

# You Can Touch This! Bringing HST images to life as 3D models

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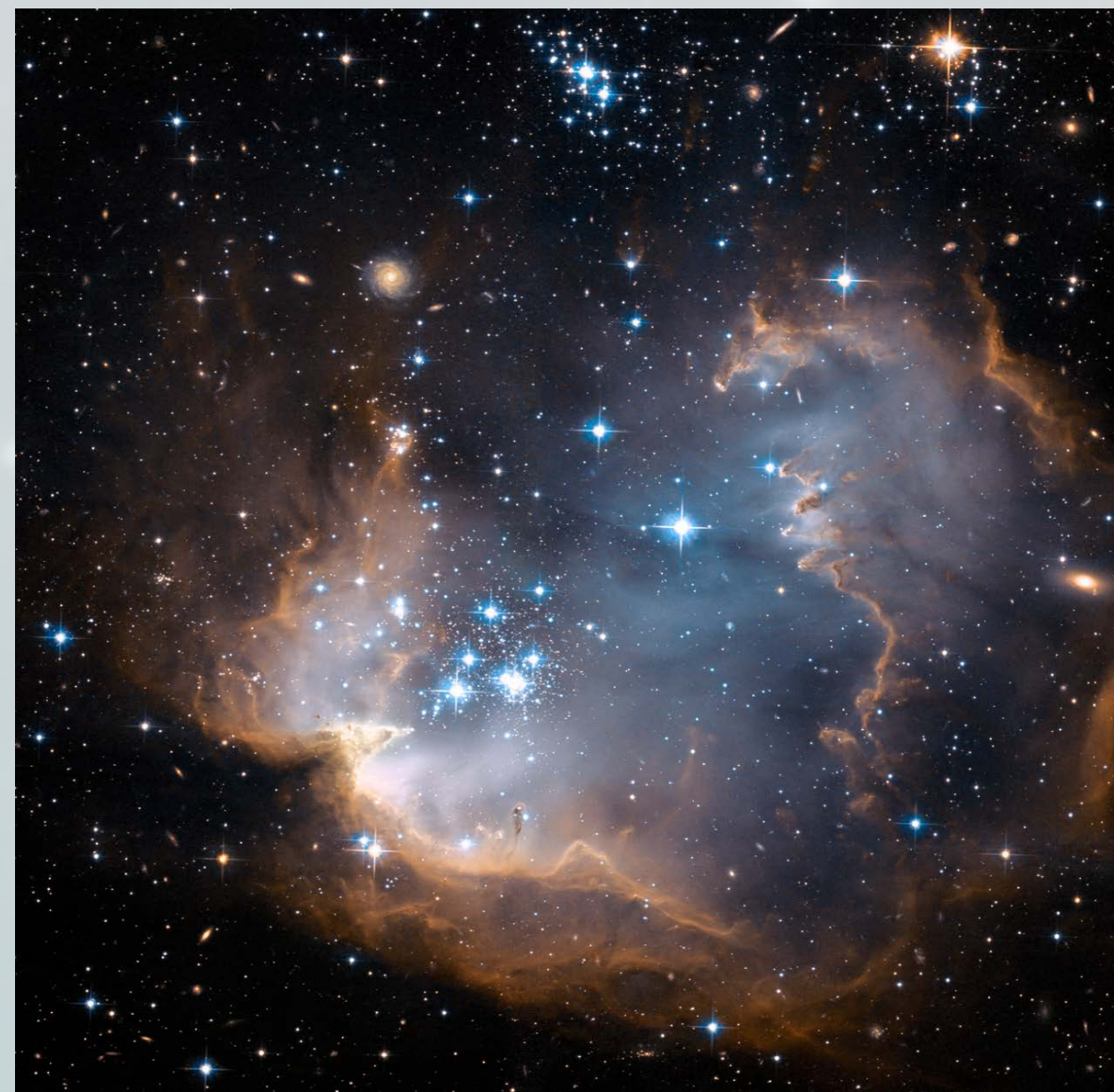
These are the **very first results** of an **innovative process** to **transform Hubble images into tactile 3D models of astronomical objects**.

- a very new, unique tool for portraying astronomical phenomena
- designed to make astronomy accessible to visually impaired children and adults
- data digitally sliced into layers, each featuring touchable patterning and Braille characters printed on a 3D printer
- explore the structure of a cluster environment with fingertips, slice-by-slice, analogous to a visual fly-through
- identify and spatially locate the different components of complex astronomical objects
- audience is **middle school and high school blind students**, blind adults, and individuals with **varied multi-sensory learning styles**

## Prototype Process:

Our HST Target NGC 602, a young cluster in the Small Magellanic Cloud

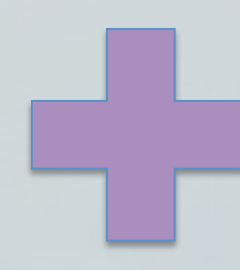
Visual image



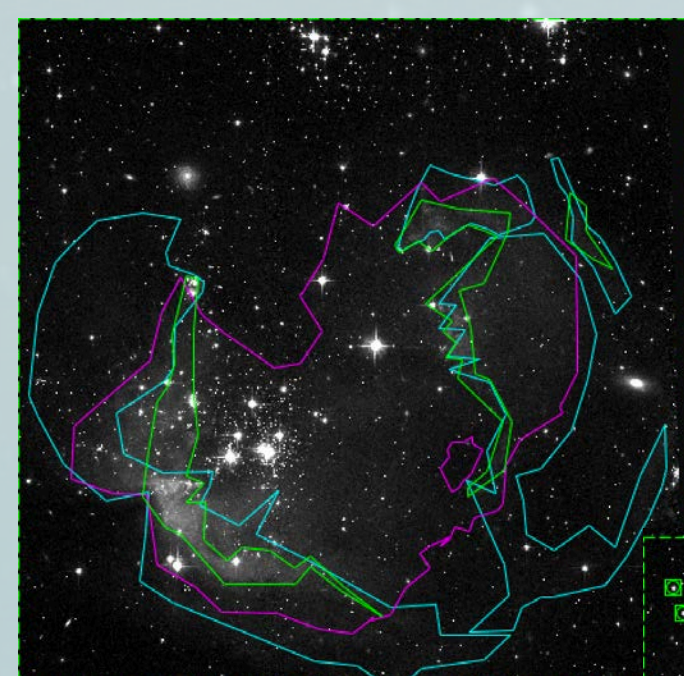
Science data:

type of feature (star, gas, dust, filament, etc.), X-Y position on sky, distance (Z), intensity

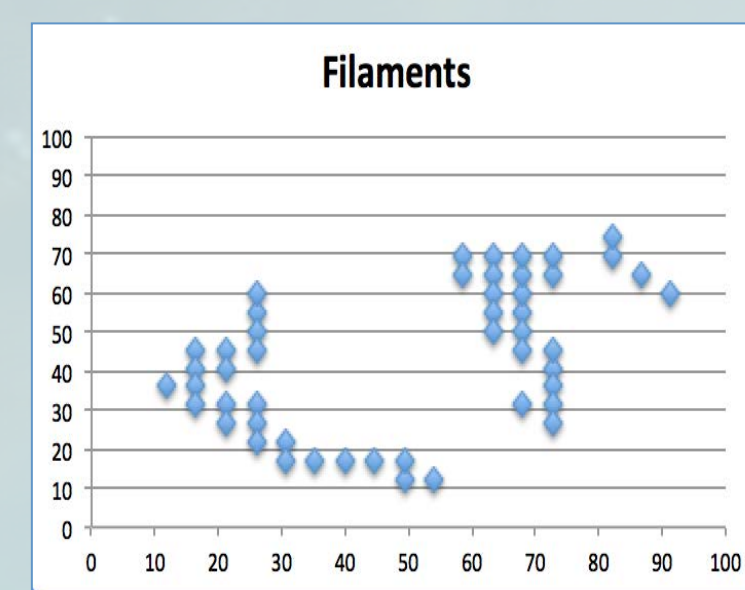
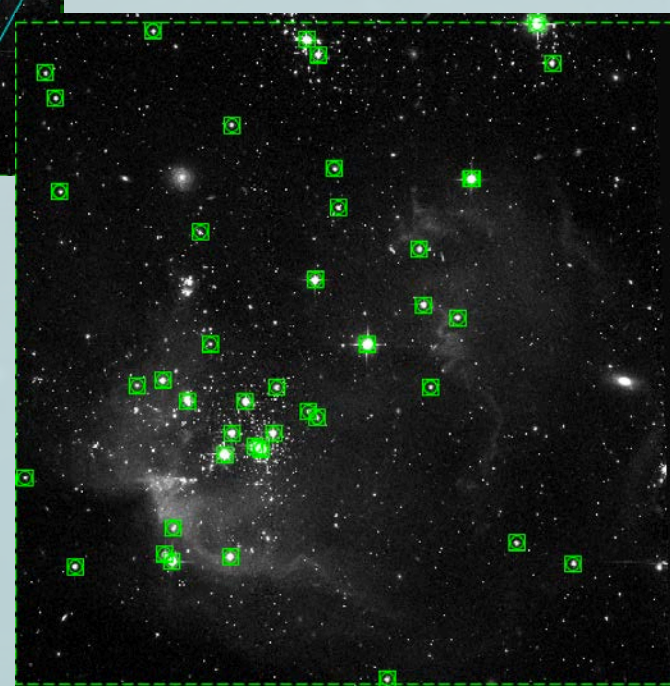
Stars	Z=1	Z=2	Z=3	Z=4	Flux	Filaments	Z=1	Z=2	Z=3	Z=4	Flux	Dust+Gas	Z=1	Z=2	Z=3	Z=4	Flux	
1.4	21	0	0	0	1093.3	11.8	36	1.0	0.0	0.0	205.0	11.8	40.7	0.0	74.7	0.0	74.7	149.4
4.5	93	0	0	0	1228.0	16.4	40.5	1.0	0.0	0.0	185.4	11.8	31.2	0.0	74.4	0.0	74.4	148.7
6	89	0	0	0	1062.7	16.4	40.7	1.0	0.0	0.0	228.7	21.2	35.1	0.0	66.0	0.0	66.0	132.0
6.7	75	0	0	0	1310.8	16.4	39	1.0	0.0	0.0	366.1	21.2	35.1	0.0	74.4	0.0	74.4	148.7
6.7	75	0	0	0	1310.8	16.4	39	1.0	0.0	0.0	359.6	21.2	35.1	0.0	74.4	0.0	74.4	148.7
8.9	18	0	0	0	2461.2	21.2	40.5	1.0	0.0	0.0	248.8	20.0	18.8	0.0	69.7	0.0	69.7	139.3
18	45	0	0	0	1423.0	21.2	40.7	1.0	0.0	0.0	374.3	30.5	26.4	0.0	228.6	0.0	228.6	457.2
21	99	0	0	0	1745.6	21.2	31.2	1.0	0.0	0.0	293.3	30.5	26.4	0.0	228.6	0.0	228.6	457.2
21	99	0	0	0	1511.4	21.2	26.4	1.0	0.0	0.0	265.2	35.3	21.6	0.0	178.6	0.0	178.6	357.1
22	46	0	0	0	3123.2	26	45.1	1.0	0.0	0.0	136.4	39.9	21.6	0.0	126.0	0.0	126.0	252.0
23	20	0	0	0	3518.8	28	50.3	1.0	0.0	0.0	222.2	39.9	12.0	0.0	65.4	0.0	65.4	130.8
24	19	0	0	0	16328.0	26	45.1	1.0	0.0	0.0	265.1	44.7	12.0	0.0	68.8	0.0	68.8	137.5
24	24	0	0	0	13311.0	28	31.2	1.0	0.0	0.0	532.6	38.6	74.2	0.0	51.3	0.0	51.3	102.5
24	24	0	0	0	13311.0	26	26.4	1.0	0.0	0.0	495.3	43.4	74.2	0.0	66.5	0.0	66.5	133.0
26	43	0	0	0	13598.8	28	21.6	1.0	0.0	0.0	397.3	67.9	74.2	0.0	93.8	0.0	93.8	187.5
28	69	0	0	0	13307.4	26	26.4	1.0	0.0	0.0	276.8	72.7	74.2	0.0	63.3	0.0	63.3	126.6
29	53	0	0	0	13990.4	30.5	21.6	1.0	0.0	0.0	372.8	72.7	59.9	0.0	115.6	0.0	115.6	231.2
30	37	0	0	0	20311.3	30.5	16.8	1.0	0.0	0.0	111.7	72.7	55.1	0.0	100.0	0.0	100.0	200.0
32	19	0	0	0	4196.7	35.3	16.8	1.0	0.0	0.0	247.1	72.7	50.3	0.0	89.2	0.0	89.2	178.3
33	38	0	0	0	7646.0	39.9	16.8	1.0	0.0	0.0	253.8	72.7	49.4	0.0	75.9	0.0	75.9	151.8
33	85	0	0	0	1558.8	44.7	16.8	1.0	0.0	0.0	195.1	72.7	44.6	0.0	105.4	0.0	105.4	210.8
35	43	0	0	0	7008.1	49.3	12	1.0	0.0	0.0	92.7	72.7	39.9	0.0	110.5	0.0	110.5	221.0
36	36	0	0	0	7184.6	49.3	16.8	1.0	0.0	0.0	80.3	72.7	35.1	0.0	96.4	0.0	96.4	192.7
37	35	0	0	0	4602.7	54	12	1.0	0.0	0.0	64.0	72.7	30.3	0.0	93.6	0.0	93.6	187.1



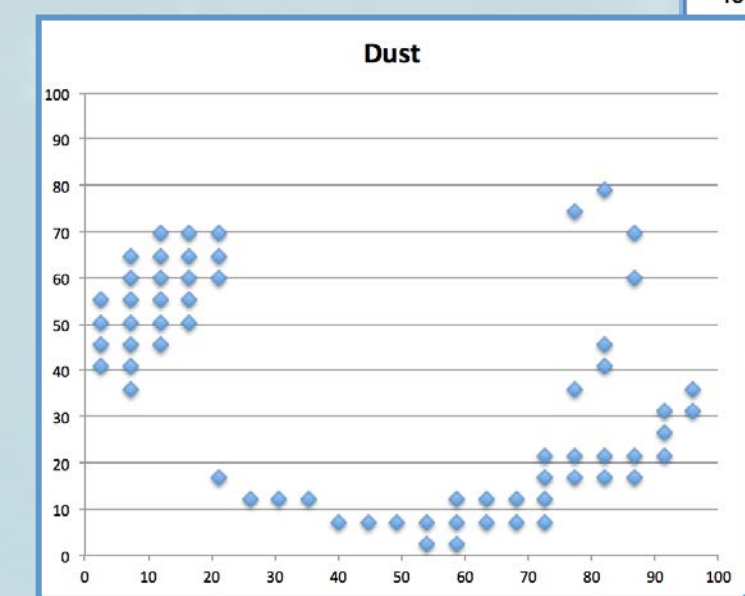
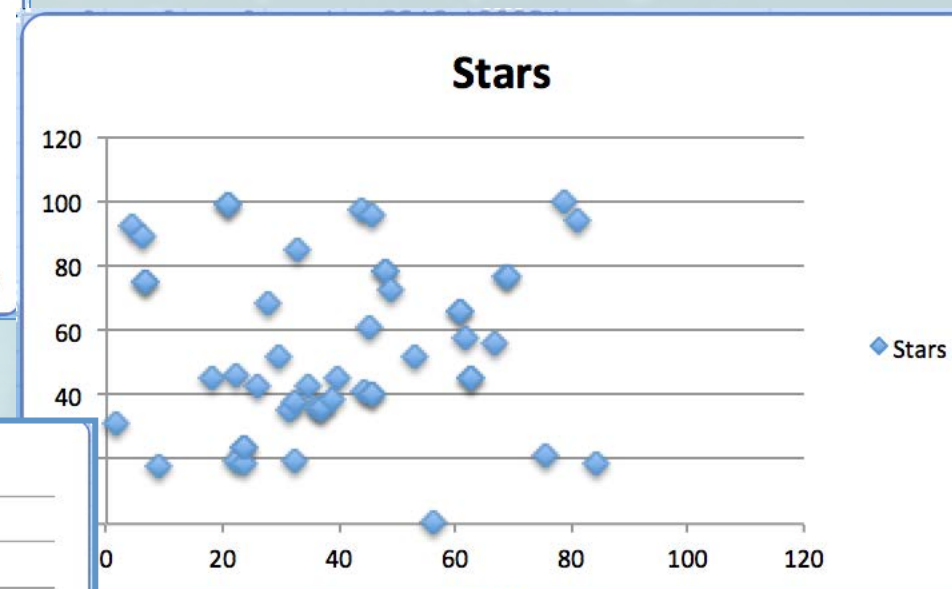
Combine information from annotated visual image with science data



Graphical annotation



X-Y, Z, intensity data



Textures for all features on swellform paper

NGC 602 TEXTURE KEY  
Dust & gas combined

NGC 602 TEXTURE KEY  
Stars

NGC 602 TEXTURE KEY  
Gas

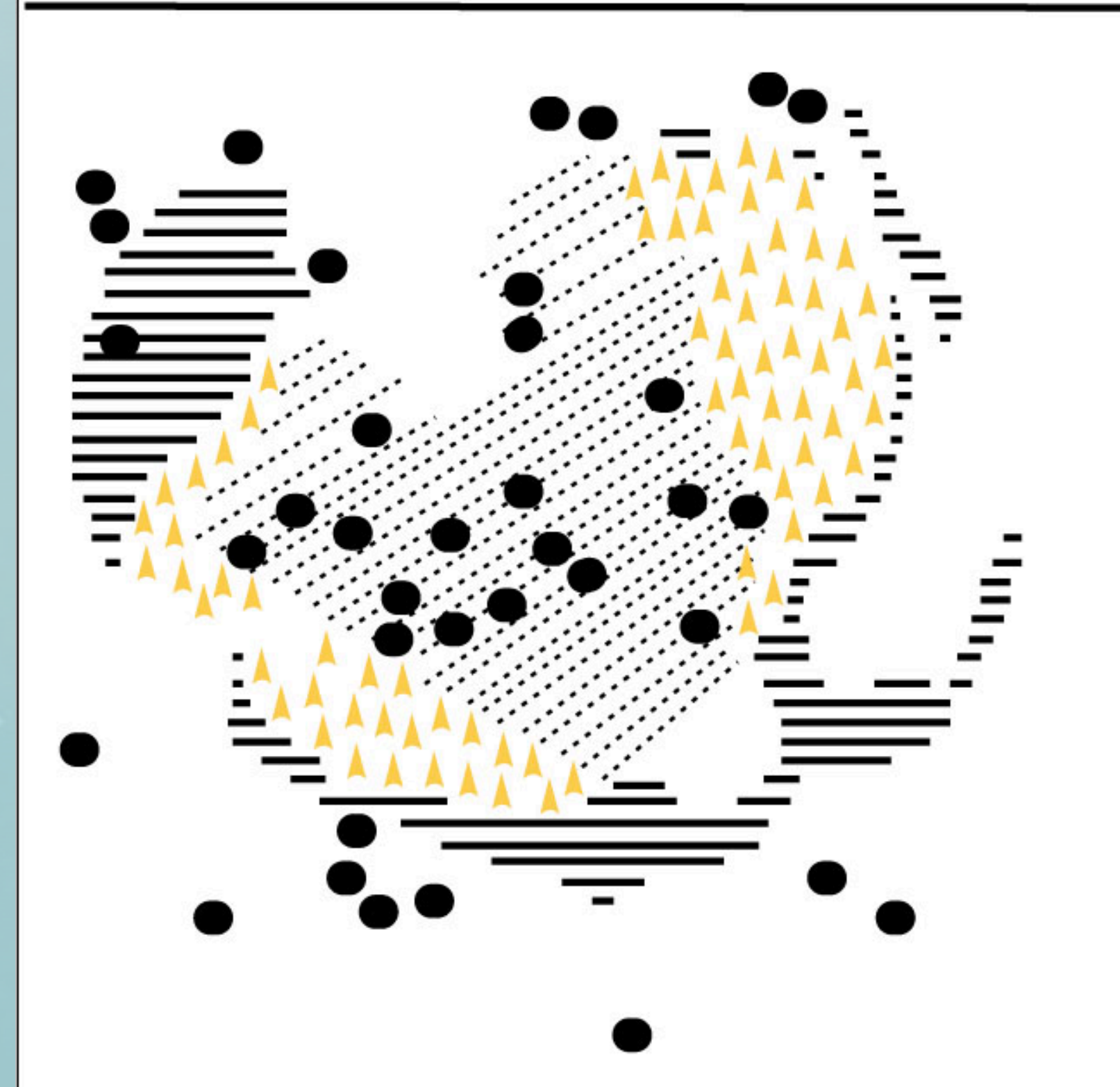
NGC 602 TEXTURE KEY  
Dust

NGC 602 TEXTURE KEY

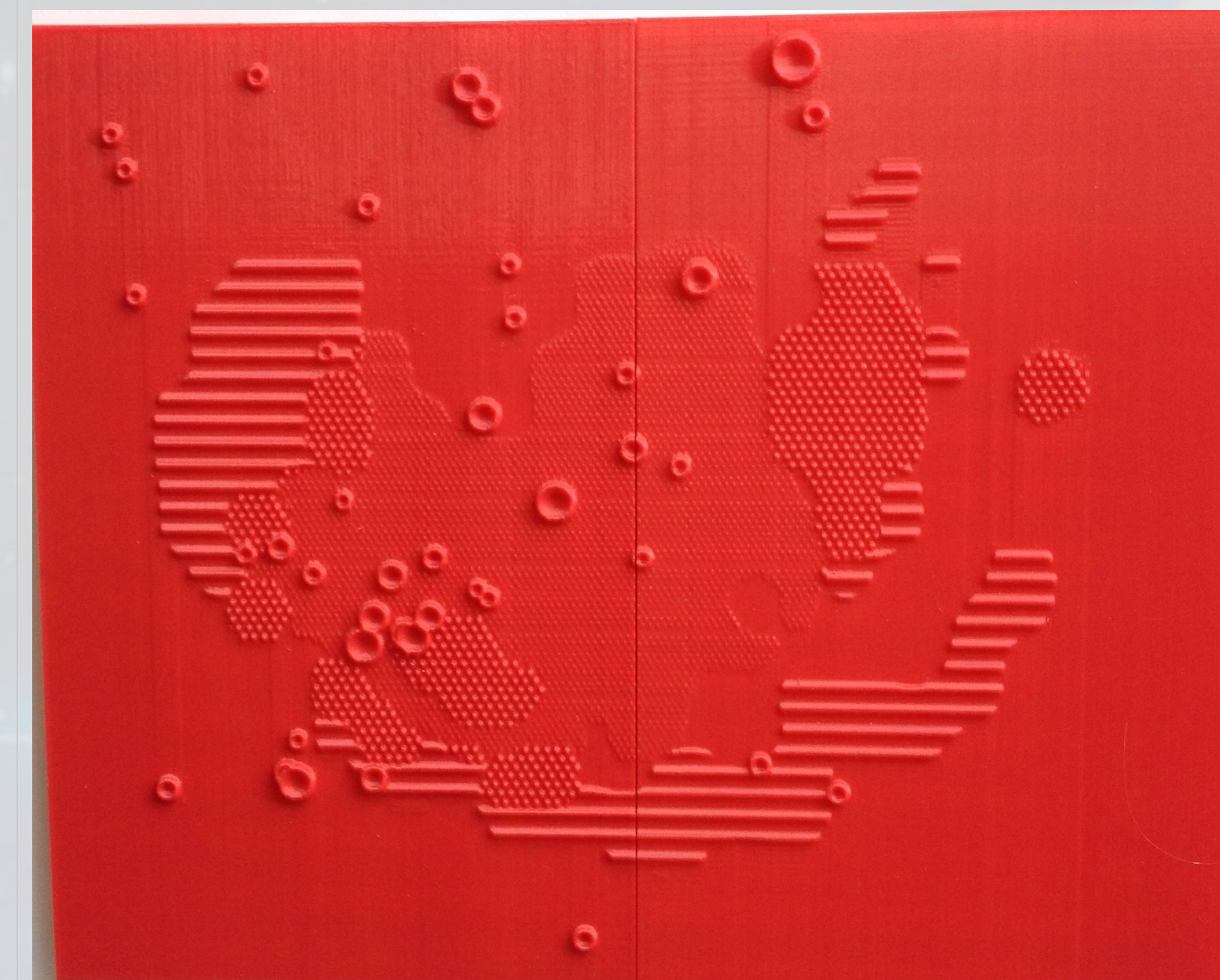
≡≡≡ dust

▲▲▲ dust and gas combined

● star



## Composite textures and interpolated intensity maps

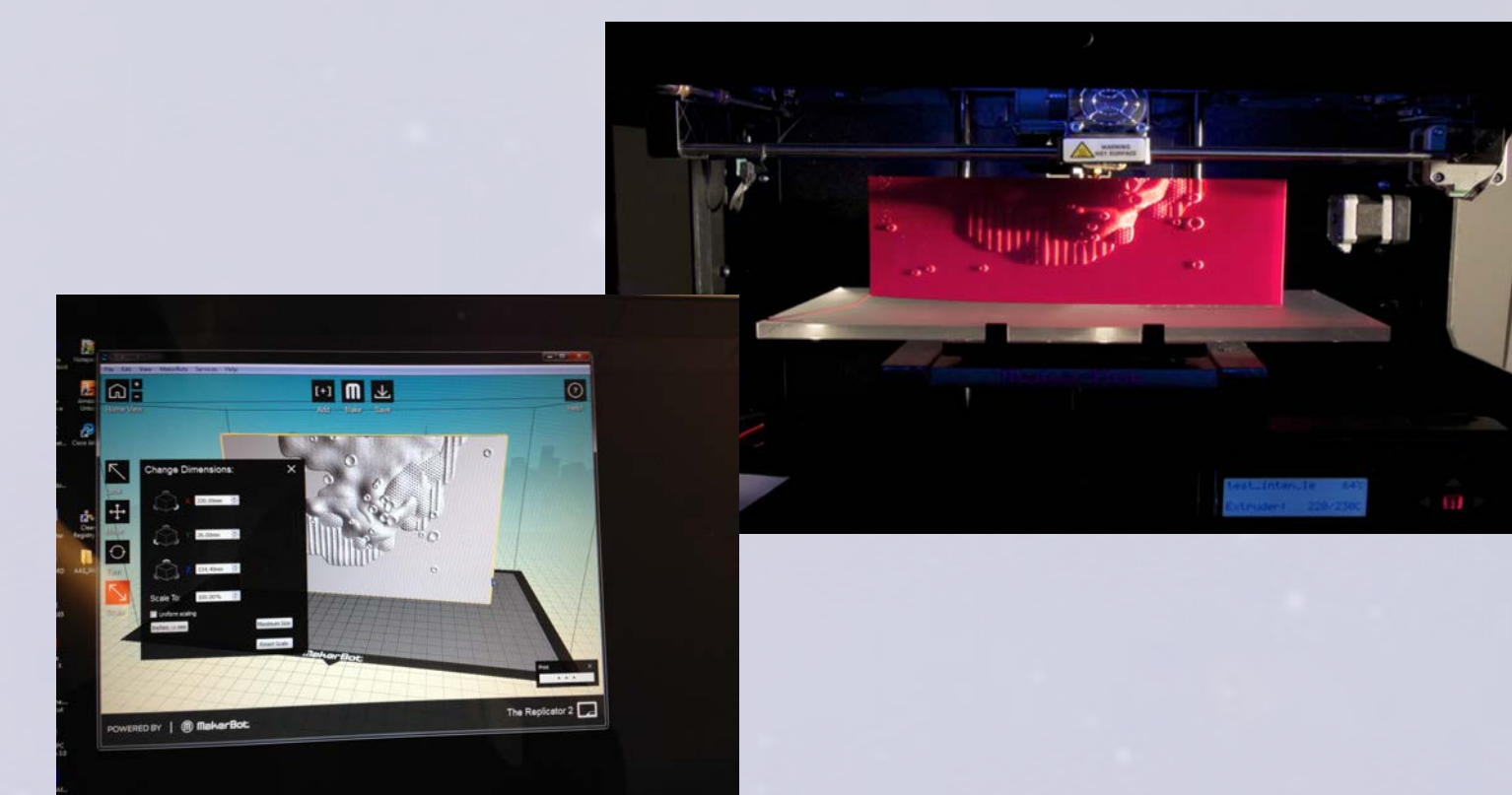
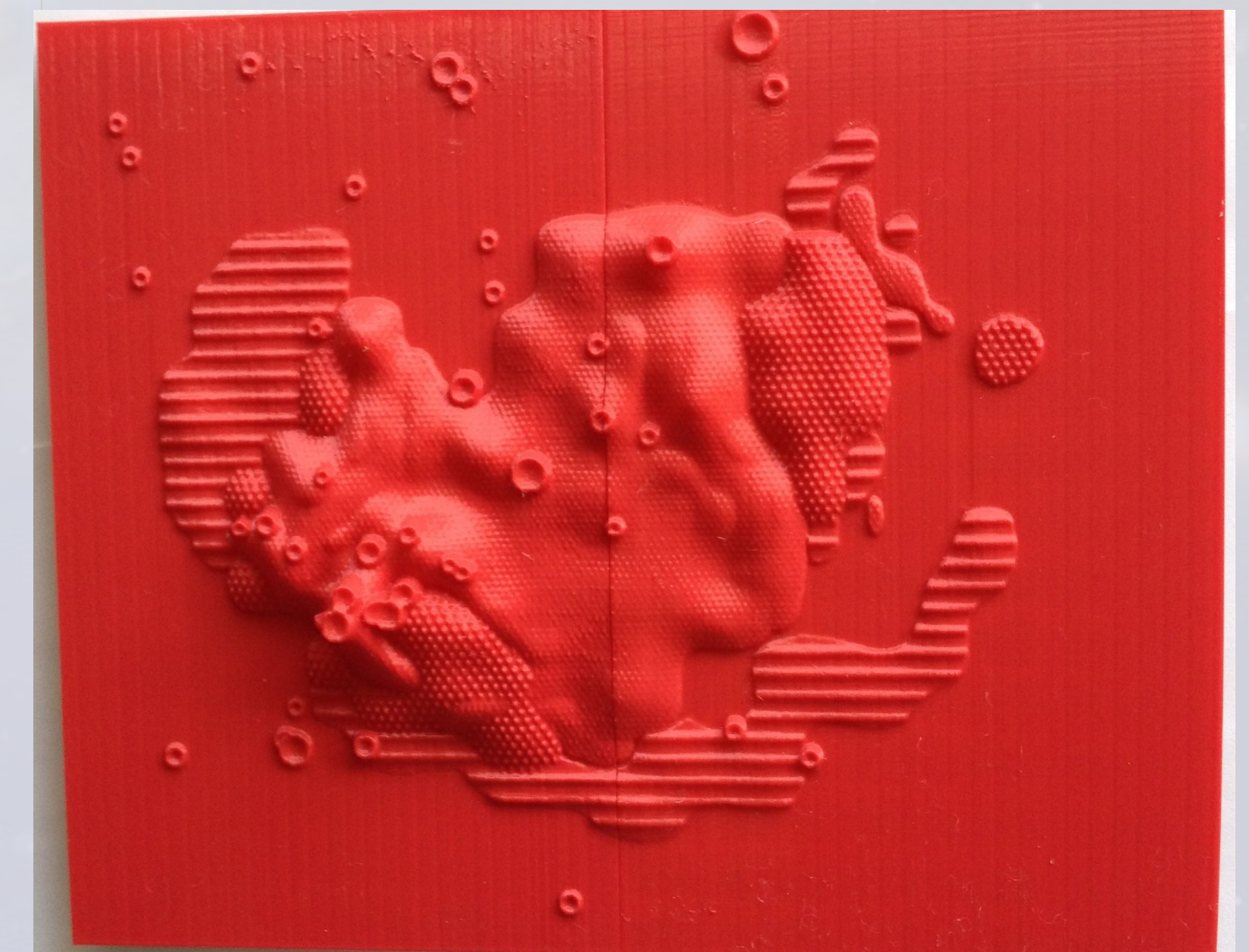


NGC 602 composite 3D texture print

- Tactile equivalent of the HST image
- Features are represented by unique textures

NGC 602 composite 3D intensity elevation print

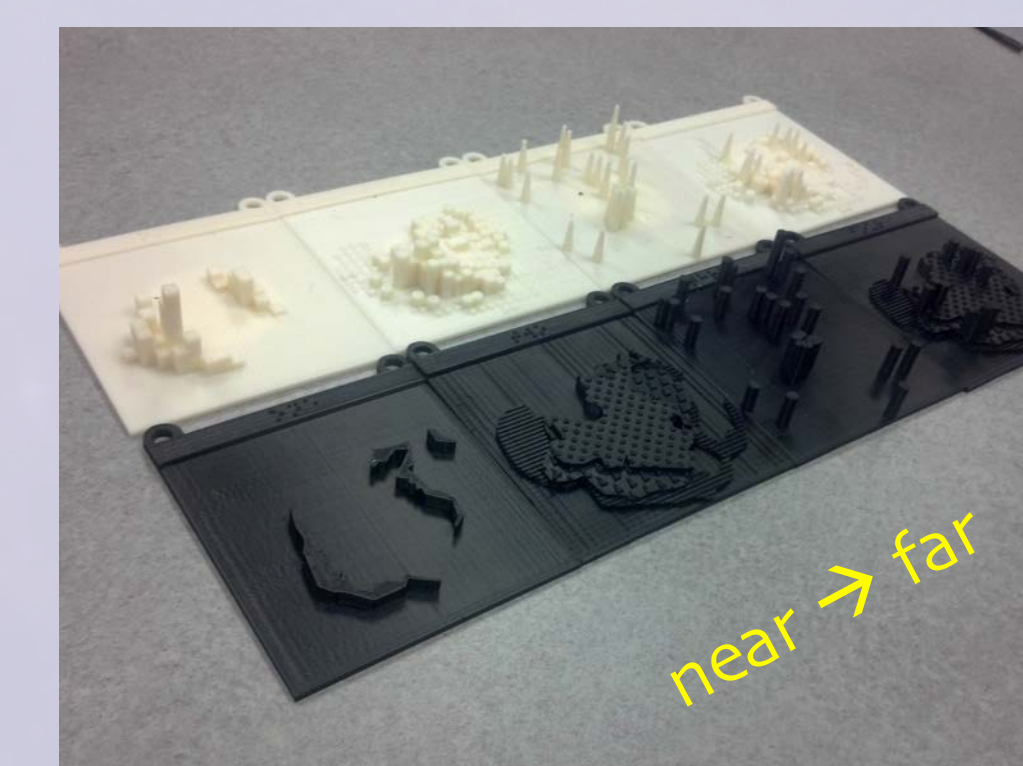
- Exhibits features with unique textures *and* elevation representing the scaled intensities
- Intensity related to "amount" of material



Transformation from image information, graphic representation, science data *plus* artistry to 3D format at desired resolutions through custom programs created at STScI

Users at National Federation of the Blind events provide feedback and recommendations: Tested usability, clear identification of features, understanding of distance layers

Low resolution early test prints – "toy stack"



- textured features (black)
- intensity layers (white)
- each distance a separate layer

