DESIGN AND DEVELOPMENT OF A RAMAN LIDAR FOR CTA

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REQUIREMENTS
(TECHNICAL)

- Capable of extracting the extinction coefficient with 4-5% error
- Full characterization of the atmosphere up to 25 km distance
  - *Shower development up to 10km but observation can happen at lower angles*
- Fast pointing capabilities
  - *Atmospheric profiles in the direction of observations*
- Relatively compact
  - *Constraints on laser choice*
- Fast spectrum (120 seconds) with Raman capabilities
  - *Minimize dead time of physics runs*
  - *Laser interference with Telescopes forbitten*
- Full sky coverage up to 60° zenith angle
- At least 2 detection lines within sensitive window of the detected Cherenkov spectrum
- Capable to withstand desert type of meteorological conditions

CONCEPT

- Elastic / Raman combination
  - *Avoid lidar ratio assumptions etc …*
- Maximizing detecting surfaces and detection efficiencies
  - *Mirror size*
  - *Photomultiplier size*
  - *Fiber Optics optimization*
  - *Fast tracking*
- Remotely operated
  - *Robotic type of operation*
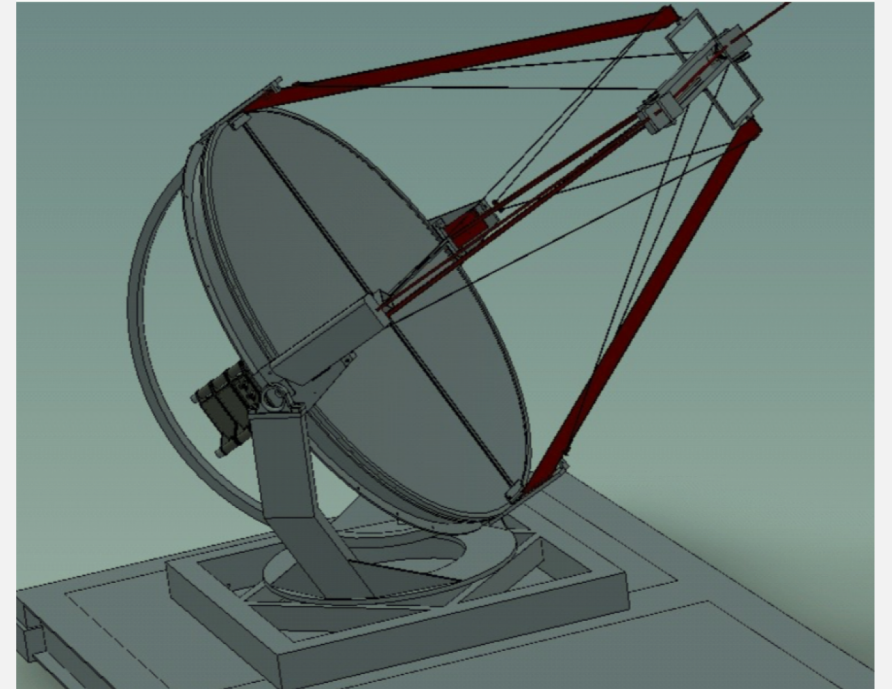
RAMAN LIDAR DESIGN

| Element	Choice
Telescope & Container (CLUE experiment)	1.8m diameter F1 aperture
Elastic & Raman Lines	355nm, 532nm,387nm, 607nm
Laser	Quantel CFR400 90mJ@355nm 10ns pulse 20Hz frequency
Polychromator	RAYMETRICS
DAQ system	LICEL 12 bits
Photodetector	HAMAMATSU R329P/R2257 2" photocathode
Alignement System	Newport / ThornLabs
Light Guide	LUMATEC 300 series 8mm diameter
Weather	Wind & Rain detection system
Automation	Panasonic FP7 PLC
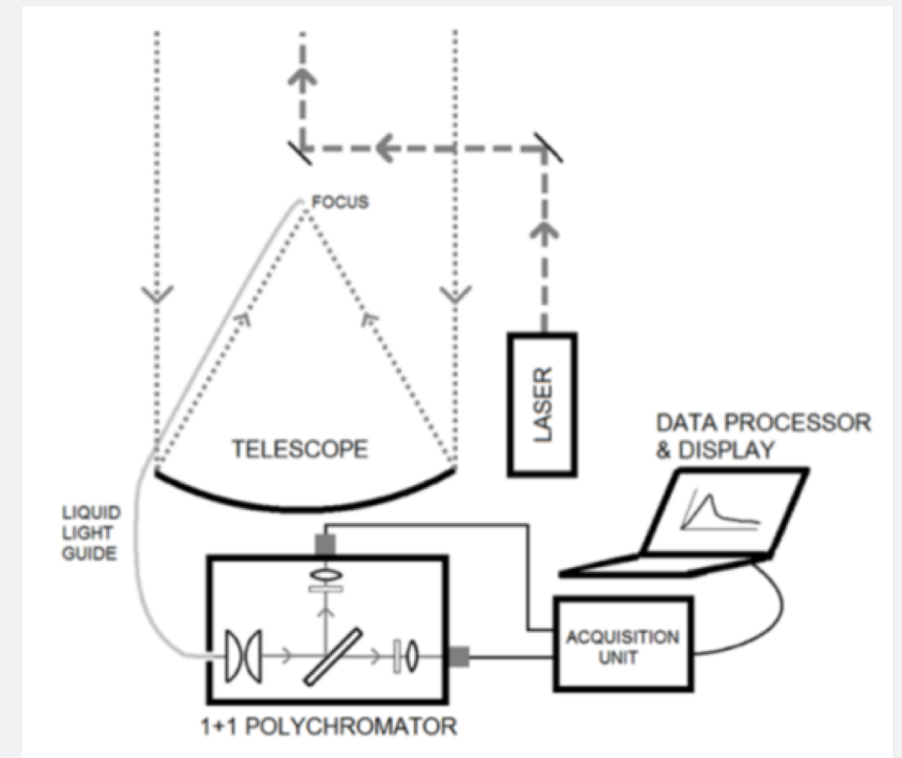
In blue common elements with IFAE/UAB Lidar
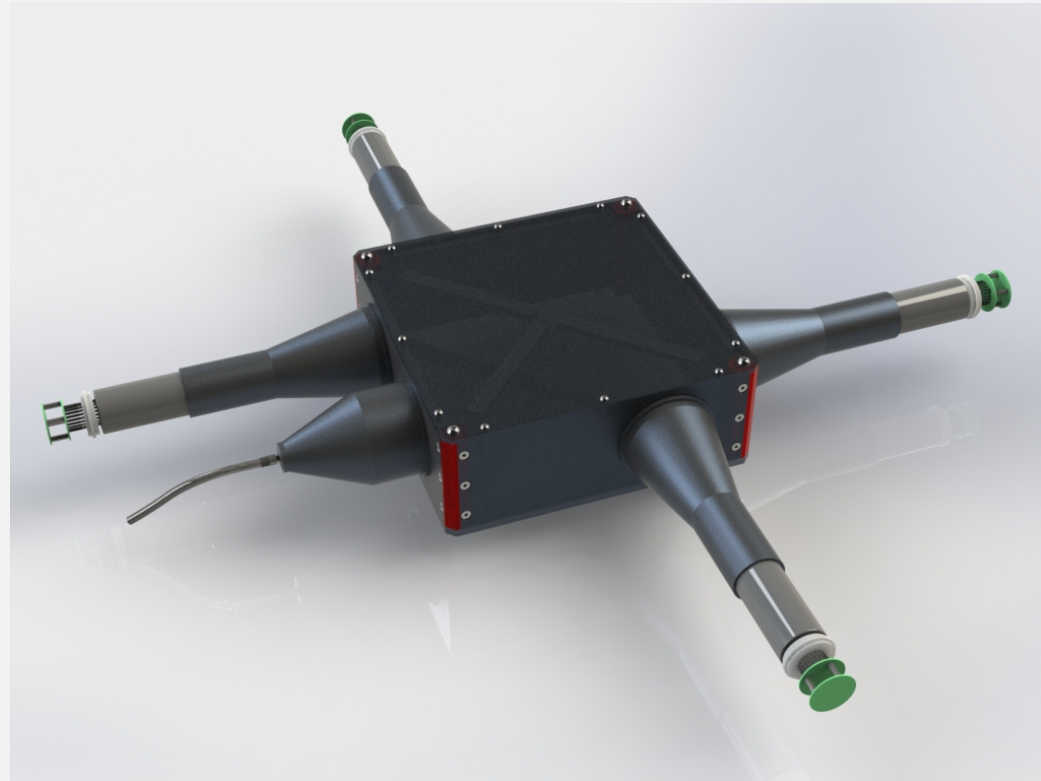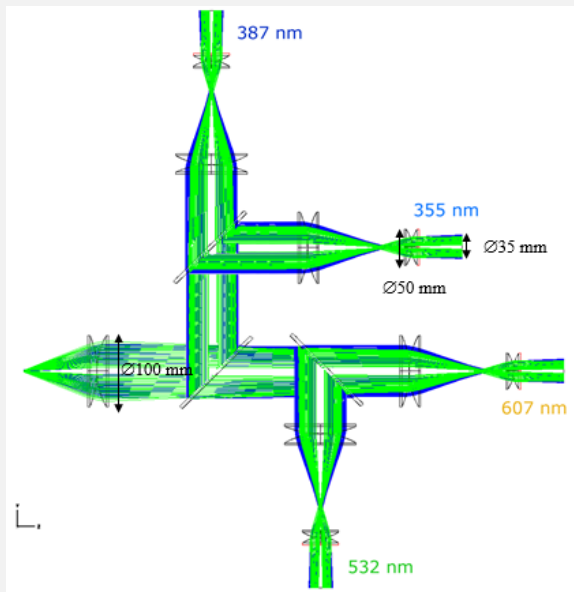
THE RAMAN LIDAR

TELESCOPE MIRROR
&
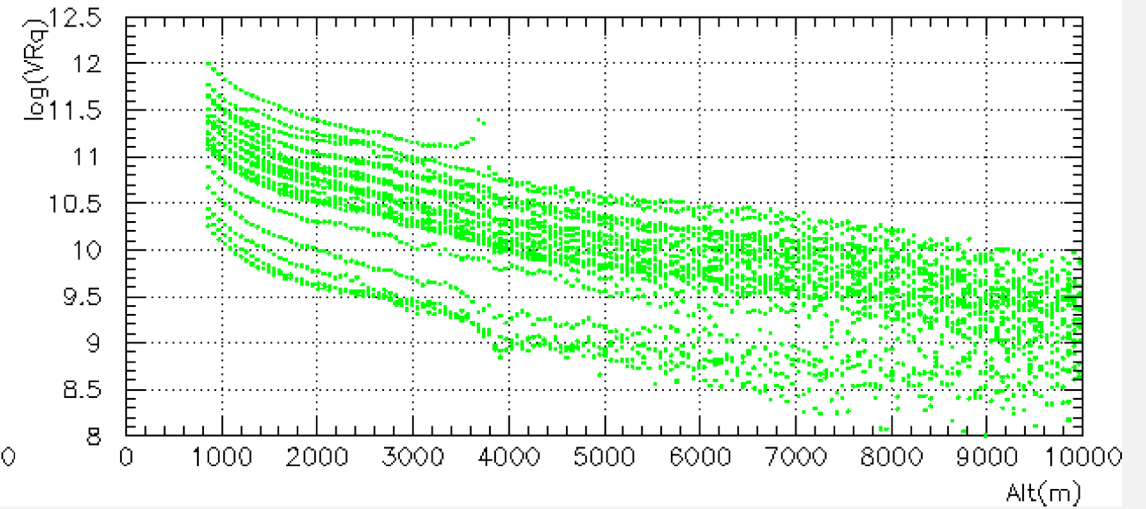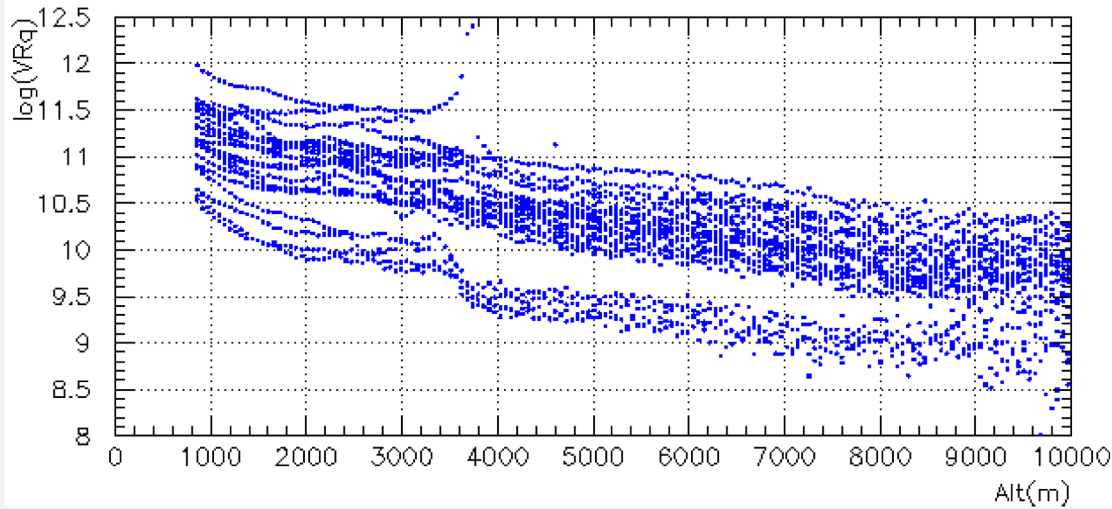# MECHANICAL ISSUES
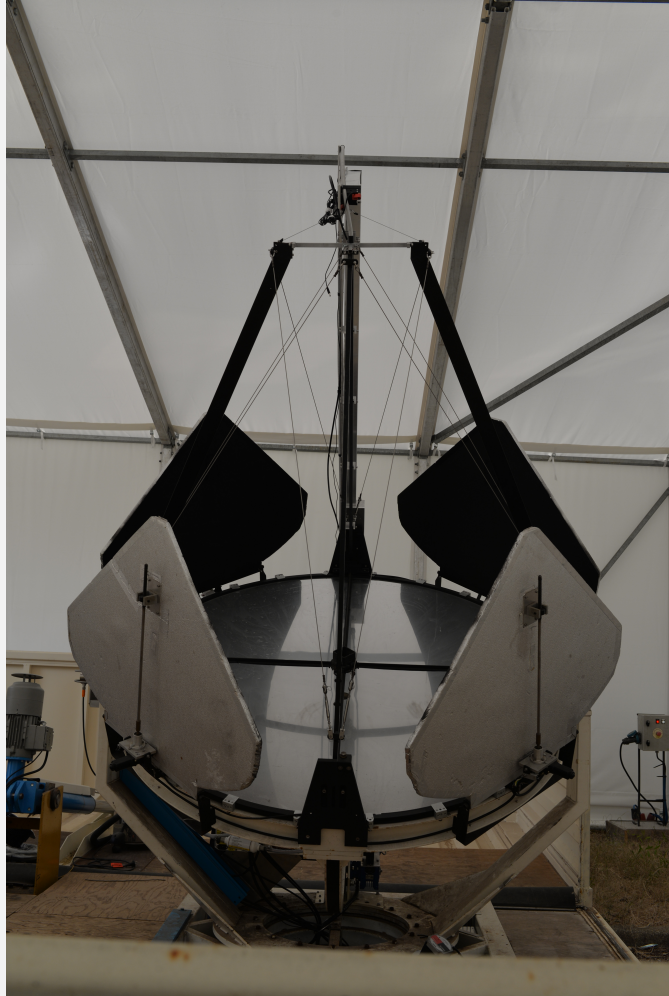
- Reinforcement Alu plate
  - *Laser*
  - *Laser beam guidance*
  - *Alignment system*
- Automation system
  - *Fully operational*
  - *Panasonic PL7 PLC*
  - *NON CTA standard compliant*
- Electromechanical parts
  - *Motors/activators/sensors new ISO-9999 std*
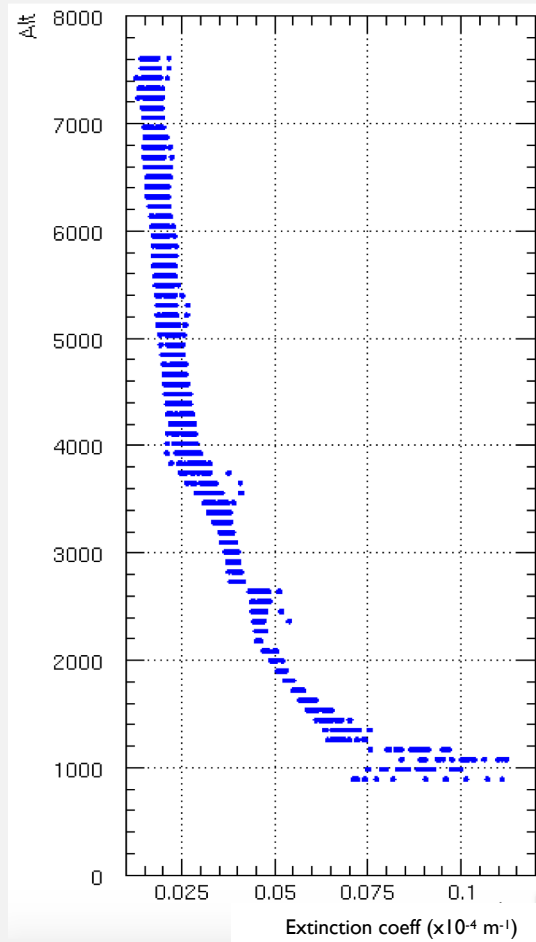
RAYMETRICS POLYCHROMATOR
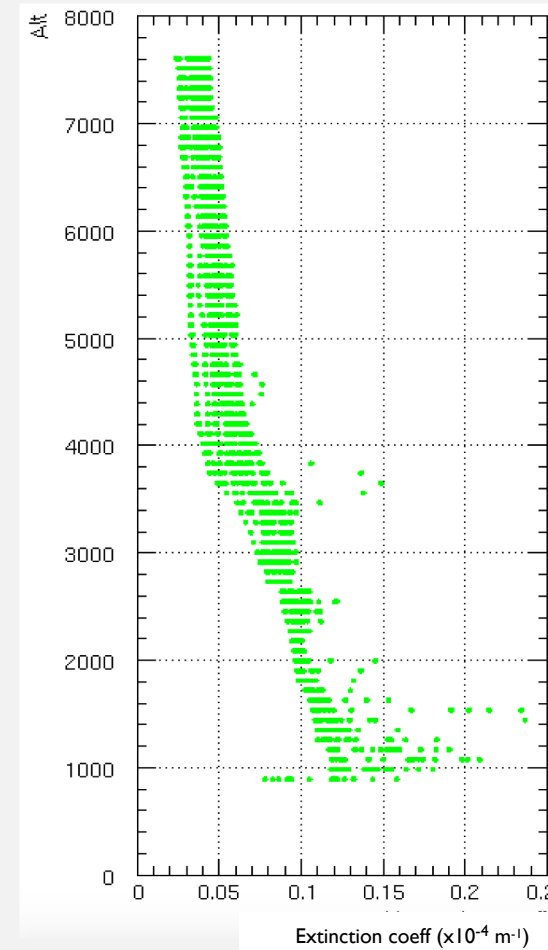
PRELIMINARY PERFORMANCE

- Range corrected signal return spectra for the elastic lines 355 & 532 nm

- Verify overall design

  - *Alignment procedure*

  - *Mirror and fiber optics collection efficiency*

PRELIMINARY PERFORMANCE

Extinction coefficient
profiles at 355nm & 532nm

THE HI-RANGE/LOW-RANGE ISSUE

- PMTs gets saturated from low altitude signals
  - Relaxation time and Licel recovery time to long for efficient PMT use
  - Hamamatsu/Licel confirmed so.
  - S/N ratio to high for high altitude observations
- Traditional Lidars use long observation times to resolve this issue
  - Integration spectrum of Raman signal much bigger the noise
  - We cannot do this
- Only solution : Gated PMTs (dynode/cathode modifications)
  - Solution used in 2000 by LATMOS(Metrology Lab Paris/Fr) for their Raman Lidar (OHP Lidars)
  - A pair of these modified PMT based to be delivered to LUPM for tests and possible inspiration
  - Hamamatsu ready to provide additional help

NEXT STEPS

- Preliminary results satisfying enough

- Alignment and low altitude performance to be optimized

- Robotic operation to be finalized

- Full Raman characterisation still to come

- Long term tests to start late 2019 on site (Montpellier/Fr)