'Trying to understand end of time to learn its beginning'

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Juan Martin Maldacena, renowned string theorist and physicist is still grappling with multiple questions. Having begun his science quest as a child wanting to know how washing machines and cars work he has made significant contributions to understanding the universe. With several questions remaining unanswered, he's trying to understand the end of time inside black holes to learn about the beginning of time. He spoke to **TOI** during his visit to the International Centre for Theoretical Sciences (ICTS), Bengaluru.

Are scientists anywhere close to describing the origin of time?
Not yet. Our motivation is to learn that but it's very difficult. We're working on easier problems, like the end of time. We have the end of time in the theory of black holes which we're trying to understand.

Do we know how the interior of a black hole works?
We understand somewhat the exterior of black holes. There are very precise theories and we're trying to leverage it to understand the interior and the end of time. Once we do that, we'll be able to understand the beginning of time.

Juan Martin Maldacena, string theorist and physicist

How much has the Higgs boson changed our understanding?
The Higgs boson helped us understand the electroweak symmetric matrix. It has postulated a kind of symmetry between electricity and weak interactions (the mechanism of interaction between subatomic particles that causes radioactive decay). These two forces are very different in our daily experience. We see photons or particles of light with our naked eyes, but we don't see particles of weak interactions. But the latter are very important, they have the ability to move mountains... We believed the two forces are similar, like twin sisters, but Higgs boson is what makes them different.

Hows did the discovery of Gravitational Waves impact quantum physics?
Gravitational Waves are a classical process, they confirm our view of space time as a dynamic object. It has also given us the best evidence that black holes exist and about the geometry near the black hole horizon. There are many interesting options for astrophysics.

Are you seeking any GW signatures for your work?
Not really. If the theory works as expected, we won't find any signals for quantum gravity as its effects are very small for astrophysical black holes. The best way to explore the quantum world is through colliders, although astrophysical findings may play a role too.

What are biggest science projects we need to track?
I'm looking forward to the 21cm thermography which is a way of looking at the universe. It looks at some aspects of the cosmic microwave backgrounds that have to do with time in the universe hydrogen was emitting radiation at the wavelength of 21cm. This can teach us about hydrogen in the very early universe. The cosmic microwave gives us a 2D understanding, while this may help us understand things in 3D.