TRANSPORT AND COUPLING OF AN ULTRA-COLD ATOMIC GAS WITH A NANO-STRUCTURED SURFACE.

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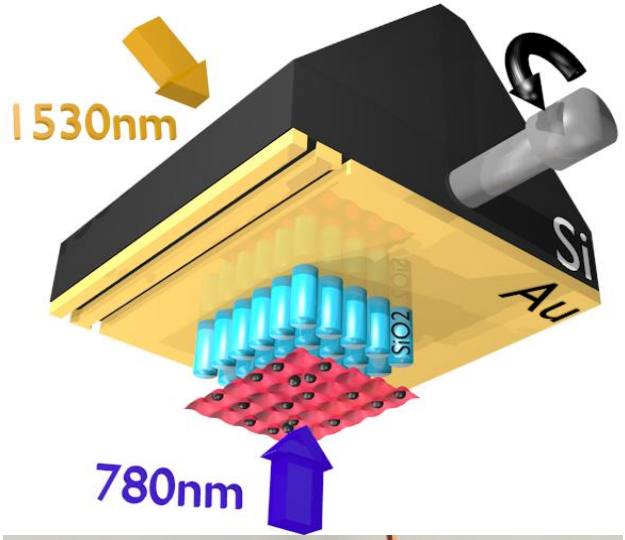
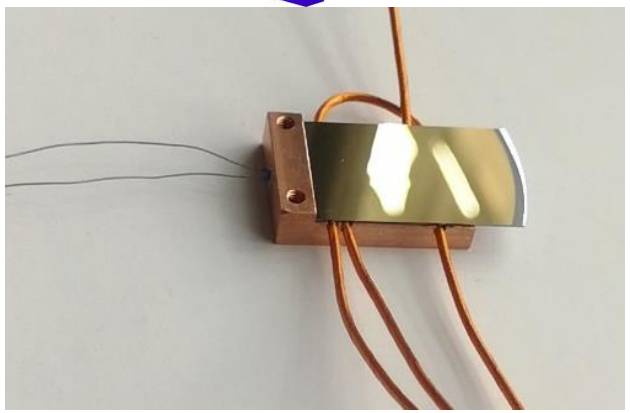
Atom chip

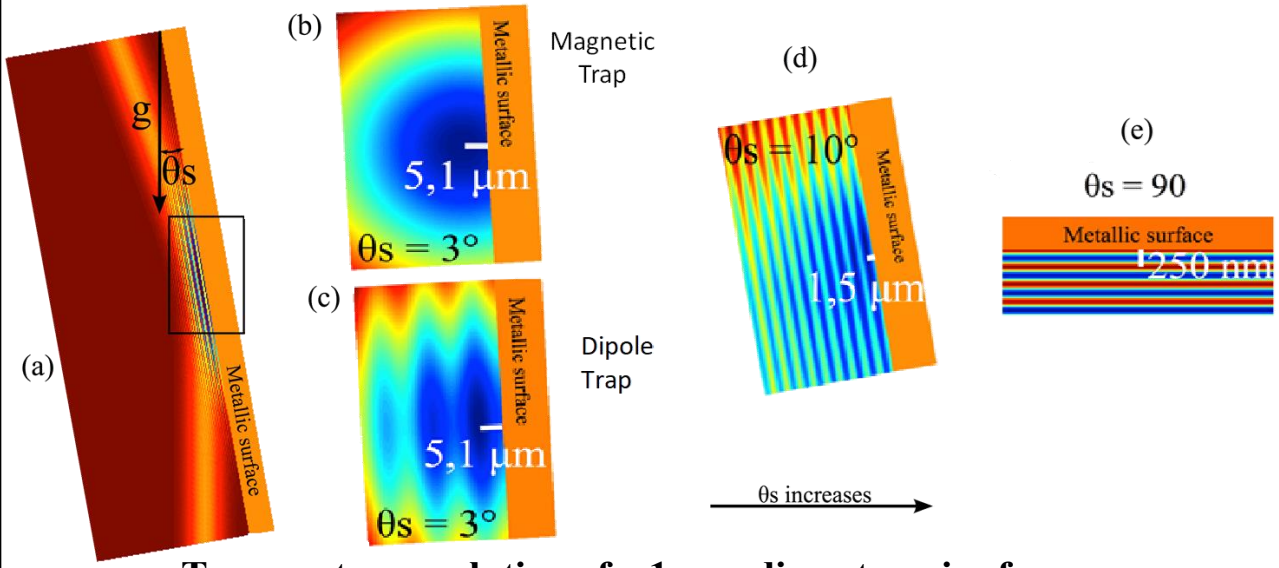


Projet AUFRONS:Ultra-cold atoms trapped in Nano-structured optical lattices.

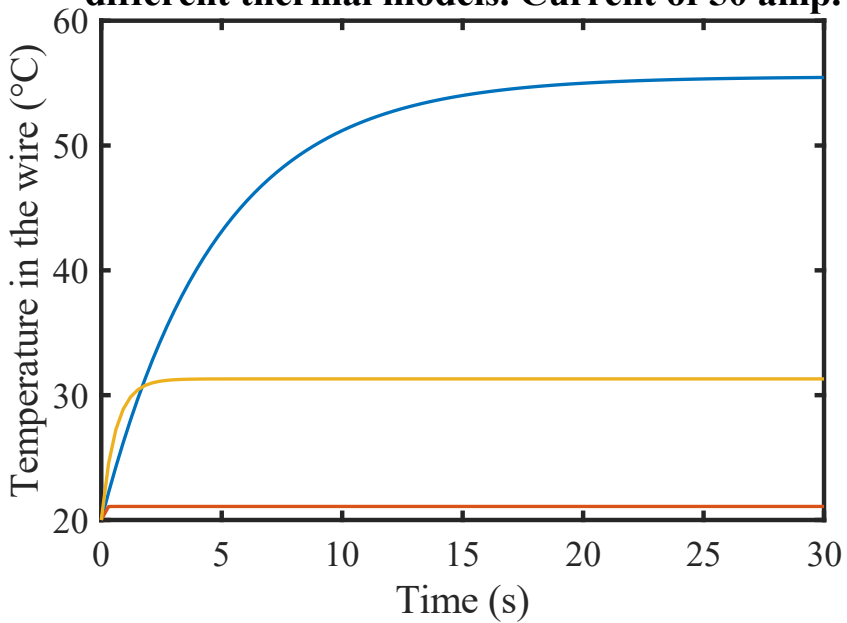


Actual version of the chip : testing with a Copper substrate and a Silicon wafer on top with a gold coating. Investigating thermal properties and electromagnetic behavior.

Exemple of simulated trap :
Trapping at $225\ \mu m$ of the top of the surface, 20 amp in the wires with a trap bottom at 500 mG. = trapping frequencies (737 ; 75.9 ; 743) Hz. Ramping currents to 40 A = (1476 ; 43.9; 1490) Hz.



Temperature evolution of a 1 mm diameter wire for different thermal models. Current of 50 amp.



Noise induce heating during the transport by surface rotation

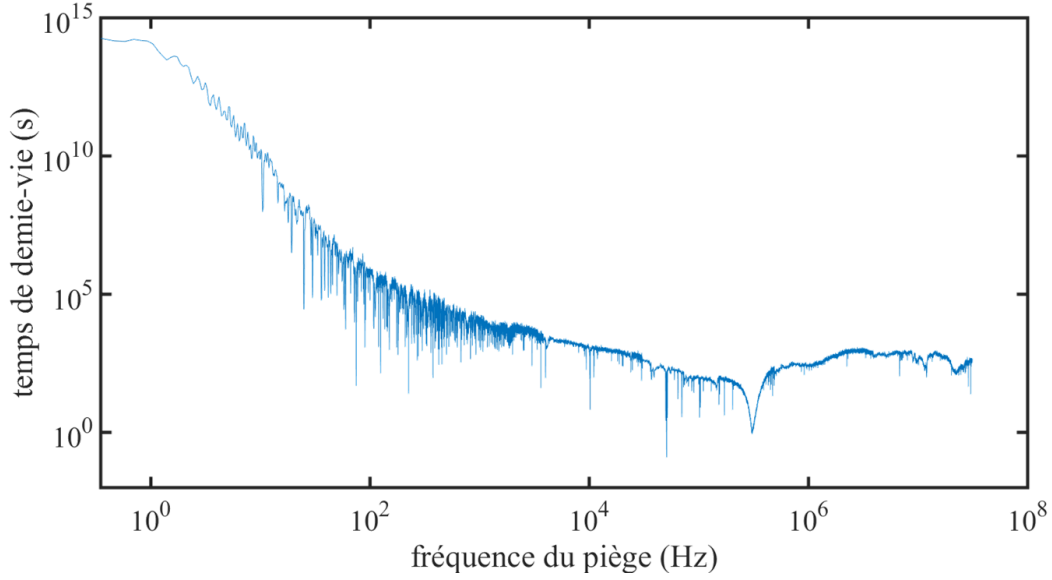
$$H(t) = \frac{p^2}{2m} + \frac{m}{2}\,\omega_x^2\,\left(1 + \epsilon_\omega(t)\right)\left(x - \epsilon_x(t)\right)^2$$

- Spring constant fluctuations

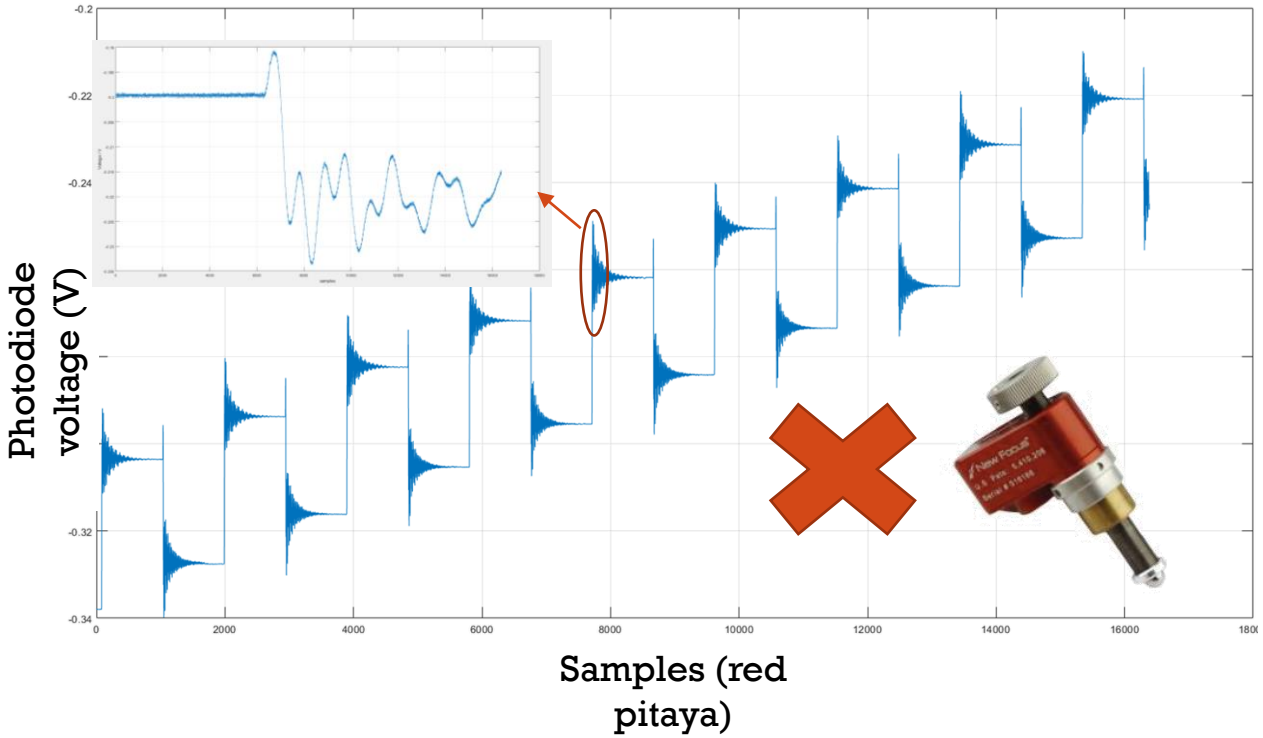
$$\Gamma_x = \frac{1}{t_x(s)} = \pi^2 \nu_x^2 S_k(2\,\nu_x)$$

- Trap center position fluctuations

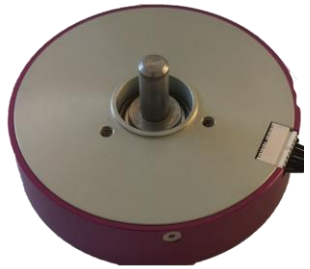
$$\frac{1}{t'_x(s)} = \frac{\pi^2 \nu_x^2 S_x(\nu_x)}{\langle x^2 \rangle}$$



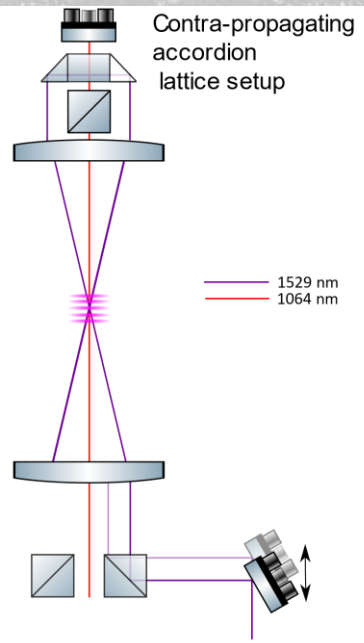
Laser intensity fluctuation are not an issue.

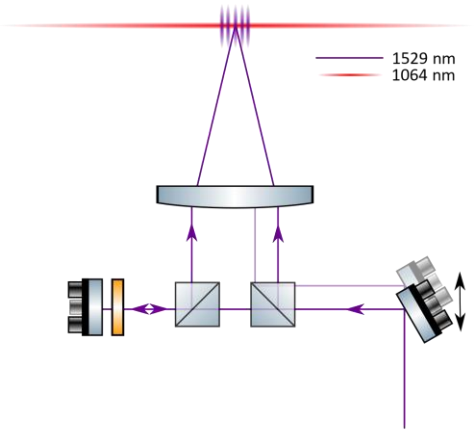


Previous motor (piezo driver from Newport) not good enough, and was generating heating, testing now with a supersonic piezo motor from Tekceleo.

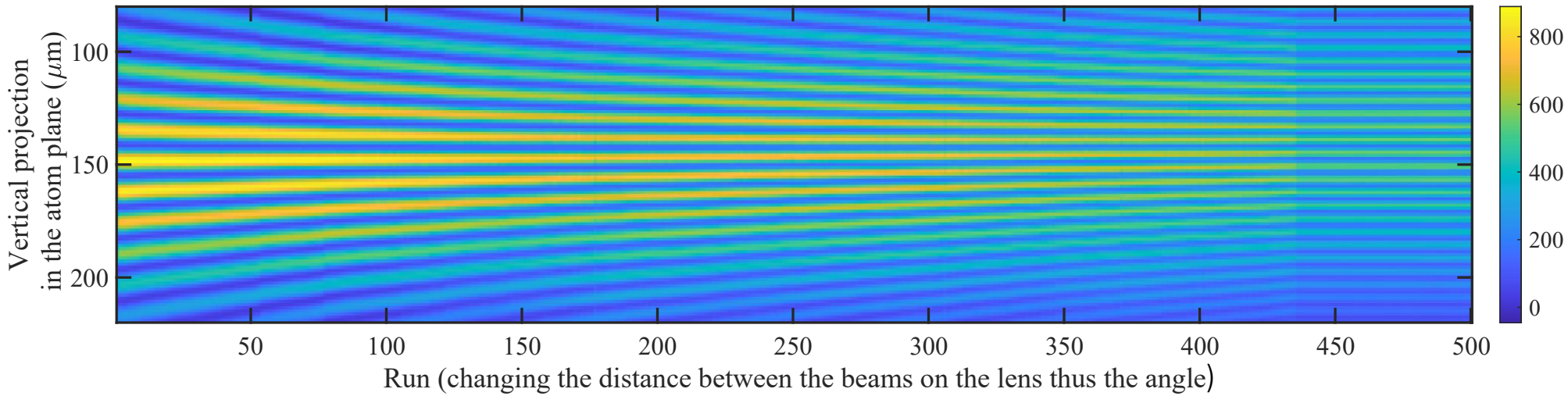


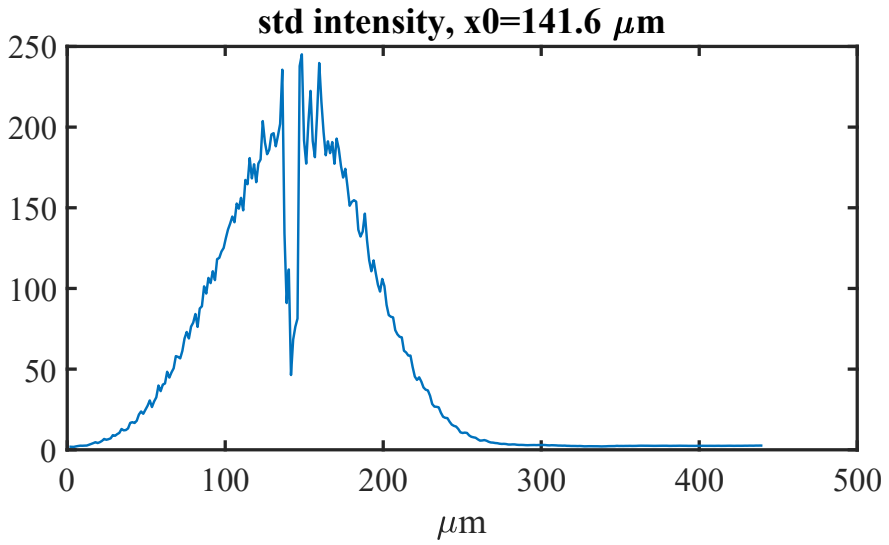
Dynamic accordion lattice

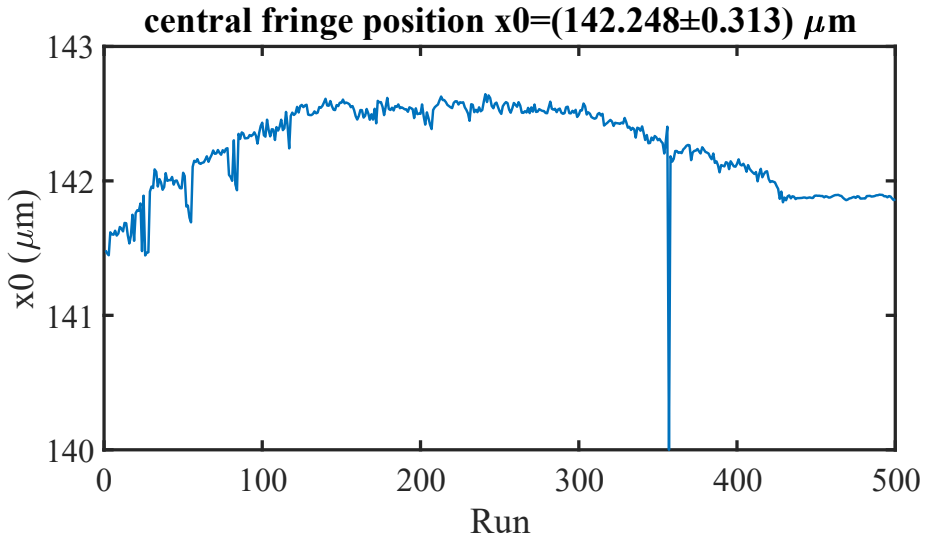




Co-propagating accordion lattice setup







With our setup, we can tune the distance between the beams from $12\ to\ 38\ mm$