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Società Italiana di Relatività
Generale e Fisica della Gravitazione

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The Amaldi Medal of the Italian Society of General Relativity and Gravitational Physics for the year 2021 is awarded to Professor **Andrzej Trautman** for his fundamental contributions to the theory of gravitational waves


**Andrzej Trautman** gave an exceptional contribution on several aspects of gravitational theory.
He set some of the pillars on which out current understanding of gravity and general relativity relies.
Moreover, some of his intuitions anticipated some of the developments of later years, and greatly influenced the way we now think about gravity.


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*The most important result obtained by Trautman is the contribution to our understanding of the nature of gravitational waves.*


## Understanding the nature of gravitational waves *(see the talk of Bernard Schutz)*

Today, gravitational waves are mainstream physics.
They are currently observed by LIGO and Virgo, and are used to shed light on astrophysics, nuclear physics, high-energy physics.
However, in the middle of the XX century, is was not clear at all that gravitational waves existed!


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Then, Trautman understood:

- That gravitational waves should be defined by assigning their boundary conditions, in a coordinate-independent way. He introduced such *radiative boundary conditions,* generalizing the Sommerfeld wave condition, and clarified the properties of such spacetimes.


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- That the energy of the waves should be defined globally, in a coordinate-independent way.
  He determined the four-momentum of the gravitational field of a spacelike surface in a radiative spacetime in terms of a closed three-form.
  This is equivalent to later definitions of the gravitational wave energy-momentum in terms of the stress-energy pseudo-tensor.


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- That gravitational waves should be defined by assigning their boundary conditions, in a coordinate-independent way. He introduced such *radiative boundary conditions,* generalizing the Sommerfeld wave condition, and clarified the properties of such spacetimes.
- That the energy of the waves should be defined globally, in a coordinate-independent way. He determined the four-momentum of the gravitational field of a spacelike surface in a radiative spacetime in terms of a closed three-form. This is equivalent to later definitions of the gravitational wave energy-momentum in terms of the stress-energy pseudo-tensor.
- In collaboration with Robinson he found the first family of exact solutions of full Einstein's equations describing gravitational waves, which satisfy his radiative boundary conditions, and carry positive energy


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With these results the existence of gravitational waves was theoretically well-estabilshed.
This opened the way to the experimental work leading, decades later, to their detection.


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Other important results of Trautman's work should be mentioned. In particular:


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Other important results of Trautman's work should be mentioned. In particular:

- he pioneered the use of the most advanced tools of differential geometry in the study of gravity;


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Other important results of Trautman's work should be mentioned. In particular:

- he pioneered the use of the most advanced tools of differential geometry in the study of gravity;
- he studied the connections between gravity and gauge fields. In this context, he pioneered the use of fiber bundles, which are now commonly used also in high-energy physics.


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It is thus a great honor for us to award the Amaldi Medal for the year 2021 to Andrzej Trautman