



K O N I N K L I J K E N E D E R L A N D S E  
A K A D E M I E V A N W E T E N S C H A P P E N

## **Jury speech Lorentz Medal 2018 for Juan Martín Maldacena**

**Given by Renate Loll, chair of the Lorentz Medal jury, on 19 November 2018**

Ladies and gentlemen,

It is an honour and a pleasure to give the laudatory address for Juan Martín Maldacena.

Professor Maldacena will shortly be receiving the Lorentz Medal.

The Academy presents the medal only once every four years.

It is intended to honour pioneering research in theoretical physics.

In the opinion of the jury – of which I was the chair – Juan Martín Maldacena is a more than worthy recipient.

The reason for bestowing this honour upon him are his unique contributions to theoretical physics over the past two decades. –

Let me try to give you an idea of what these contributions are.

In 1997 – 21 years ago – Prof. Maldacena discovered a very surprising theoretical relation between gravity in a 5-dimensional spacetime and field theory in our usual 4 dimensions.

This relationship is known by three different names:

1. the AdS/CFT correspondence (where AdS stands for anti-de Sitter space and CFT for conformal field theory), or
2. the gauge/gravity duality, or
3. simply Maldacena duality.

This duality between two different theories is not only profound, but also immensely useful.

It relates the weak-coupling sector of one theory – where we can easily perform calculations – to the strongly coupled regime of the dual theory, where we do not know how to calculate in a reliable way.

Initially the duality was proposed in the context of superstring theory and super Yang-Mills theory.

However, a beautiful aspect we have understood since is that this duality is much more universal.

It has been applied successfully to completely different physical systems.

One example is the quark-gluon plasma, an extreme and strongly coupled state of matter, which has been studied experimentally at particle accelerators at Brookhaven and at CERN.

Another example are strongly coupled high-temperature superconductors, a major research area in solid state physics.

Prof. Maldacena's AdS/CFT correspondence also throws new light on black holes, the still somewhat mysterious objects predicted by Einstein's theory of General Relativity. Intriguingly, black holes and some of their quantum properties can now be described in terms of a quantum field theory, which does not know *anything* about gravity.

Applying the Maldacena duality to black holes also suggests strongly that their behaviour is consistent with the standard rules of quantum mechanics.

This in turn would imply that information *cannot* get lost in black holes, contrary to what has sometimes been speculated.



Pursuing such ideas further has in more recent times led Prof. Maldacena to look for a more fundamental connection between quantum information – in the form of quantum entanglement – and the structure of spacetime itself.

These exciting developments may lead us in due course to a completely new view on spacetime.

Besides black holes, I have already mentioned superconductivity, heavy-ion collisions and quantum information.

These are three entirely different disciplines that all make use of Juan Martín Maldacena's ideas.

The jury would like to emphasise specifically the breadth of impact Prof. Maldacena's work has had in many branches of physics. To illustrate the point, his original article on the AdS/CFT correspondence is the most cited article of all time in the field of high-energy physics.

Ladies and gentlemen,

Juan Martín Maldacena was born in 1968.

After secondary school, he studied at the universities of Buenos Aires and of Cuyo, both in Argentina.

He obtained his PhD from Princeton University and subsequently did research at Rutgers and Harvard University.

Since 2001, he has been a professor at the Institute for Advanced Study in Princeton.

As I hopefully have been able to convey to you, Prof. Maldacena is an extremely original and versatile thinker,

whose ideas and articles have profoundly influenced and inspired many theoretical physicists.

In recognition of his pioneering and innovative work in theoretical physics, the jury therefore nominates Juan Martín Maldacena as the recipient of the 2018 Lorentz Medal.

Thank you.