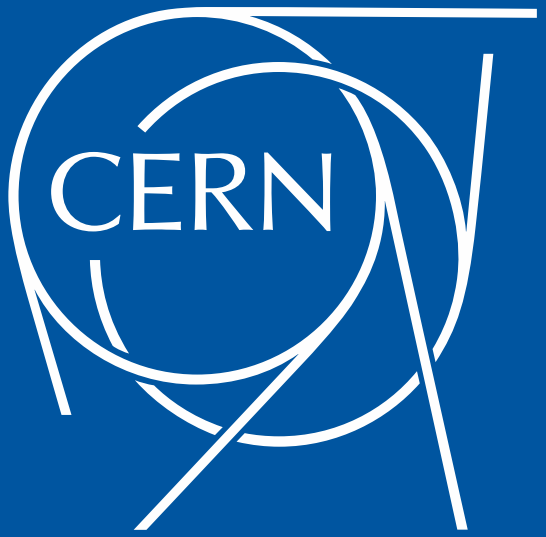

CERN

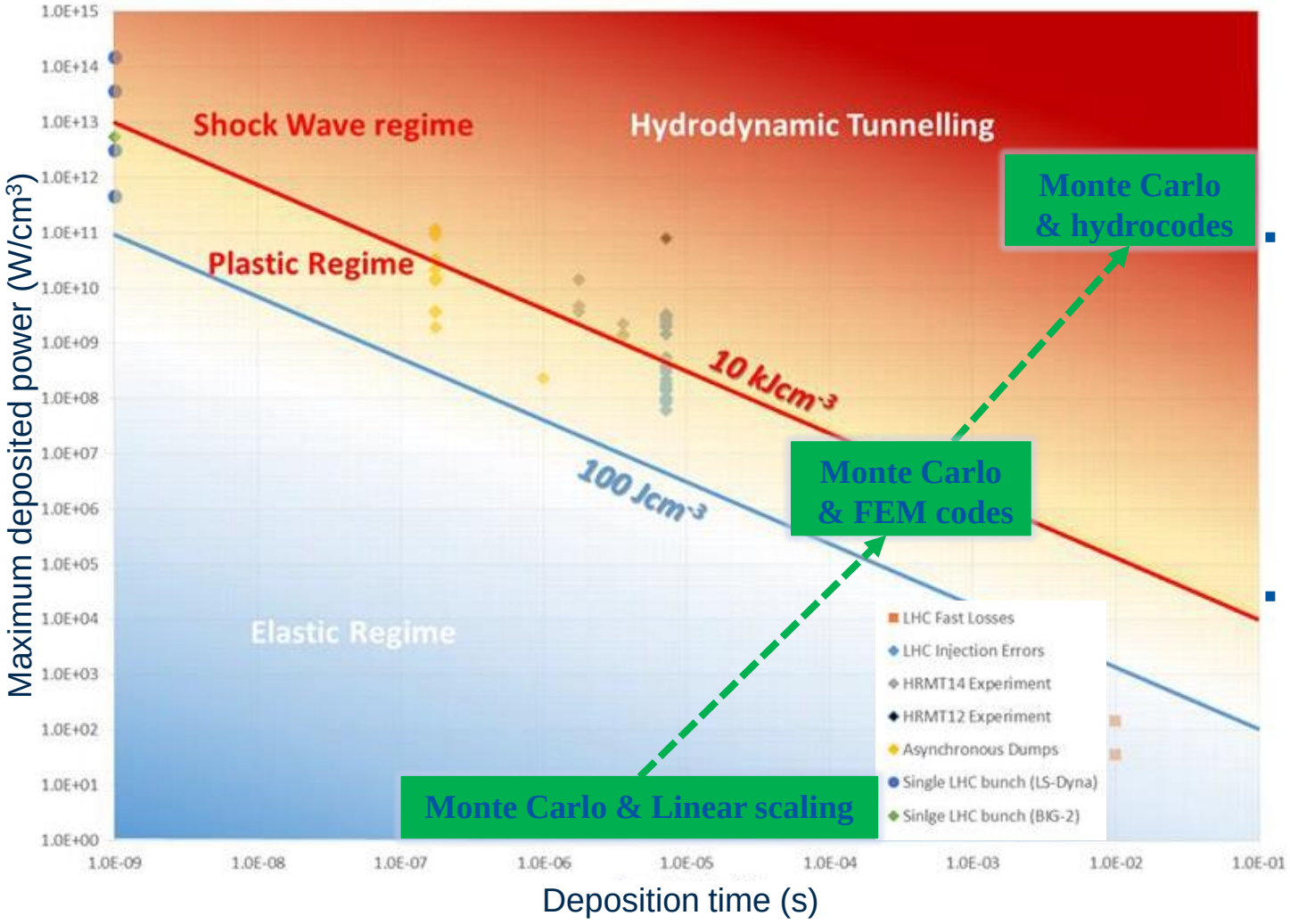
Beam impacts on simplified targets: cylinders made of copper and graphite

Yuancun NIE
TE-MPE-PE

Acknowledgments:
L. Mettler, C. Fichera, F. Carra, A. Bertarelli,
R. Schmidt, N. Tahir, F. Burkart, D. Wollmann, etc

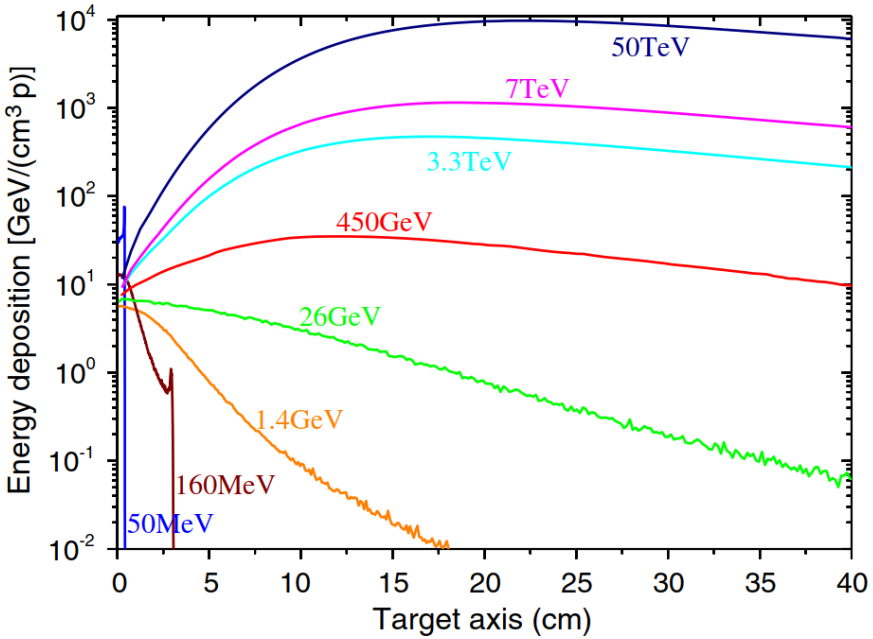
Mechanical responses to beam impacts in different regimes

[A. Bertarelli, ***Joint Accelerator School*** 2014]

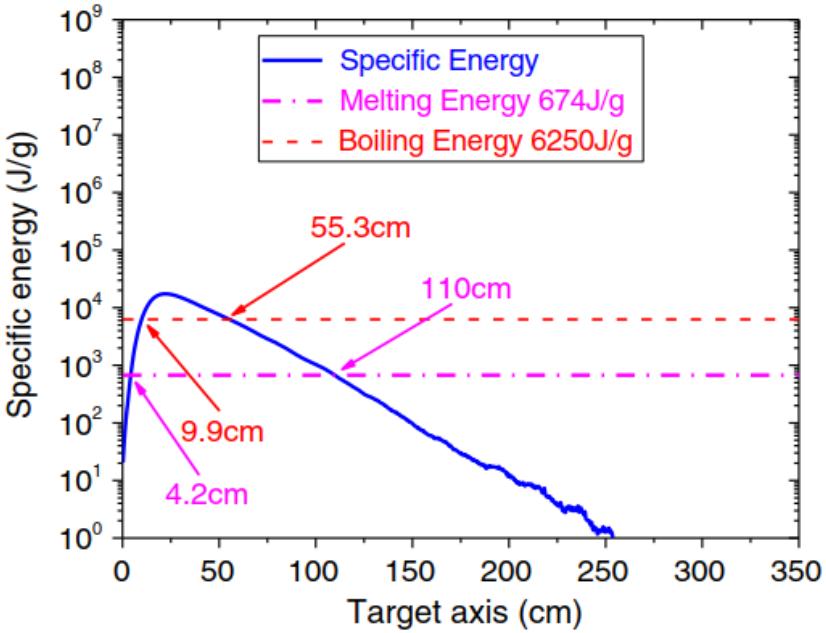


- Accelerator components are usually designed to work in the **elastic regime**. → Linear scaling from energy deposition per proton for order-of-magnitude estimation of temperature increase.
- **Hydrodynamic tunneling** is the extreme situation which would be likely if a large number of bunches are lost at the same place (e.g. during injection/extraction).

Beam impacts on copper and graphite
(50 MeV-50 TeV p+, various beam sizes, less-severe losses)



Energy deposition along cylinder axis of copper target ($\sigma_{x,y}$ = 0.2 mm)



Specific energy of one nominal bunch (FCC-hh, 50 TeV, 1.0×10^{11} p, $\sigma_{x,y}$ = 0.2 mm)
Peak specific energy:
17000 J/g > > 6250 J/g (boiling energy)

- This integral study provides a reference for quick assessment of beam impacts (**temperature**) on components in FCC-hh and its injector chain, in the case of less-severe beam losses (**no density change**).

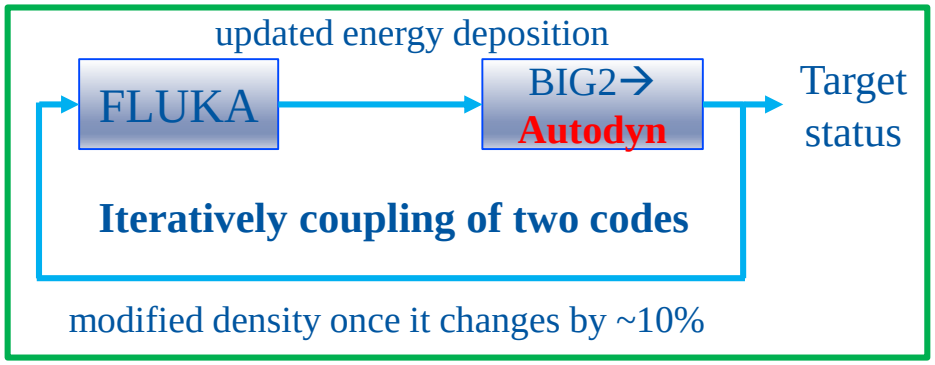
[**Y. Nie**, et al., ***Phys. Rev. Accel. Beams*** 2017; ***CERN-ACC-2017-0054***]

Beam impacts on copper

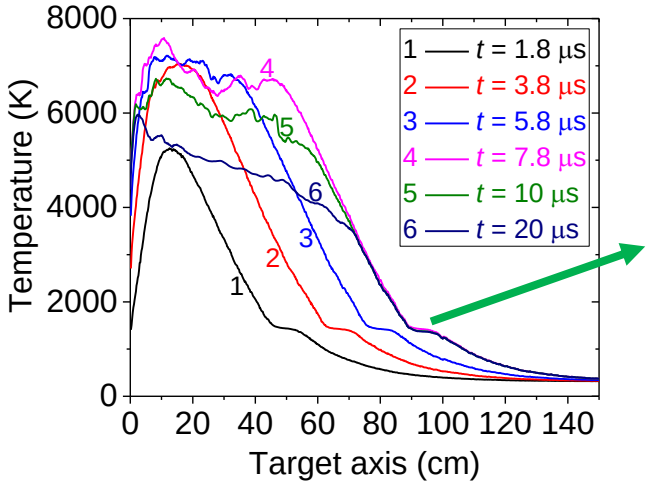
(Benchmark simulation of hydrodynamic tunneling with FLUKA&Autodyn)

HiRadMat-12 experiment at SPS

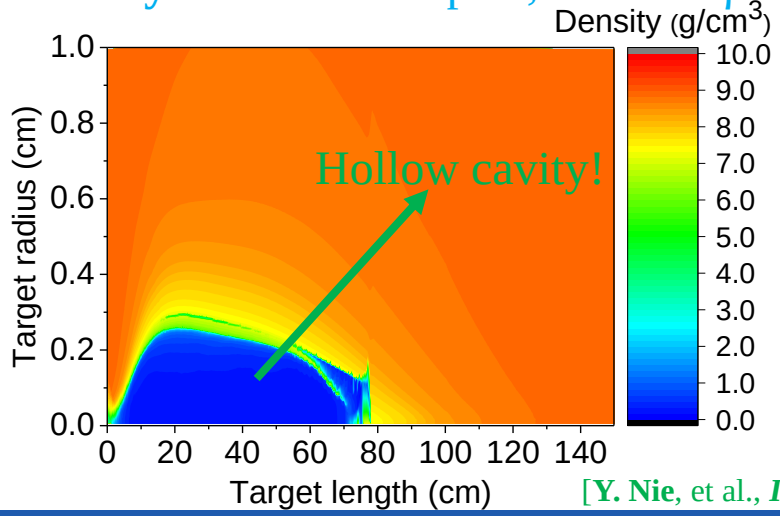
Damage of a beam (144b) with an energy of 1.5 MJ (FLUKA&BIG2: **hydrodynamic tunneling effect**)
[N.A. Tahir, et al., ***Phys. Rev. E*** 2014; F. Burkart, et al., ***J. Appl. Phys.*** 2015]



Temperature vs. target axis at different times



Density after beam impact, at t = 20 μs



[**Y. Nie**, et al., ***IPAC*** 2018]

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