



LASP

Laboratory for Atmospheric and Space Physics
University of Colorado **Boulder**



UNIVERSITY
OF WYOMING

A New Generation of Balloon Borne Aerosol Sizing Instruments to Extend the Mid-latitude Stratospheric Aerosol Record.

Lars Kalnajs¹, Terry Deshler^{1,2}

¹*Laboratory for Atmospheric and Space Physics, University of Colorado at Boulder,*

²*Department of Atmospheric Science, University of Wyoming*

Introduction

- In situ measurements of stratospheric aerosol have been made from Laramie Wyoming, since 1971
- There have been both personnel and instrument changes made over the past 45 years
- The current instrumentation and PI are nearing retirement
- Proposed project to design new instrumentation and move measurements to Boulder, Colorado, 1° South of Laramie Wyoming
- New instrumentation allow the continuation of the measurement and new opportunities.

Measurement Heritage

Instrument	Time	Radius (μm)	Channels	Flow Rate (l/m)	Sample Rate Hz	Light Source	Scattering Angle
Dust	1971-1992	0.15 – 0.25/0.30	2-4	1	0.1	White Light	25
WPC	1989- 2010	0.15 – 2/10	8-12	10	0.1	White Light	40
PMI-UW	2008 – 2016	0.075 – 4/15	8	10/30	0.5	He-Ne Laser	90
LPC	2016-?	0.15 – 12.5	8 - ?	30	1	Diode Laser	35

Research Highlight

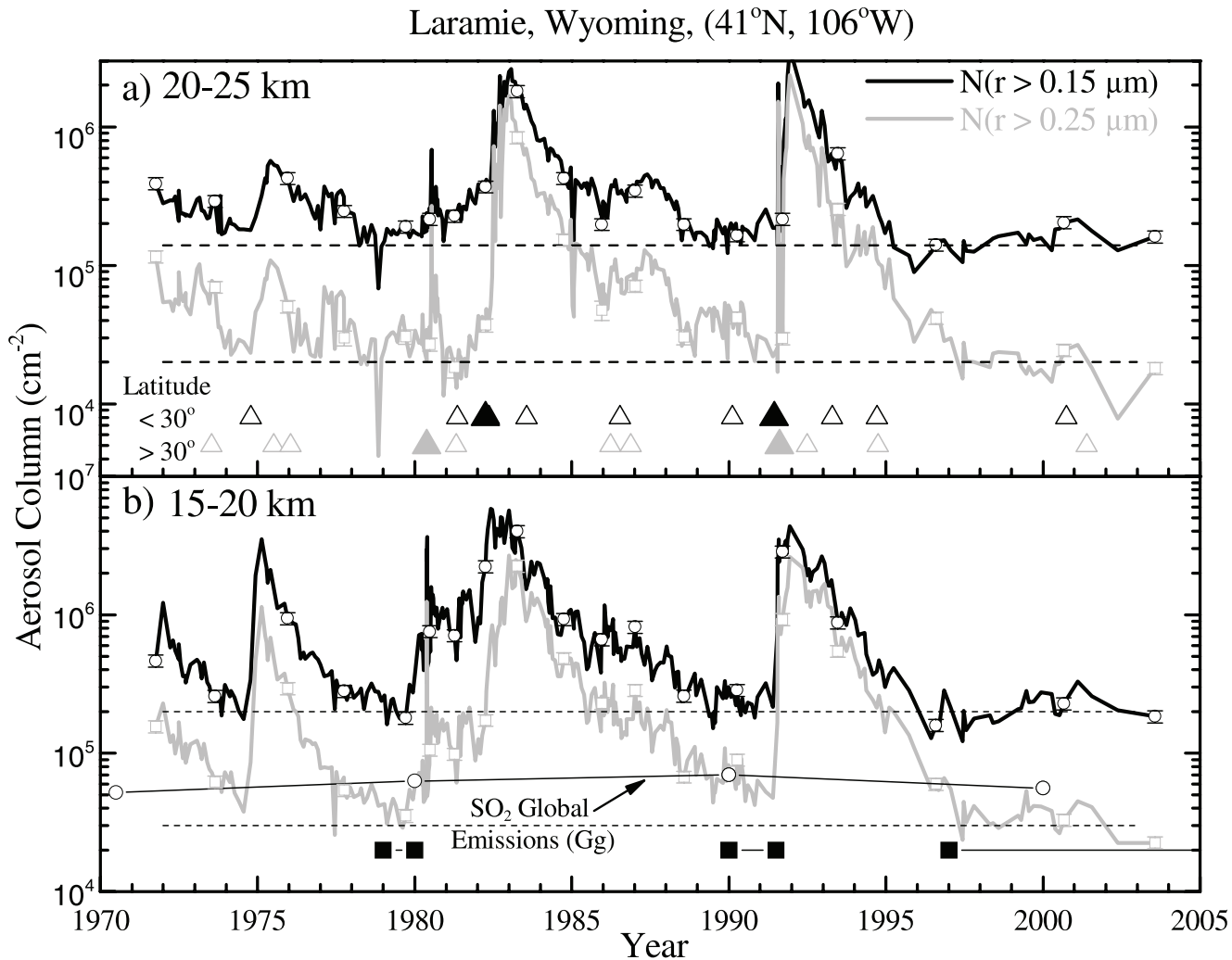
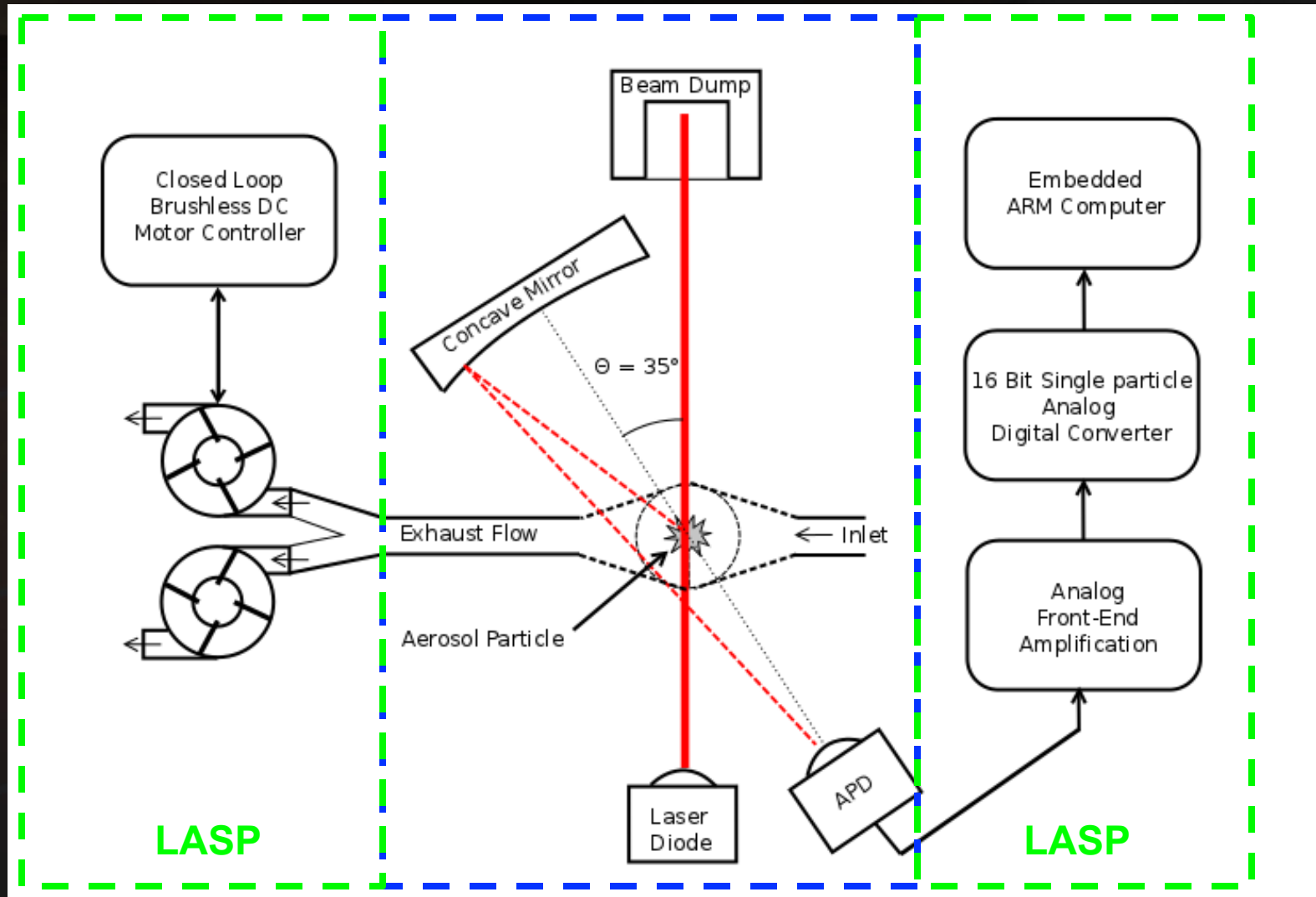


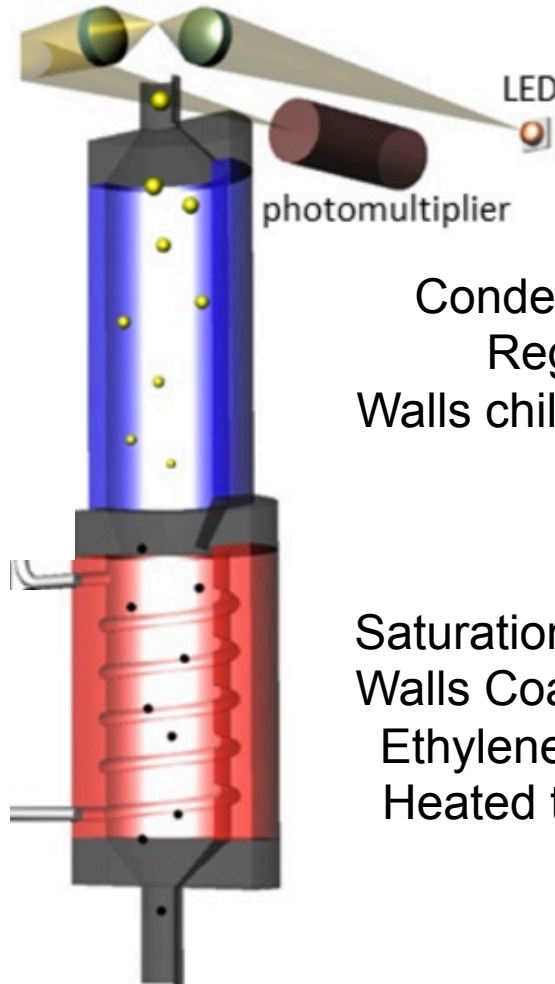
Figure: Deshler et al., 2006
SSiRC Meeting, Lars Kalnajs

Next Generation Optical Particle Counter



Condensation Nuclei Counter

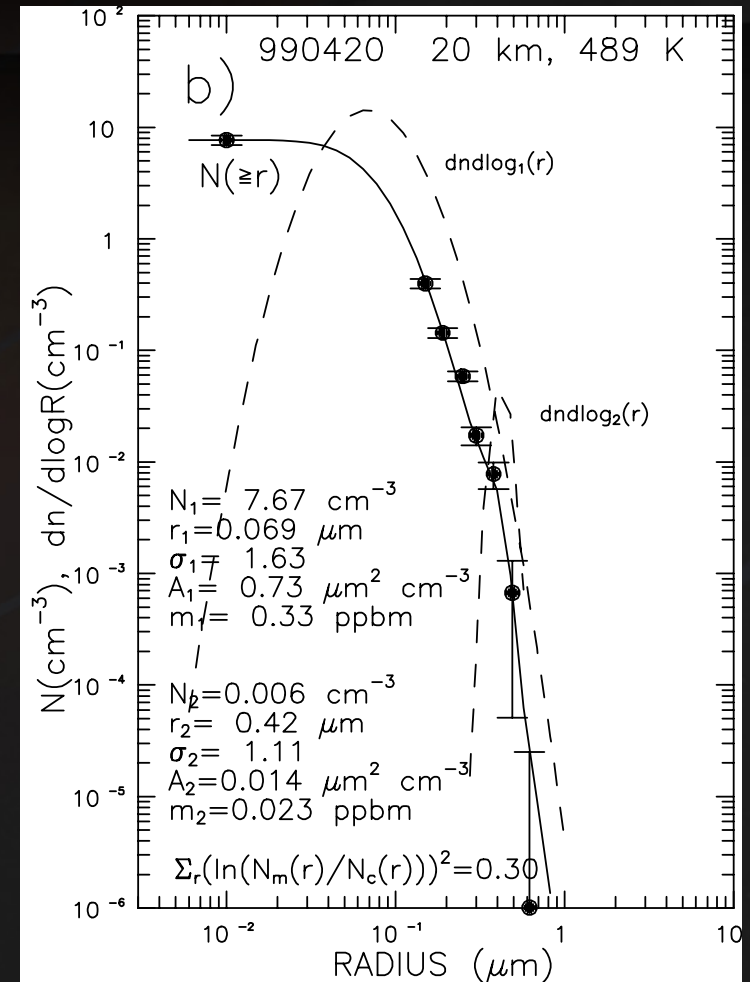
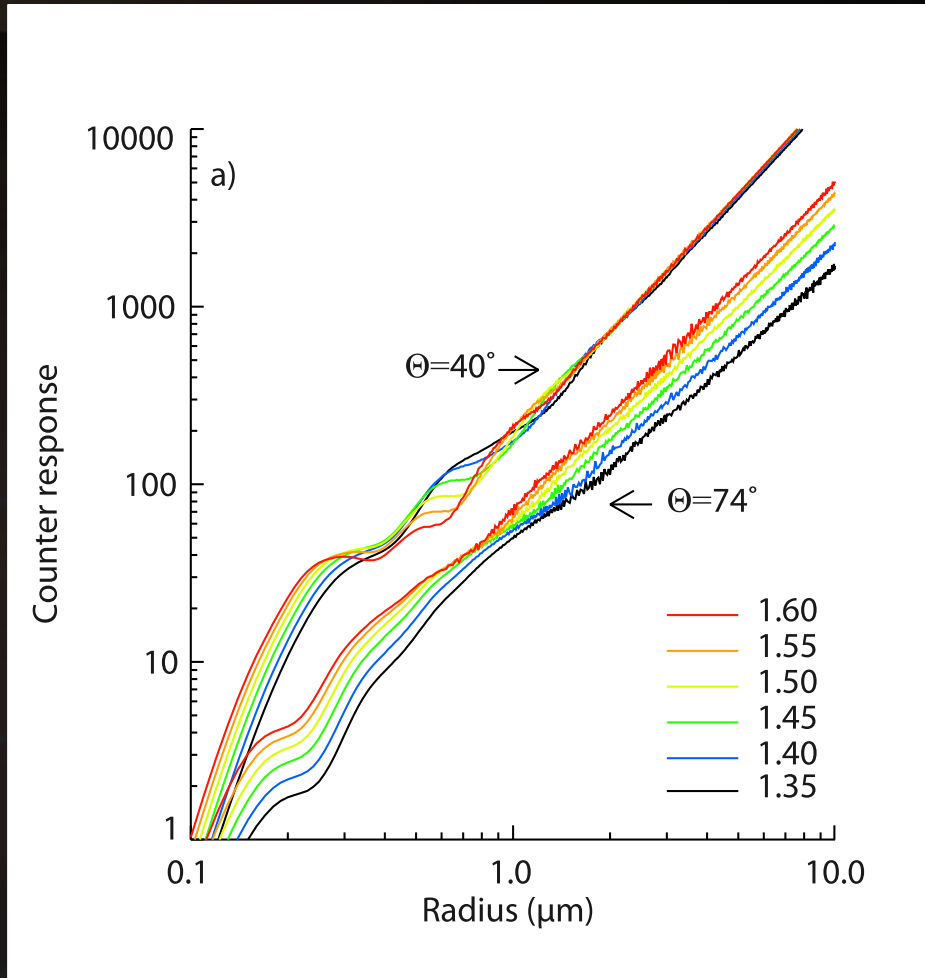
CN Counter:
Grows all particles
with $r > 0.006 \mu\text{m}$
up to particles with
 $r > 0.25 \mu\text{m}$ which
can be counted
with a single
channel OPC.



Condensation
Region
Walls chilled to 0°C

Saturation Region
Walls Coated with
Ethylene Glycol
Heated to 35°C

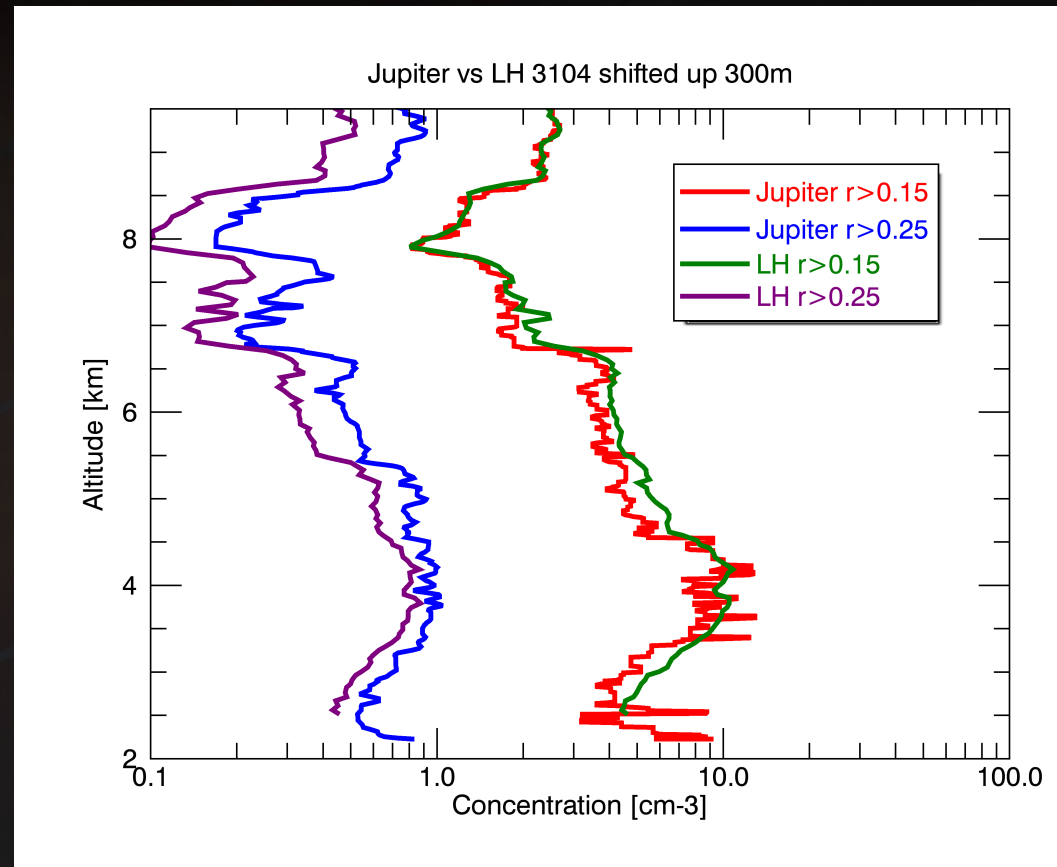
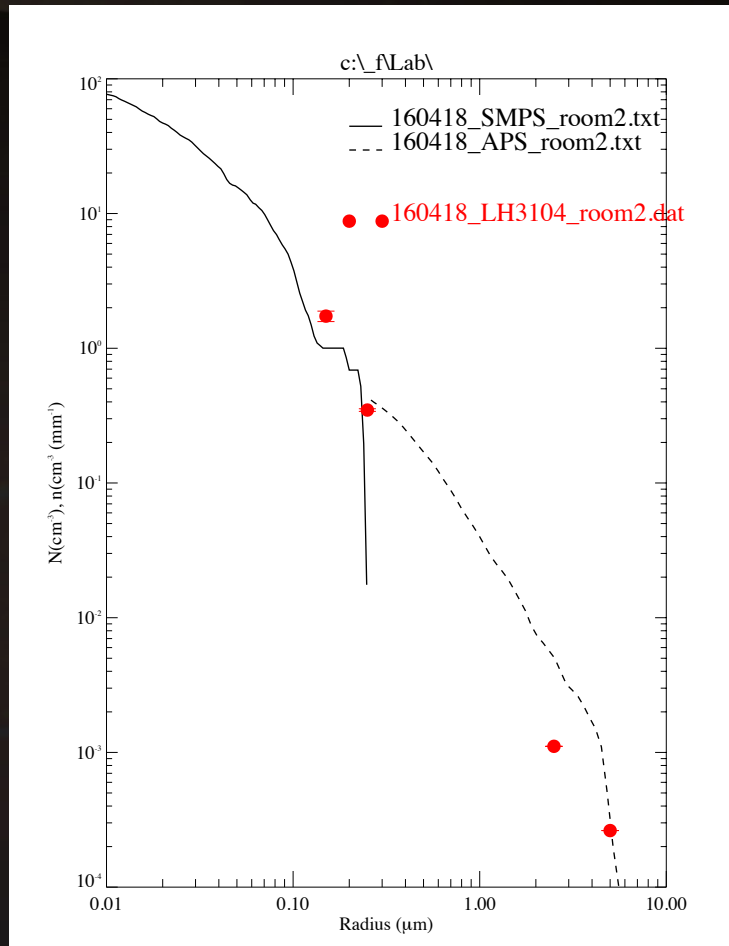
Measurement Challenges



Left: Eidhammer et al 2008, Right: Deshler et al 2003

SSiRC Meeting, Lars Kalnajs

Instrument Calibration



Instrument Advances

- Reduce instrument weight from ~12 Kg to ~3Kg
- Reduce balloon volume from 4000m³ plastic balloon to 1000m³ rubber balloon
- Lifting gas requirements **decrease by factor of 4**
- Launch cost **decreases by factor of 10**
- Digital pulse by pulse height analysis – possibility to digitize and record every aerosol particle
- Customizable number of size bins
- Instrument can be (re)calibrated after the fact

Light-Weight Instrumentation



Rapid Deployment Capability

- Use Iridium Satellite SMS messages for telemetry – no ground station or tracking required
- Cost of payload < \$10K / each.
- 'Suitcase' launches with no telemetry and no recovery
- Dynamic range suitable for background and volcanic measurements.
- Suitable for long duration measurements – will be deployed on long duration lower stratospheric balloon campaign – Stratéole 2.