Let's get physics-al: Computing will continue to evolve into the future

June 14 2011, By Amina Khan

Will the future bring us the teleportation devices of "Star Trek" or the sinister machines of the "Matrix"? Theoretical physicist Michio Kaku of the City College of New York says that many of the things that were once the domain of science fiction - cars that navigate rush-hour traffic on their own, wallpaper that can switch colors when you remodel, an elevator that takes you into outer space - are already here, or well on their way. His book "Physics of the Future," published in March, looks at how the advancement of our understanding of the laws of physics will transform computers, artificial intelligence, biotechnology, space travel and the very ways in which we experience the world.

Q: Why do computers seem to get stronger, faster and sexier every year?

A: What's driving this huge explosion is Moore's law. Moore's law simply says computer power doubles every 18 months, almost like clockwork. That's why the number of genes we can sequence doubles about every year and a half.

But silicon cannot sustain its computability down to the atomic scale. When you cram that many transistors into a chip that's smaller than a fingernail, it gets so hot that the chip melts. So it does mean computer power will slow down. If that progress stagnates, it will stunt the growth of the Internet, and of the economy. The world economy depends on that growth. After 20 years, Silicon Valley could become a rust belt.

We physicists are trying to create the post-silicon era - atomic

computers, quantum computers, DNA computers, protein computers - but none of them are really ready for prime time yet.

Q: How do you see technology affecting our everyday lives, decades into the future?

A: The research in computers and nanotechnology is racing forward to the point that chips will cost about a penny. Bubblegum wrappers will cost more. The Internet will be everywhere, including in your contact lenses - when you blink, you'll go online. When you see somebody, it will display their image and biography. And if they speak to you in another language, it will translate to English in subtitles. In the future, you'll know exactly who to suck up to in any cocktail party.

You'll go to a doctor several times a day - when you go to the toilet. This is going to revolutionize how we diagnose disease. Take pancreatic cancer: Aretha Franklin has it; so does Steve Jobs. Normally it's considered highly aggressive. We now know that's not true. Scientists have discovered it's slow-growing, taking 20 years to grow in the body, but only in the last few years do you feel anything. Chips in toilets will look at proteins emitted from cancer colonies of just 100 cancer cells decades before a tumor actually forms - which means the word "tumor" could disappear from English language.

Q: Are there aspects of our lives today that that you think our children and children's children will look back on and see as backwards, or even barbaric?

A: Take a look at chemotherapy. It's a horrible process - your hair falls out, you vomit - but it's a necessity to fight cancer. In the future, we'll have nanoparticles that can zap cancer cells, individually, one by one. Those are molecules that home in on cancer cells like smart bombs. In one trial, they were found to be 90 percent effective against tumors.

When we have the capability to knock out cancer cells one by one, we will view chemotherapy like we view the leeches and bloodletting of a hundred years ago.

Q: How has the approach toward nanotechnology changed as we've learned more about nature?

A: When nanotechnology was first thought about 20 or 30 years ago, people thought about building mechanical robots, scissors that were the size of molecules ... that original dream never panned out. It's very difficult to make things that tiny.

The original dream of a full-fledged robot the size of a molecule that could attack cancer cells - that's 100 years from now. Right now, we're using tricks to zero in on cancer cells and kill them. We know these nanomolecules are too large to fit though the walls of healthy cells but they can get through the large raggedy holes of cancer-cell walls and kill them. So that takes advantage of a loophole in Mother Nature.

Here's another example. If we want to build nanobots - robots that cut, splice, weld - well, Mother Nature created one, called the ribosome. It cuts fragments of organic molecules at certain points, joins them at others, just like a welder. We scientists are not good at duplicating that. It took nature millions of years to perfect that machinery, so some scientists are trying to go with the flow and use that natural cutting and splicing ability for our purposes.

Q: A lot of the technologies you've looked at are the stuff of science fiction. Are there any science fiction writers who you think were best able to predict the future?

A: Jules Verne (author of "20,000 Leagues Under the Sea," published in 1869, has probably the greatest record for hitting it right on the dot. He

predicted the moon program to within 10 percent accuracy: the size of the capsule, that it would take three days to reach the moon, that the launch would be in Florida and the splashdown would be in the ocean. The only thing he missed was the fuel source - and that's because liquid fuel was not invented until decades later.

That's because he would always talk to any scientists or engineers passing through Paris. He was up-to-the-minute on every scientific breakthrough.

He wrote that Paris in the 20th century would, instead of small shacks, have huge glass skyscrapers. Instead of horses, there would be cars. Instead of communicating by yelling out of your window, there would be fax machines. So he got right every prediction of the 1960s.