The Laser Megajoule Full Automated Sequences

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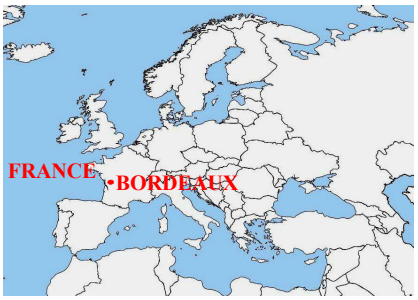
LMJ: LASER MEGA JOULE

- LMJ is a 176-beam laser facility developed by the French Nuclear Science directorate CEA, located at the *CEA CESTA site near Bordeaux
- Part of the French Simulation Program, it is designed to deliver about 1.4 MJ of energy on targets, for high energy density physics experiments, including fusion experiments
- Since 2022, the LMJ facility aims at carrying out experiments with 13 bundles of 8 laser beams and 20 target diagnostics.
- In order to achieve daily shots including all the preparatory steps, the LMJ performs night activities without operators. These sequences work on vacuum windows inspection and beam alignment. They are scheduled automatically one after the other.

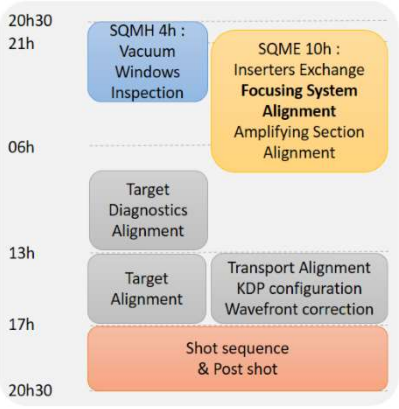


*CEA: Commissariat à l'Energie Atomique et aux Energies Alternatives

LMJ Automated Night Sequences

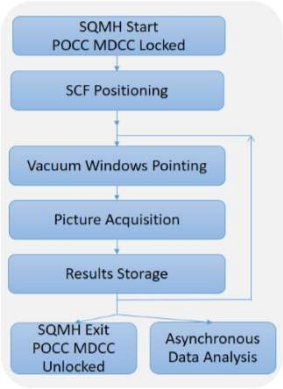
As prerequisites to shots, two sequences are performed during the night **without operator control** :

- vacuum windows damage inspection (**SQMH** sequence)
- alignment of laser beams (**SQME** sequence)



SHOT DAY SEQUENCE

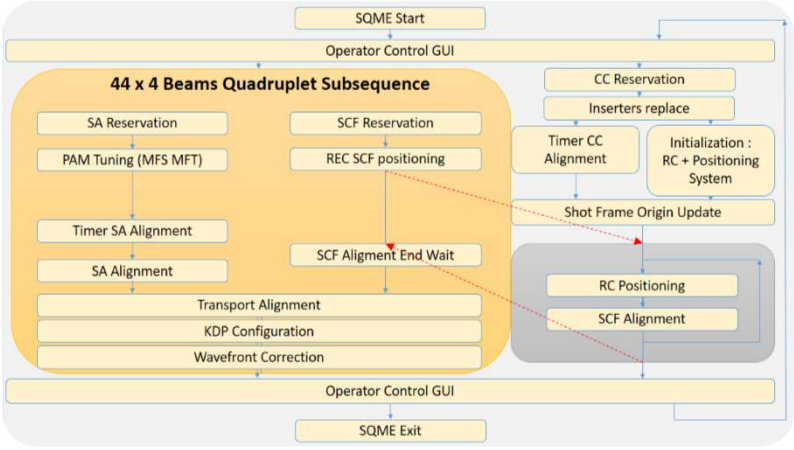
SQMH comes first and SQME waits.
When SQMH ends, **reservation mechanism** unlocks SQMH resources for SQME use.



SQMH SEQUENCE

Full automated sequence :

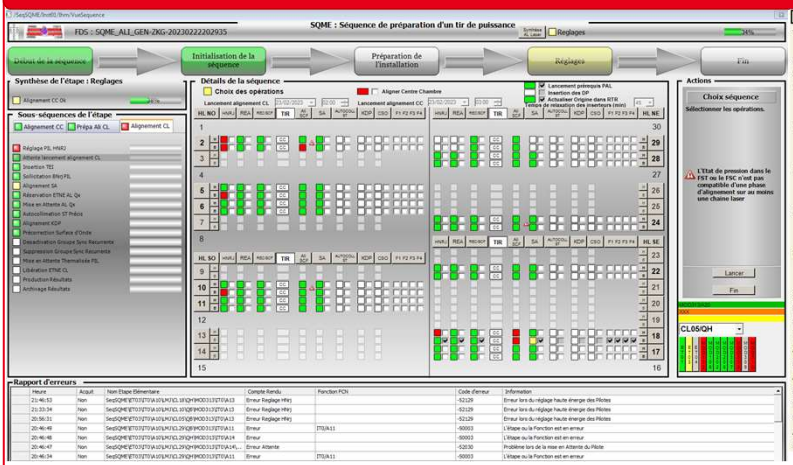
- Exit against all constraints
- Let SQME work during SQMH data analysis

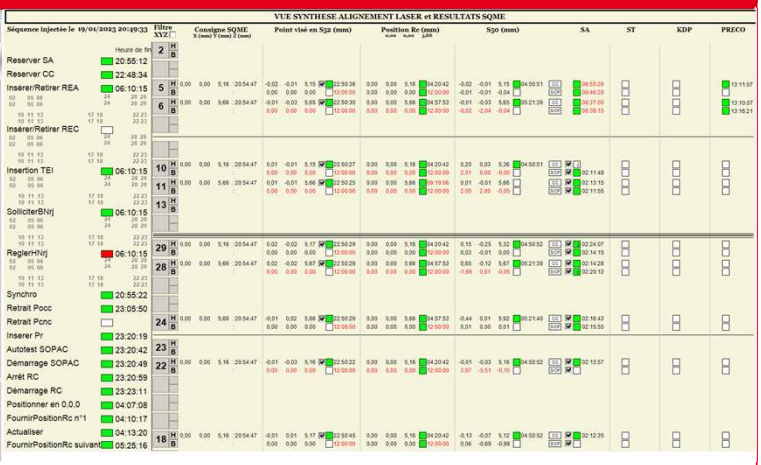


SQME SEQUENCE

SQME **paralell scheduling** and **re-initialization availability** improve succes probability. They allow processing PAM tuning and SA reservation while SQMH is running.

Control GUI





SQME GUI :

- Displays actions that are carried out by the sequence in **a single windows**
- Details **an indicator for each function** of 4 beams bundle granularity
- Indicates alignment **function states** : running, successful or not
- Enables to **set parameters** : perimeter, alignment actions and SA SCF alignment start times

ALIGNMENT SYNTHESIS GUI :

- Based on **control points and success date**
- Overview of all SQME steps **results with time-stamping**
- **Highlighting not matching** SCF/RC set up, RC position and SCF position

Enhancements

LAST IMPROVEMENTS :

- SQME Reservation Check
- SQMH Error Resilience
- Inserter Anticollision Control
- Positioning System Availability

FUTURE DEVELOPMENT:

- **Anticollision** : Target Diagnostic Position Checking
- **Alignment** : Target Diagnostic Integration to RC Alignment

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