About Us
Founded in 2006 in Neuchatel, Switzerland, T4Science is a leading designer and manufacturer of a full range of advanced, cost-effective and high-performance maser clock solutions. Its products are used in a wide variety of scientific applications and in the time and frequency industry.

Products
The iMaser™ is a high-performance, compact active hydrogen MASER. It features advanced phase noise and short term stability for high-precision Frequency & timing applications.

Services
We offer a complete set of first-class services over the product lifecycle for total customer satisfaction. These services, though not limited, include the following:
Supply & Installation, Training, Remote & On-Site Maintenance, On-Site Support
4 generations of Maser

– EFOS A

– EFOS B

– EFOS C

– iMASER (EMC/CE)
Active Hydrogen Maser principle

• **MASER**
  – for Microwave Amplification by Stimulated Emission of Radiation

• **Active**
  – Oscillator based on quantum transitions of Hydrogen atoms (1.42 GHz)

• **High atomic quality factor**
  – ( > 1E+9)

• **Cavity factor**
  – Qcav > 30000
Active Hydrogen Maser principle

- The maser is active: it radiates 1.42GHz
- The interrogation time is prolonged due to Teflon coating on the storage bulb
- Output is derived from a Crystal Oscillator locked to the maser output (PLL)
Hydrogen atomic beam and storage bulb

- Storage Bulb & Cavity
- Hydrogen supply.
- Magnetic state selector
- Hydrogen flux regulator
- Dissociator
Stability of H maser and various frequency standards

Log (\(\sigma_y(\tau)\)) vs. Log (\(\tau\)), seconds

-9 -8 -7 -6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6 7

1 day 1 month

Quartz
Rubidium
Cesium

Hydrogen Maser

sales@t4science.com  www.t4science.com
iMaser vs other clocks (EFTF 2010)
Typical Performance

FREQUENCY STABILITY
iMaser 3000 3 Corner Hat

Allan Deviation, $\sigma_\alpha(\tau)$

$10^{-15}$

$10^{-14}$

$10^{-13}$

Averaging Time, $\tau$, Seconds

$10^0$  $10^1$  $10^2$  $10^3$  $10^4$  $10^5$

3-Cornered Hat Analysis

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Phase noise 5MHz  1Hz -100kHz

\[ \epsilon(f) \text{ [dBc/Hz]} \text{ vs. } f(\text{Hz}) \]
Phase noise 100 MHz
T4Science Customers & location

– 30 years operations
– 70 masers operating
– Worldwide customers on all continents
– Solution for difficult environment
  • 5000 m altitude ESO in Atacama
  • South pole
Application

– VLBI
  • BKG/ MPI / IRAM / MIT / INAF…

– Deep space tracking
  • (ESA/ ISRO)

– Timing/Frequency Station
  • National (CH / Taiwan…)

– Navigation
  • Ground stations European Galileo, Indian and Chinese

– Space
  • Collaboration for ACES on ISS

– Electronic
  • Radar
  • SLR (Satellite Laser Ranging)
Quality & Maintenance

• Global Maser Lifetime > 20 years
  – EFOS 1 still operating in WETTZEHL

• MTBF > 20 Years on last generation
  – >250 years of cumulative operation for iMaser generation

• Fast maintenance & support available
T4Science Features

• Particular Features
  – EMC Standard
  – CE Certification
  – Remote Ethernet control
  – Diagnostic Parameters analysis
  – remote alarms
  – New ULN OCXO 9E-14@1s
  – 1PPS low jitter
  – Heater cooler box
R&D

• Continuous upgrade for better:
  – Performance
  – Quality
  – Operability
  – Control
  – Cost efficiency
Thank You