

# BOOST

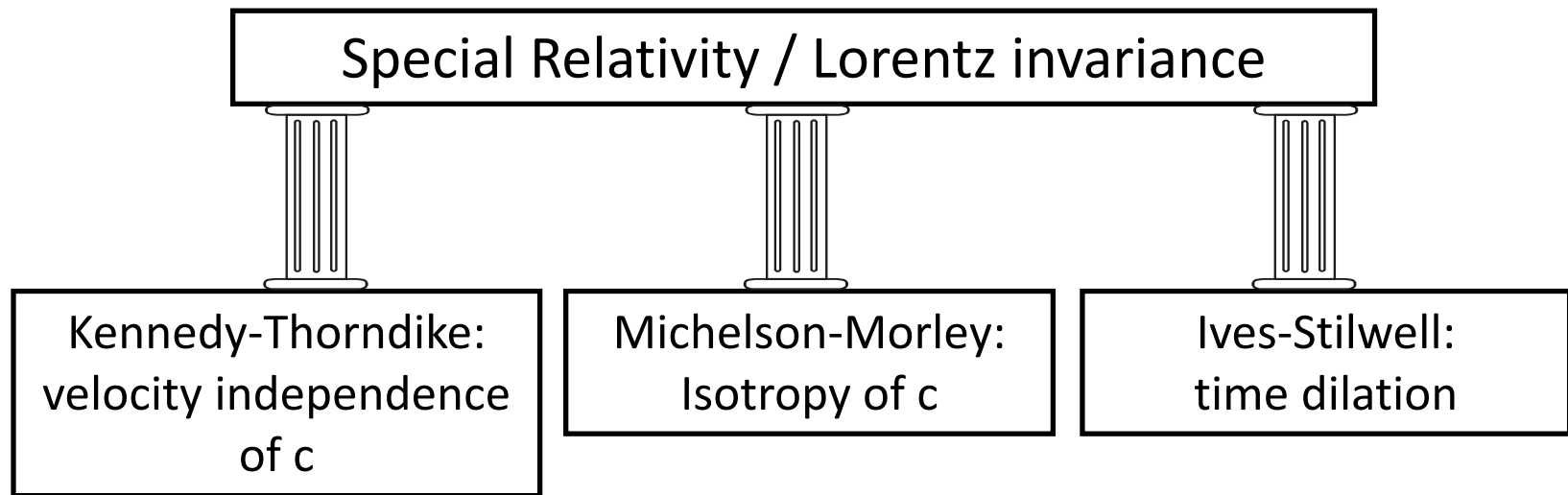
Norman Gürlebeck for the BOOST collaboration

07/11/16

**NEW YORK – GR21**

## Science Case

# Foundations of SR and GR



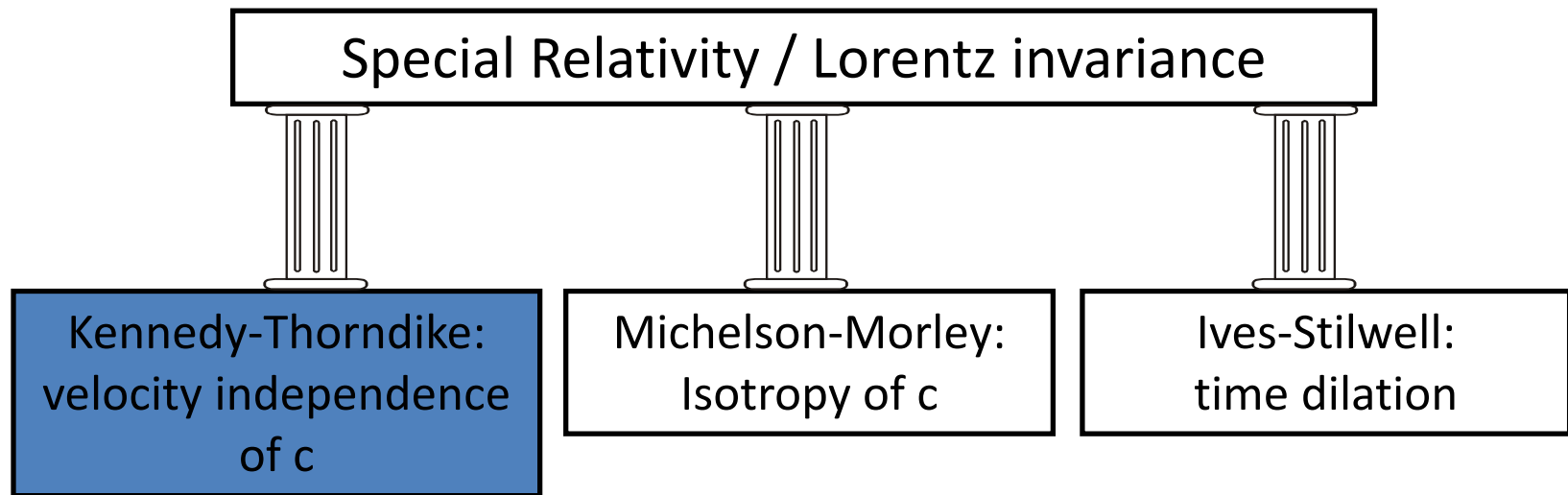
## Test Theory – Robertson-Mansouri-Sexl:

*H.P. Robertson, Rev. Mod. Phys. **21**, 378ff, 1949*

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More general: Standard Model Extension [*D. Colladay et al. 1998*]  
→ More columns necessary

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# RMS test theory

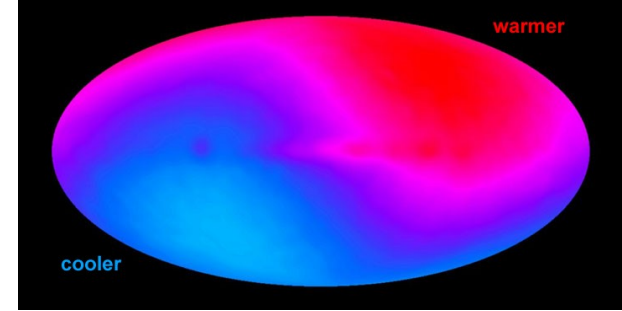
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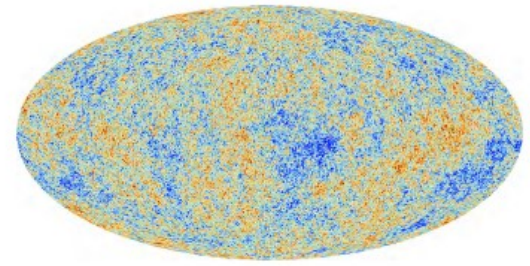
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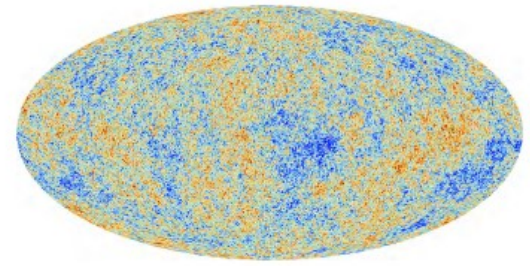
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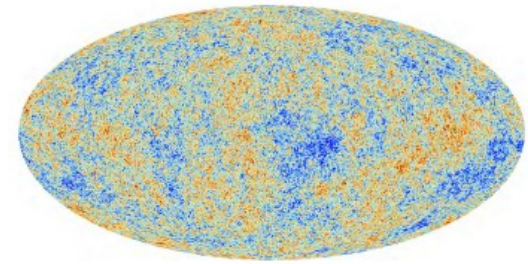


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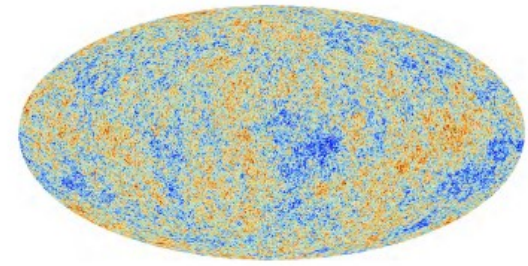
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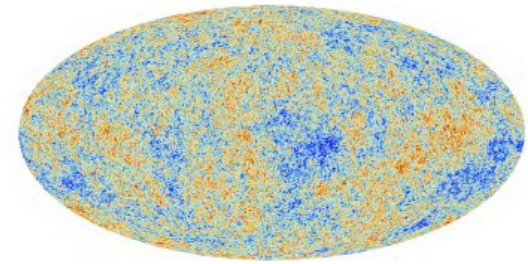


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Kennedy-Thorndike Michelson-Morley

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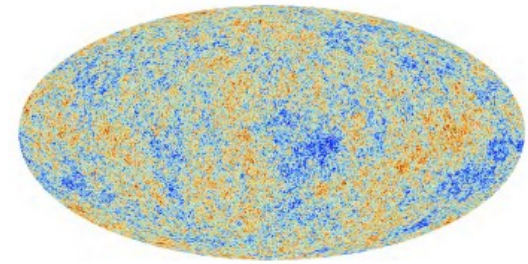
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- ▶ in special relativity:  $\alpha = -\frac{1}{2}$ ,  $\beta = \frac{1}{2}$ ,  $\delta = 0$

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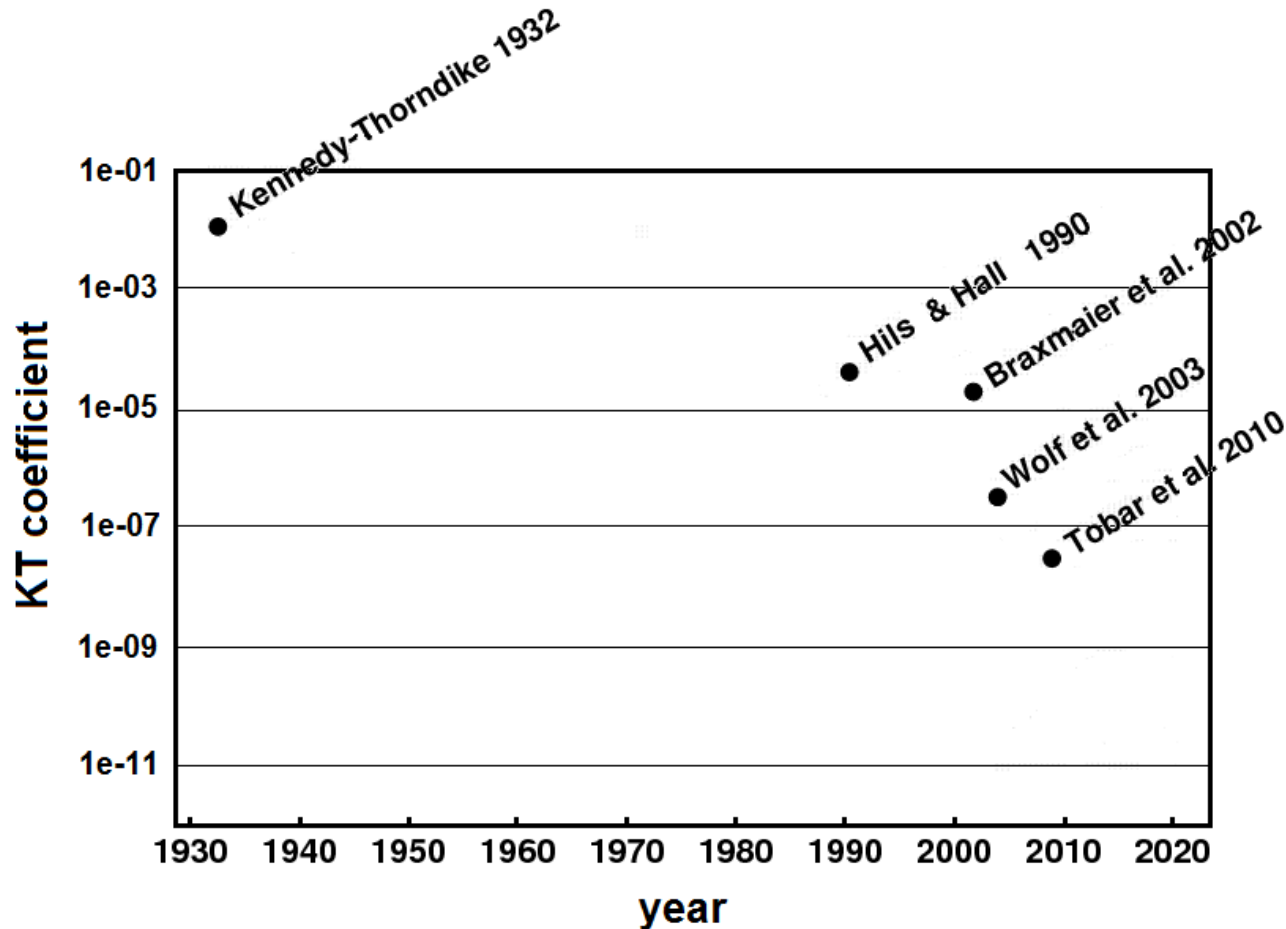
other values  $\Rightarrow$  new physics

# Planned accuracy

- ▶ Current best measurement:  $\alpha_{KT} \leq 4 \cdot 10^{-8}$
- ▶ *[Tobar et al. 2010]*

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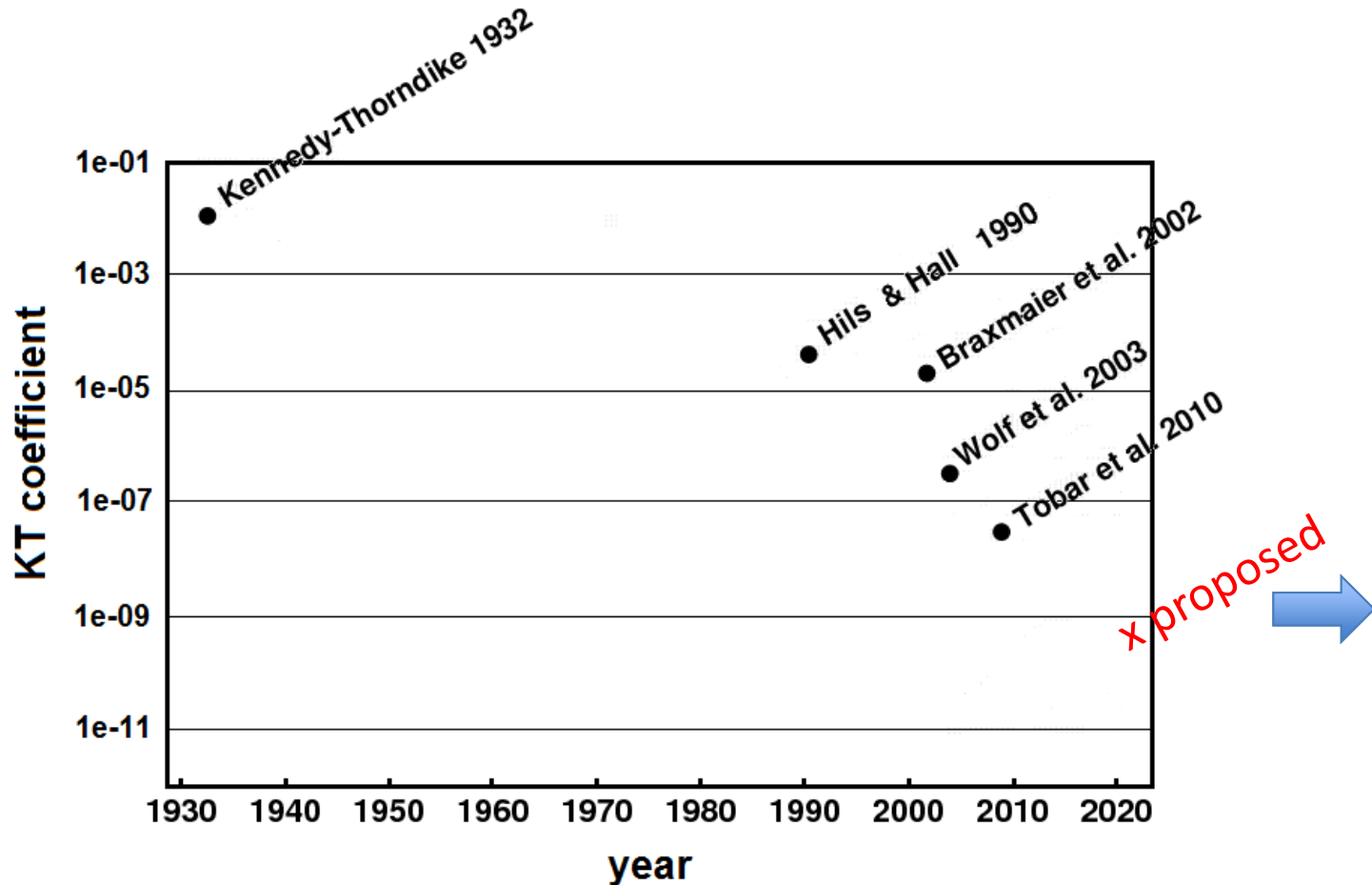
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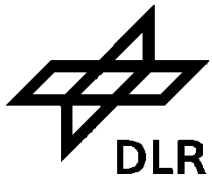
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Faktor 50-60  
improvement



## Mission Outline

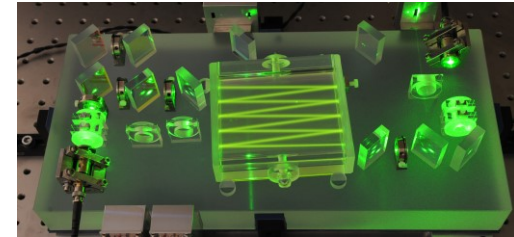
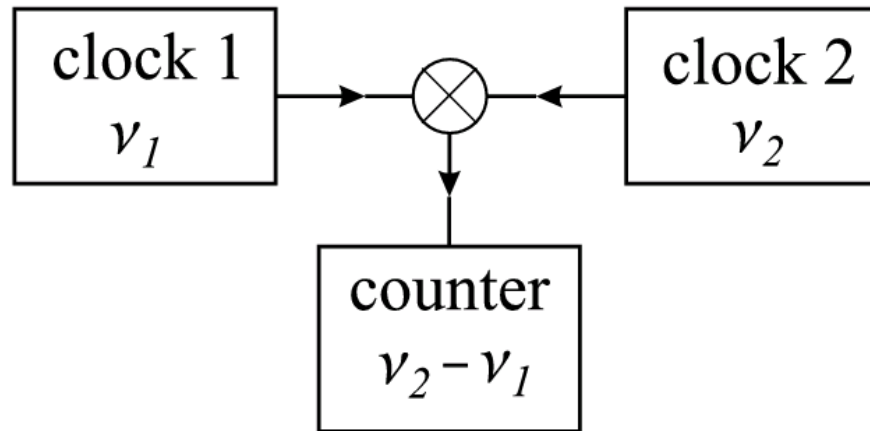
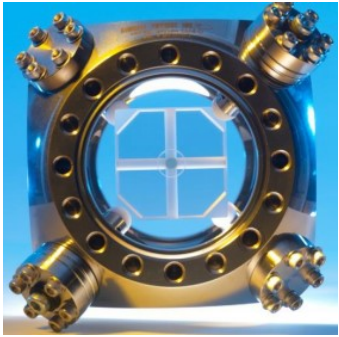


# BOOst Symmetry Test: Mission Detail

- ▶ DLR funded national „Large Mission Programm“
  - ▶ DLR small satellite bus (Eu:Cropis)
  - ▶ Currently Phase 0 study
  - ▶ Downselection after 12/2016
- 
- ▶ Similar proposal together with Stanford University & KACST (Saudi Arabia): mSTAR

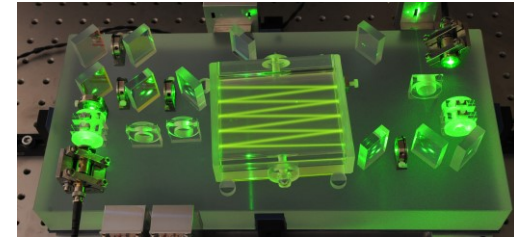
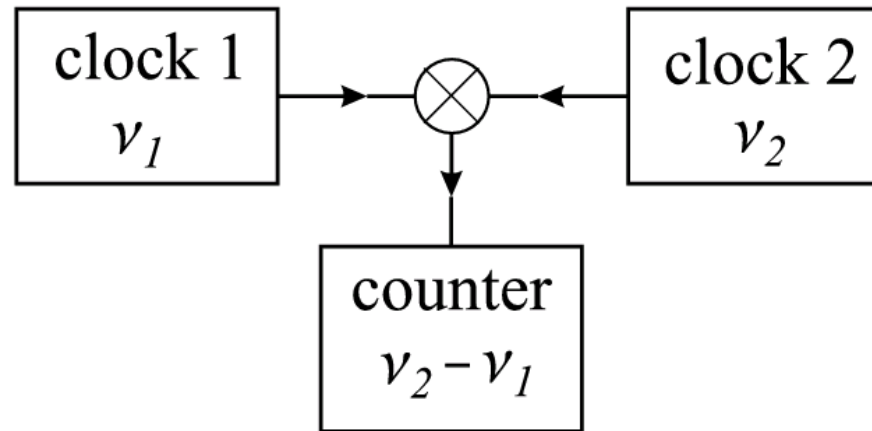
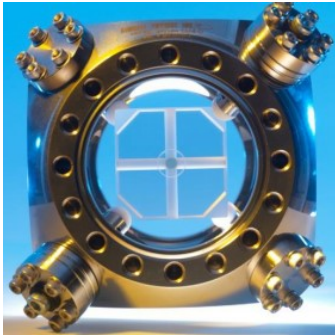


# Frequency comparison



- ▶ Cavity frequency:  $\nu = \frac{mc}{2L} \Rightarrow \delta\nu = \nu \frac{\delta c}{c}$
- ▶ [H. Müller et al. (2003)]
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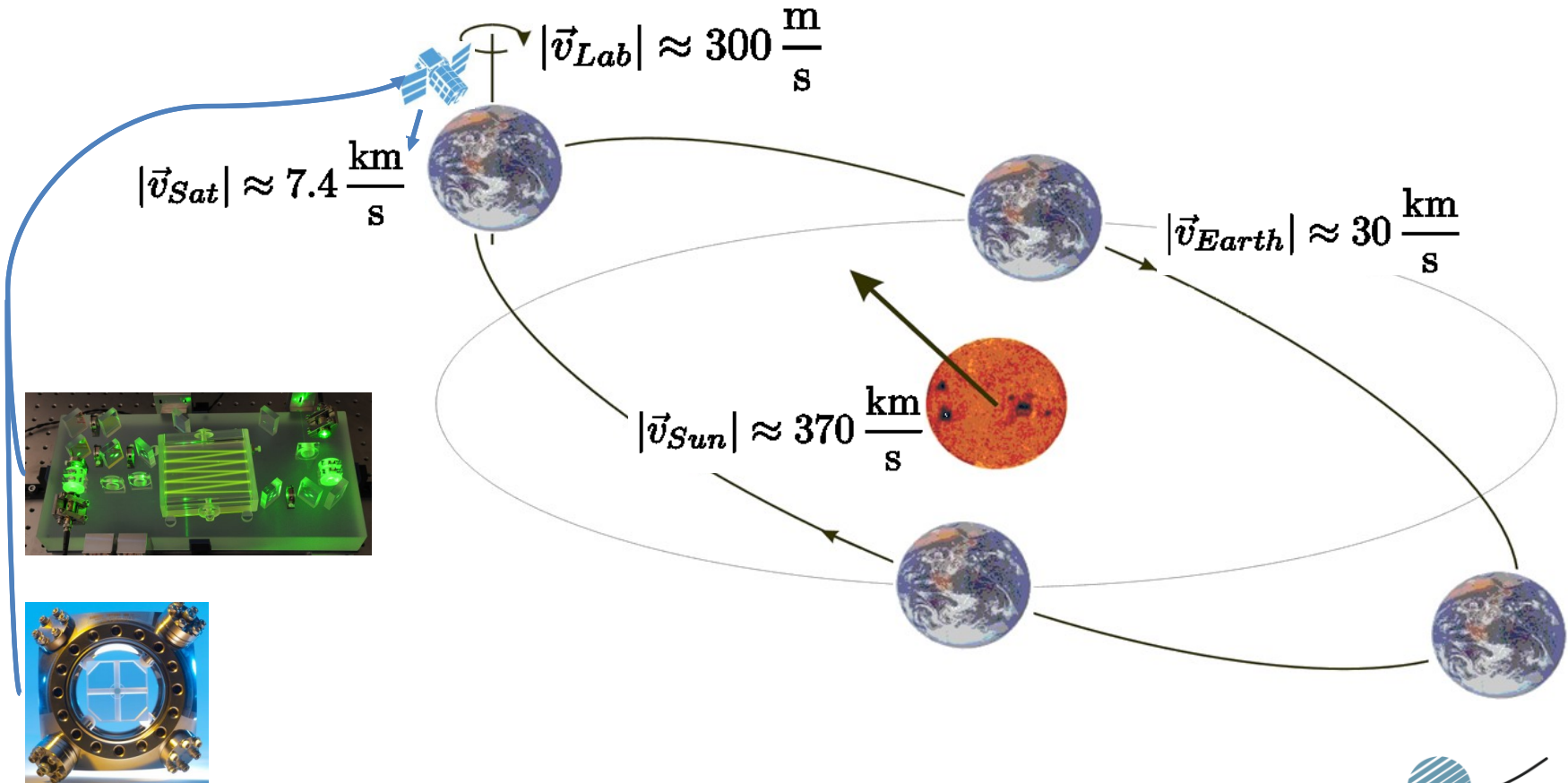


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# The idea in RMS

- laboratory moving with velocity  $\vec{v}$  relative to a preferred rest frame (e.g. CMB)



# Iodine clock

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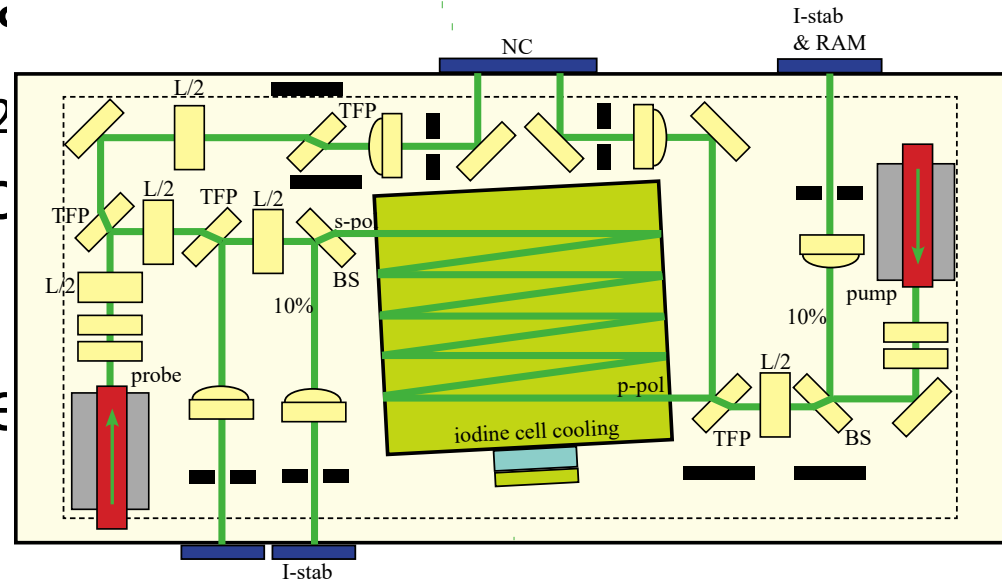
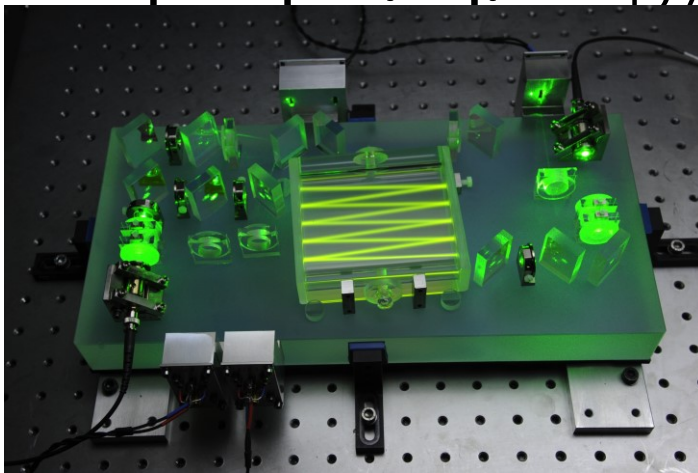
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- ▶ Hyperfine transition:  $\approx 10^{-6}$  Hz

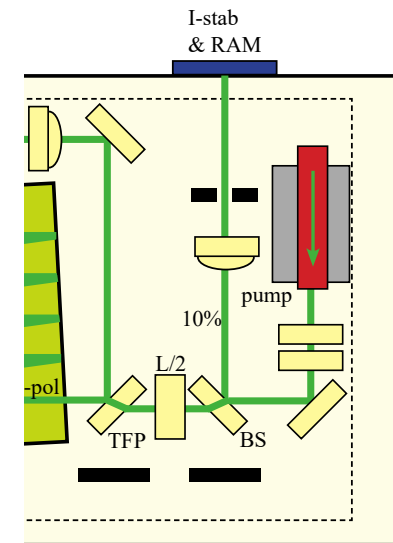
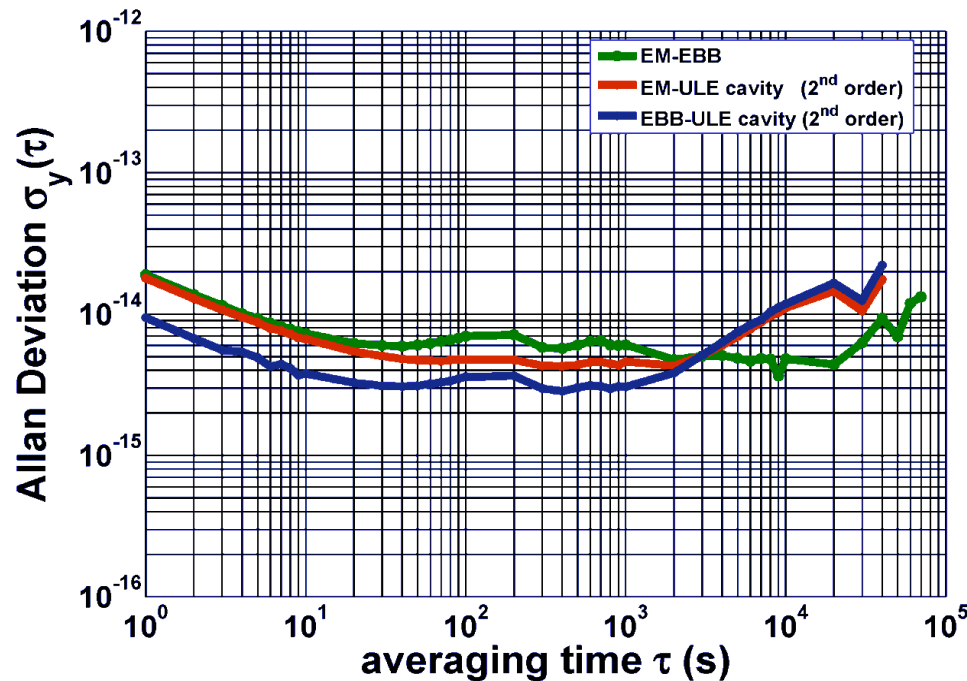
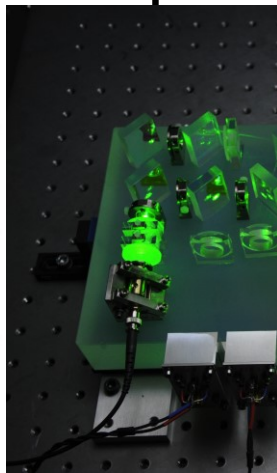


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- Hyperfine transition  $\sim 10^{-12}$  Hz  $\rightarrow$  D/50/2000



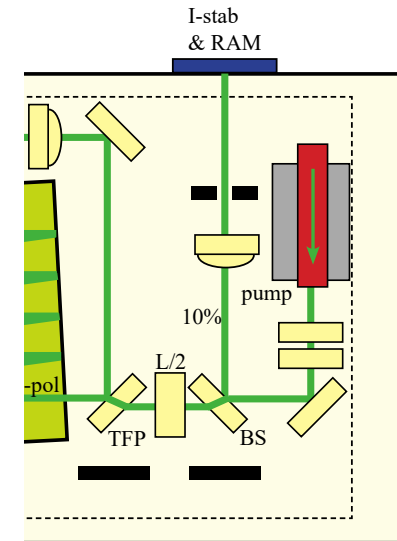
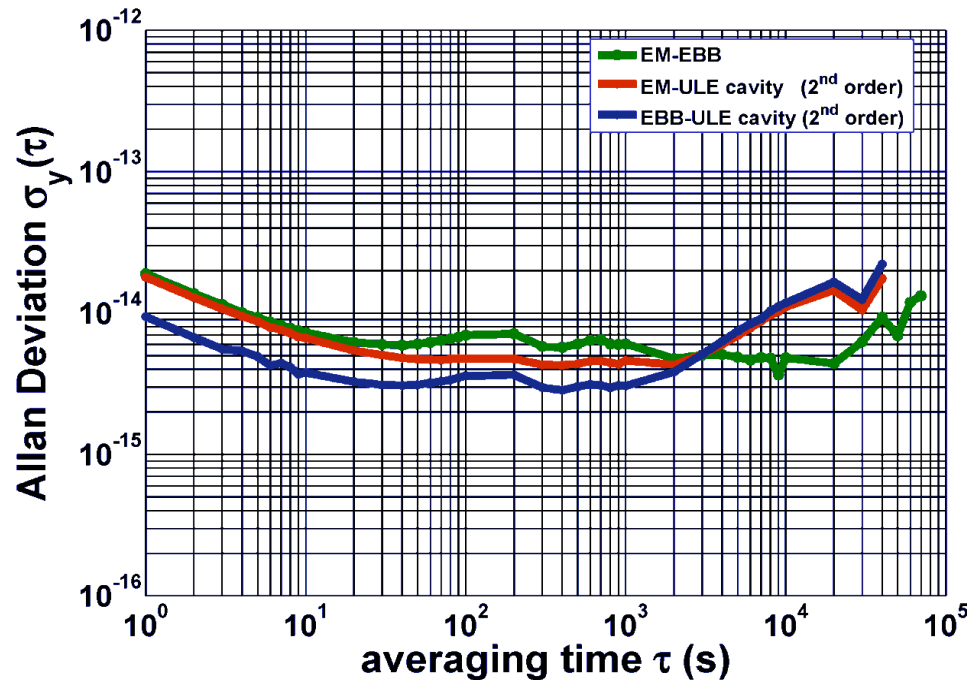
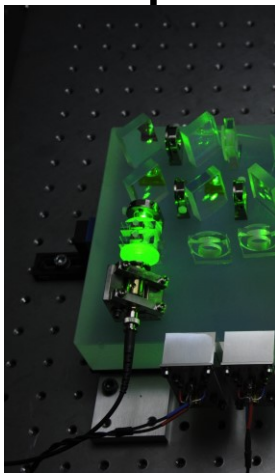
- Thermal
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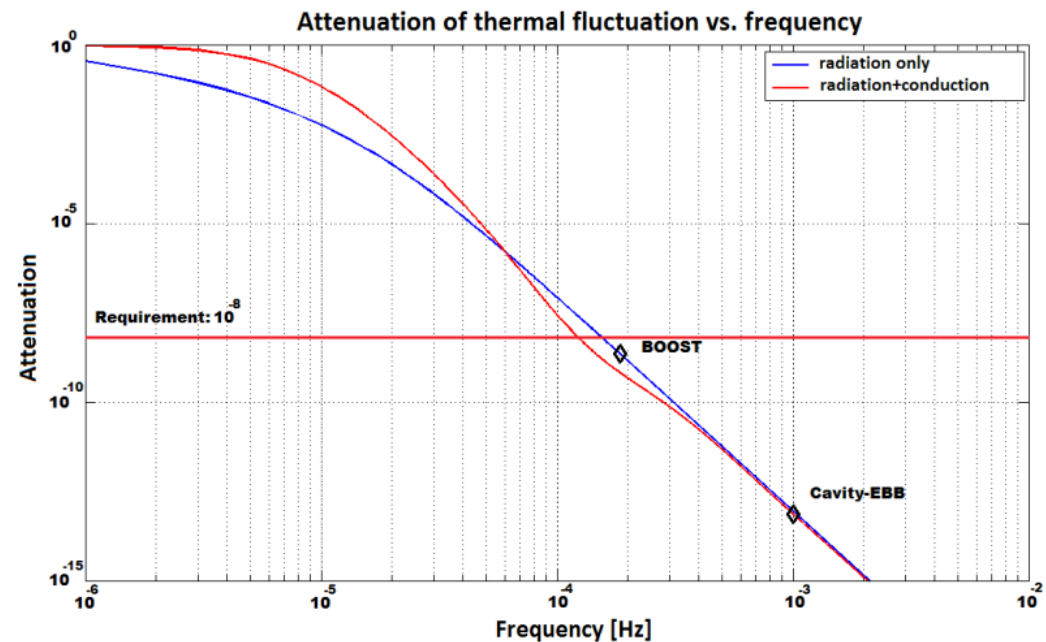
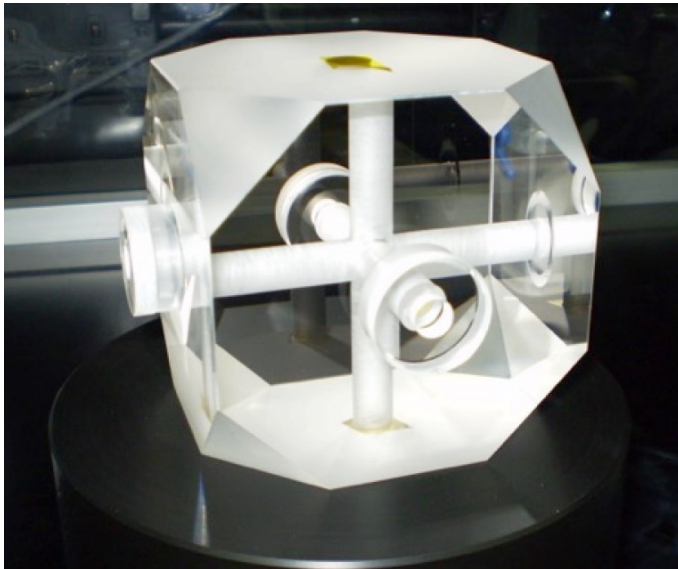
- ▶ Will fly on the sounding rocket JoKARUS 2018



ZARM

# The cavity

- ▶ Currently developed at ZARM based on NPL cube ULE cavity with FS mirrors [Webster et al. 2011]
- ▶ 5 layer thermal shield [Sanjuán et al. 2015]
- ▶ Outer shield actively stabilized to 1 mK



**Thank you!**