Electro-Magnetic Pulse Measurements at the VEGA Laser Facility

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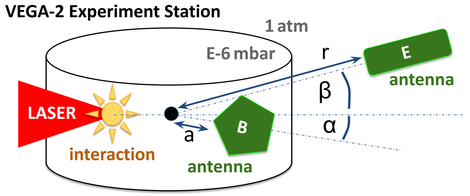
Goals

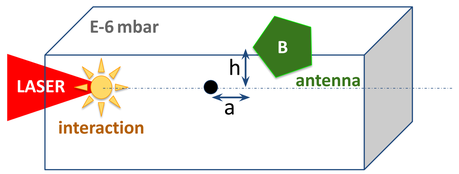
- ★ systematic record of the EMP strength inside the interaction chamber and in Target Area (TA) for gas/solid/liquid targets driven by 100ds of TW to PW relativistic laser pulses
- ★ correlation of set-up and EMP spectrum
- ★ user support and failure analysis

Set-up and Methodology

VEGA-2 Experiment Station



VEGA-3 Experiment Station

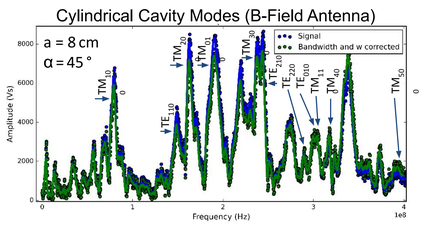


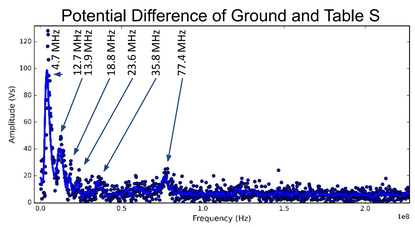
- ★ E- and B-field antenna signal recorded on GHz oscilloscope (calibrated circuit!)
- ★ analytical calculation of modes in cylindrical and rectangular cavities
- ★ towards high repetition rate online analysis with python software 'pyWA'

Experimental Results

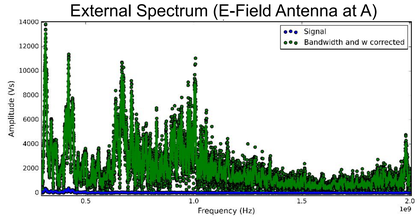
Gas Target

- ★ driver laser VEGA-2 at (3 — 5) J in 30 fs to several 10^{19} W/cm^2 by F/13
- ★ 8 mm FWHM gas jet target at 10^{18} /cc He

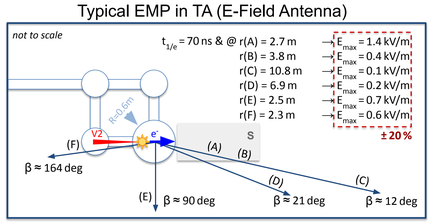




External Spectrum (E-Field Antenna at A)



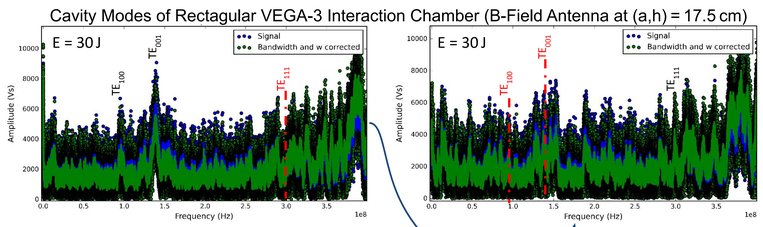
Typical EMP in TA (E-Field Antenna)

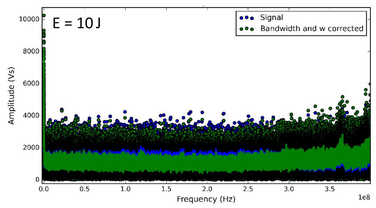


→ 100s of μT B-field amplitude (≈ 10 stronger than Earth's magnetic field), and 100s of V/m E-field (maximum fields sent by GSM mobile phones)

Solid Target

- ★ driver laser VEGA-3 at (10 — 30) J in 30 fs to several 10^{20} W/cm^2 by F/10
- ★ solid density target of 3 μm thickness





→ spatio-temporal evolution of laser-driven charge distributions has an EMP fingerprint

Perspectives

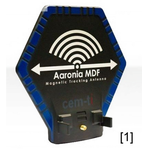
- ★ careful noise subtraction (mobile phones. WiFi, etc.)
- ★ determination of power in EMP
- ★ identification of applications (outcoupling of modes, etc.)
- ★ measure & log the EMP in TA with an antenna array
- ★ identify 'calm' bands for experiment specific RF measurements with sensitive B-dot and D-dot probes

Toolbox

- ★ calibrated commercial solutions

Magnetic Field

MDF9400 (Aaronia)
★ 9 kHz — 400 MHz



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Electric Field

OmniLOG 30800 (Aaronia)
★ 300 MHz — 8 GHz

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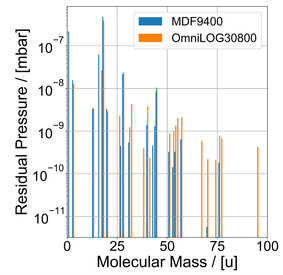

[1] Aaronia AG Product Overview 2021