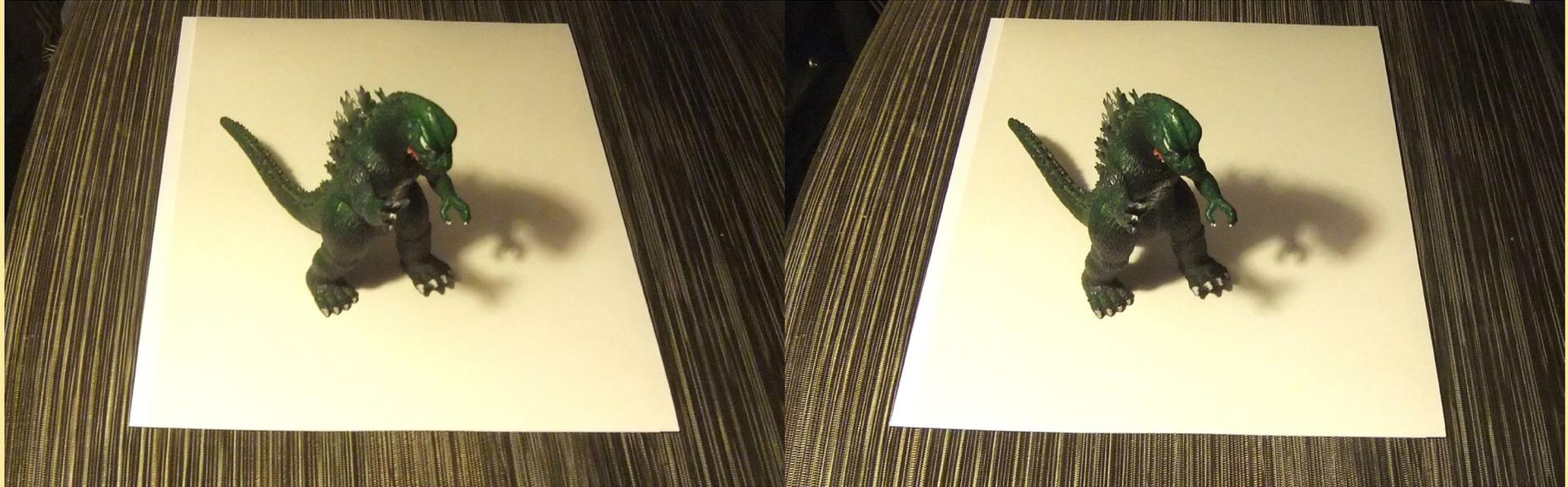2. Apply perspective transform

Note the shadow, which is on the surface, has no disparity

3. Crop, print as anaglyph

When the print is placed on table and viewed at 45-degrees through anaglyph glasses the object appear to 'pop-up' from the surface!

Creating a Phantogram with StereoPhoto Maker

- Place on object on a flat, rectangular surface or frame
- Take a stereo pair from approximately 45-degrees, centered on the rectangle
- Be sure that all parts of the object and all shadows(!) are within the rectangular border

Creating a Phantogram with StereoPhoto Maker

LAST MINUTE NOTE!!!!

It was brought to my attention when this presentation was given that SPM has a built-in tool for automatically creating some phantograms: *Auto Detect Rectangle*.
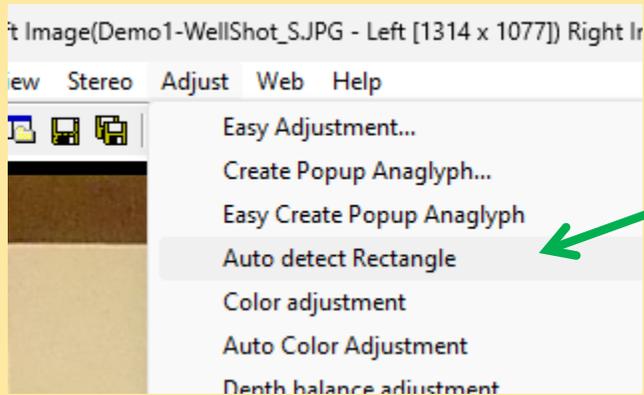
YouTube video explaining Auto Detect Rectangle
https://www.youtube.com/watch?v=7bw6GRkK5mg

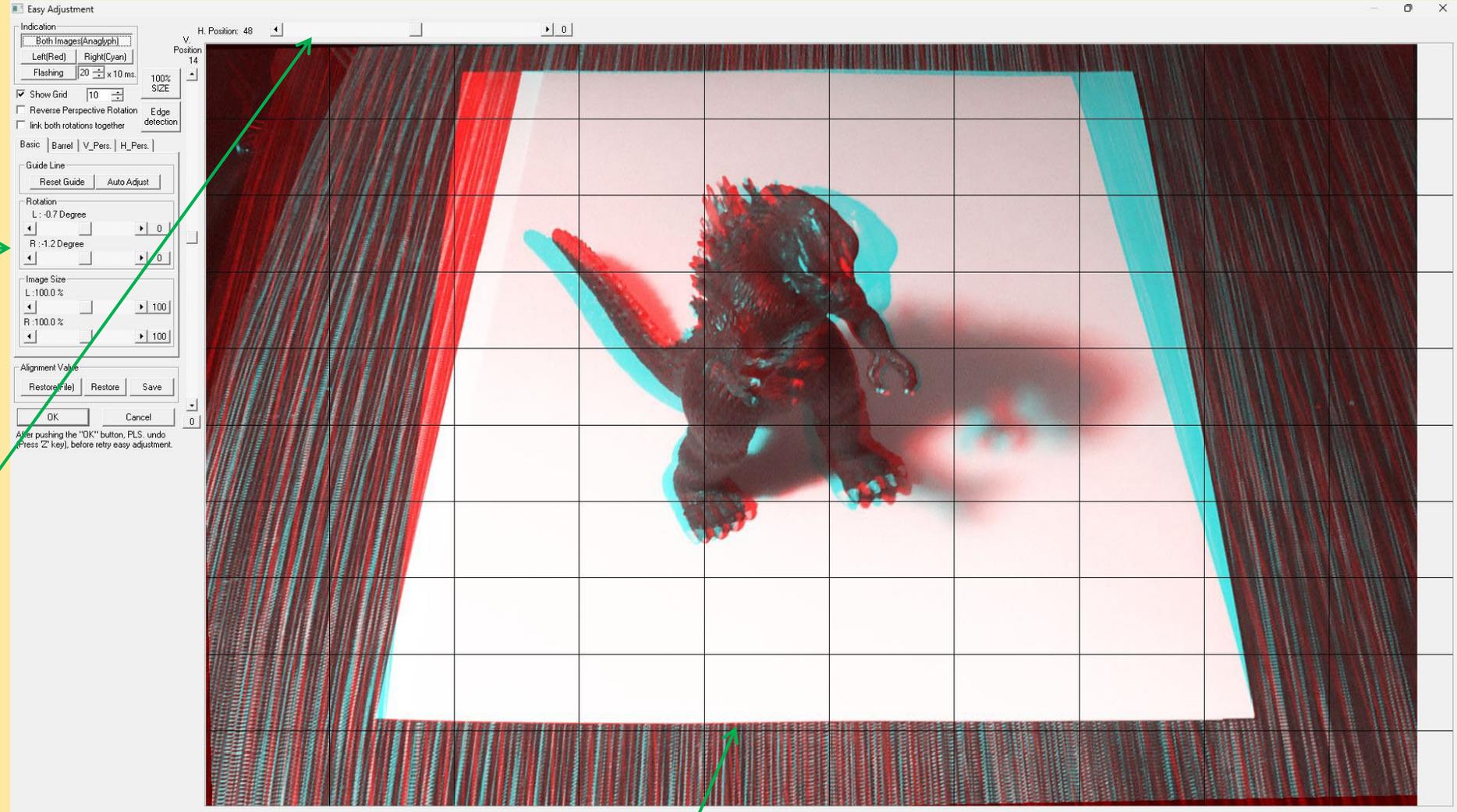SPM Auto-detect rectangle for creating phantogram
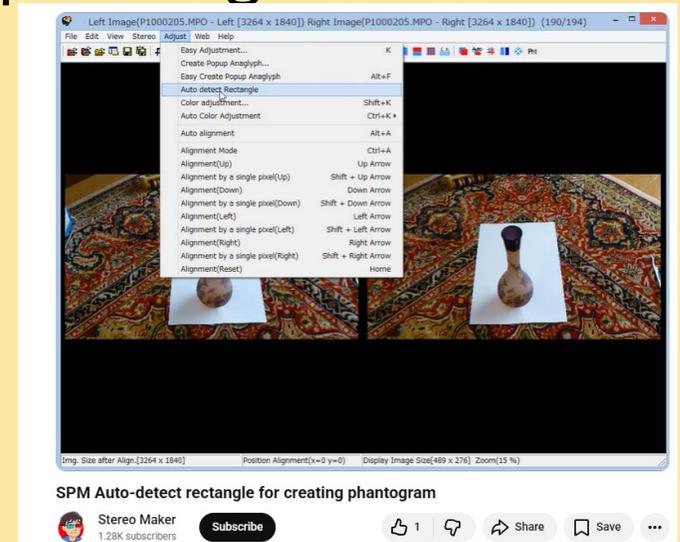
This may not work for all images, so the following slides show how to do it manually.

Easy Adjust and align the stereo pair as usual

- Use Easy Adjustment
- Show Grid
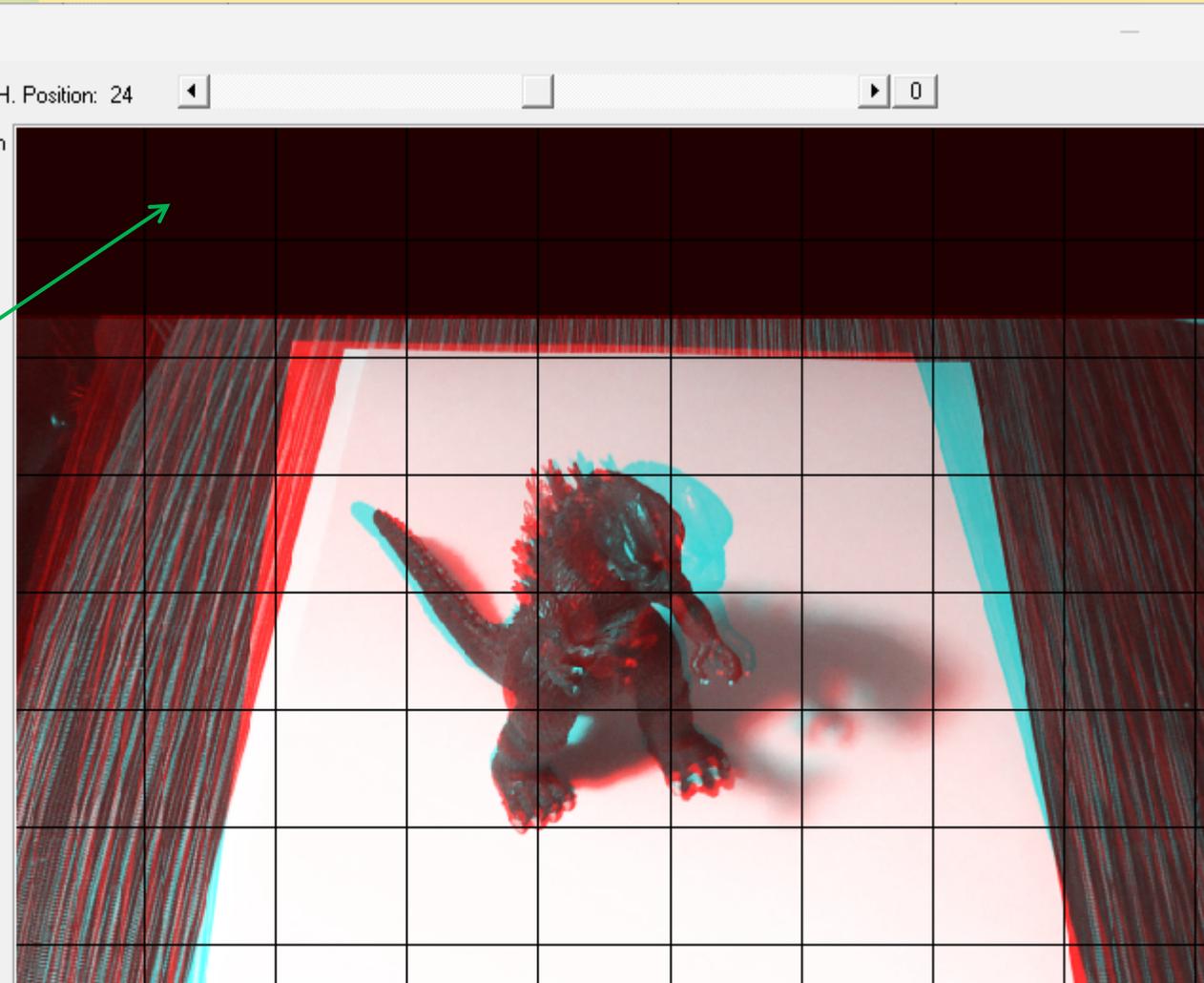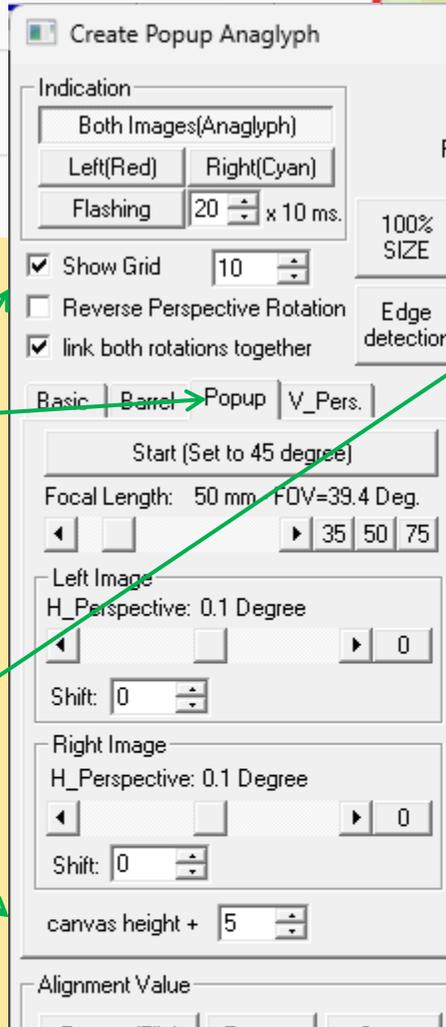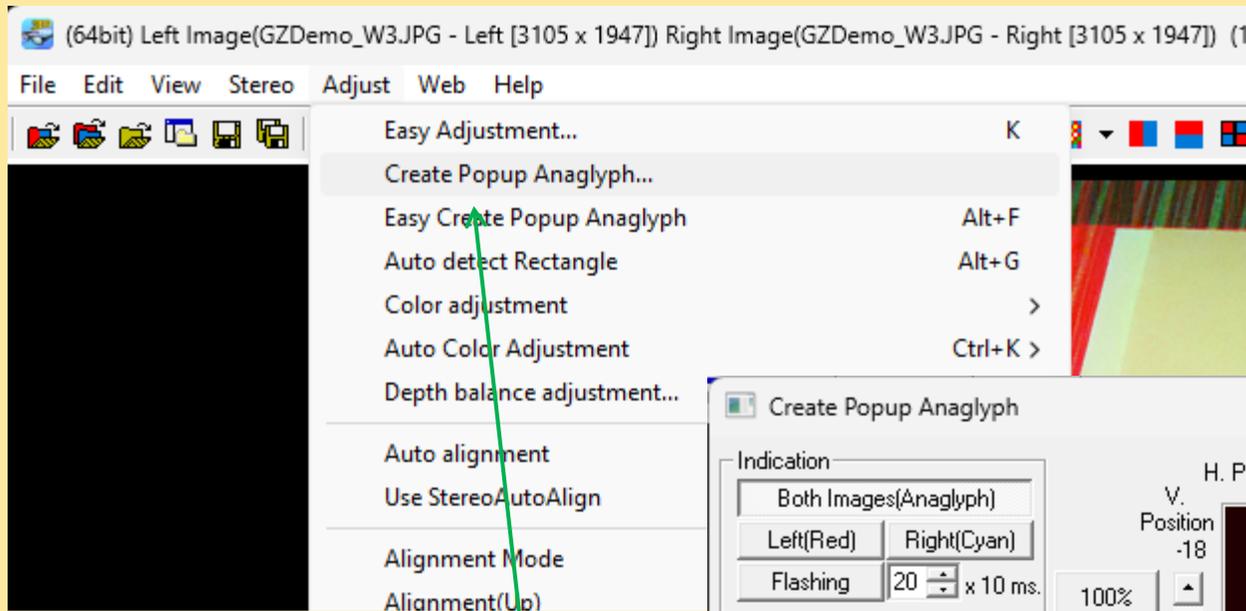- Unlink both together

- Rotate R and L if needed to straighten bottom

- Adjust H and V position to align R/L bottom

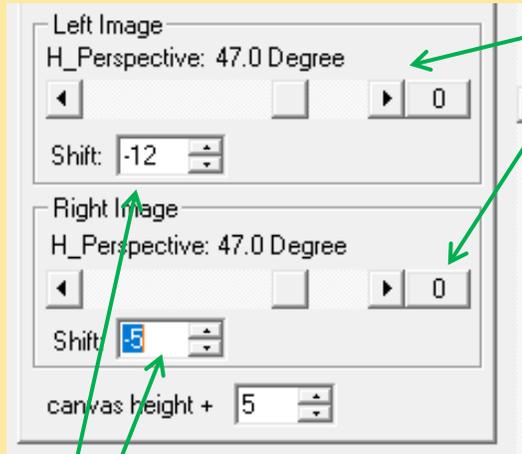Align this edge

Create Popup Anaglyph

- Select 'Create Popup Anaglyph'
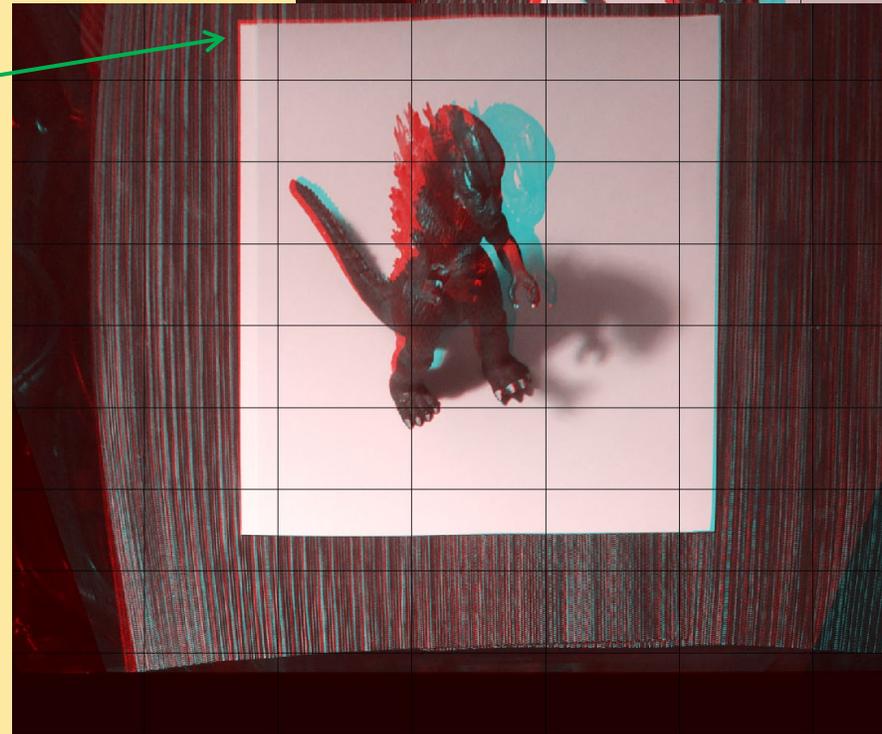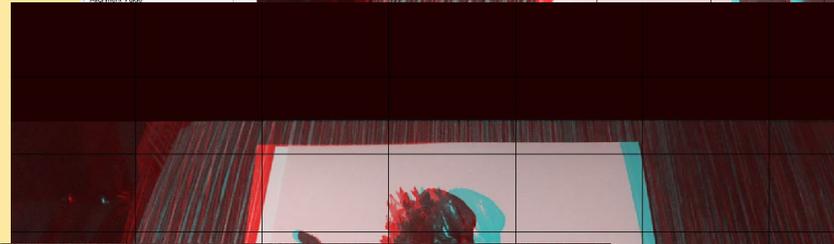
  - Set 'Show Grid' and 'Link Rotations'
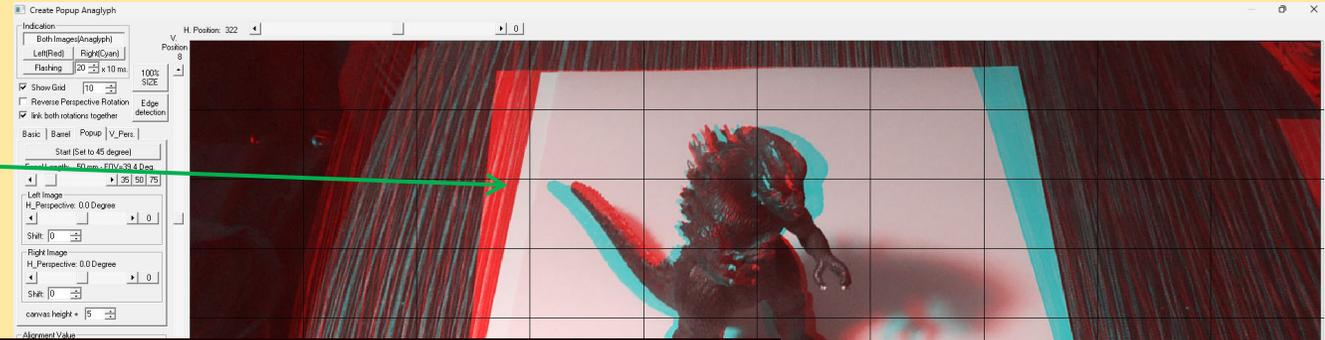
- You may need to expand canvas height since 'perspective transformation' expands upper portion of image

Create Popup Anaglyph

These adjust Perspective angle

These Shift and align the top edges

Left Image
H_Perspective: 47.0 Degree
◄ ▶ 0
Shift: -12

Right Image
H_Perspective: 47.0 Degree
◄ ▶ 0
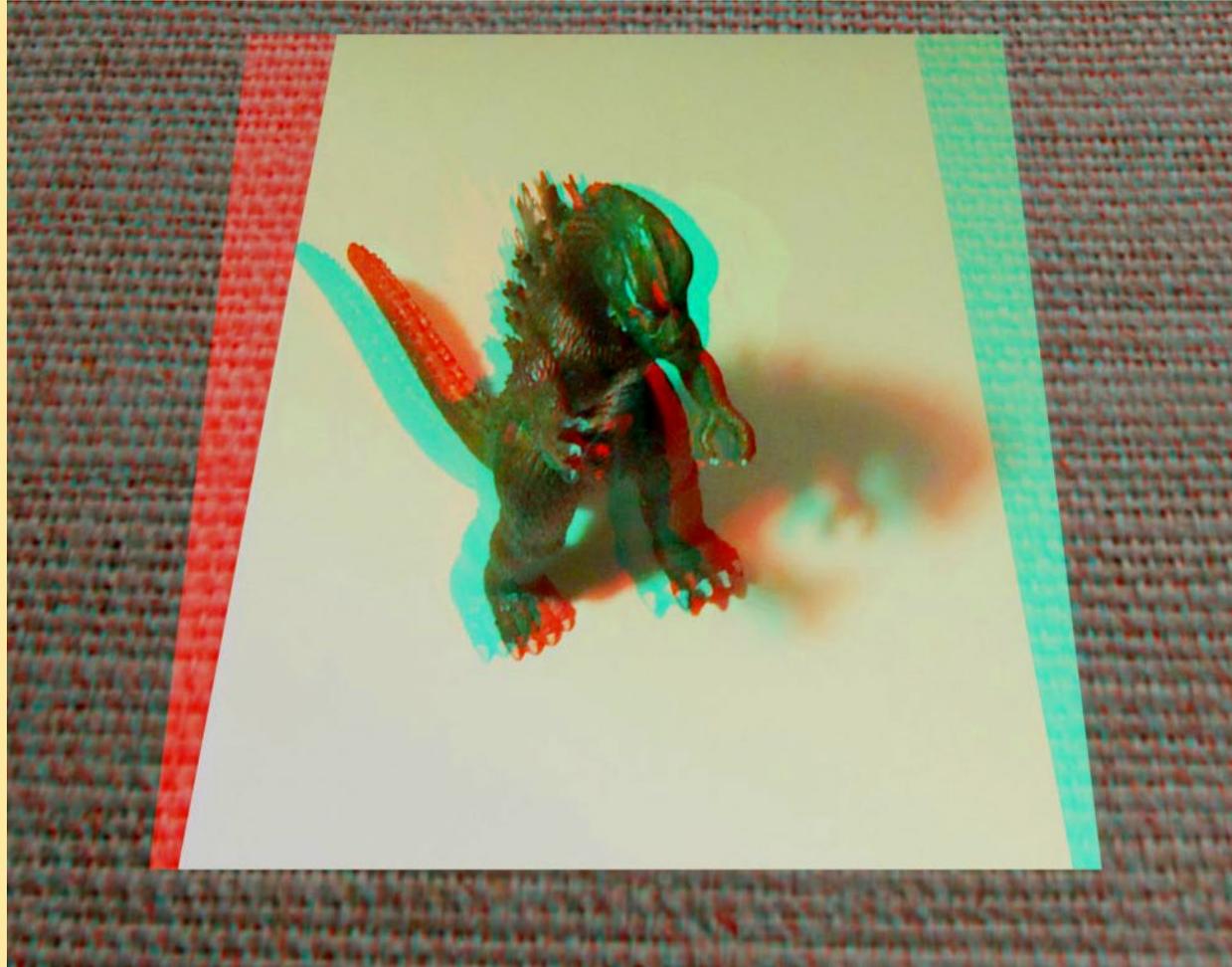Shift: 5

canvas height + 5

You want a rectangular background with all edges aligned

Crop and Save as Anaglyph to Print
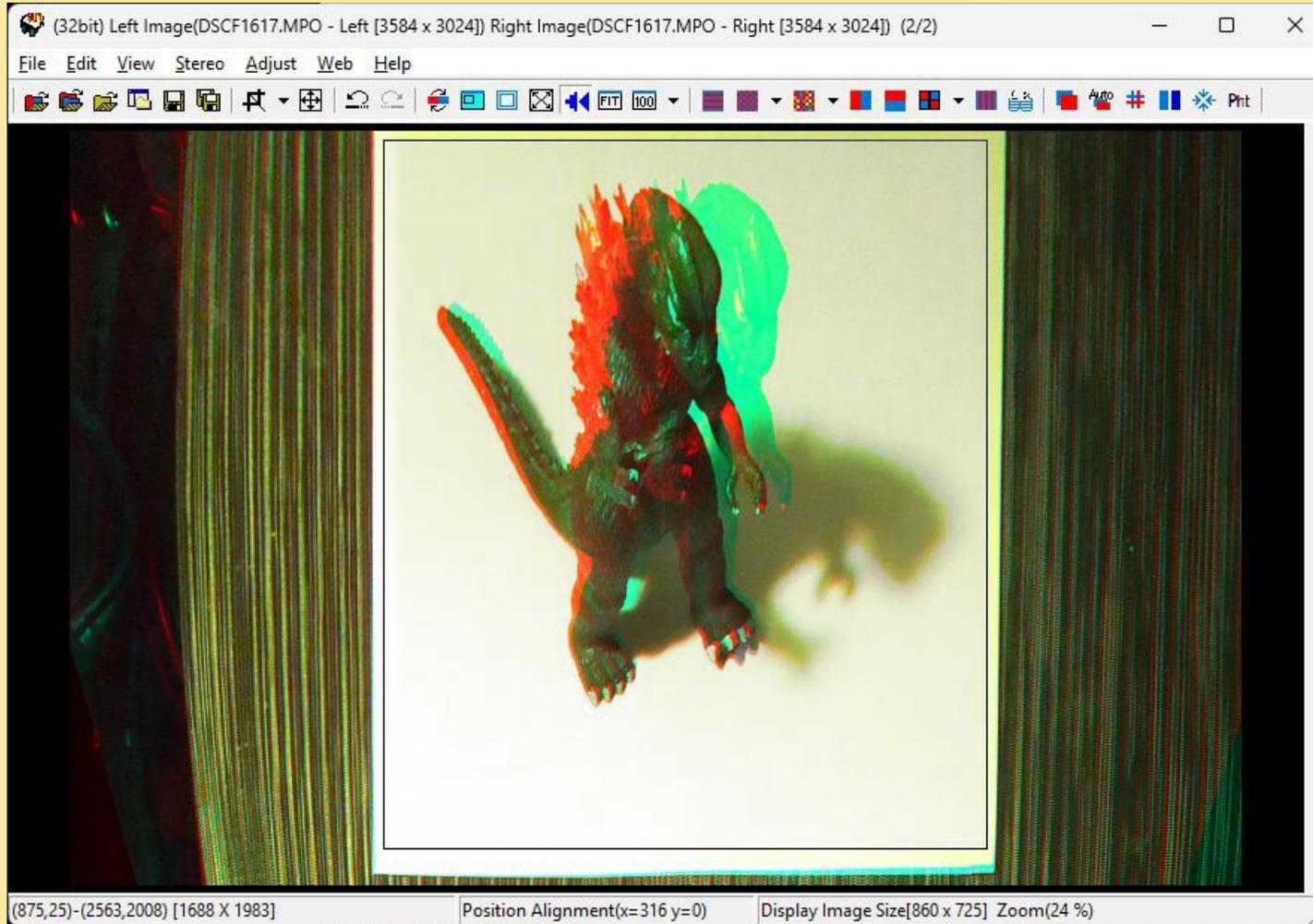
Note: Save a side-by-side as well. It can help adjusting L/R color balance for printing.

Put it on a table, view from 45-degrees and amaze your friends!

Presentation Outline

- The Popup Phantogram Illusion
- Understanding The illusion
- Creating the Phantogram
- **Printing the Phantogram**

- Printing anaglyphs is hard because the CMYK color inks many printers use aren't filtered correctly by cyan/magenta glasses, resulting in significant ghosting
- Run lots of tests selecting different SPM, computer and printer options
- Printing anaglyphs would probably be a good future presentation (Once I figure out how to do it!)
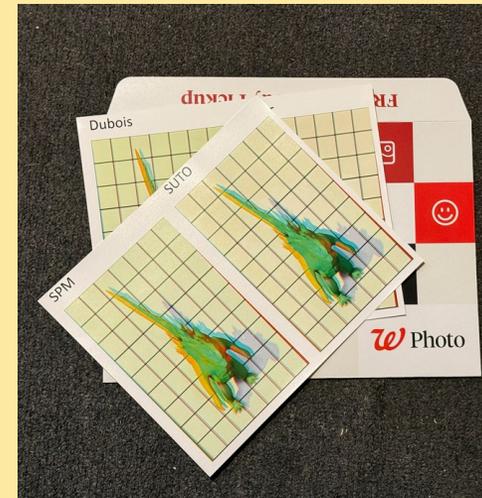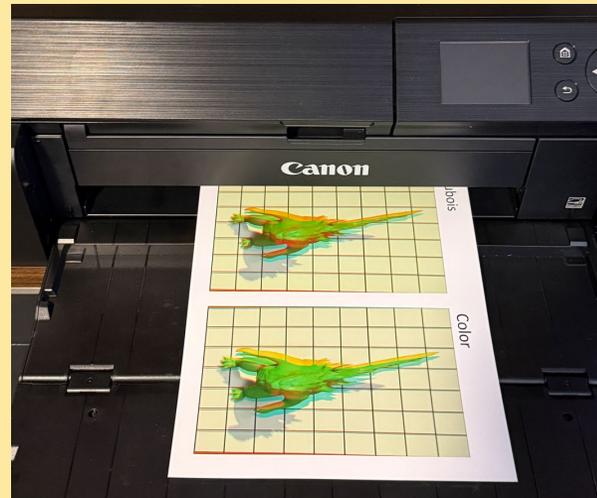
Neither my $600 8-ink photo printer nor Walgreens Photo produced ghost-free anaglyphs ☹
But the results were still good enough to impress less critical friends.

Further Reading
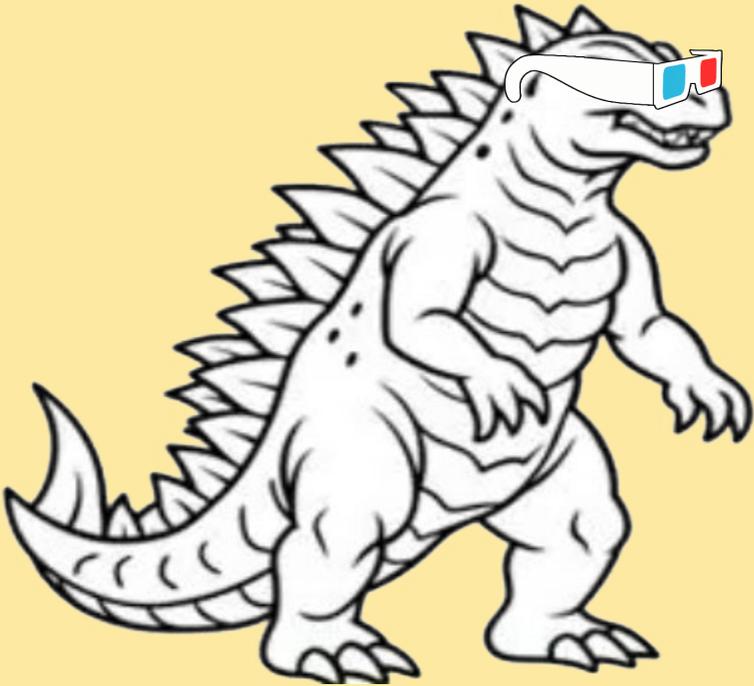
- Barry Rothstein's site has several examples and tutorials on Phantograms
    https://3ddigitalphoto.com/

- StereoPhoto Maker's Online Help is a good guide to aligning and adjusting perspective.
    https://stereo.jpn.org/eng/stphmkr/help/index.htm
  Follow Menu -> Adjust -> Create Popup Anaglyph

- Google 'popup phantogram tutorial' and you'll find more

The End