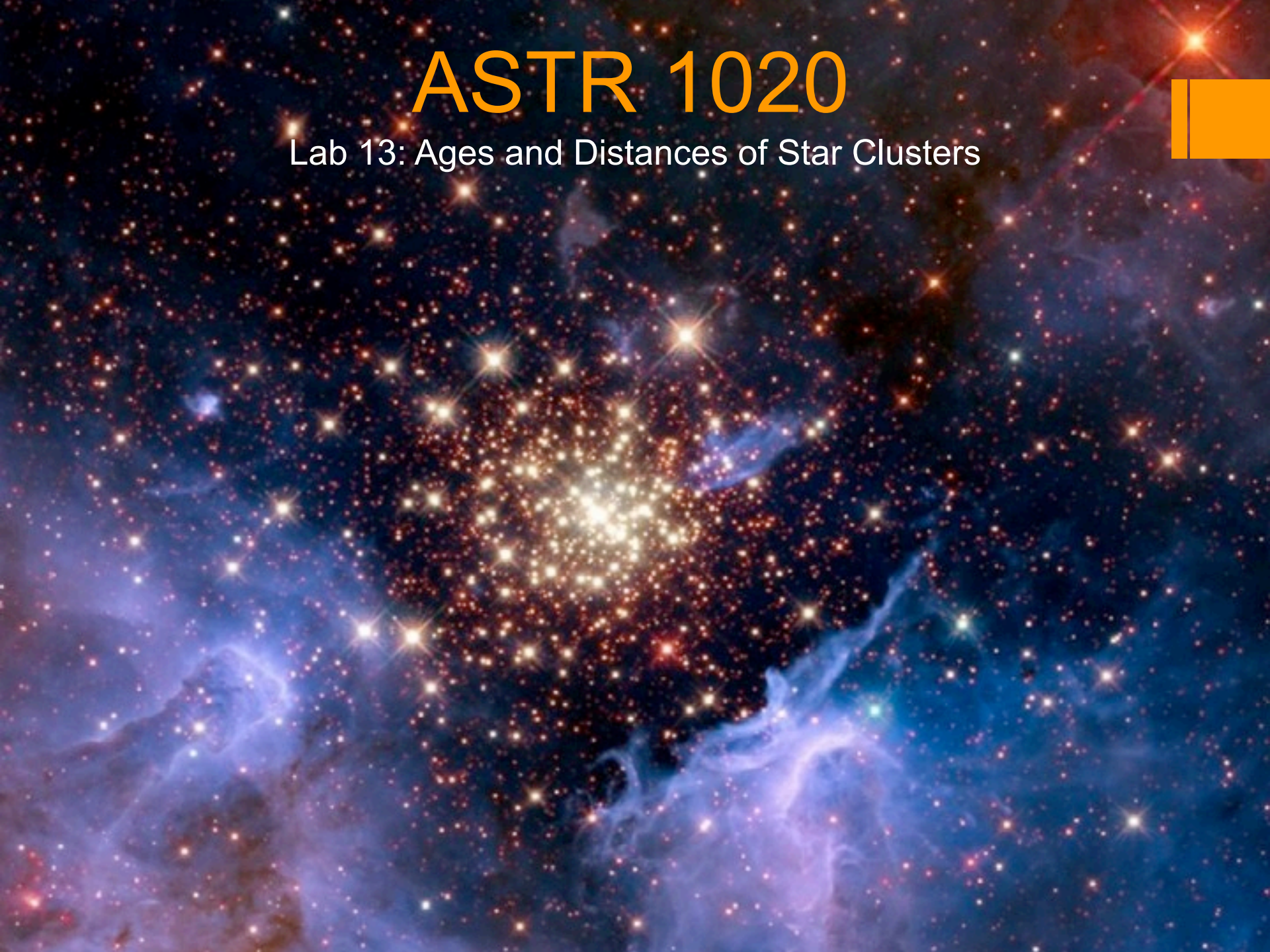
ASTR 1020

Lab 13: Ages and Distances of Star Clusters

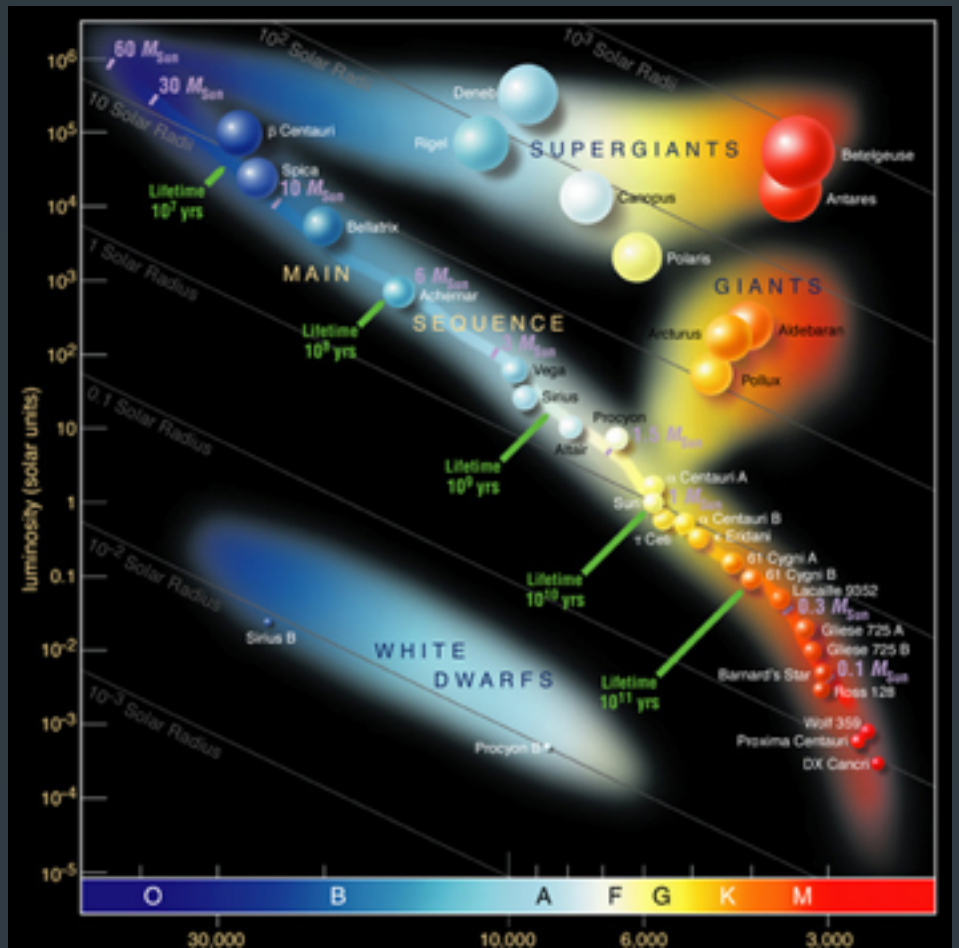


Star Clusters

Remember these guys? The Pleiades are part of a star cluster. They formed together and probably all have roughly the same age, composition, and distance from earth.

Age and Distance of a Star Cluster

Last week we studied stars using photometry. Plotting the results of individual stars gave us an HR diagram showing the star cluster's brightness vs. color. By comparing our observed magnitude and color HR diagram with a theoretical **zero-age main sequence** HR diagram, we can deduce the age and distance of our star cluster.

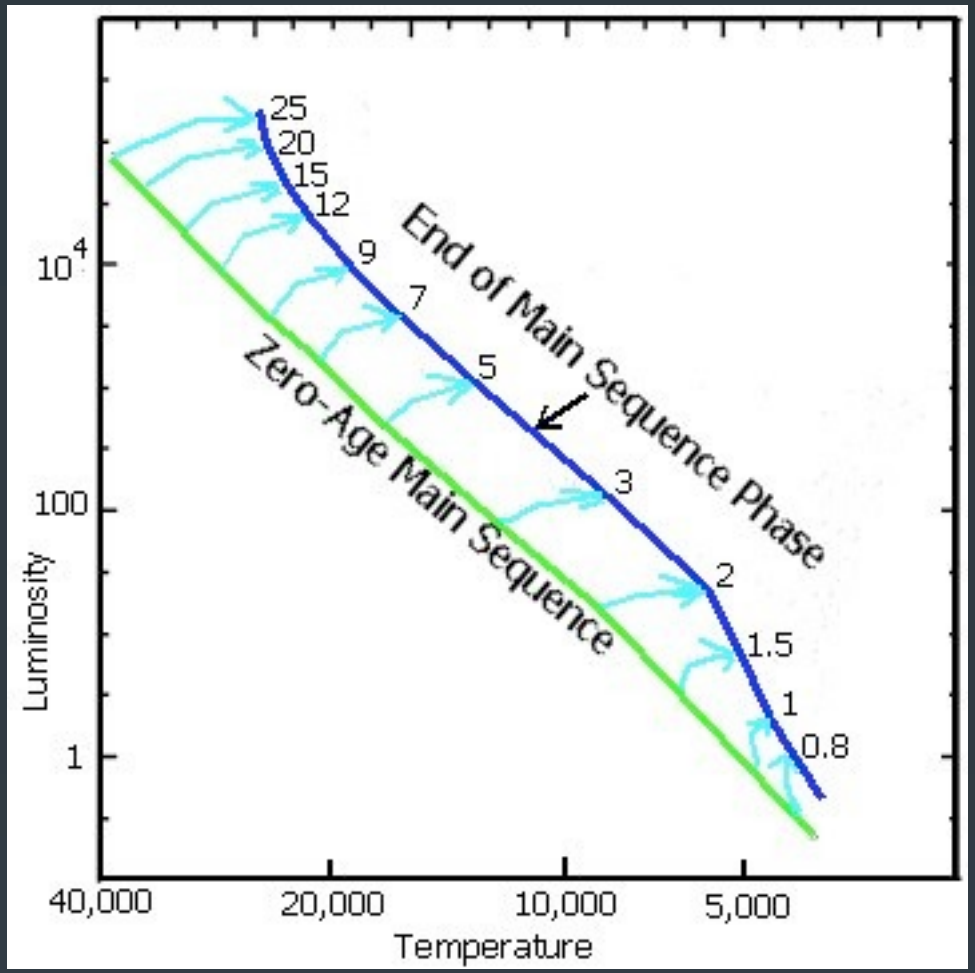


Zero Age Main Sequence and Turn-Off

Stars spend most of their lifetime along the main sequence curve, which is a special relation between stars' color (or temperature) and brightness. Hot stars are brighter, cool stars are colder. Hot, massive stars die young, whereas cold, small stars live a long time.

Hot : Bright

Cold : Dim

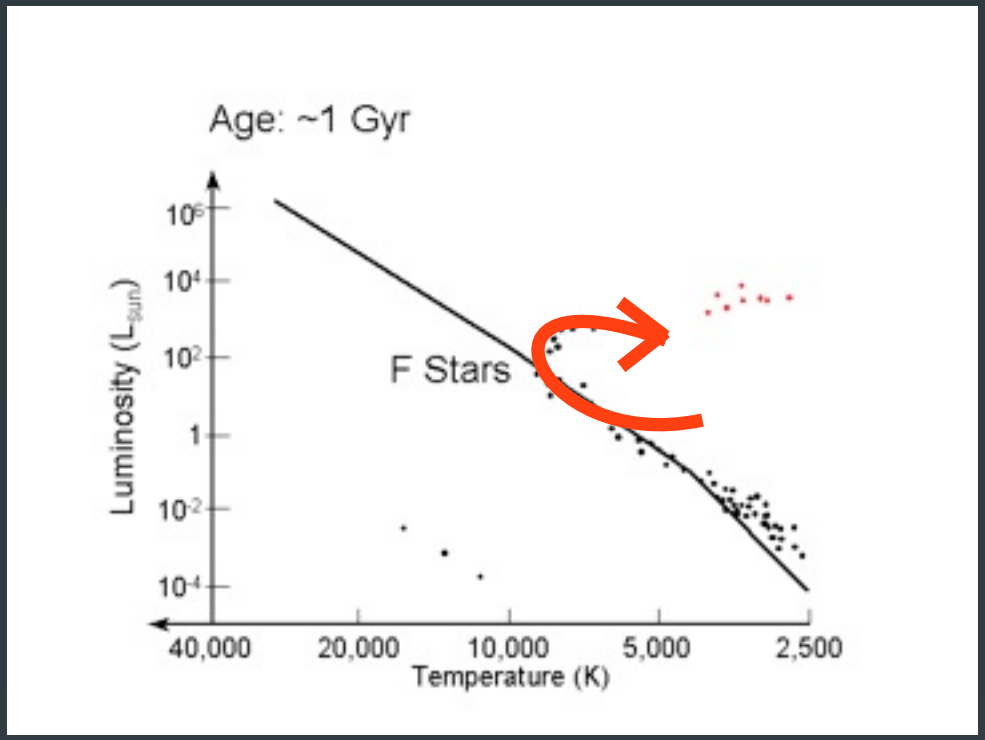


Age

Hot, massive stars die young, whereas cold, small stars live a long time. After a while, the hot bright stars die out, and those that are left start to curve away towards the red giant branch. The position and distinctness of this **turn-off point** can tell you the age of the star cluster.

Hot : Bright

Cold : Dim



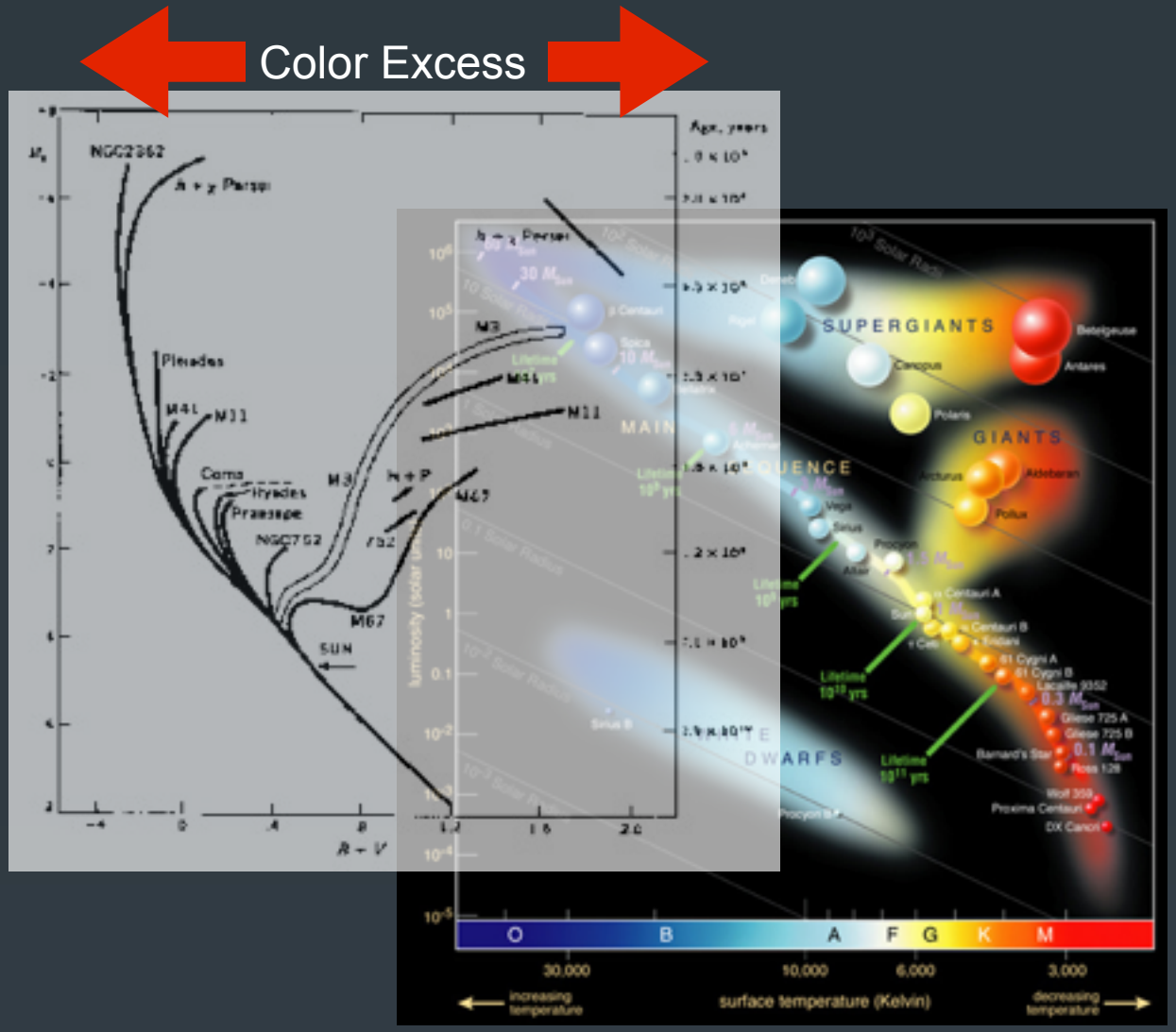
Color Excess

Dust in space reddens light on its way to us. It scatters away blue light. This can throw off our distance calculations, so we track dust-caused reddening by measuring the color excess E(B - V). That is, we compare the observed color of the star cluster to the color it would be if there were no dust between us and the star cluster. We **correct** for the reddening caused by dust.

$$E(B-V) = (B-V)_{observed} - (B-V)_{corrected}.$$

Color Excess

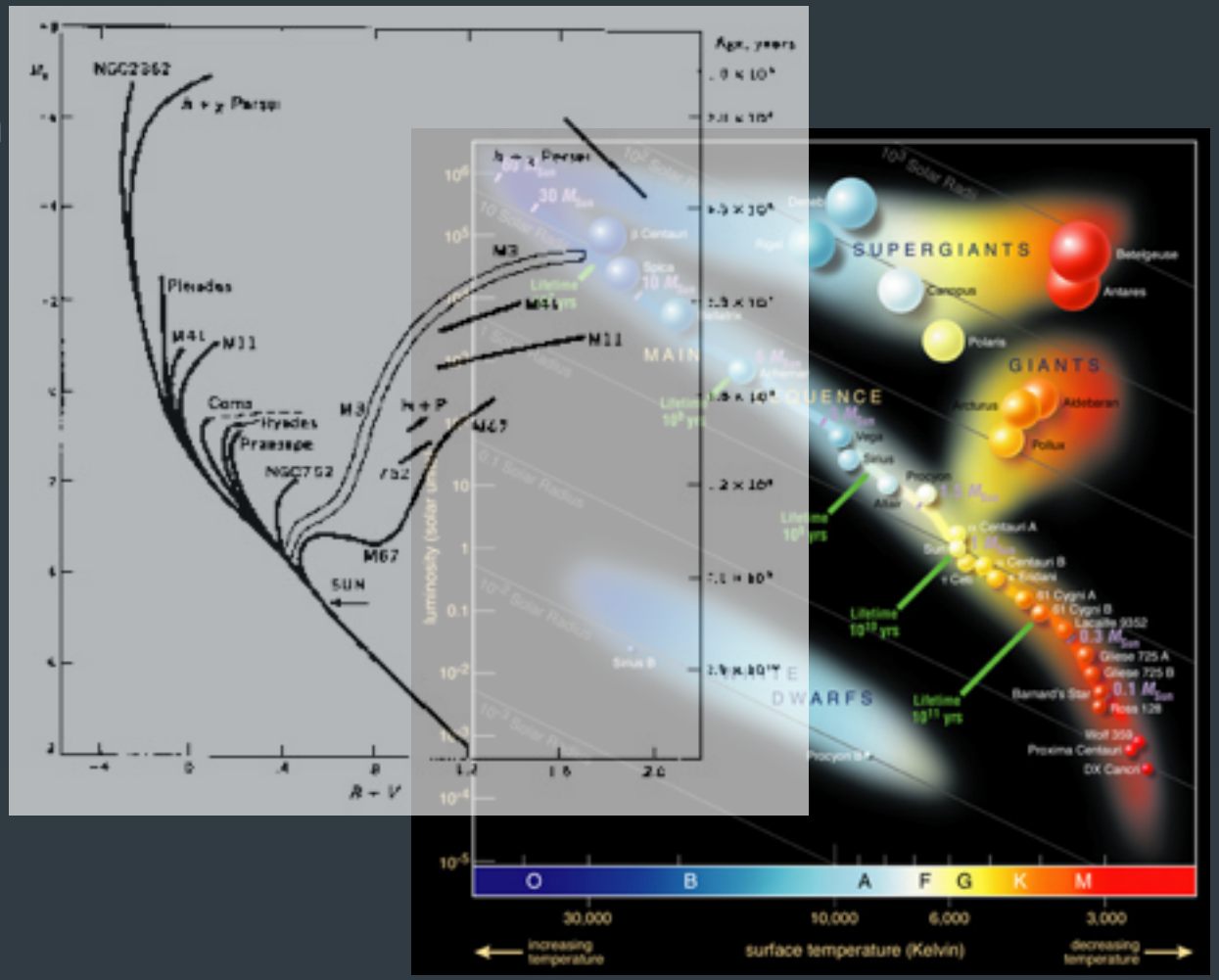
Line up the CORRECTED colors. That is, line up the transparency's B-V with the paper's TOP SCALE. The color excess is the difference between the paper's bottom scale and top scale and should be a positive number.



Distance Modulus

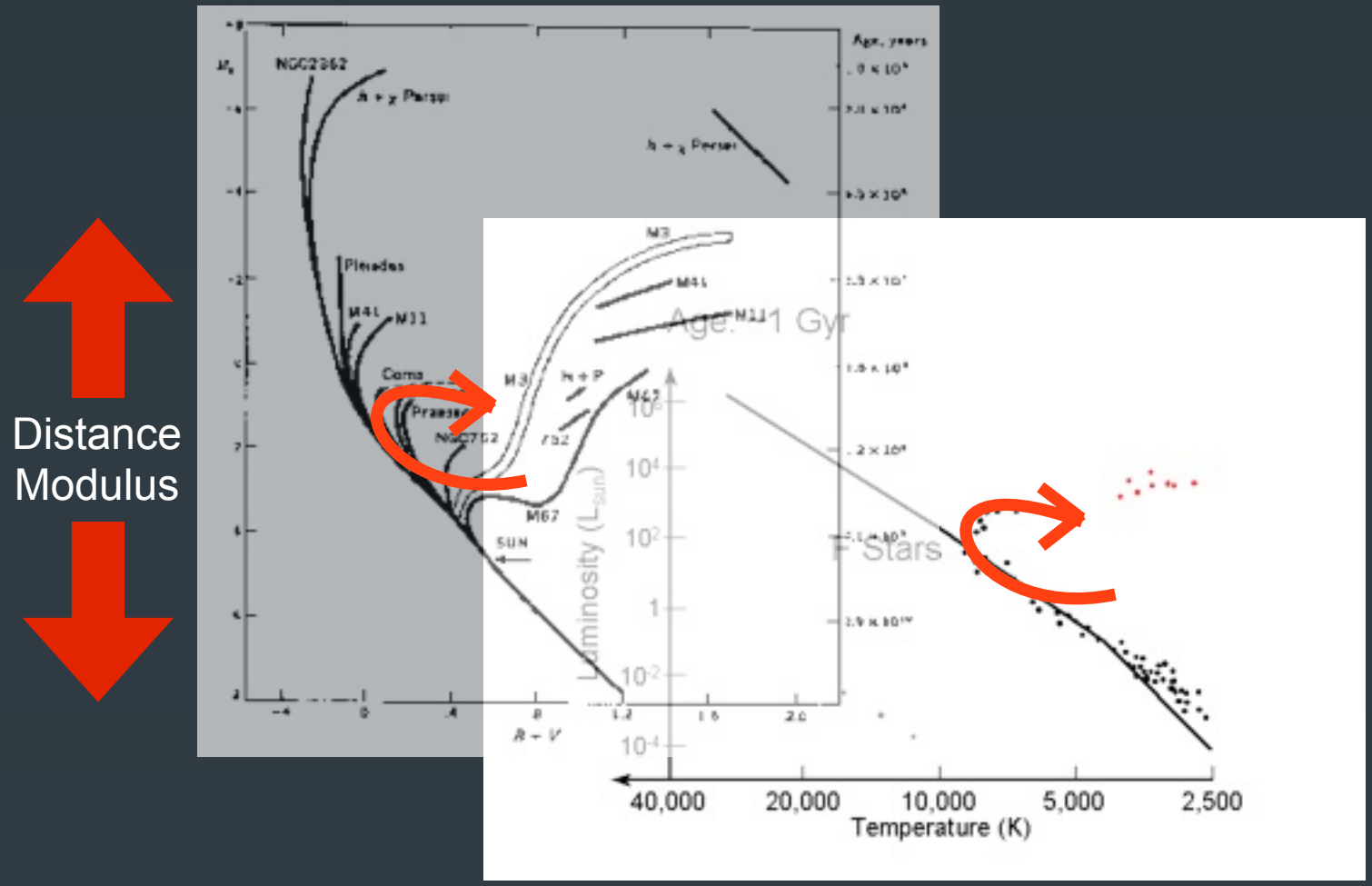
The transparency gives absolute magnitude and corrected color index. Get the distance modulus from the difference between observed brightness (apparent magnitude V) and intrinsic brightness (absolute magnitude M_V), much like last week: Line up whatever lower diagonal you see with the transparency's main diagonal. Where does the trans-parency's 0 hit on the paper scale?

Distance Modulus



Age

The age comes from which labeled curve on the transparency best fits the cluster's leftward turn off from the diagonal main sequence. If the turn-off is between the transparency's curves, you can interpolate some value between the two nearest curves.

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