



SPARKLY BUT NOT TOO SPARKLY!

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Anti-aliasing a procedural sparkle effect

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SIGGRAPH 2015 Advances in Real-Time Rendering in Games

SNOW SPARKLE



SNOW SPARKLE



WHY PROCEDURAL?

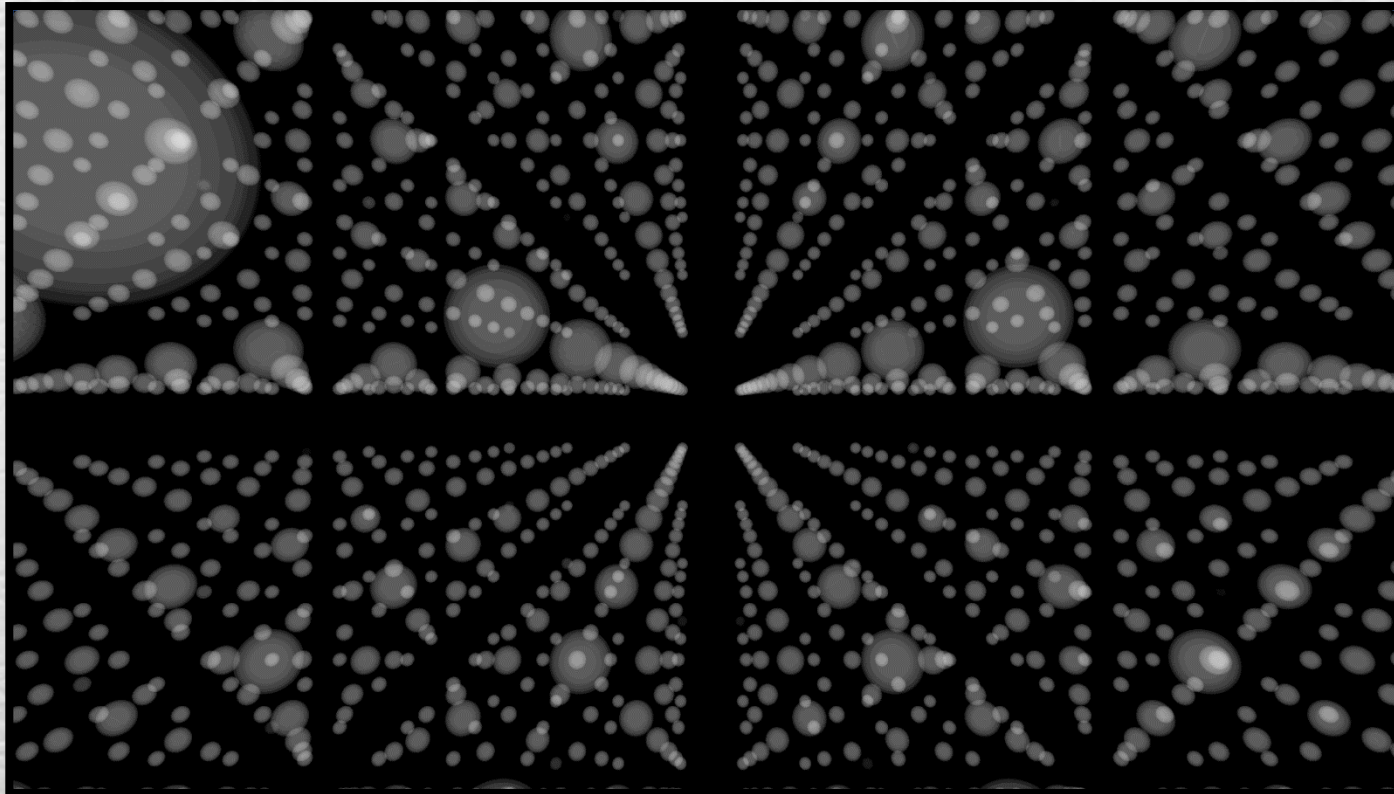
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- Reasonably difficult to achieve with normal maps
- Wanted option to have procedural sparkles over a large depth range
 - Miniaturisation of scene
- To work independent of lighting conditions
- To be present in shadows and indoors

PROCEDURAL SPARKLES

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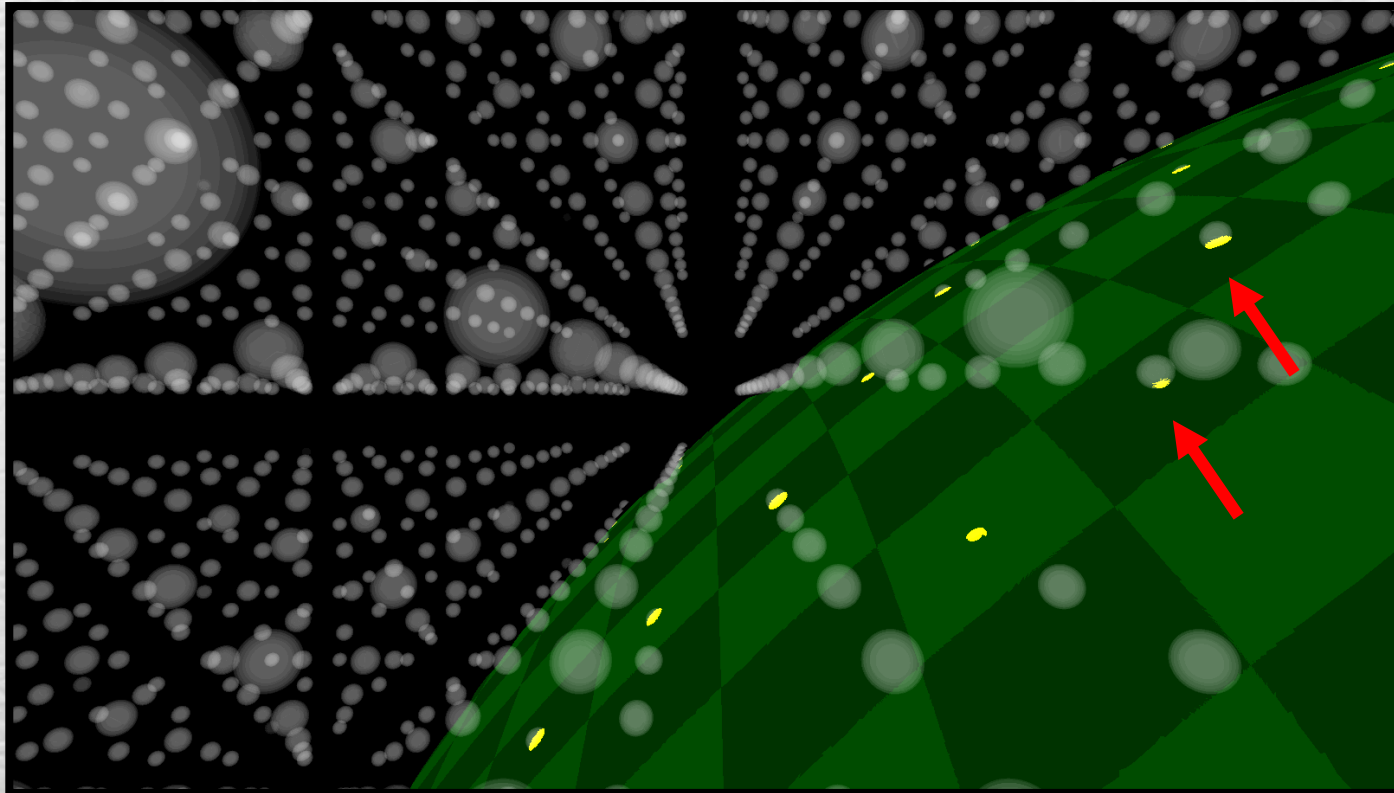
- Algorithm from Shopf: intersect sparkle grid with surface



PROCEDURAL SPARKLES

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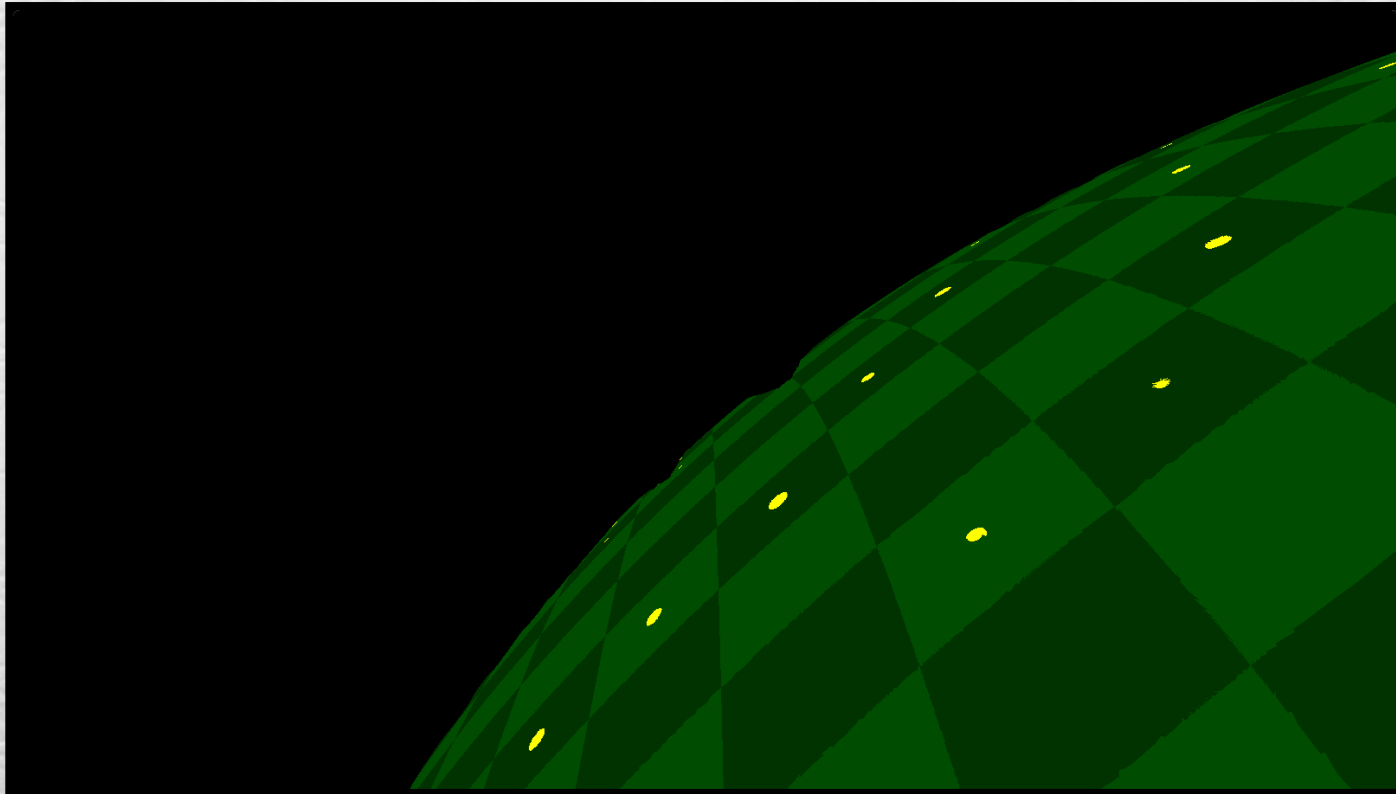
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PROCEDURAL SPARKLES

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- Algorithm from Shopf: intersect sparkle grid with surface



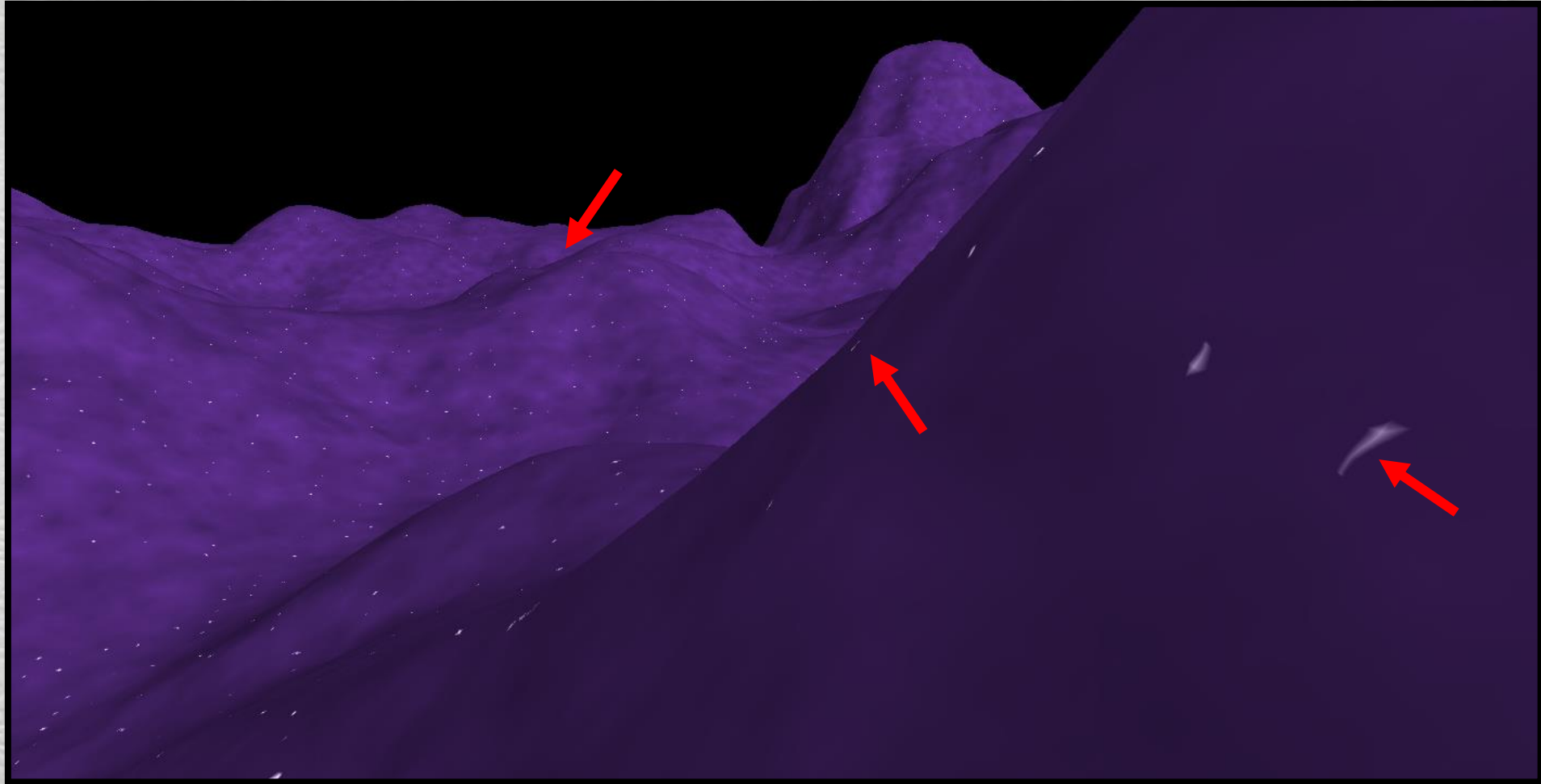
PROCEDURAL SPARKLES

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- Finally, a number of offsets are applied to the grid
 - 3D noise
 - View vector
 - Time component

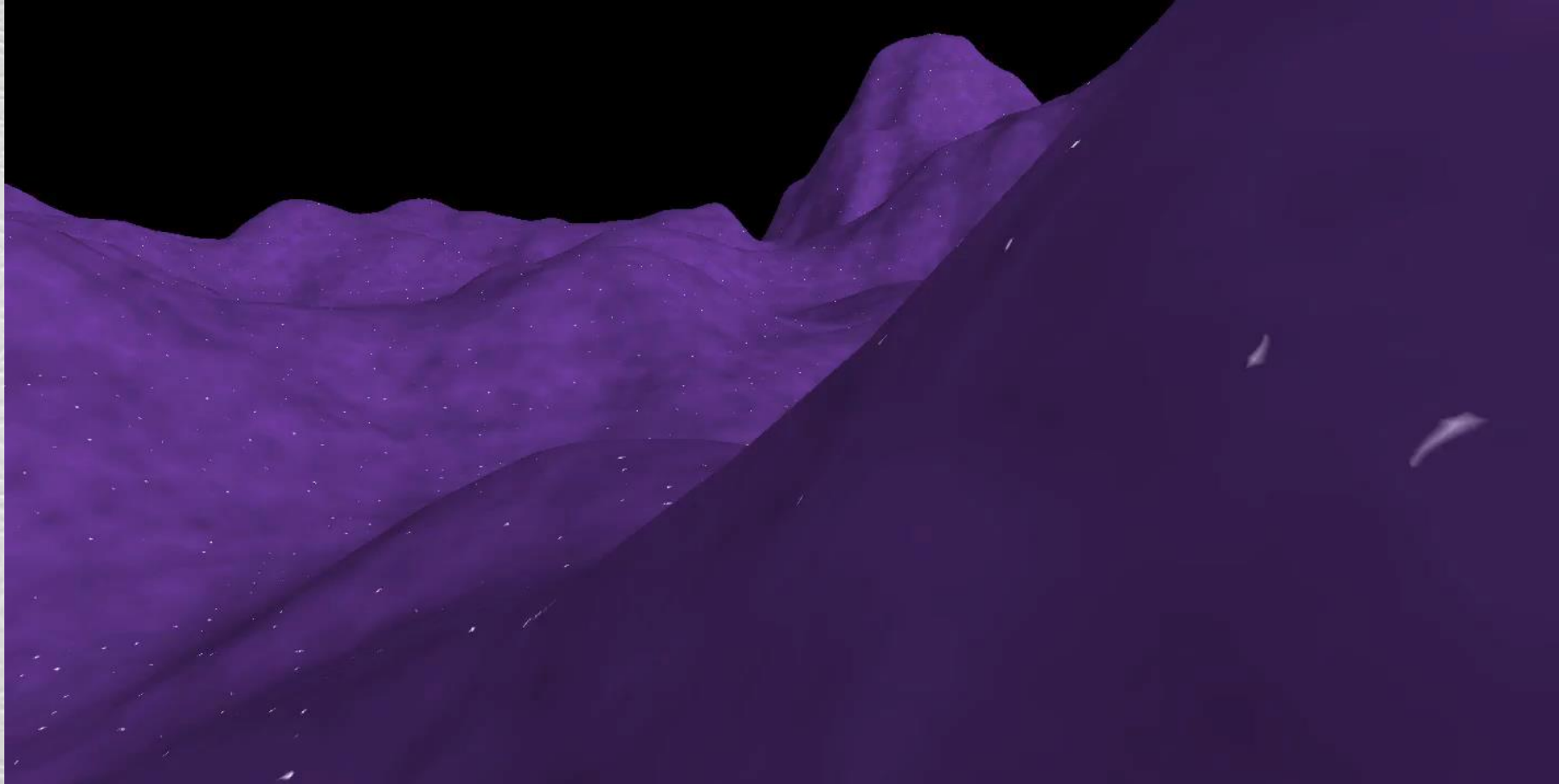
PROCEDURAL SPARKLES – ISSUES

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PROCEDURAL SPARKLES – ISSUES

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CONTENTS

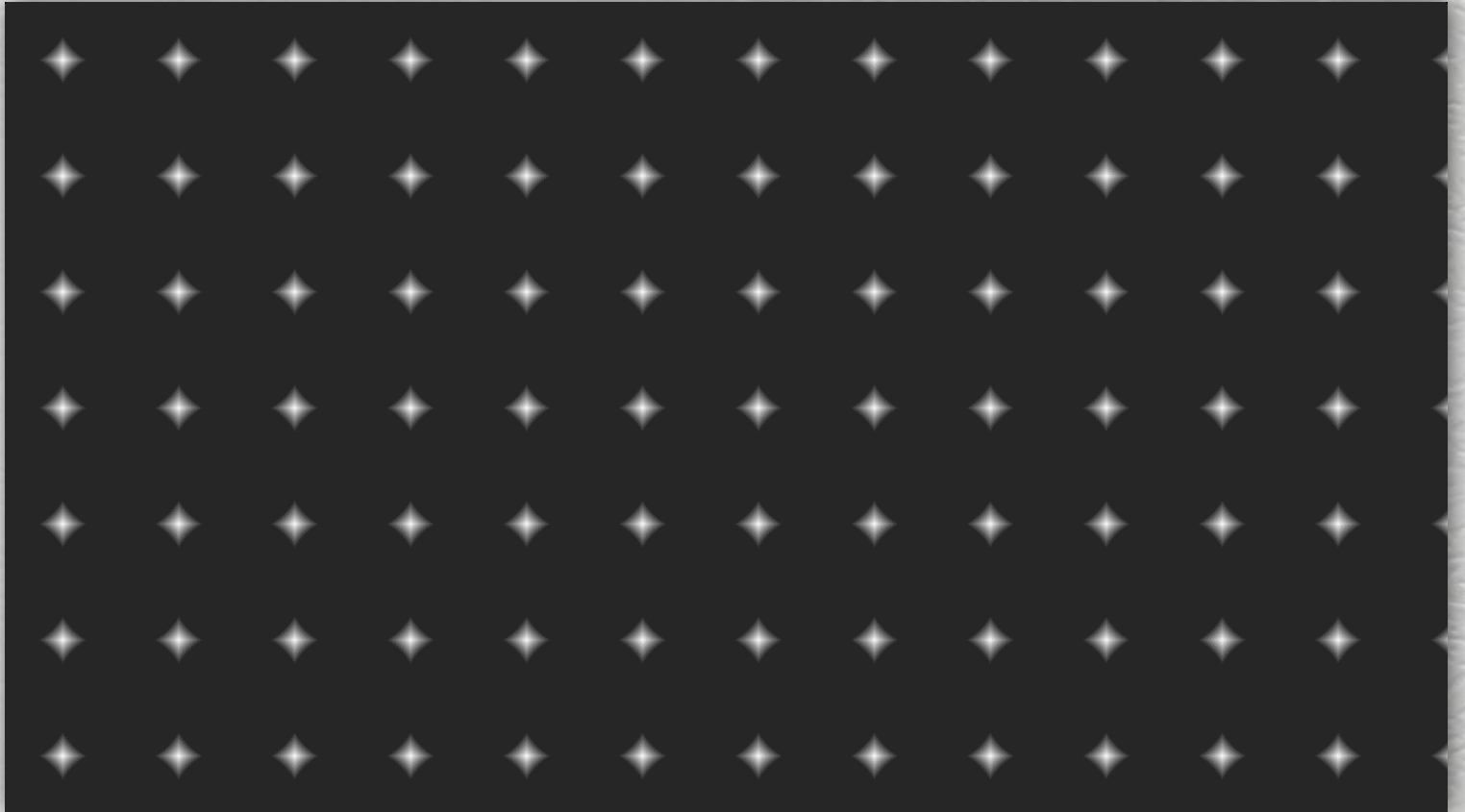
- Sparkle shape
- Expanding distance range
- Noise distortion
- Anisotropy

CONTENTS

- Sparkle shape
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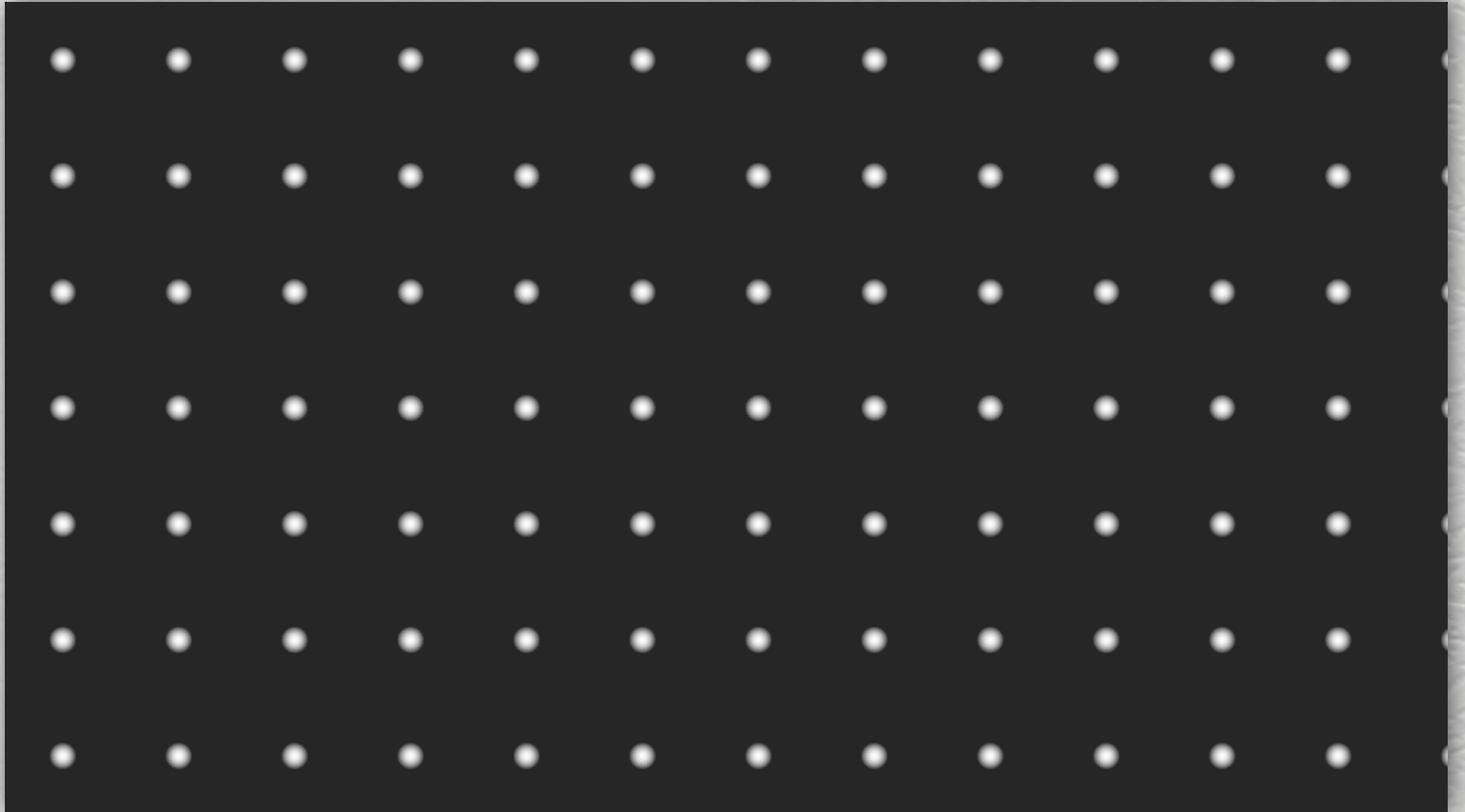
SPARKLE SHAPE

- Sharp and pointy
- Frequent odd shapes
- Does not scale down well



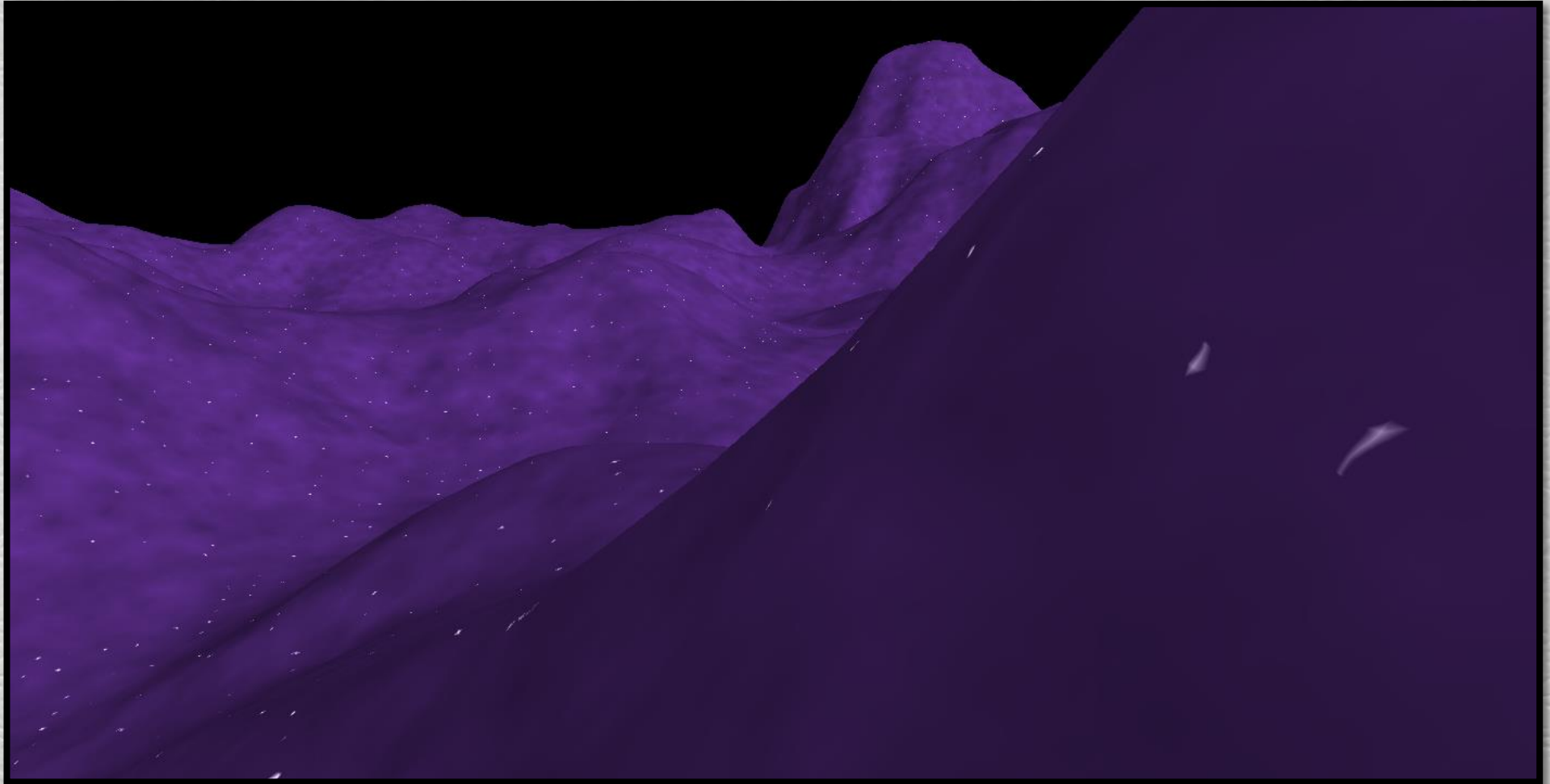
SPARKLE SHAPE

- Simply make round
- Reduces odd shapes
- Scales down well
- Simpler



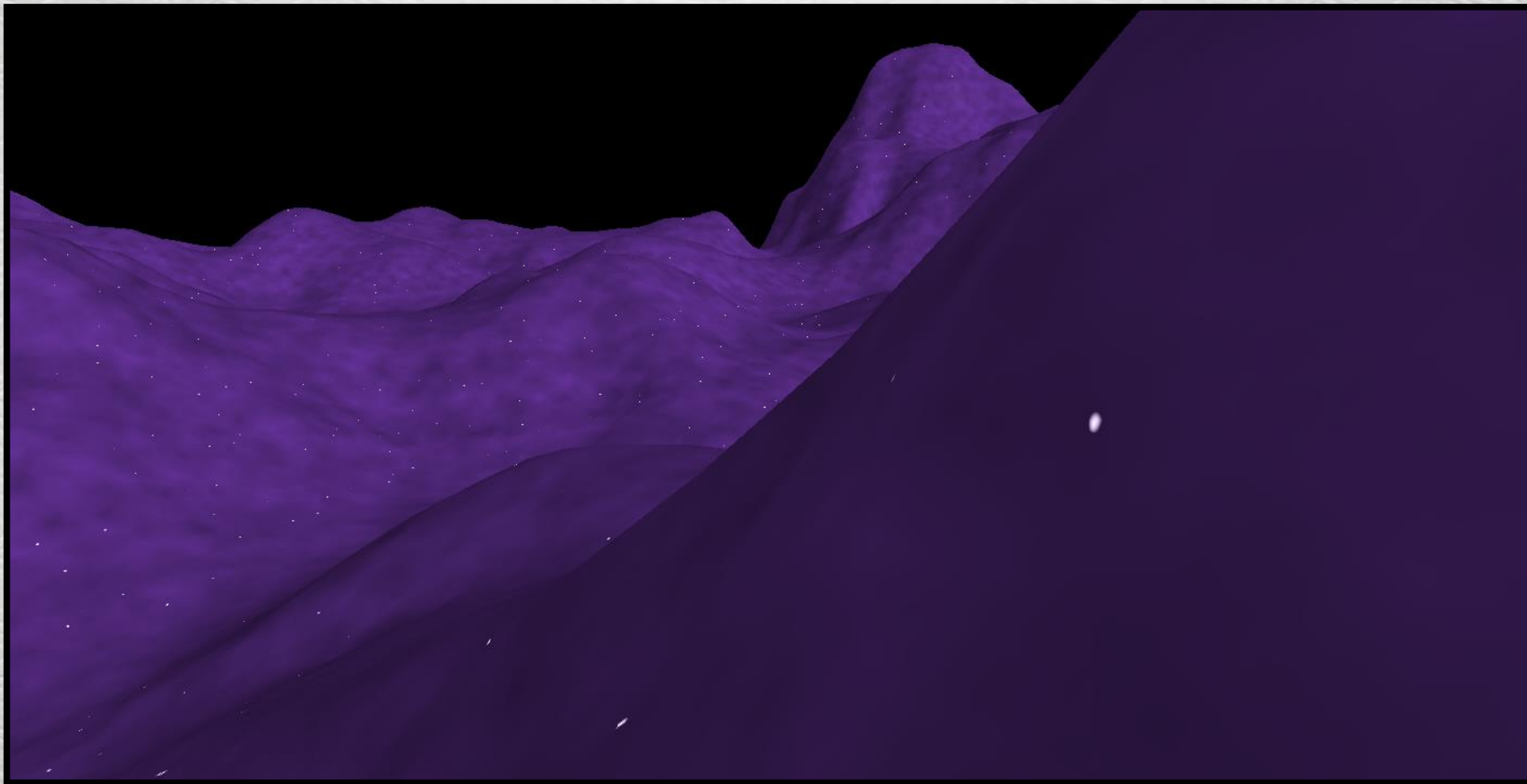
SPARKLE SHAPE – BEFORE

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SPARKLE SHAPE – AFTER

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CONTENTS

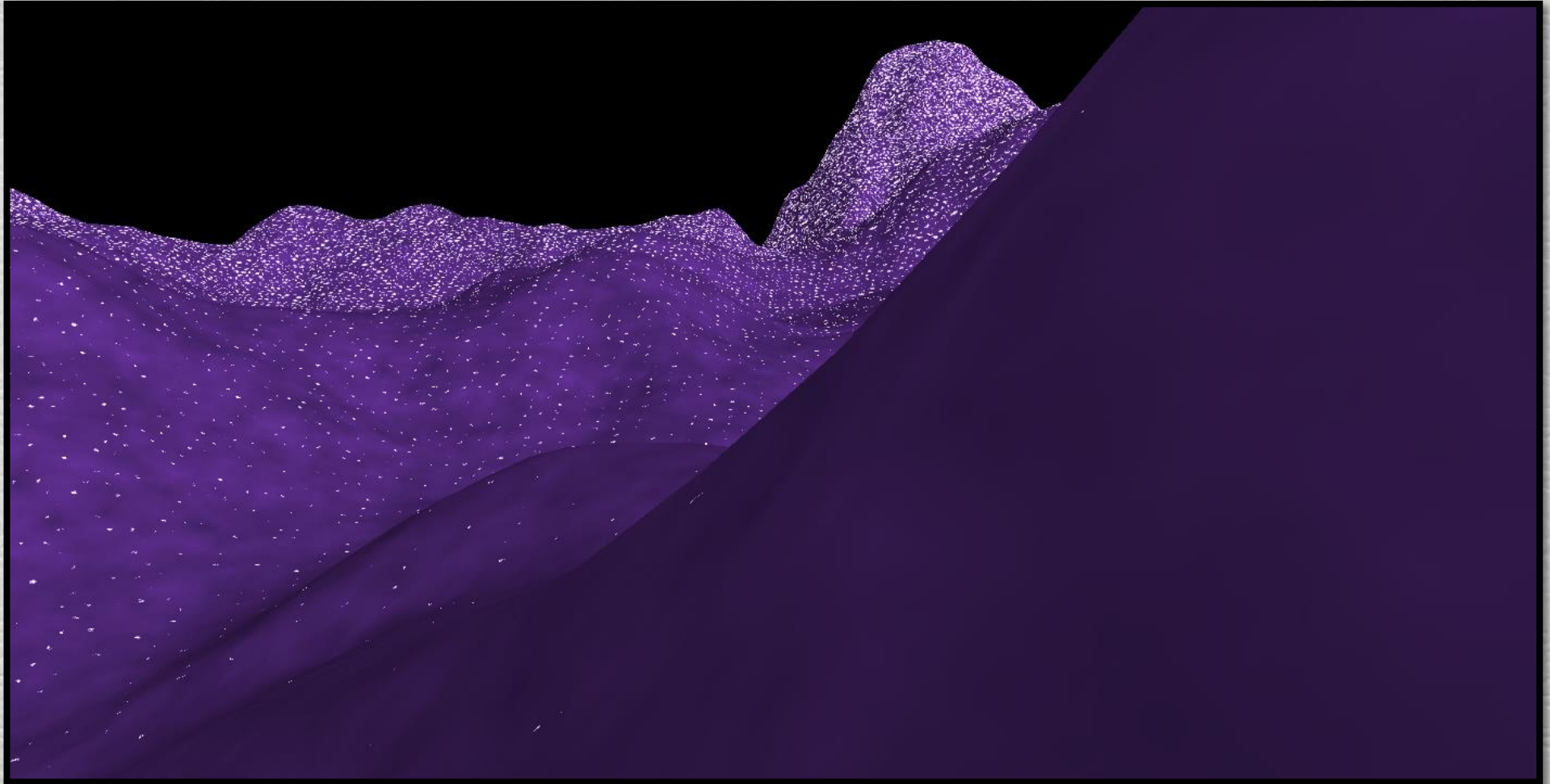
- Sparkle shape
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SPARKLE SIZE

- Sparkle size inappropriate outside narrow depth range
- Multiply size by Z to compensate for perspective

SPARKLE SIZE

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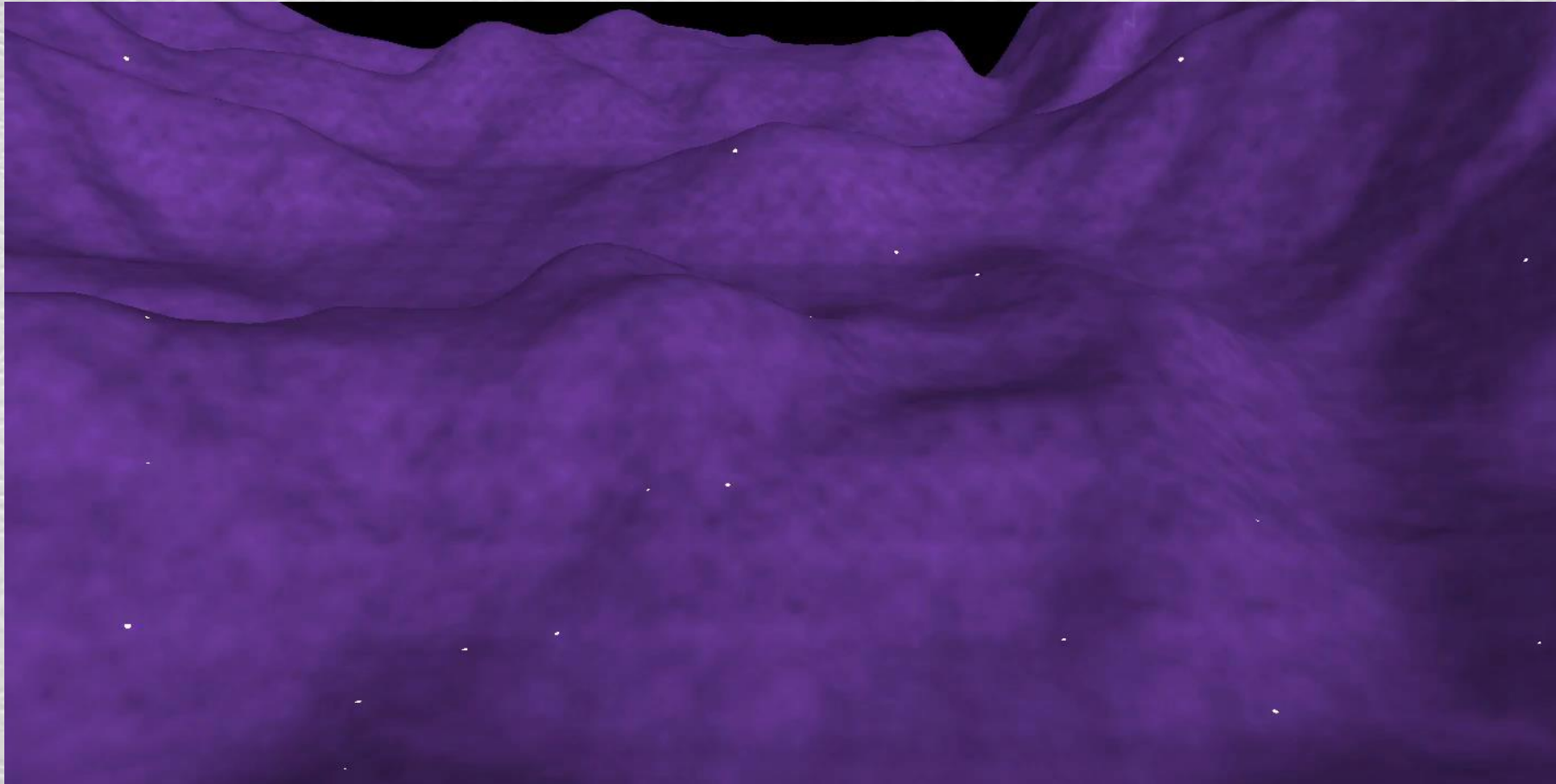


GRID SCALING

- Could blend multiple grids
 - Requires multiple sparkle computations
- Scale grid based on distance?

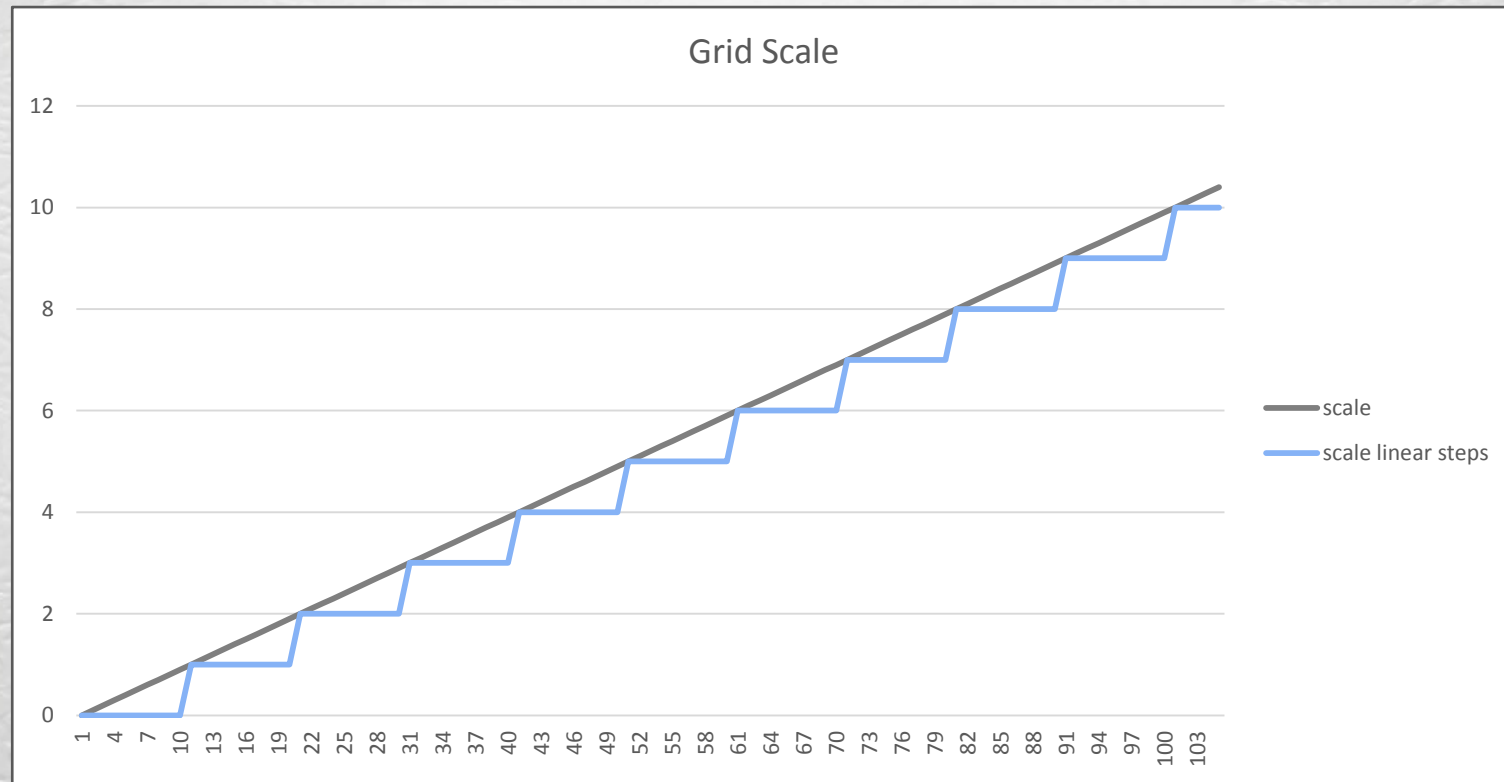
GRID SCALING

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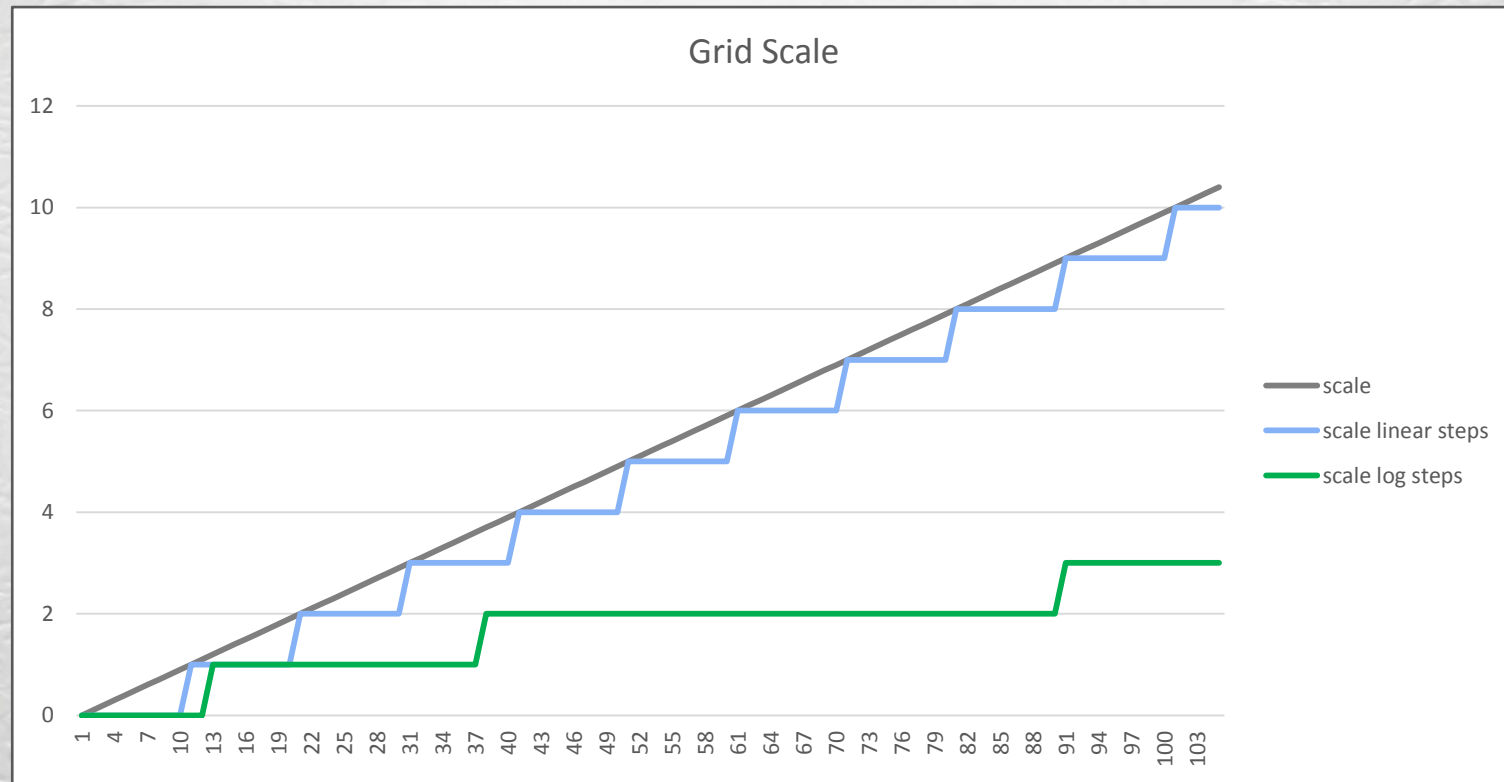
GRID LEVELS

- Solution - step the grid scale



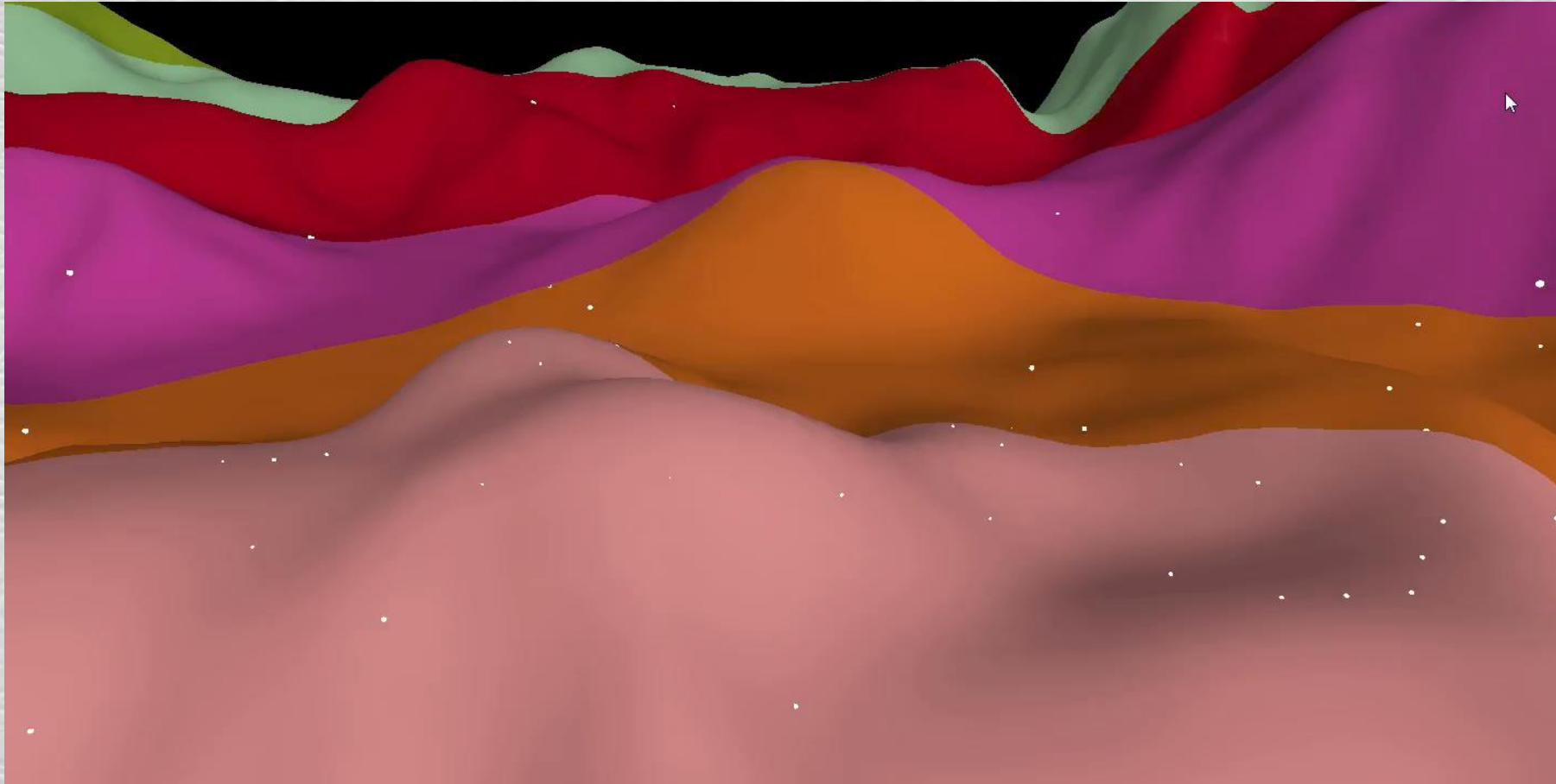
GRID LEVELS

- Logarithmic steps

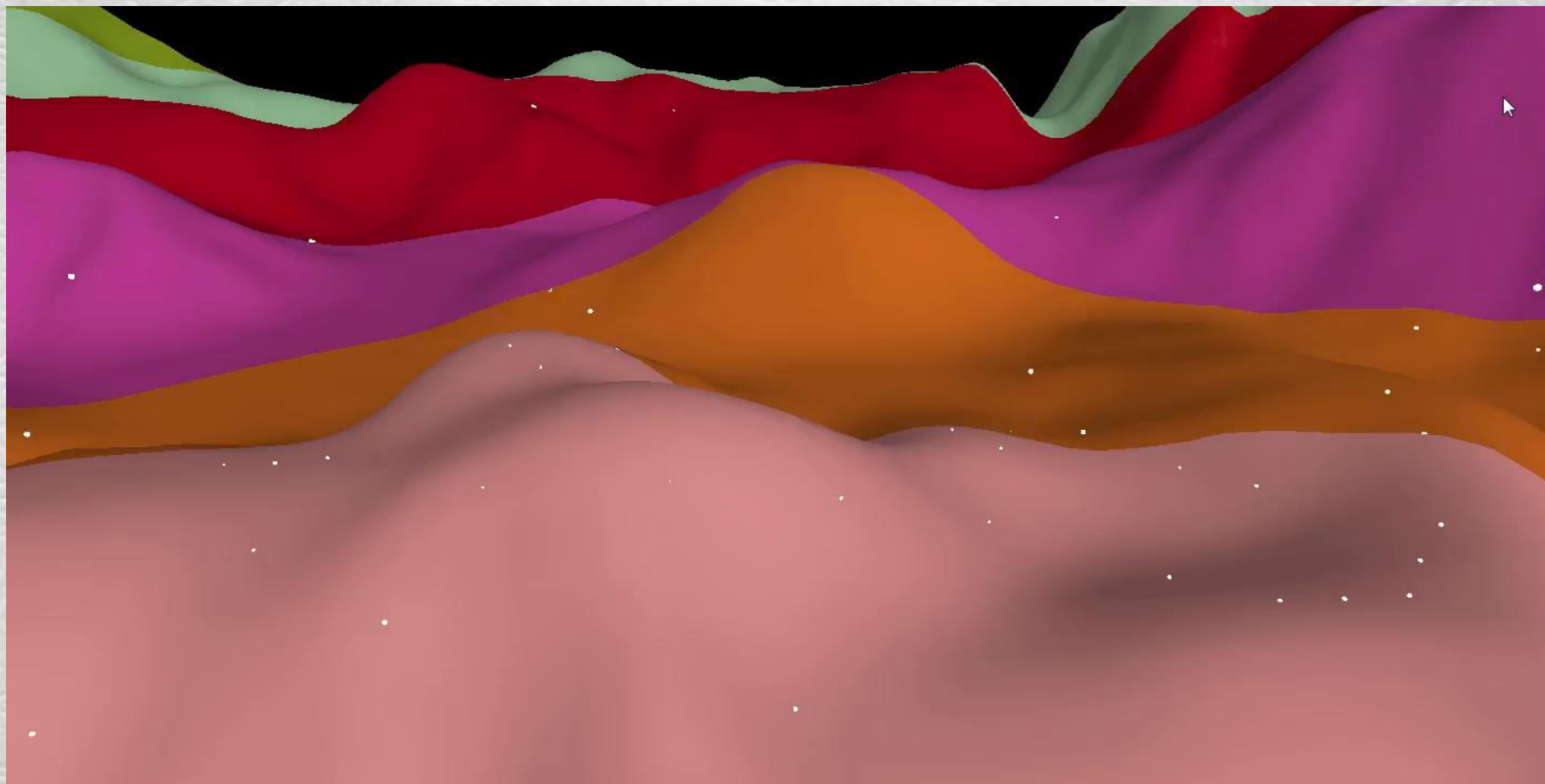


LINEAR GRID LEVELS

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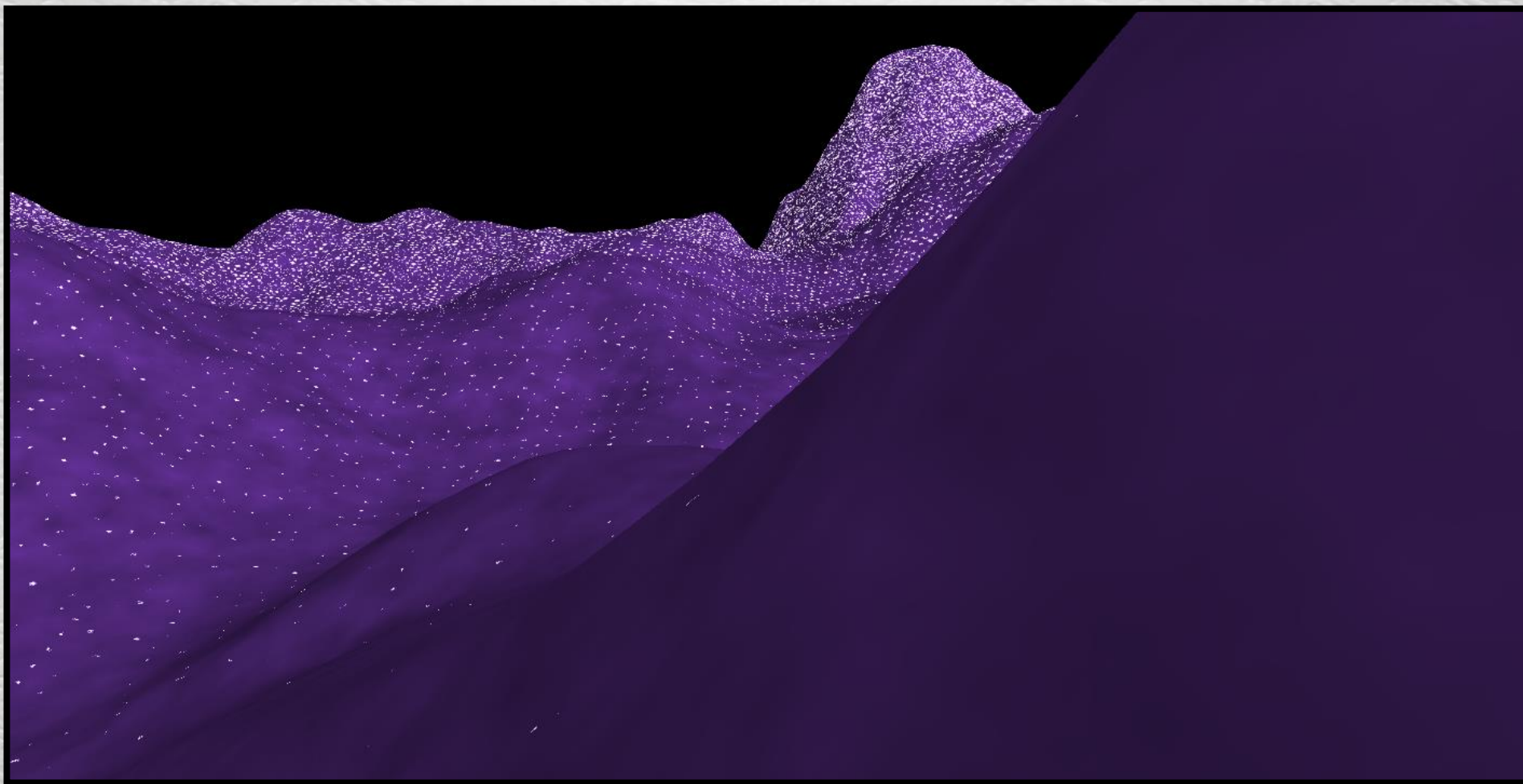


LOG GRID LEVELS



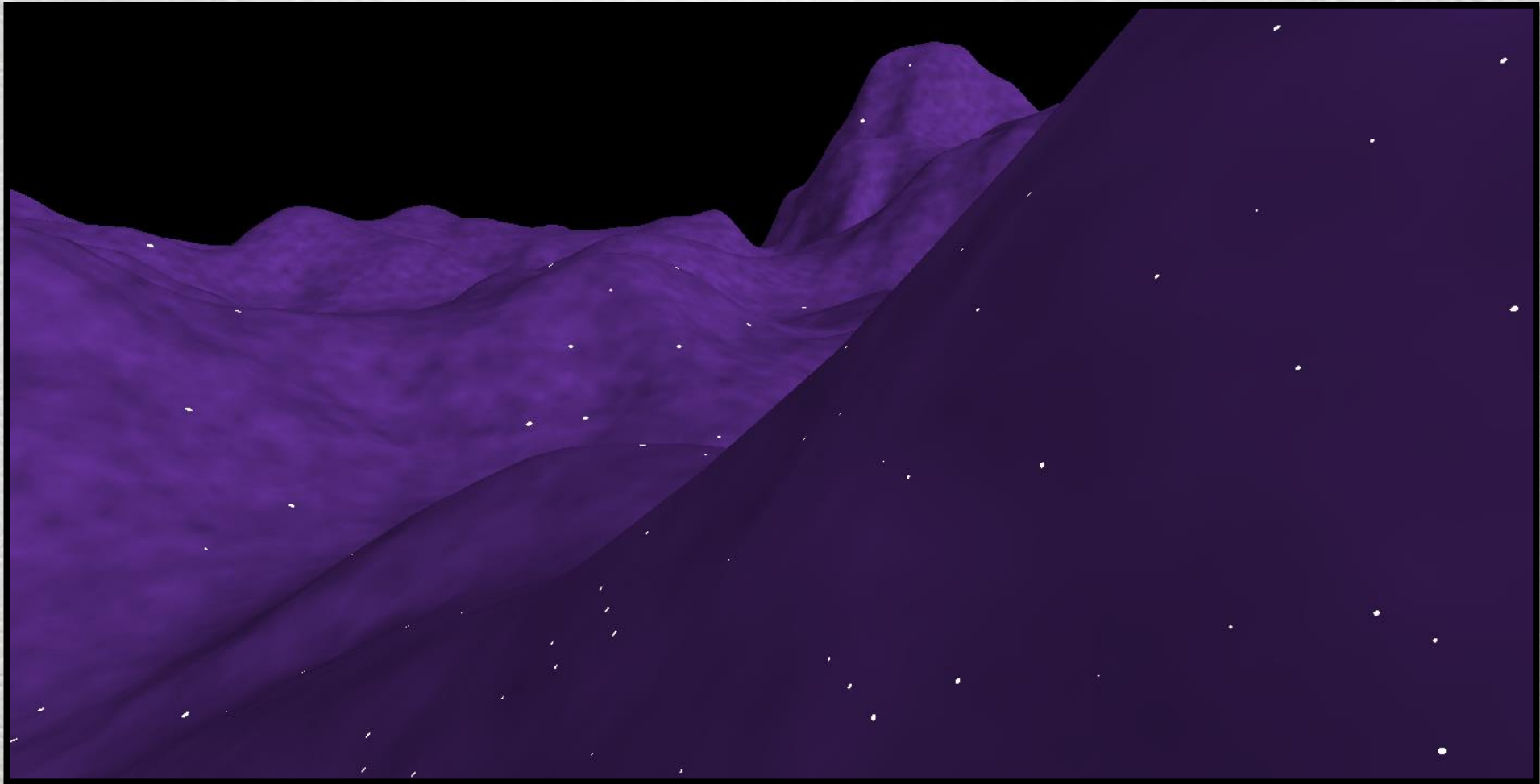
ONE GRID LEVEL

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MULTIPLE GRID LEVELS

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VIEW DEPENDENCE

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- We shift the sparkle grid based on the view vector



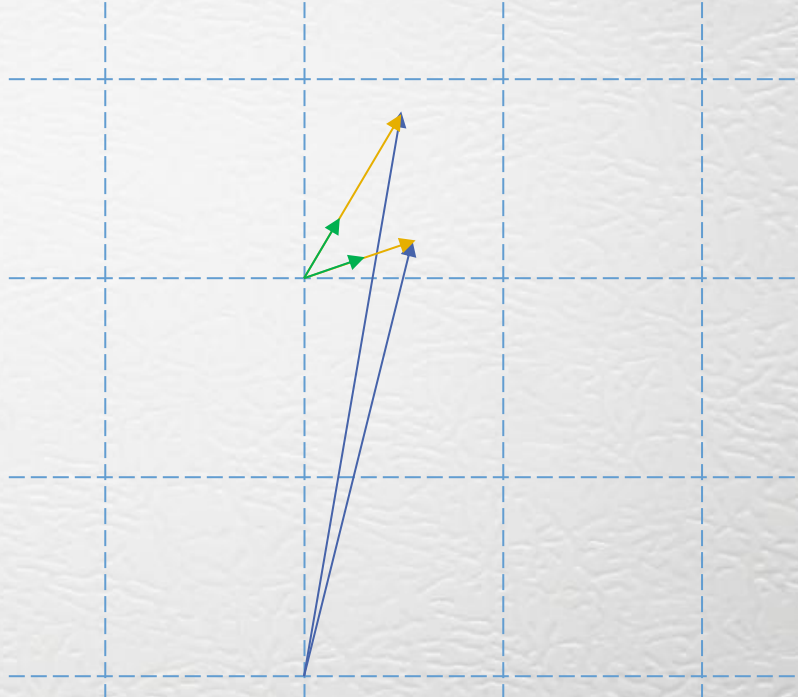
View vectors (blue) very similar
when normalized (green)

VIEW DEPENDENCE

- We shift the sparkle grid based on the view vector



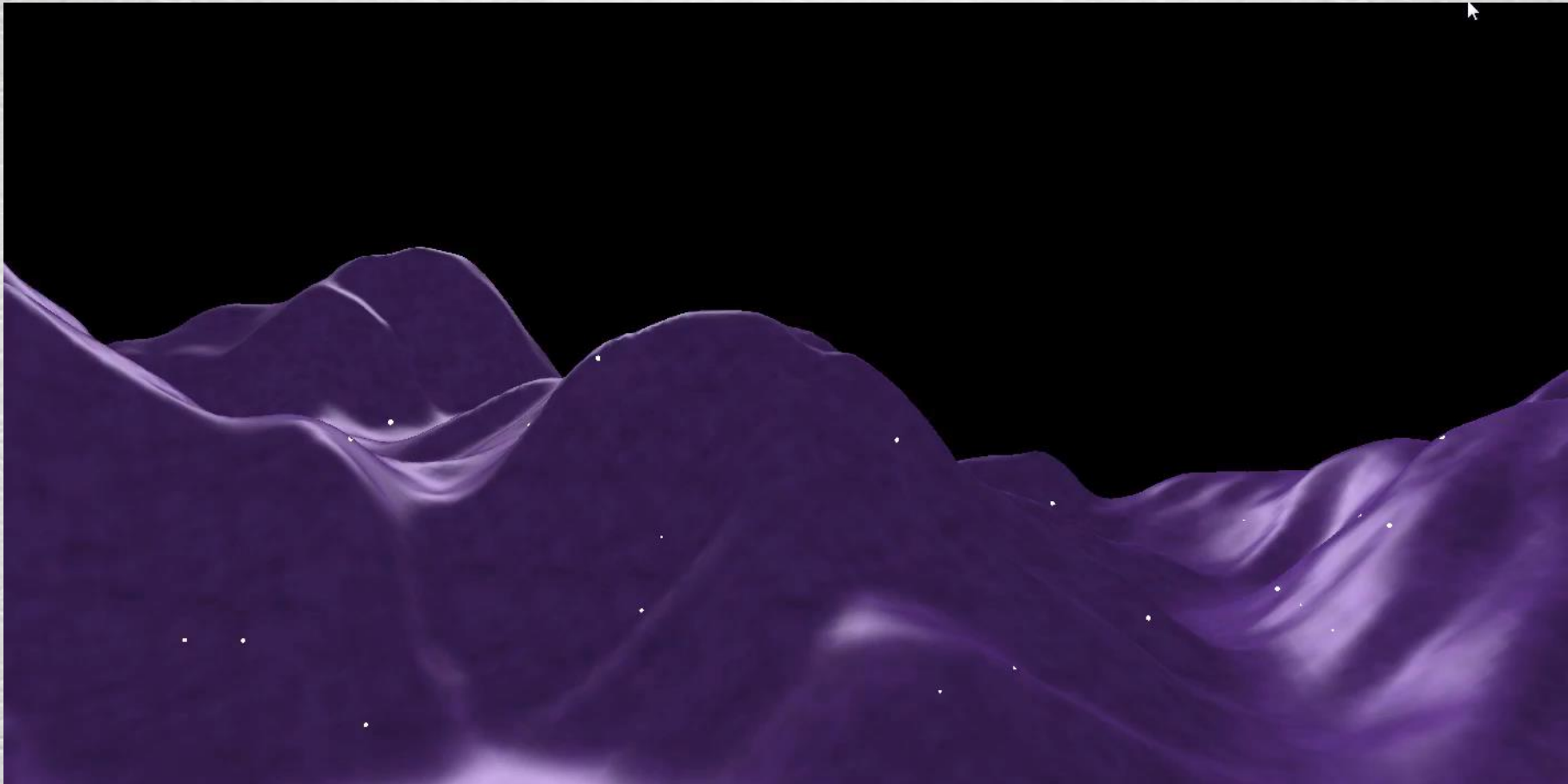
View vectors (blue) very similar
when normalized (green)



Modulus (orange) before normalisation
produces variation in result (green)

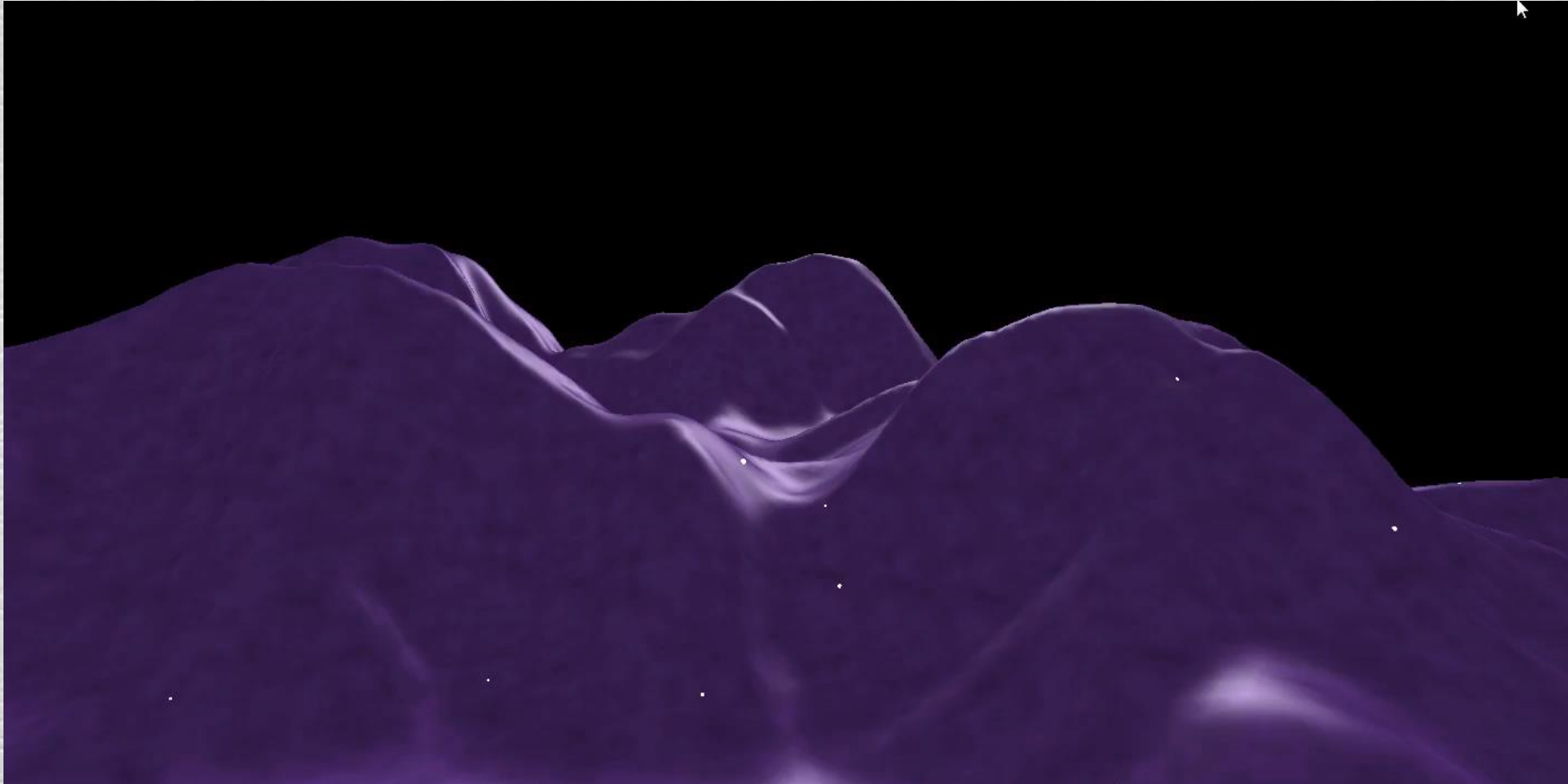
VIEW DEPENDENCE OFF

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VIEW DEPENDENCE ON

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CONTENTS

- Sparkle shape
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NOISE DISTORTION

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- Grid look ups jittered by a 3D noise function
- Strong compression/expansion of the sparkle shapes
- Looks unattractive and makes aliasing difficult to deal with

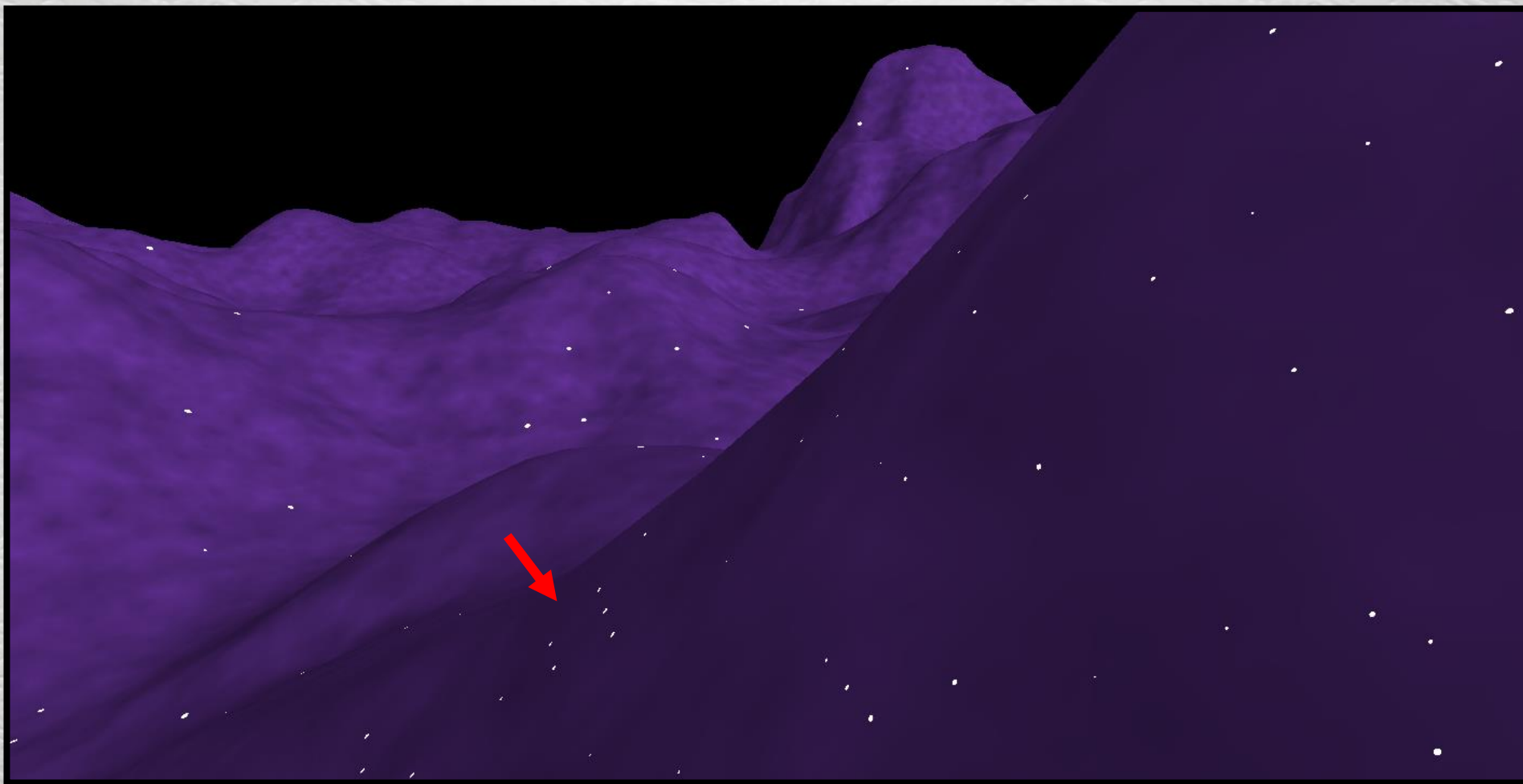
NOISE DISTORTION

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- Jitter sparkle center only
- Compute nearby sparkle grid point and jitter its position
- No distortion

WITHOUT NOISE

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APPLY NOISE TO LOOK UPS

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APPLY NOISE TO SPARKLE CENTER ONLY

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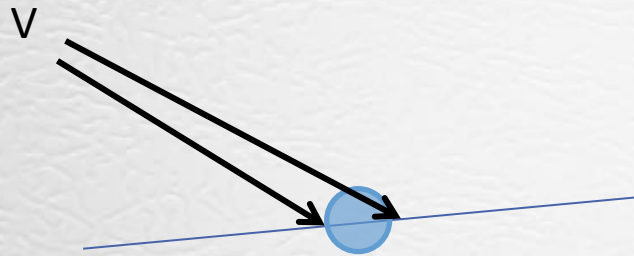
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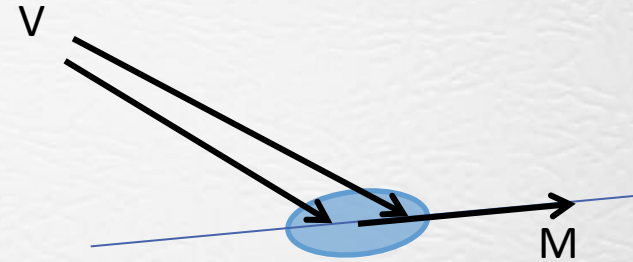
ANISOTROPY

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- Before



After



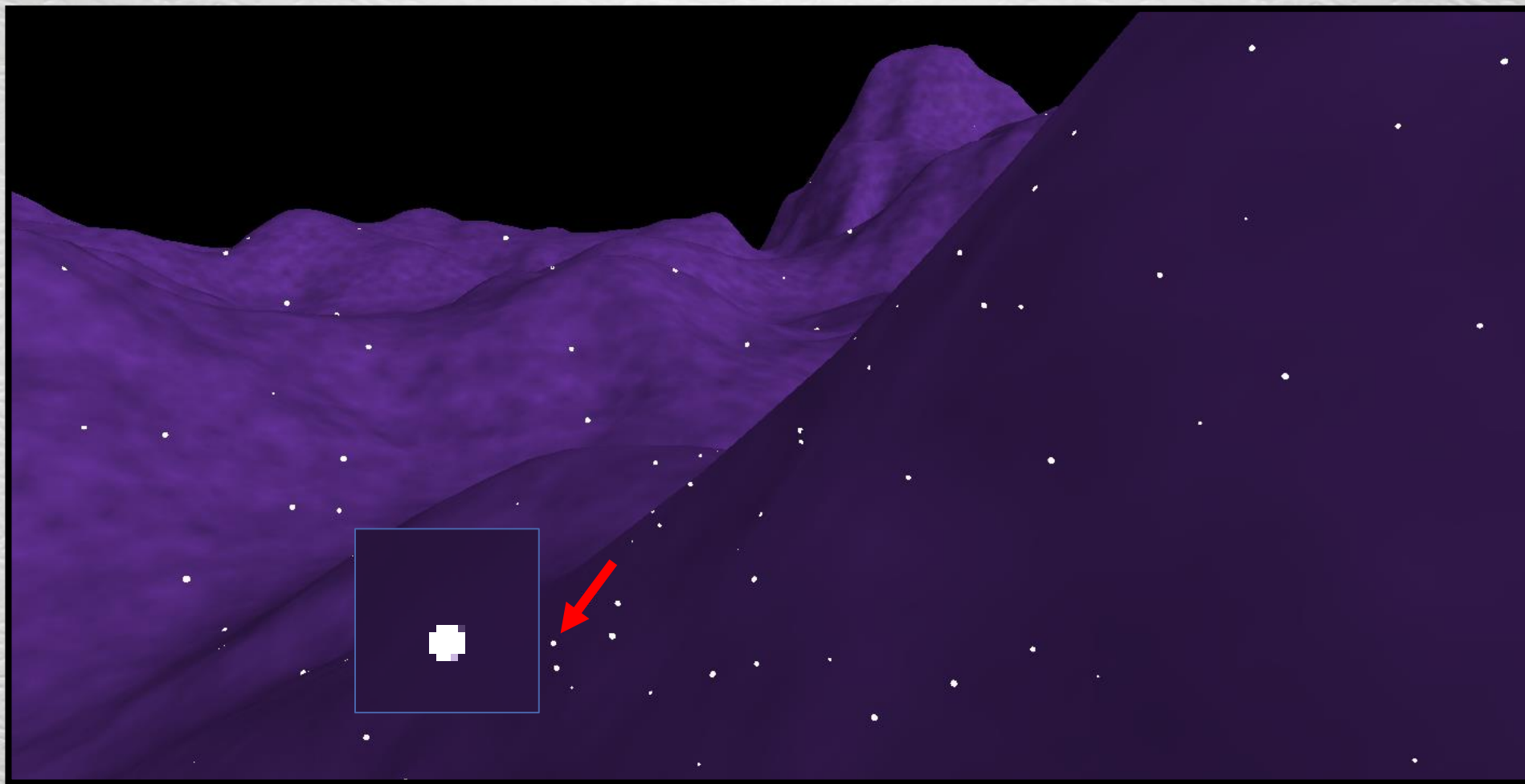
ANISOTROPY - BEFORE

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ANISOTROPY - AFTER

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RESULT



CONCLUSIONS

- We provide a number of practical improvements to the grid based sparkle algorithm
- Boosted flexibility and robustness
- Could push sparkle size down
- The effect was independent of lighting conditions

CONCLUSIONS

- Important to ensure shading signal is appropriate for the sampling
- Our additions provide direct and explicit control over the sparkle size and shape

REFERENCES

- 2012 Shopf, J., Gettin' Procedural, <http://amd-dev.wpengine.netdna-cdn.com/wordpress/media/2012/10/Shopf-Procedural.pdf>

ACKNOWLEDGEMENTS

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- Shadertoy + community for knowledge & inspiration
- The amazing team that worked on the game that we cannot name
- For the conversations and support
 - Tom Williams, Jim Callin, Kenneth Mitchell
- Natalya Tatarchuk for this course!

THANKS!

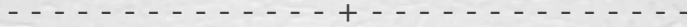
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- Questions?
- Please let us know what you think!
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Shadertoy: [huwb](#)
 - Beibei Wang beibei.wang@studiogobo.com

ADDITIONAL SLIDES

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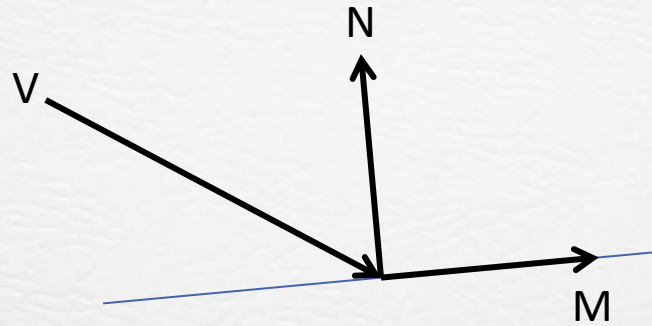
SHADER CODE



- See slide notes

ANISOTROPY

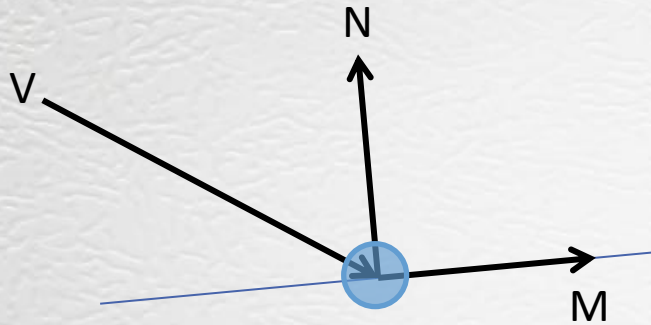
- Project the view vector V onto the surface to get a new vector M which will be the major axis of the elliptical sparkle shape



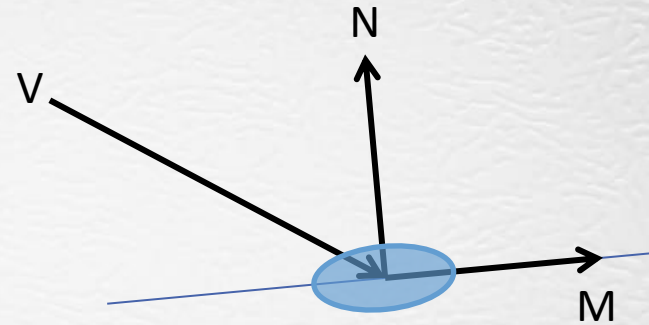
- $M = V - \text{dot}(V, N) * N$

ANISOTROPY

- Before



- After



- Let X denote lookup offset from sparkle center
- Project X onto major axis: $X_M = \text{dot}(X, M) * M$
- Shift X along this axis: $X -= (1.0 - \text{abs}(\text{dot}(V, N))) * X_M$

FAST FLOOR LOG2

- An obscure result thrown in for fun
- For our grid scale levels computation, the level index was given by
 - $\text{floor}(\log(\text{depth}))$
- For base 2, this is exactly the *exponent* stored in a IEEE float, which can be unpacked as follows, assuming inp is positive:

```
float fastfloorlog2( float inp ) {  
    return (floatBitsToInt( inp ) >> 23) - 127.0;  
}
```