Towards real-time density profile reconstruction with CUDA

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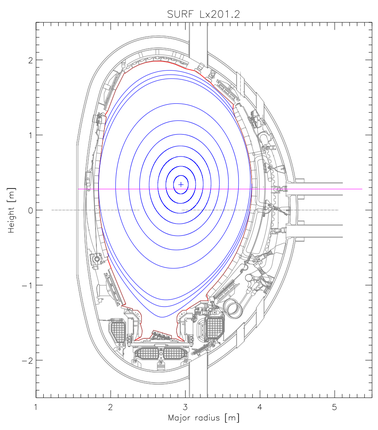
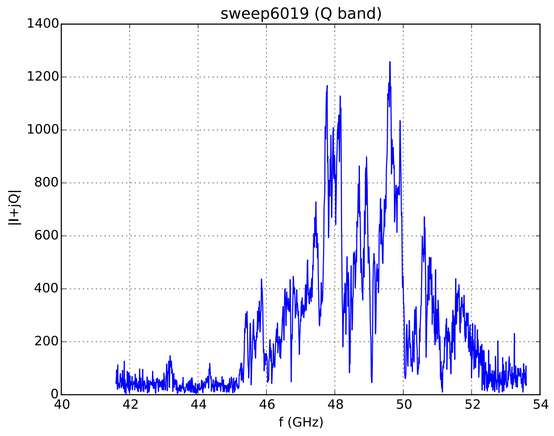
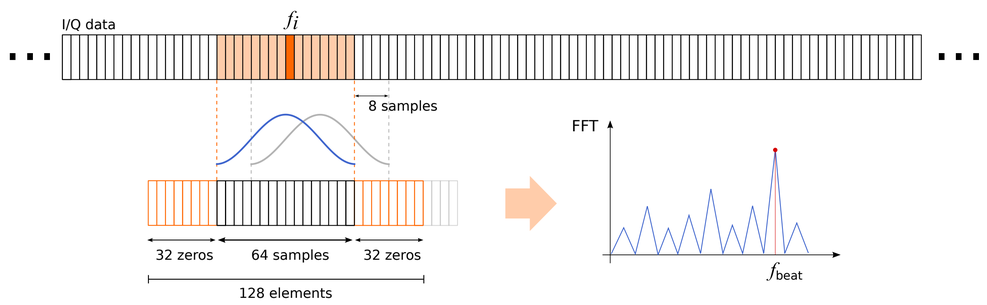
[*]See the Appendix of F. Romanelli et al., Proceedings of the 25th IAEA Fusion Energy Conference 2014, Saint Petersburg, Russia

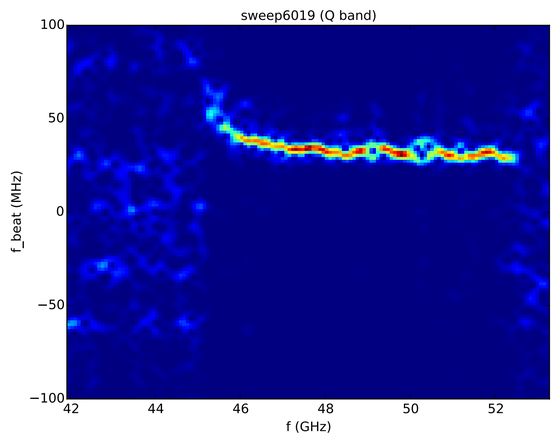
Plasma reflectometry and I/Q data





Short-Time Fourier Transform and beat frequencies

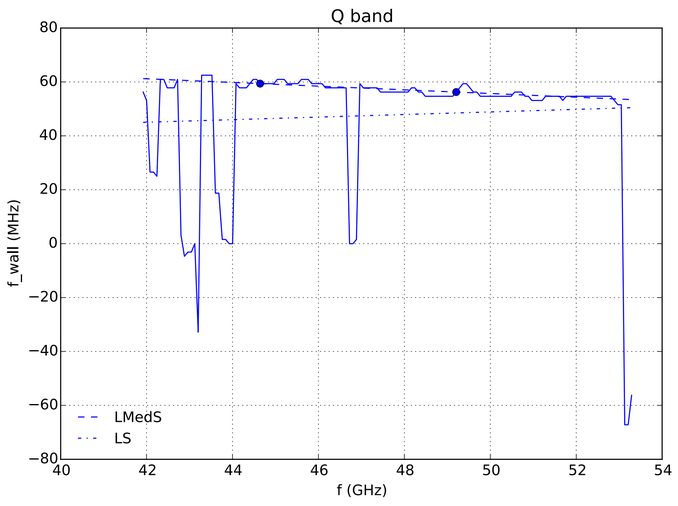




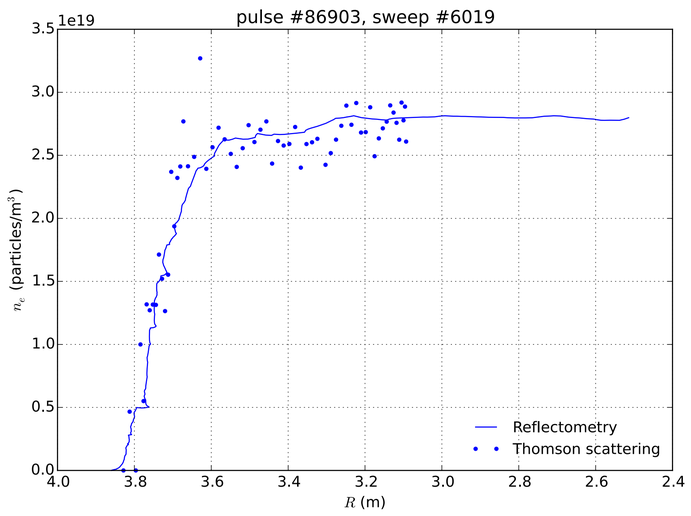
Group delay inside the plasma region

$$\tau(\omega_i) = \frac{f_{\mathrm{beat}}(\omega_i)}{df/dt} - \left(\frac{f_{\mathrm{wall}}(\omega_i)}{df/dt} - \frac{2(R_0 - R_{\mathrm{wall}})}{c} \right)$$

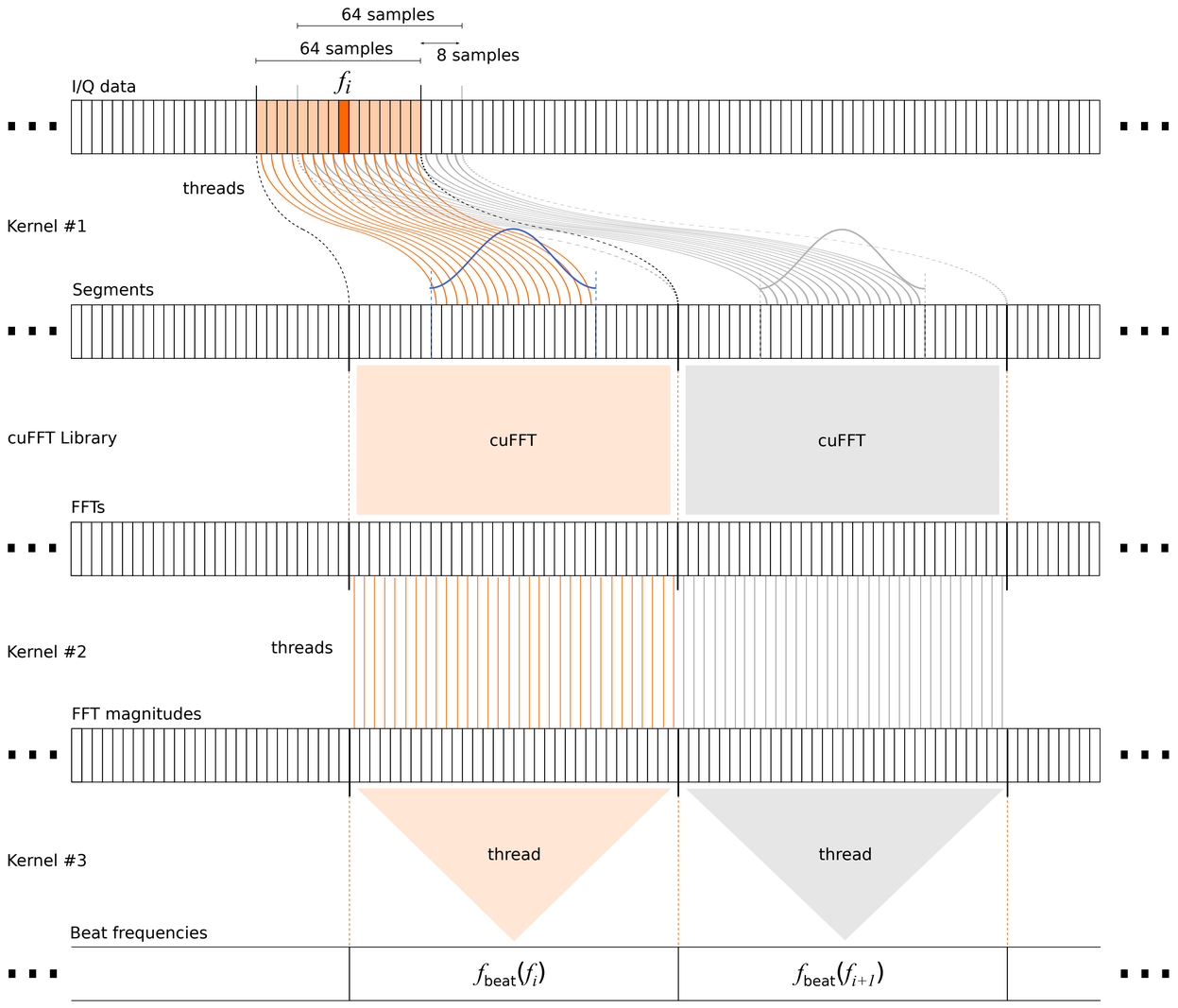
Linearization of f_{wall} (empty chamber)



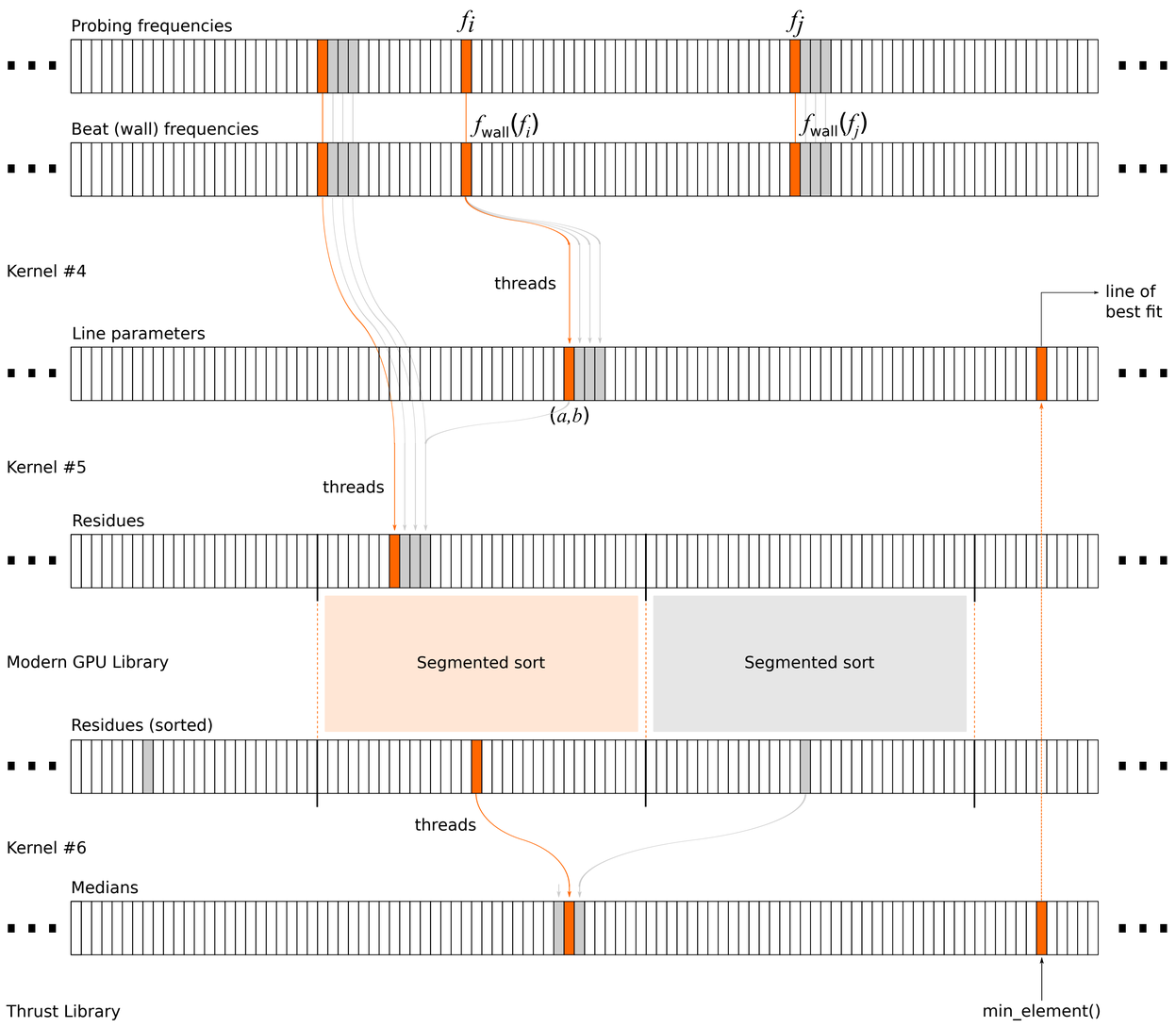
Density profile



Computing the beat frequencies with CUDA



Linearizing f_{wall} with CUDA



Results

CPU: Intel Core i5-4690 @ 3.5 GHz GPU: NVIDIA GeForce GTX 750 Ti SM5.0 with 640 CUDA cores @ 1137 MHz			
Run time (s)	C version	CUDA version	Performance gain
f_{wall} linearization	1.240397	0.130477	9.5x
sweep #6019	0.011204	0.003446	3.3x
sweep #10019	0.011178	0.003402	3.3x
sweep #73185	0.011247	0.003429	3.3x

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