



# LIGHT IONS ACCELERATION LINE (L3IA): TEST EXPERIMENTS AT ILIL-PW



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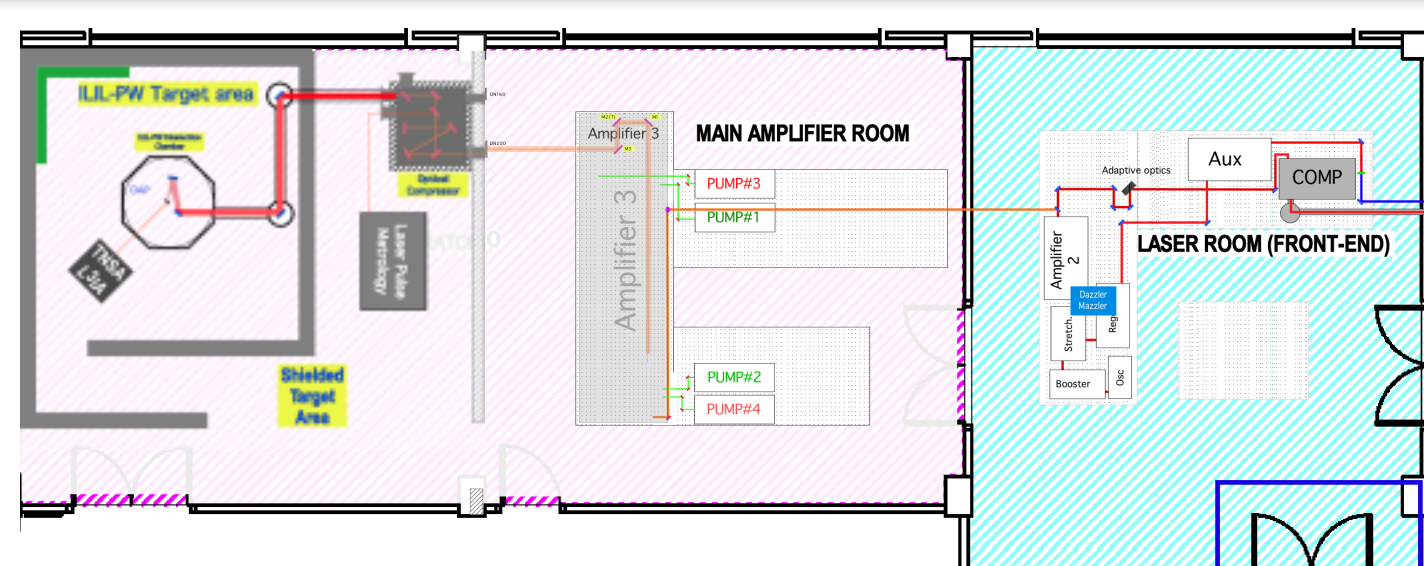
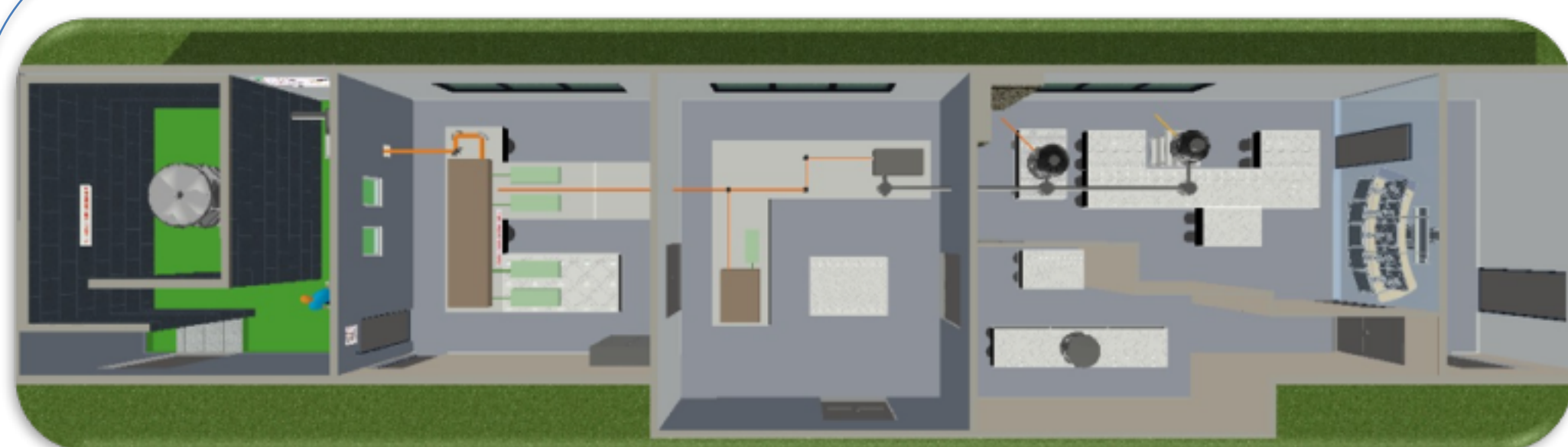
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## Abstract

The construction of a novel Laser driven Light Ions Acceleration Line (L3IA) is progressing rapidly towards the operation, following the recent >100 TW scale upgrade of the ILIL-PW laser facility at CNR-INO (Pisa). The Line was designed following the pilot experimental activity carried out [1] earlier at the same facility to define design parameters and to identify main components including target control and diagnostic equipment, also in combination with the numerical simulations for the optimization of laser and target parameters. A preliminary set of data was acquired following the successful commissioning of the laser system. Data include output from a range of different ion detectors and evaluation and a first set of target parameter scans carried out for qualification of the laser-target interaction. An overview of the results will be given along with a description of the L3IA set up and a summary of the relevant upgraded ILIL-PW facility and features.

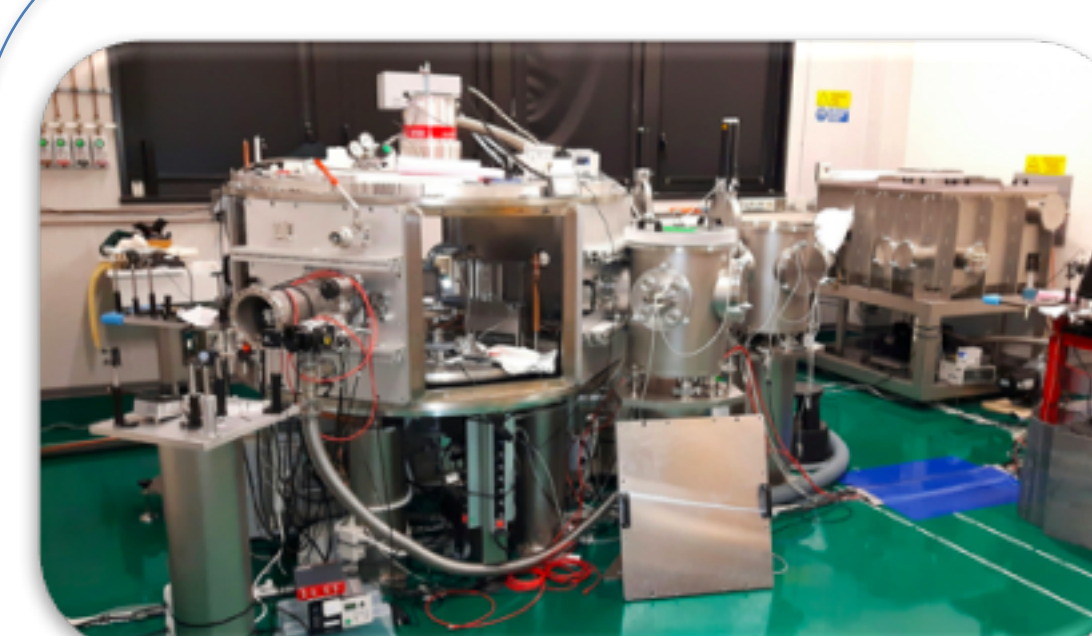
### The ILIL-PW facility



MAIN BEAM	Front-end	1 <sup>st</sup> Phase	2 <sup>nd</sup> Phase
Wavelength (nm)	800	800	800
Pump Energy (J)	1.8	12	24
Pulse Duration (fs)	40	30	25
Energy Before Compression (J)	0.6	4.7	7.9
Energy After Compression (J)	0.4	>3	>5
Rep. Rate (Hz)	10	1	2
Max intensity on target (W/cm <sup>2</sup> )	2x10 <sup>19</sup>	2x10 <sup>20</sup>	>4x10 <sup>20</sup>
Contrast@100ps	>10 <sup>9</sup>	>10 <sup>9</sup>	>10 <sup>10</sup>
Beam Diameter (mm)	36	100	100

Phase 1: operational since July 2017

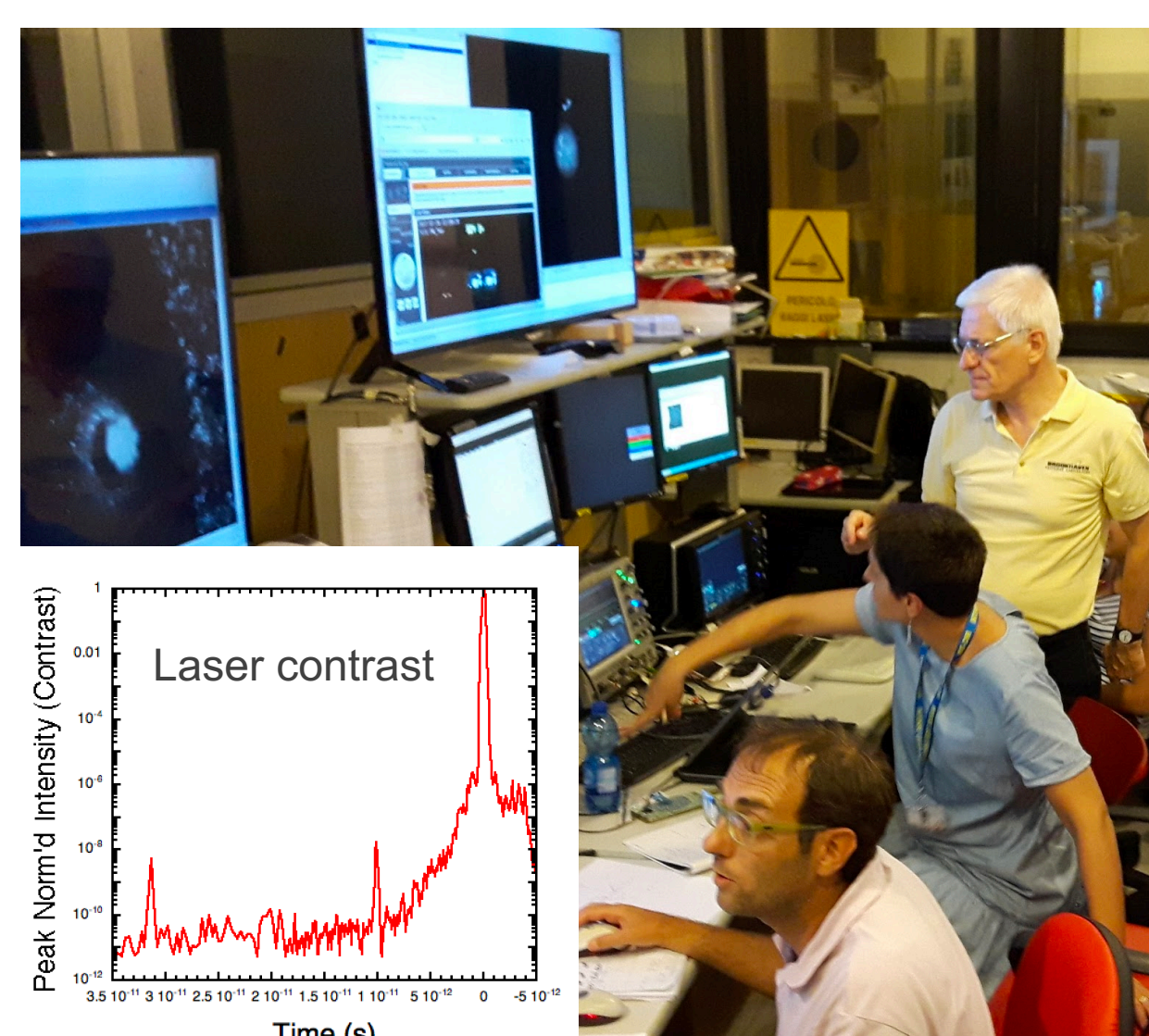
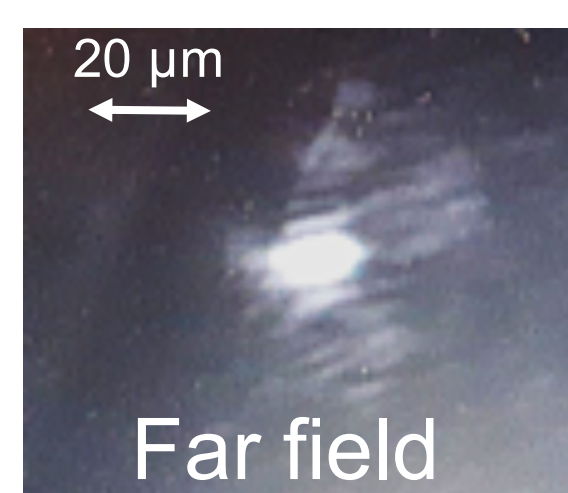
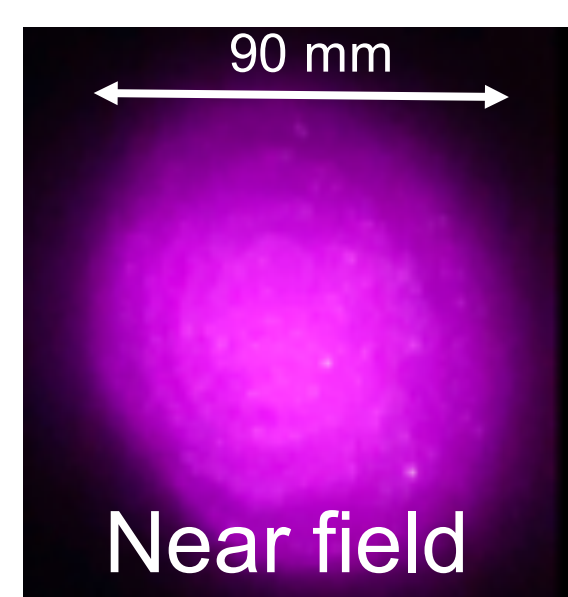
### The target chamber



Main components of the laser-plasma interaction set-up have been designed according to the highest standards of operation for PW-class laser-plasma acceleration[2].

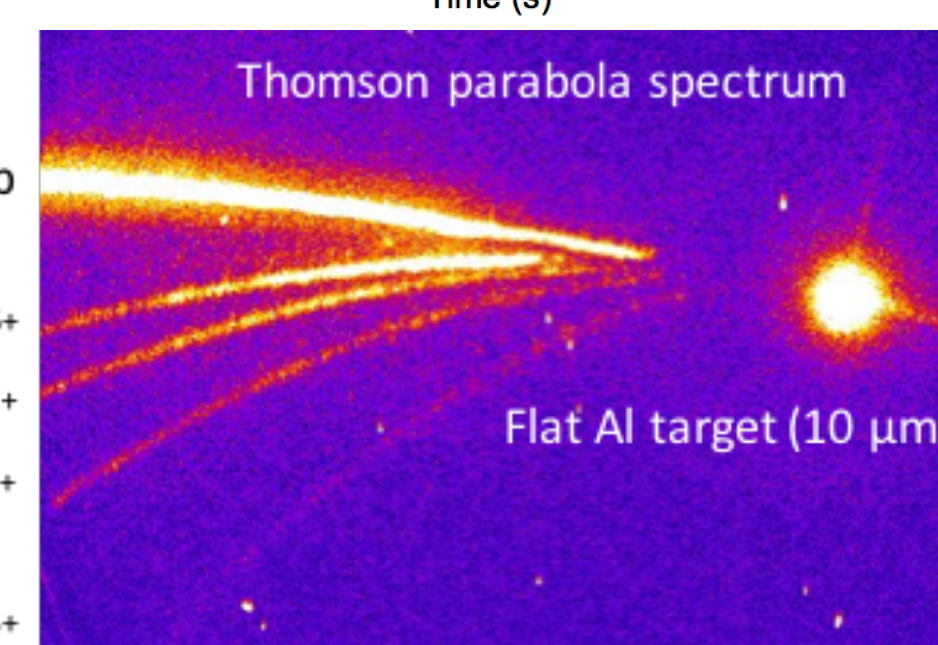
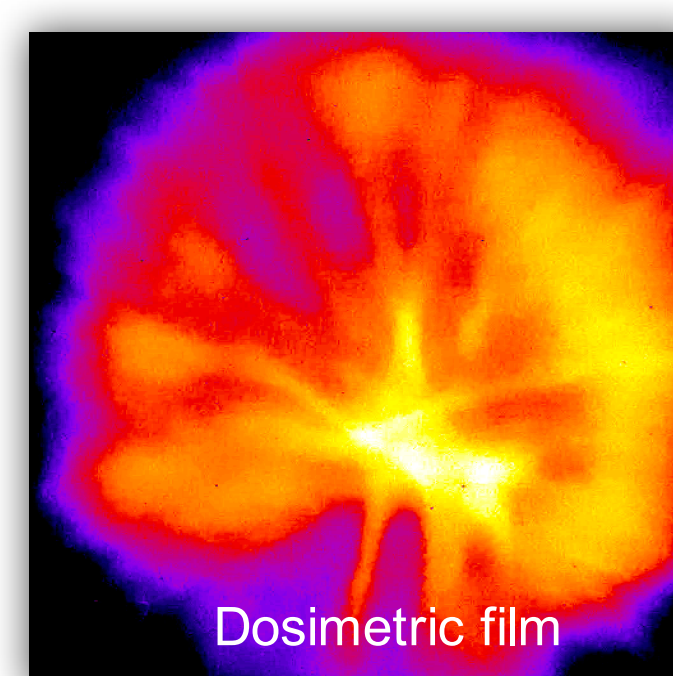
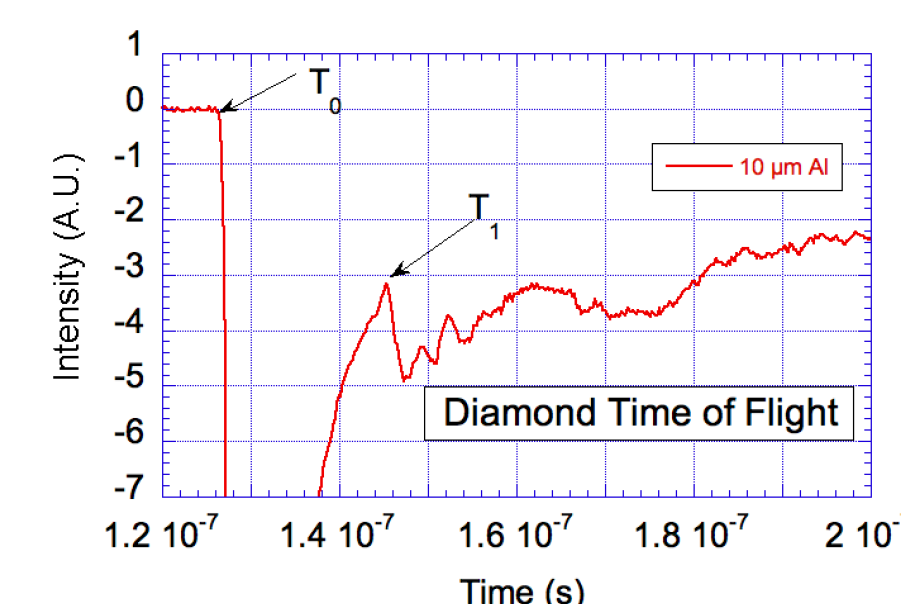
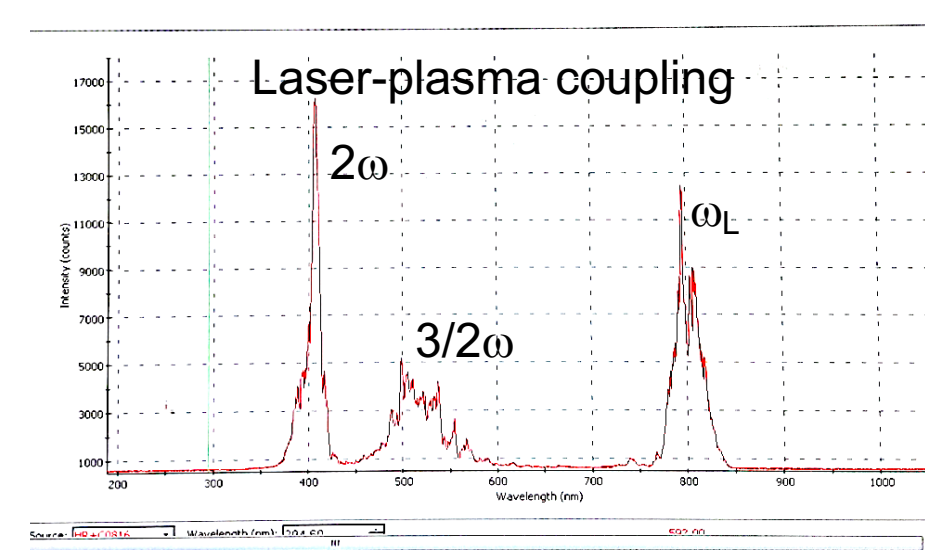
Large,  $\mu\text{m}$  resolution target motion for reproducible target refreshing

### Laser and experiment control



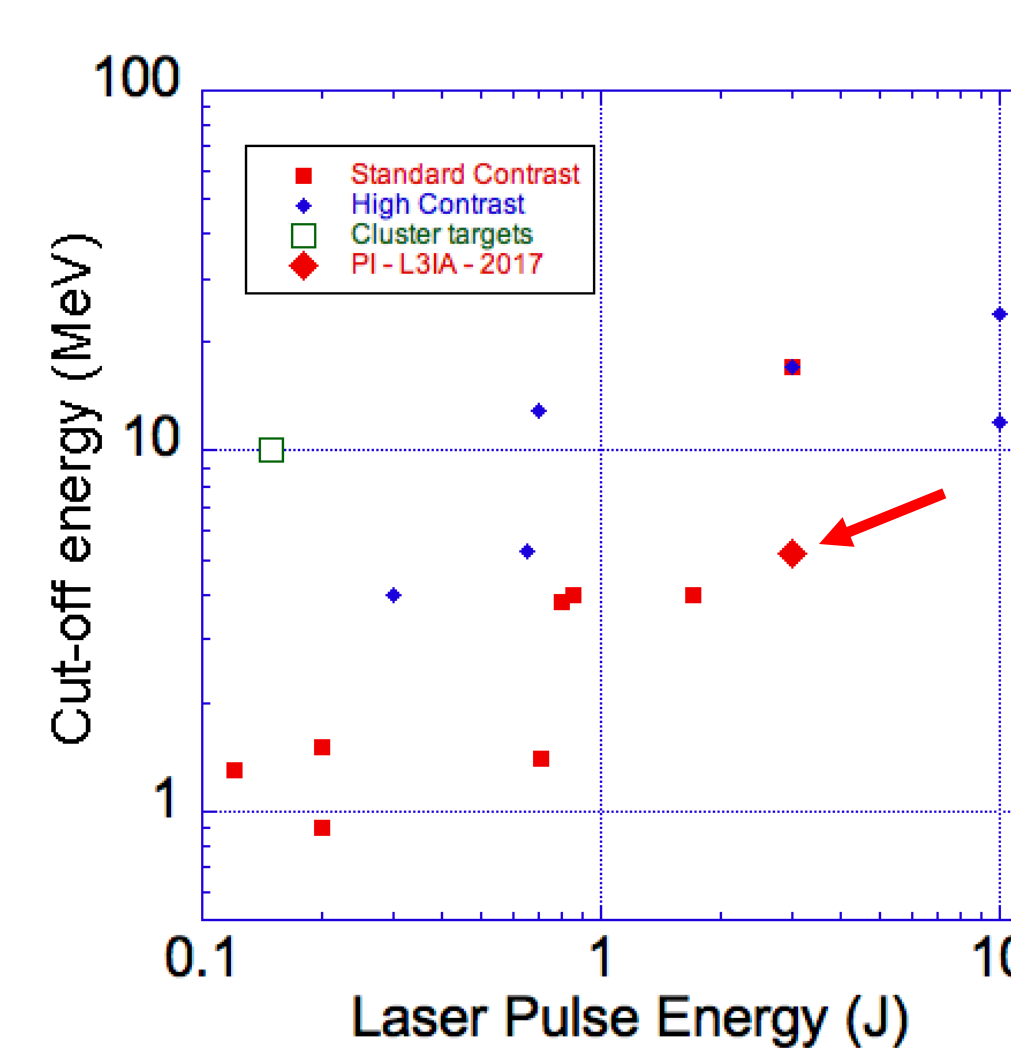
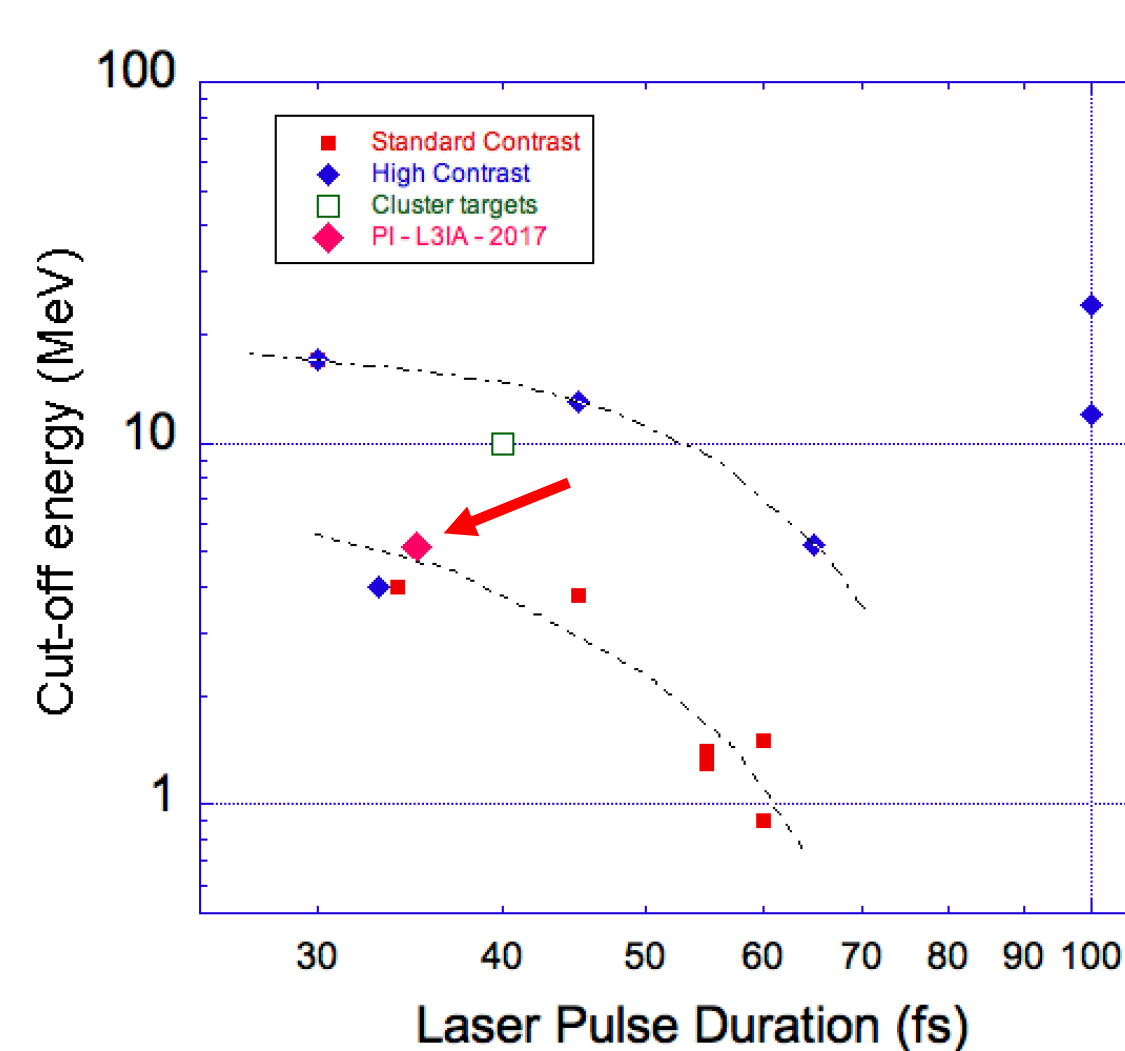
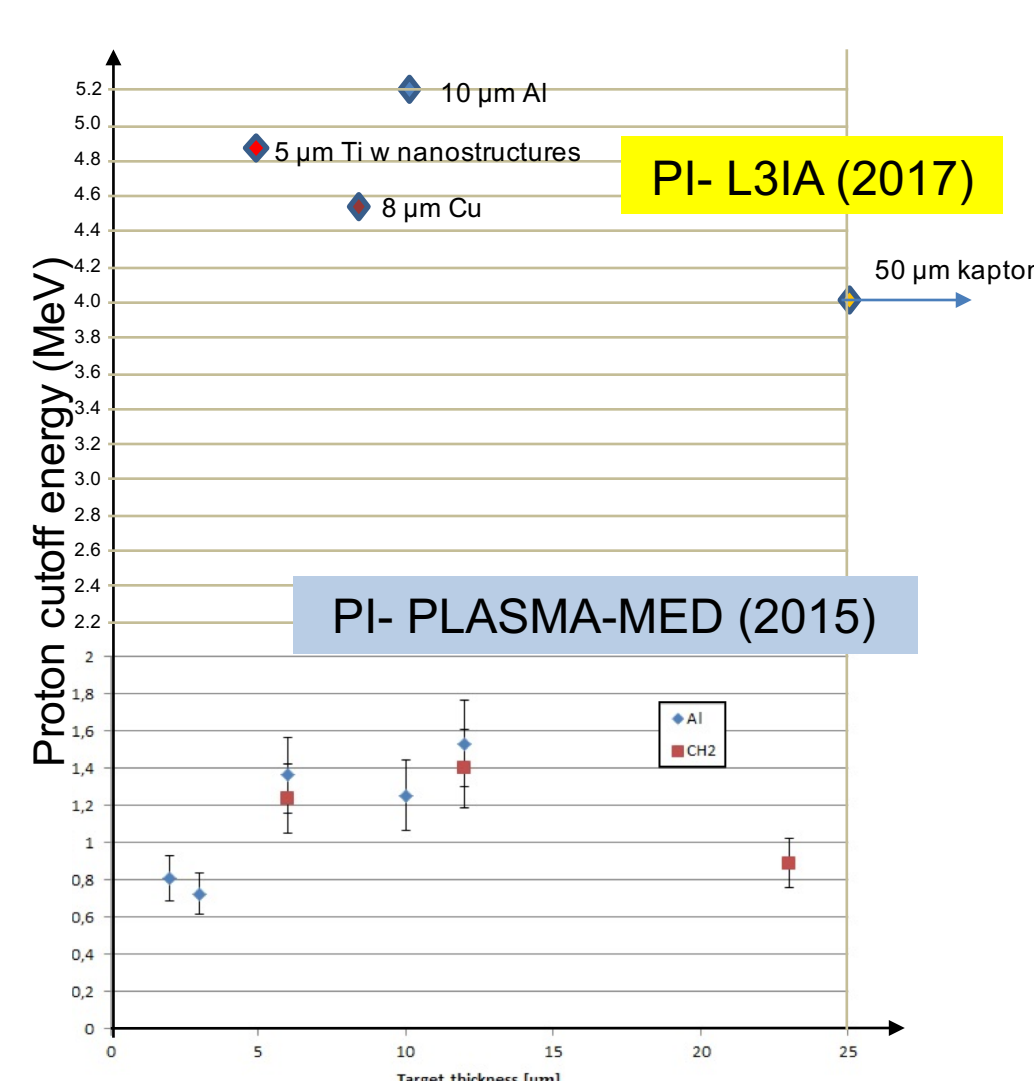
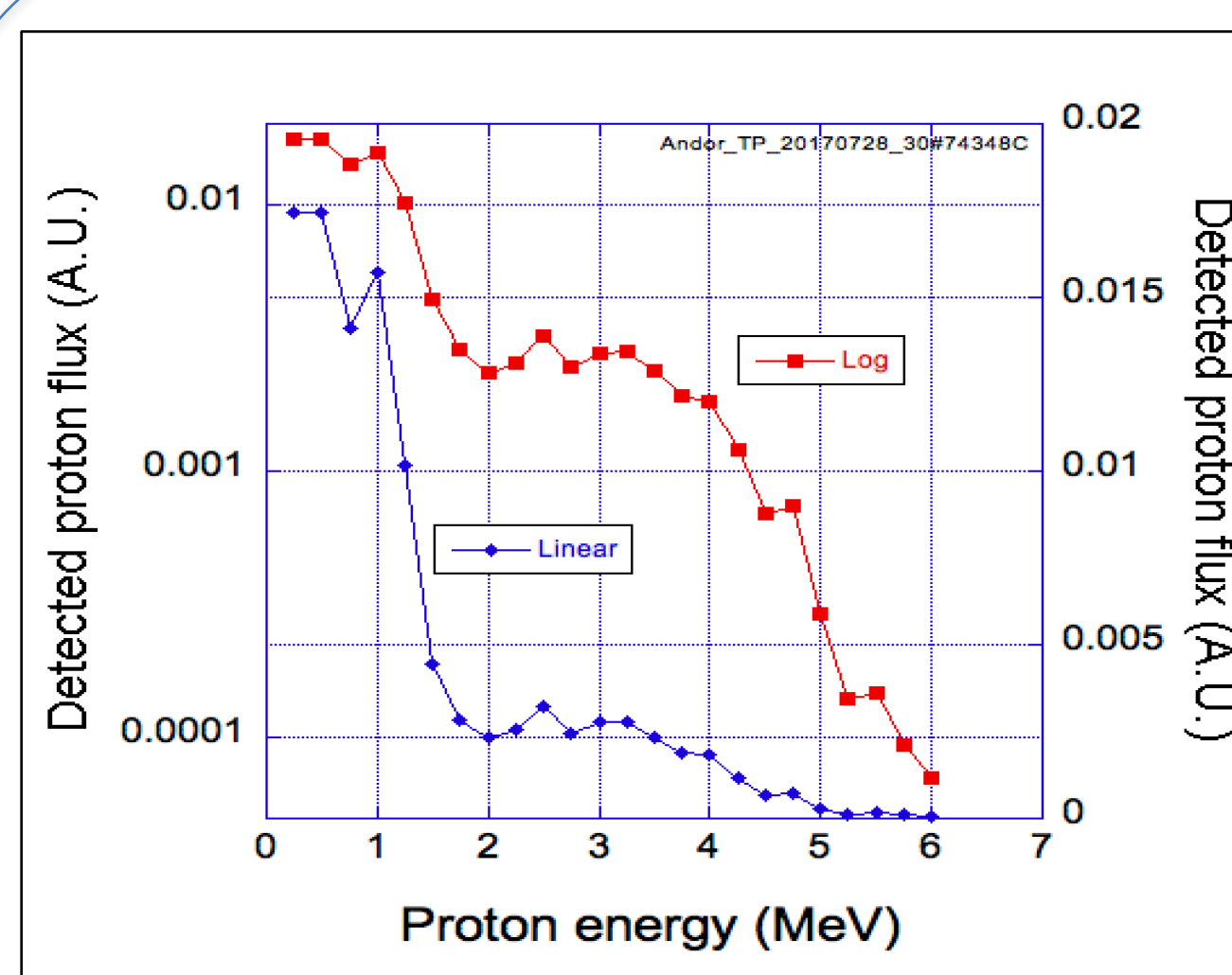
Full remote control of laser and diagnostics, metrology and data automatic data storage.

### Plasma and ion measurements



High quality, complementary plasma monitoring and ion detection and characterization

### Main results



Preliminary results from first run fulfill expectations from first phase of L3IA and enable foreseen applications. Comparison with published data shows that the cut-off energy measured in our experiment exceeds values measured in similar experiments [3] with standard contrast (no plasma mirror). Further increase of ion energy and flux will require characterization and tuning of laser pulse contrast and focal spot control devices:

### Acknowledgements

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### References

- [1] L.A. Gizzi et al., Nuclear Instruments and Methods in Physics Research **A829**, 144–148 (2016)
- [2] L.A. Gizzi et al., Applied Sciences, in press (2017)
- [3] H. Daido et al., Rep. Prog. Phys. **75**, 056401 (2012)

