­**Can computer chips be air-conditioned?**

https://computer.howstuffworks.com/computer-chip-air-conditioning.htm

During the hot months of summer, many people stay indoors in order to avoid sweat and [sunburns](https://health.howstuffworks.com/skin-care/beauty/sun-care/sunscreen.htm), enjoying the cool comforts of an air-conditioned apartment or house instead. While a room without any cooling system would feel stuffy and uncomfortable, [air conditioners](https://home.howstuffworks.com/ac.htm) provide us with comfortable, 70-degree temperatures.

The air conditioner in your living space works just like the refrigerator in your kitchen -- it uses similar liquids, gases and cooling systems to create cooler temperatures. Instead of simply circulating air around like a fan, both technologies work by actually removing heat from a specified area. A compressor compresses the cool gas known as a refrigerant, causing it to become hot. The hot gas runs through a set of hot coils and condenses into a liquid until it reaches an expansion valve. The valve turns the liquid back into a cool gas by evaporating it; the gas then runs through another set of coils. This second set of cooled coils, facing the area that needs to be air-conditioned, absorbs any warm air to cool down an apartment -- or [refrigerator](https://home.howstuffworks.com/refrigerator.htm).

The big difference, of course, is that the cooling system in your refrigerator is a small, enclosed box. Once closed, the door traps cool air inside to keep food and drinks fresh for long periods of time. An apartment's air conditioner, on the other hand, is responsible for cooling a much larger space. The walls and doors of the apartment act like the refrigerator door, keeping the cool air from escaping.

But what if engineers took the technology used in air conditioners and applied it to a much smaller scale -- a micro scale, for instance? Scientists working at the Purdue University of Mechanical Engineering, led by Professor Issam Mudawar, are developing an experimental system that takes cooling techniques from air-conditioning systems to cool down small, hard-working computer chips.

How does an air-conditioned computer chip work, especially on such a small scale? Will you soon find air-conditioning systems in [personal computers](https://computer.howstuffworks.com/pc.htm), or do computers even get hot enough to require such an efficient technology? If not, what kinds of computer chips actually need to be air-conditioned?

**[CPU Cooling: Microchannels and Microjets](https://computer.howstuffworks.com/computer-chip-air-conditioning.htm" \l "page1)**

Will we all carry air-conditioned [laptops](https://computer.howstuffworks.com/laptop.htm) around with us in the near future? It's highly unlikely; not only would it make computers several times more expensive, but it would be an entirely unnecessary addition. [Microprocessors](https://computer.howstuffworks.com/microprocessor.htm) in our personal computers generate a good amount of heat -- if you've ever worked with a laptop poised on your thighs for a long period of time, chances are after a while you noticed the bottom of the machine is warm to the touch.

Personal computers never generate more than 100 watts of heat for every half-inch square of microprocessor [source: [Callahan](http://www.msnbc.msn.com/id/25702898/)]. That's why internal fans (the whirring sound you hear while your computer's on) and clever uses of space and materials are sufficient enough to keep a desktop or a laptop from suffering a meltdown.­

The devices the team at Purdue University hopes to cool down aren't our measly personal computers. Instead, the air-conditioning research is directed at **high-flux thermal management**, the heating problems associated with more complex computing systems used for weapons systems and defense devices such as [radar](https://science.howstuffworks.com/radar.htm), directed-energy [laser](https://science.howstuffworks.com/laser.htm) and microwave weapons and aviation electronics.

As the microprocessors for these systems become significantly smaller and more powerful, the heat generated also increases dramatically -- experts expect heat fluxes from future defense systems to reach more than 1,000 watts per half inch, or 10 times the amount of heat produced from a powerful home computer [source: [Callahan](http://www.msnbc.msn.com/id/25702898/)]. Not only is this a big waste of [electricity](https://science.howstuffworks.com/electricity.htm), but a meltdown from such a system could damage expensive equipment and potentially cause a great deal of harm to the people operating it.

The new air-conditioned chip cooling system would attempt to reduce temperatures to no greater than 257 degrees Fahrenheit by combining two prominent cooling technologies: **Microchannels** and **microjets** (or jet impingement). The surfaces of computer chips would be cut with microchannels, which are simply very small grooves about three millimeters deep, and covered with metal plates punched with microjets, or tiny holes. The system would pump **hydrofluorocarbons (HFCs)**, the same liquid used in conventional air conditioners, through the microjets and into the microchannels. The HFCs would vaporize inside the grooves, cooling the chips, and cycle around via a small loop.

The school has received $500,000 from the Office of Naval Research, and although the concept is still in the experimental stages, the Purdue scientists hope to team up with defense contractors in the near future to further develop the technology.

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