

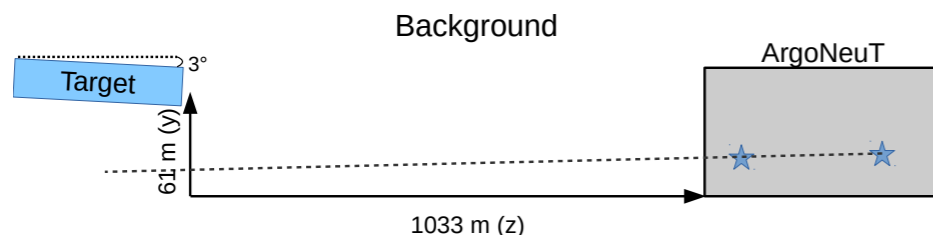
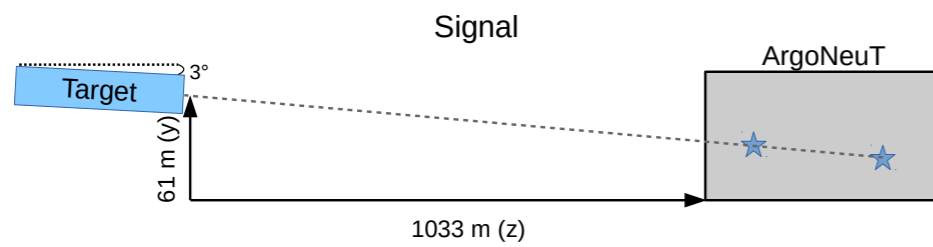
# **BSM**

**roni**

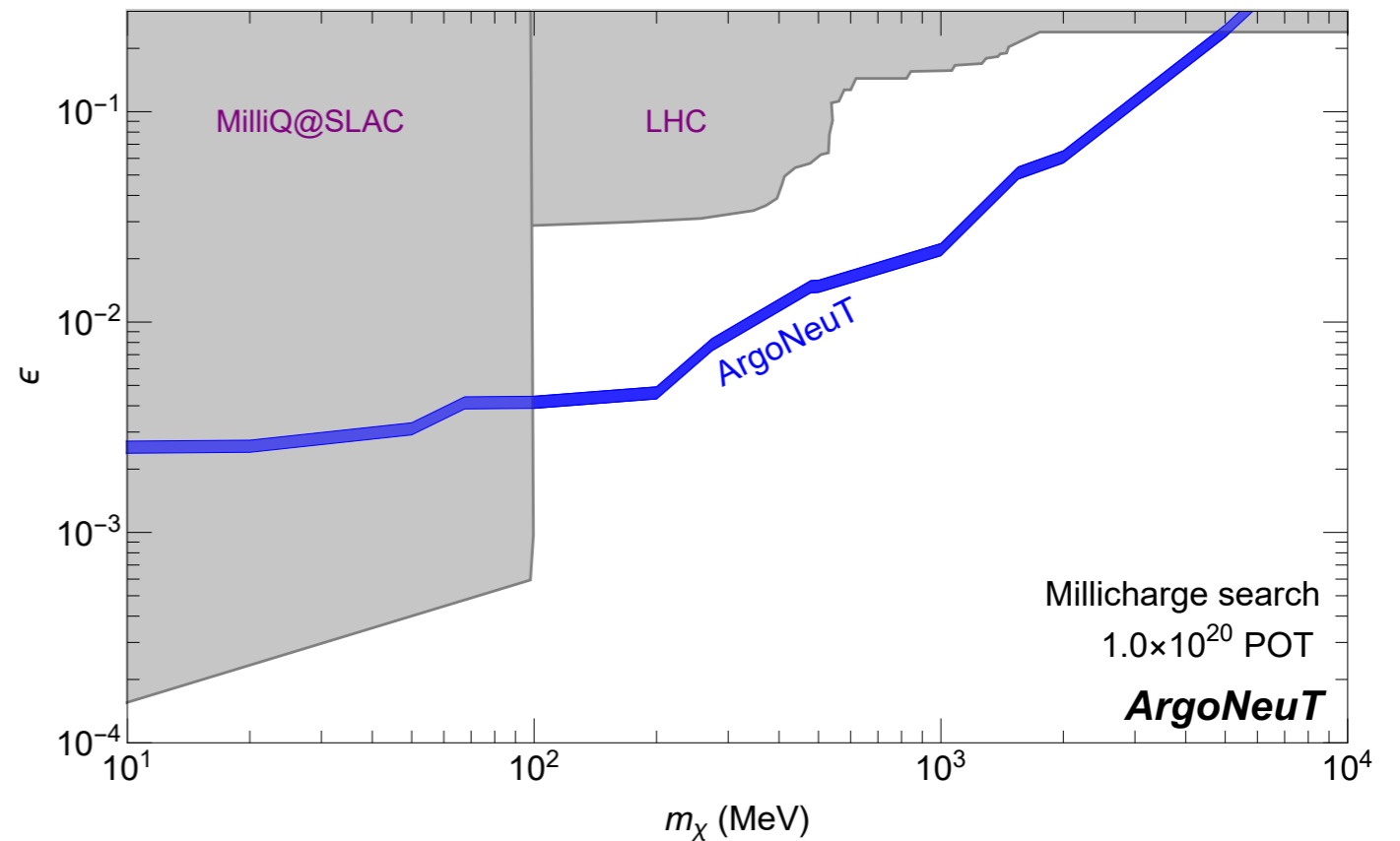
**Theory-treat, Nov 2019**

# Improved Limits on Millicharged Particles Using the ArgoNeuT Experiment at Fermilab

R. Acciarri,<sup>1</sup> C. Adams,<sup>2</sup> J. Asaadi,<sup>3</sup> B. Baller,<sup>1</sup> T. Bolton,<sup>4</sup> C. Bromberg,<sup>5</sup> F. Cavanna,<sup>1</sup> D. Edmunds,<sup>5</sup>  
R.S. Fitzpatrick,<sup>6</sup> B. Fleming,<sup>7</sup> R. Harnik,<sup>1</sup> C. James,<sup>1</sup> I. Lepetic,<sup>8,\*</sup> B.R. Littlejohn,<sup>8</sup> Z. Liu,<sup>9</sup>  
X. Luo,<sup>10</sup> O. Palamara,<sup>1,†</sup> G. Scanavini,<sup>7</sup> M. Soderberg,<sup>11</sup> J. Spitz,<sup>6</sup> A.M. Szelc,<sup>12</sup> W. Wu,<sup>1</sup> and T. Yang<sup>1</sup>  
(The ArgoNeuT Collaboration)

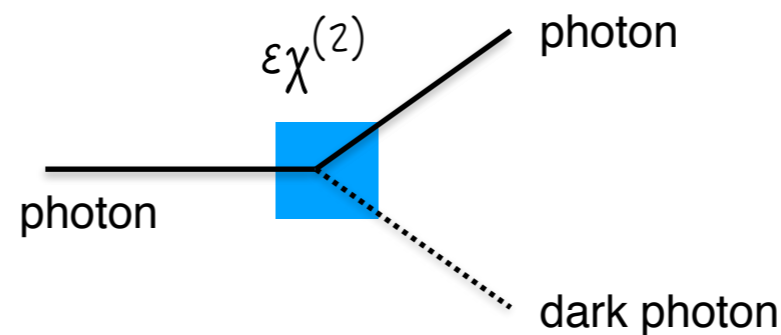


**coming this week.**

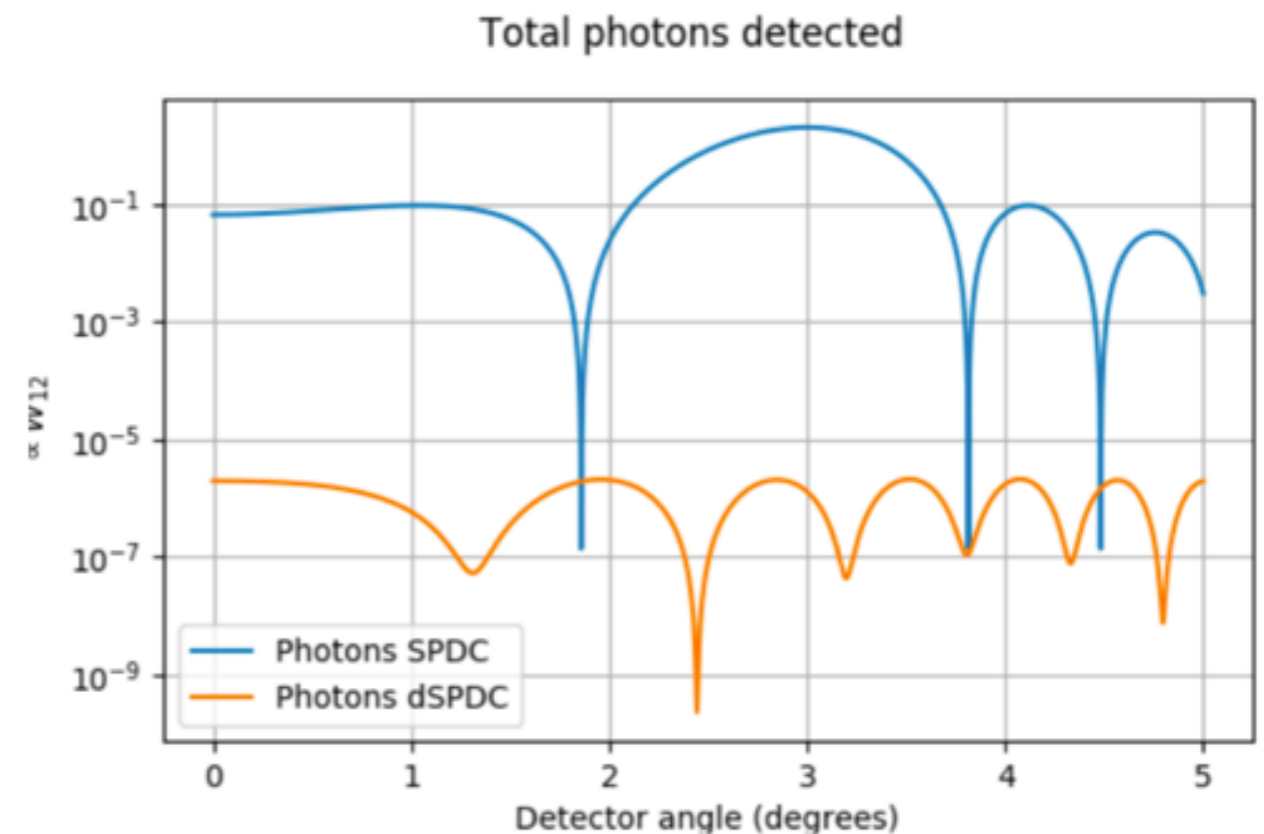


**Nonlinear optics:** there are crystals with effective 3-photon and 4-photon vertices.

→ associated photon+dark photon production.



Mono-photon on the optics table!  
with Estrada's group.

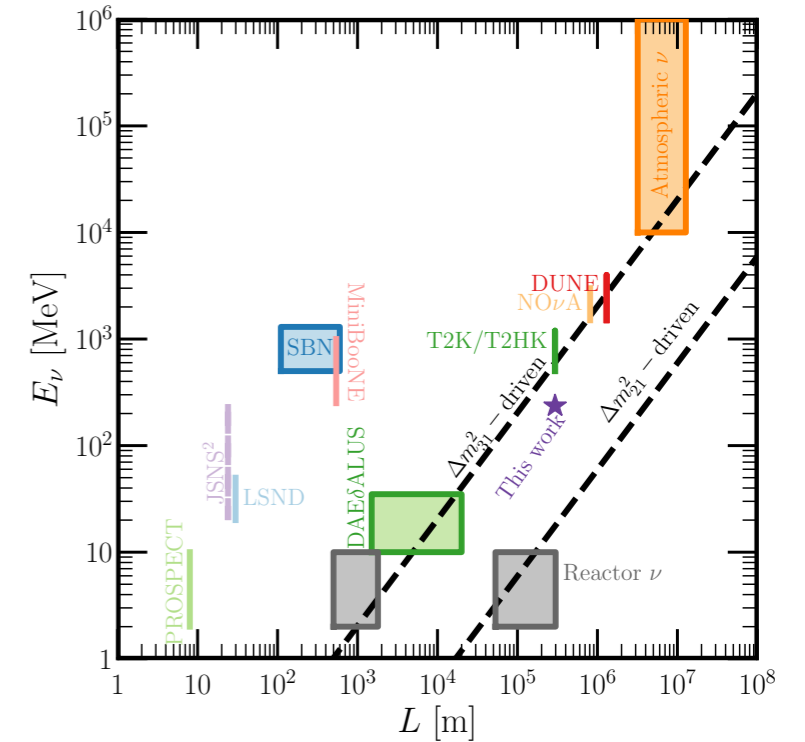


$\nu'$  s:

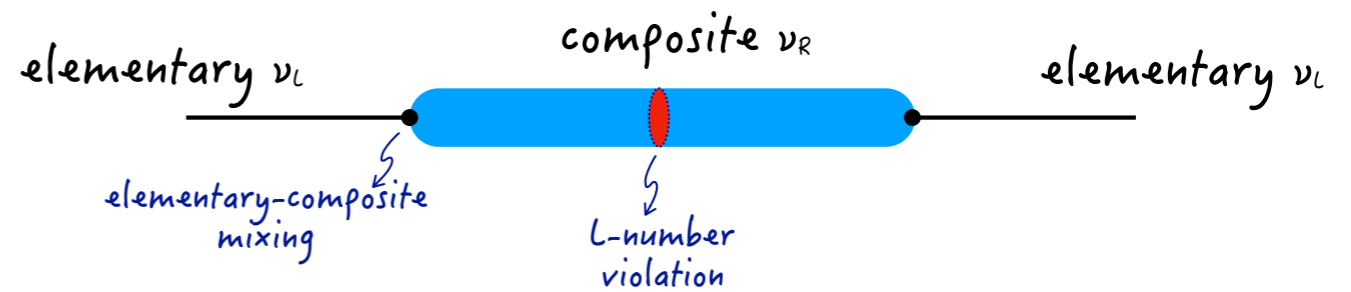
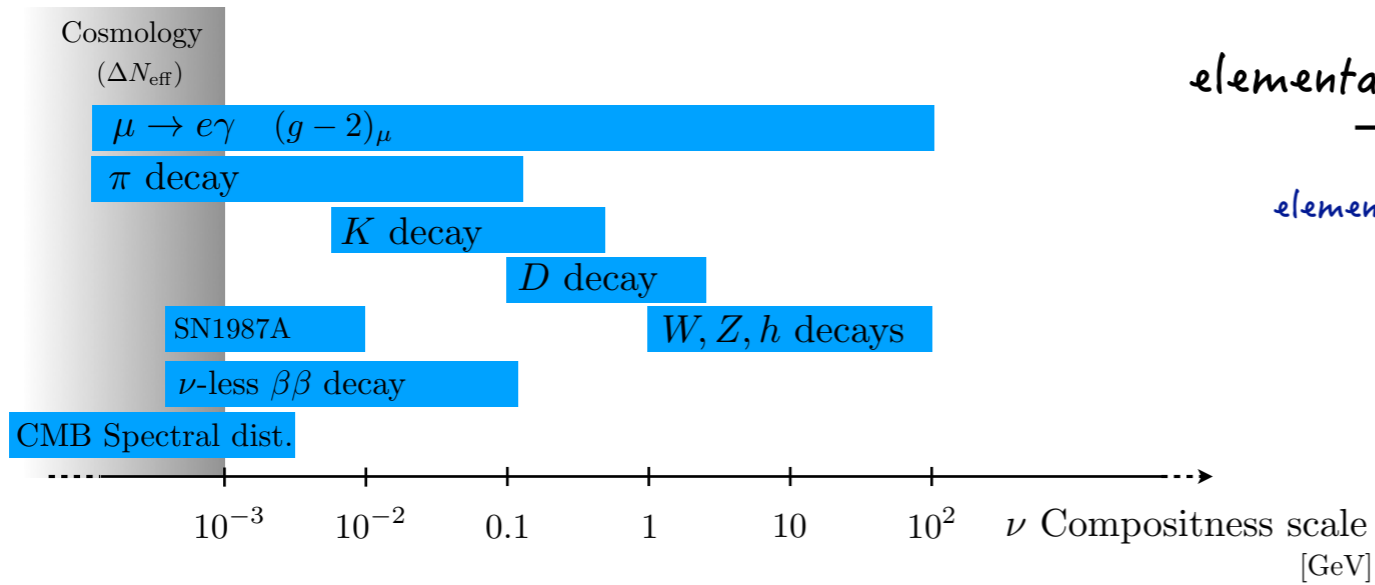
came out last week:

Prospects of Measuring Oscillated Decay-at-Rest Neutrinos at Long Baselines

Roni Harnik, Kevin J. Kelly, and Pedro A.N. Machado  
*Theoretical Physics Department, Fermilab, P.O. Box 500, Batavia, IL 60510, USA*  
 (Dated: November 14, 2019)



In preparation:



**with paddy, chacko, zhen.  
 we are currently confused.  
 in a good way.**

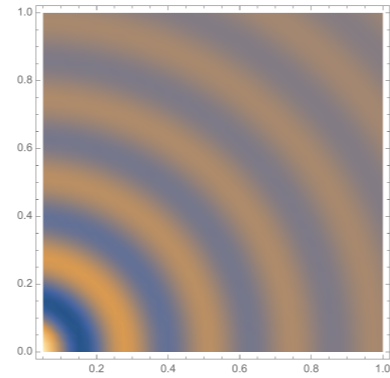
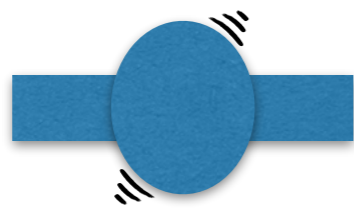
Figure 2: A sketch of the various probes of neutrino compositeness arranged by the range of compositeness scales they are potentially sensitive to.



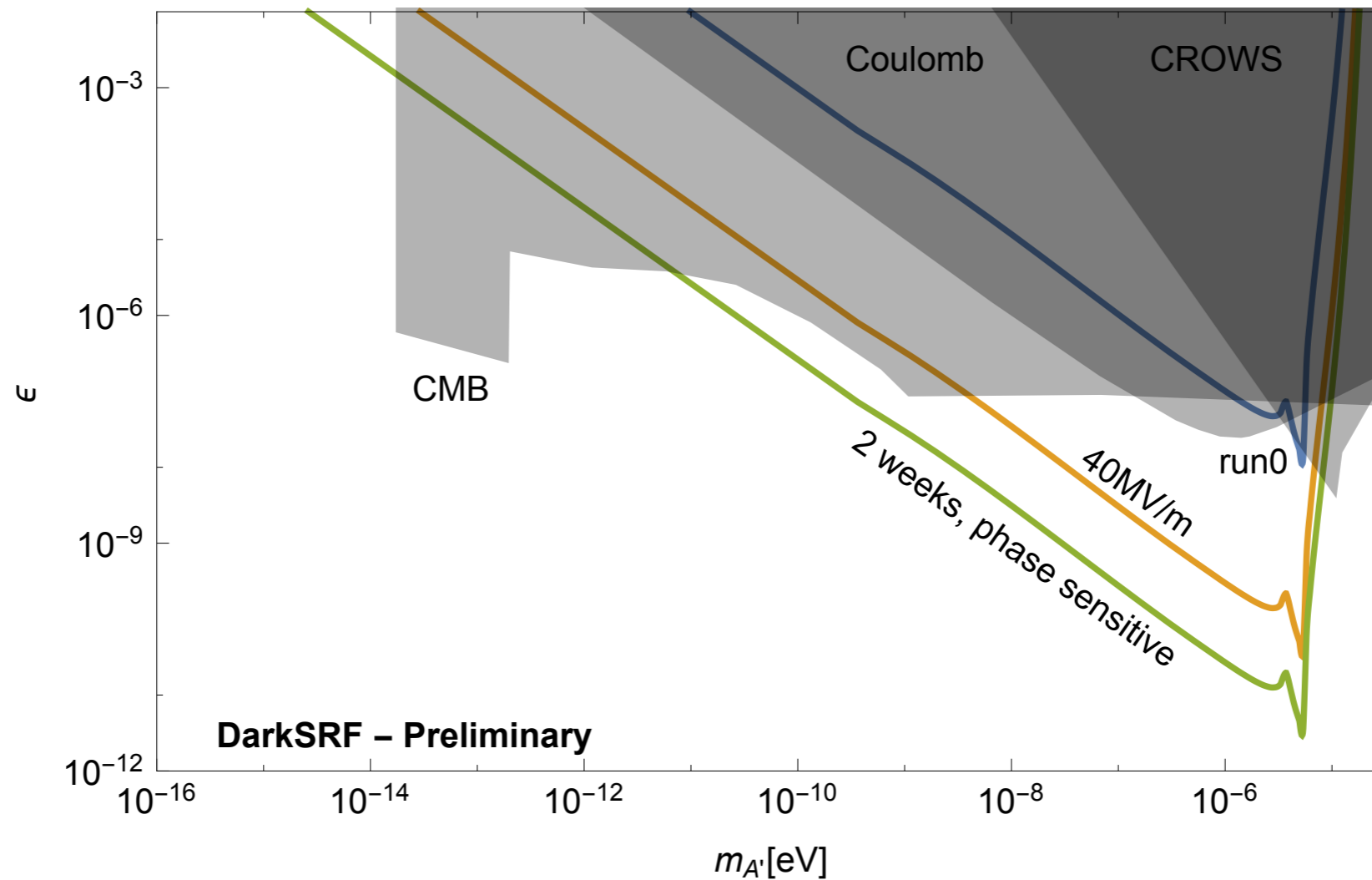
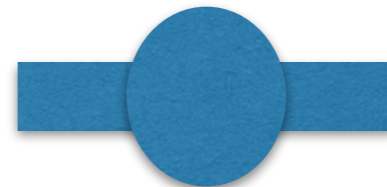
# Dark SRF

ongoing work w/ APSTD. Also involved: Josh and Zhen.

Emitter Cavity

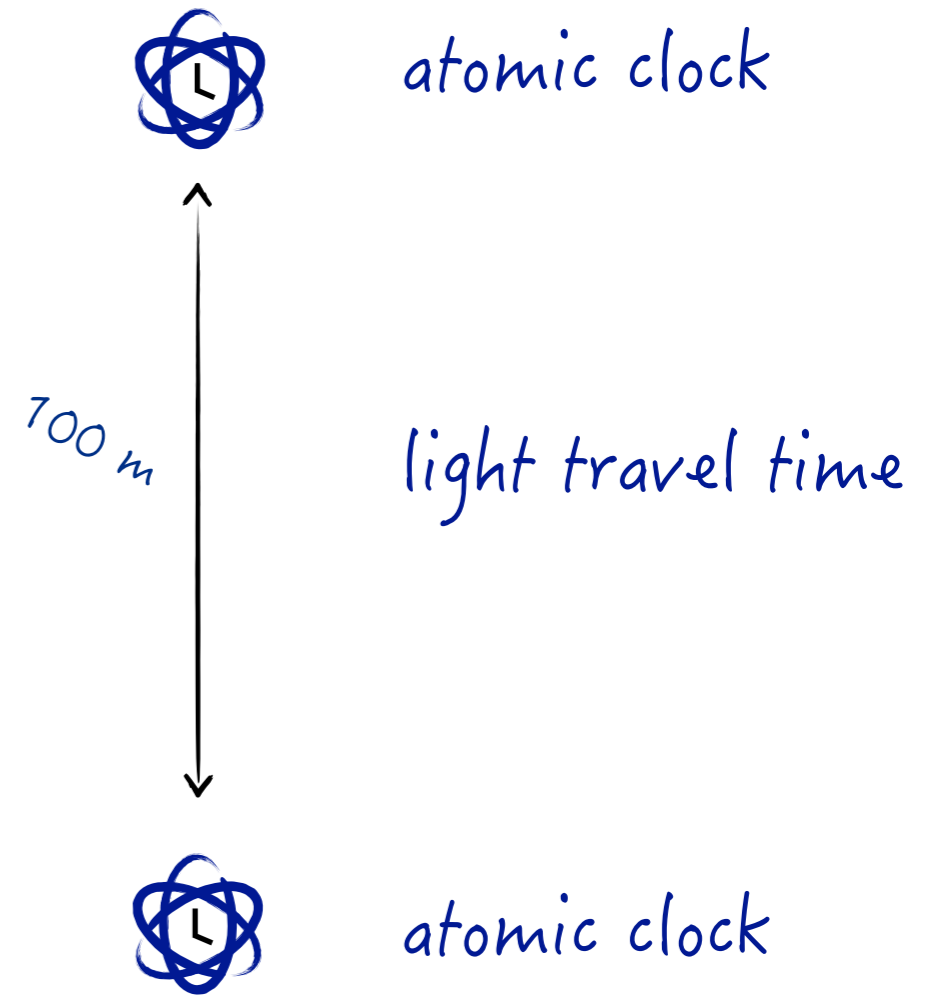
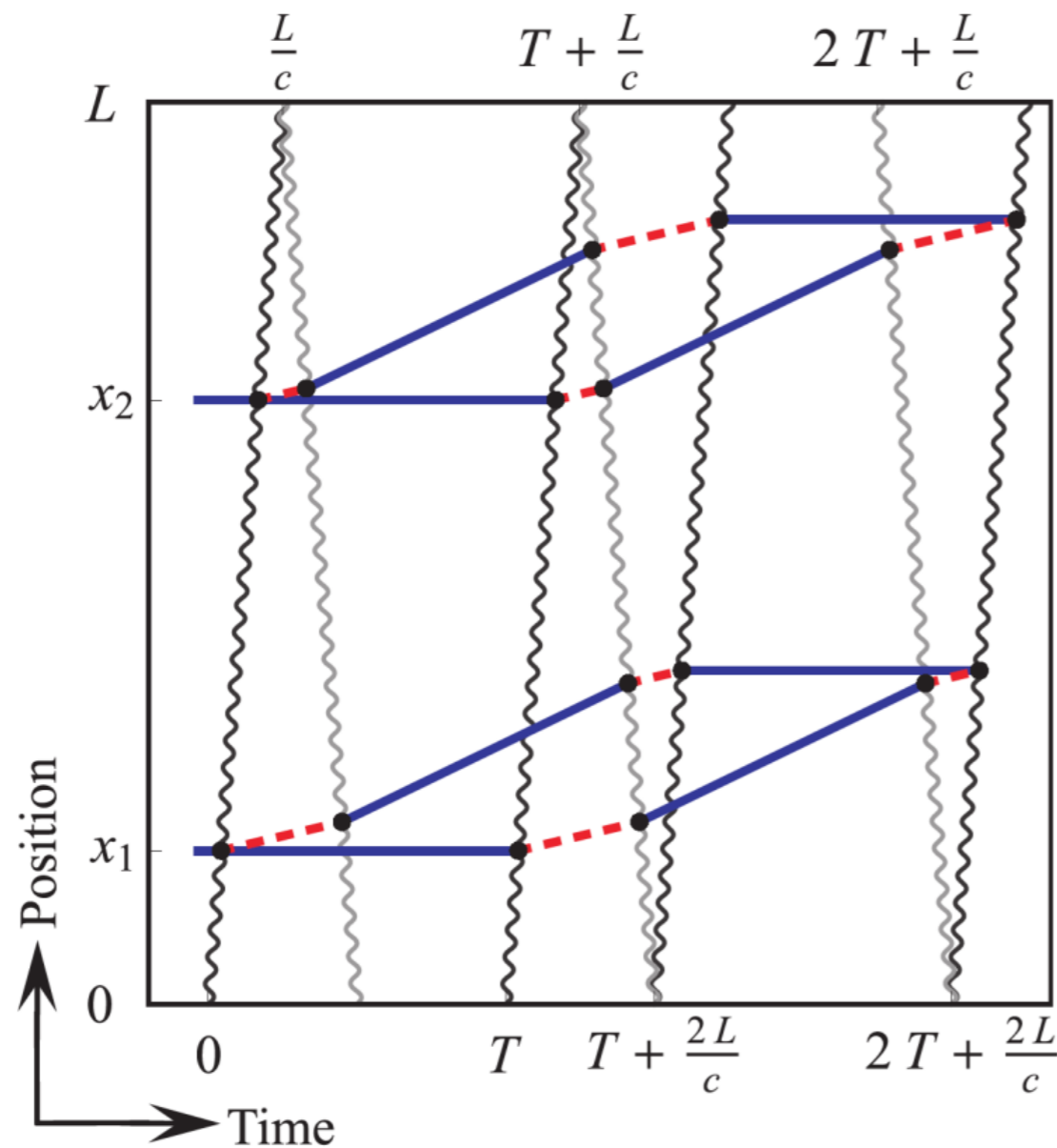


Receiver Cavity

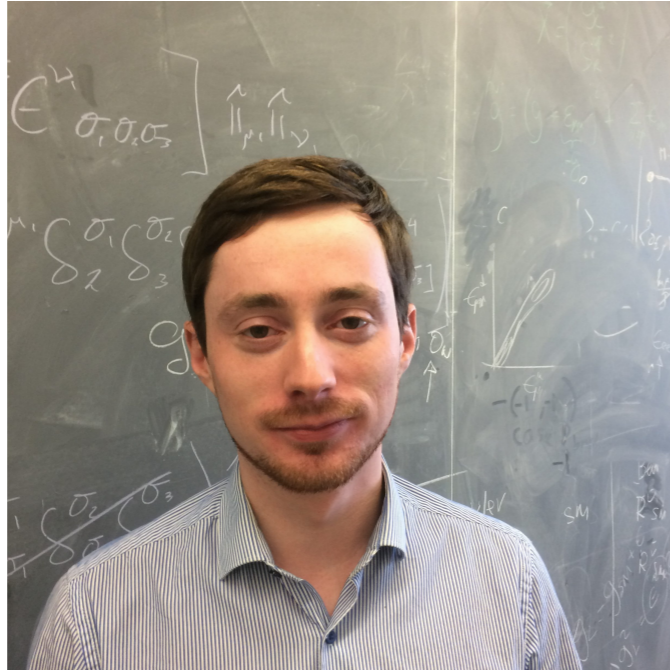


# MAGIS 100

A 3 clock comparison (2 atomic, 1 light travel time):



# QIS theory postdocs:



**Ciaran Hughes**  
2016-2019 Lattice  
2019-2021 quantum



**Hank Lamm**  
2019-2022

**We may have funds for more QIS?  
Simulation? Sensors?**

# **QIS FQI people:**

**Just moved to our floor:**



**Alex Macridin (staff)**



**Andy Li  
(postdoc, 2018-2021?)**

# **QIS visitors → staff?:**



**Martin Savage**

**Coming mid-february for ~ 1 year.  
Potentially staying for good.**

Area	Task	Institution(s)
Simulation	Lattice scalar field theory: (state preparation, time-evolution, scattering, topology, phase transitions, entanglement, digitization)	Caltech, Fermilab, UIUC, UW-INT
Simulation	Lattice gauge theory and QCD: (qubit mapping and plaquettes, time evolution, circuits, inelastic processes and fragmentation, entanglement, S-matrix, topology, scattering)	Caltech, Fermilab, Purdue, UIUC, UW-INT
Analysis	Algorithms for event ensembles Hybrid algorithms for preprocessing QIS-inspired classical algorithms	MIT
Sensors	Cavity sensor developement Dark SRF theory support MAGIS-100 long range interactions Dark photon searches w/ nonlin. optics searches DM search w/ photon pairs in nonlin. optics Quantum limited impulse detectors for DM Quantum sensors for dark radiation Spin precession experiments and neutrinos	Fermilab

Table 1.1: Research topics and collaborating institutions. Further details are given in the budget justification.