I. Prencipe, M. Cernaianu, G. Fiquet, J. Fuchs, Z. Konopkova,
P. Lutoslawski, D. Margarone, S. Pascarelli, D. Schumacher,
B. Schramm, R. Stephens, M. Tolley, T. Tschentscher, T. Cowan

Consideration of a Target Network for Advanced Laser Light Sources

This project has received funding from the *European Union's Horizon 2020 research and innovation programme* under grant agreement No 654220

Upcoming Advanced Laser Facilities

Emerging demands for high repetition-rate target delivery

European XFEL

HIBEF UC

ESRF

HPLF

eli beamlines

eli Nuclear Physics

eli attosecond

efficient use of HIGH POWER LASERS at MAJOR X-RAY USER FACILITIES

realization of the promise of the EXTREME LIGHT INFRASTRUCTURE

CilexApollon

access to national and international LASER FACILITIES

DRESDEN concept

HZDR

Upcoming Advanced Laser Facilities

Emerging demands for high repetition-rate target delivery

GOALS

LONG TERM DEVELOPMENT OF THE USER COMMUNITY

- **lower the barriers-to-entry for new users/small groups**
- **exploit synergies between European and national laser facilities**
- **promote innovation, education & training**

MAIN ISSUES

enabling operation at HIGH REPETITION RATE (HRR)

0.1 – 10 Hz

development of a SUSTAINABLE TARGET SUPPLY mechanism

1 Hz = 3600 targets/hour

Challenge: how do we deal with target supply and HRR issues?

HZDR

HELMHOLTZ ZENTRUM DRESDEN ROSSENDORF

EUCALL SATELLITE WORKSHOP
Dresden, August 29-31, 2016
90 participants

EUCALL

I. Prencipe, M. Cernaianu, T. Cowan, G. Fiquet, Z. Konopkova, P. Lutoslawski, D. Margarone, S. Pascarelli, M. Tolley

ASSESSMENT of the CURRENT STATUS

DISCUSSION of a COORDINATED STRATEGY

DRESDEN concept

HZDR

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First consequence of the workshop

Network for TARGET SUPPLY and HRR ISSUES identified as FORESIGHT ACTIVITY by the European Cluster of Advanced Laser Light Sources

DRESDEN concept

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Target needs

TARGET = CONSUMABLE

UPCOMING FACILITIES

- Increased availability/accessibility
- high repetition rates
  (1 Hz = 3600 targets/hour)

→ demand for
a large number of targets
mass production or rapid prototyping?
+
issues related to repetitive irradiation

TARGET DESIGN

on the basis of

- physical phenomenon
- experimental configuration
  (laser properties, diagnostics)

→ huge **variety**
of possible target configurations
(often **complex**)

TARGET PROPERTIES

affect strongly the laser-matter interaction process

→ **production**
controllable and reproducible
characterization
density, thickness, crystalline structure, surface quality

Target needs

Laser-driven particle and radiation sources

Julien Fuchs

HRR

PRODUCTION of PARTICLE and RADIATION BEAMS for APPLICATIONS

Target needs

- Solid targets: multi-layer, structured, controlled/near critical density, surface patterns, 3D shapes, multiple targets
- Gas jets and cells (need modeling)
- Droplets (need stabilization)
- Liquid crystals (no high Z)
- Cryogenic (thickness, shape)

Target needs

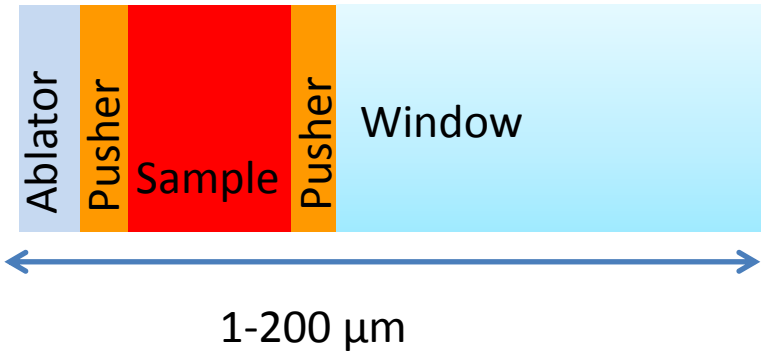
Shock-compression phyisics

Sakura Pascarelli

HRR

MATERIALS WITH POOR SCATTERING PROPERTIES (low Z; liquids…)

Target needs: multilayer targets, layer characterization!



EXPERIMENT AND TARGET DESIGN

User-friendly HIDRODYNAMIC CODES

BETTER MODELING

Target needs

Electron transport and isochoric heating

Richard Stephens

HRR **STUDY OF SMALL EFFECTS (large shot to shot variations)**

Target needs

- 2D: multilayer, buried structures and wafer based (RMT, gratings...)
- 3D: cones, spheres (precise geometry constraints)
- Multi-target configurations

High repetition rate challenges

Fast target positioning and alignment

Douglass Schumacher

EUCALL HIREP High Repetition Rate Sample Delivery

Prototype of a target positioning and alignent system

INTEGRATED SETUP

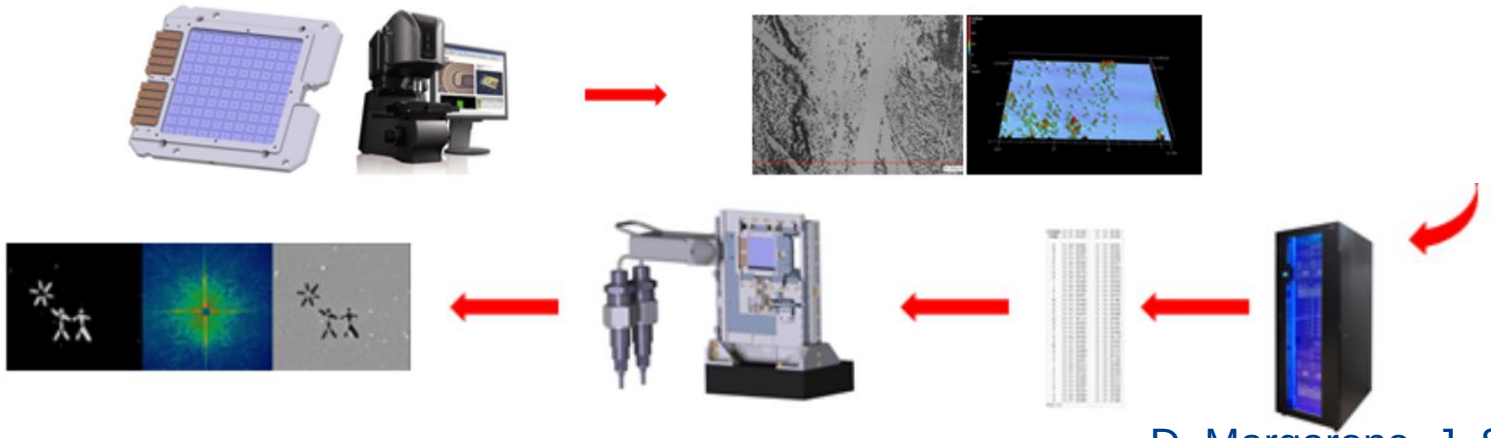
Holder, stages, UHV microscope

(EMP resistent, low activation, thermal loads)

INTEGRATED SOFTWARE

Sample identification

and alignment



D. Margarone, J. Schulz

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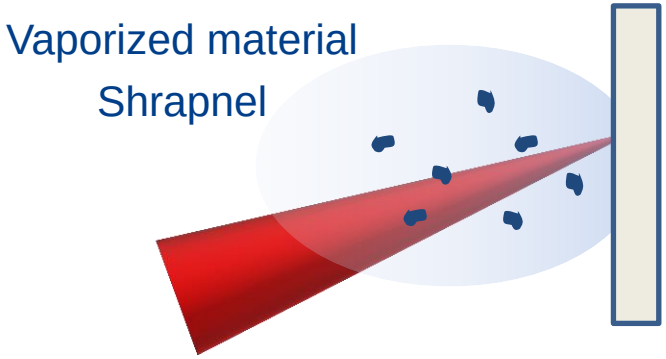
High repetition rate challenges

Collateral issues

Douglass Schumacher

DEBRIS

Study case



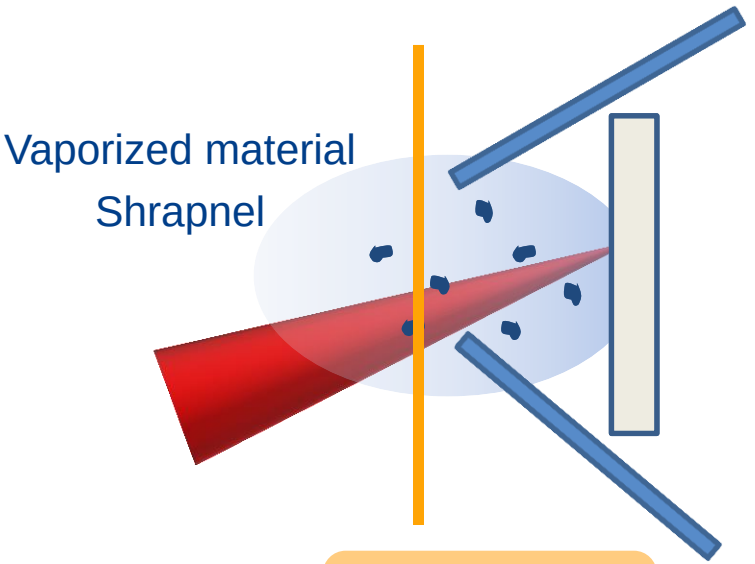
High repetition rate challenges

Collateral issues

Douglass Schumacher

DEBRIS

Study case



Membrane

not enough:
shrapnel can break it

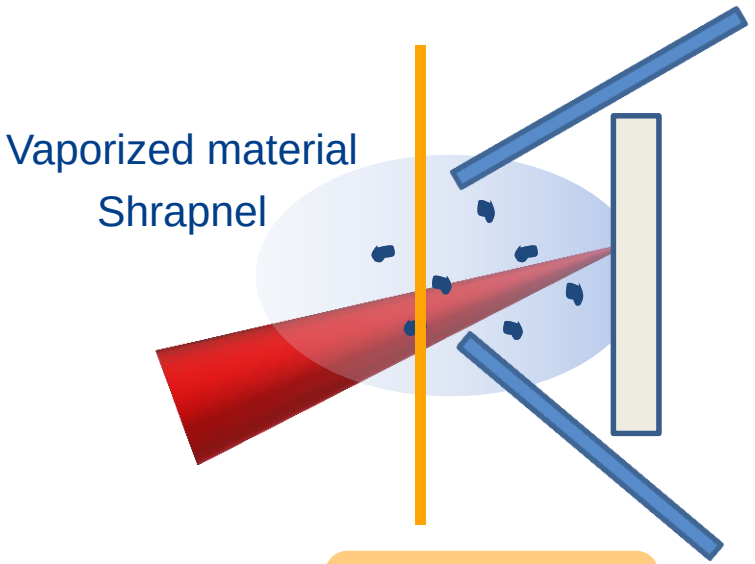
High repetition rate challenges

Collateral issues

Douglass Schumacher

DEBRIS

Study case



Membrane

- **STRONG DEPENDENCE ON THE EXPERIMENTAL CONFIGURATION**
- **PARTIAL SOLUTIONS AVAILABLE BUT STRESSED AT HRR**

TOOL KIT
better than single solution

Reduced mass targets

Renewable mirrors (liquid Hg/Ga)

E-field guiding

Renewable plasma mirrors (liquid crystals)

High repetition rate challenges

Collateral issues

Douglass Schumacher

DEBRIS

ELECTROMAGNETIC PULSES

DAMAGE OF NEARBY TARGETS

PLASMA DAMAGE and ACTIVATION OF THE HOLDER FRAME

THERMAL LOADS

TARGET BACKREFLECTONS AND SCATTER

- **STRONG DEPENDENCE ON THE EXPERIMENTAL CONFIGURATION**
- **PARTIAL SOLUTIONS AVAILABLE BUT STRESSED AT HRR**

TOOL KIT
better than single solution

ONLINE CHARACTERIZATION

X-RAY + OPTICAL LASER
ADDITIONAL ISSUES?

Challenge: how do we deal with target supply and HRR issues?

HZDR

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DRESDEN concept

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A coordinated strategy for target supply

Possible synergy levels

BILATERAL COLLABORATIONS

In-kind contributions, co-authorship, know-how sharing

- **WORKSHOPS**
- **BILATERAL FUNDING SCHEMES**
- **TARGET CATALOGUE**

USER CONSORTIUM CONTRIBUTIONS

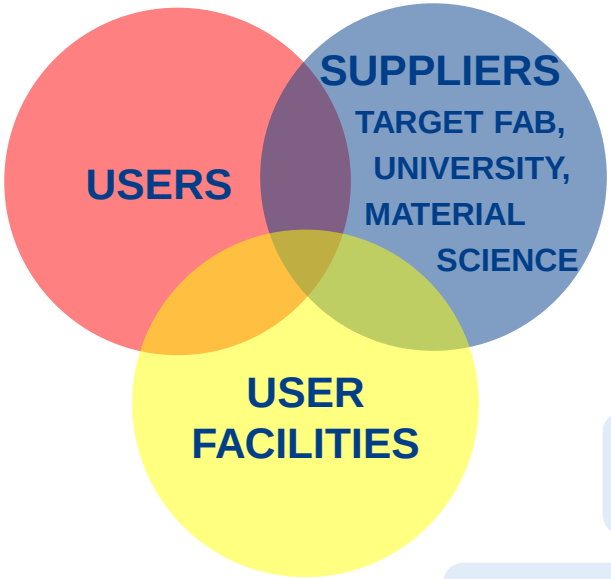
Target supply = service to users

- **ESRF Long Term Proposals**
- **HIBEF User Consortium**

A coordinated strategy for target supply

Possible synergy levels

INTEGRATED NETWORK



JOINT RESEARCH ACTIVITIES

SUSTAINABLE TARGET SUPPLY

TRAINING OF TARGET EXPERTS

SUPPORT PARTNERS IN GRANT WRITING

BUDGET for TARGET DEVELOPMENT

SUPPORT USERS IN TARGET DESIGN

A Target Network for Advanced Laser Sources

Next steps

EXPERT PANEL

- **NETWORK SCOPE AND STRUCTURE**
- **FUNDING SCHEME**
- **ACCESS MODELS**

FUNDING STRATEGY

- **EU LOBBYING for an APPROPRIATE CALL in H2020 2018-2019 (perfect timing)**
  - **INFRASTRUCTURE CALL**
    Transnational Access to a VIRTUAL TARGET LAB?
  - **FUTURE AND EMERGING TECHNOLOGIES?**
  - **FACTORIES OF THE FUTURE?**
- **INNOVATIVE TRAINING NETWORK**

A Target Network for Advanced Laser Sources

Transnational/Virtual Access Network

3 PILLARS

- Trans-national access to a pool of research infrastructures
- Joint research activities to improve the service to users
- Networking activities (workshops/trainings...)

Up to 10 M€ which also cover user access costs!

VIRTUAL ACCESS
to TARGET FABRICATION/CHARACTERIZATION LABORATORIES
(instrumentation/manpower/know-how)
if possible free of charge

Lobbying for an appropriate call:

2018-2019 – EUROPEAN RESEARCH INFRASTRUCTURES

A Target Network for Advanced Laser Sources

Next steps

EXPERT PANEL

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- **INNOVATIVE TRAINING NETWORK**

WHITE BOOK

- **AWARENESS about target related issues**
- **support partners in GRANT WRITING**
- **support for EU LOBBYING**

DRESDEN concept HZDR

A Target Network for Advanced Laser Sources

White book contents

Scopes and goals

Research at advanced laser-light sources

- Laser-matter physics: research and applications
- Advanced laser-light sources
- The role of targets

Targets for high-power laser experiments

- Target needs
- Target fabrication: state of the art
- High-repetition rate challenges

Targeting the future: coordinated strategies

- Strategies
- Investigation of the potential of a target network for advanced laser-light sources
- Next actions

List of endorsing partners

A Target Network for Advanced Laser Sources

Conclusions

MESSAGE

- **We need to be AWARE of**
  TARGET RELATED ISSUES
- **We can WORK TOGETHER to address them**

STRATEGY

- **COORDINATION**
  - **Not to duplicate efforts**
  - **Better chance of increasing funding**
- **OPEN TO CONTRIBUTIONS!!!**

Acknowledgements

ORGANIZING COMMITTEE

M. Cernaianu, T. Cowan, G. Fiquet, Z. Konopkova, P. Lutoslawski, D. Margarone, S. Pascarelli, M. Tolley

PANEL LEADERS

J. Fuchs, S. Pascarelli, D. Schumacher, R. Stephens, T. Tschentscher

HZDR

B. Schramm, J. Fassbender, U. Schramm, J von Borany, J. Grenzer, A. Erbe, B. Gross, D. Kraus, N. Hartley, J. Metzkes, T. Kluge, S. Vellguth, M. Rödel, A. Laso Garcia, M. Molodtsova, A. Ferrari, A. Pelka…

EUCALL HIREP

D. Margarone, J. Schultz, R. Appio, M. Cernaianu, C. Deiter, J. Dreyer, M. Gugiu, A. Meents, A. Pelka, T. Ursby, T. Wiste

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for any information, don't hesitate to contact i.prencipe@hzdr.de

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