



# PhD in INGEGNERIA DELL'INFORMAZIONE / INFORMATION TECHNOLOGY - 40th cycle

## Research Area n. 4 - Telecommunications

**THEMATIC Research Field: DEVELOPMENT OF MODELS FOR THE USE OF HYBRID FSO/RF LINKS IN SATELLITE COMMUNICATIONS, EARTH OBSERVATION AND DEEP SPACE EXPLORATION**

### Monthly net income of PhDscholarship (max 36 months)

**€ 1400.0**

In case of a change of the welfare rates during the three-year period, the amount could be modified.

### Context of the research activity

#### Motivation and objectives of the research in this field

The research activity aims at investigating the combined use of optical wavelengths (typically referred to as Free Space Optics - FSO) and radio frequencies (from Ku band to W band), in the context of satellite communications, Earth observation and deep space exploration. Spacecrafts currently make use of frequencies ranging from the Ku band to the Ka band, with the Q and V bands ready for commercial exploitation. Such carriers offer a limited bandwidth, while a much larger data rate could be theoretically achieved using optical wavelengths. On the other hand, however, FSO links are strongly impaired by atmospheric constituents such as fog, clouds, rain and turbulence: when atmospheric impairments become extremely high, to the point of preventing connectivity, radio frequencies could be used as a backup to extend the link availability, though at a lower data rate. It is therefore key to develop and test electromagnetic propagation models to predict and operate Earth-space FSO links, as well as for their combined use with RF links.

#### Methods and techniques that will be developed and used to carry out the research

The research activity will include developing theoretical and semi-empirical models, to be devised and tested using extensive datasets (e.g. global meteorological ones produced by ECMWF, as well as Earth-space FSO and



	RF data collected at ground stations).
<b>Educational objectives</b>	<ul style="list-style-type: none"> <li>• Become an expert on Earth-space propagation at optical wavelengths and in the EHF range</li> <li>• Gather experience in model development and testing</li> <li>• Acquire skills on data processing</li> </ul>
<b>Job opportunities</b>	<ul style="list-style-type: none"> <li>• R&amp;D positions in manufacturers of telecommunication technologies</li> <li>• R&amp;D positions in telco and satellite operators</li> <li>• R&amp;D positions in space-oriented institutions (e.g. NASA, ESA)</li> </ul>
<b>Composition of the research group</b>	1 Full Professors 1 Associated Professors 0 Assistant Professors 3 PhD Students
<b>Name of the research directors</b>	Prof. Lorenzo Luini

<b>Contacts</b>	
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<b>Additional support - Financial aid per PhD student per year (gross amount)</b>	
<b>Housing - Foreign Students</b>	--
<b>Housing - Out-of-town residents (more than 80Km out of Milano)</b>	--

<b>Scholarship Increase for a period abroad</b>	
<b>Amount monthly</b>	700.0 €
<b>By number of months</b>	6

<b>Additional information: educational activity, teaching assistantship, computer availability, desk availability, any other information</b>
<p><u>EDUCATIONAL ACTIVITIES</u> (purchase of study books and material, including computers, funding for participation in courses, summer schools, workshops and conferences): financial aid per PhD student. 5.707,20 Euro</p>



TEACHING ASSISTANTSHIP: availability of funding in recognition of supporting teaching activities by the PhD student.

There are various forms of financial aid for activities of support to the teaching practice.

The PhD student is encouraged to take part in these activities, within the limits allowed by the regulations.

COMPUTER AVAILABILITY:

1st year: Yes

2nd year: Yes

3rd year: Yes

DESK AVAILABILITY:

1st year: Yes

2nd year: Yes

3rd year: Yes