

they were expected to point out that hot spots (as revealed by blackbody radiation – in this case infrared – measurements) might indicate shorting or some other form of circuit failure, and cold spots and regions might indicate an open circuit preventing current from flowing. This was all hypothetical, but logical. Some students pointed out that chip features are now of nanometer scale, whereas typical infrared wavelengths are of micrometer scale, so the diagnostics technique will lack resolution: another important point.

Finally, students were asked if they have heard about cosmic microwave radiation (CMR), which is understood to have originated shortly after our universe originated according to the “big bang” theory. It was pointed out that the gases doing the radiating would be extremely hot. Next, it was pointed out that the measured spectrum of CMR corresponded to that of a black body at a temperature of around 3 K. How could the “extremely hot” be reconciled with the measured 3 K? Students went off in a number of different directions, but many pointed out that the CMR was being emitted by gases traveling at very high speed away from the earth and that it would be subject to a doppler shift that could go some way to accounting for the low frequency of the 3 K CMR. The key points were to convert from temperature to a frequency point of view and then to realize that the CMR sources were traveling away from the observer and thus the CMR would undergo a doppler shift to lower frequencies.