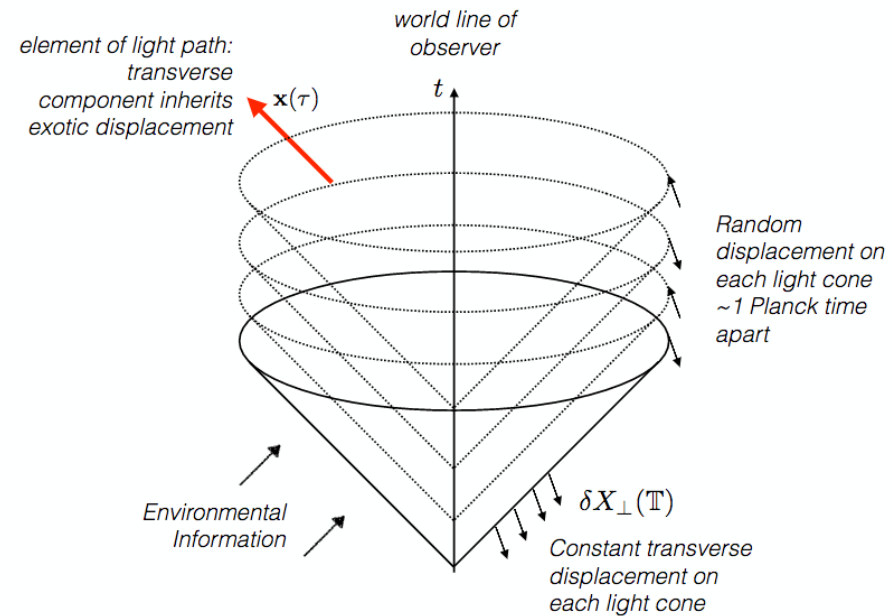
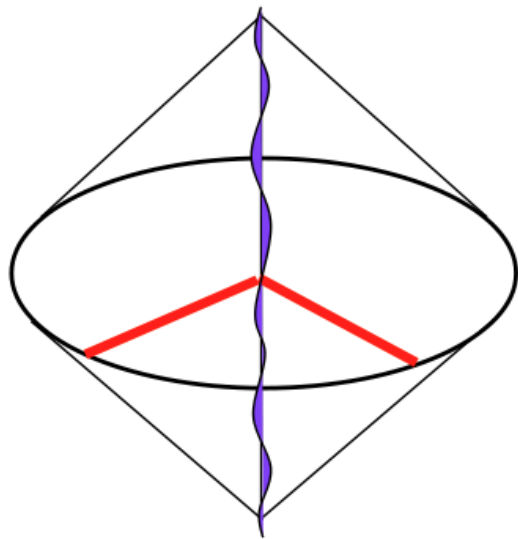


Search for Space-Time Correlations from the Planck Scale with the Fermilab Holometer

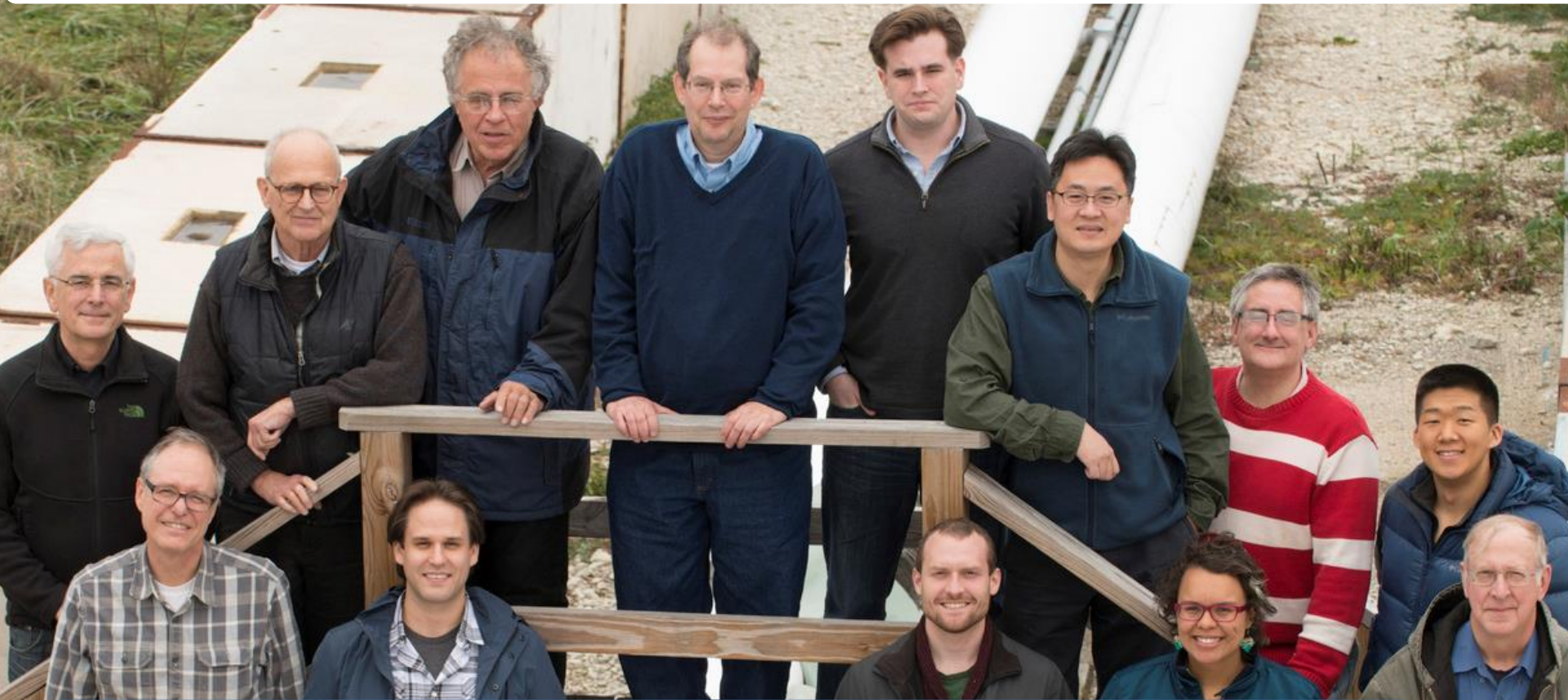


Chris Stoughton (Fermilab)
for the Holometer Collaboration
ICHEP Chicago August 4, 2016

Outline: The Title Backwards

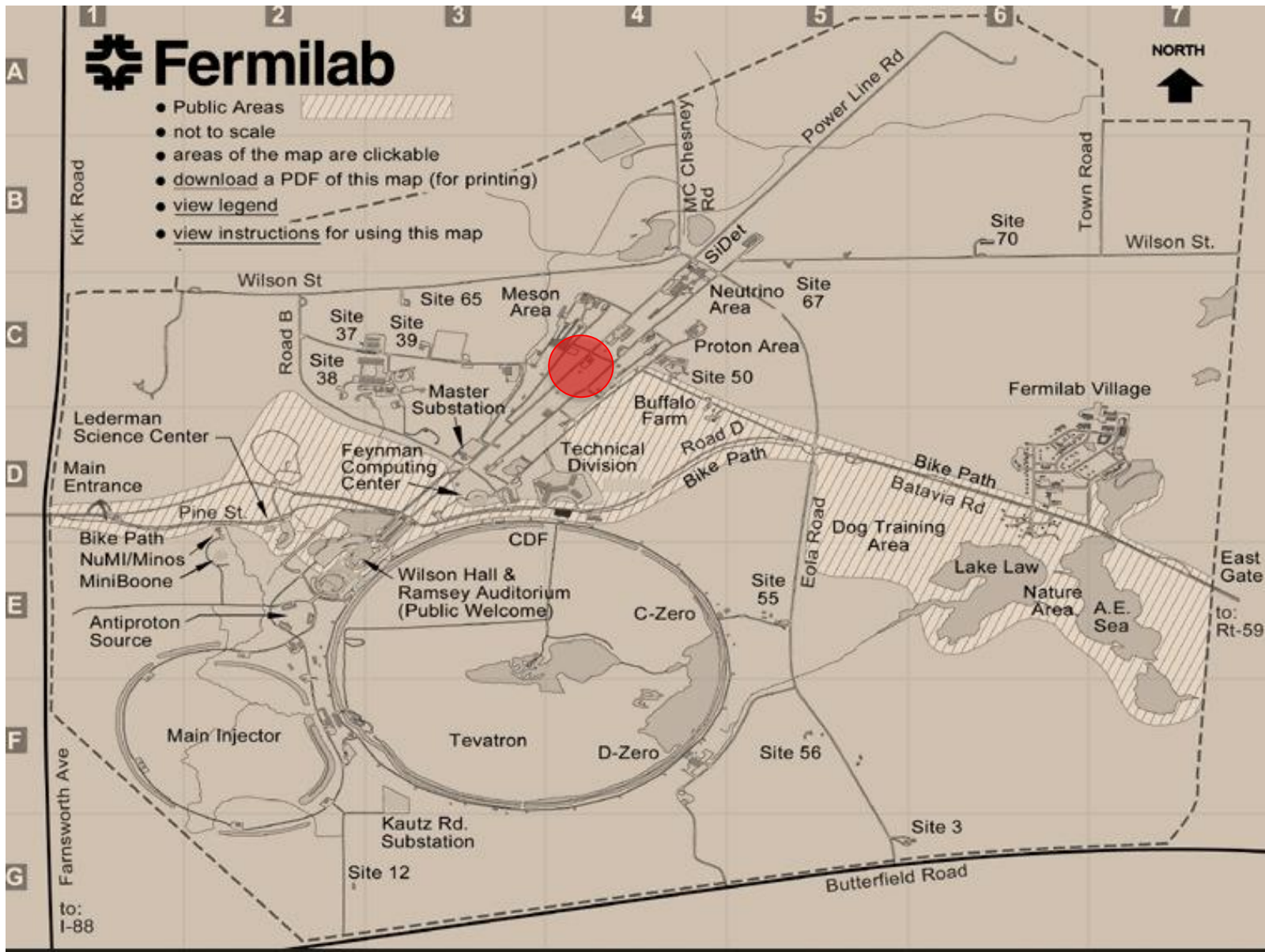
- The Fermilab Holometer
- The Planck Scale
- Space-time correlations
- The Search

The Fermilab Holometer



- A eight-year \$2.5M project
- Exceeded design specifications on time and budget
- Position measurement to a fraction of the Compton wavelength of the Higgs Boson
- Current reconfiguration: shear \rightarrow rotation

The Fermilab Holometer (E990)



The Fermilab Holometer (E990)

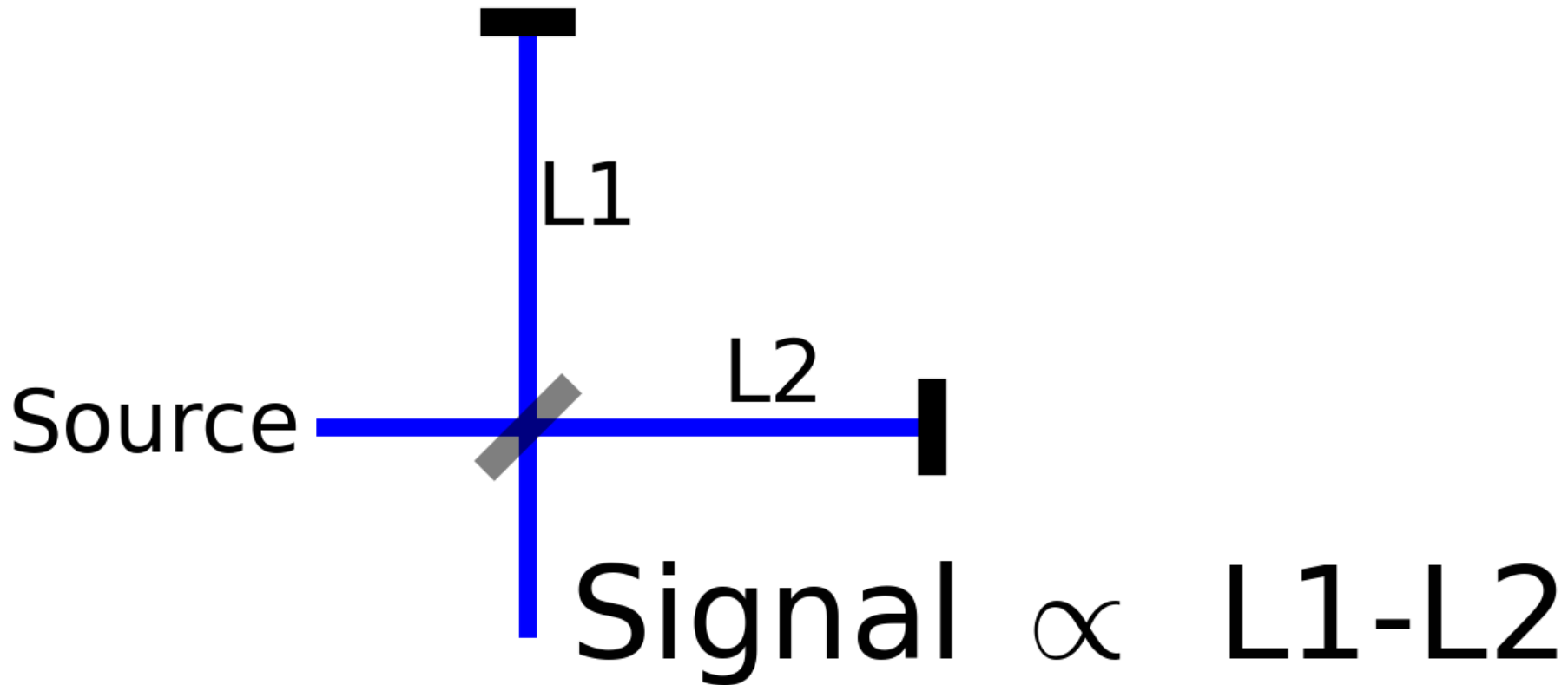


The Fermilab Holometer (E990)

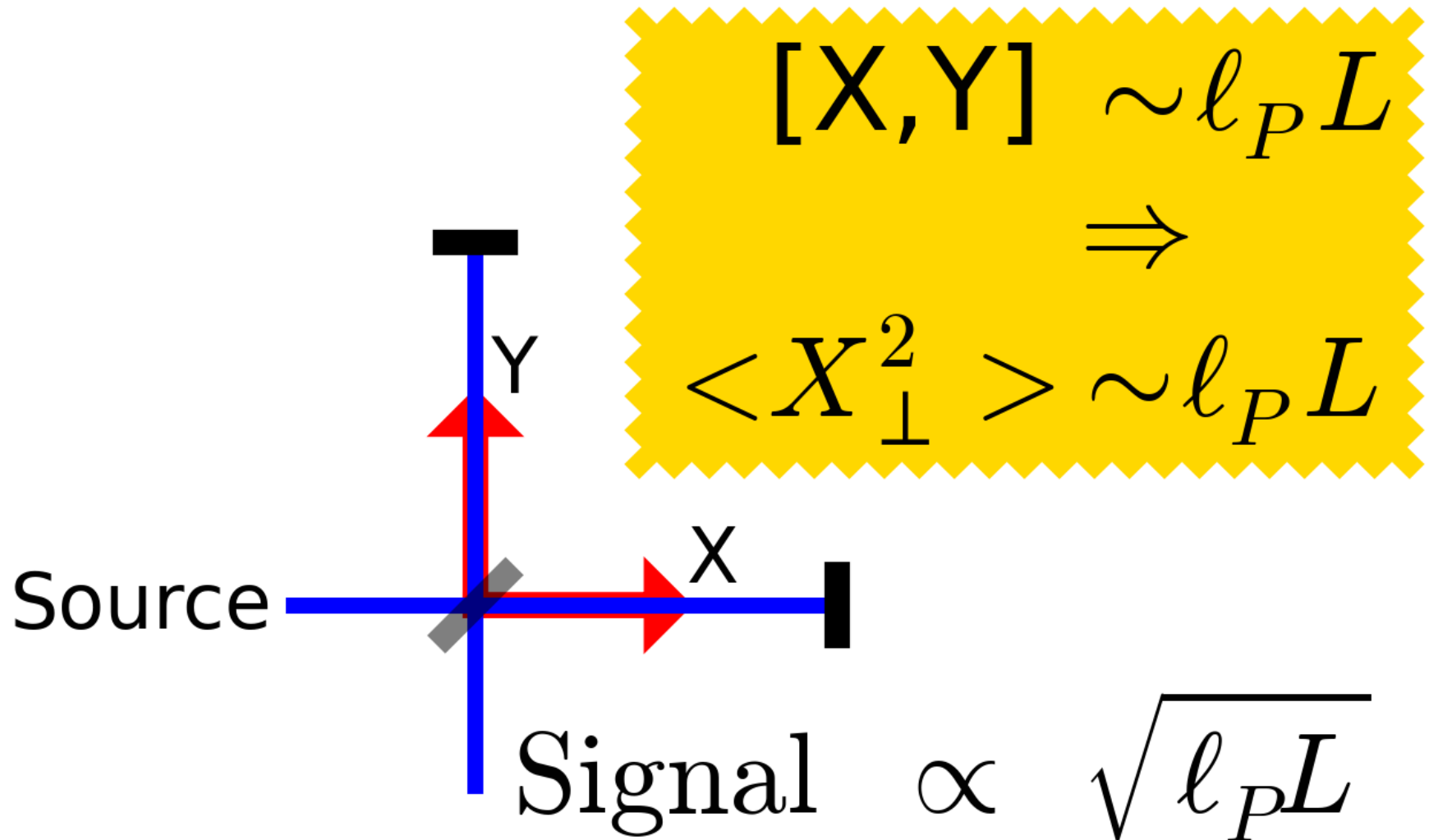


During Construction (2012)

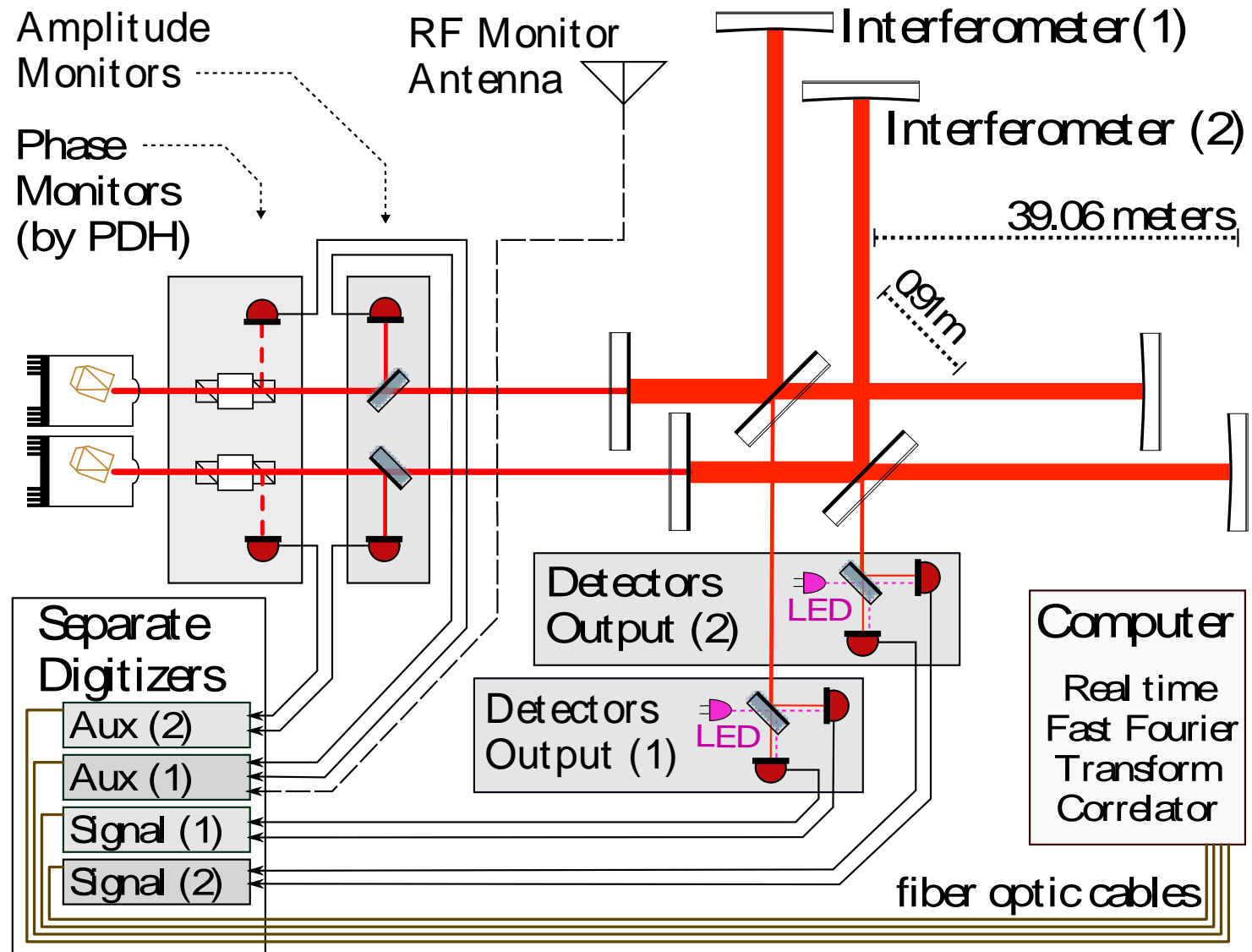
The Fermilab Holometer: One Interferometer



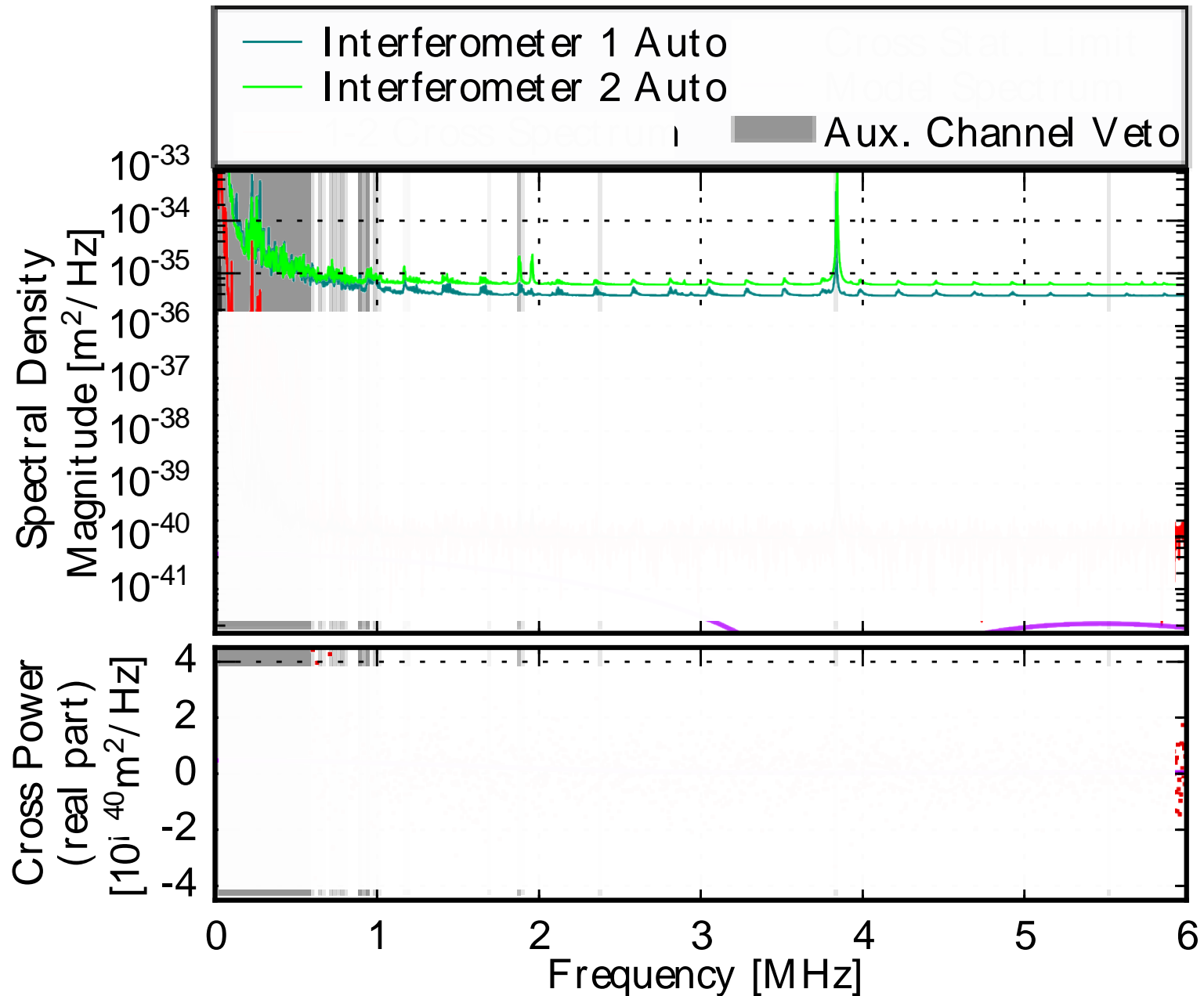
The Planck Scale (and quantum geometry)



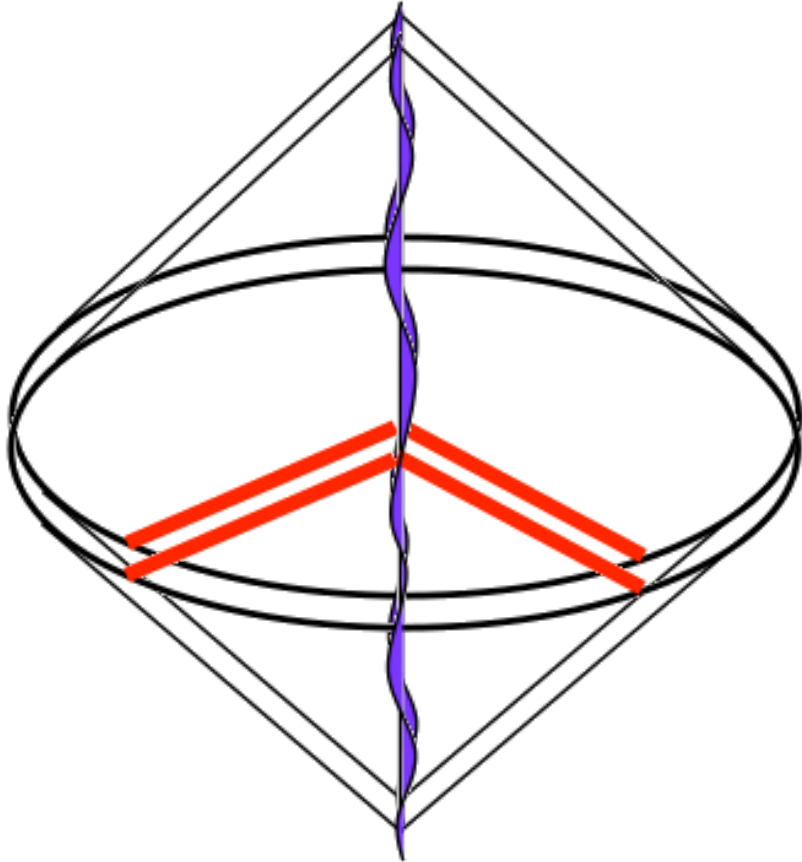
Holometer – Signal Chain



Planck Scale: difficult with 1 IFO

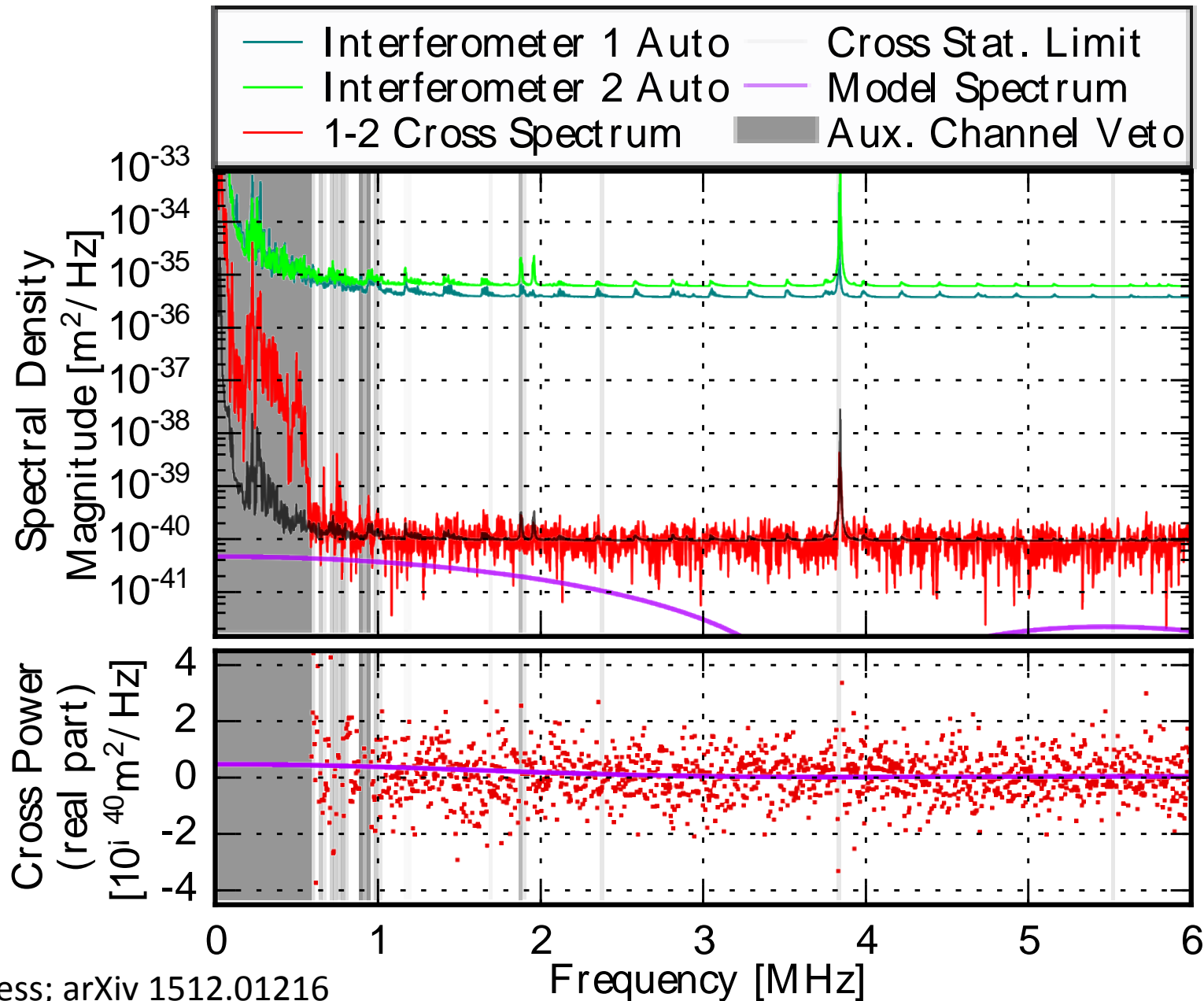


Space-time Correlations

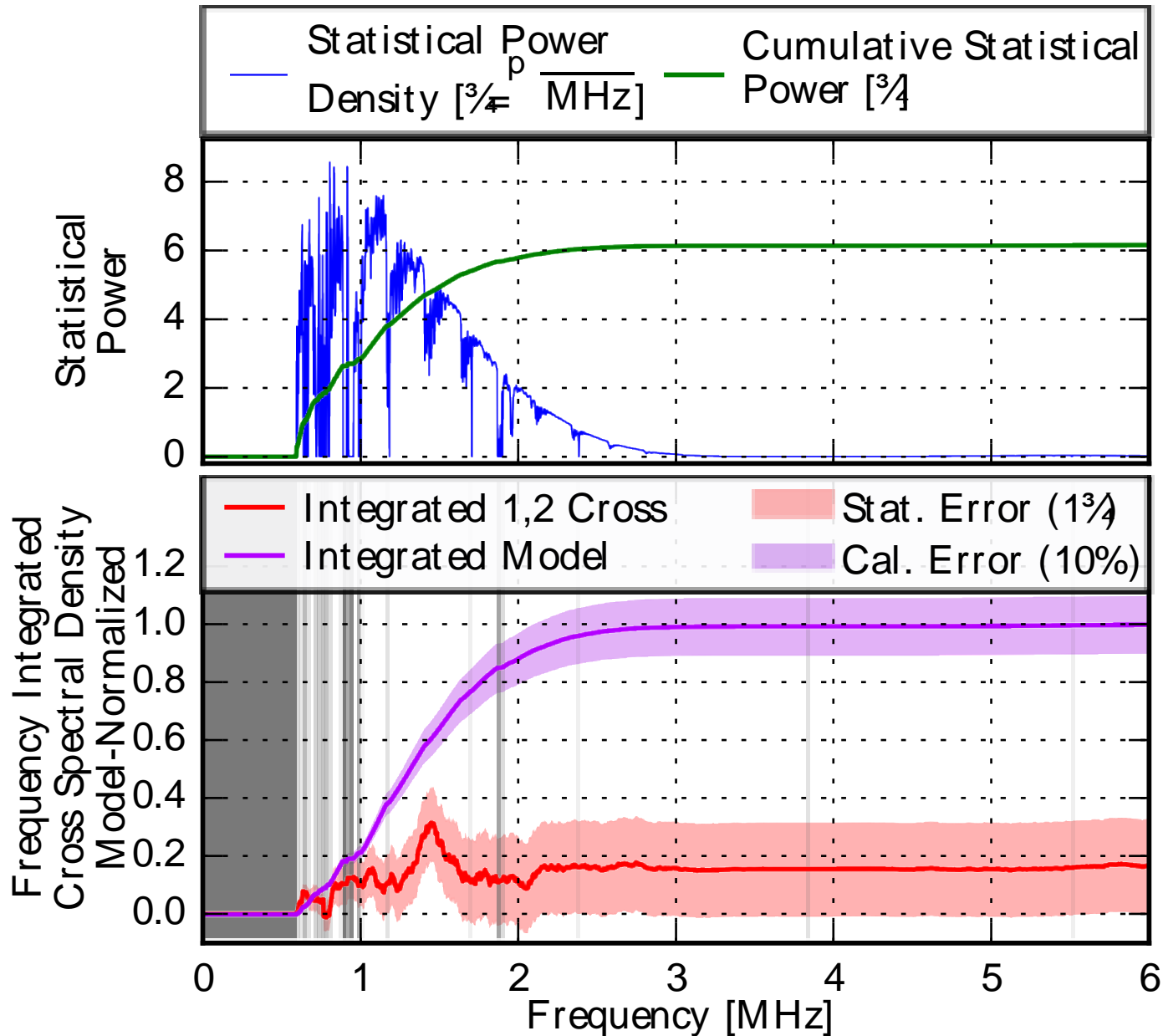


The signals
for two
colocated
interferometers
are correlated

Cross Correlation → Planck Scale

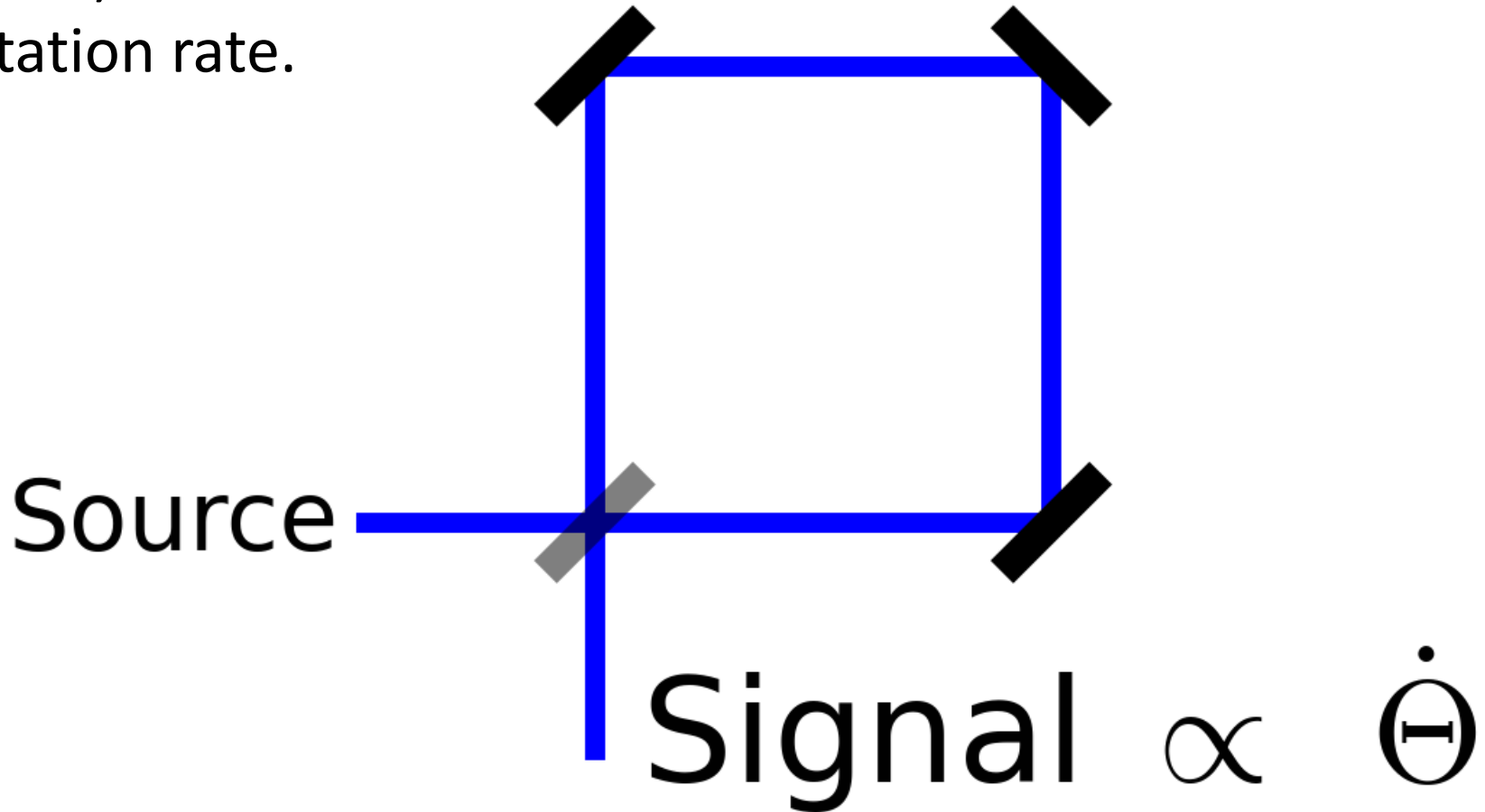


Search Result



But wait, there's more!

Michelson-Gale-Pearson
(1925) measured Earth's
rotation rate.

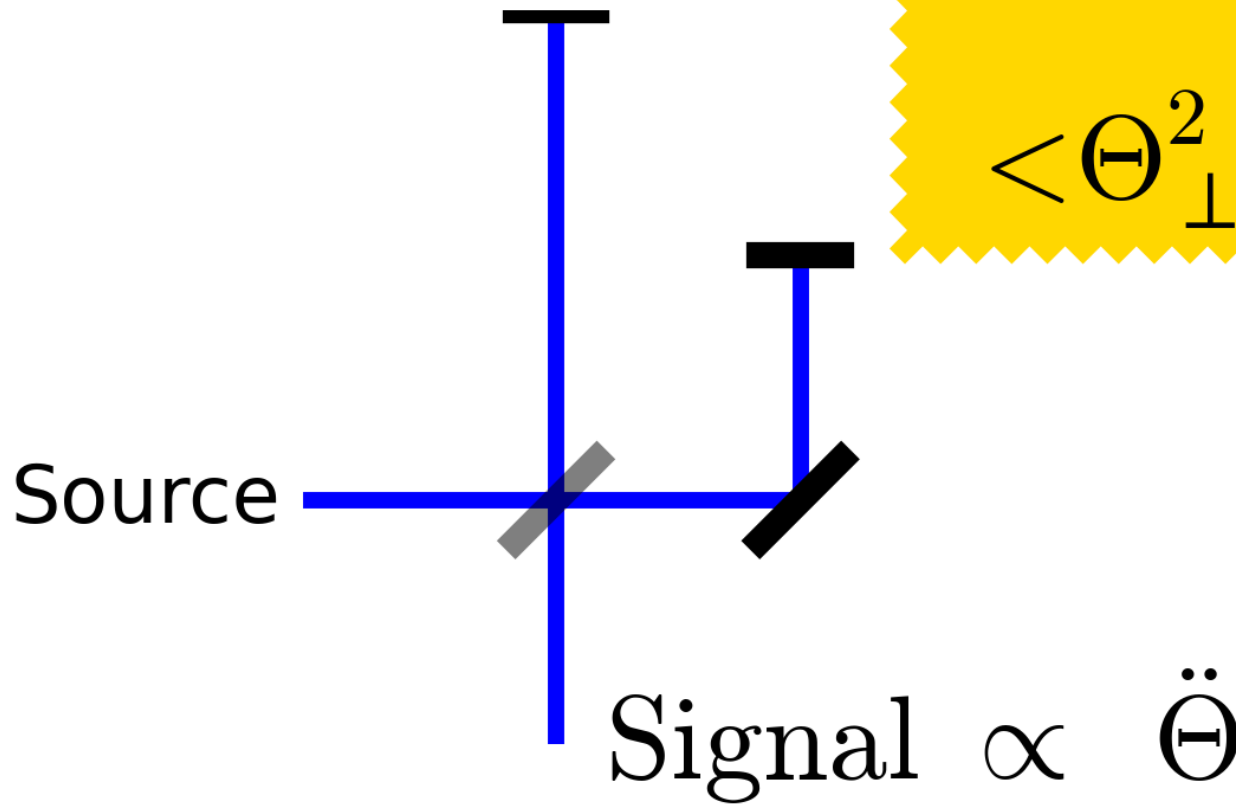


Single Bent Arm IFO

$$\langle X_{\perp}^2 \rangle \sim \ell_P L$$

\Rightarrow

$$\langle \Theta_{\perp}^2 \rangle \sim \ell_P / L$$



Conversion to Bent Arms



Conclusions

- E990 – The Fermilab Holometer – completed on time and budget
- We see no evidence for quantum geometry in the shear measurements – to $\sim 1\%$ of l_p
- Same equipment can be used for a new measurement
- Civil and mechanical work for the bent arm interferometers is finishing now
- Expect a measure of exotic quantum rotation in a year

Allen Chou, Craig
Ray Tomlin, Stephen
Brittany Kamai, Lee McCuller,
Jonathan Richardson, Chris
Stoughton, Rainier Weiss
and Richard Gustafson