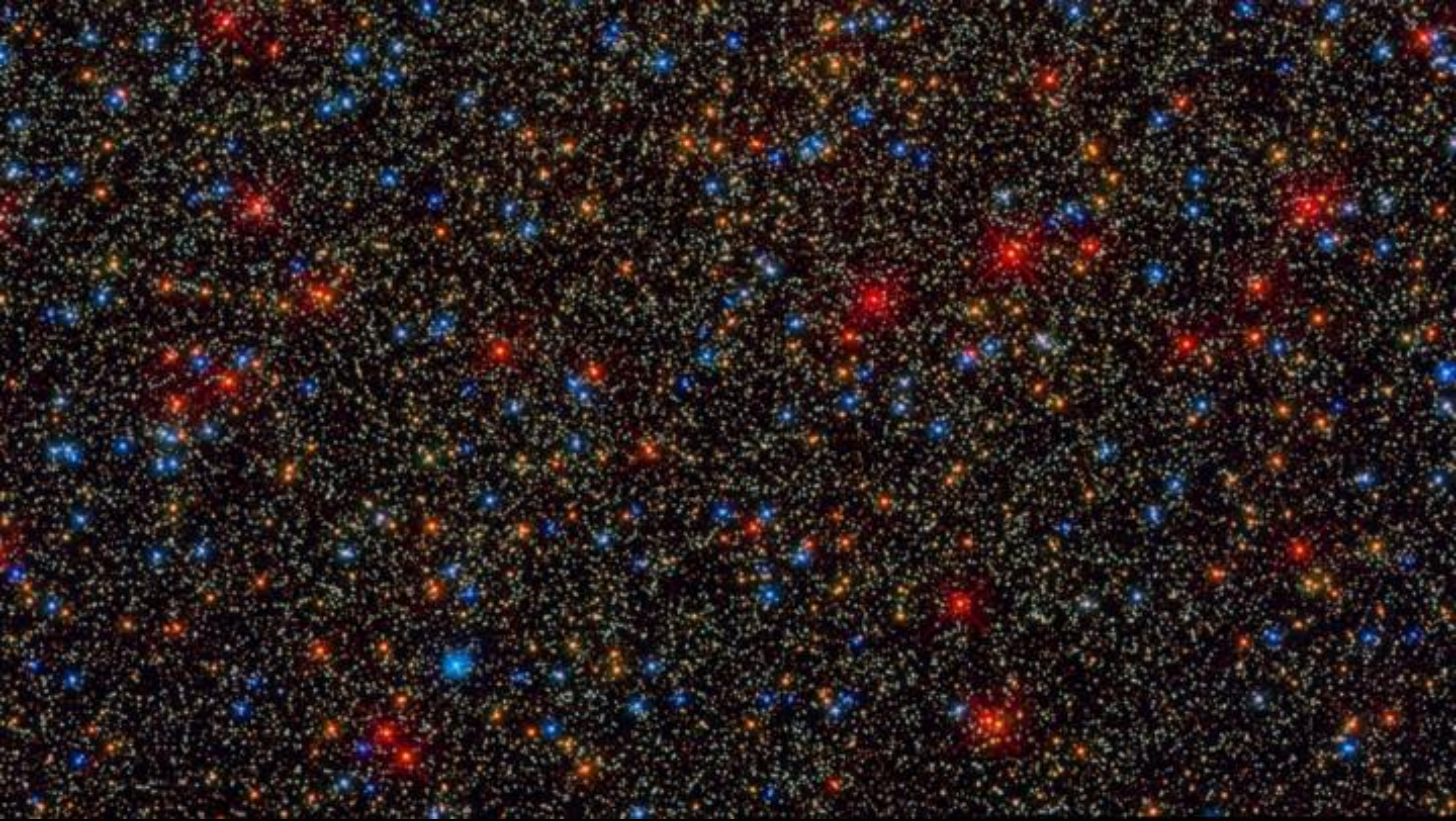
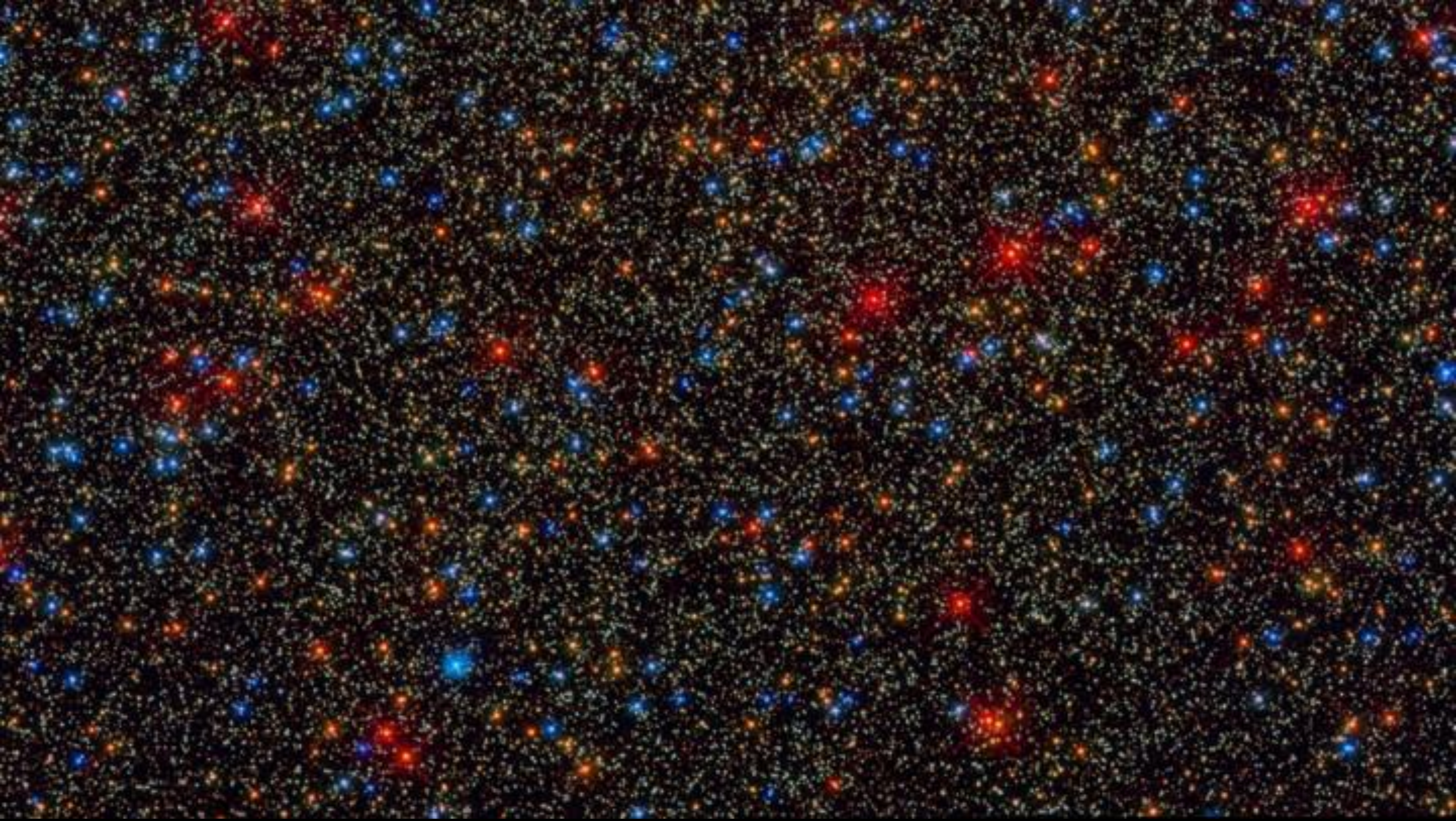


Making a Color-Magnitude Diagram for Globular Cluster Omega Centauri

Jay Anderson,
STScI

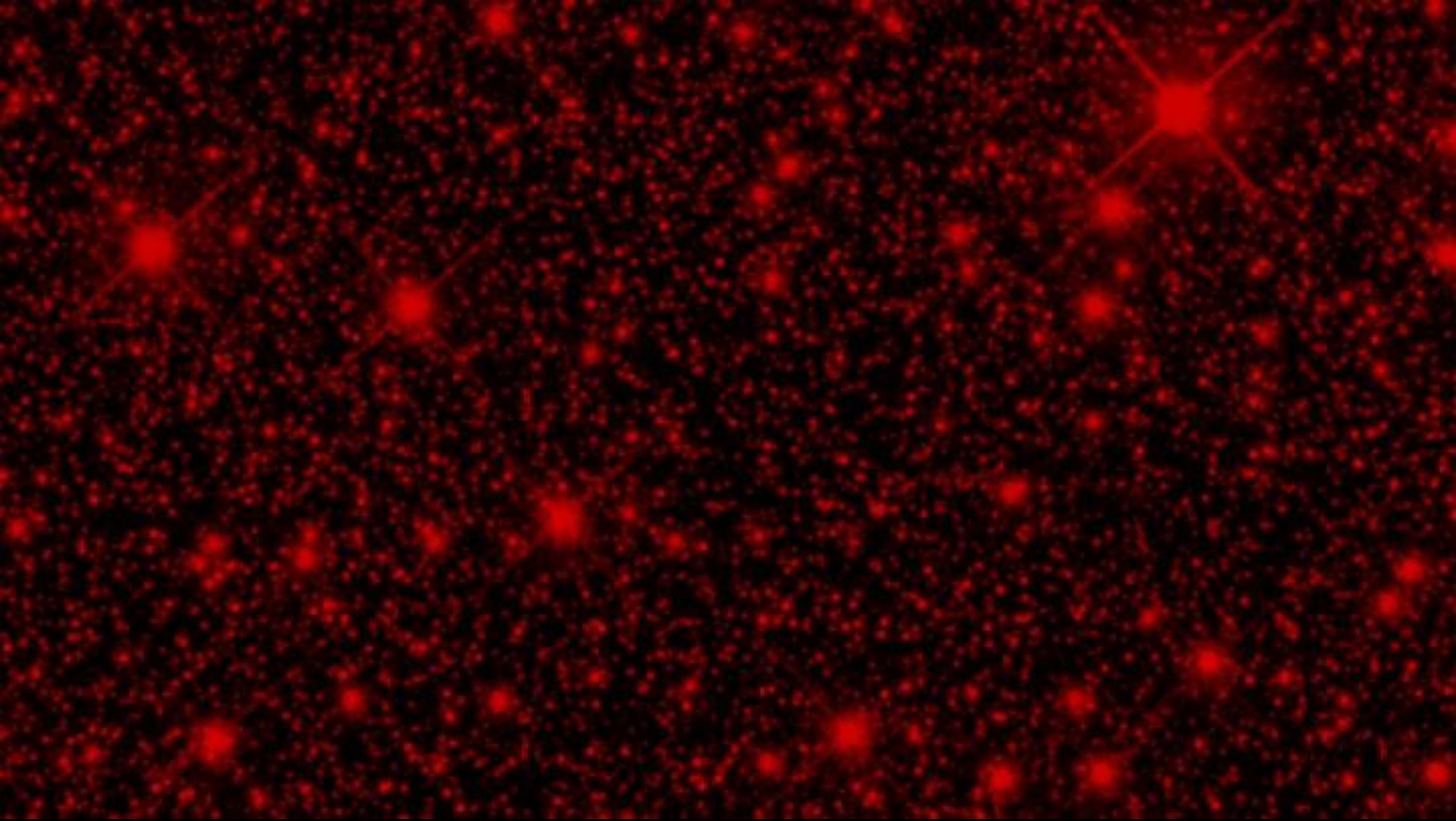


http://hubblesite.org/gallery/wallpaper/pr2009025q/

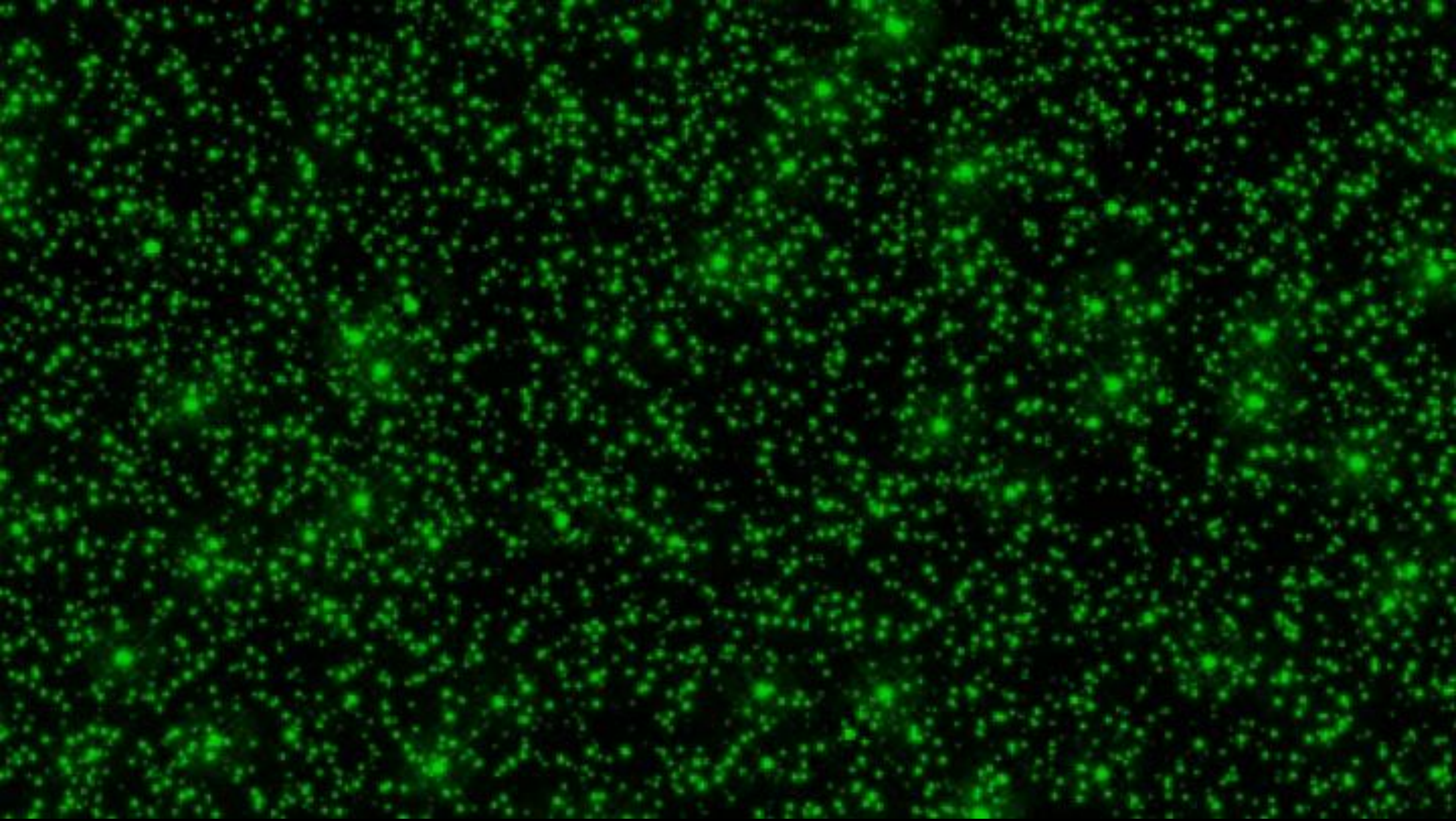
This is the Early-Release Image of Omega Centauri, taken by WFC3/UVIS on board the Hubble Space Telescope (HST)

A close up of the
central region.

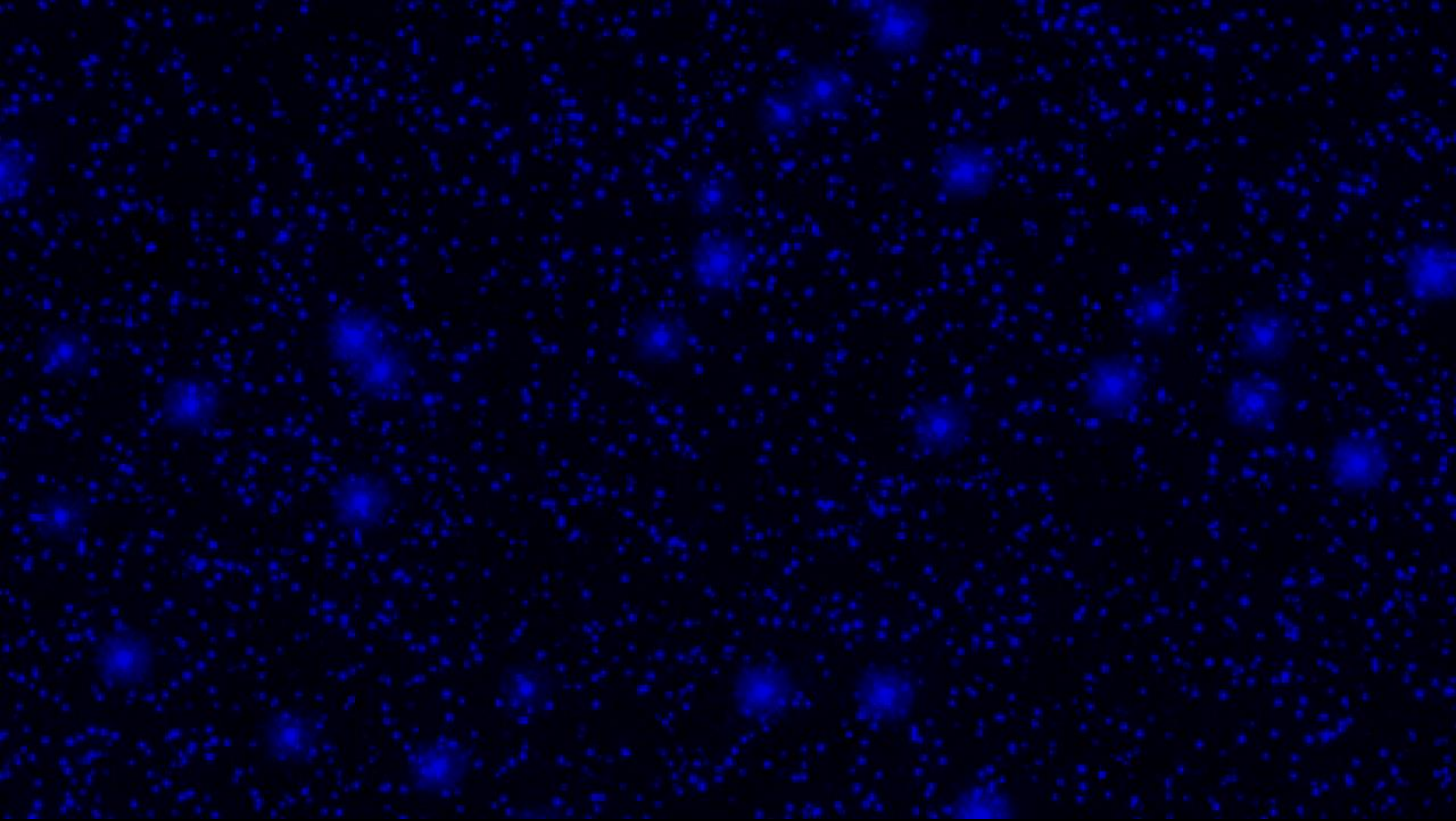
This image was made by combining separate red, green, and blue images.



The **red** image is from filter F814W,
which sees only very red light.



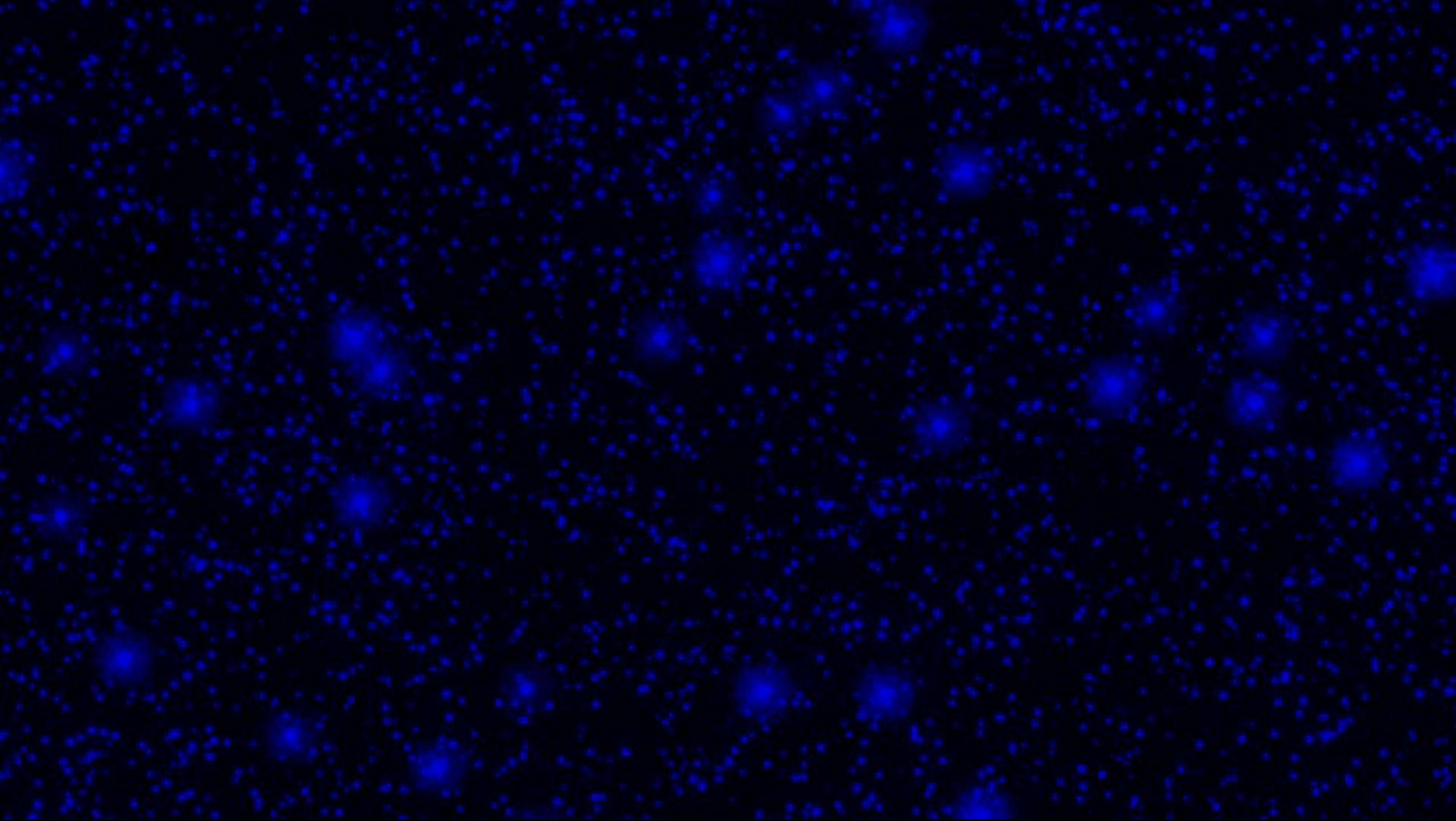
The **green** image is from filter F336W, which sees only blue light.



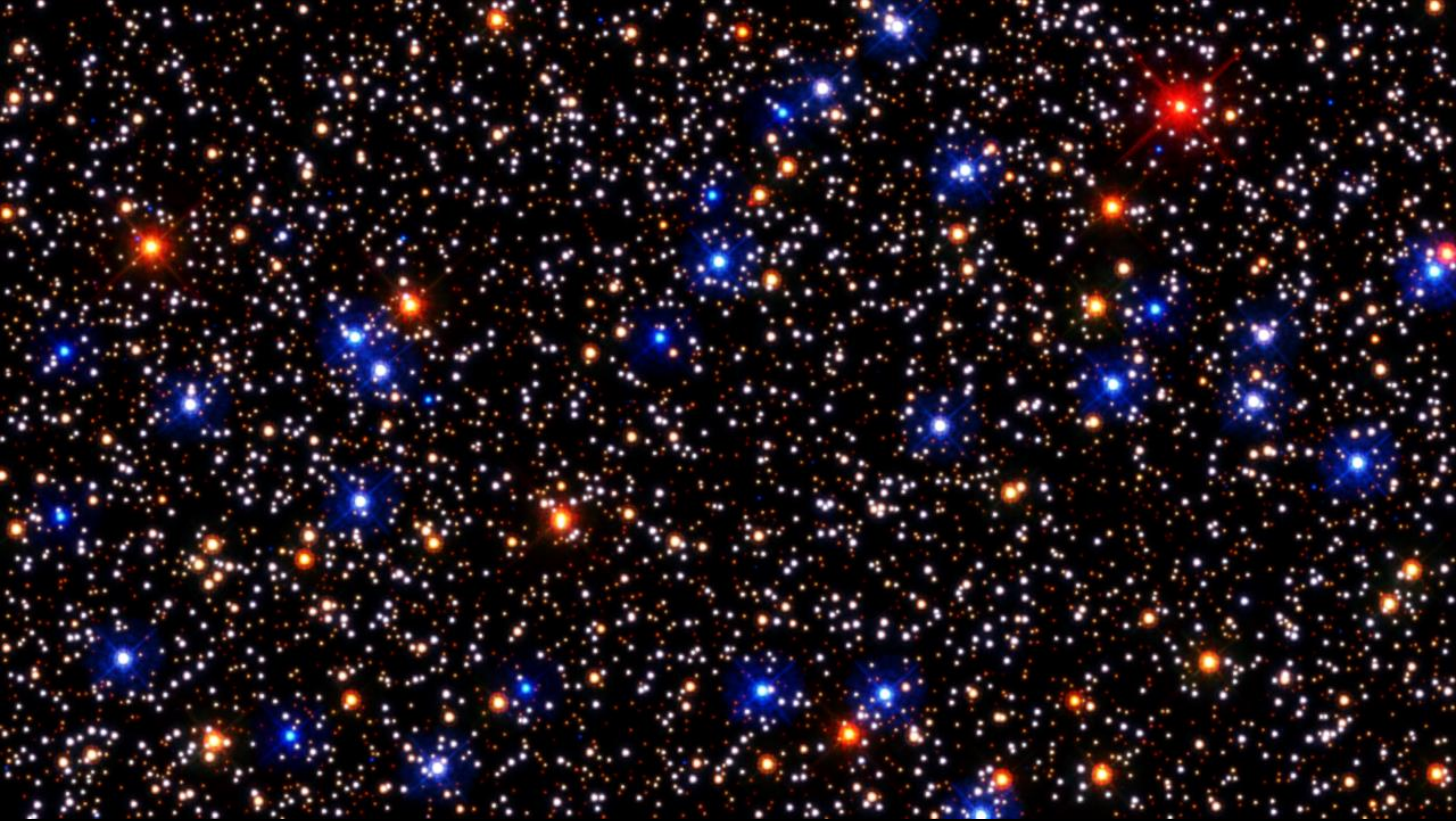
The **blue** image is from filter F225W,
which sees only ultra-violet light.

The combined image again.

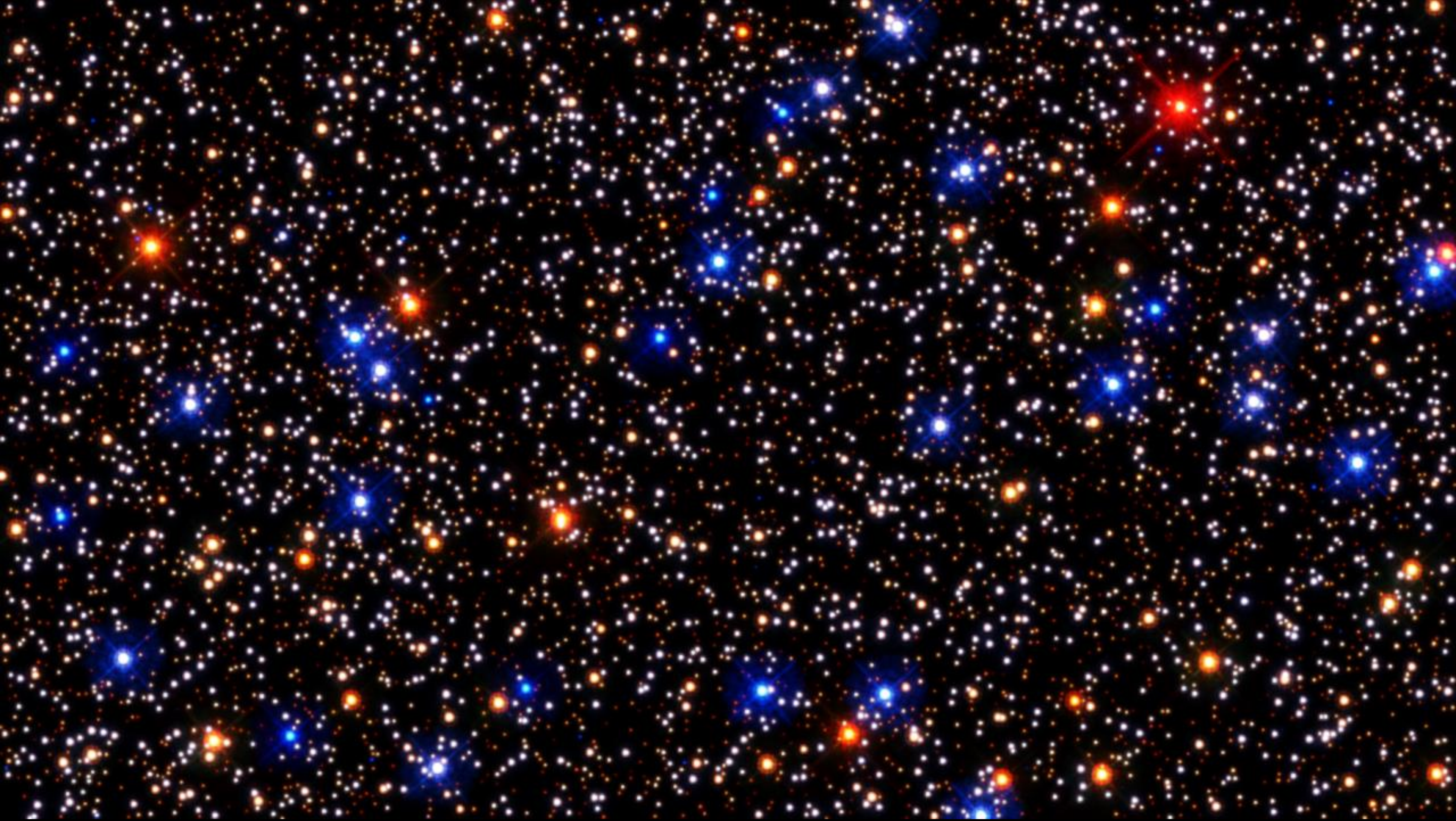
The colors are so extreme because…



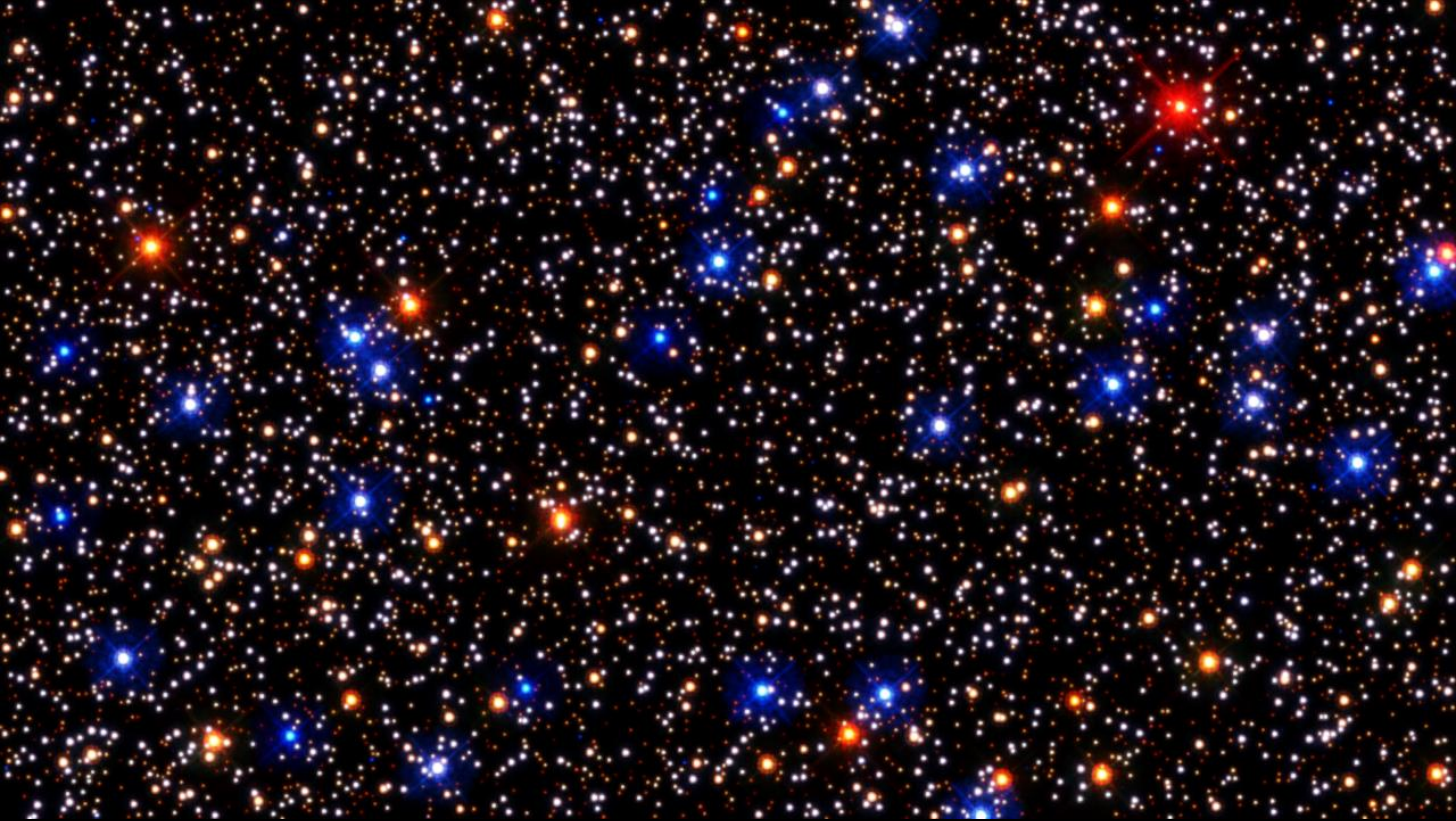
… the **red** stars have almost no **blue** light,
and the **blue** stars have almost no **red** light.



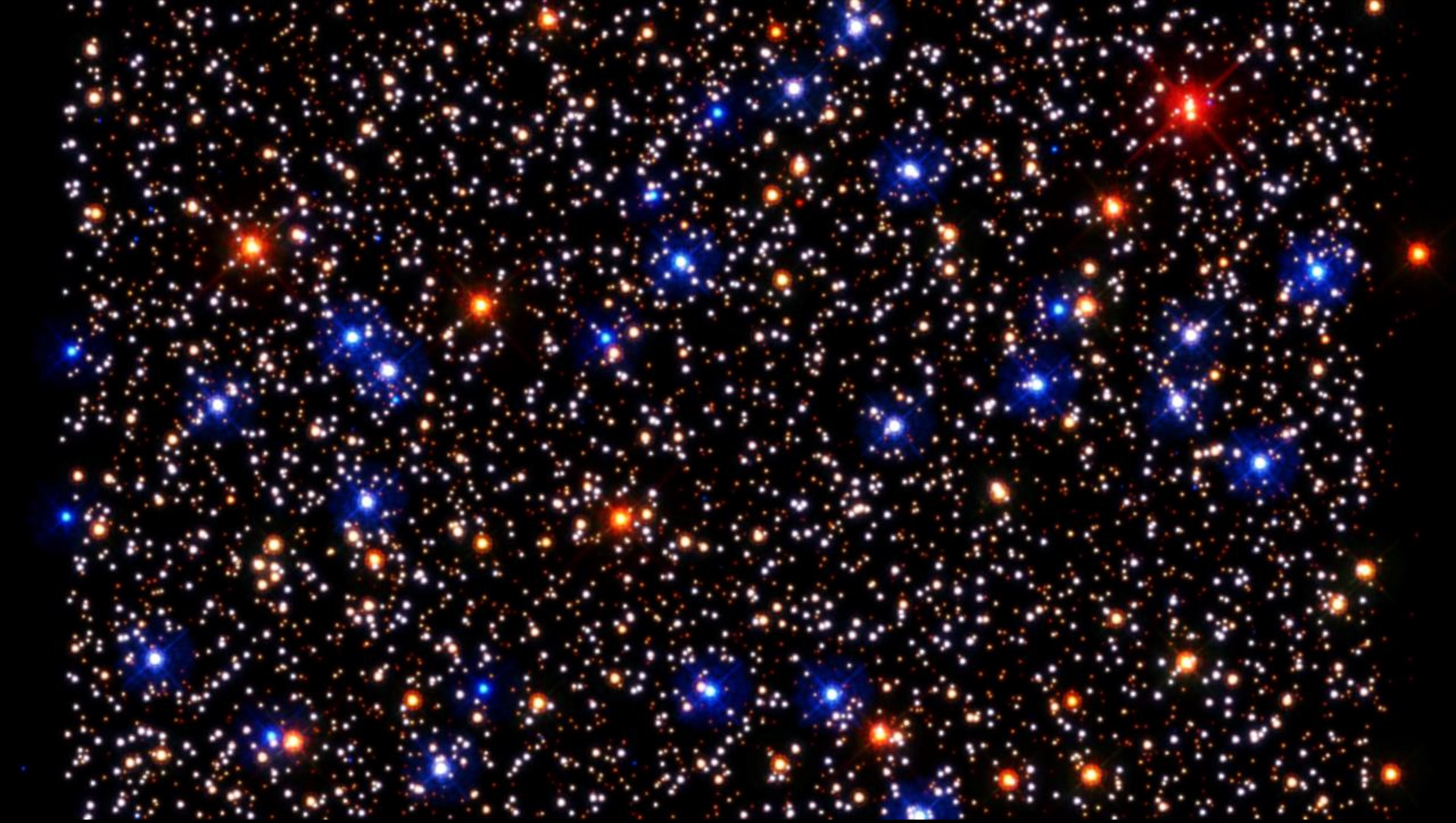
The composite image again.



Astronomers like to study the colors of stars in a quantitative way.



They like to sort the stars by color, putting the **blue** stars on the left and the **red** stars on the right.



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13e

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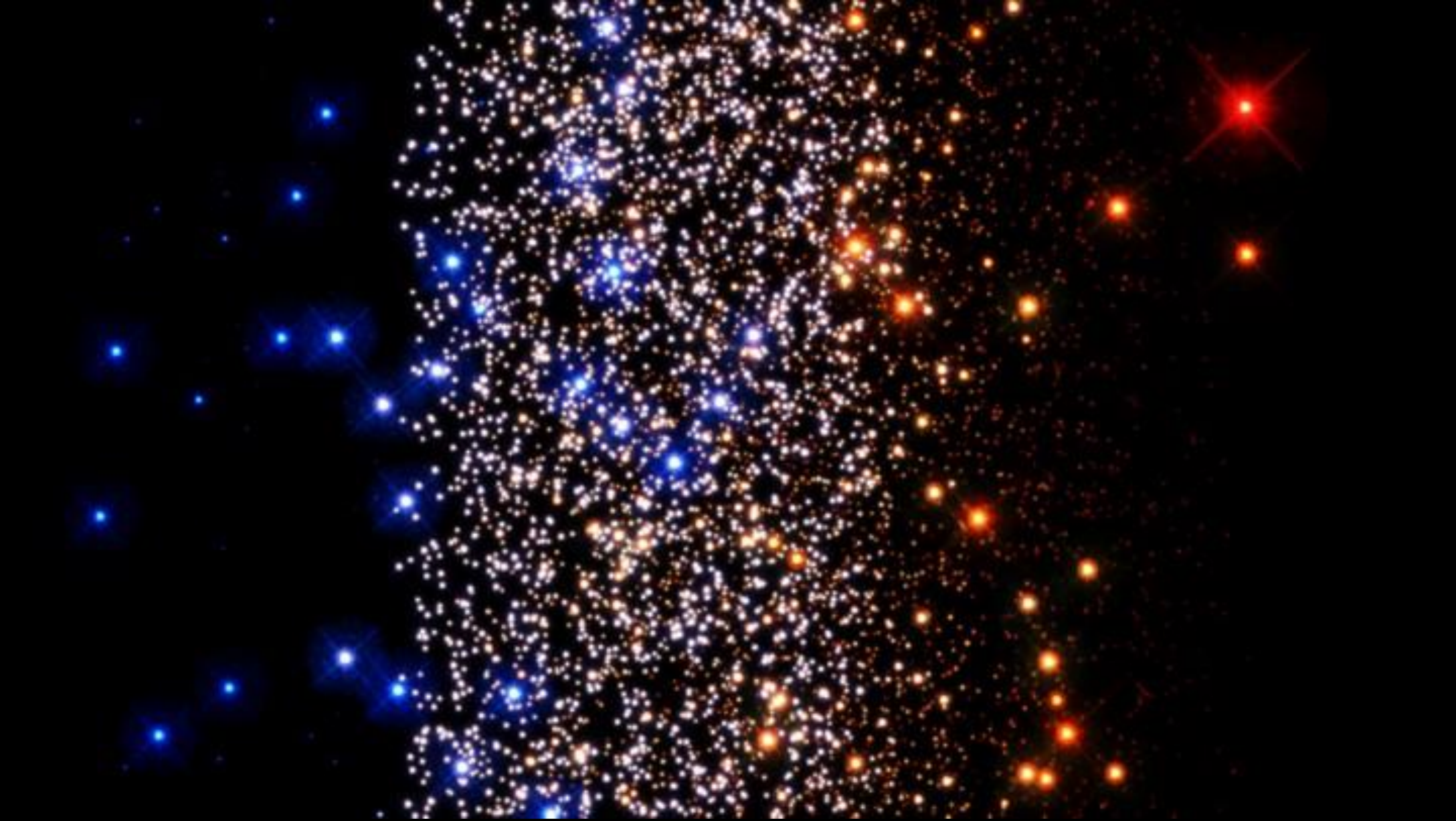

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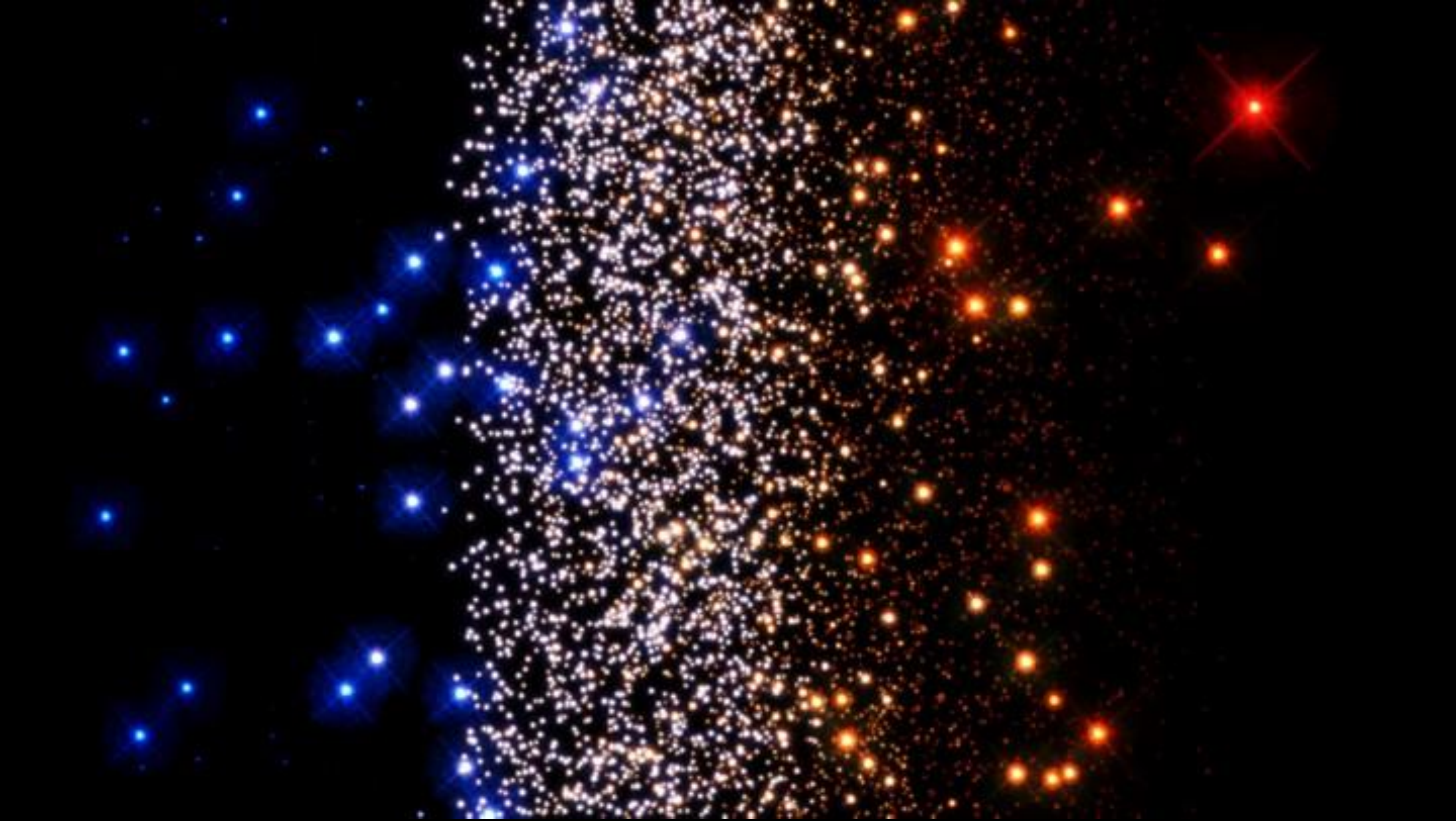

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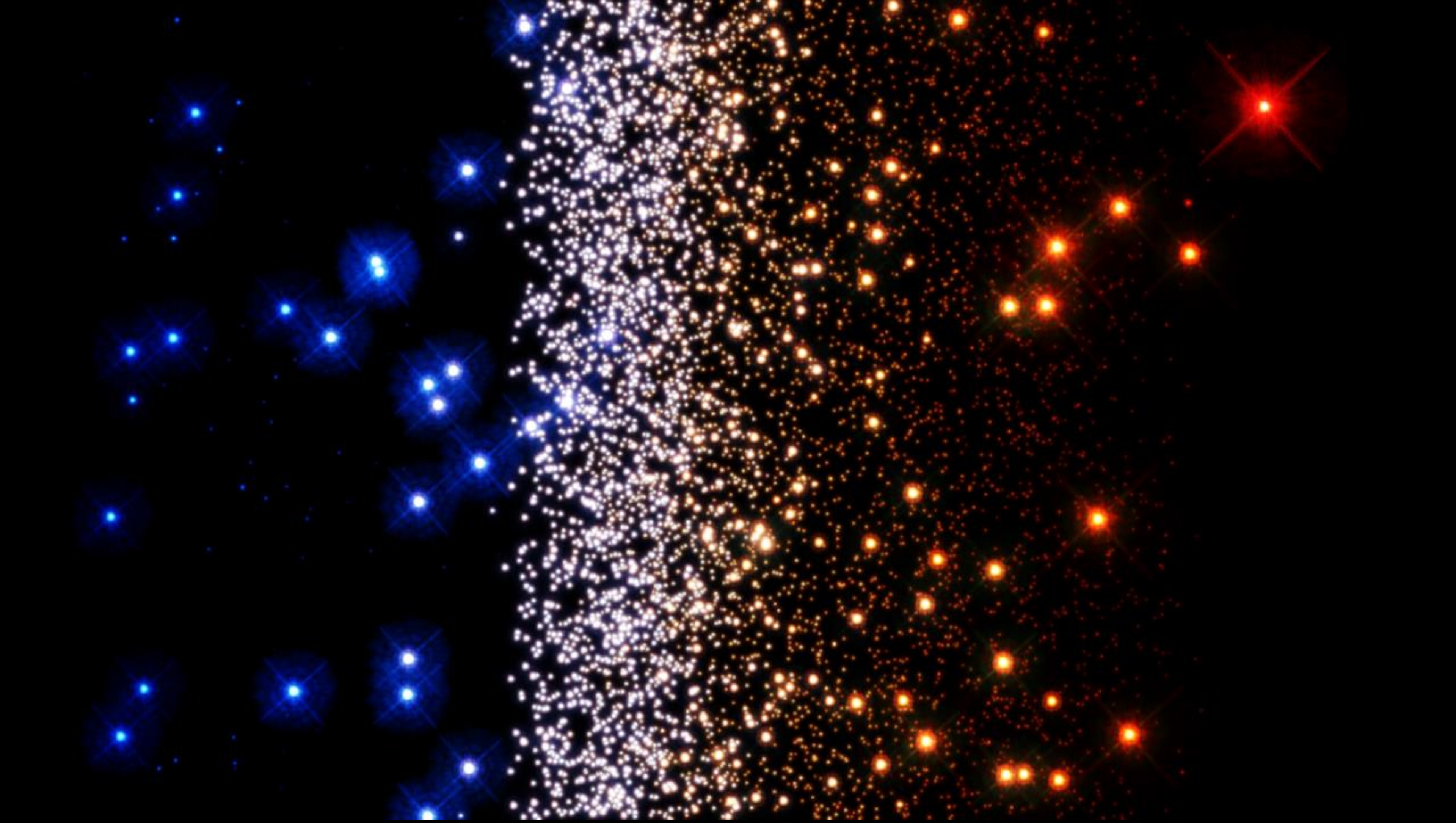

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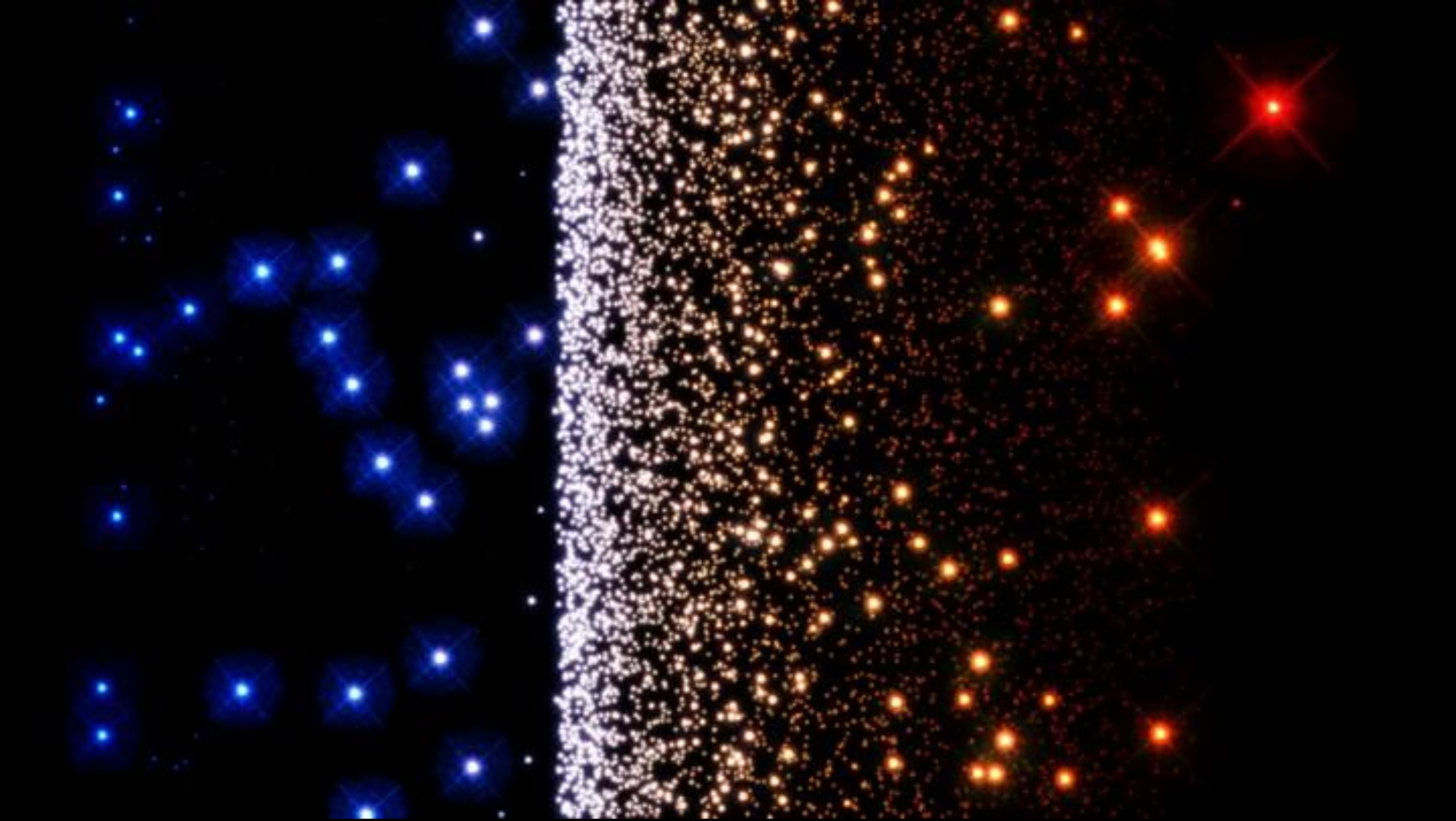
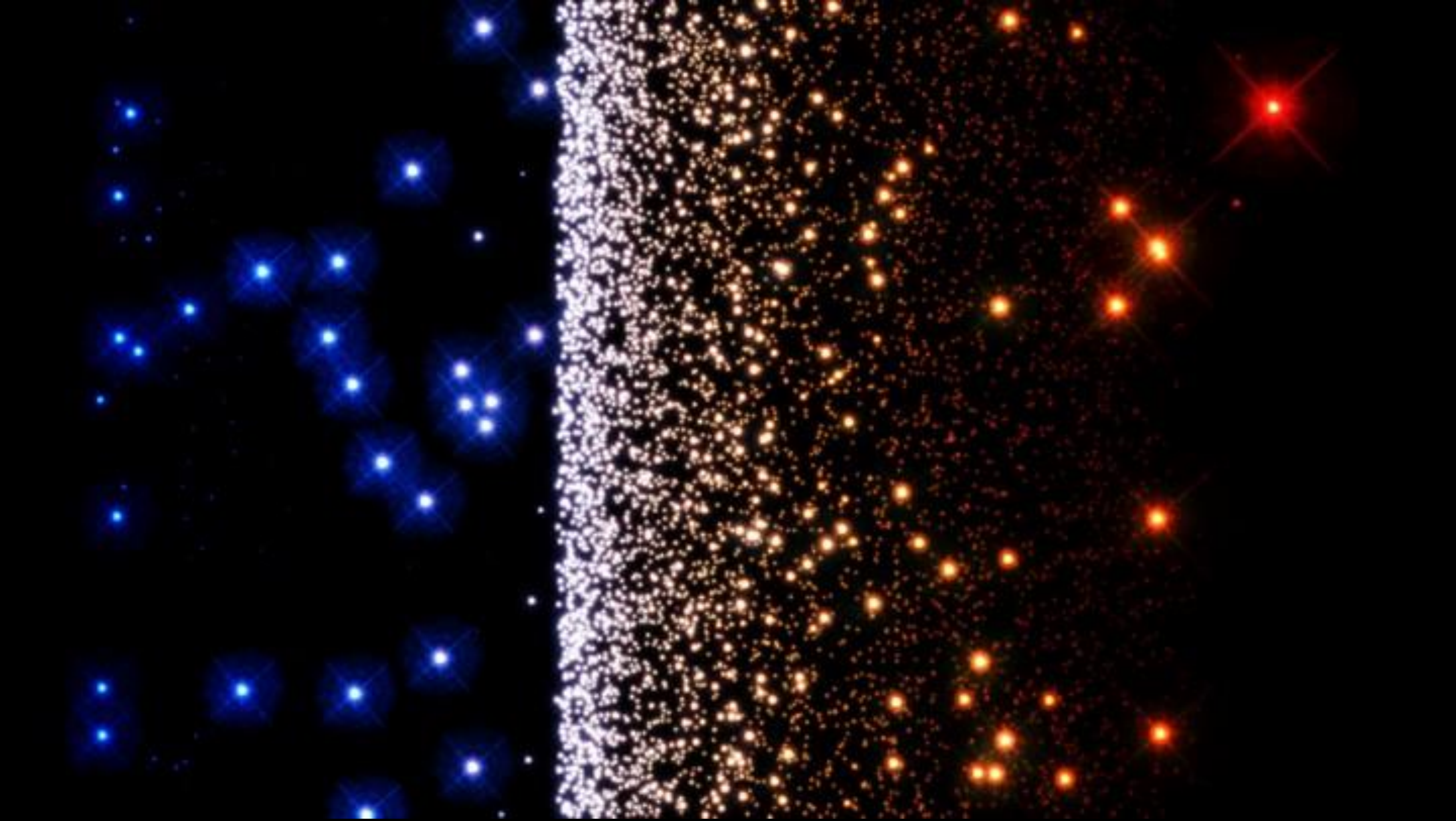
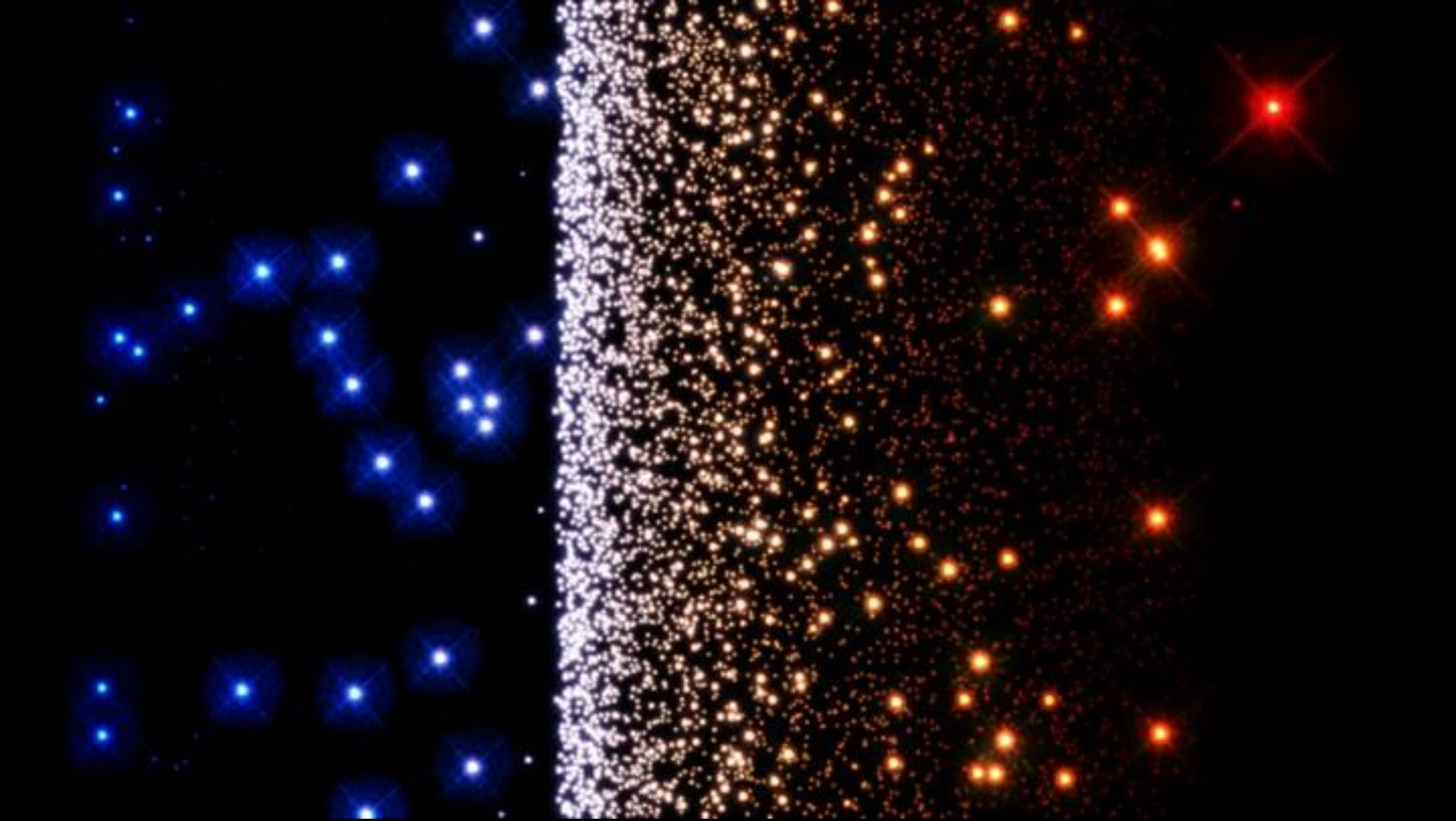


They like to sort the stars by color, putting the **blue** stars on the left and the **red** stars on the right.

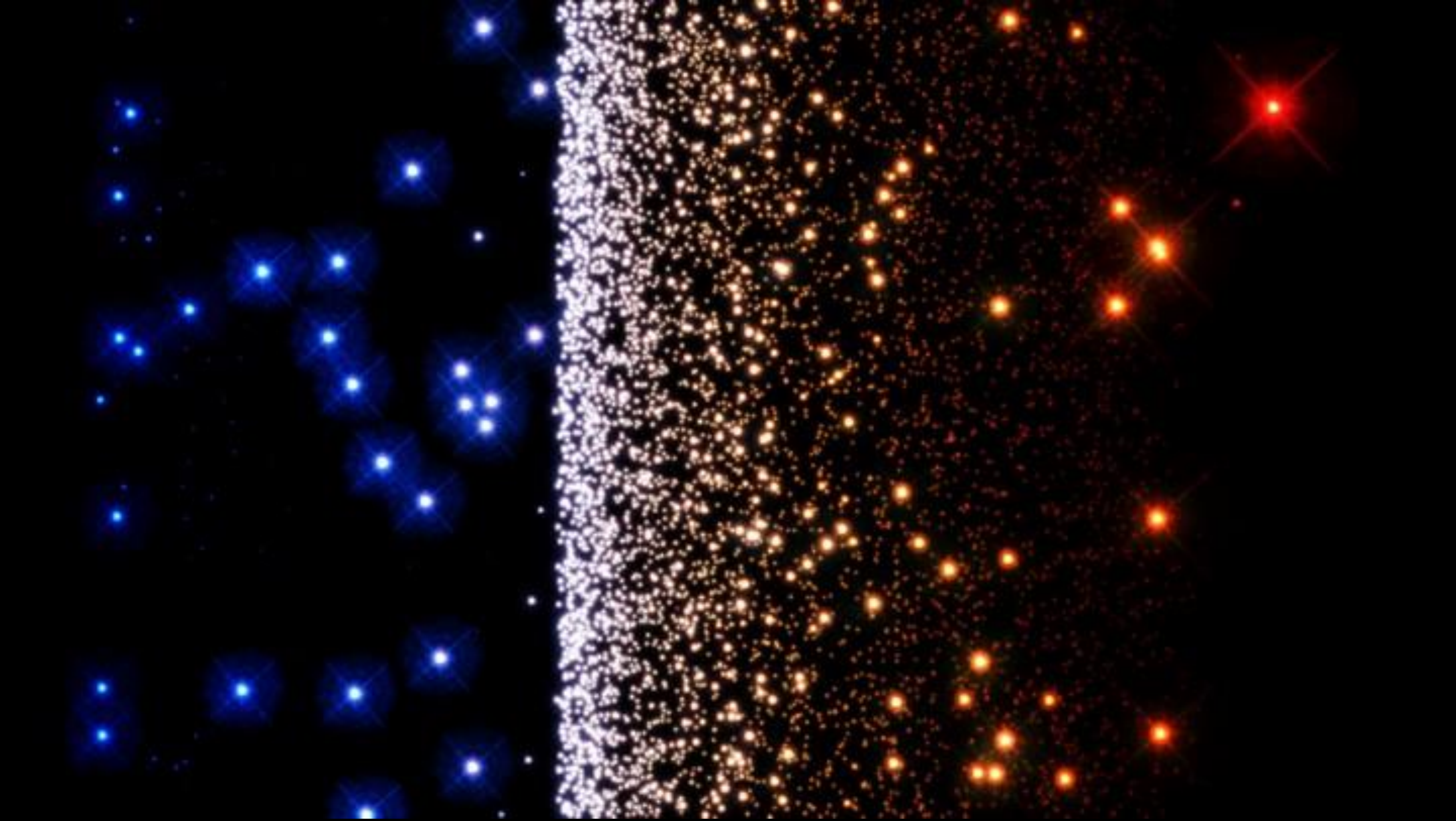
13k



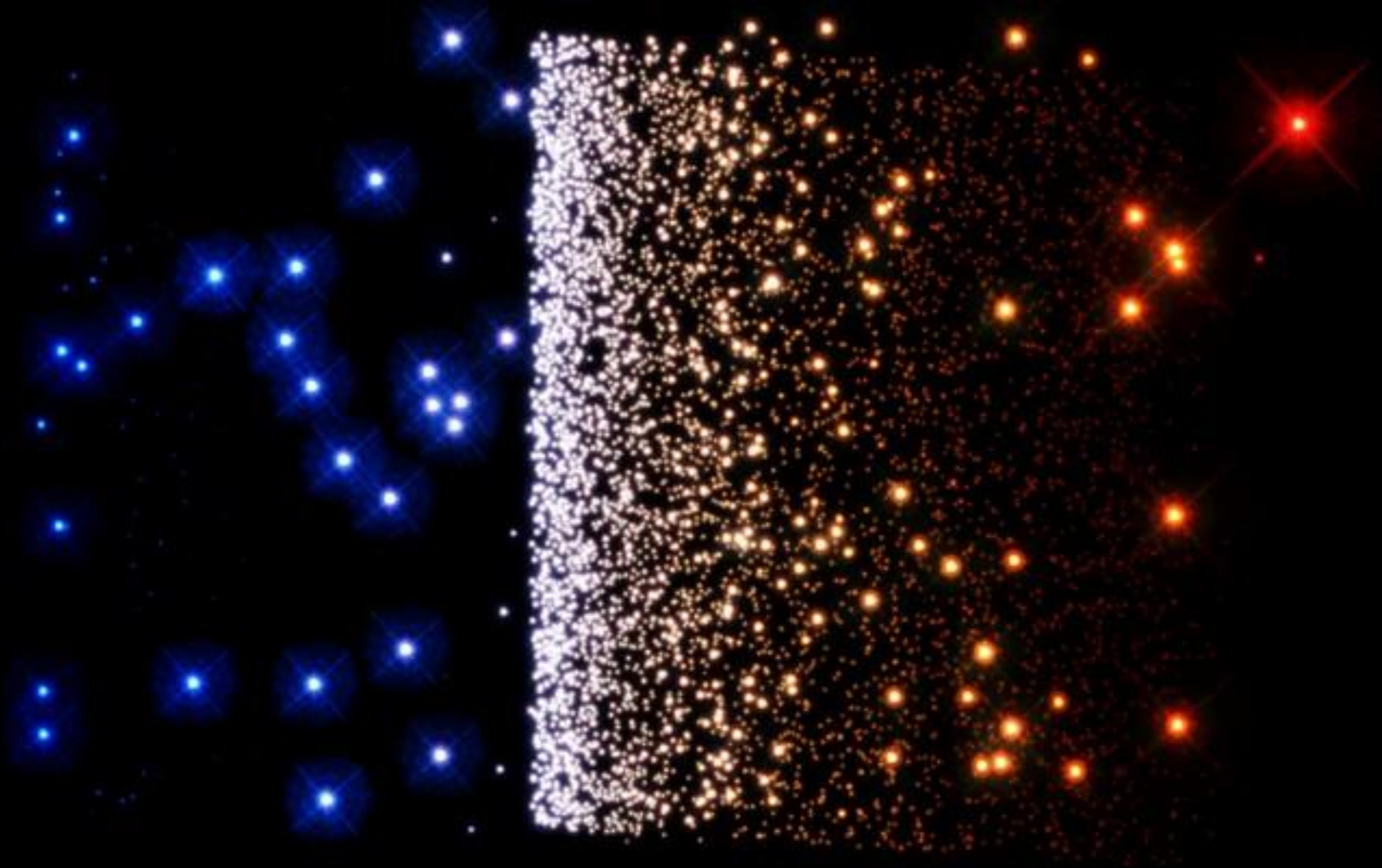
Note that there are very few extreme stars; most stars are **white**, meaning they have a balanced spectrum.



Astronomers also like to characterize the stars in terms of brightness.



They like to sort the stars,
putting the **bright** stars on top,
and the **faint** stars on the bottom.



They like to sort the stars,
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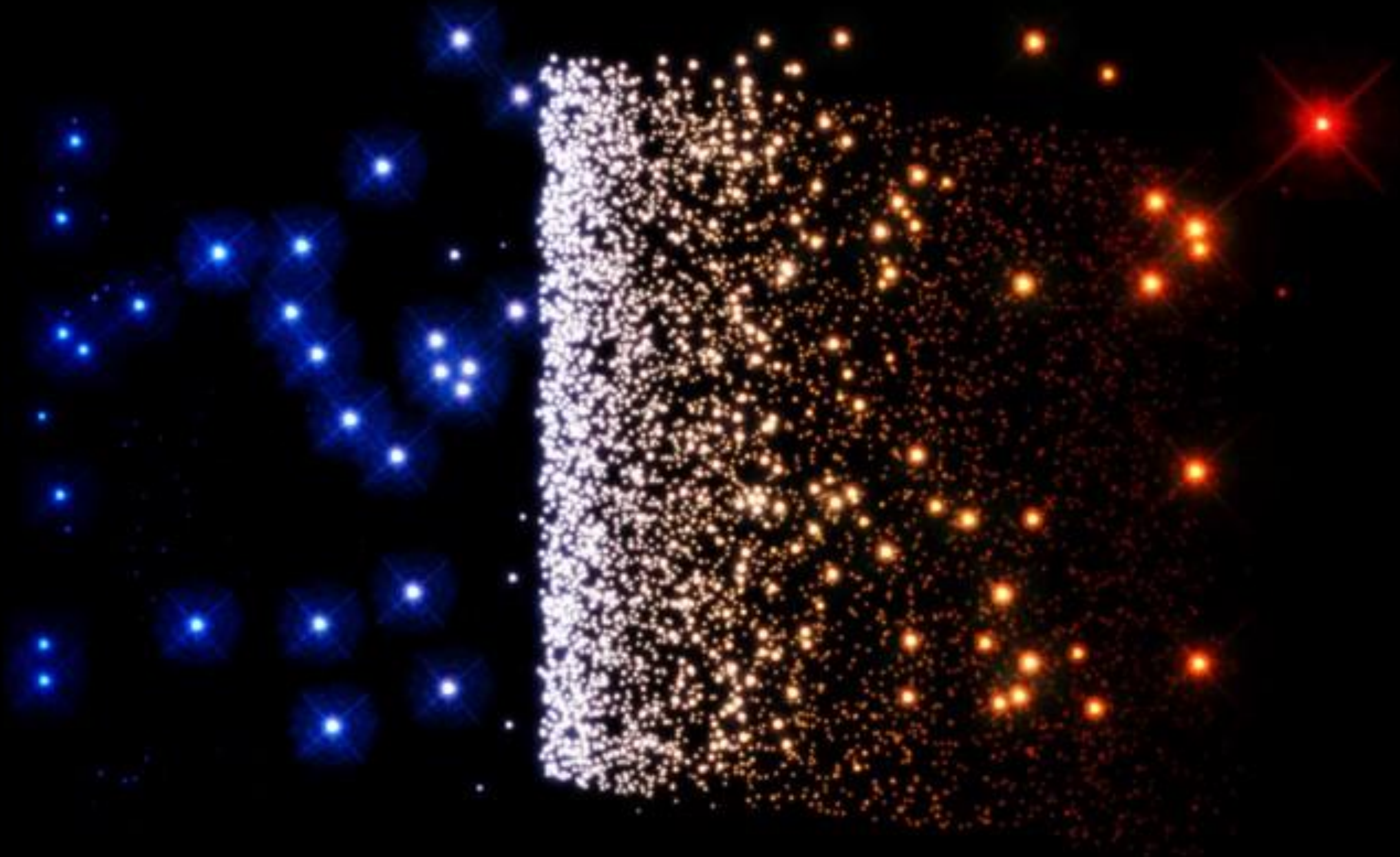
and the faint stars on the bottom.



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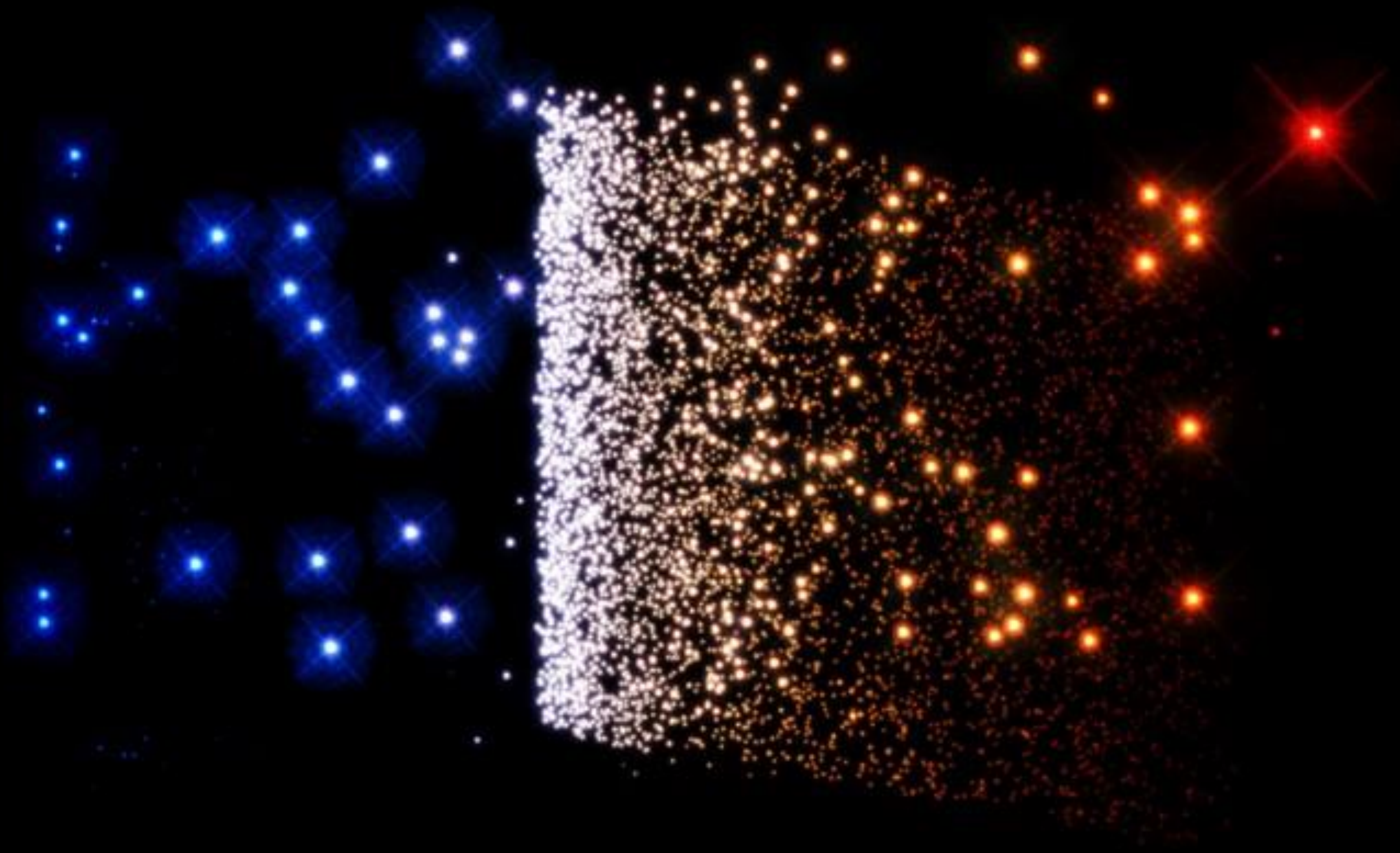

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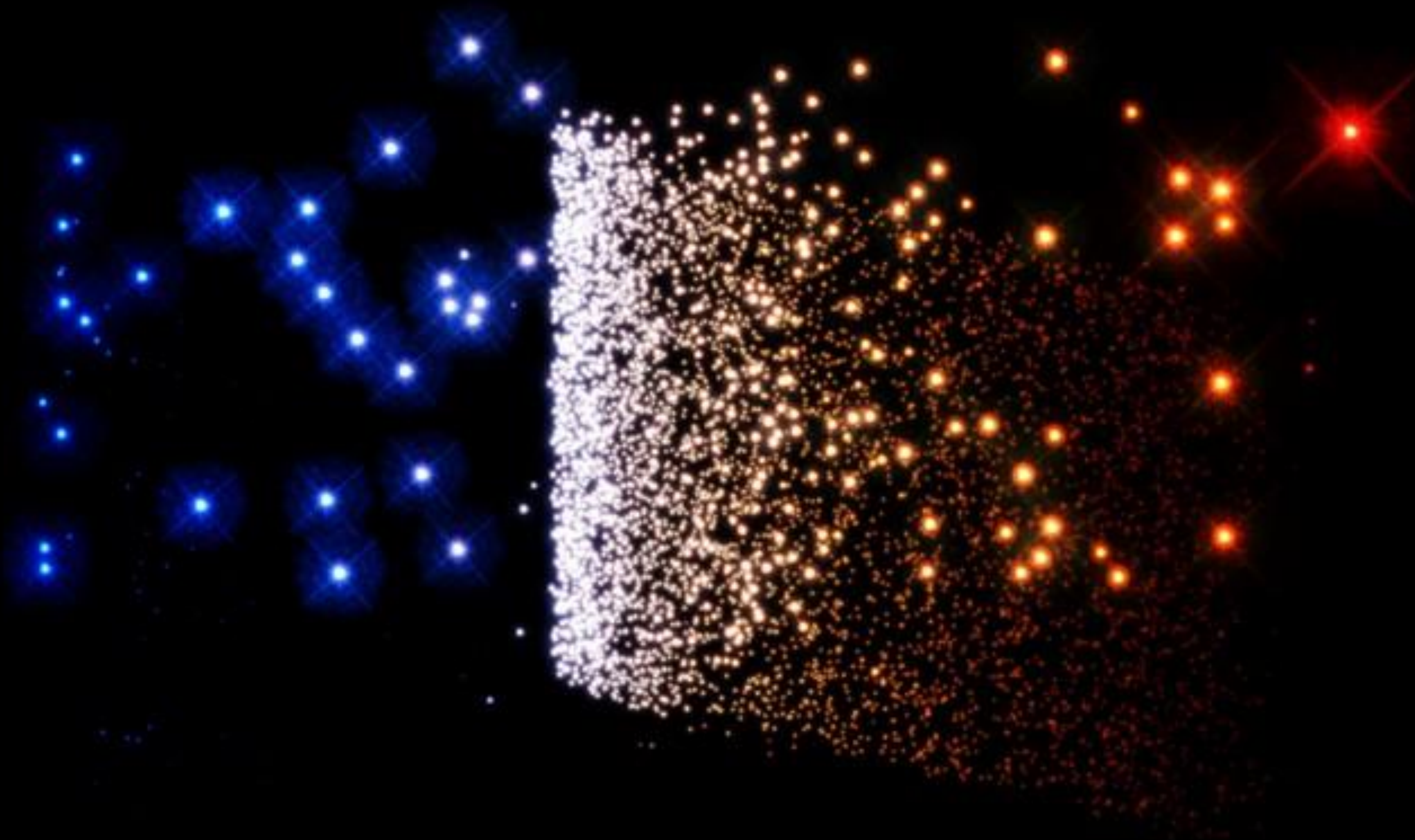

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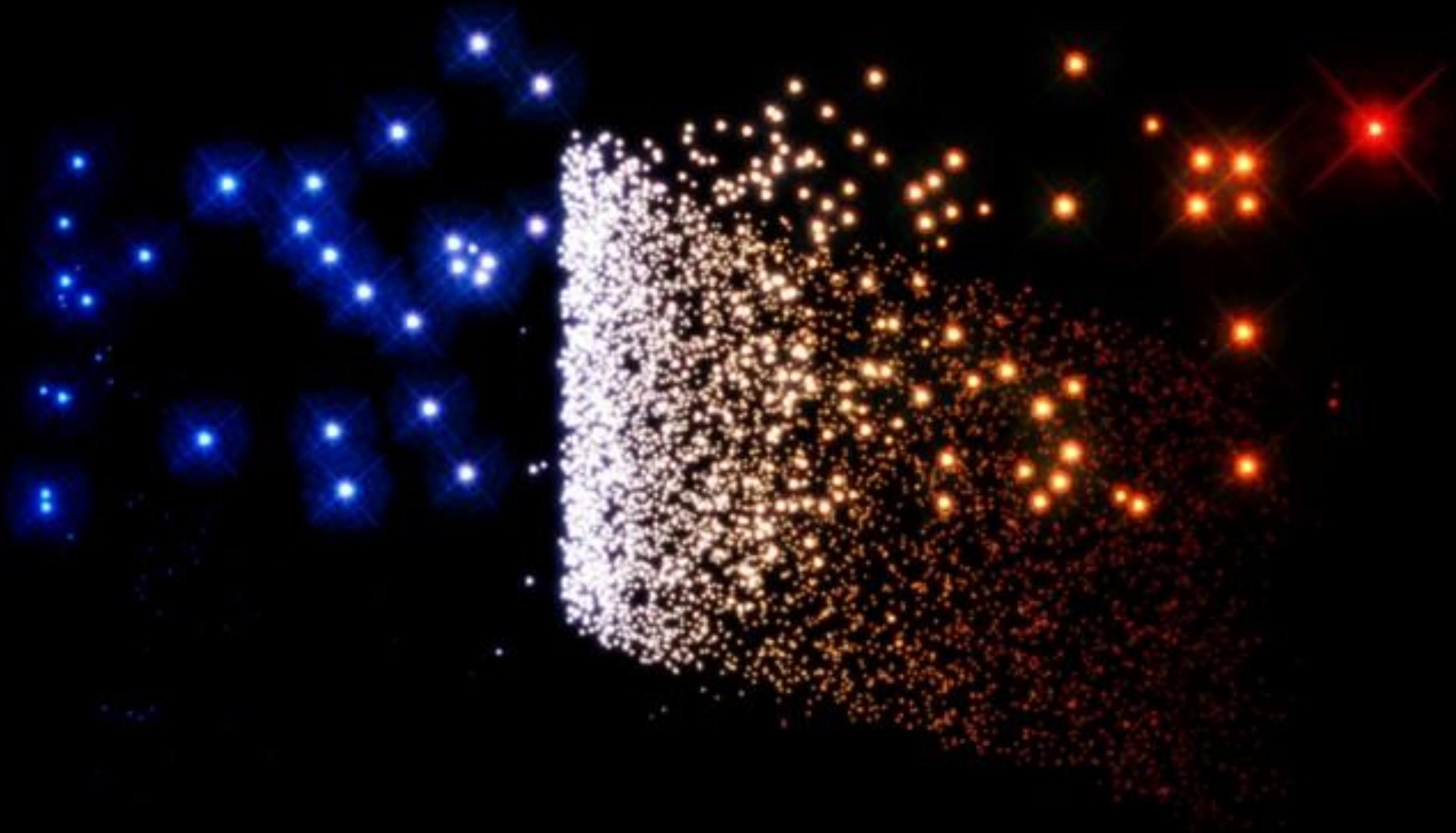

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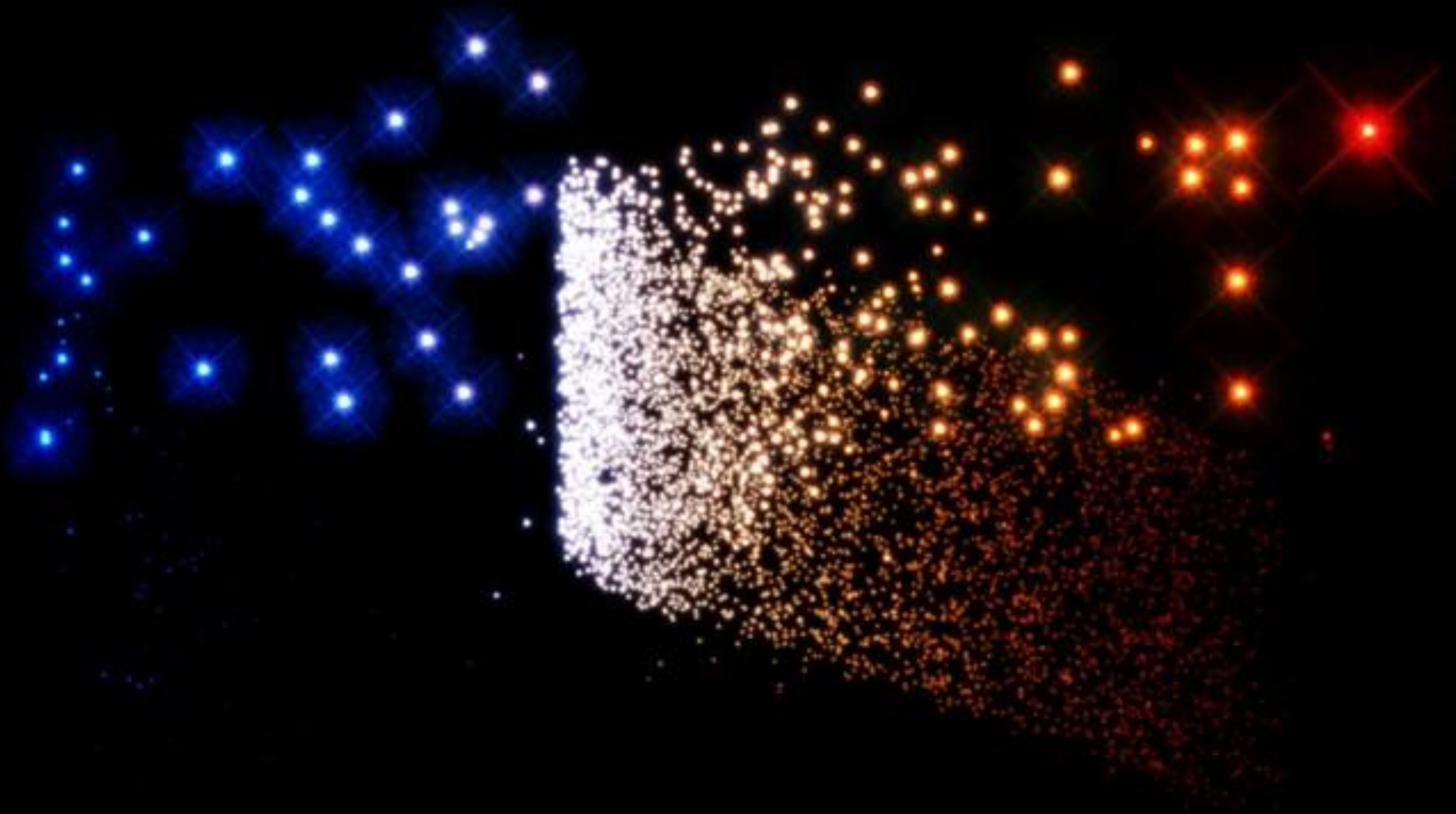

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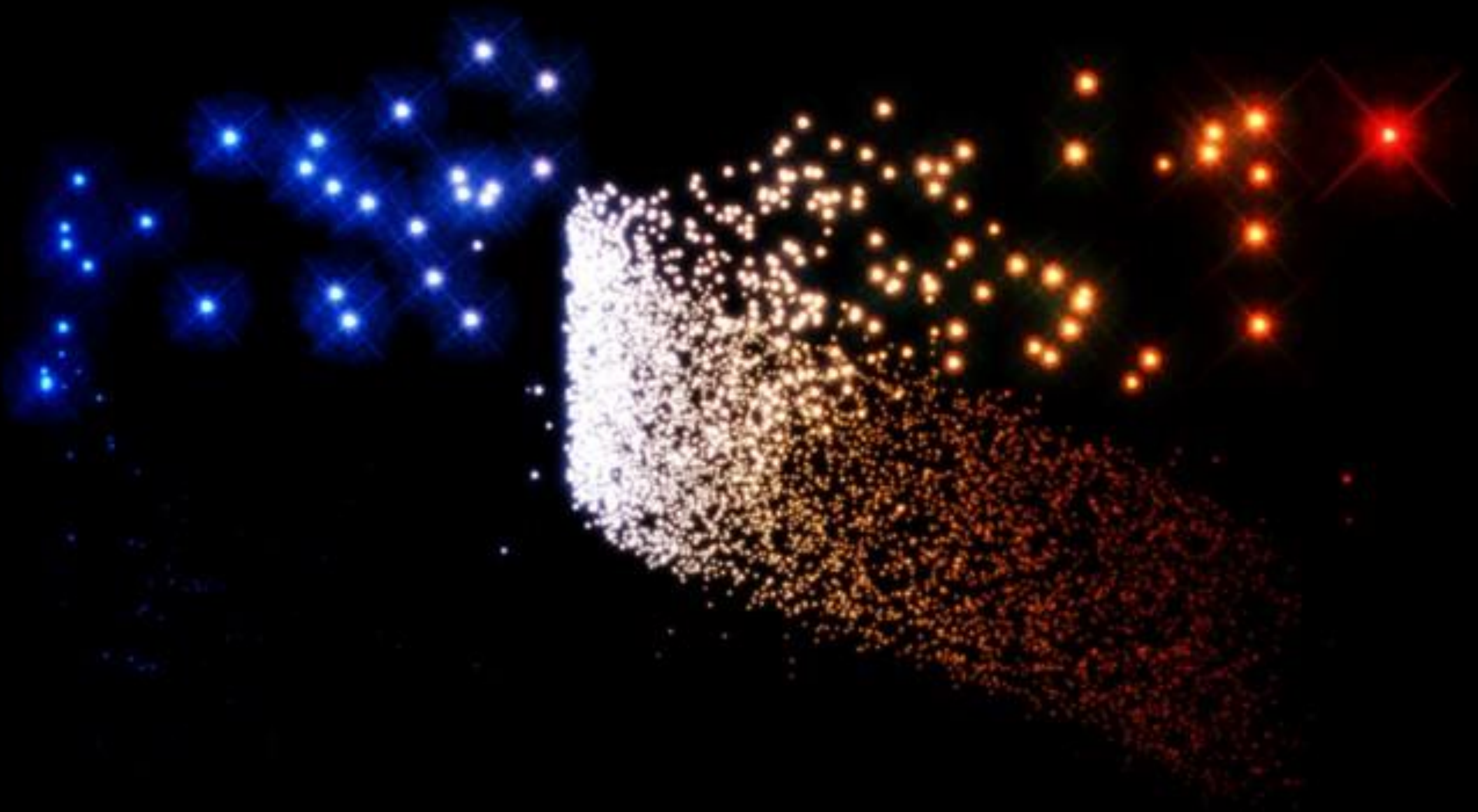

They like to sort the stars,
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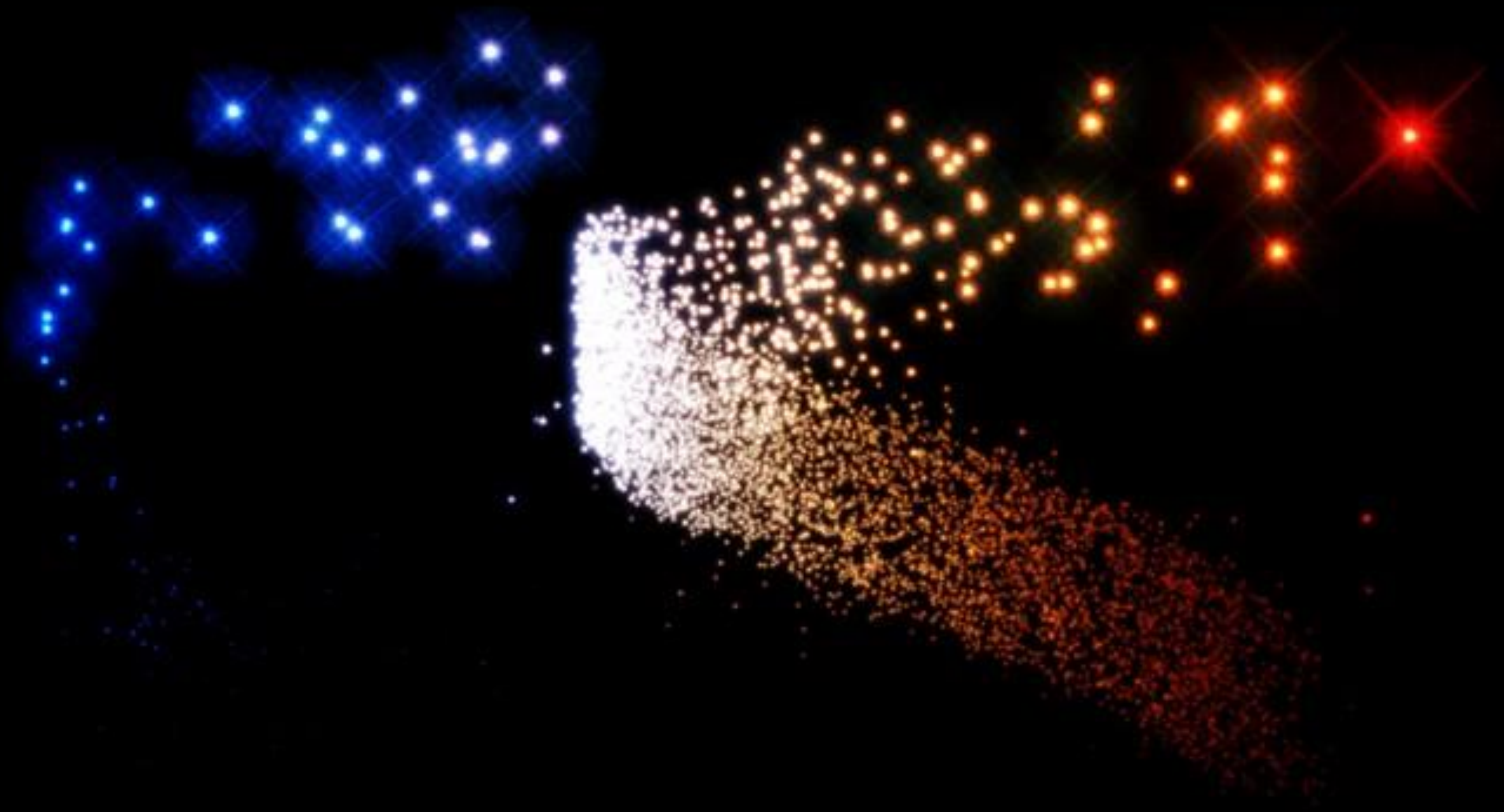
and the faint stars on the bottom.

15h



They like to sort the stars,
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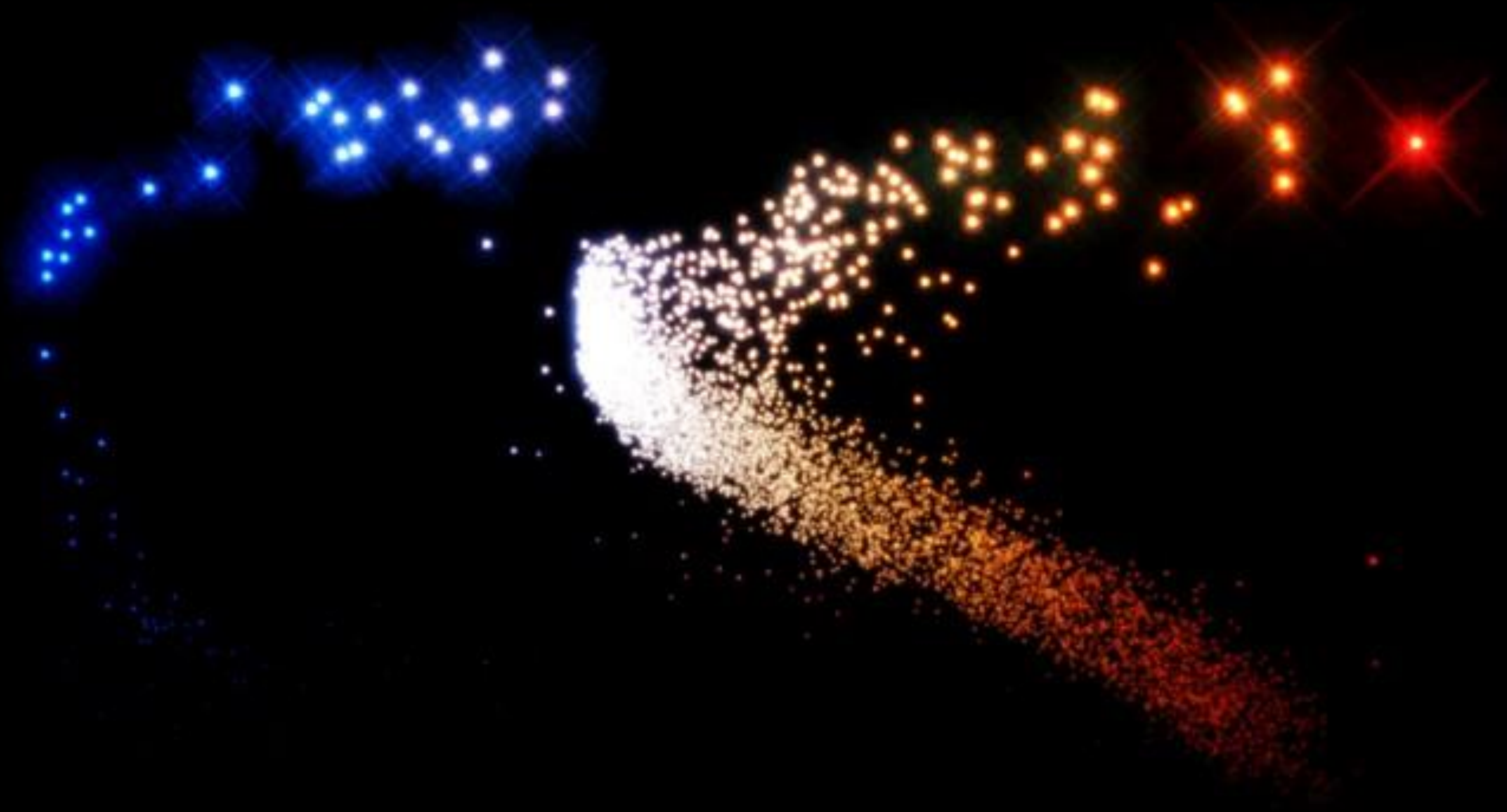

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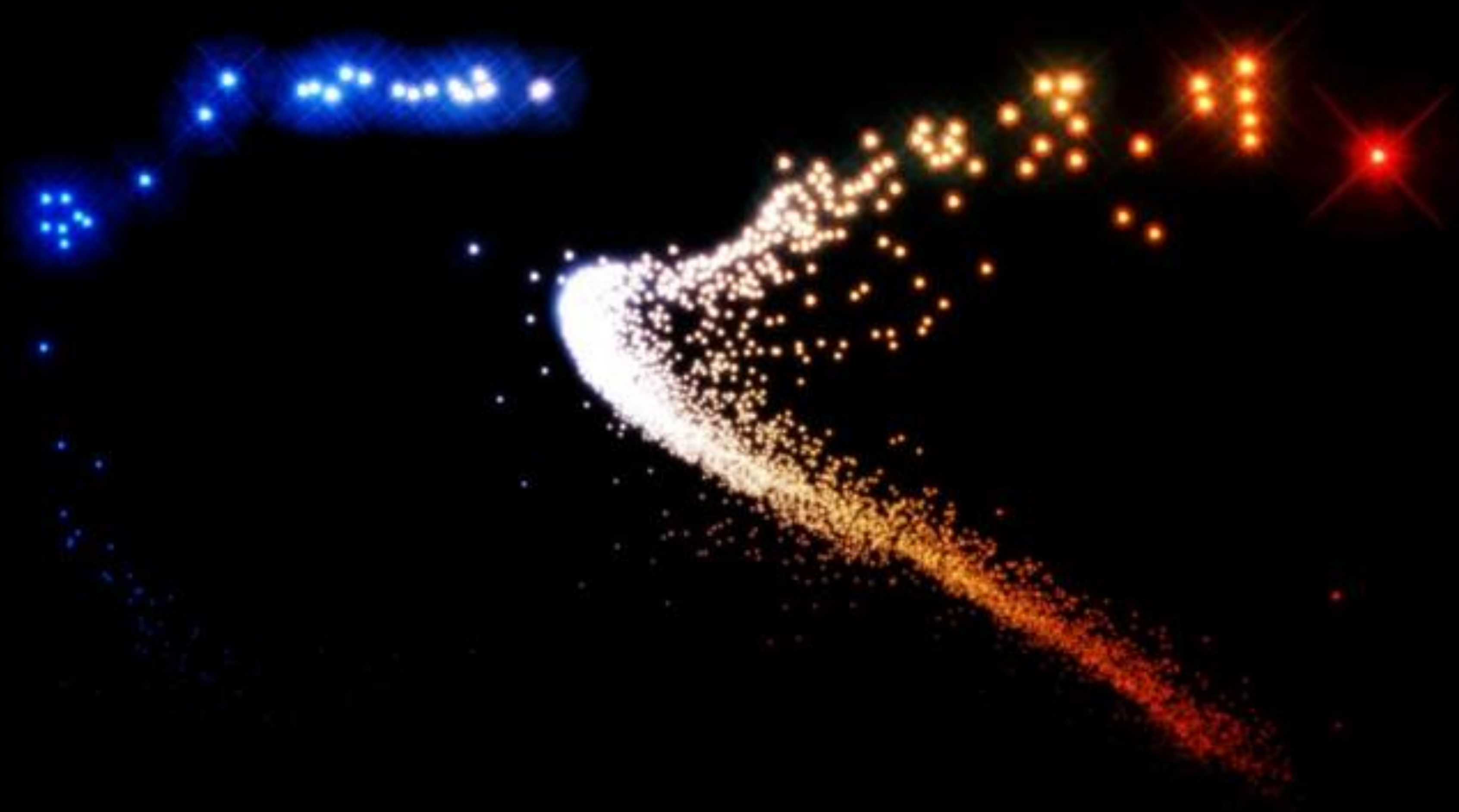

They like to sort the stars,
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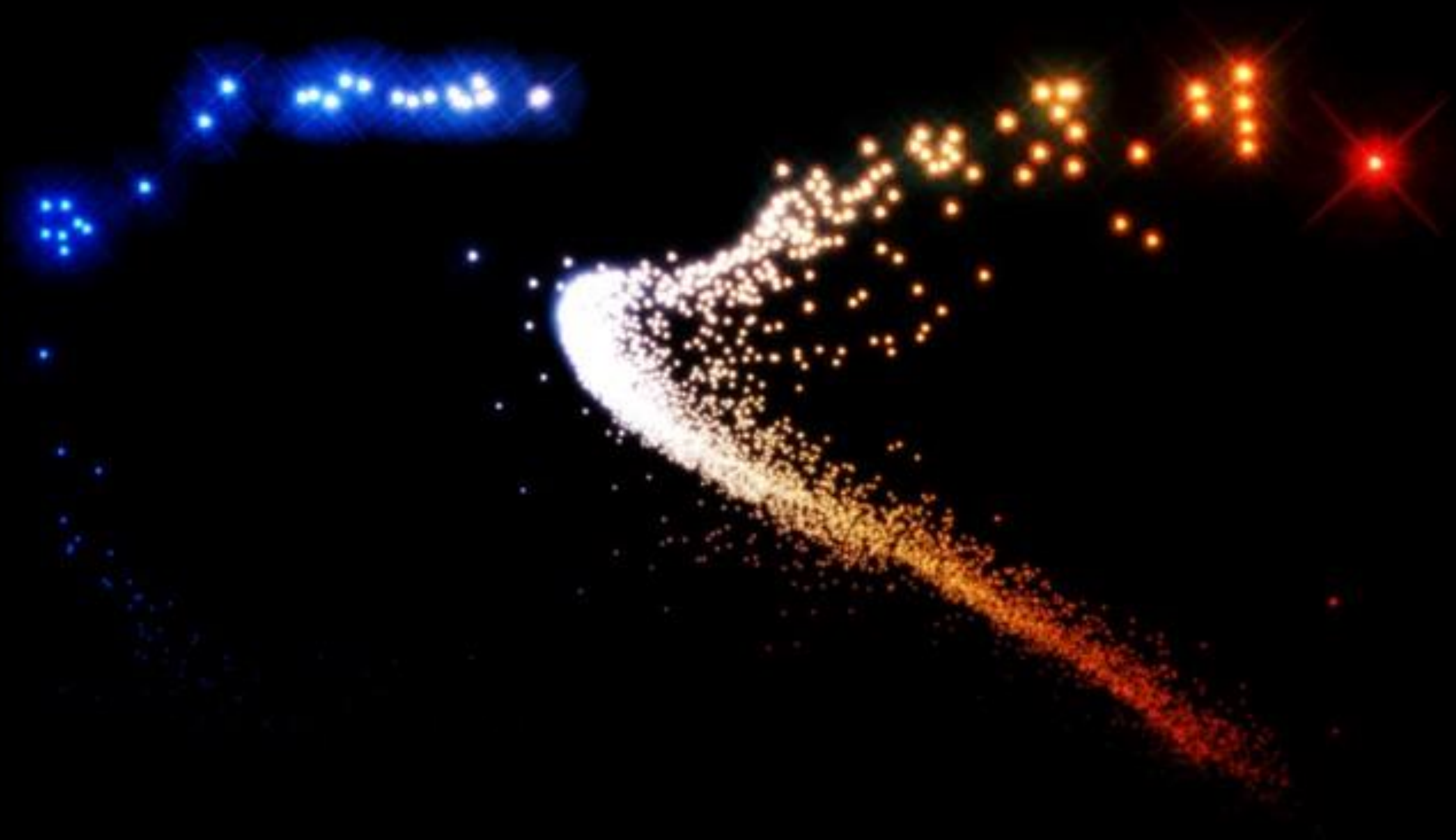
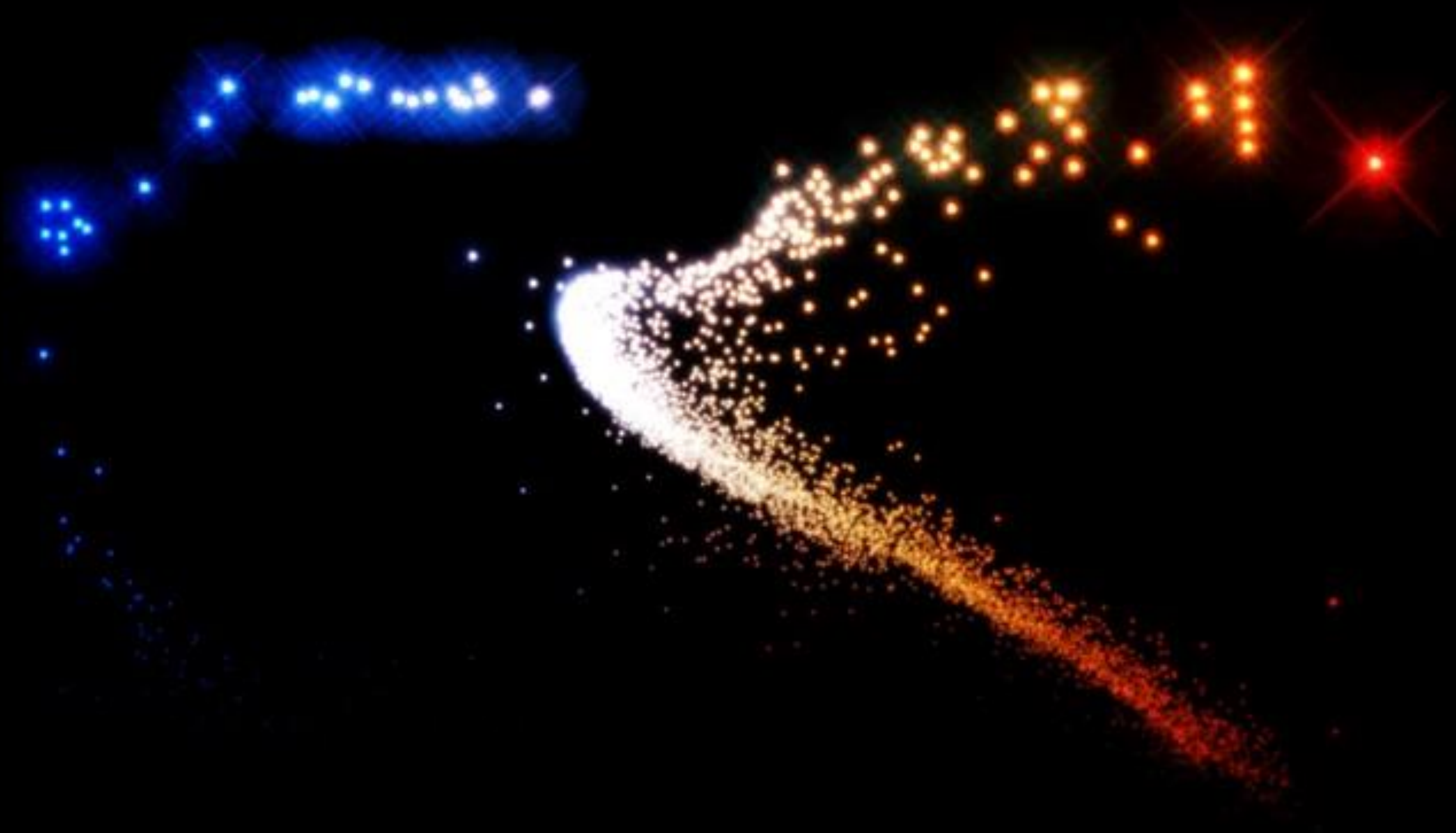
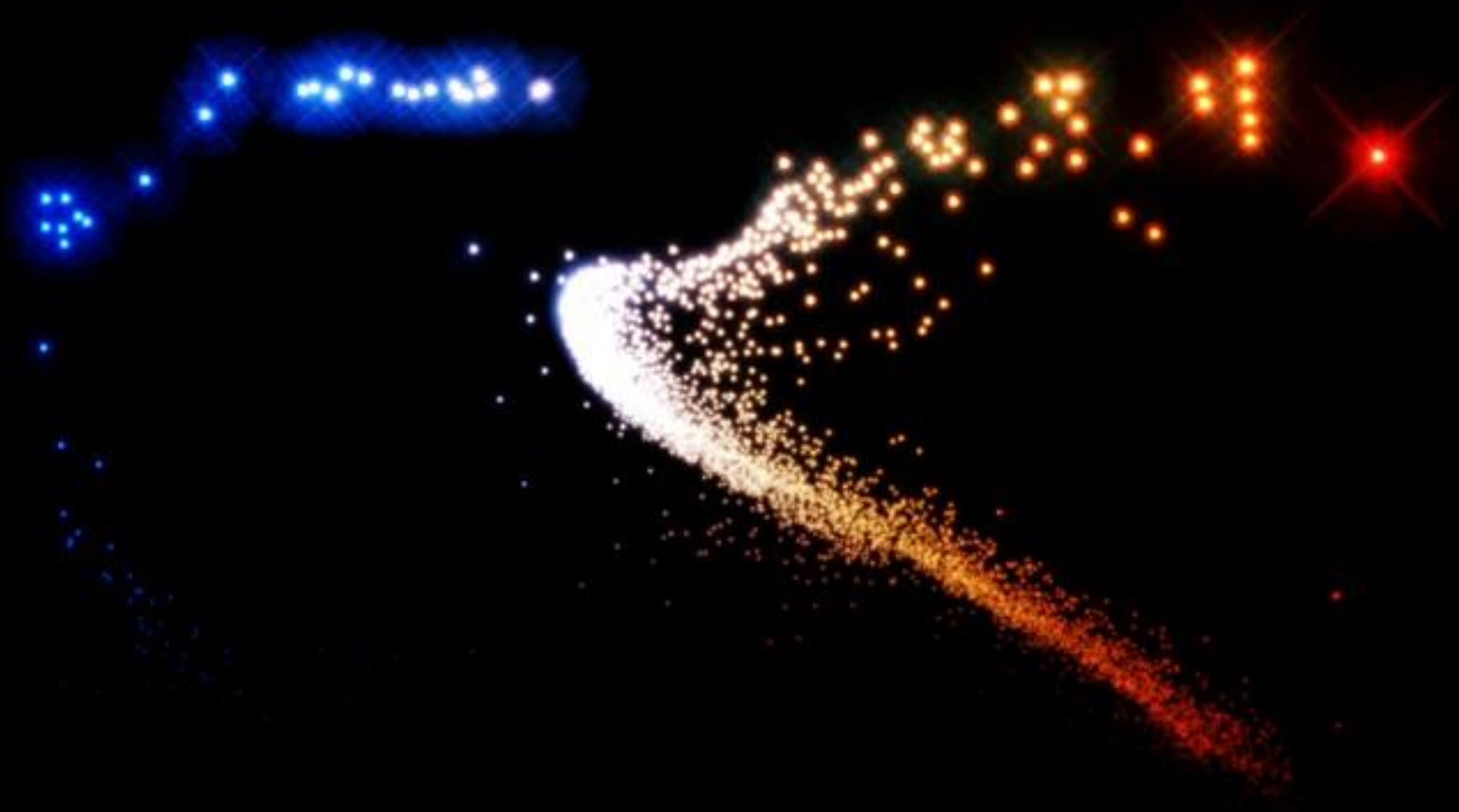
15k



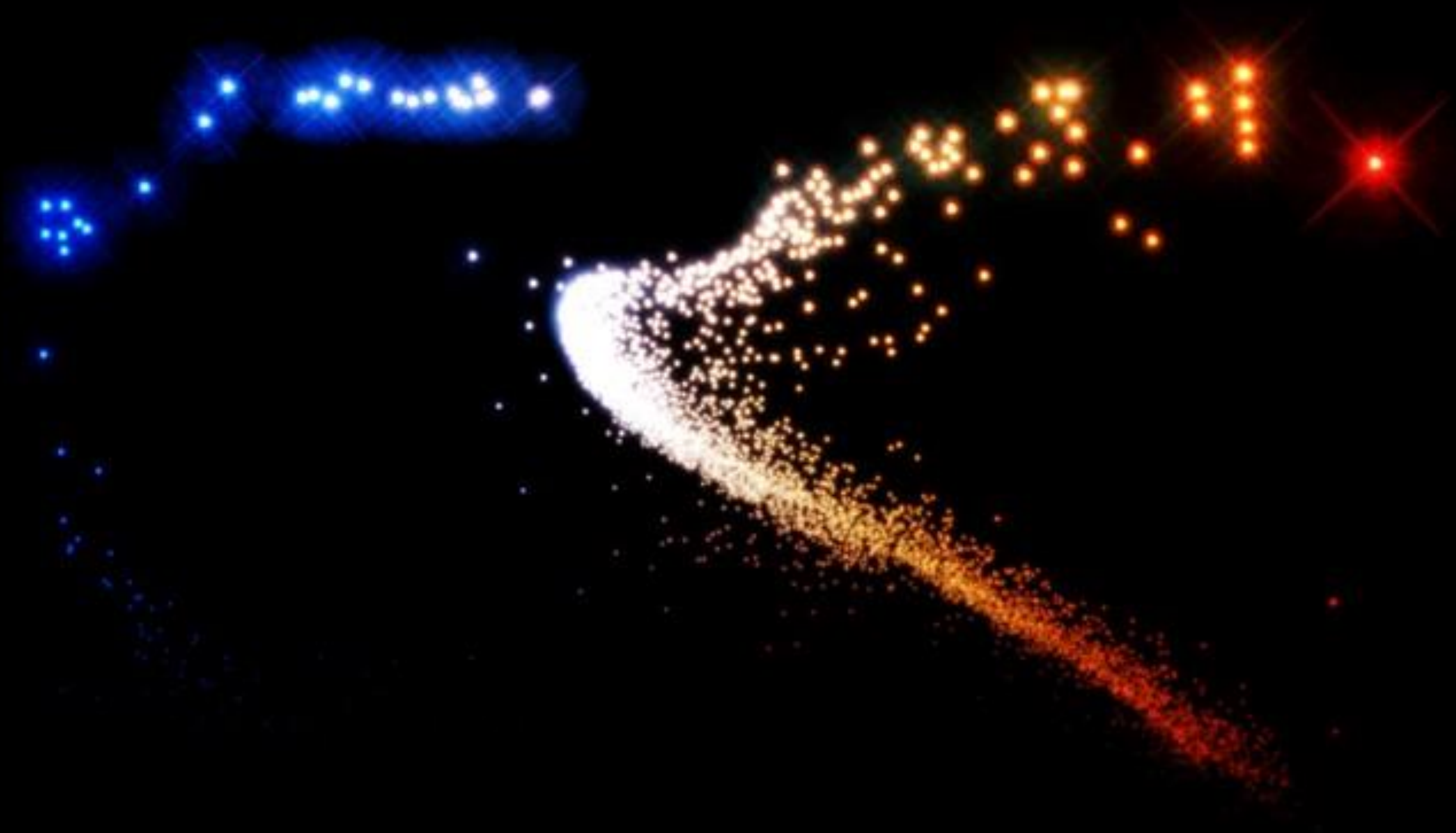
This is called a
Color-Magnitude Diagram
(CMD).



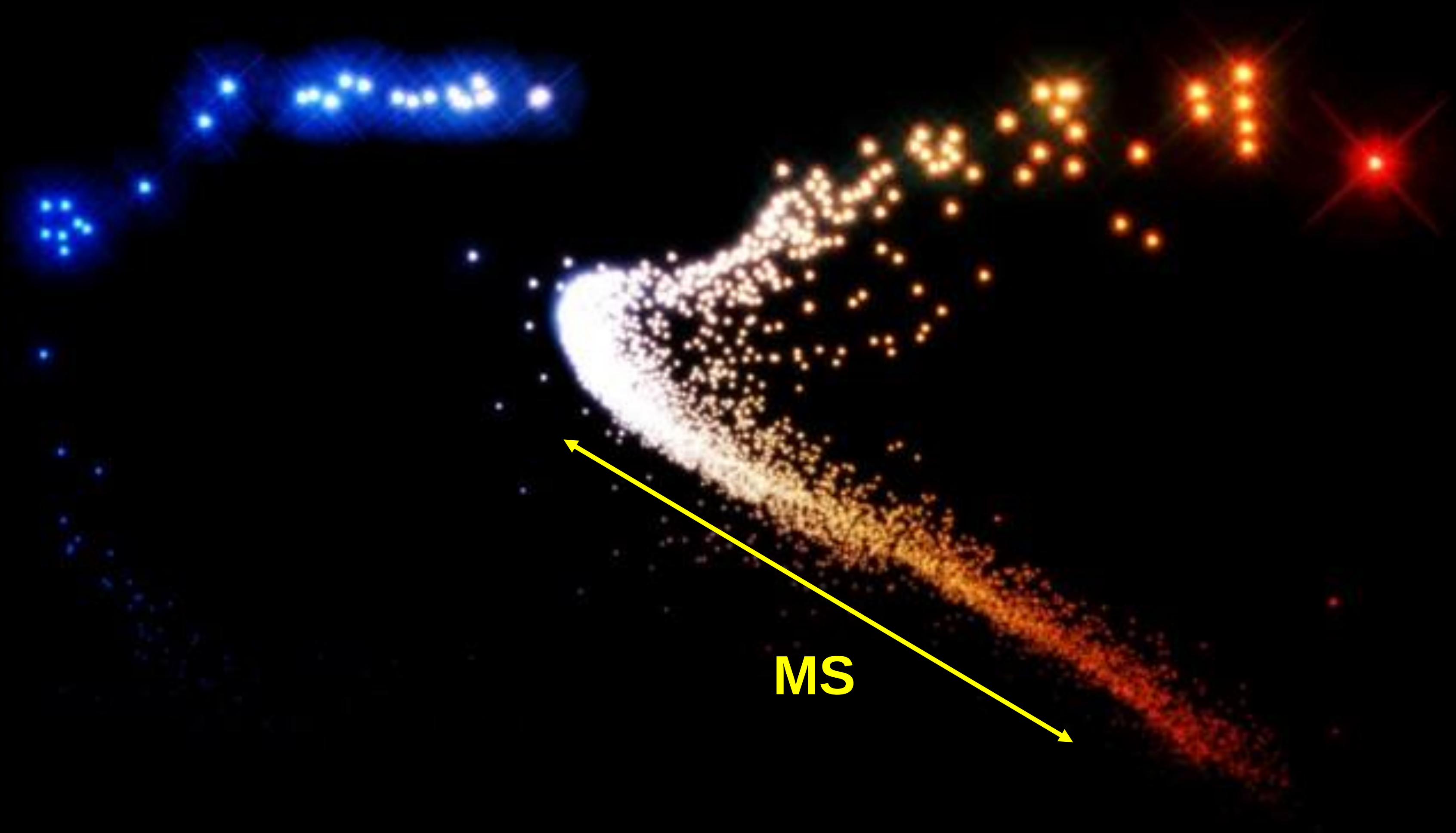
When Astronomers first plotted stars this way, they realized that stars don't fall just anywhere in the diagram.



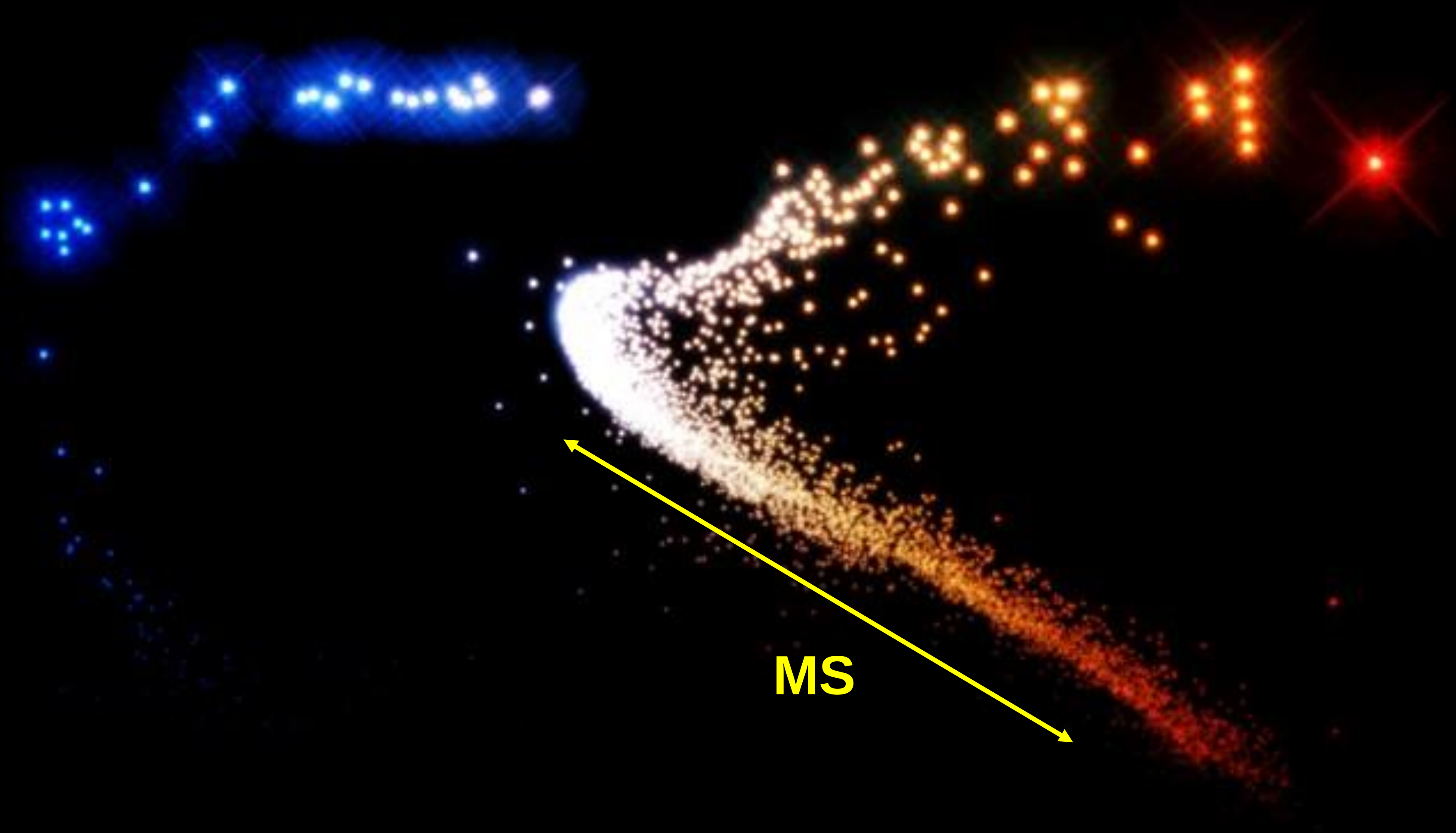
Stars tend to lie along a few well-defined sequences.



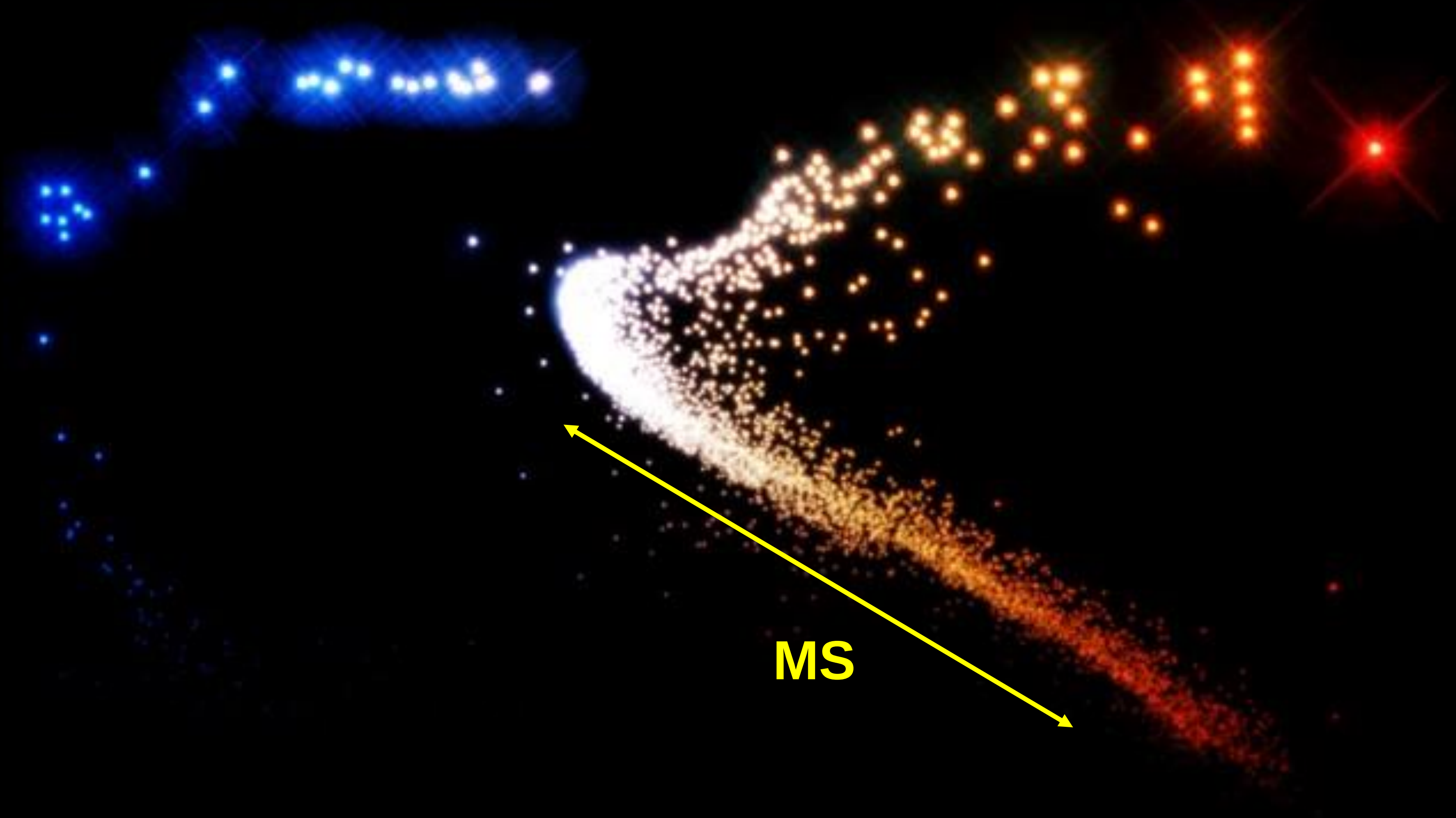
The unmistakable order in diagrams like this led astronomers to develop theories to explain stellar evolution.



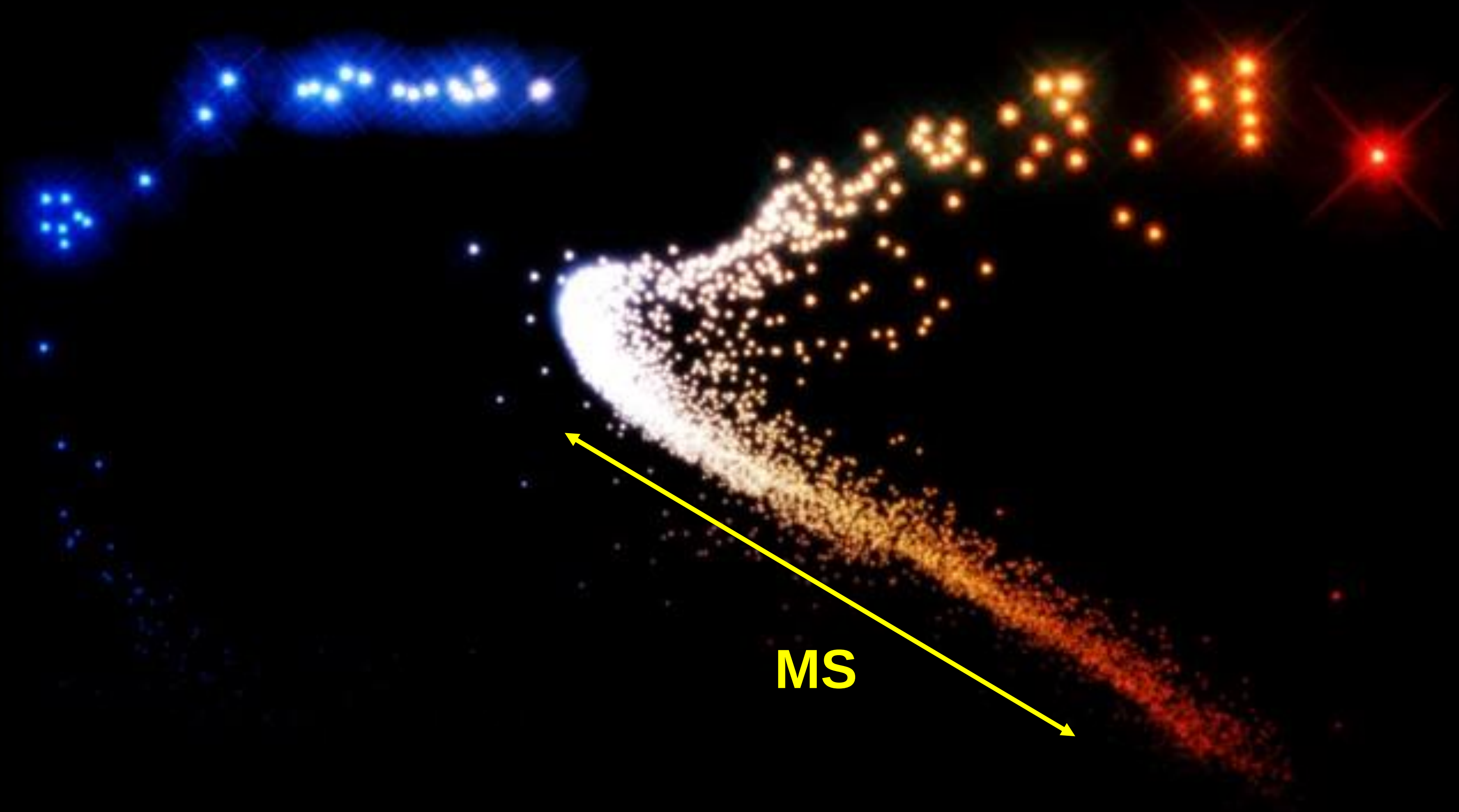
The vast majority of stars lie along the **Main Sequence (MS)**.



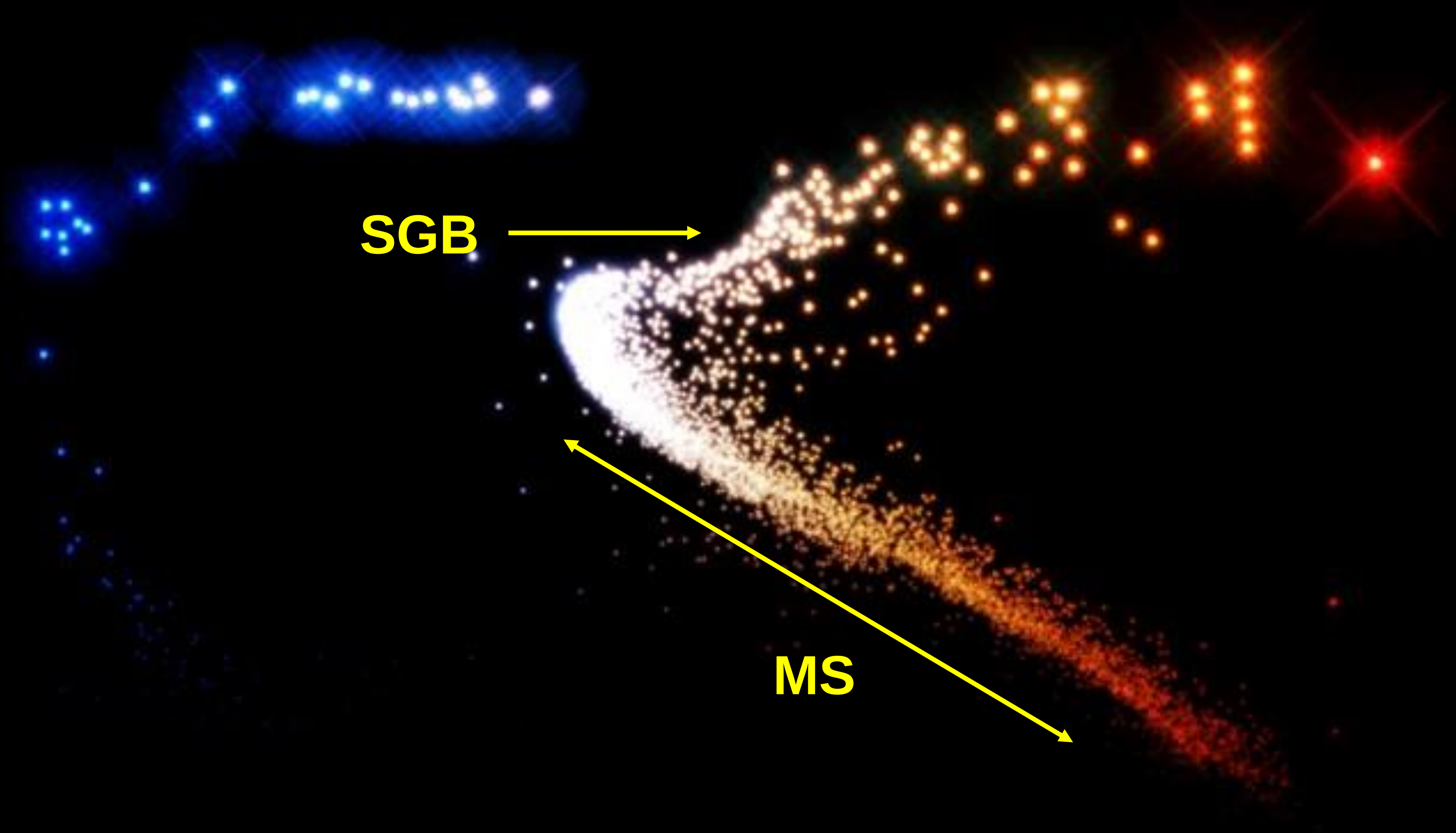
Stars don't move along this sequence; rather they sit at the same place for a long time fusing their hydrogen into helium.



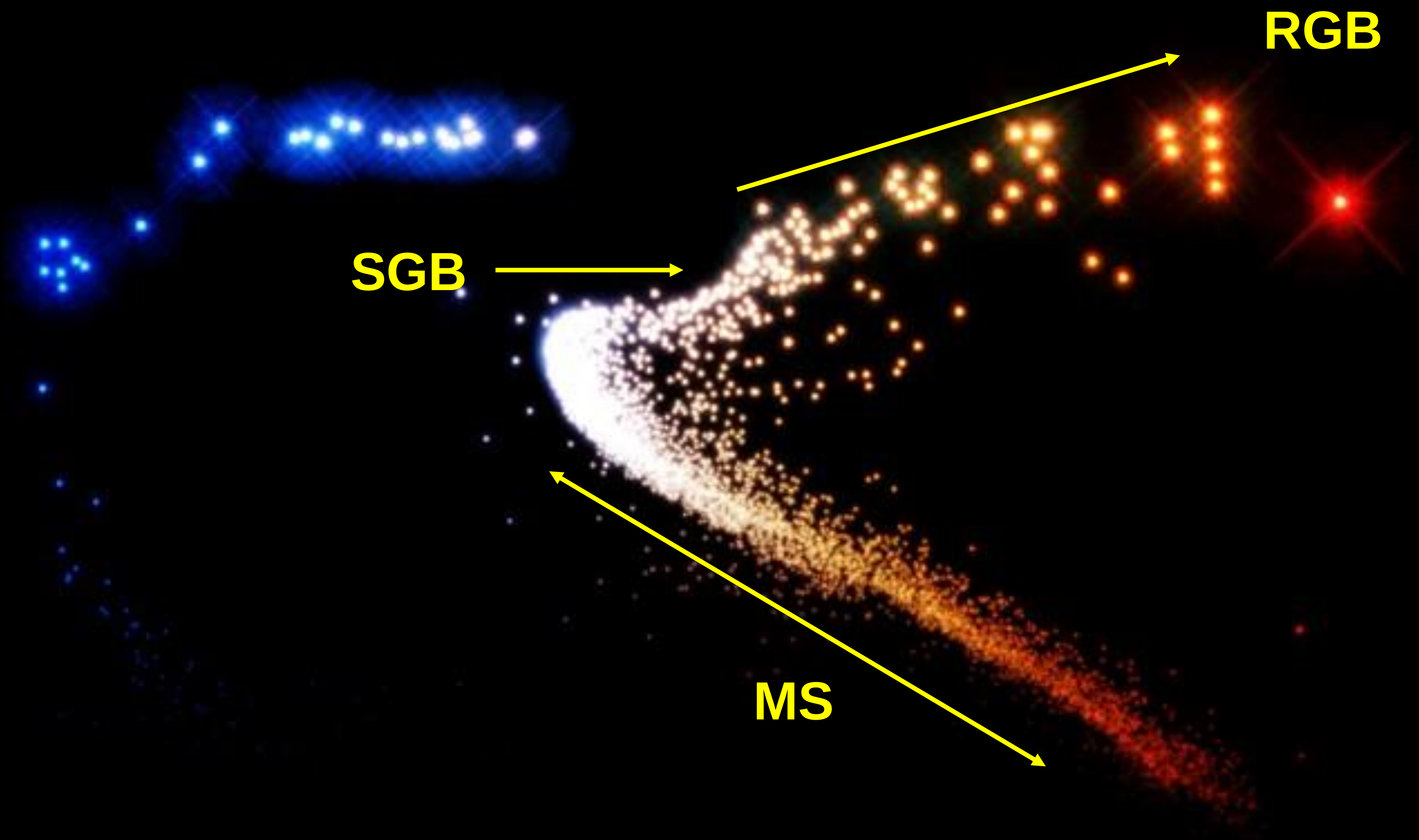
This is a sequence in mass. Stars at the bright end are massive, and those at the faint, red end have very low masses.



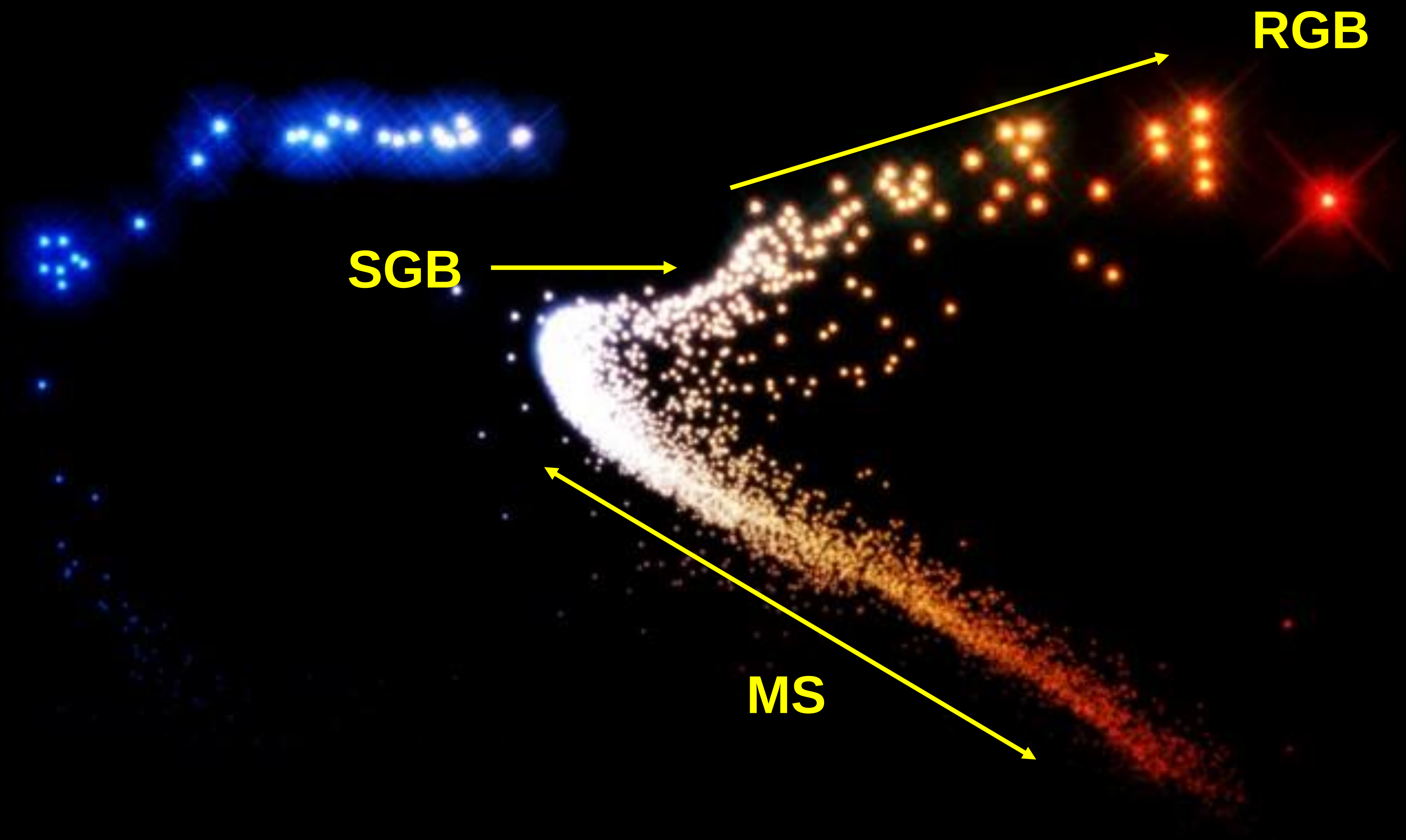
The more massive stars consume their hydrogen fuel much faster than the lower-mass stars.



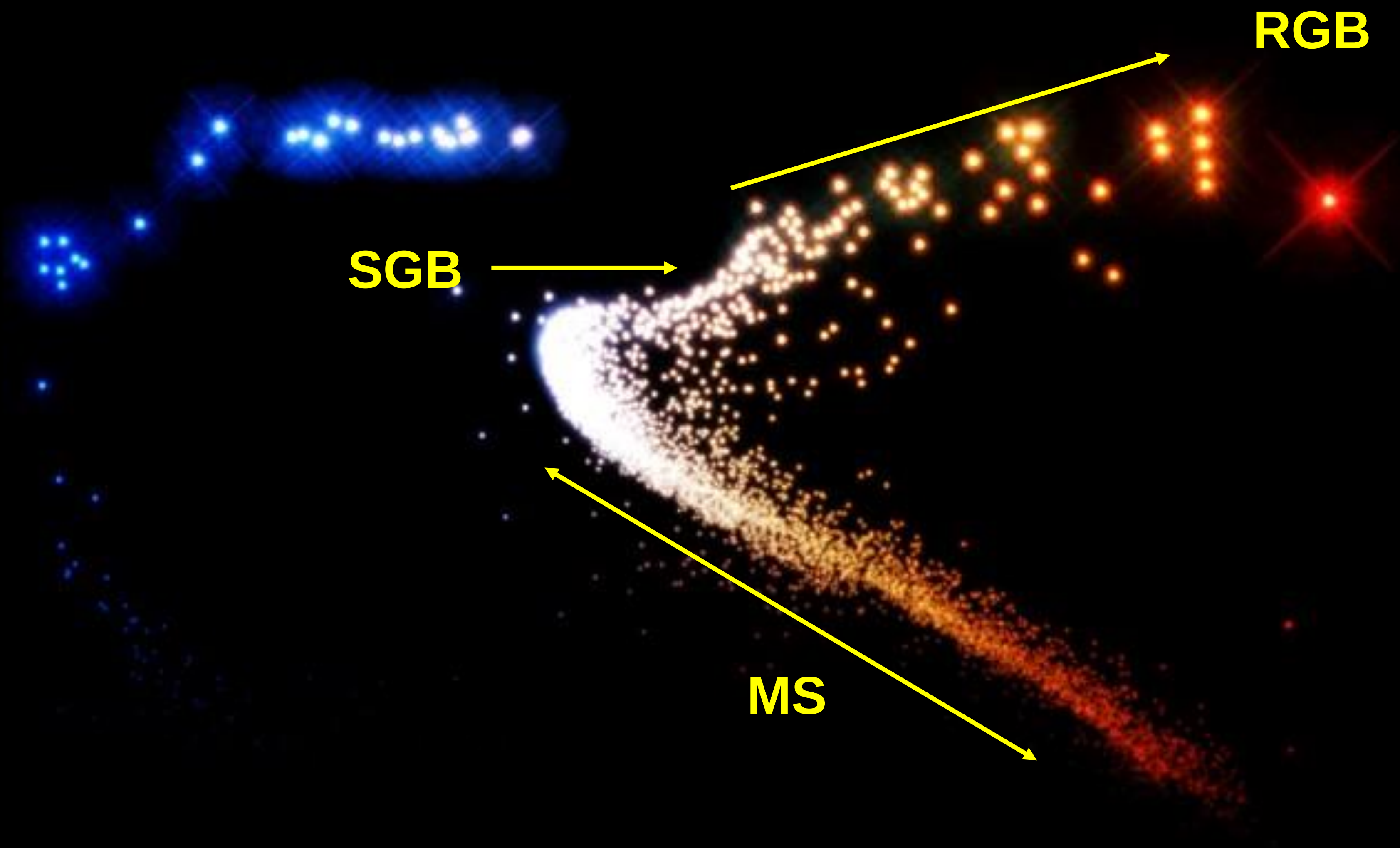
When fuel becomes sparse in the stellar core, stars readjust their internal structure and move red-ward along the **Sub-Giant Branch (SGB)**.



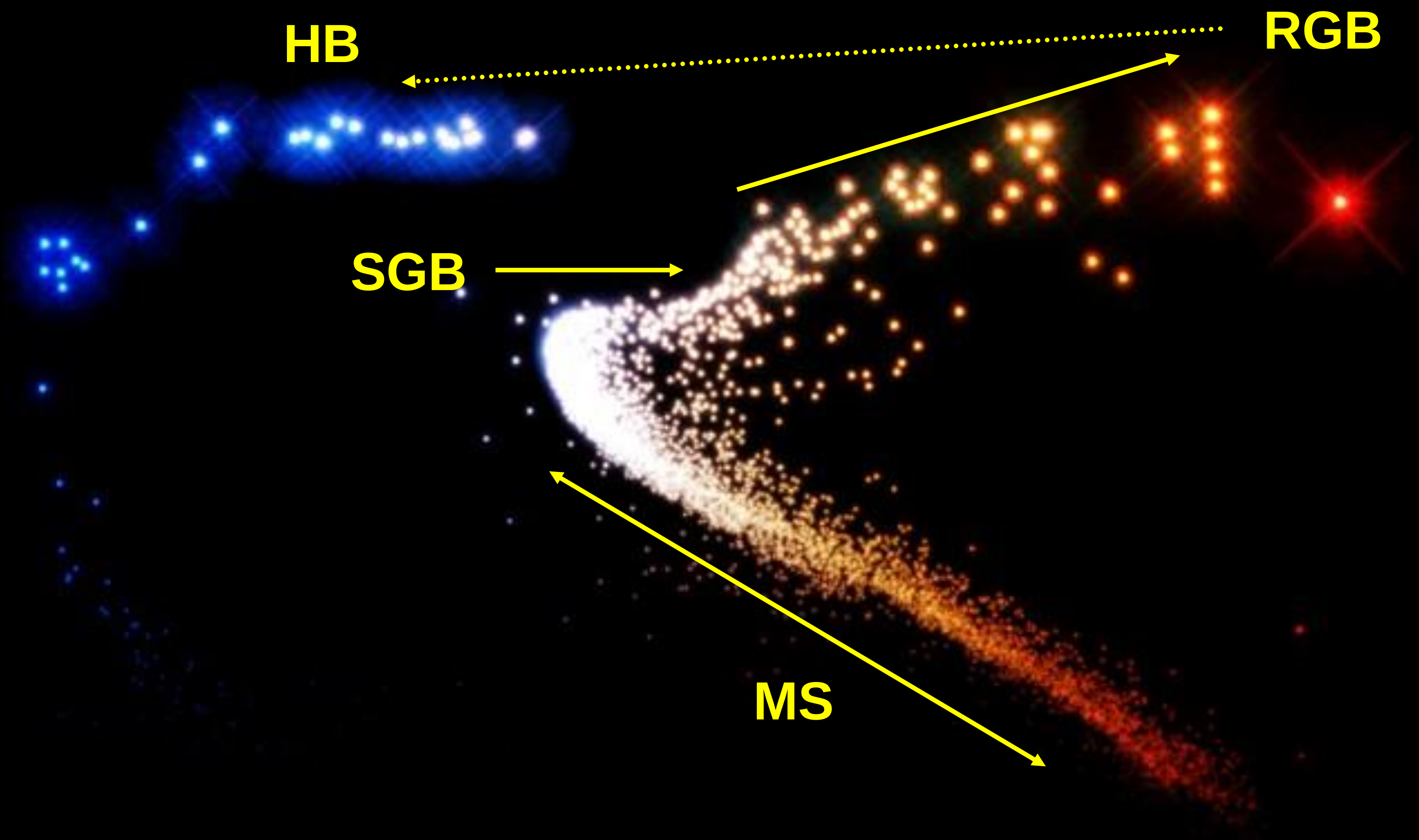
They start to burn the hydrogen in a shell around the core and become big and bloated as they move up the **Red Giant Branch (RGB)**.



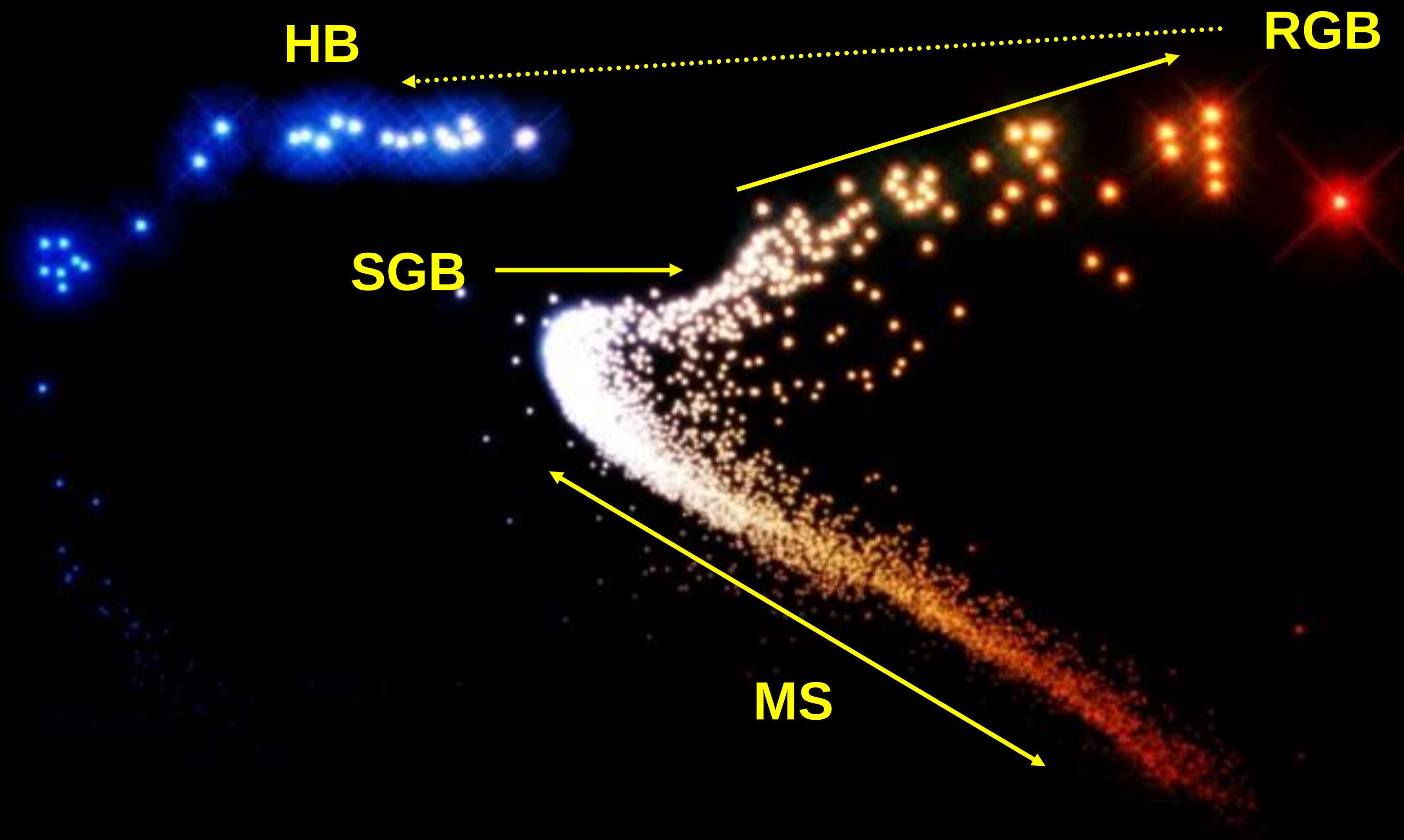
As the shell-burning continues, more and more helium gets deposited onto the core.



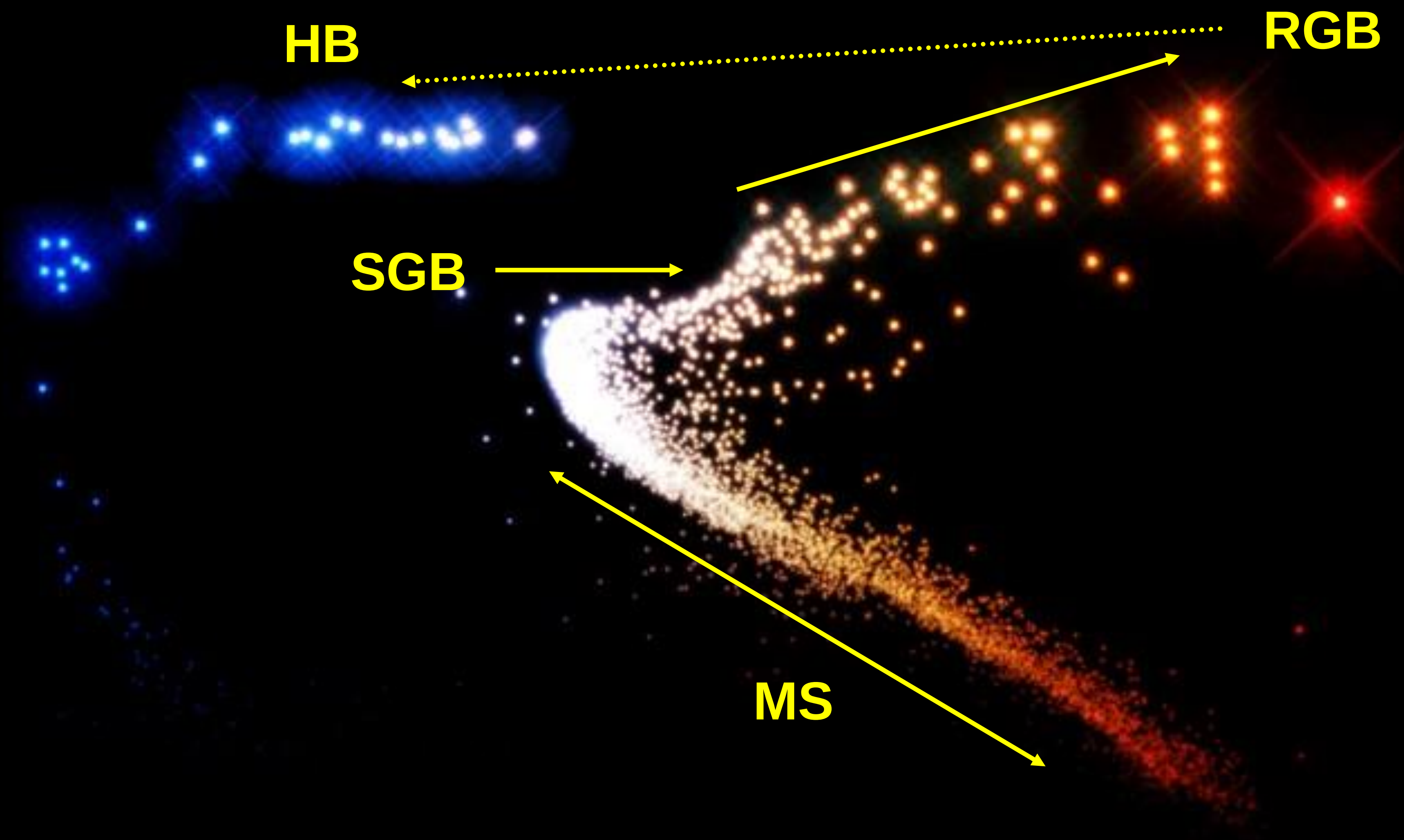
When the core has enough mass, it is finally able to ignite helium into carbon.



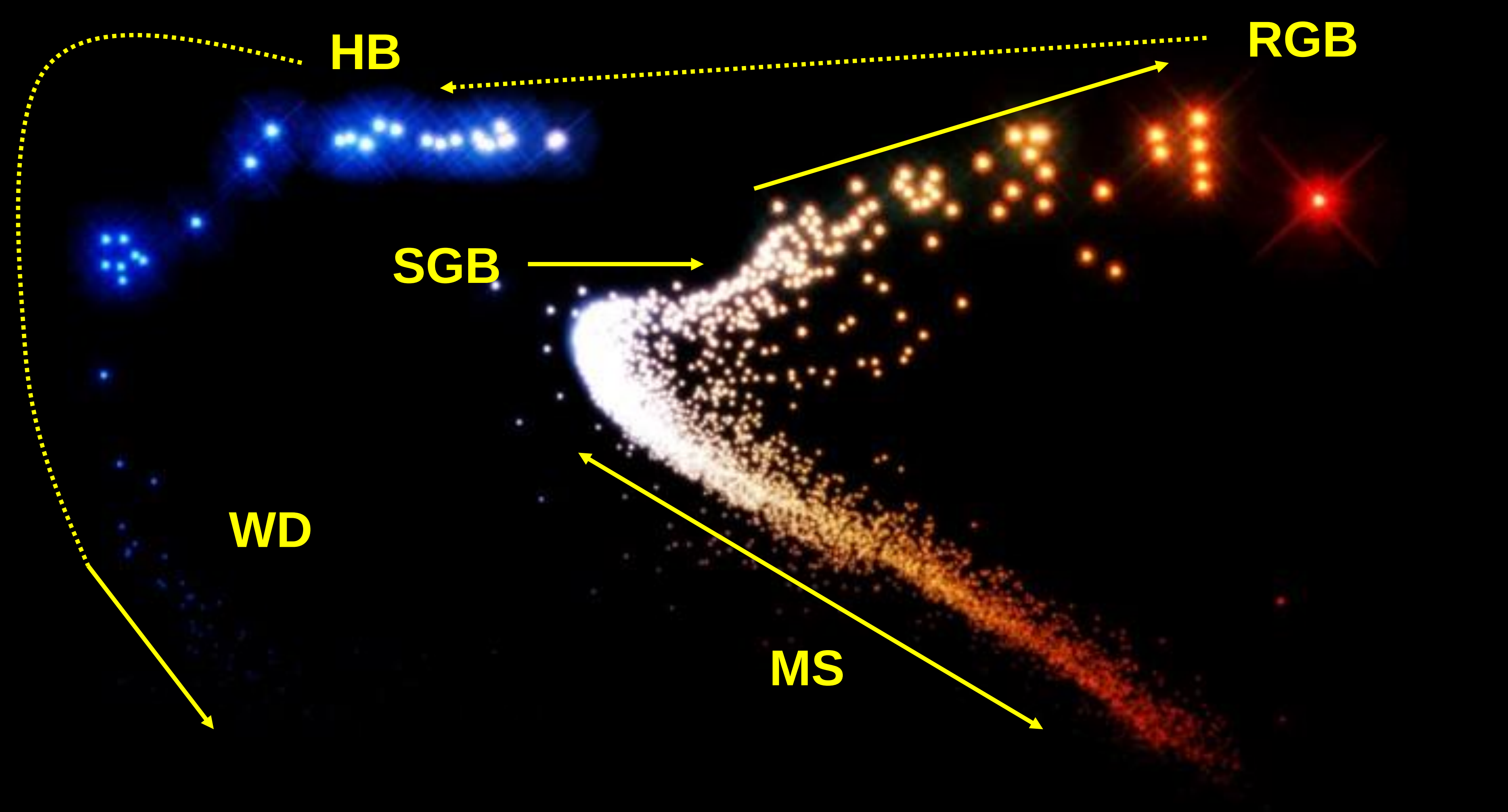
The star readjusts its structure again and finds itself on the **Horizontal Branch (HB)**.



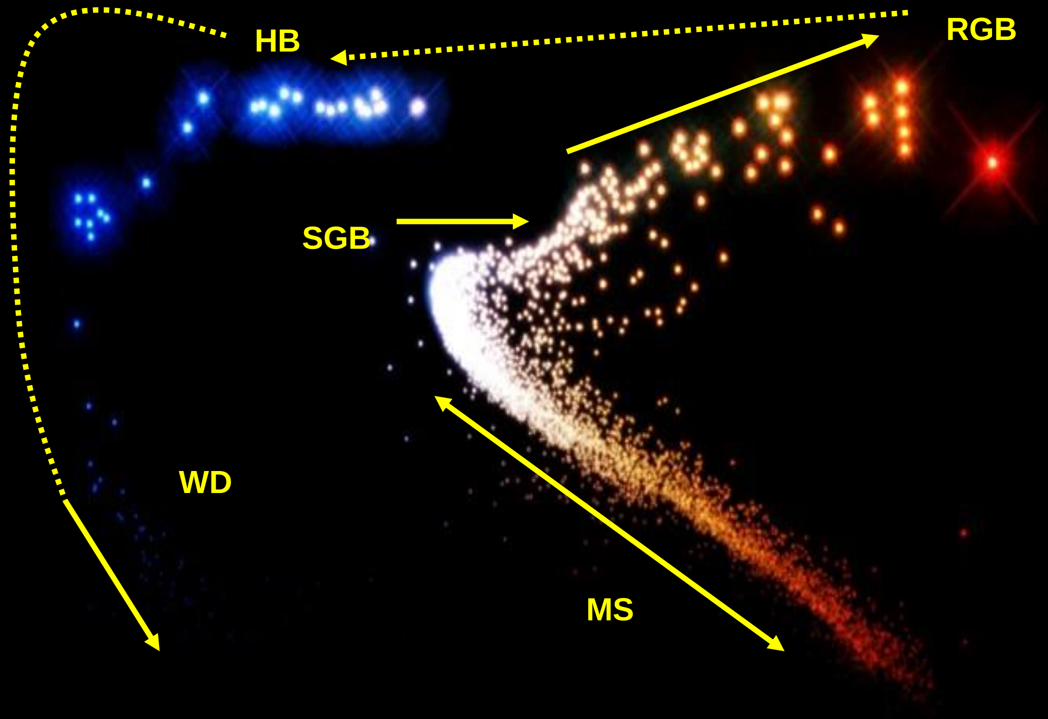
The helium fuel is not as potent as the hydrogen, so it runs out quickly.

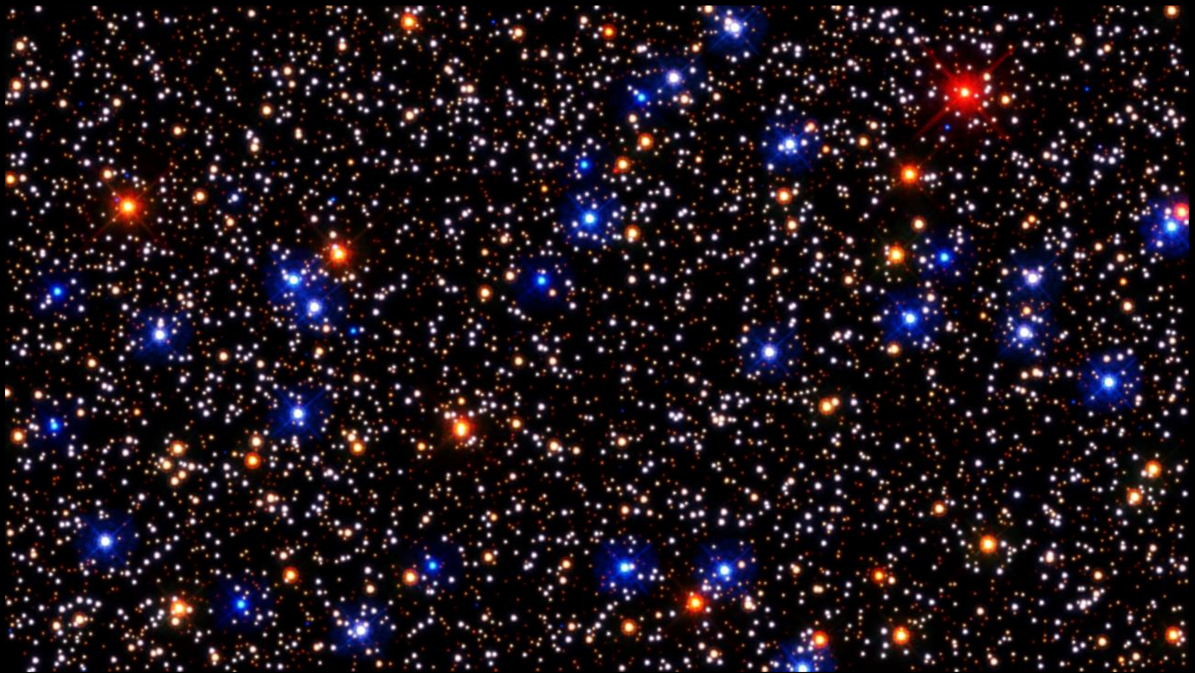


That is why there are so few stars on the **HB** compared to the **MS**. Stars do not spend much time on the **HB**.



When the helium is gone, the star has no more fuel. With nothing left to burn, it fades away into blue darkness as a **White Dwarf (WD)**.





Since a star's color and brightness tell us its evolutionary phase, we can easily identify stars by phase in the image.