

MAGIS-100: 100 m Atomic Interferometry at Fermilab

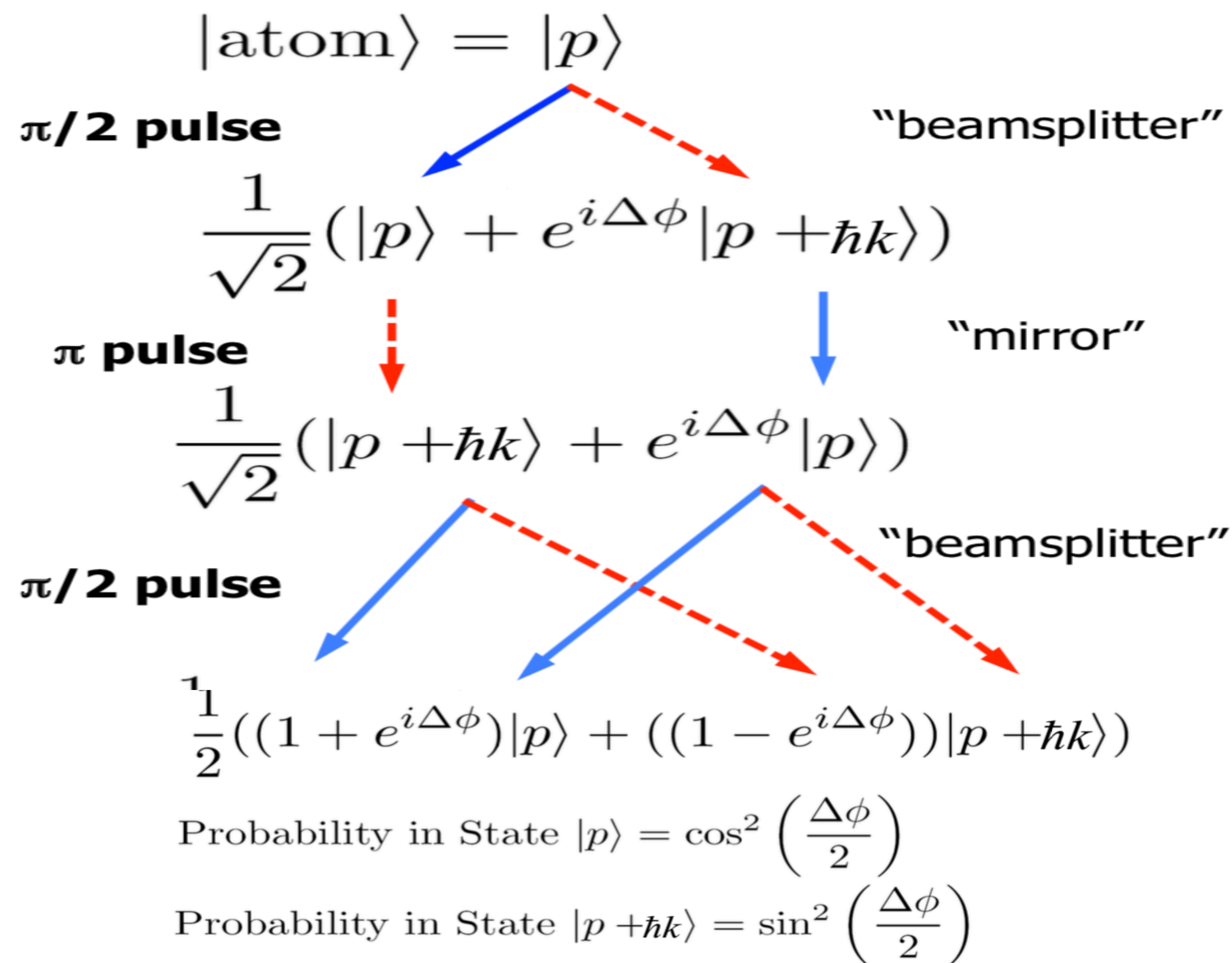
Rob Plunkett, Fermilab – for the MAGIS-100 Collaboration

Chicago Quantum Exchange 10/27/2019

FERMILAB-POSTER-19-131-QIS

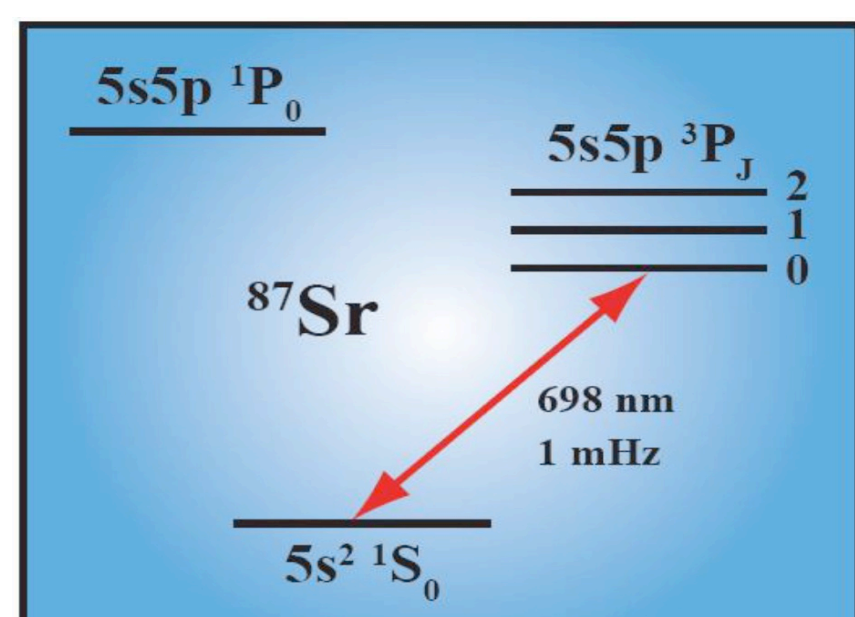
Atom Interferometry

- Laser pulses act as beam splitters and mirrors for atomic wavefunction
- Highly sensitive to accelerations (or to time-



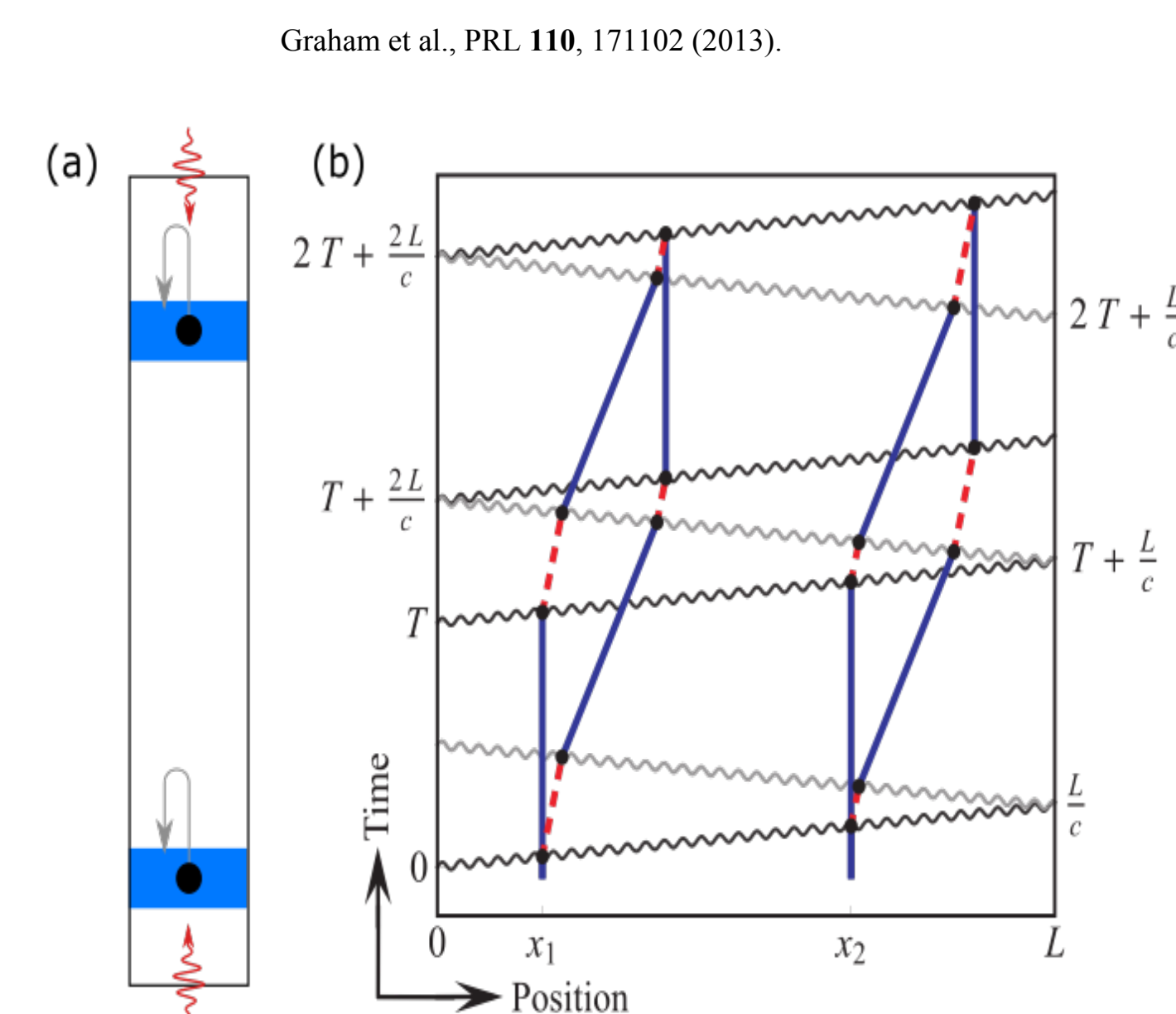
Extreme Quantum Science

Ultra-precise Strontium Clock Transition



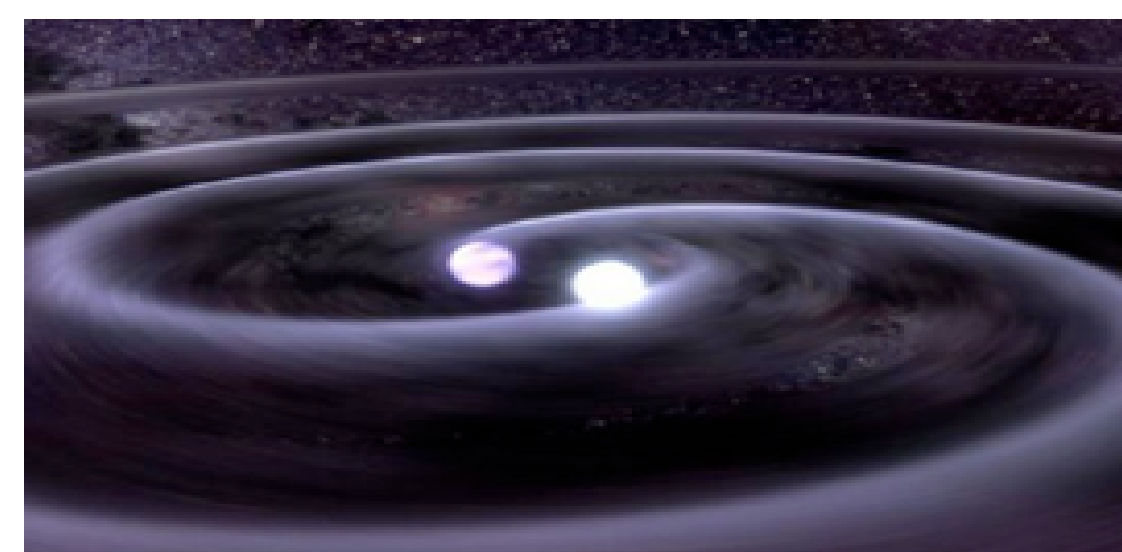
Order of magnitude improvement over current records

- Quantum Science:** Demonstrate/test quantum superposition over distances of several meters and times of several seconds.

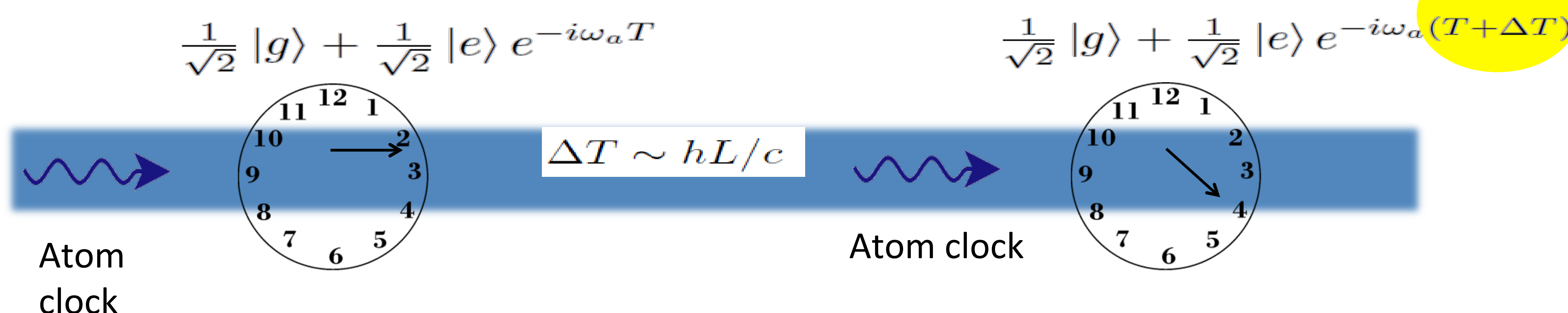


Gradiometer with 2 interferometers

Prototype Gravitational Wave Detector



GW changes light travel time



Ultra-light Dark Matter

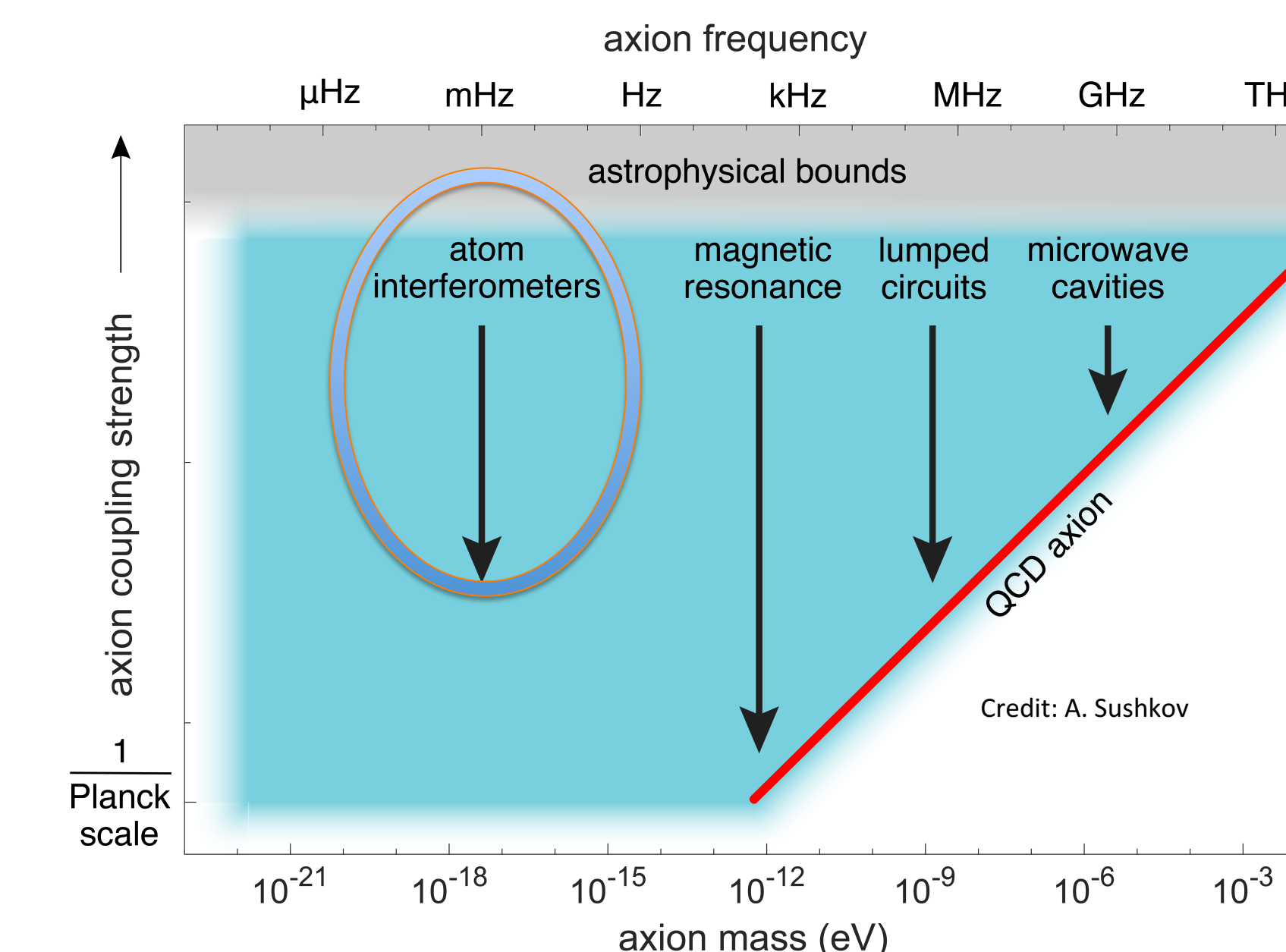
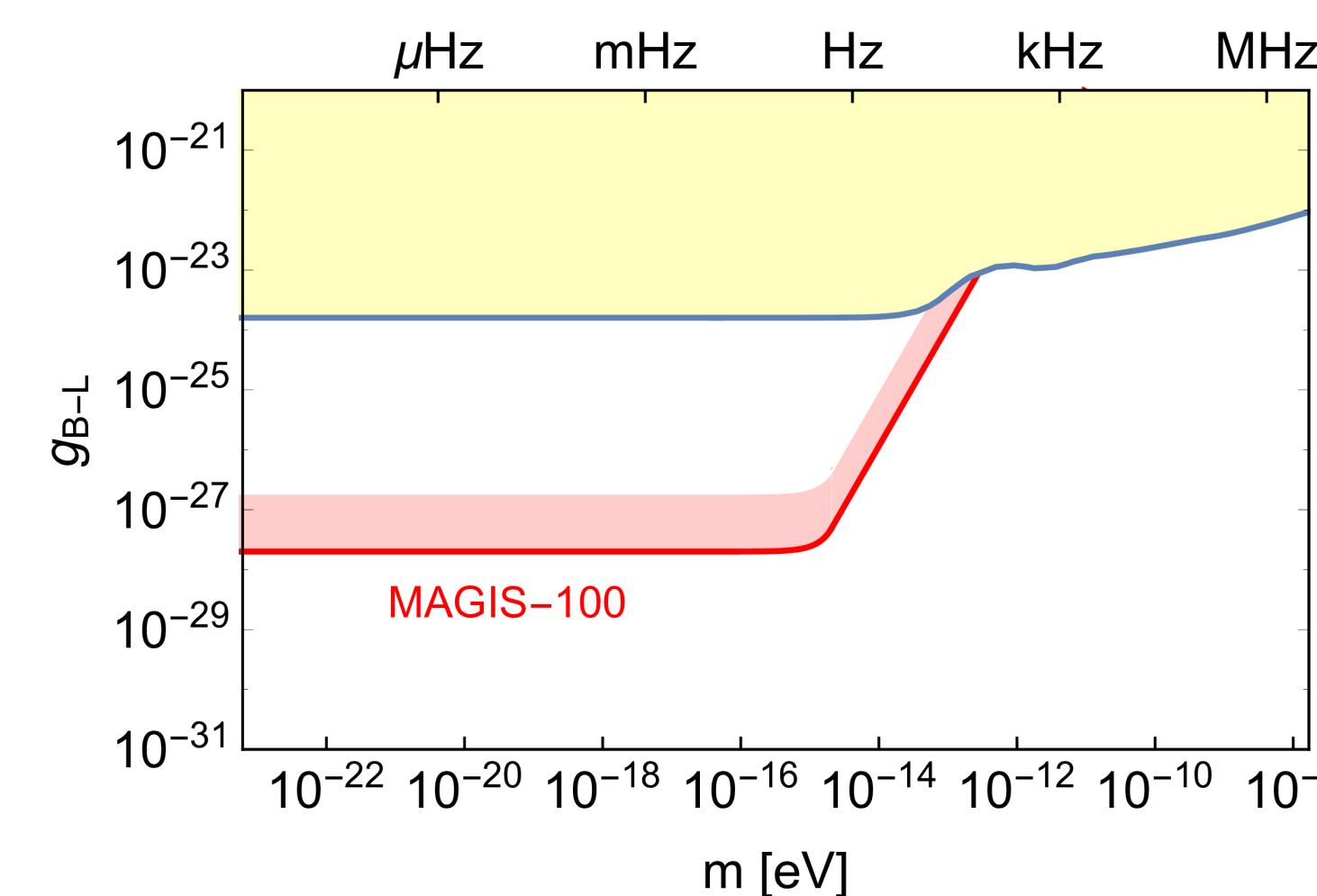
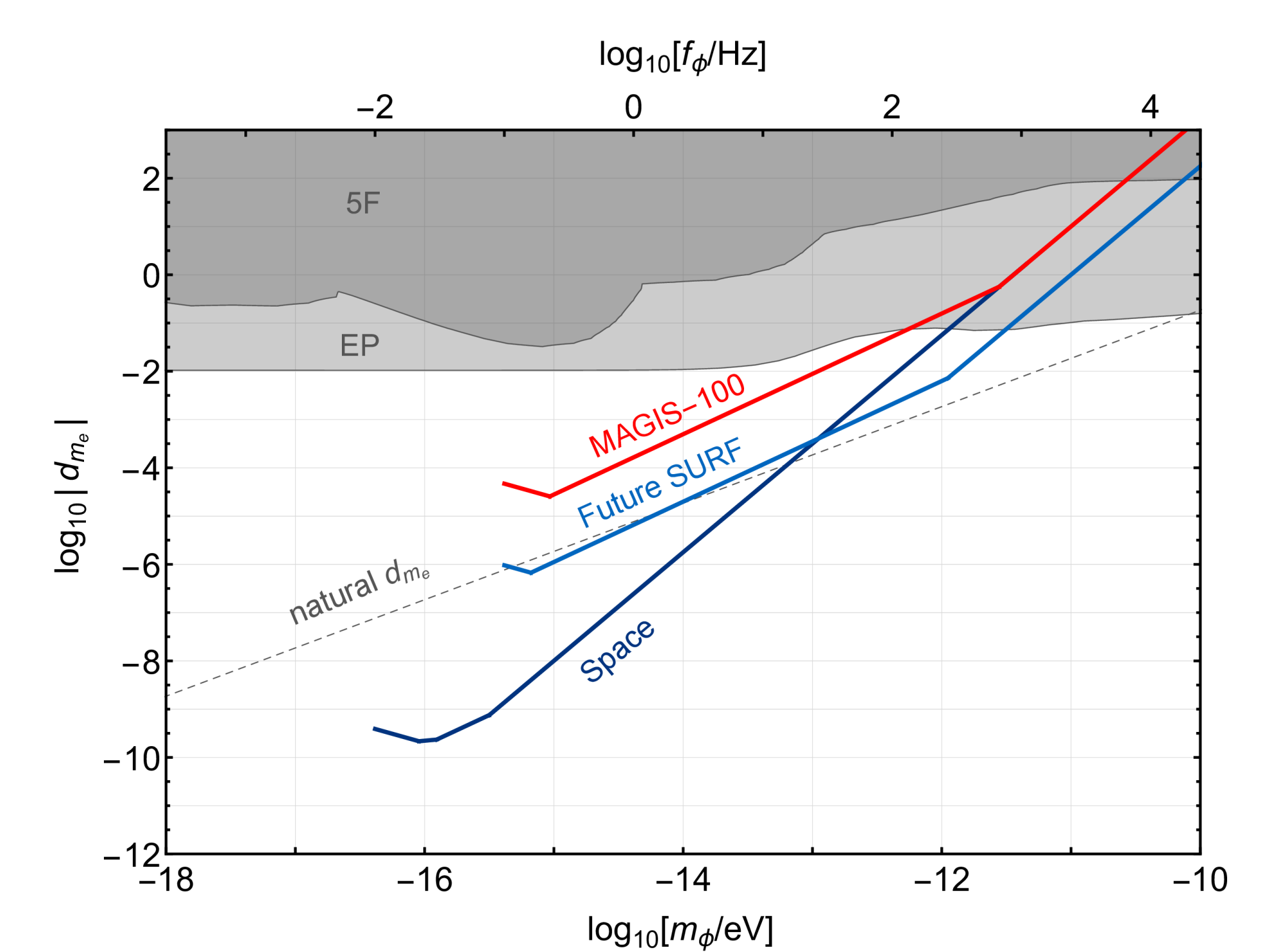
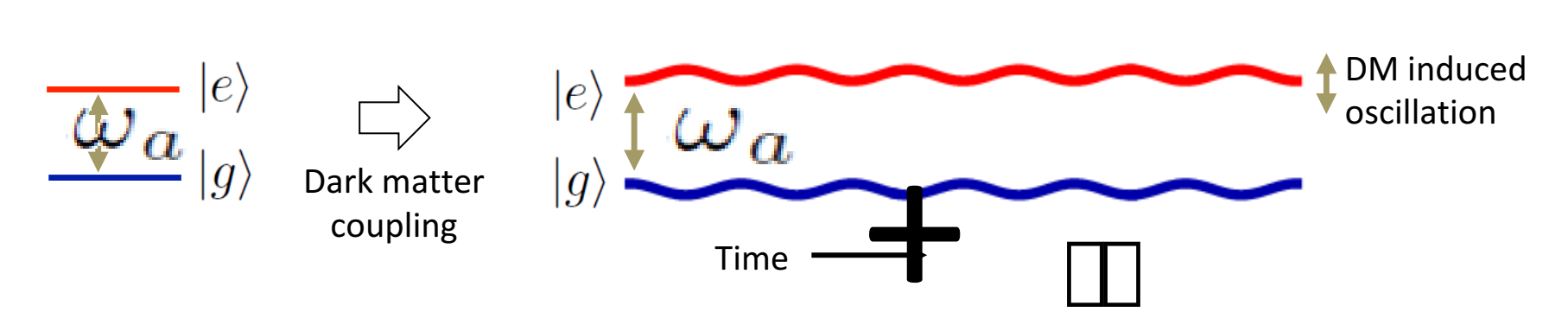


Figure from DOE Dark Matter Research Needs Report, 2018

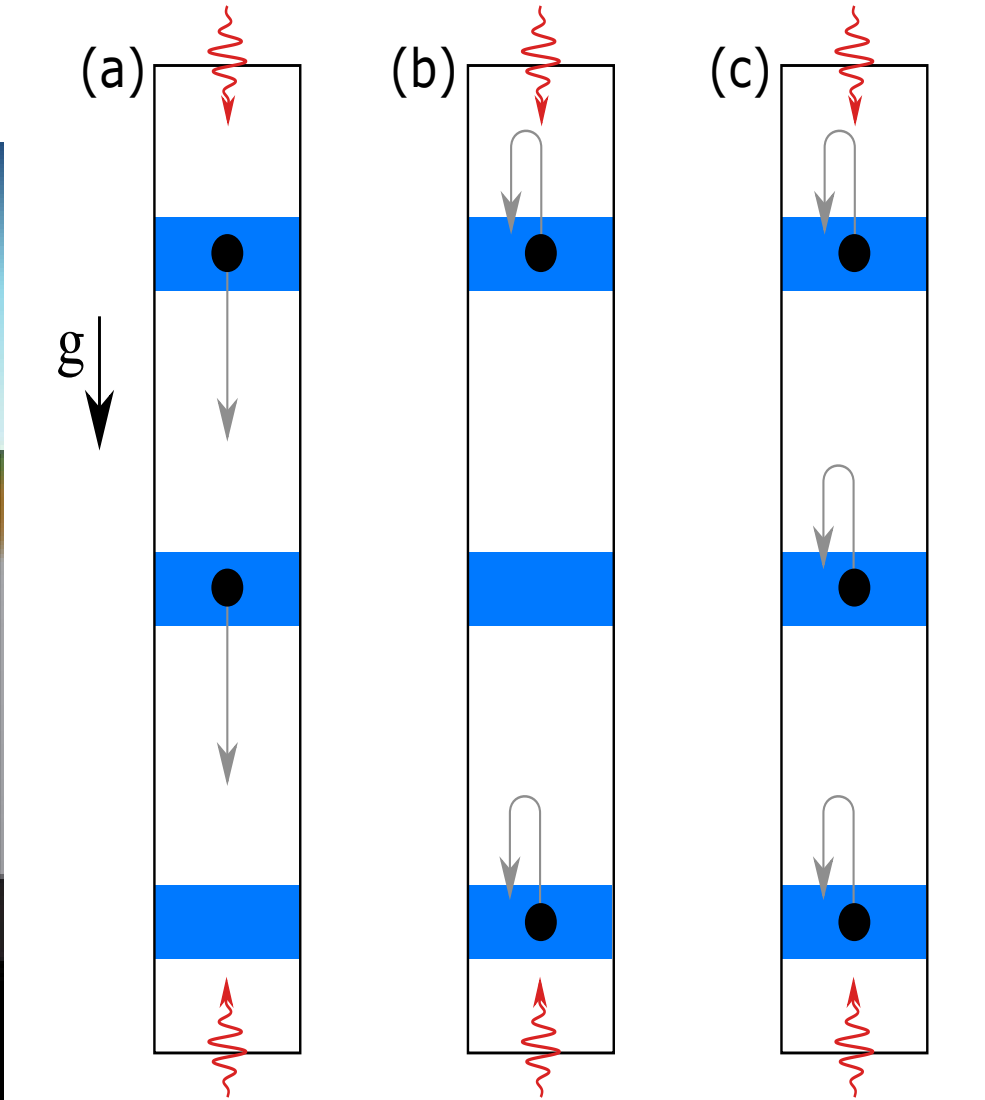
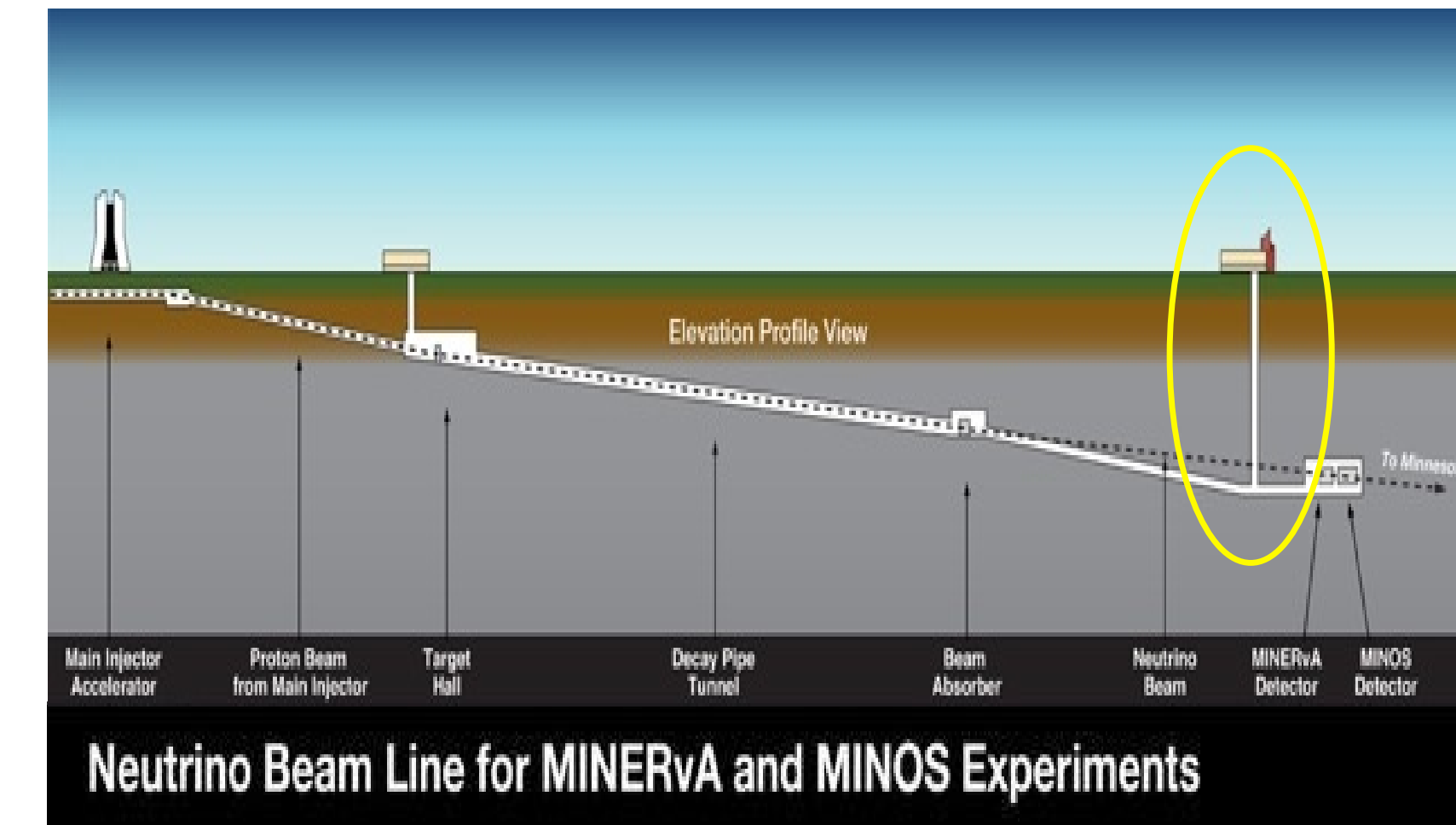


Expected MAGIS-100 B-L dark matter sensitivity

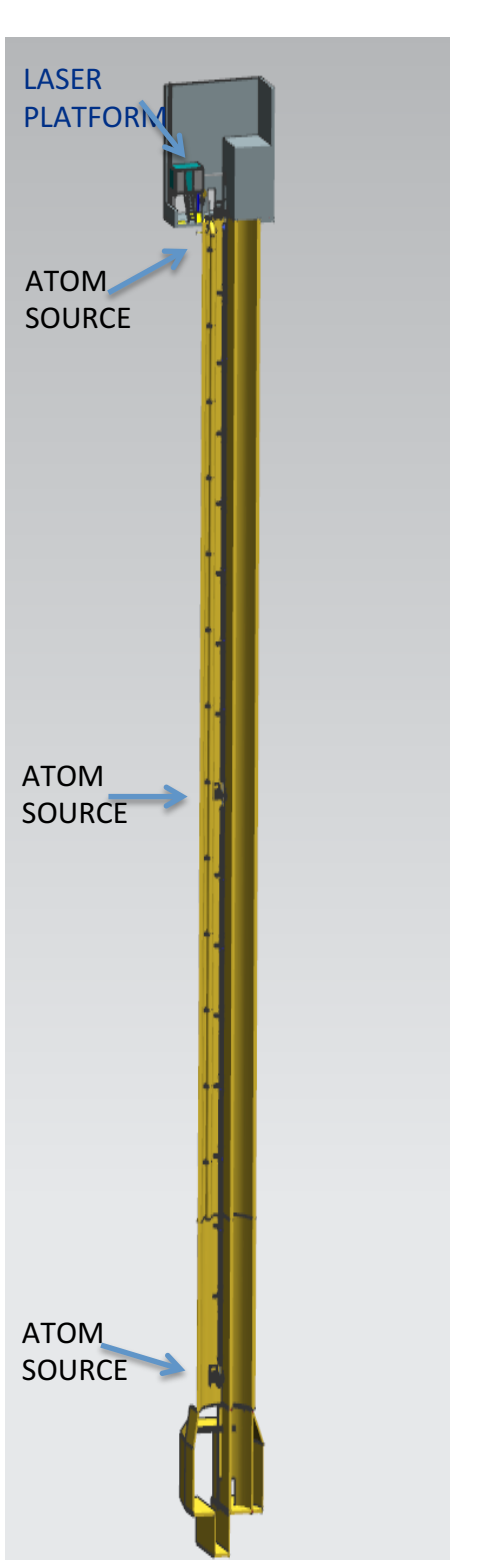
DM coupling causes time-varying atomic energy levels:



MAGIS-100: Bringing Large Scale Interferometry to Fermilab



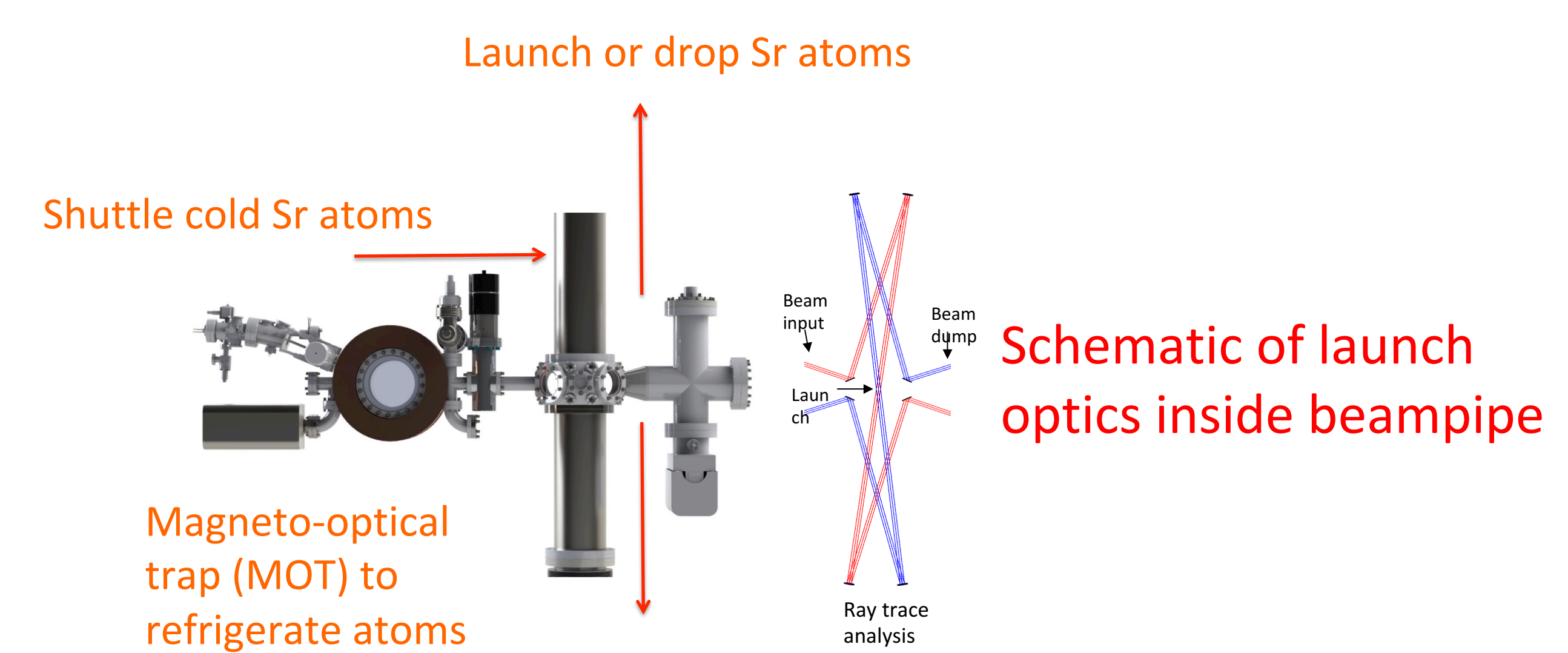
Operating Modes



Detector Layout

Use existing 100 m shaft from NuMI/MINOS program
Equipped surface building because underground experiments still active.
Serves both to study fundamental physics and as prototype for longer baseline (km scale) in future.
Installation goal late 2021.

Details of Atom Source (one of 3)



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