μQUANS

Absolute Quantum Gravimeter

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General presentation of MUQUANS

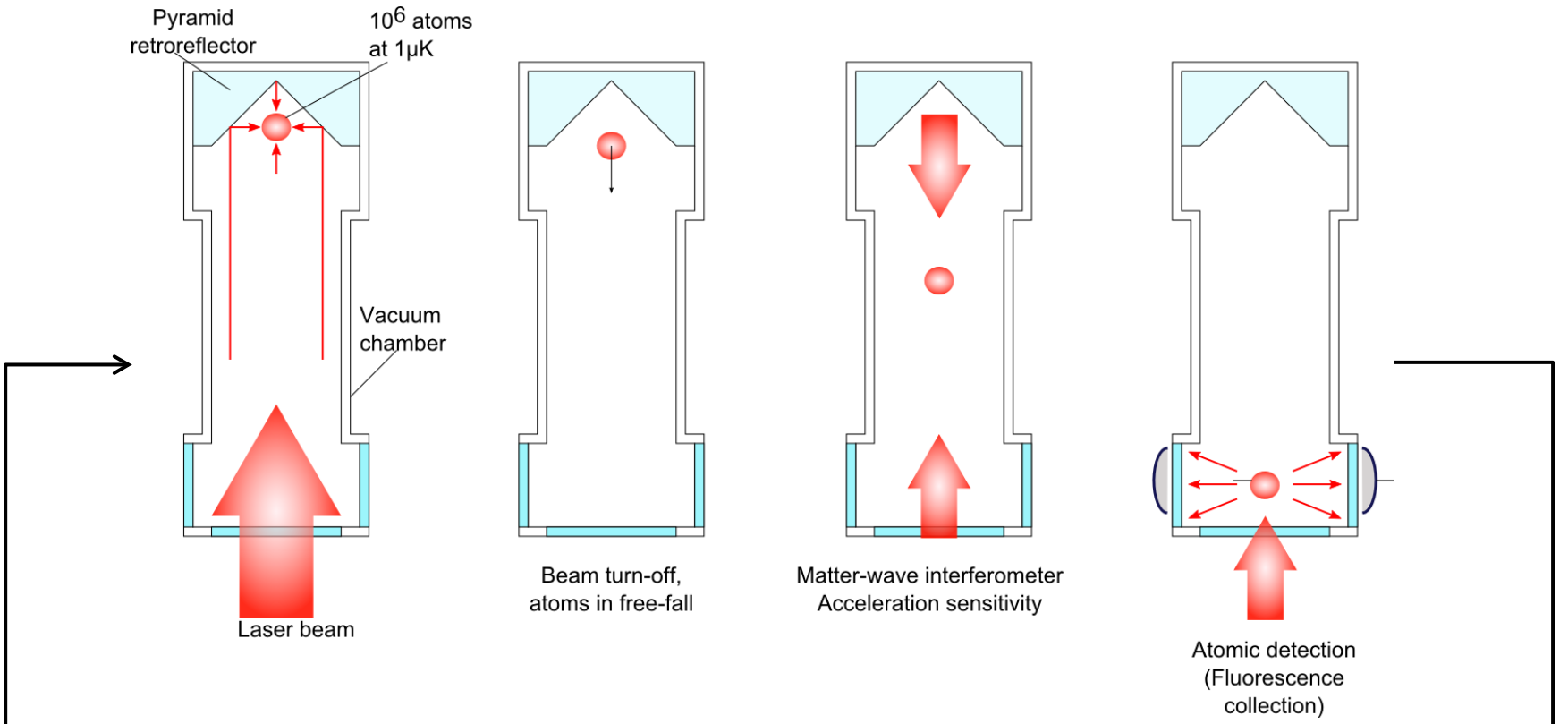
- Start-up created at end of 2011. Currently 15 people
- Objective : launch on the market place a new generation of high precision instruments, based on cold atoms
  - Absolute Quantum Gravimeter
  - High performance Atomic Clock

- Technology transfer from two academic labs :

l'Observatoire de Paris | SYRTE
Systèmes de Référence Temps-Espace

INSTITUT d'OPTIQUE GRADUATE SCHOOL

AQG : principle of operation



Repetition frequency : 2 to 3 Hz

Key technological innovations

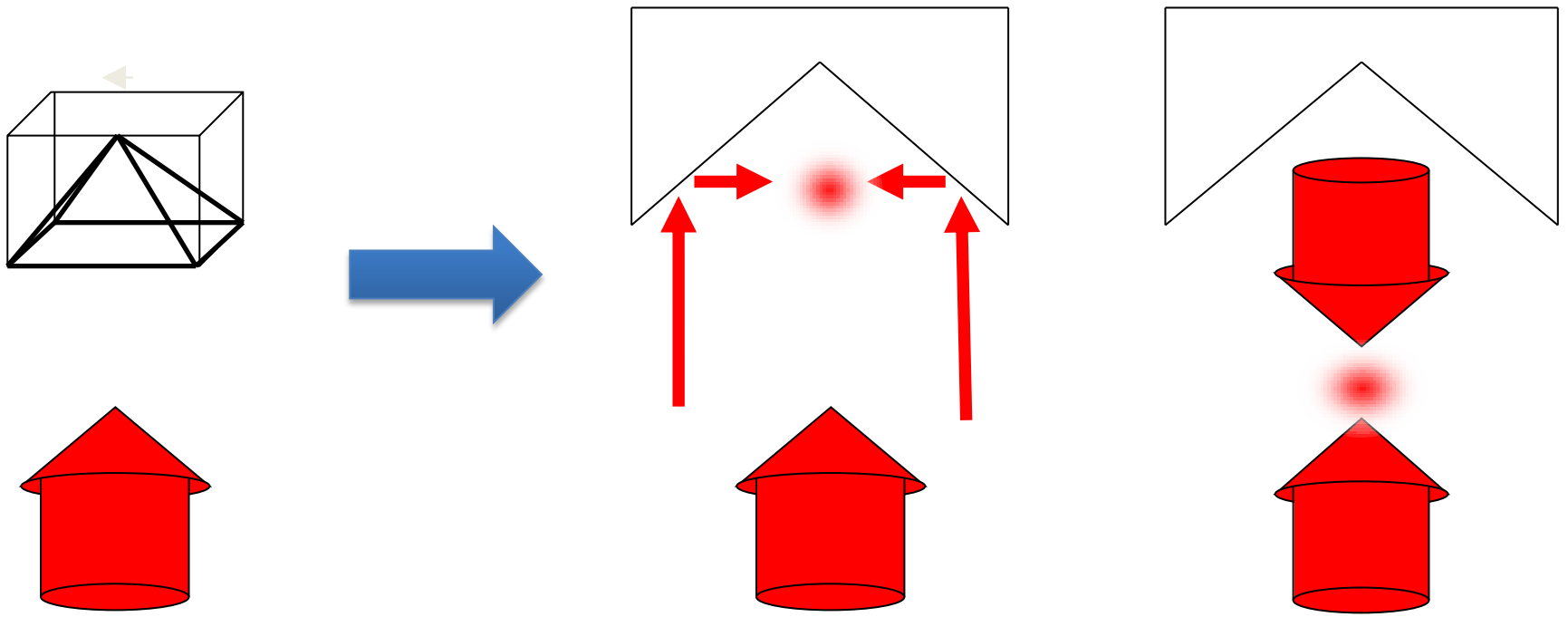
- Final objective is to develop a field gravimeter :
  - Absolute measurement at the µGal level
  - Portability and robustness
  - Reduced maintenance constraints

- Instrument design based on several technological innovations :
  - Pyramidal reflector
  - Fibered laser system
  - Feed-forward concept for vibration filtering

Pyramidal reflector

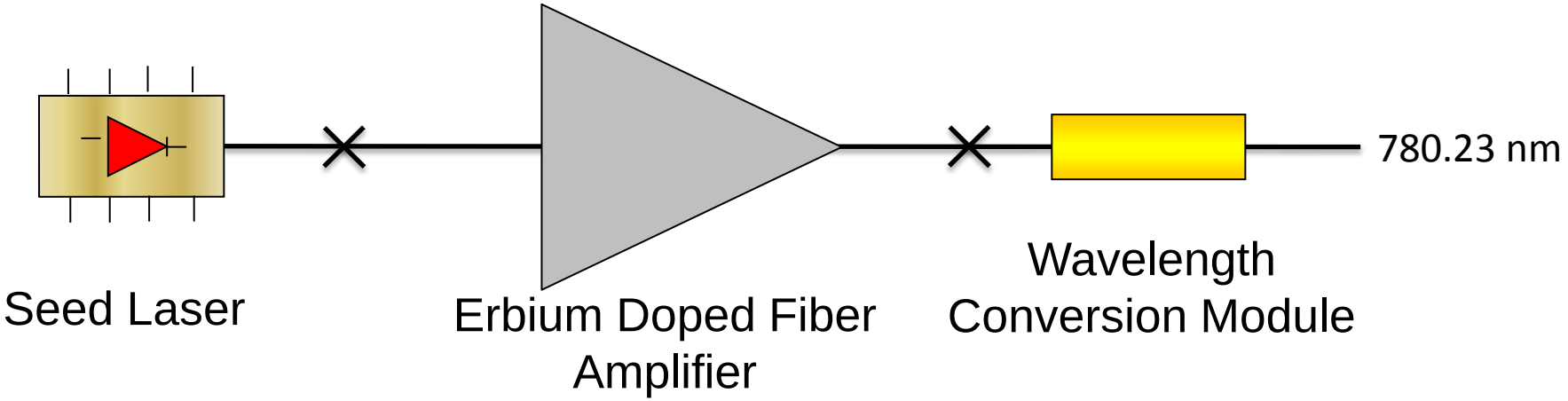
- Pyramidal reflector : All functions implemented with <u>one single laser beam</u>

  => drastic simplification of the sensor head



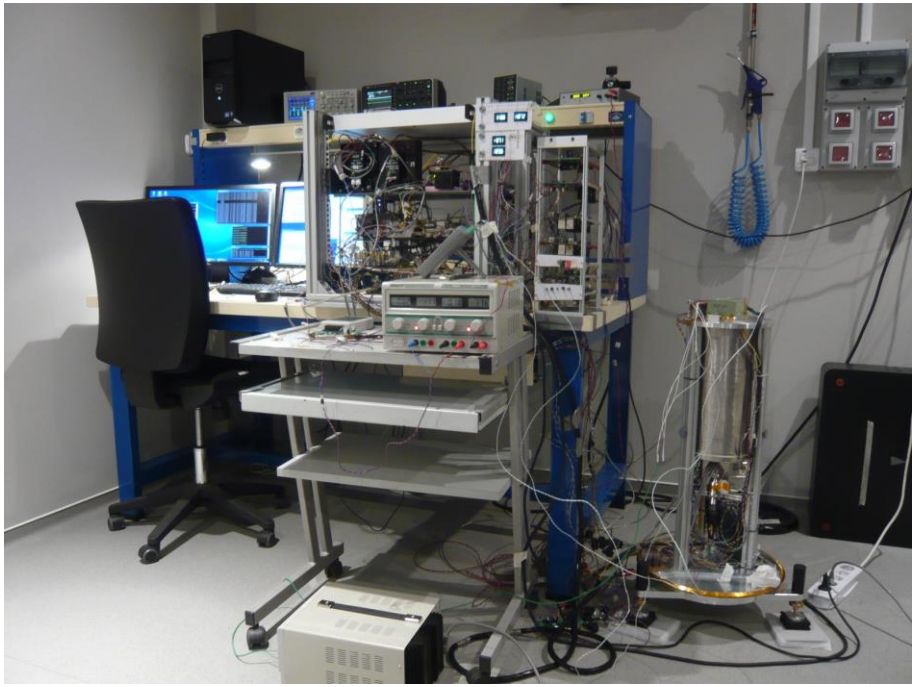
Fibered laser system

- 780.23 nm based on second harmonic generation of 1560.48 nm (telecom wavelength)



- Many advantages:
  - Standard optical telecom components
  - No alignment procedure
  - Extreme compactness

A few pictures

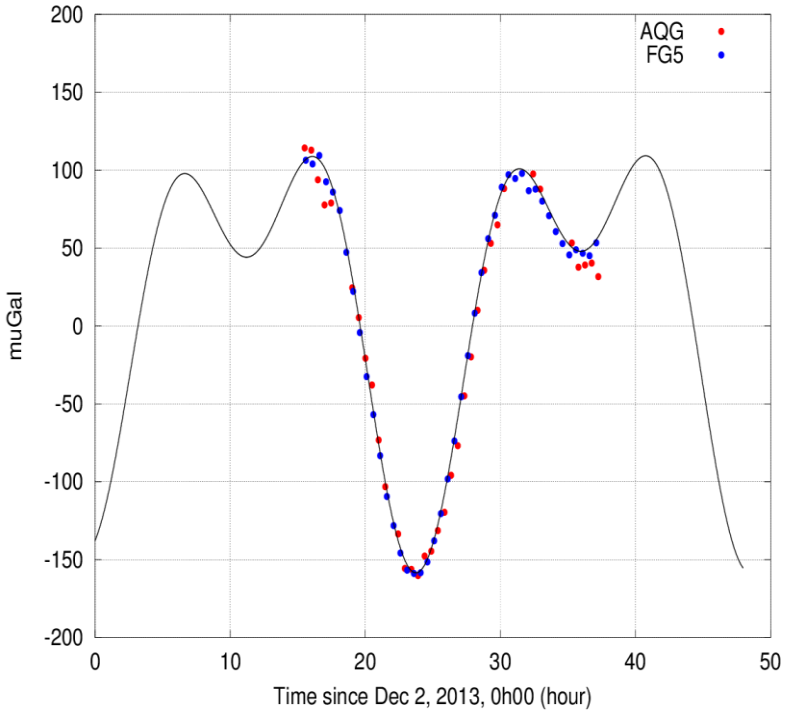


Our research prototype

AQG 01 (β version,
to be delivered to RESIF)

Comparison with FG5 (12/2013)

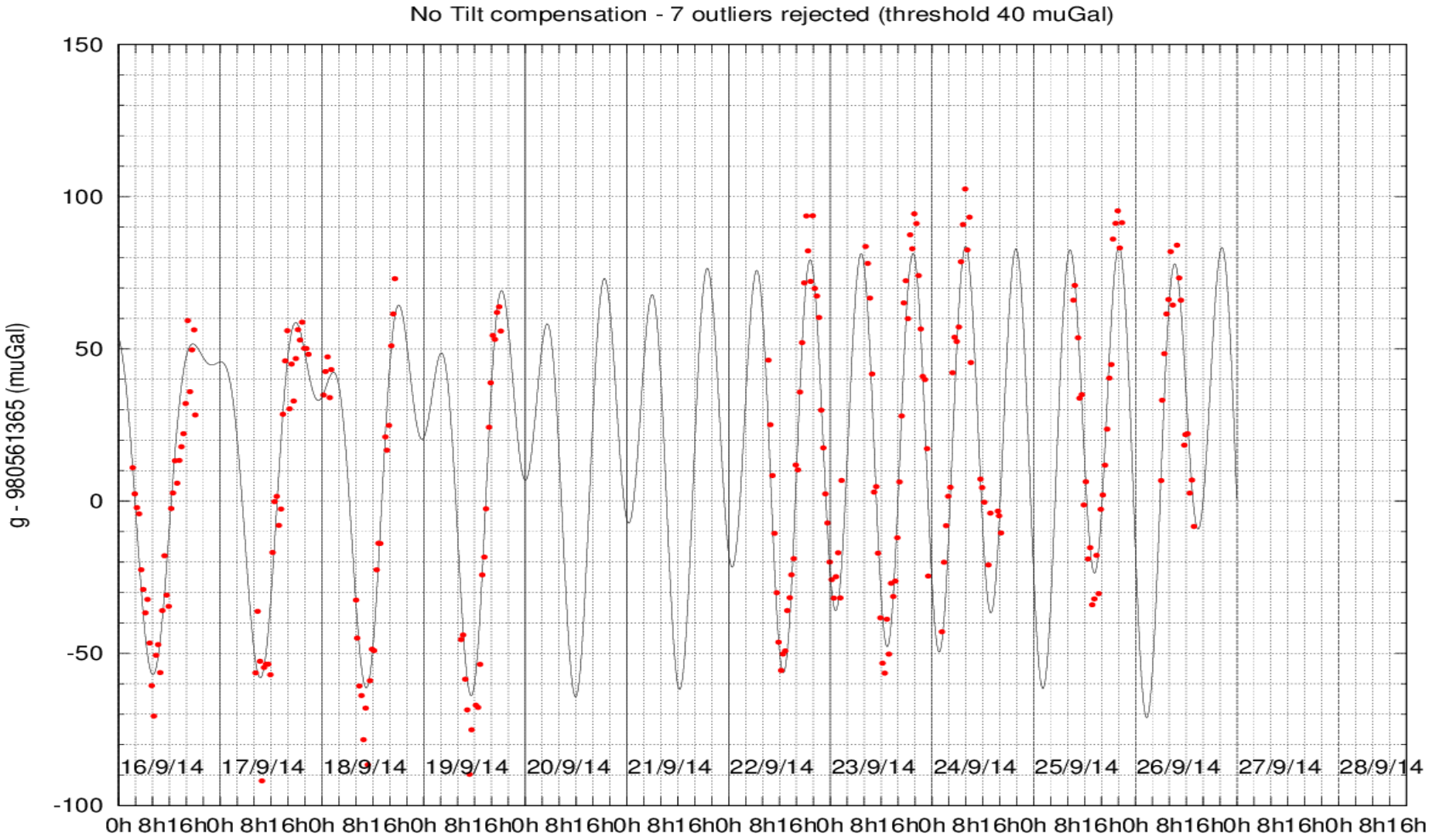
Experiment conducted in collaboration with N. Lemoigne (CNRS/ RESIF, FG5 #228)



68 µGal difference between AQG and FG5 :

- Horizontal gravity gradient
- Coriolis effect
- Light shifts

Gravity measurements (09/2014)



Gravity measurements

- No measurable drift over 2 week
- No warm-up effect (AQG fully operational less than 30 minutes after power-on)
- Measurements are now clearly limited by short-term sensitivity :
  - Current sensitivity = 250 µGal/sqrt(Hz)), limited by Raman SNR. Under investigation.
  - Detection SNR shows 50µGal/sqrt(Hz) is achievable

Conclusion

- Prototype operational. Limit on short term sensitivity under investigation.
- Promising perspectives :
  - Measurement at the µGal level… or better (cf S. Merlet's talk) ?
  - Easy to use (no primary pumping, no optical alignment, no mechanical assembly)
- First unit to be delivered to RESIF early 2015.
- Next steps :
  - hardening of the instrument
  - Reduction of mass, improvement of compactness