



*“GGranSasso RD”*  
*(GINGER - Gyroscopes in General Relativity)*

*Alberto Porzio (Resp. Loc.)*

*Raffaele Velotta*

*Carlo Altucci*

*Salvatore Capozziello (2018 ?)*



# The collaboration

- INFN

- Pisa – A. Di Virgilio
- Napoli – A. Porzio
- Torino – M.L. Ruggiero
- Padova/Legnaro – G. Naletto/A. Ortolan

- Other partners

- TUM and Bavarian Goedelical Observatory
- Univ. of Christchurch (NZ)
- INGV
  - molto interessato ai dati sulle maree crostali, c'è un accordo tra gli enti per una partecipazione dell'INGV per ora concretizzata nel pagamento di una borsa annule per laureate a Pisa

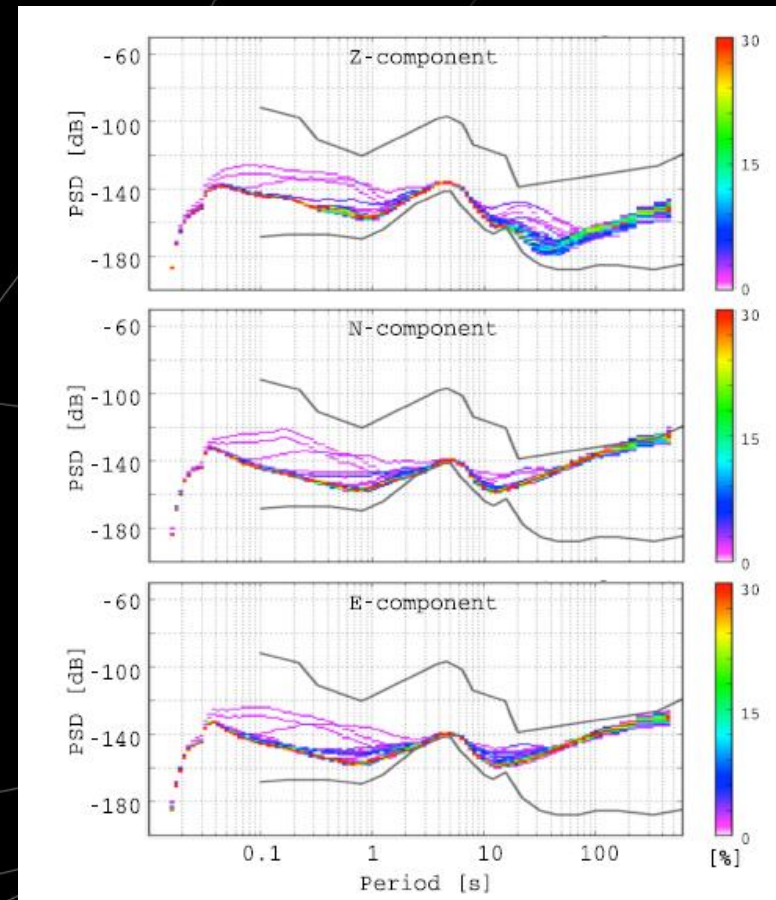
# Core Activity (so far) - GINGERINO



- A 3.6m side Sagnac ringlaser is operative inside LNGS since the beginning of 2016
- Preliminar results
  - Rev. Sci. Inst. **88**, 034502 (2017)
    - highlights on Nature Physics, AIP, riportato anche su La Repubblica

LNGS is close to the seismic background (Low noise model) for the crustal motion so it is suited for GINGER

N.B. siamo nella zona attualmente incriminate per il problema dell'acqua... probabile trasloco interno nel 2018



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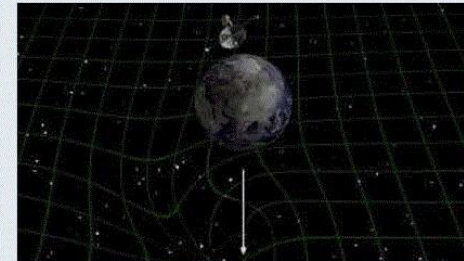
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## research highlights

GENERAL RELATIVITY  
**Going underground**  
Rev. Sci. Instrum. **88**, 034502 (2017)

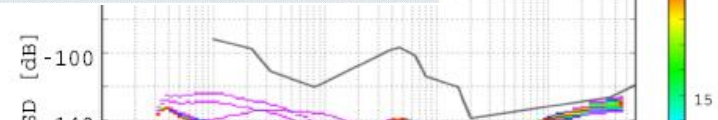
### SCIENZA



La Terra gira a 1600 km orari:  
un laser ci darà la misura esatta

Test nei Laboratori sotto il Gran Sasso  
per confermare la tesi di Einstein [video](#)

di ELENA DUSI



## "Going Deep" to Measure Earth's Rotational Effects

[publishing.aip.org/publishing/journal-highlights/going-deep-measure-earth%E2%80%99s-rotational-effects](http://publishing.aip.org/publishing/journal-highlights/going-deep-measure-earth%E2%80%99s-rotational-effects)

Period [s]



# Core Activity (so far) – GP<sub>2</sub> and modelling

- GP<sub>2</sub> in PISA
- Sagnac with 1.5m side for system tech development
- New control strategies (diagonals, geometry, laser dynamics)
- Novel model for the LT measure
  - Eur. Phys. J. Plus (2017) **132**: 157
    - highlights...
- Two ring lasers are enough for measuring LT effect.

**EurekaAlert!** | AAAS  
The Global Source for Science News

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PUBLIC RELEASE: 10-MAY-2017

### Proving Einstein right using the most sensitive Earth rotation sensors ever made

*A new study use the most precise inertial sensor available to date to measure whether Earth partially drags inertial frames along with its rotation*

SPRINGER

**EPJ Plus Highlight - Proving Einstein right using the most sensitive Earth rotation sensors ever made**

Published on Friday, 21 April 2017 22:55



# Scientific Impact

- Direct
  - first ever LT measurement on the Earth (sitting on a rotating object...)
  - 1% precision goal (it seems not impossible...)
- Indirect
  - the measure has strong connection with some not solved theoretical questions (S. Capozziello)
  - RL data are of extreme interest for geodesy and rotational seismology as well as for more *fundamental* studies on the Physics of the Earth
  - there is a tech transfer interest connected to metrology (precise goniometry)



# Our role

- Optical model (plasma and capillary, cavity, optical monitoring of the geometry...)
- Supporting experimental activity at LNGS
  - few visits
  - tech support with Pino Passeggio (thermal isolation and stability of the containing box... in stand-by due to the forthcoming moving in another place)
- general modelling (S. Capozziello is going to take the lead on this...)

# Funding and man power

- INFN

- Gruppo V (2008-2011)
- Gruppo II since 2012 (150k€/year)

- INGV

- one year fellowship, some technical instruments for external monitoring

- LMU

- a joint PhD student on geodesy is analysing our data from that point of view

- In the FUTURE

- MAN POWER

- Possible joint facility for mirror testing in Pisa (with our German partners)
- The main project would require  $\geq 2\text{M€}$  for construction and  $0.2\text{M€/year}$  running costs.