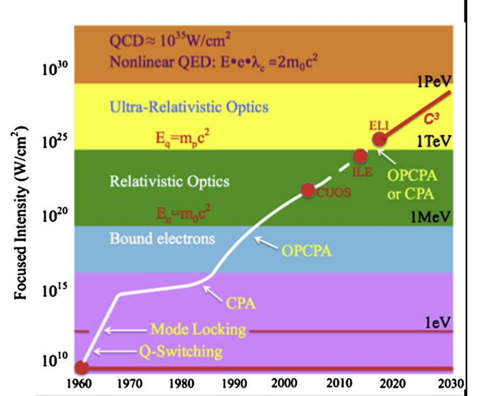
Femtosecond single shot autocorrelation Chirp compensation for real time pulse width diagnosis

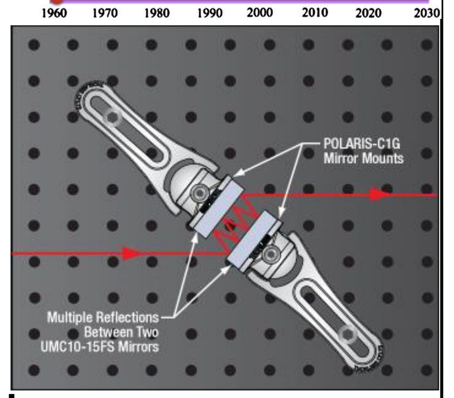
SLAC NATIONAL ACCELERATOR LABORATORY

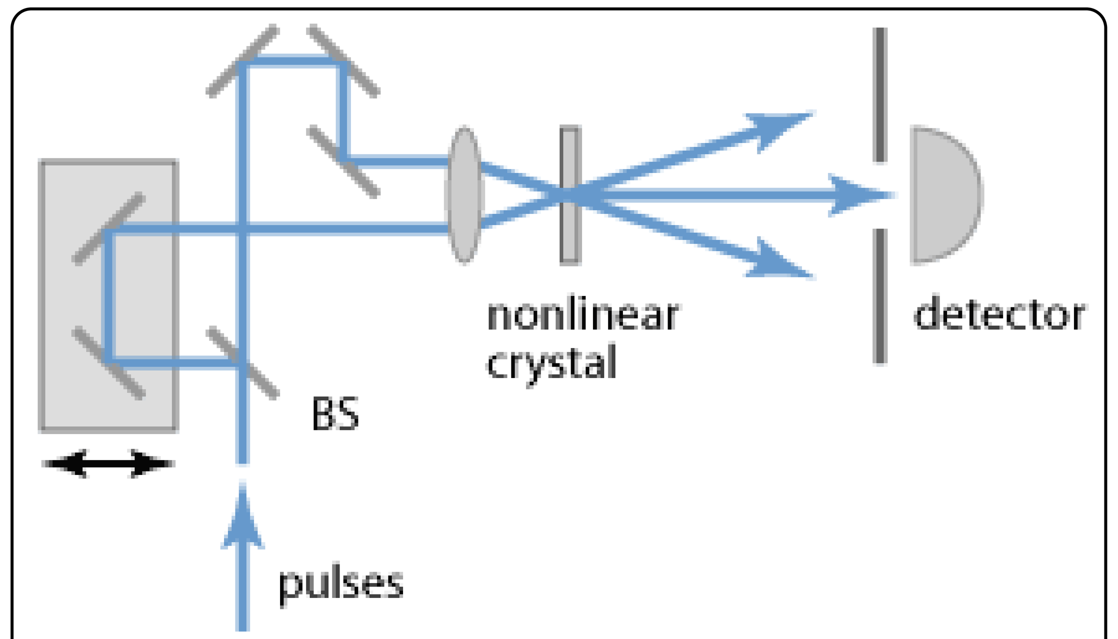
Jasper Hawkins & Hai-En Tsai

Introduction

- CPA used to create ultrafast high intensity pulses in MEC's SPL
- Created new beam path to allow use of SSA
- Installed Chirp Mirrors to compensate for dispersion introduced by Glass



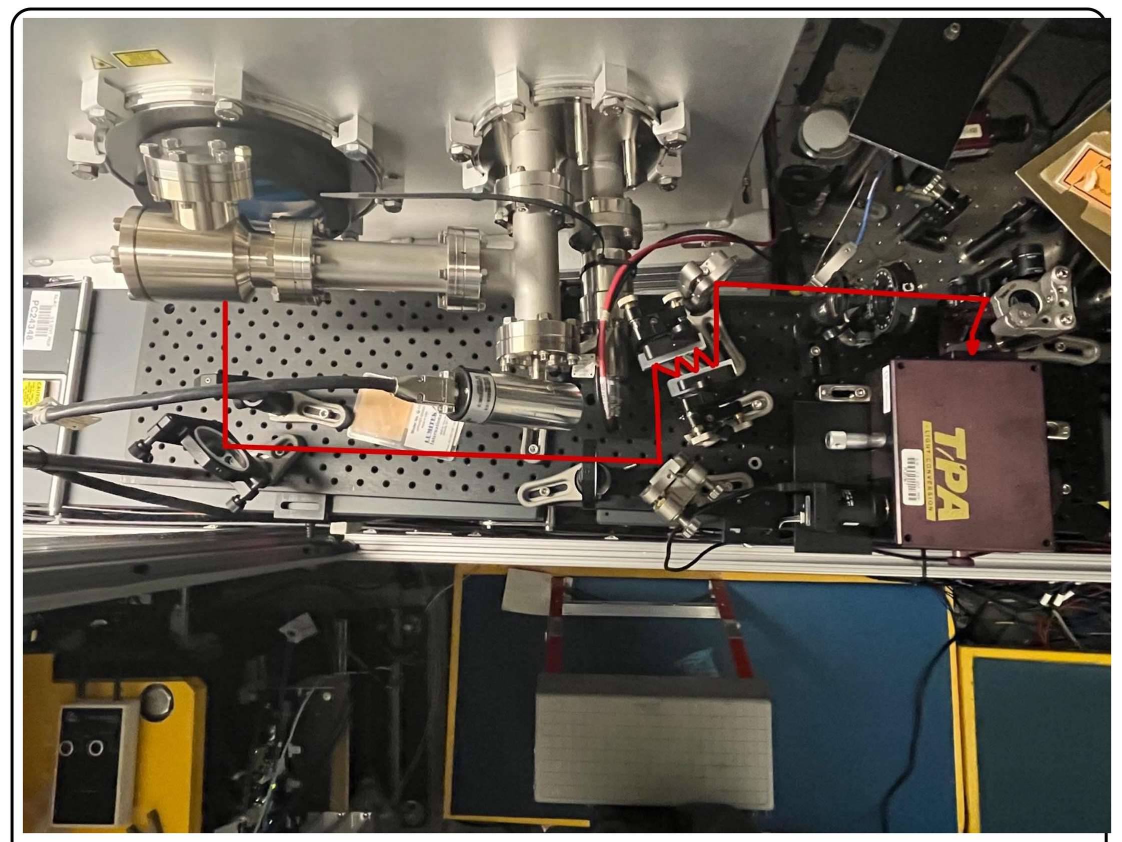




Single Shot Autocorrelation

- Works by taking the sum frequency generation
- Affected by the time delay applied by moving translation stage.
- The dependence of the autocorrelation signal on the temporal delay is given by

$$I_{ac}(\tau) = \int P(t)P(t+\tau)\,dt$$



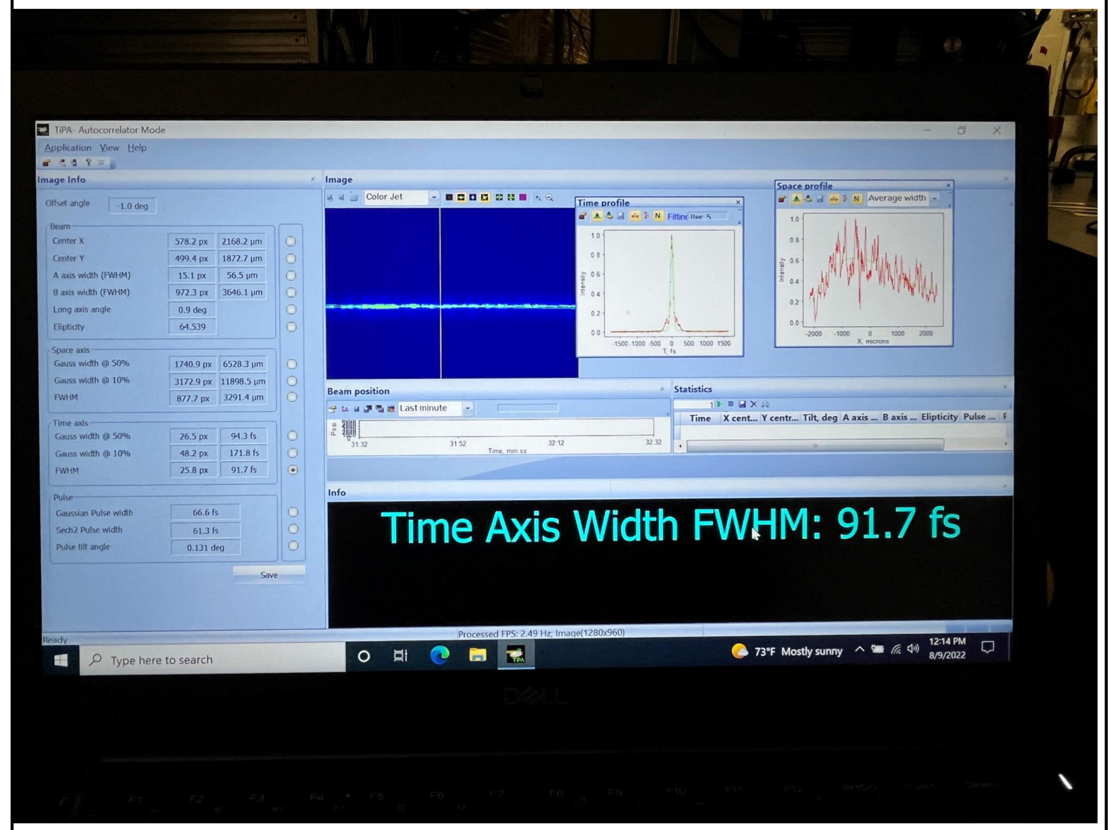
Optics Used

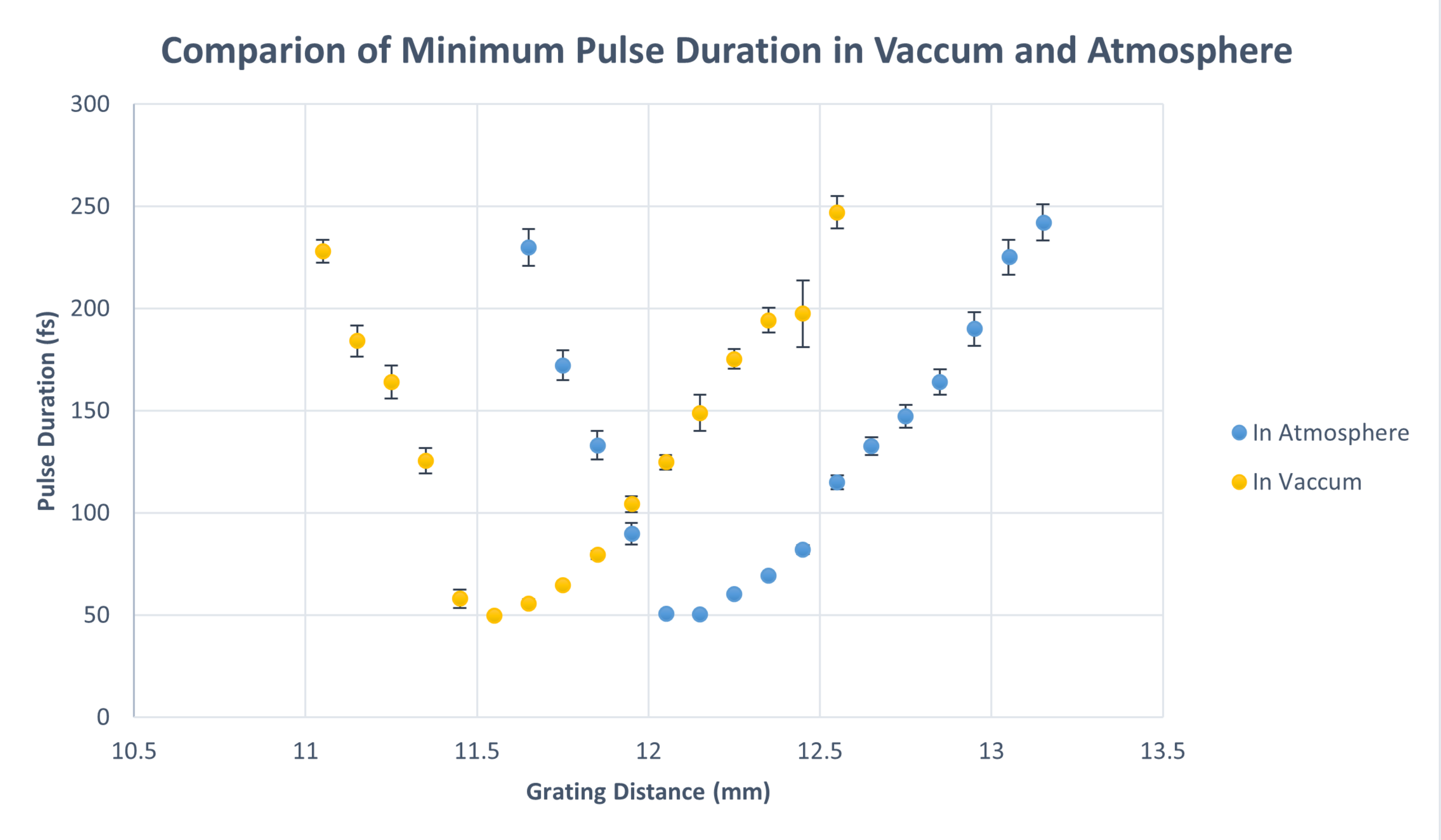
- Telescope to reduce beam size
- Chirp Mirrors
- Wave Plate

- Calculations showed that 8 bounces on the **DCMP175** chirp mirrors were needed to compensate for the 43.3 mm of Fused Silica Glass.
- This required to adding 4.2 mm of additional glass to the beam path. As the Chirp mirrors were overcompensation for the existing amount of Glass.

Results

- Tested by taking several reading and then averaging these points.
- Showed the difference between vacuum and atmosphere.
- In atmosphere 12.05 mm gave the shortest pulse
- In Vacuum 11.65 mm gave the shortest pulse





Conclusions

With the newly installed system the pulse width can be measured while in vacuum allowing for more efficient optimization of pulse with during experiments.

Acknowledgments

Thank you to Bob E., Marc Walsh, Eric Cunningham, Gilliss Dyer, Ben Armentrout, and all the staff at MEC. For answering any questions, I had and helping me with my project. In addition, thank you to all the LCLS for creating this wonderful internship program.