



# 2<sup>nd</sup> Annual Meeting of ARIES WP17: Welcome and Introduction

Video Meeting, 13.07.2020

Marilena Tomut, <u>Alessandro Bertarelli</u> on behalf of the ARIES WP17 collaboration

## **ARIES WP17 PowerMat**

- Welcome to the 2<sup>nd</sup> (Virtual) Annual Meeting of the ARIES WP17 PowerMat, following 1<sup>st</sup> Annual Meeting in Malta, in October 2018
- This event was initially planned for March 2020 at ELI-NP in Magurele, Romania, which was eventually cancelled because of COVID-19 outbreak ...
- ... thanks anyway to local organizing committee and Marilena for having performed all the preparatory work. We still hope to meet in this brand new facility in a not-too-far future!



#### PowerMat WP in a nutshell

- Develop and characterize novel composite materials based on graphitic and metal matrices with carbide and diamond reinforcements
- Test and online monitor materials behaviour under thermal shock (particle- or laser-beam induced) and irradiation
- Investigate radiation damage using numerical and experimental approaches.
- Identify and test novel materials for broader accelerator applications for high power targets, beam catchers, beam windows and luminescence screens
- Explore societal applications of these novel materials such as advanced engineering, medical imaging, quantum computing, energy efficiency, aerospace, and thermal management



### WP17 Organization

- WP17 (PowerMat): 6 main beneficiaries (CERN, GSI, POLITO, POLIMI, ELI-NP, UMALTA), 1 associate (NIMP) from 5 different countries
- Strong interaction with WP14 (Promoting Innovation)
  - 1 beneficiary industry (RHP-Technology, AT), 1 associate industry (Brevetti Bizz, IT) in Task 14.4 (F. Carra, CERN)
- JRA is organized in 5 Tasks:
  - 17.1: Communication & Coordination
     A. Bertarelli, CERN; M. Tomut, GSI
  - 17.2: Materials development and characterization
     A. Bertarelli, CERN
  - 17.3: Dynamic testing and online monitoring
     L. Peroni, POLITO
  - 17.4: Simulation of irradiation effects and mitigation methods
     A. Lechner, CERN
  - 17.5: Broader accelerator and societal applications
     M. Tomut, GSI

# ARIES WP17 PowerMat: Objectives of the meeting I

- Review and present work progress in last 18 months
- Discuss and decide about activities in the final months, noting that:
  - ARIES project may be extended by at least 6 months because of COVID, but should avoid significant overlap with I-FAST (new H2020 project)
  - TNA (e.g. HiRadMat) activities to be extended by 12 months
  - A modular approach may be negotiated, with some WP extended by 12 months (WP17?)
  - A proposal to be discussed in early autumn '20 at the Steering Board, also taking into account COVID evolution ...



# ARIES WP17 PowerMat: Objectives of the meeting II

- **Main activities** to come in future months, largely affected by COVID outbreak:
  - 2<sup>nd</sup> irradiation campaign at GSI
    - approved and initially planned for spring 2020; postponed to 2021, formal approval pending ..
    - Goal is to improve/extend findings of 2019 irradiation and test latest material grades
  - **Dynamic characterization tests at high temperature** in POLITO
    - Postponed due to lockdown and delays in delivery of dedicated vacuum chamber
    - New timeline to be defined
  - High power laser beam experiments at ELI-NP
    - Laser beam impacts represent a unique opportunity to test effects on material of not-yet-available high intensity/energy particle beams, without many downsides of particle irradiation
    - New timeline to be defined; discussion on feasibility, energy and time scales, acquisition methods to be held at this meeting
  - Workshop "Extreme Beams meet Extreme Materials" (MS62)
    - To be replaced by virtual workshop or by a different format

## ARIES WP17 PowerMat: Meeting Timetable

# One day meeting

- 4 presentation sessions
  - Task 17.2 combined with 14.4
  - Task 17.3
  - Task 17.4
  - Task 17.5
- 2 discussion sessions
  - Morning: Discussion on shock experiments on accelerator materials with lasers and high energy beams
  - Afternoon: Wrap-up and discussion on future plans and activities



#### **Milestones**

Milestone number <sup>18</sup>	Milestone title	WP number <sup>9</sup>	Lead beneficiary	Due Date (in months) <sup>17</sup>	Means of verification	
MS58	Organisation of PowerMat kick-off meeting (Task 17.1)	WP17	1 - CERN	б	Agenda, summary report	
MS59	Irradiation campaigns at GSI for radiation hardness studies (Task 17.3)	WP17	23 - POLITO	27	Report to StCom	
MS60	Irradiation effects analysis (Task 17.3)	WP17	1 - CERN	36	Report to StCom	
MS61	Comparative compendium of materials developed (Task 17.2)	WP17	1 - CERN	40	Report to StCom	
MS62	Dissemination of R&D results on novel materials for accelerator and societal applications (Task 17.5)	WP17	12 - GSI	46	Report to StCom	



Deliverable Number <sup>14</sup>	Deliverable Title	Lead beneficiary	Type <sup>15</sup>	Dissemination level <sup>16</sup>	Due Date (in months) <sup>17</sup>
D17.1	Material characterization	1 - CERN	Report	Public	12
D17.2	Irradiation effect simulations	1 - CERN	Report	Public	44
D17.3	Irradiation test results	23 - POLITO	Report	Public	46



#### WP17 Outreach: Publications

- 10 PowerMat-related Articles and 2 Theses (PhD and Master) uploaded in Zenodo
- 2 additional PhD theses including one with IP-sensitive content with deferred publication
- Open Access articles in Carbon and Acta Materialia journals
- Two volumes in ARIES monographs published by WUT
- **Special Issue** in Shock and Vibration devoted to Structural and Wave Propagation Effects in High-Energy Particle Impacts)

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Open Special Issues Published Special Issues Special Issue Resources	This special issue aims to publish eriginal research in the field of high-energy particle beam interaction from a shock and obtain perspective. Paper concerning the assessment of induced shockwaves and their structural effects on mechanical components will be considered. Contributions the discuss the devioyment and validation of experiments, simpside analytical and numerical bools for the analytic of wave propagation and dreams: loadent scenarios, are perturbative resolution. This secoal issue also encourages researchen to submit
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# What's next - IFAST – WP4.3

#### • IFAST Task 4.3. - GRAPH&BEAWIN

Beam windows for high-power accelerator applications. Suspended graphenic membrane beam windows for next generation accelerators

Continuation of activities in task 17.5. on materials for broader accelerator applications

Objectives:

- Production of innovative materials suitable for beam-windows applications in high power accelerators
- Particle transport and thermomechanical simulations for beam windows under high intensity operation conditions
- Characterisation of beam windows materials under thermomechanical load and extended radiation damage and their integration in accelerator environment
- Participants: CERN, GSI, WWU Münster, RHP
- EC contribution: 100 k€ / Duration: 32 months



#### graphenic membrane



Raman spectra of graphenic membrar



# What's next - IFAST - WP4.4

- **IFAST WP4.4 "Large scale Carbide-Carbon Materials for multipurpose applications**" naturally follows the R&D and industrialization phases for the carbide-carbon materials.
- Aim is to **decrease the production costs** to broaden the industrial use, by two methods:
  - Increase the dimension of the sintered blankets (less cycles needed to sinter a given volume of material)
  - **Decrease the sintering temperature** of the composite, tailoring the base composition (less power and duration of each cycle)
- Participants: CERN, Nanoker (ES)
- EC contribution: 120 k€ / Duration: 4 years







### **Overview and Outlook**

- Significant progresses in materials development, characterization, testing, and simulation in all WP tasks.
- ARIES greatly contributed to have some of these materials qualified, produced in series and installed in HL-LHC Collimators for LS2.
- All deliverable and MS achieved so far. Substantial outreach, including articles, theses and workshops.
- WP activity continuing (at smaller scale) as tasks 3 and 4 in WP4 of I-FAST
- COVID-19 pandemic has jeopardized a number of activities planned for end of year and year 4:
  - Additional TNA irradiation experiment at GSI
  - Dynamic characterization of materials in POLITO with new high temperature set-up
  - Preparation of first high power laser beam experiments at ELI-NP
  - Dissemination activities through joint workshop with WP6

 Strategy and planning for next WP17 activities to be discussed at this meeting, taking a possible extension of 6 to 12 months into account ...





# Thank you for the attention, and let's have a productive meeting!