

## AWAKE: harnessing plasma instabilities for high-gradient acceleration

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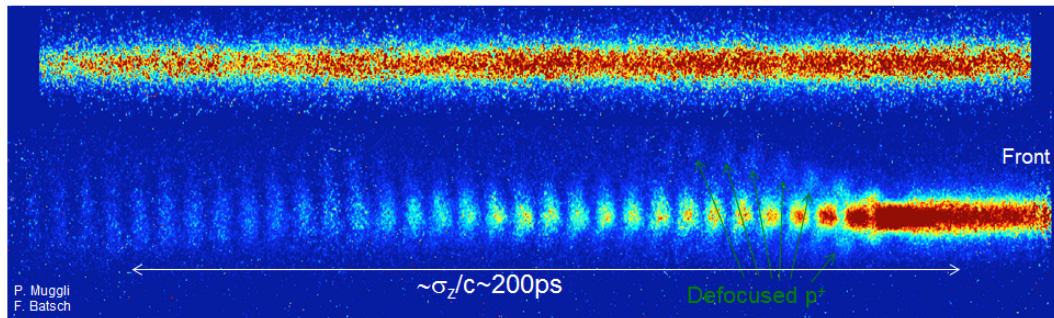
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The AWAKE project at CERN makes use of plasma to transfer energy from the SPS proton beam to a short witness beam of electrons [1]. We here give an overview of the project, from the first simulations demonstrating the exploitation of beam-plasma instabilities to generate large accelerating fields [2], through to the most recent experimental results [3]. The next stages of the project, which will demonstrate sustained accelerating gradients and control of the witness bunch emittance [4], are also presented. These developments will allow the first applications of AWAKE-like technology to particle physics in the 2030s.

### References

- [1] AWAKE Collaboration, *Nature* **561**, 363 (2018)
- [2] A. Caldwell and K. V. Lotov, *Phys. Plasmas* **18**, 103101 (2011)
- [3] M. Turner et al. (AWAKE Collaboration), *Phys. Rev. Lett.* **134**, 155001 (2025)
- [4] E. Gschwendtner *et al.* (AWAKE Collaboration), *Symmetry* **14**, 1680 (2022)



**Figure 1.** Time resolved image of a proton beam after propagation through rubidium vapor (top) and rubidium plasma (bottom). The self-modulated beam created through the beam–plasma interaction can drive large-amplitude wakefields suitable for the acceleration of a witness electron beam. Image credit P. Muggli and F. Batsch (AWAKE Collaboration).