

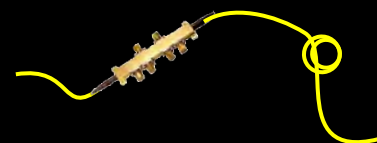
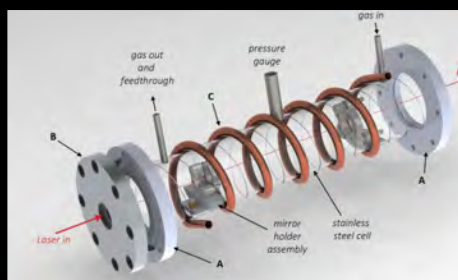
Mesures moléculaires de précision avec REFIMEVE

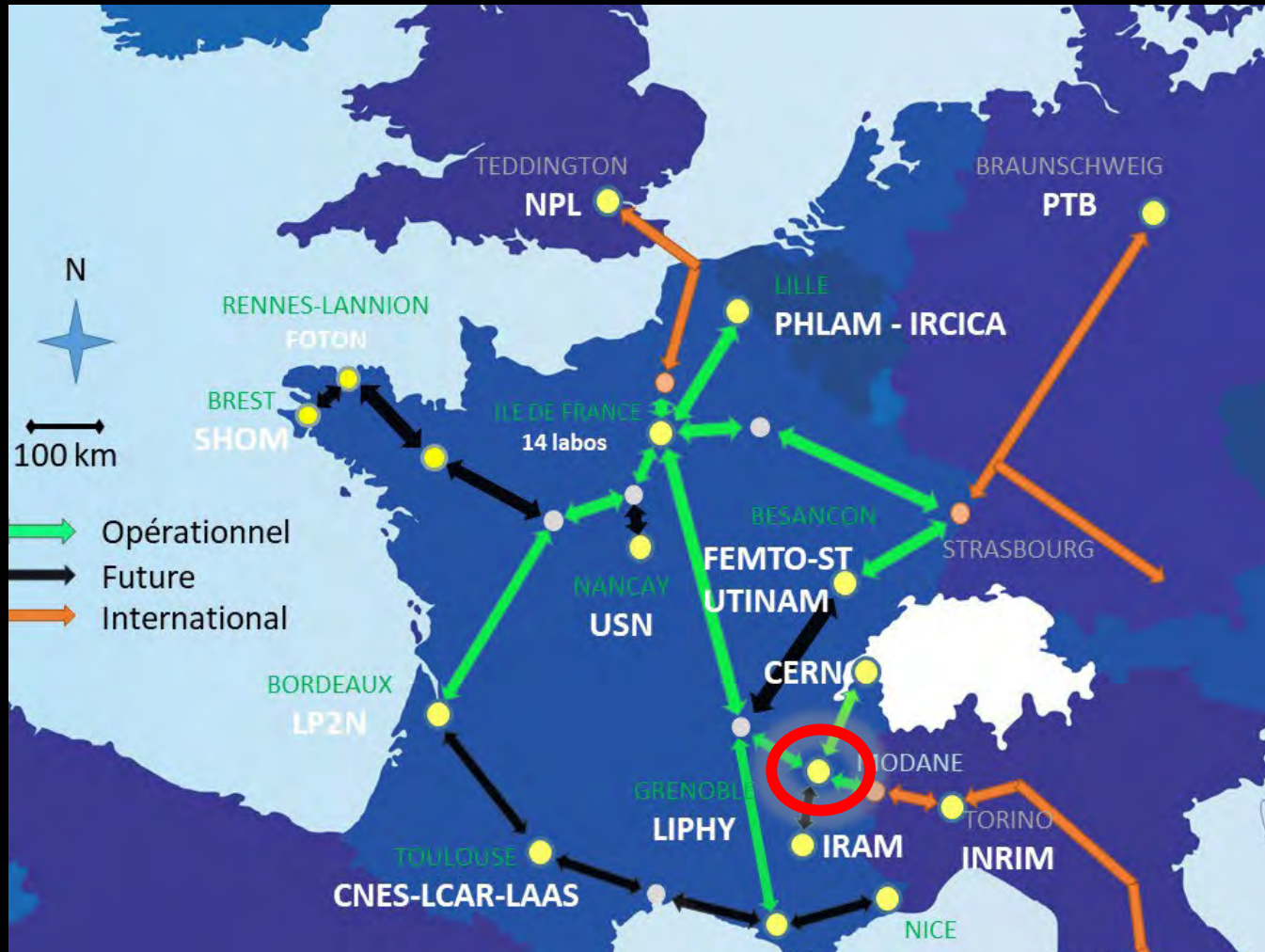
Hélène Fleurbaey, Samir Kassi, Daniele Romanini,
Didier Mondelain, Alain Campargue

LIPhy, Laboratoire Interdisciplinaire de Physique, 38402 Saint-Martin d'Hères



Comb-assisted CRDS
Coherence transfer





LIPhy is an important node of the network



LAME team activities

Gas phase molecular spectroscopy

Astrophysics,
exoplanets...

**Le télescope James Webb détecte
du CO₂ autour d'une exoplanète,
une première**

Ultra weak absorption

Trace gas detection

Fundamental physics

Molecular physics

Databases

Geoscience

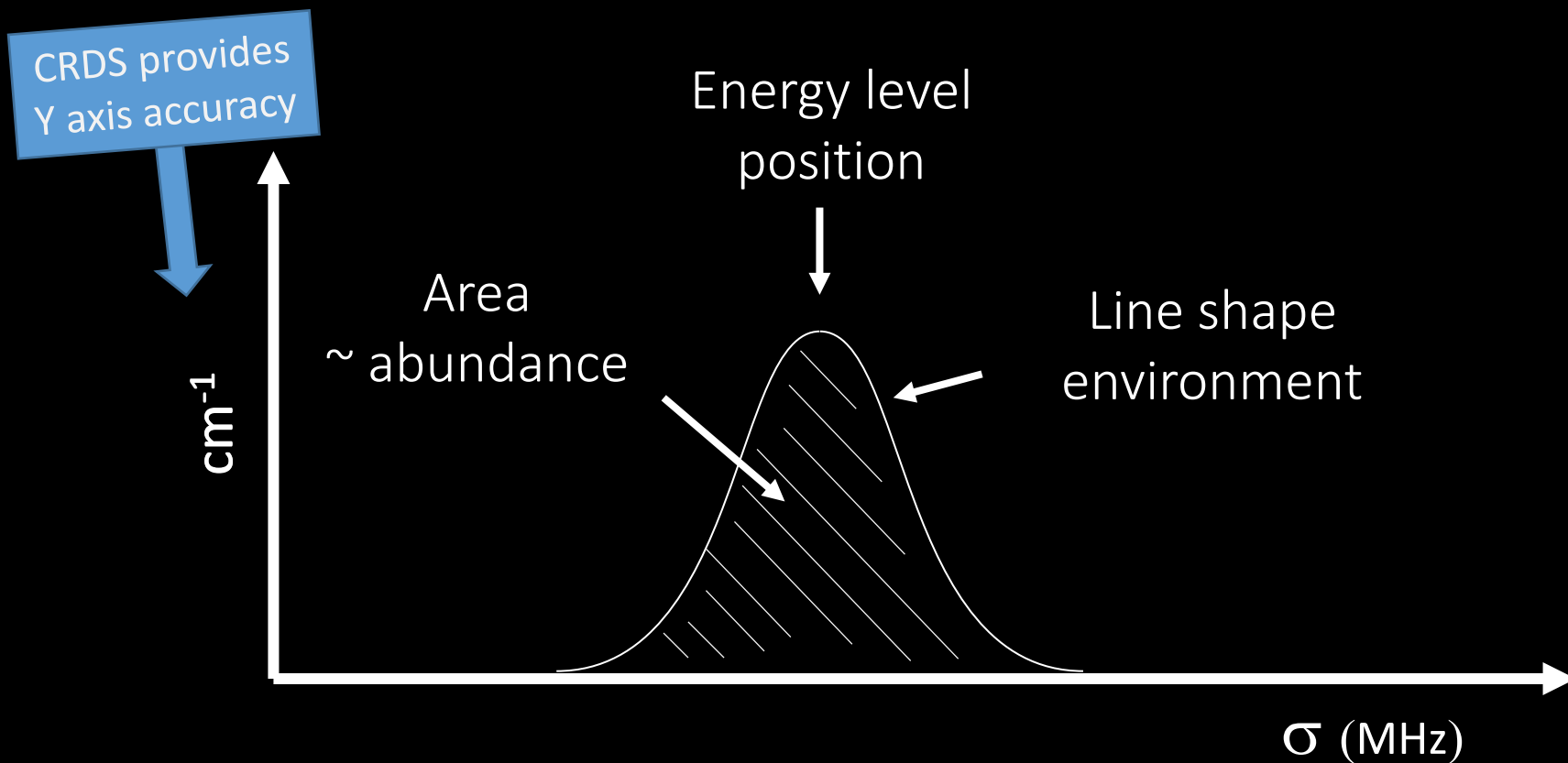
Spectroscopy is in the spotlight

International databases, tests for physics, trace gas, analytical spectrometry...



LIME team activities

Providing high quality spectroscopic data

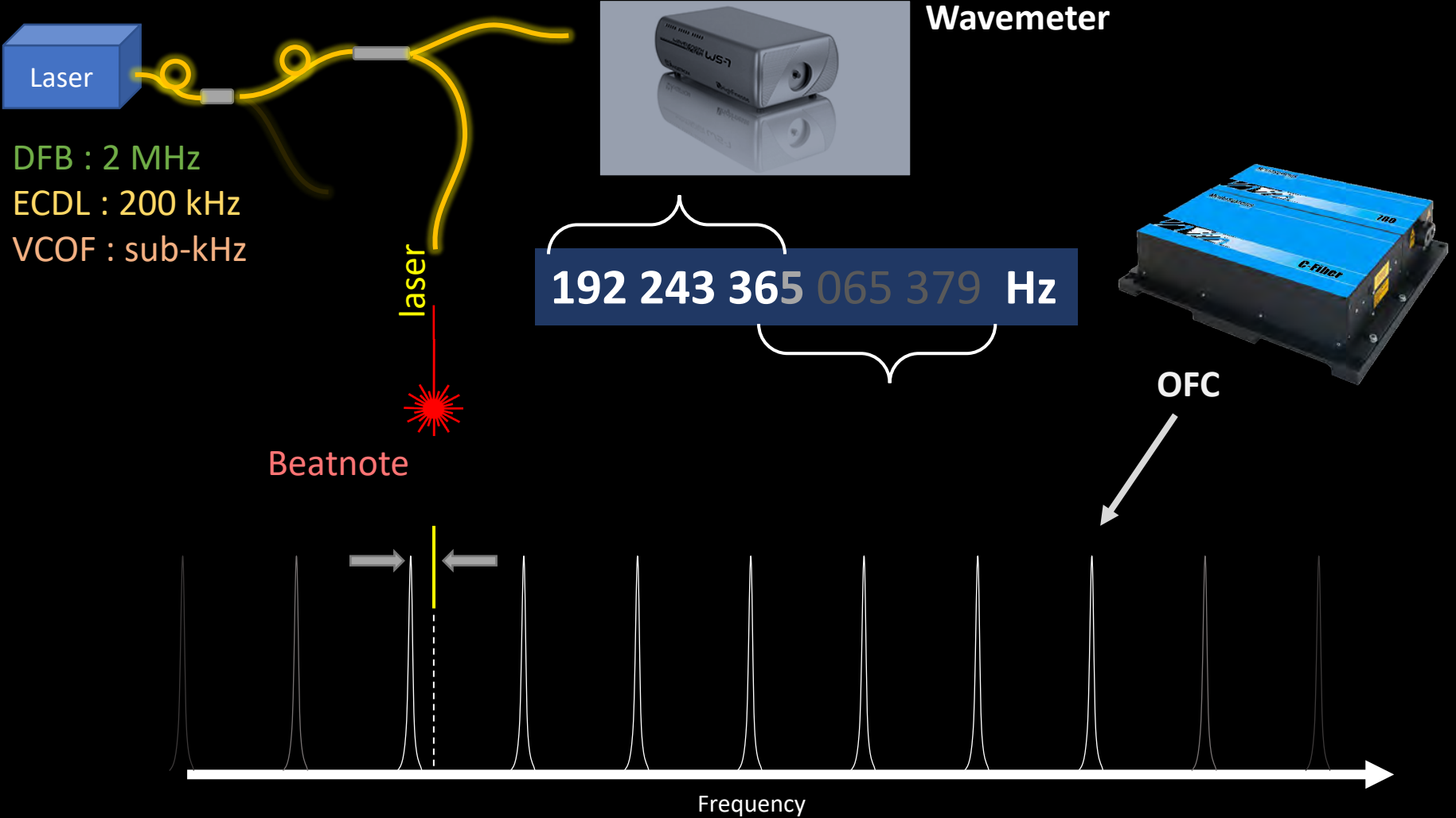


Frequency axis is essential !!!



Absolute frequencies

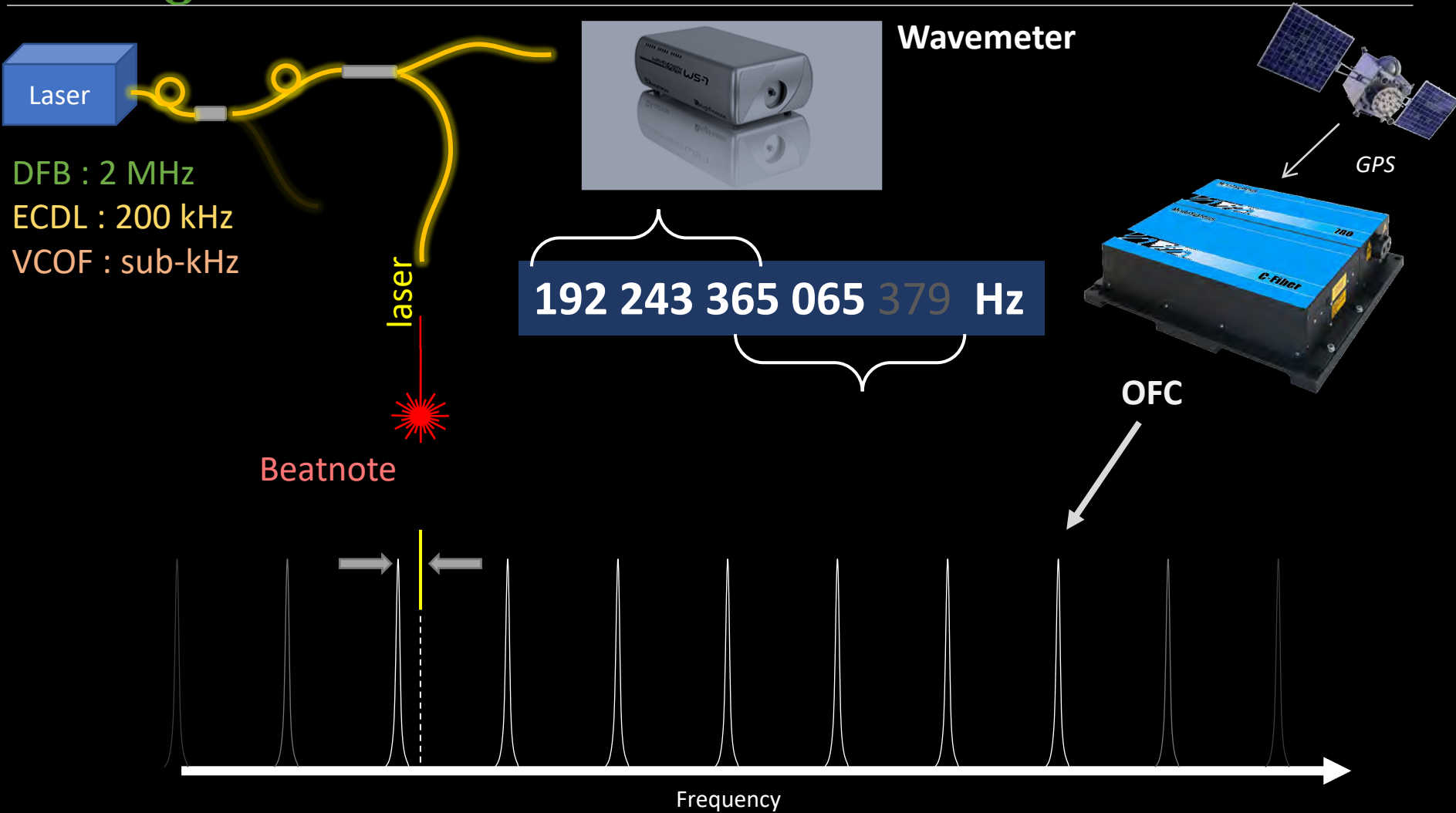
Refining a coarse measurement





Absolute frequencies

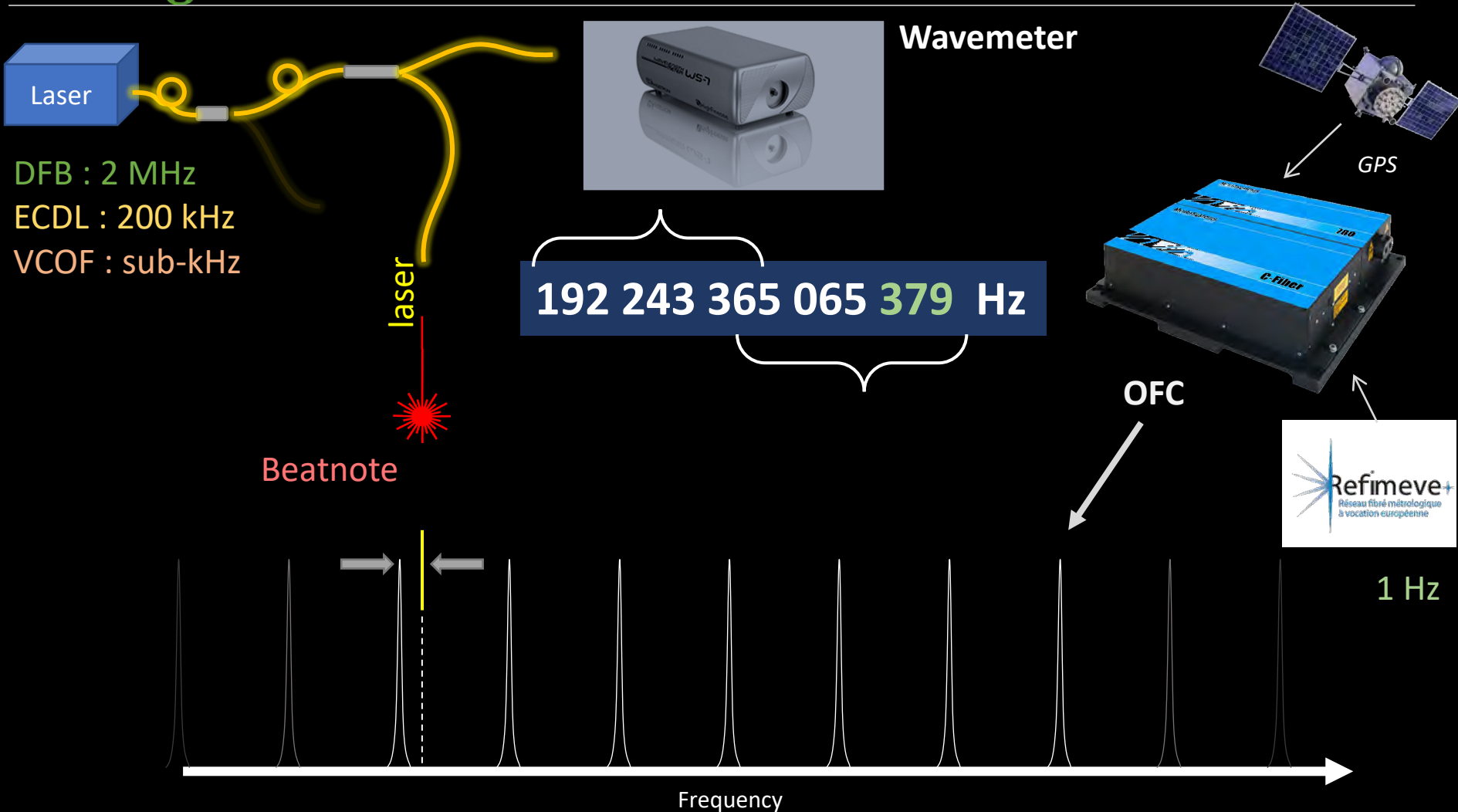
Refining a coarse measurement





Absolute frequencies

Refining a coarse measurement



Laser absolute frequency determination down to a few Hz

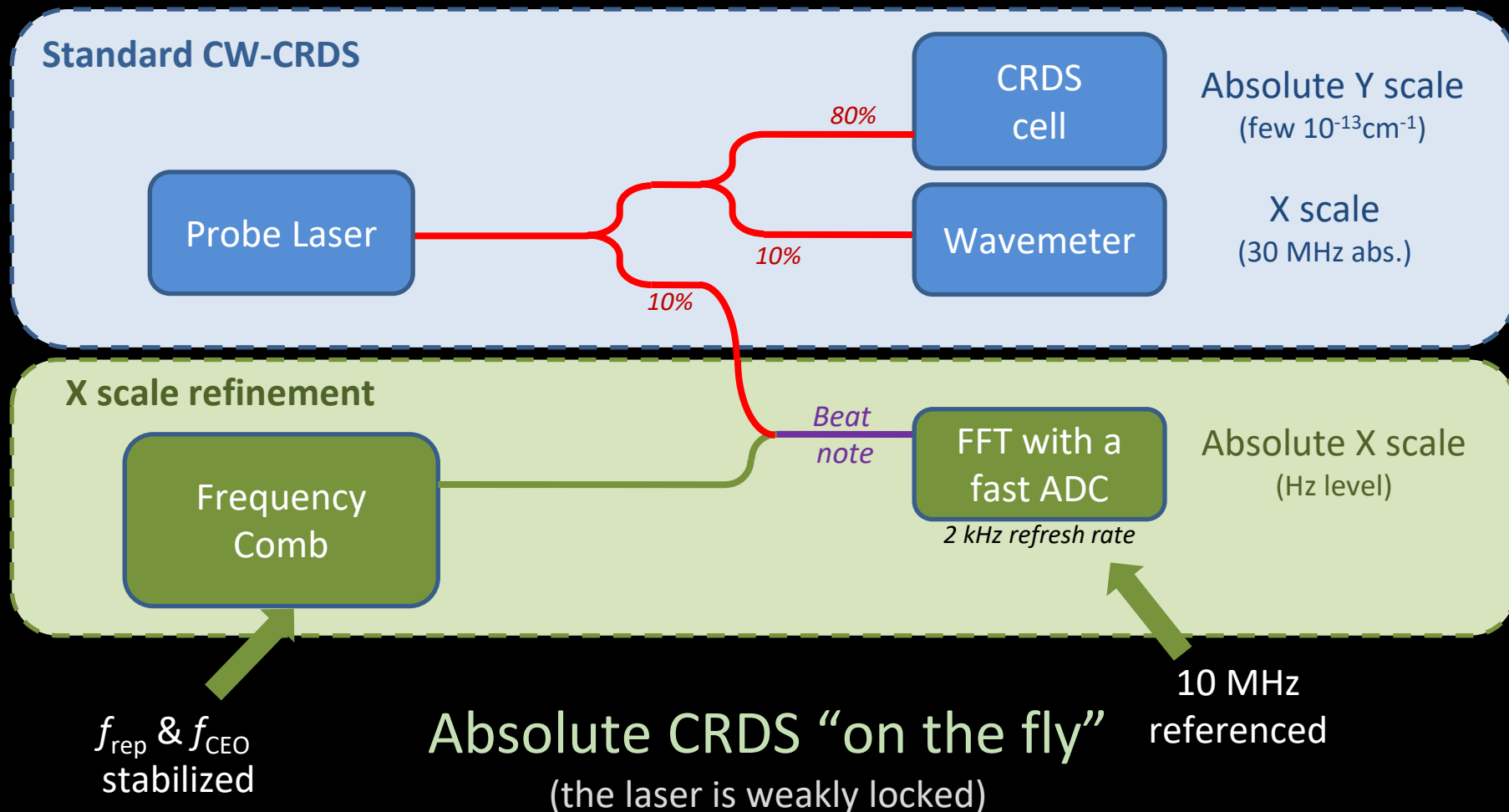
Part 1

The comb as a
frequency reference



Absolute frequency calibration

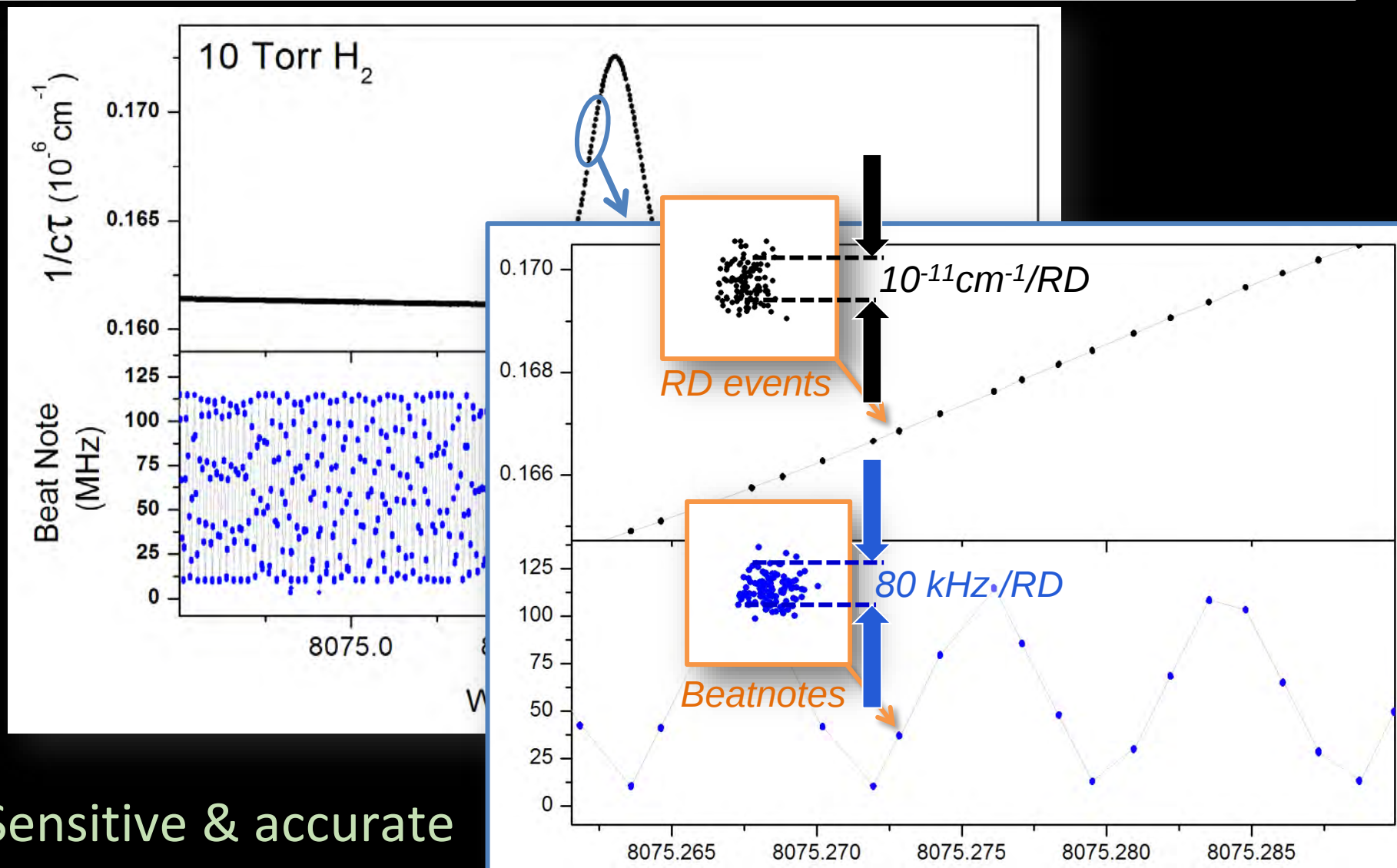
Practical implementation





On the fly calibration

Performances with an ECDL



Sensitive & accurate

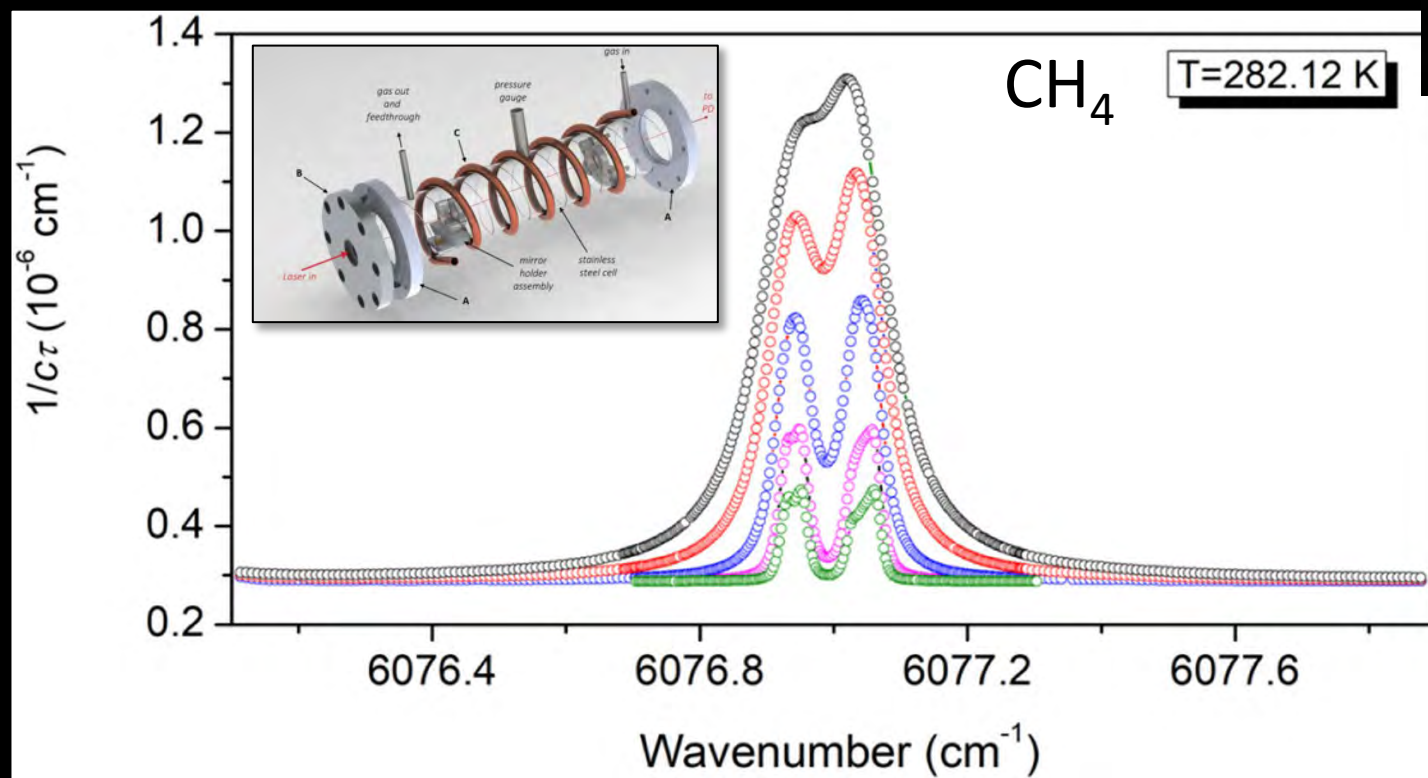


On the fly calibration

Performances with a “VCOF” source



MERLIN CNES Mission



This methane $2\nu_3$ R(6) manifold is of importance for earth atmosphere probing

Precise lineprofiles

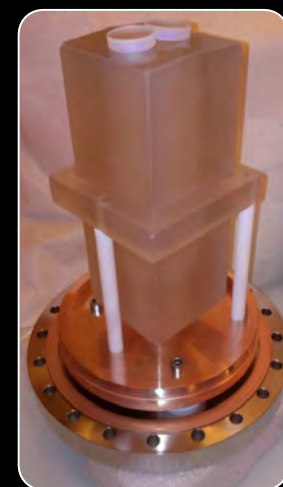
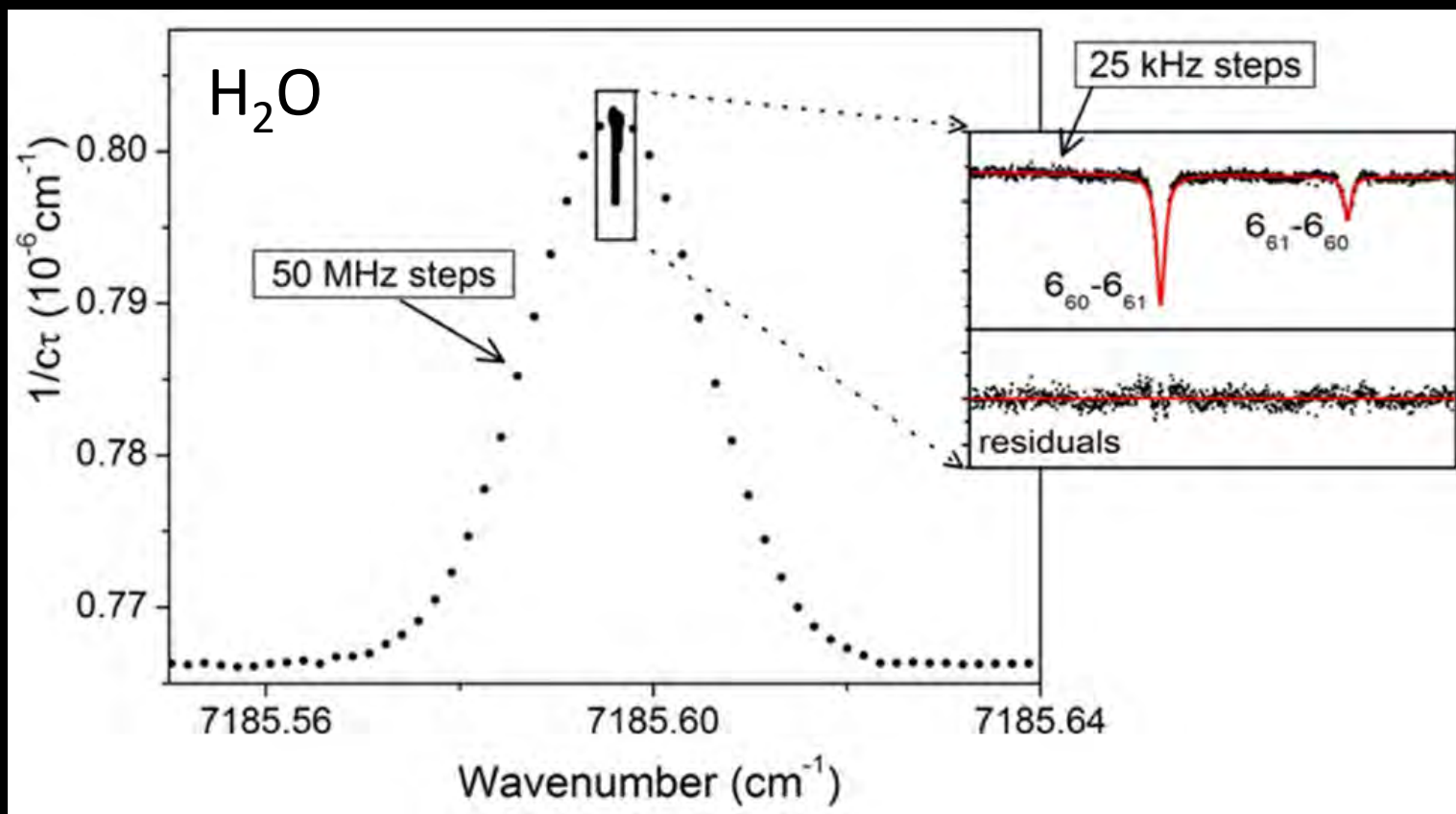


Ultra-stable
VCOF source



On the fly calibration

Performances with a “VCOF” source



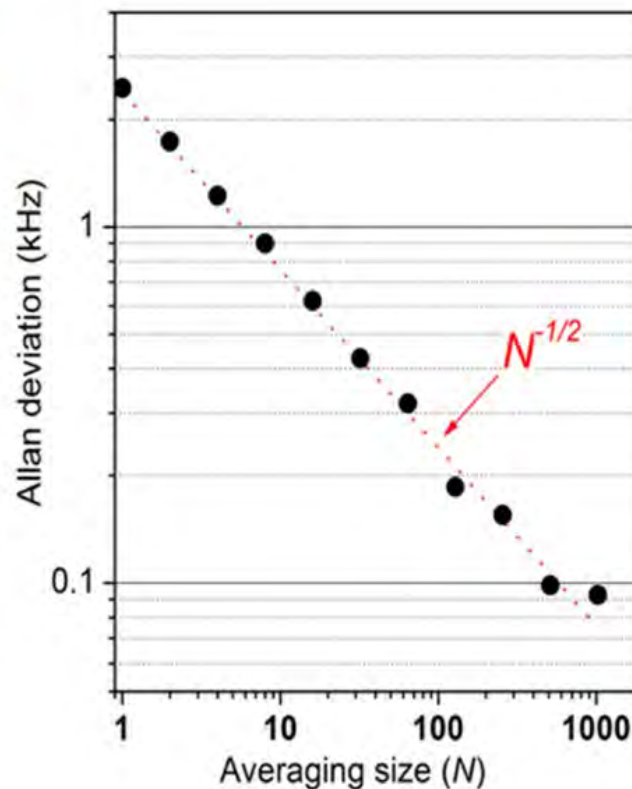
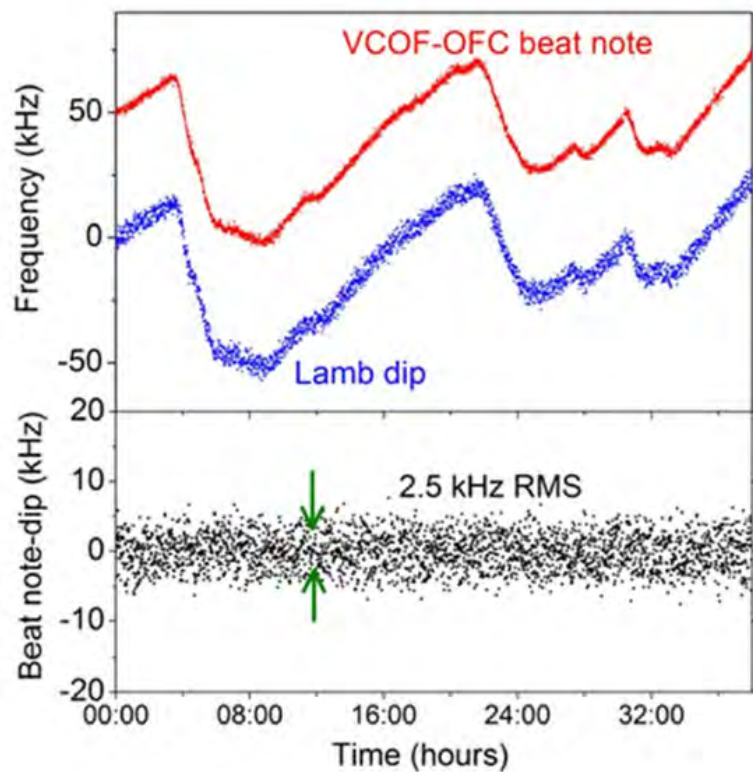
Ultra-stable
VCOF source

Saturated absorption

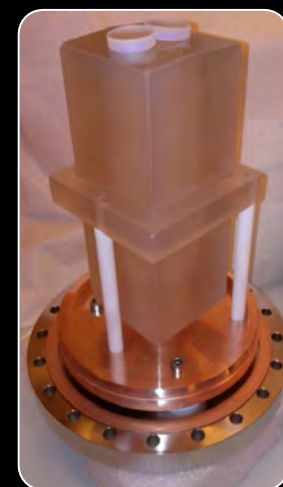


On the fly calibration

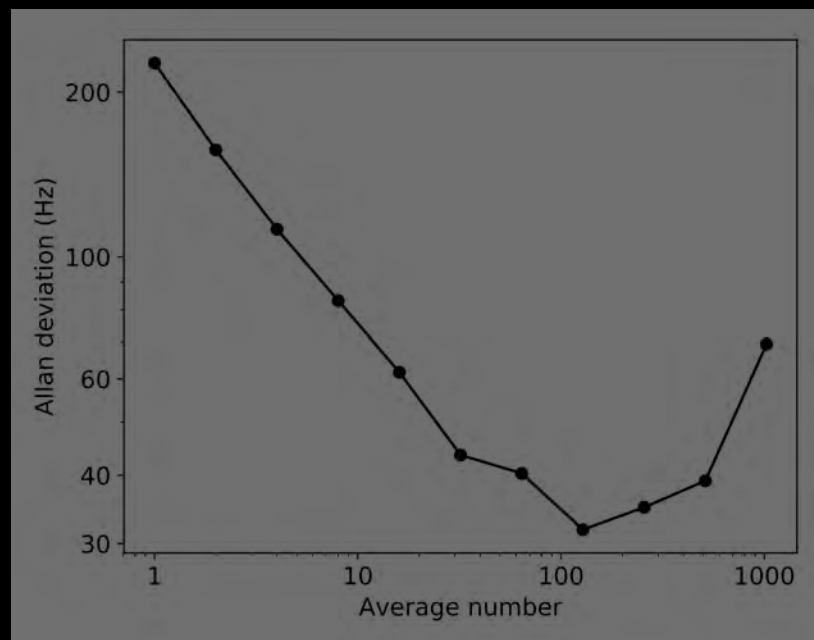
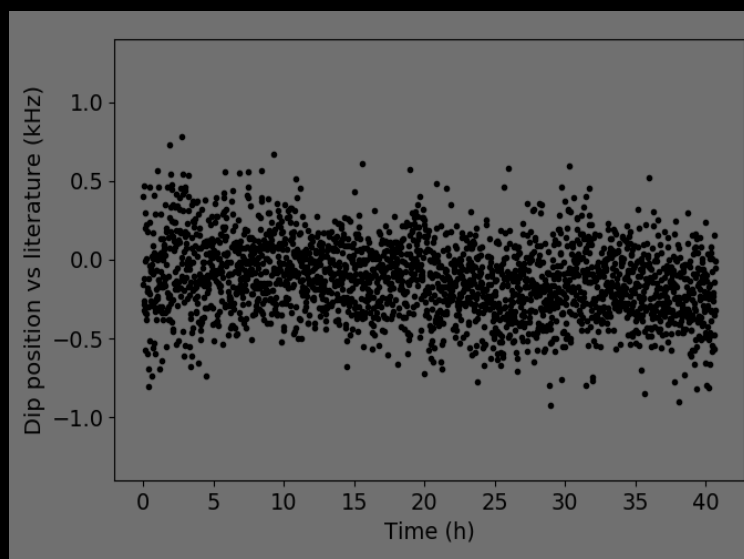
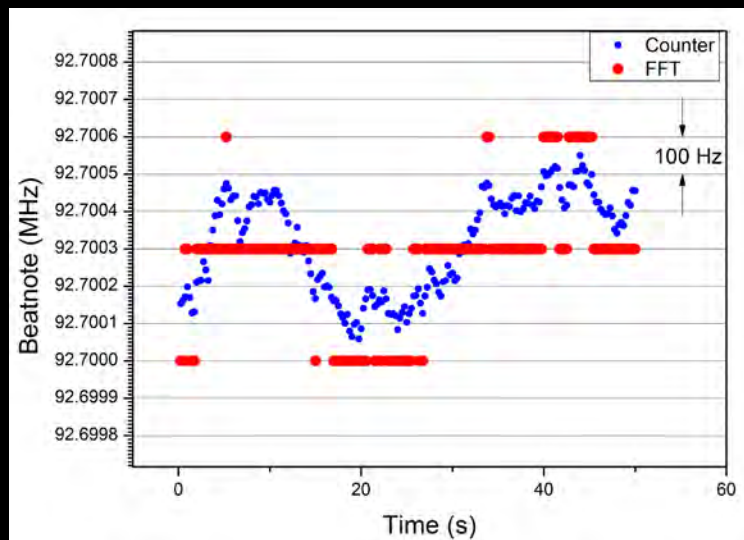
Performances with a “VCOF” source



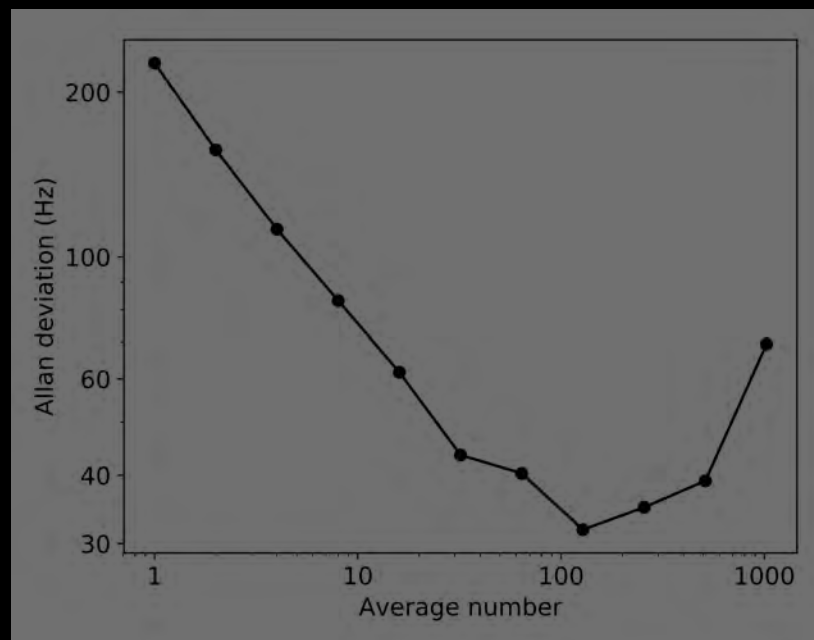
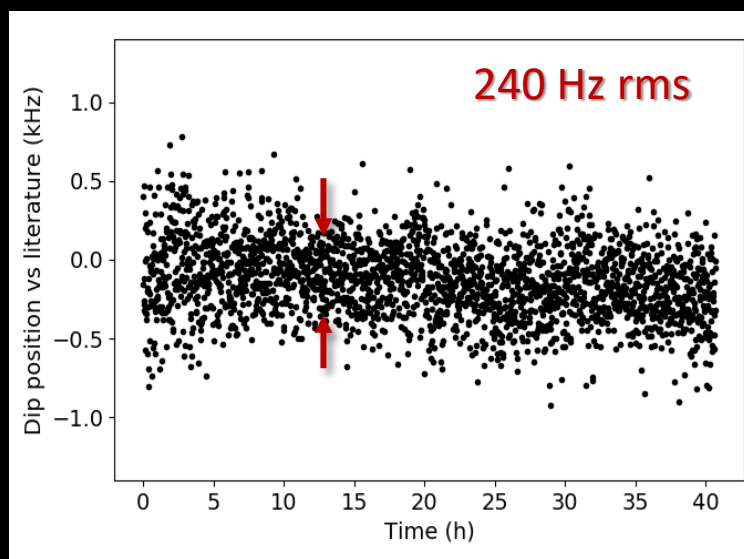
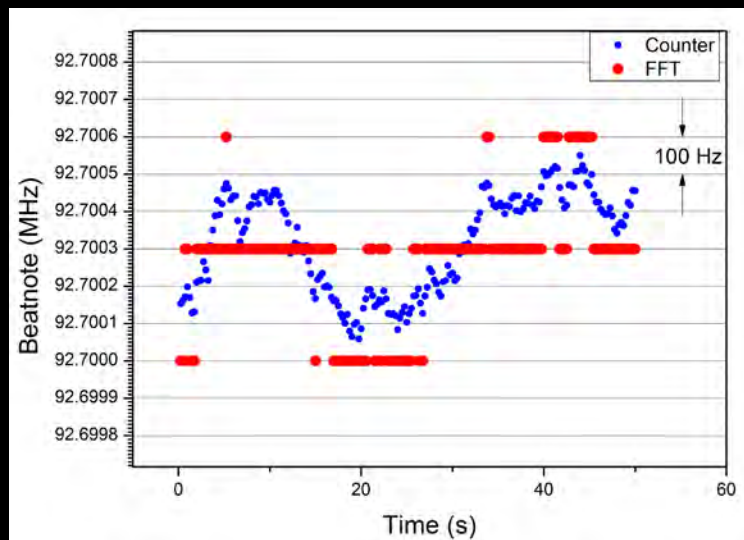
Comb f_{rep} locked to GPS



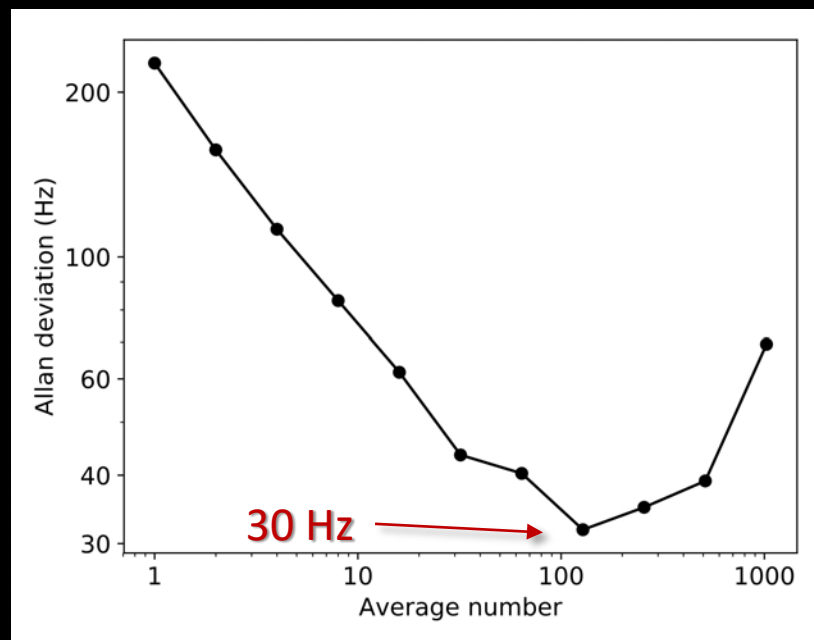
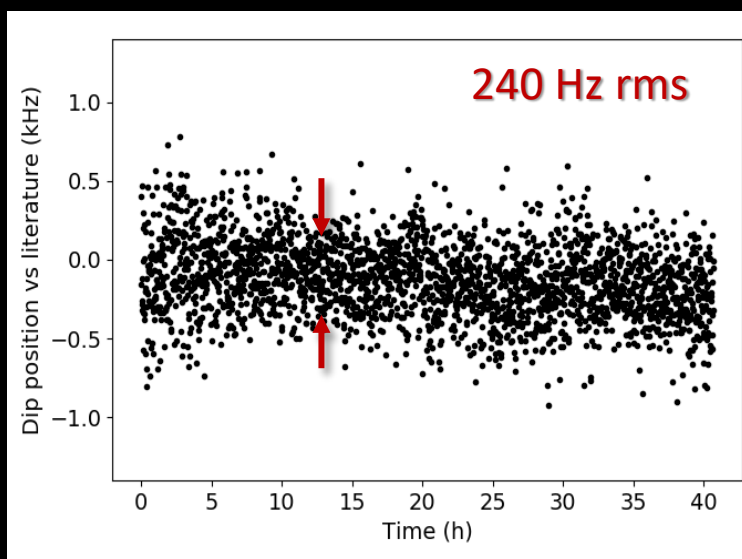
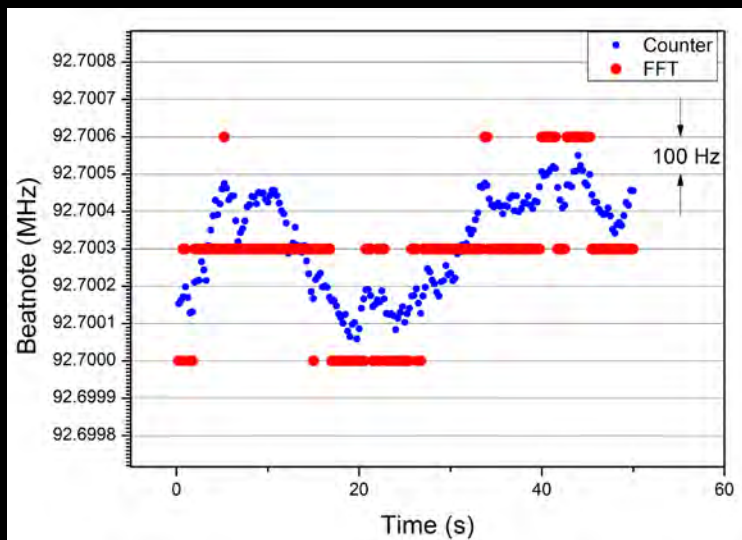
Ultra-stable
VCOF source



Comb f_{rep} locked to REFIMEVE



Comb f_{rep} locked to REFIMEVE

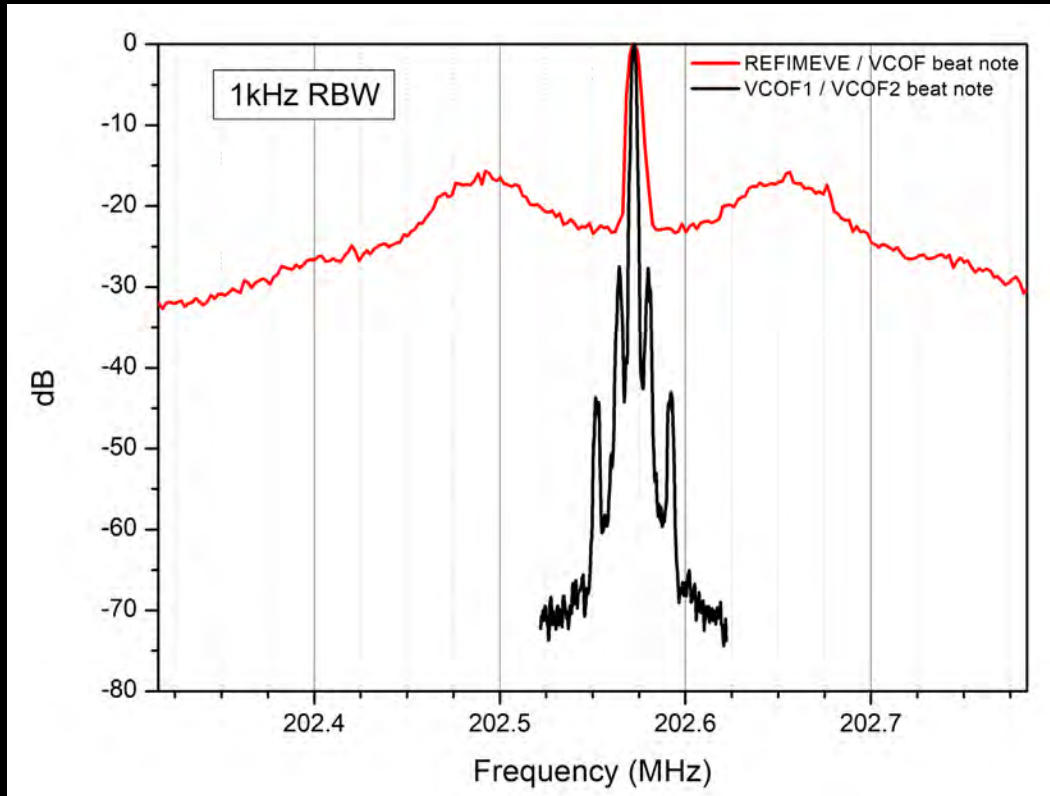


Comb f_{rep} locked to REFIMEVE

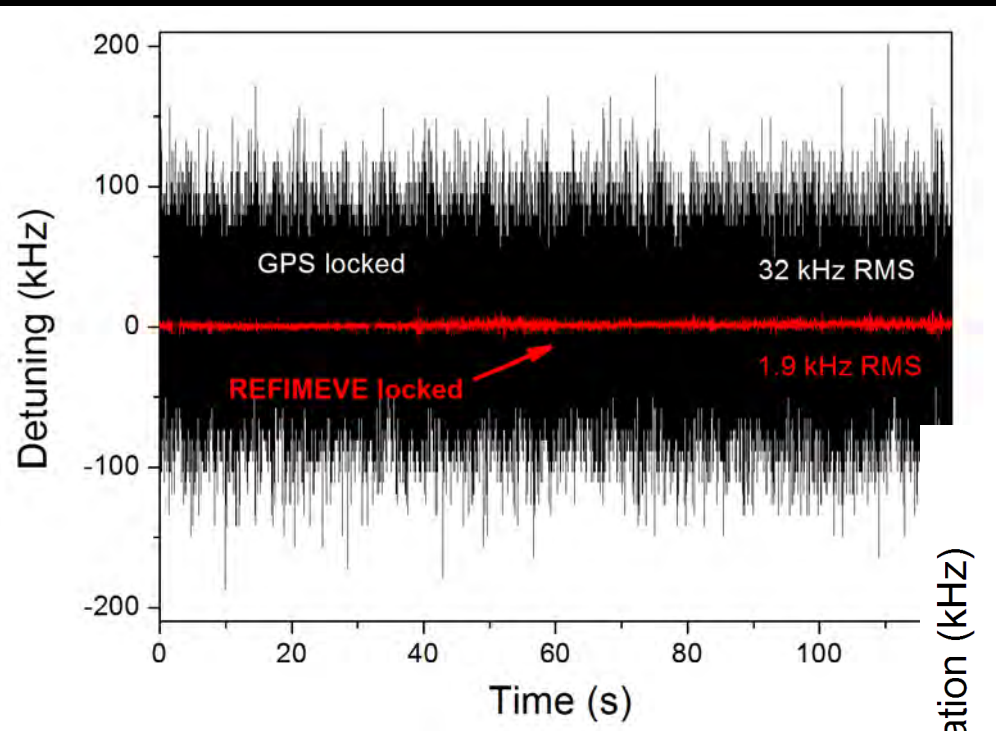


REFIMEVE signal at LIPhy

Beat note with sub-kHz VCOF source

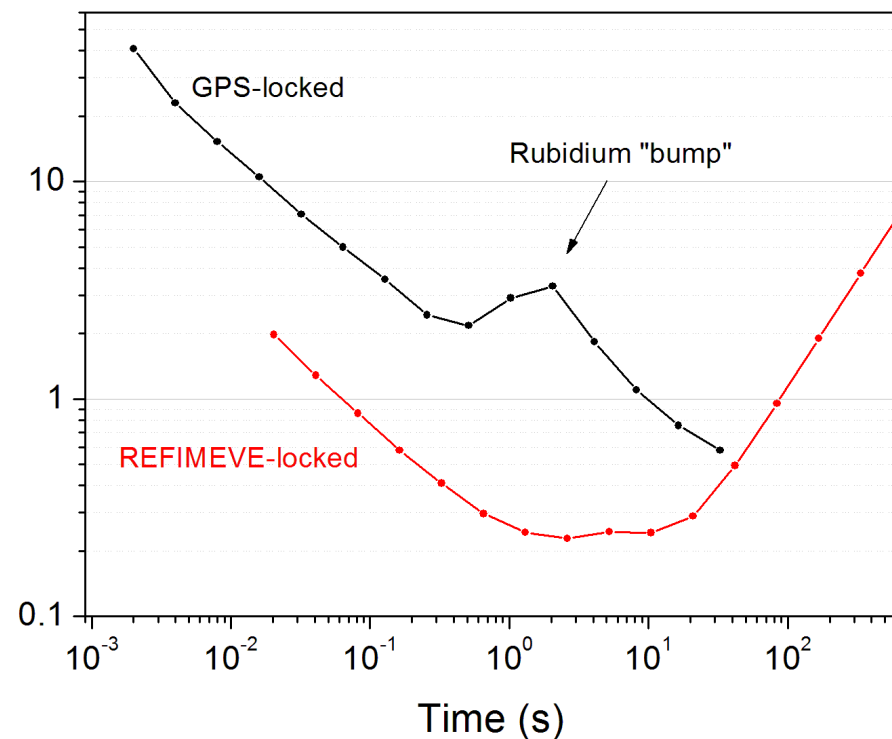


REFIMEVE signal
as received at LIPhy
is typically ~6 kHz wide



Narrower comb
spectral width

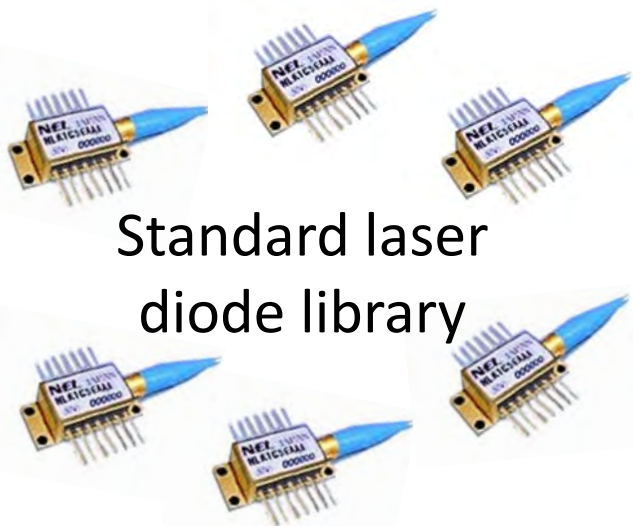
Allan deviation (kHz)



Part 2

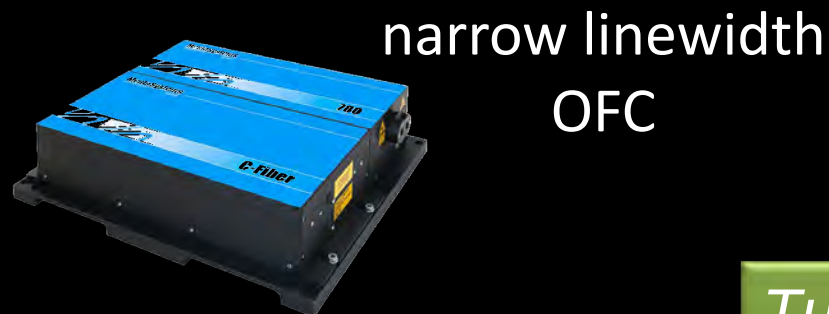
The comb as a source of
master frequencies

Coherence transfer (feed-forward)

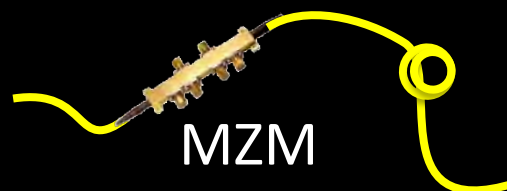


Standard laser
diode library

2 MHz linewidth



narrow linewidth
OFC



MZM



Radio frequency



Electronics

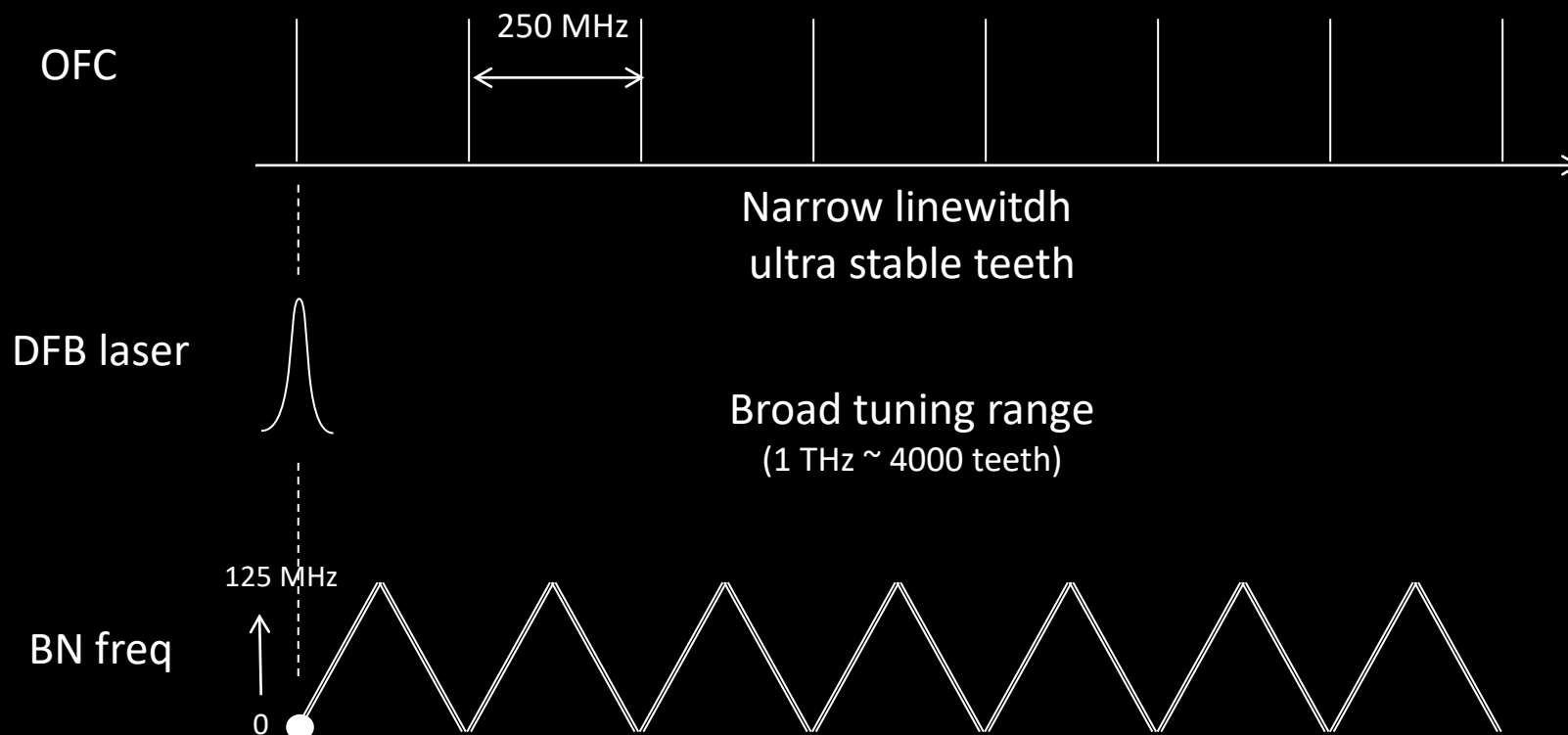
*Tunable
narrow
laser*

Transfer single tooth comb quality to your standard laser



Phase cloning of an OFC tooth

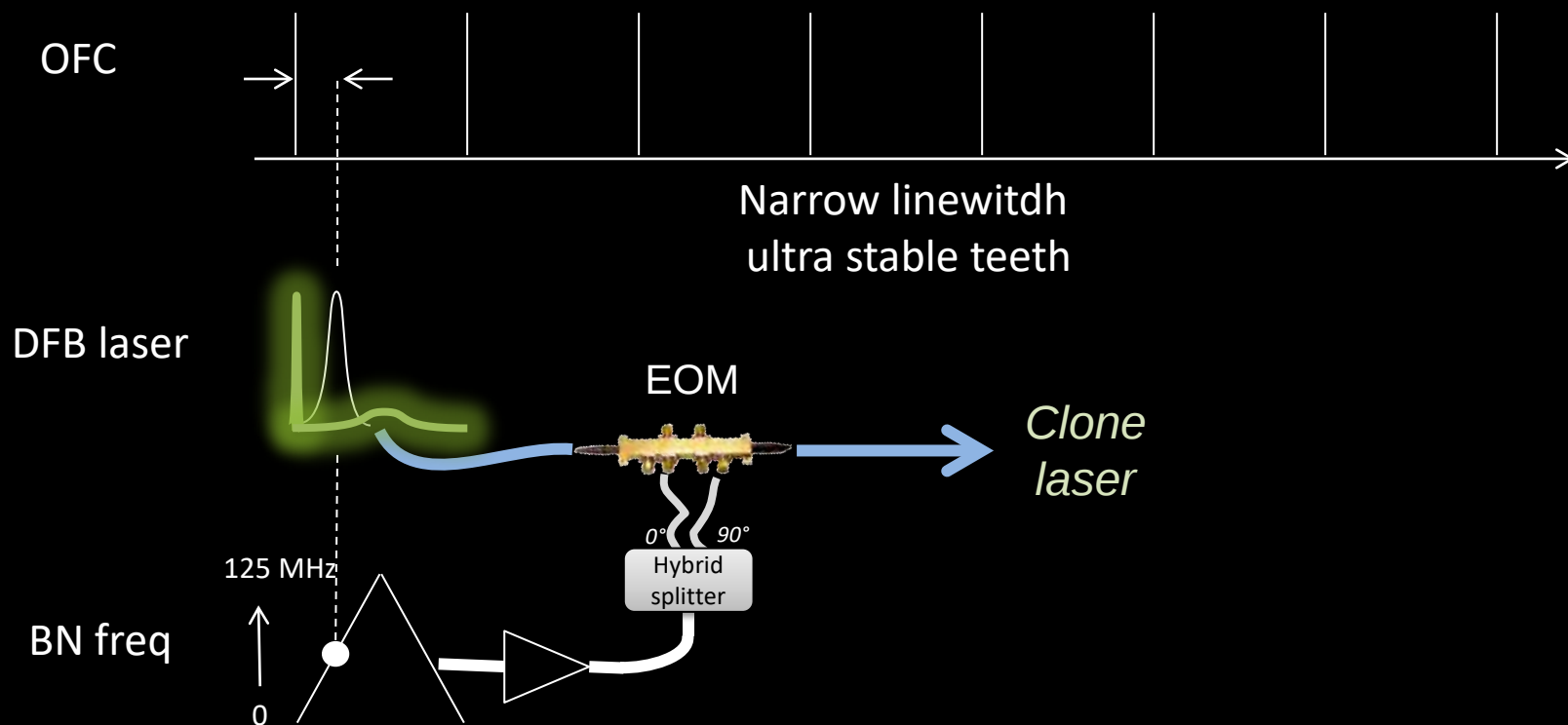
Feed-forward





Phase cloning of an OFC tooth

Feed-forward

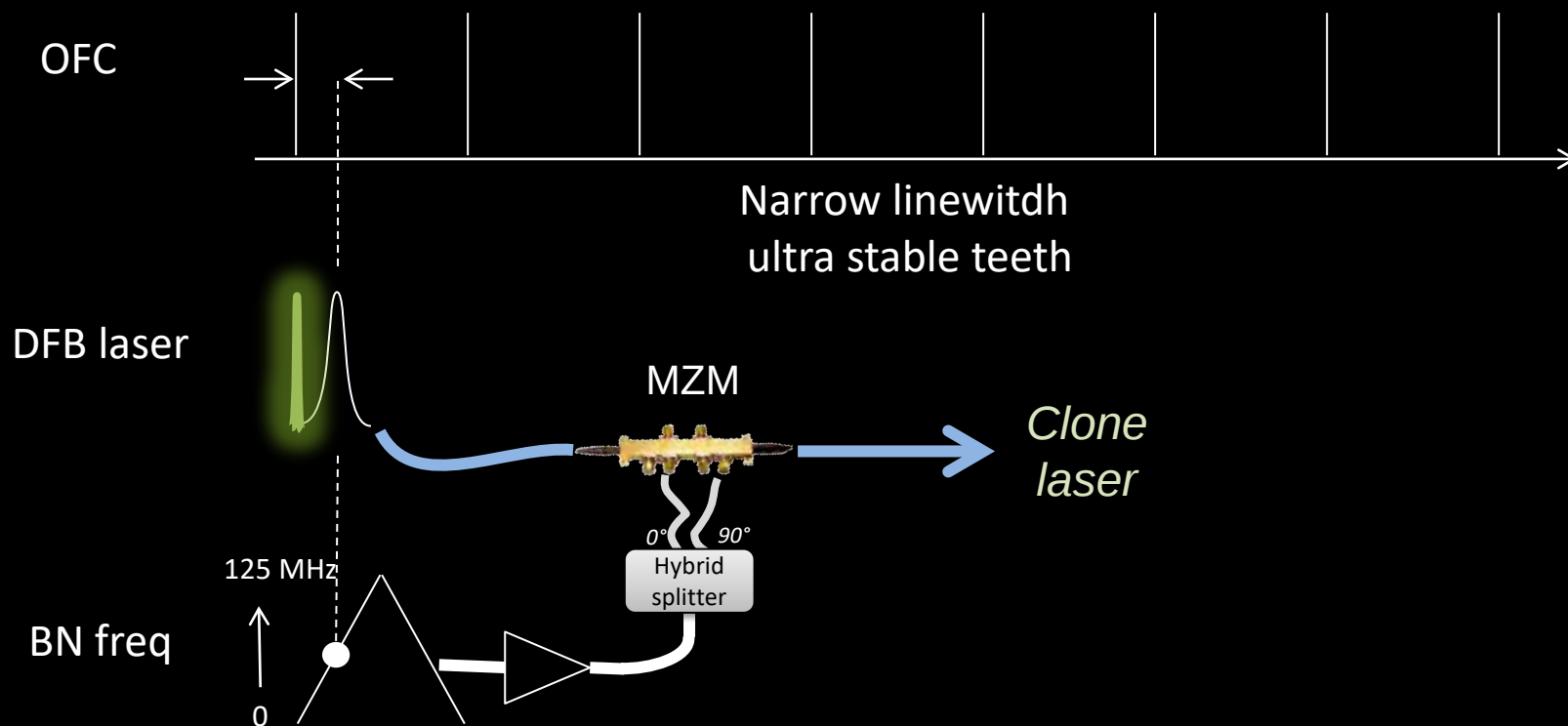


*Applying phase cloning
Narrow laser at OFC tooth frequency*



Phase cloning of an OFC tooth

Feed-forward

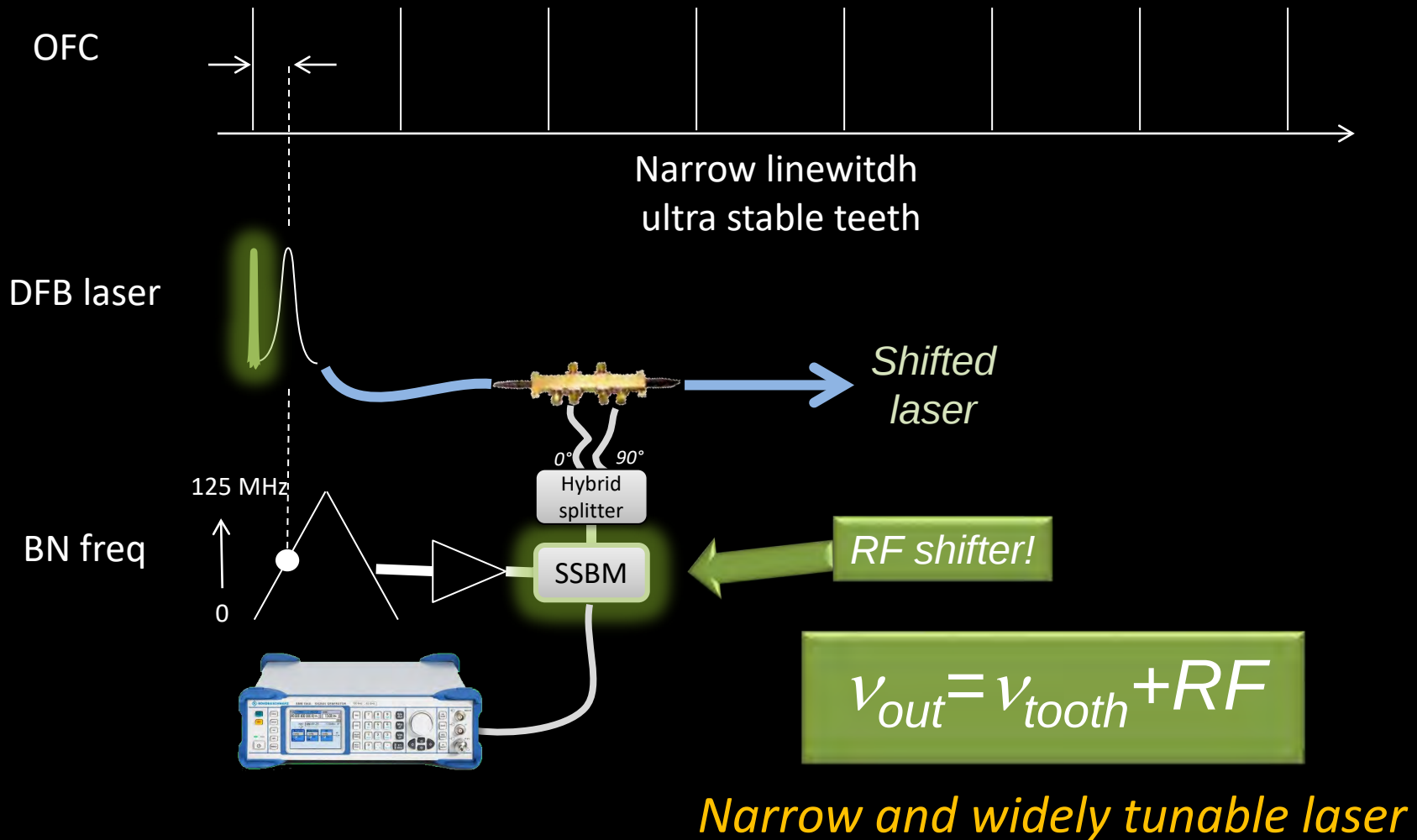


*Applying phase cloning
Narrow laser at OFC tooth frequency*



Phase cloning of an OFC tooth

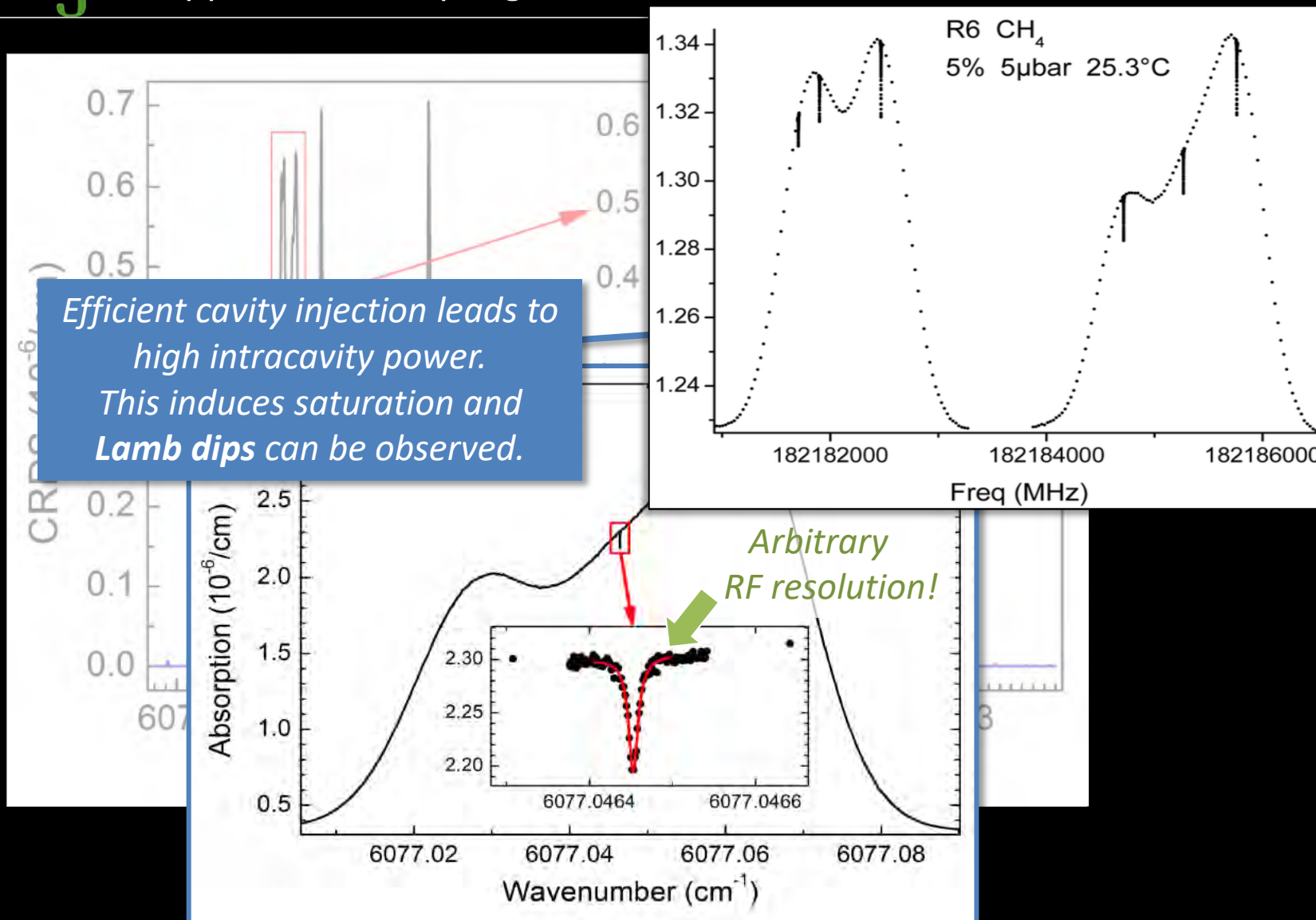
Feed-forward with RF shift





Phase cloning of an OFC tooth

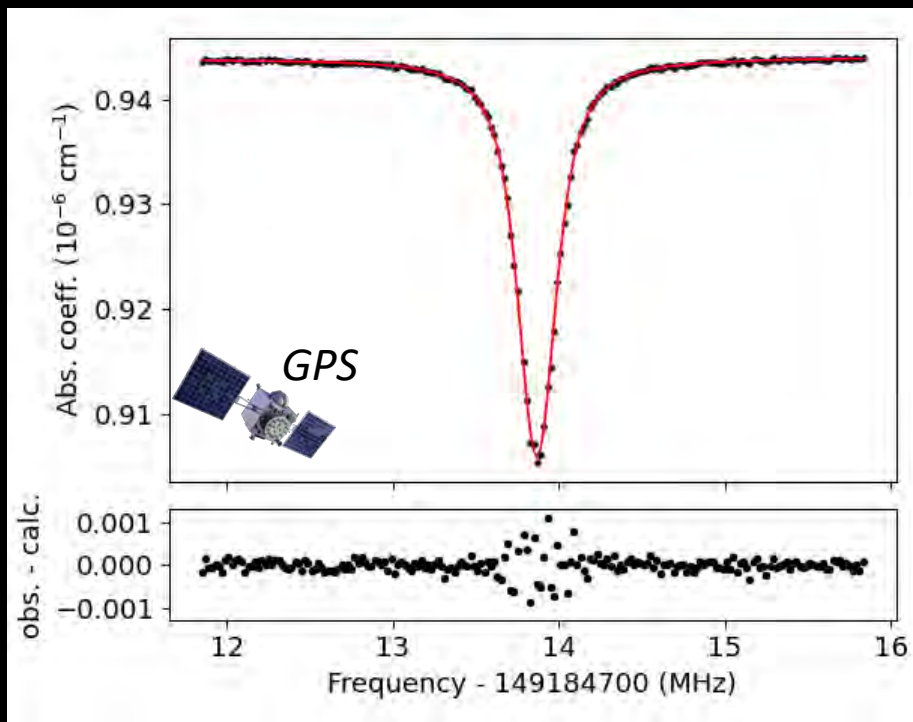
Application: coupling to CRDS



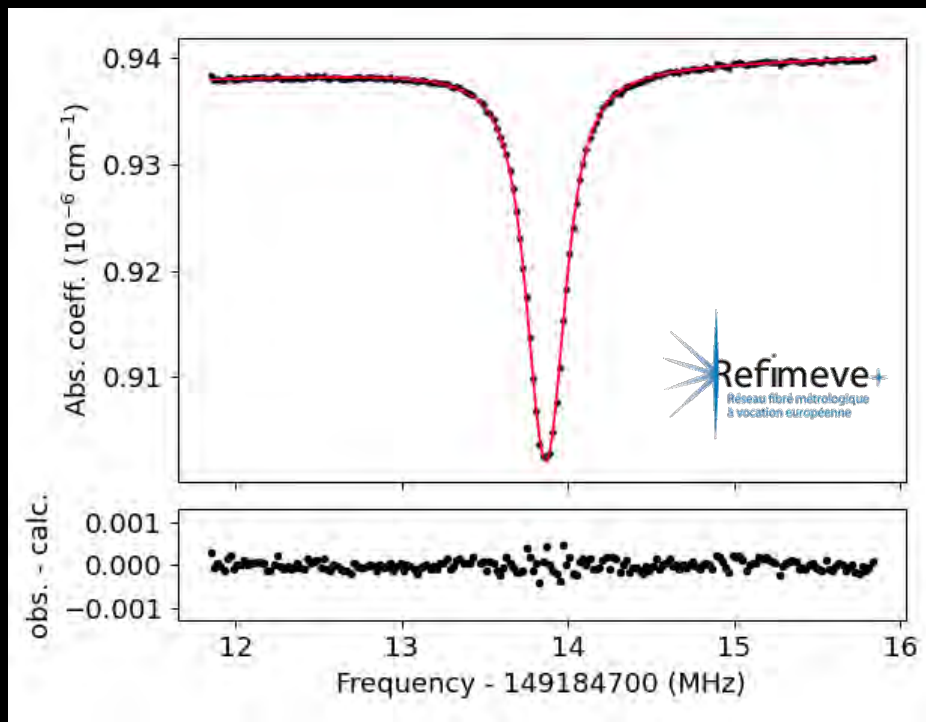


REFIMEVE vs GPS comb lock

Illustration with CO₂ Lamb dip



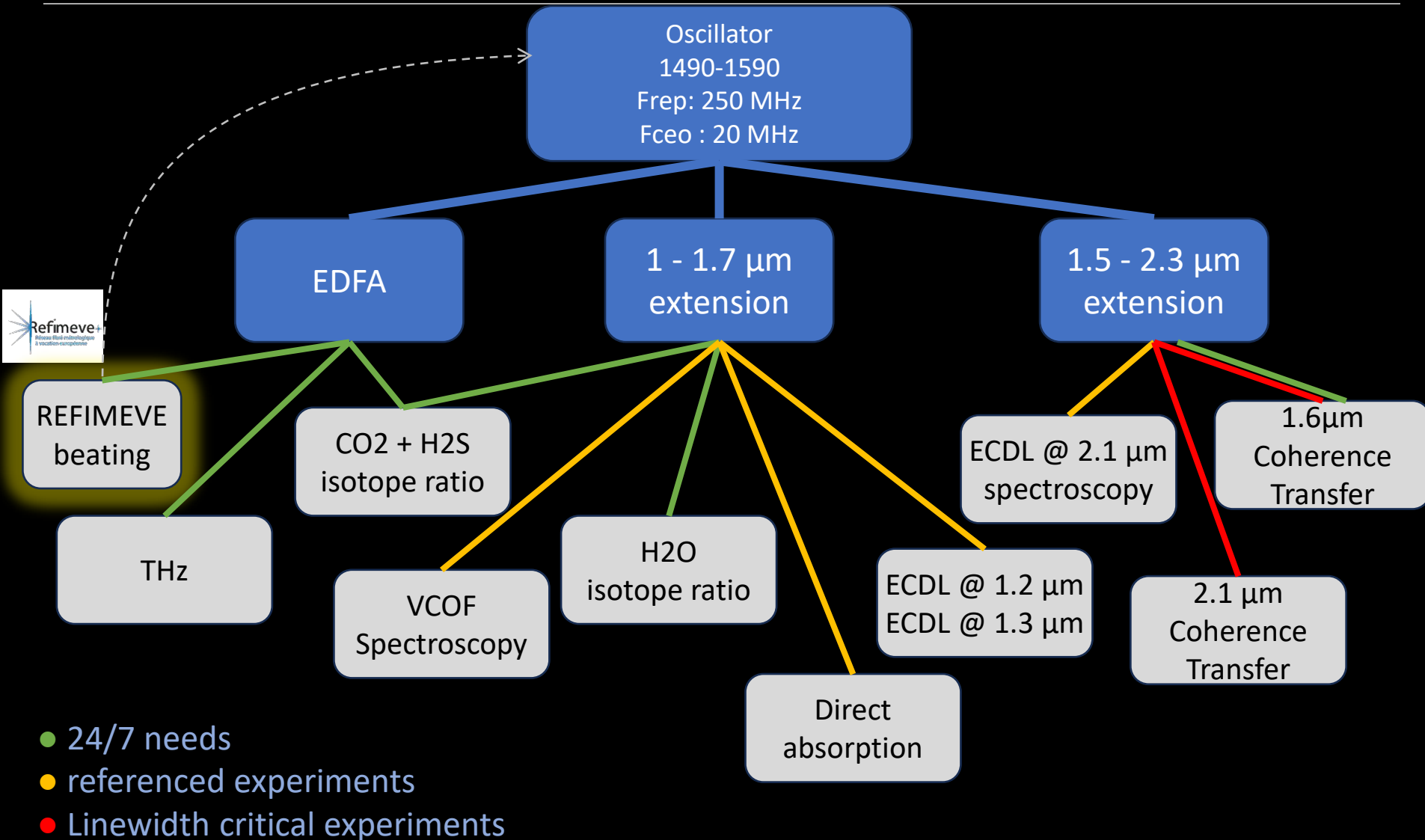
Excess noise on dip betrays
larger laser linewidth



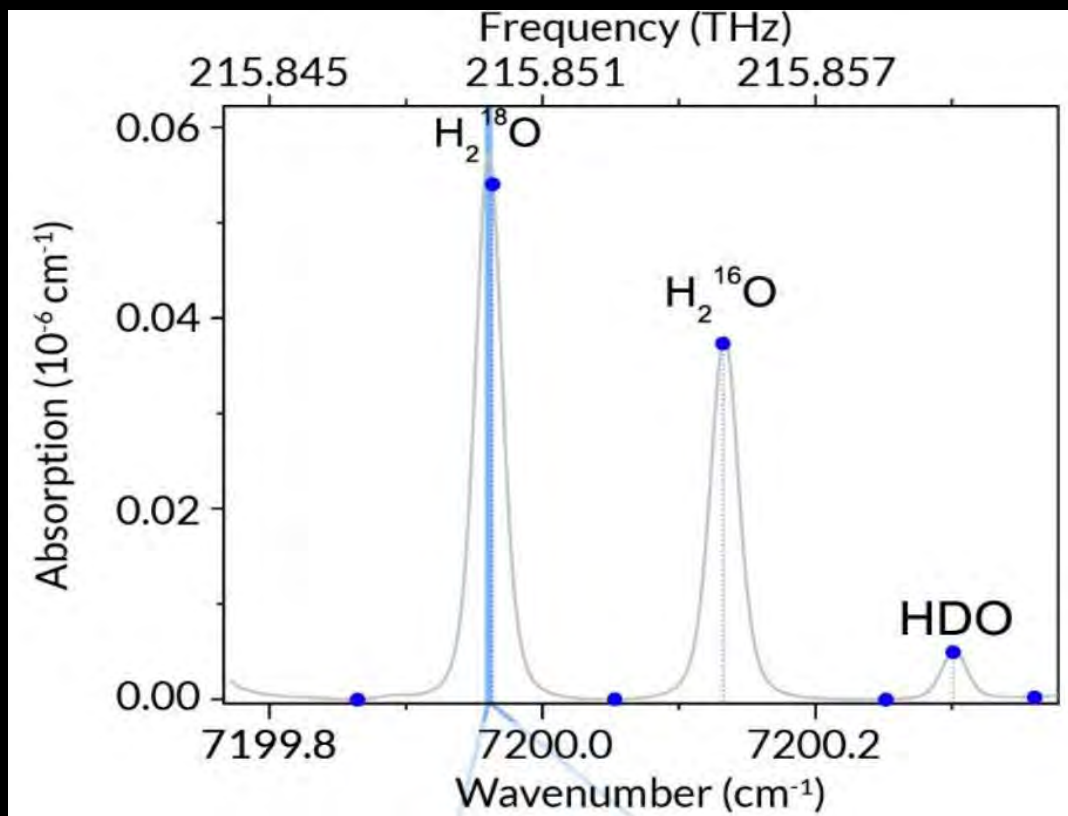
Better SNR with Refimeve

Signal distribution

Highly exploited OFC comb



Note: all experiments are comb linewidth dependent



The OFC permits to correct for frequency drift

Long term stability and accuracy



Paleoclimate
study in
polar regions



Ultra-stable
VCOF source

Thank you for your attention!

