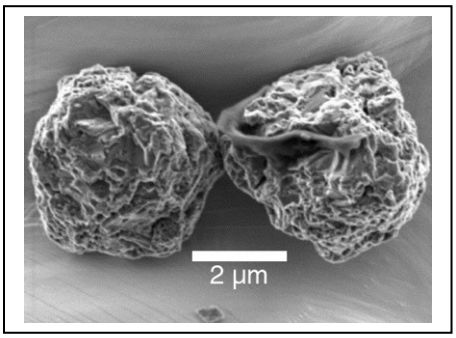

Although dust grains can be very small, like the pair of grains shown in the figure to the right, when enough of them get together over vast distances of space, they can extinguish the light from distant stars. The picture on the left is the dark dusty nebula Barnard 68, which obscures the light from background stars in the Milky Way. With the help of infrared telescopes, astronomers can determine the sizes of the dust grains in space and also their temperatures as they emit their own infrared 'heat' radiation.

Problem 1 – The two dust grains in the above picture are composed of silicon dioxide, which resembles beach sand. If they are approximated as spheres with a radius of 2×10^{-6} meters, what is the volume of one such dust grain in cubic-meters?

Problem 2 – Silicon dioxide has a density of 3300 kilograms/meter^3. If mass = density x volume, about what is the mass of one of these dust grains in kilograms?

Problem 3 - The Barnard 68 dark nebula has a radius of 0.25 light years where 1 light year = 9.3×10^{15} meters. Suppose that the density of dust grains is about 0.001 dust grains per cubic meter. What is the total mass of dust in this nebula?

Problem 1 – The two dust grains in the above picture are composed of silicon dioxide, which resembles beach sand. If they are approximated as spheres with a radius of 2 x 10^{-6} meters, what is the volume of one such dust grain in cubic-meters?

Answer: Volume = 4/3 (3.141) (2 x 10^{-6})^3 = **3.35 x 10^{-17} meters^3**.

Problem 2 – Silicon dioxide has a density of 3300 kilograms/meter^3. If mass = density x volume, about what is the mass of one of these dust grains in kilograms?

Answer: M = (3.35 x 10^{-17} m^3) x (3300 kg/m^3) = **1.1 x 10^{-13} kg/grain**.

Problem 3 - The Barnard 68 dark nebula has a radius of 0.25 light years where 1 light year = 9.3 x 10^{15} meters. Suppose that the density of dust grains is about 0.001 dust grains per cubic meter. What is the total mass of dust in this nebula?

Answer: Mass = mass of 1 dust grain x Number of dust grains in nebula.

Number of dust grains = 4/3 (3.14) (0.25 x 9.3x10^{15})^3 meter^3 x 0.001 grain/meter^3
= 5.26x10^{43} grains

Total mass = 1.1x10^{-13} kg/grain x 5.26x10^{43} grains
= **5.78 x 10^{30} kg**

Note, the mass of Sun is equal to 2.0 x 10^{30} kg, so the dust mass in this nebula is about 2.9 times the mass of our sun!