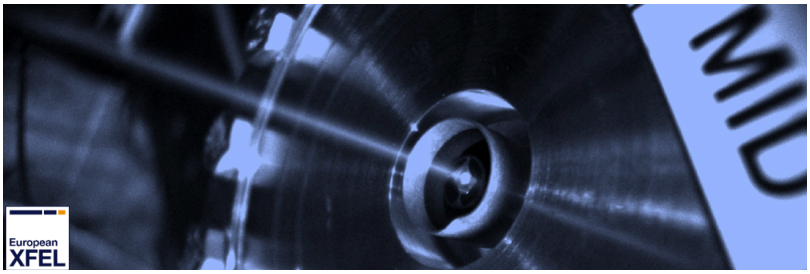

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Perspective for material under shock induced by laser: processes and material under extreme conditions

Wednesday 18 January 2023 09:55 (20 minutes)

This presentation concerns challenges in relation with planetary security (Dart Mission), spacecraft protection against debris, lightening (NDT/SHM) and life extension of structures (LSP).

In the first two cases, shocks induced by laser plasma reproduce pressure loadings involved in High Velocity Impact (HVI)(7-30 Km/s):
-to model physics,
-to select material,
-to design stacks of material
-to optimize coupling
-to provide set of datas for code validation.

Main objective is the design of new technologies to improve coupling projectile/target, to help mission impact (DART/HERA), to discover innovative materials (like metallic glass) and geometries for structural protection.

Studies concern :
-laser ablation to controlHVI/analogy
-material under shock (shock wave propagation, damaging, crater formation, phase change)
-cloud of debris physics (generation, flight, particle size, phase change, impact on surface, reactivity with atmosphere)
Synthetic and natural material are concerned : metals, glasses, silicium, composite and polymers, ceramics, powder/sand, rocks.

At present time and for near future (1-3 year), in-situ diagnostics should be focused
-on visible imaging and velocimetry (VISAR/PDV)
-on residual impact on material (crater and bulk material) and debris recovered afterwards.

However, mid/long term researches will go towards time and space resolved diagnostics (Hard X-Ray)
-to observe shock wave propagation material (which volumes are in the range of mm3)
-to observe crater formation (depth in the range of mm)
-to measure density at um/ns scales and velocity of debris
-to detect phase changes/chemical synthesis at grain scale in bulk and in debris (Example : Hydratation controversy)
-to study secondary impact of debris on surface (solid or/and covered by particle) and clouds collision
Issues are also related to large time (ps to us) and space (nm to mm) ranges.

Concerning NDT/SHM and LSP topics, needs join these challenges of time/space resolved diagnostics in bulk material (CFRP and metal) :
to measure residual stresses fields
to observe delamination/fissure propagation in Carbone Fiber Reinforce Polymer and metal.
The final aim is a breakdown in modeling for digital twin for LSP and life time prognostic for SHM.

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