PAW ASKS CHRISTOPHER TULLY *98:

What is the Higgs boson, and why is it so important?

*Mass has played a crucial role in the laws of physics for centuries, but as Princeton physics professor Christopher Tully *98 notes, "we didn't really know where it came from." With the discovery of the Higgs boson, physicists have new clarity on that fundamental question. Tully, a member of the research collaboration that made the discovery, explains its significance.*

TULLY: The Higgs mechanism postulates that the masses of all the elementary particles come from one universal length scale, which is set by the Higgs mechanism itself. … In physical form, it's like we live in a big soup of Higgs field [composed of Higgs bosons], everywhere around us, and the mass of elementary particles comes from the degree to which these elementary particles stick to the Higgs field. It seems kind of outrageous that the properties of the particles that make us up depend on the space that we live in. But that seems to be the case.

It reminds me of the old days of science fiction … where you'd put someone on another planet. Some writers didn't care whether the oxygen had to be OK, but other people liked very much that you had to wear a suit and supply the oxygen. Now, if you wrote science fiction where you beamed into a parallel universe, if they didn't have the Higgs field, we would blow apart. We wouldn't be able to live in that universe. We are intrinsically tied to properties of the space we live in. P

— Interview conducted/condensed by B.T.

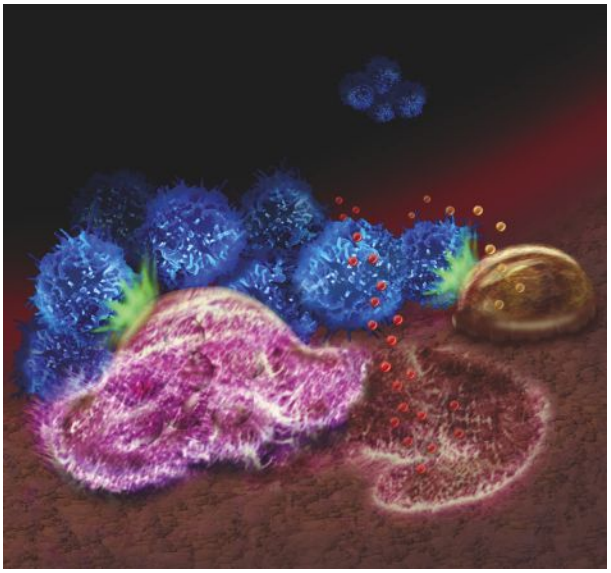
FERMILAB

ASK THE EXPERT: Read the full interview and ask questions @ paw.princeton.edu

BREAKING GROUND

How cancer cells grow

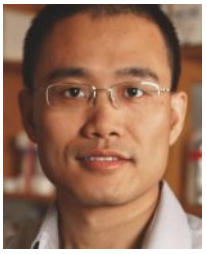
THE DISCOVERY Bone metastasis is the advanced stage of cancer when new tumors form at various sites in the body and drugs and surgery no longer can cure the disease. How tumor cells metastasize is not clear. Recent research by Princeton professor Yibin Kang shows how cancer cells manipulate their environment — in this case, bone tissue — to aid their growth while degrading the surrounding tissue.



An illustration depicts how breast cancer's spread to the bone relies on interactions among tumor cells (blue), specialized bone cells that break down the bone (pink), specialized cells that rebuild bone tissue (brown), and the bone matrix.

Kang has identified a protein called Jagged1, made by the tumor cells, that helps tumors grow within the bone tissue by revving up the activity of bone cells called osteoclasts. Osteoclasts work to break down bone tissue — a process that constantly takes place in bones but normally is balanced by the creation of new tissue. Cancer-cell invasion of the bone tissue results in overstimulation of these osteoclast cells, tipping the balance toward more bone breakdown, and Jagged1 accelerates this process. As more bone tissue breaks down, other processes are activated, further fueling tumor growth and creating a downward spiral.

Blocking Jagged1 is a potential therapy that could lead to slower tumor growth in the bone tissue or possibly prevent bone metastasis altogether. While Kang's studies have focused on breast cancer, he says his findings apply to other cancers.



THE SCIENTIST Kang, a professor of molecular biology, says his lab focuses on how tumor cells are attracted to bone tissue and are able to grow in this tissue.

Most cancer deaths take place after metastasis, but many cancer researchers have taken a defeatist approach to this final phase in cancer growth. It is a complicated process, and technically difficult to study, Kang says. His lab has developed live mouse models and imaging techniques that allow researchers to track tumor cells as they circulate through the blood system, attach to bone tissue, and begin to form tumors there.

In April, Kang was honored with the Award for Outstanding Achievement in Cancer Research, given to a scientist under 40 years old at the American Association for Cancer Research's annual conference.

WHAT'S NEXT IN THE KANG LAB Kang is collaborating with Amgen, a California-based biotechnology company that has developed an antibody against Jagged1. The goal is to move the recent discovery into the clinic. The laboratory also is continuing work to understand how bone metastasis occurs. P *By Anna Azvolinsky *09*

FROM TOP: ILLUSTRATION COURTESY YIBIN KANG; BRIAN WILSON/OFFICE OF COMMUNICATIONS