



The Abdus Salam  
International Centre  
for Theoretical Physics



ICTP  
SAIFR



IFT - UNESP  
INSTITUTO DE FÍSICA TEÓRICA



Núcleo de  
Computação  
Científica



SPRACE

# WELCOME to the

## **Joint ICTP, SAIFR and UNESP School on Systems-on-Chip, Embedded Microcontrollers and their Applications in Research and Industry**

18 - 29 October, 2021

### Organizers

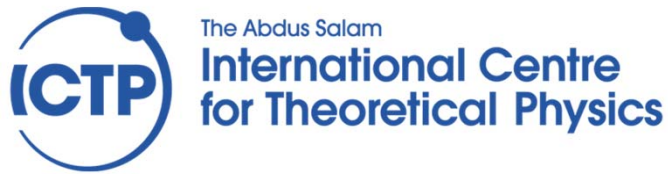
NATHAN BERKOVITS, ICTP South American Institute for Fundamental Research, Brazil

SERGIO NOVAES, São Paulo State University (UNESP), Brazil

LUIGI CALLIGARIS, UNESP, Brazil

ANDRES CICUTTIN, ICTP, Italy

MARIA LIZ CRESPO, ICTP, Italy



## FACULTY

### Lecturers

CASCADAN André Muller

Brazil

DONDO GAZZANO Julio

Argentina

GRIMA Eugenio

Brazil

MELO Rodrigo

Argentina

RINCON CALLE Fernando

Spain

SANDER Oliver

Germany

SILVA Agustin

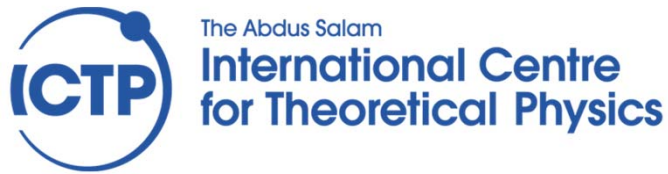
Argentina

SISTERNA Cristian

Argentina

SUTER Gustavo

Spain



## FACULTY

### Lecturers & Lab Tutors

CASCADAN André Muller

Brazil

CALLIGARIS Luigi

Brazil / Italy

FLORIAN SAMAYOA Werner

Italy / Guatemala

GARCIA ORDONEZ Luis

Italy / Guatemala

MOLINA Romina

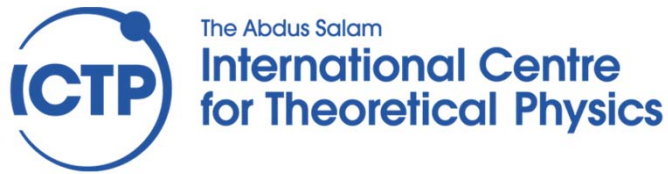
Italy / Argentina

MORALES ARGUETA Ivan

Italy / Guatemala

VALINOTI Bruno

Italy / Argentina



## PARTICIPANTS

- Requests for participation: > 200 applicants from 39 different countries
- Selected: 72 participants from 25 different countries

|                |            |           |           |           |
|----------------|------------|-----------|-----------|-----------|
| India          | Mexico     | Nigeria   | Brazil    | Pakistan  |
| Cuba           | Iran       | Italy     | Cameroon  | Argentina |
| Sudan          | Algeria    | Guatemala | Finland   | Egypt     |
| Ethiopia       | Bangladesh | Bolivia   | Spain     | Ecuador   |
| Peru           | Costa Rica | Colombia  | Sri Lanka |           |
| Dominican Rep. |            |           |           |           |

## SCHOOL PROGRAMME

- Detailed schedule can be consulted at the school website:

<http://indico.ictp.it/event/9644/>

- Typical daily timetable (CET: Central European Time zone):

| Timetable     |                          |
|---------------|--------------------------|
| 14:00 - 17:00 | Lectures/Demonstrations  |
| 17:00 - 19:00 | Lab activities w/ tutors |

- School's email (secretariat): [smr3557@ictp.it](mailto:smr3557@ictp.it)



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## First Week

|               | <b>Mon 18/10</b> |
|---------------|------------------|
| 14:00 - 14:15 | Directors        |
| 14:15 - 14:30 | M.L. Crespo      |
| 14:30 - 15:30 | L. Calligaris    |
| 15:30 - 16:30 | C. Sisterna      |
| 16:30 - 18:00 | C. Sisterna      |

|               | <b>Tue 19/10</b>  |
|---------------|-------------------|
| 14:00 - 15:30 | J. Dondo          |
| 15:30 - 16:30 | C. Sisterna       |
| 16:30 - 17:00 | L. Calligaris     |
| 17:00 - 18:30 | MCU Lab w/ tutors |

|               | <b>Wen 20/10</b>  |               | <b>Thu 21/10</b>  |               | <b>Fri 22/10</b>  |
|---------------|-------------------|---------------|-------------------|---------------|-------------------|
| 14:00 - 15:00 | C. Sisterna       | 14:00 - 15:00 | C. Sisterna       | 14:00 - 15:30 | C. Sisterna       |
| 15:00 - 16:00 | R. Melo           | 15:00 - 16:00 | R. Melo           | 15:30 - 16:30 | E. Grima          |
| 16:00 - 17:00 | R. Melo           | 16:00 - 17:00 | A. Cascadan       | 16:30 - 17:30 | Lab w/ tutors     |
| 17:00 - 18:30 | MCU Lab w/ tutors | 17:00 - 18:30 | MCU Lab w/ tutors | 17:30 - 18:30 | MCU Lab w/ tutors |

## Second Week

|               | Mon 25/10             |
|---------------|-----------------------|
| 14:00 - 15:30 | F. Rincon             |
| 15:30 - 16:30 | L. Garcia (Lab)       |
| 16:30 - 17:30 | I. Morales (Lab)      |
| 17:30 - 19:00 | SoC-FPGA Lab w/tutors |

|               | Tue 26/10             |
|---------------|-----------------------|
| 14:00 - 15:30 | G. Suter              |
| 15:30 - 16:30 | A. Cicuttin           |
| 16:30 - 17:30 | R. Melo (Lab)         |
| 17:30 - 19:00 | SoC-FPGA Lab w/tutors |

|               | Wen 27/10             |
|---------------|-----------------------|
| 14:00 - 15:30 | R. Molina             |
| 15:30 - 16:30 | O. Sander             |
| 16:30 - 17:30 | W. Florian (Lab)      |
| 17:30 - 19:00 | SoC-FPGA Lab w/tutors |

|               | Thu 28/10             |
|---------------|-----------------------|
| 14:00 - 15:30 | A. Silva              |
| 15:30 - 16:30 | B. Valinoti           |
| 16:30 - 17:30 | SoC-FPGA Lab w/tutors |
| 17:30 - 19:00 | SoC-FPGA Lab w/tutors |

|               | Fri 29/10             |
|---------------|-----------------------|
| 14:00 - 15:00 | R. Melo               |
| 15:00 - 16:00 | L. Garcia             |
| 16:00 - 18:00 | SoC-FPGA Lab w/tutors |
| 18:00 - 18:30 | Closing Remarks       |



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## Main Topics

- Microcontrollers Technology, Architecture and Peripherals.
- STM32 Evaluation and Development Boards.
- FPGA and System on Chip (SoC) Technology.
- SoC Architecture and Design Methodology.
- Zynq-7 Evaluation and Development Board.
- Real Time Operating System (FreeRTOS).
- Integrating a real-time operating system and a Linux one in a ZynqMP system.
- C for Embedded Systems.
- Fundamentals of VHDL (Hardware Description Language).
- High Level Synthesis (HLS).



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## Main Topics

- New SoC platforms for AI and Algorithm Acceleration.
- FPGA for the Acceleration of Machine Learning Algorithms.
- Reconfigurable Virtual Instrumentation (RVI) based on SoC-FPGA.
- Introduction to Quantum Computing.
- Quantum Computing Emulator based on FPGA.
- SoC-FPGA DAQ System: Demo.
- Application Examples.
- Lab Activities.

## Lab activities

- **GitLab link:**

<https://gitlab.com/smr3557/labs/-/wikis/home>

- **MCU Lab activities (first week)**

STM32CubeIDE software

STM32F411RE microcontroller

NUCLEO-F411RE board

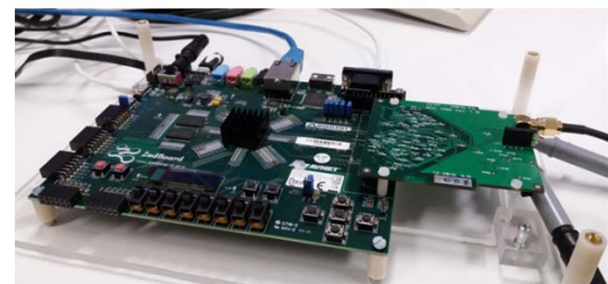


- **SoC-FPGA Lab activities (second week)**

Vivado IDE 2019.1

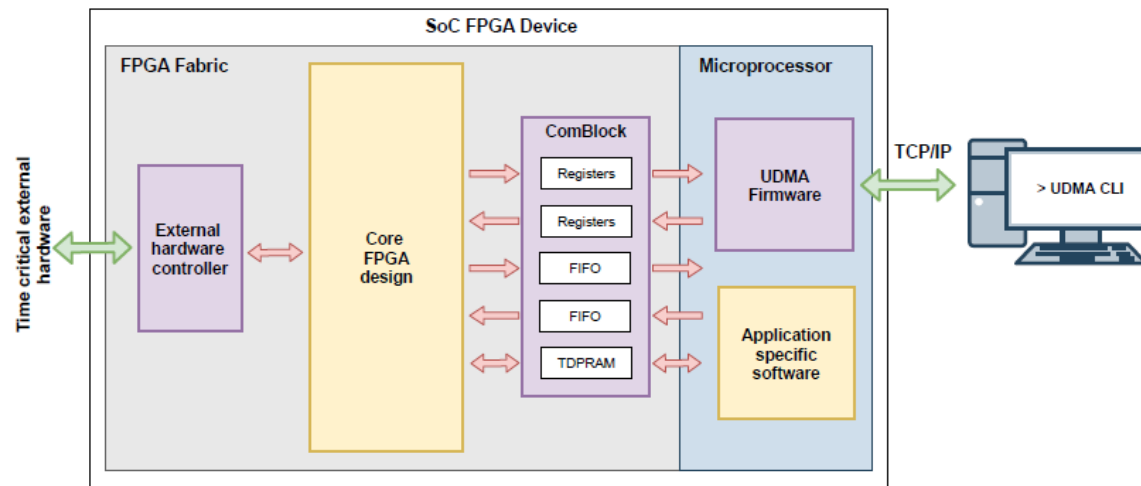
Zynq-7 family SoC

ZedBoard development kit





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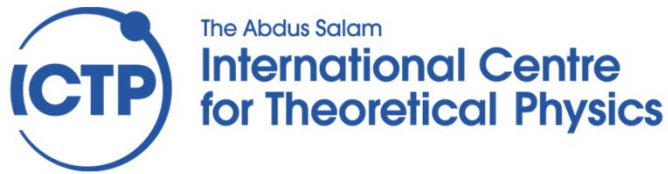


## Lectures:

- Zoom platform
- Chat or raise your hand for Q&A

## Lab Activities:

- Discord platform
- Breakout rooms



## Recommendations:

- 1) Be on time
- 2) Attend at least 70% of the lectures + labs to receive the Diploma
- 3) Feel free to ask questions!



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Monday, 18 October 2021

14:00 - 18:00

## Session 1

*Chairs:*

*Maria Liz CRESPO / Luigi CALLIGARIS*

*The time zone is CET*

*You can choose your time zone (in place of Europe/Rome) on the top right of the page and the Programme time will be modified accordingly*

### 14:00 **Welcome to the School 15'**

Speaker: Nathan BERKOVITS (ICTP-SAIFR, Brazil), Luigi CALLIGARIS (NCC-UNESP, Brazil), Andre CASCADAN (NCC-UNESP, Brazil), Andres CICUTTIN (ICTP), Maria Liz CRESPO (ICTP), Sergio NOVAES (NCC-UNESP, Brazil)

### 14:15 **School Outline 15'**

Speaker: Maria Liz CRESPO (ICTP)

### 14:30 **Microcontrollers Technology, Architecture and Peripherals 1h0'**

Speaker: Luigi CALLIGARIS (NCC-UNESP, Brazil)

### 15:30 **FPGA and System on Chip (SoC) Technology 1h0'**

Speaker: Cristian SISTERNA (University of San Juan, Argentina)

Material:  **Slides**

### 16:30 **C for Embedded Systems 1h30'**

Speaker: Cristian SISTERNA (University of San Juan, Argentina)

Material:  **Slides**

Maria Liz Crespo, ICTP Multidisciplinary Laboratory (MLab), [mcrespo@ictp.it](mailto:mcrespo@ictp.it)