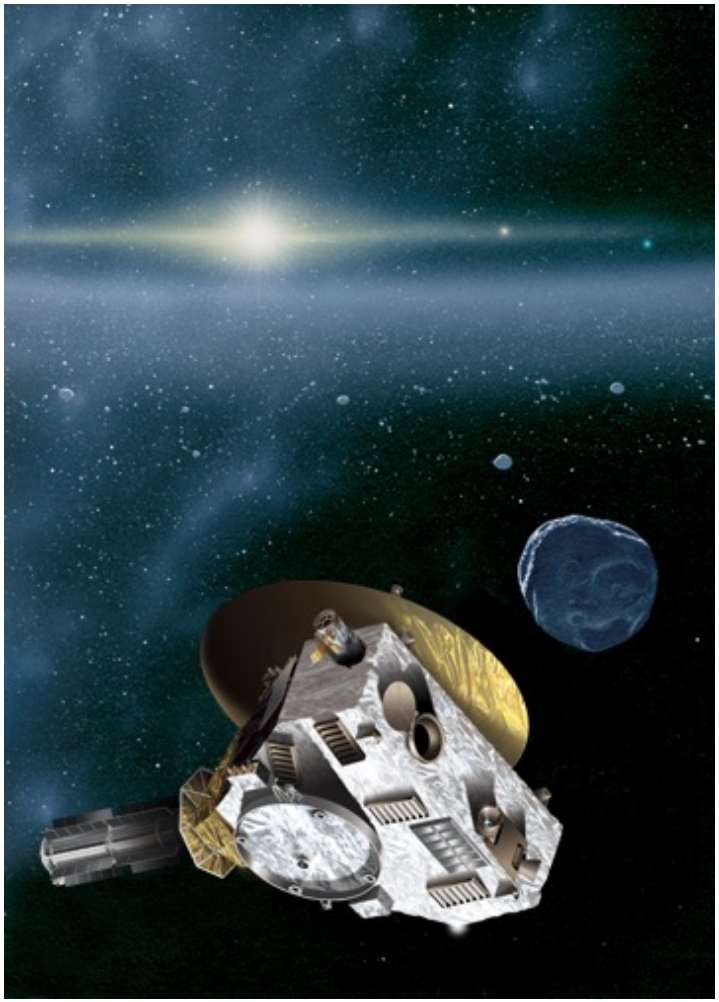
The Venetia Burney Student Dust Counter



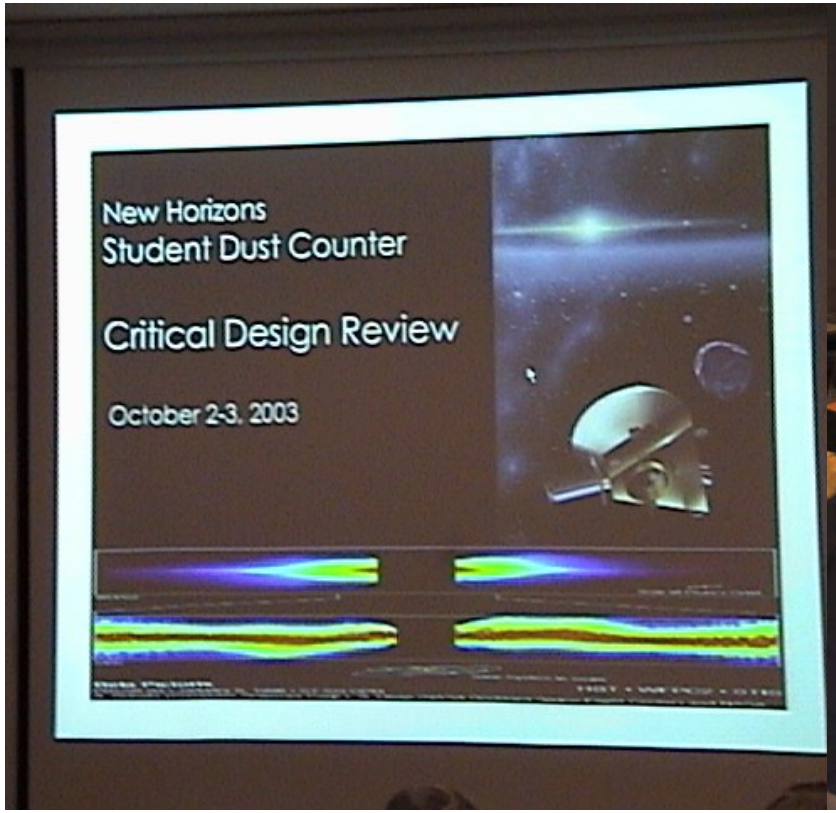
Mihály Horányi

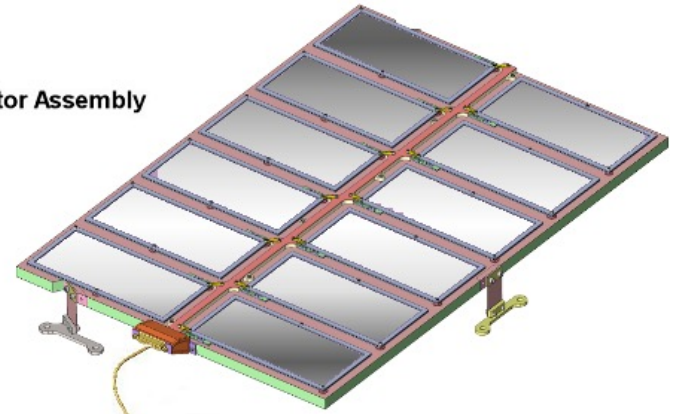
7) Alex Doner
6) Edwin Bernardoni
5) Marcus Piquette
4) Jamey Szalay
3) Andrew Poppe
2) David James
1) Colin Mitchell

Milestones:

PDR	6/2003
Heidelberg tests	7/2003
CDR	10/2003
PER	6/2004
PSR	8/2004
Ship	9/2004

Identical requirements to any other flight instrument!



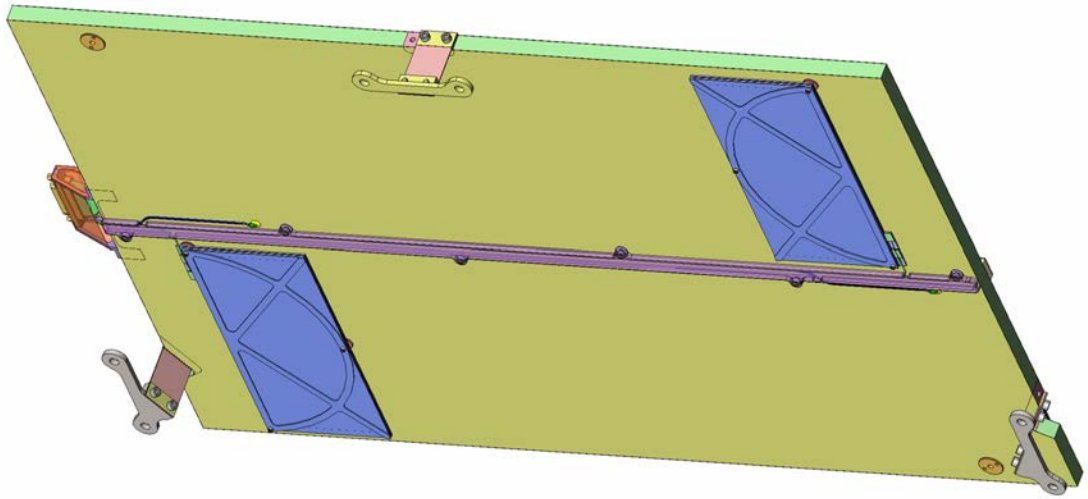


Key Properties

Active Area of 0.1 m^2

Consists of Three Assemblies:

1. **Detector Assembly (18” x 12”)**
2. **Electronics Box (5.4”x8.25”x1.825”)**
3. **Intra-Harness**

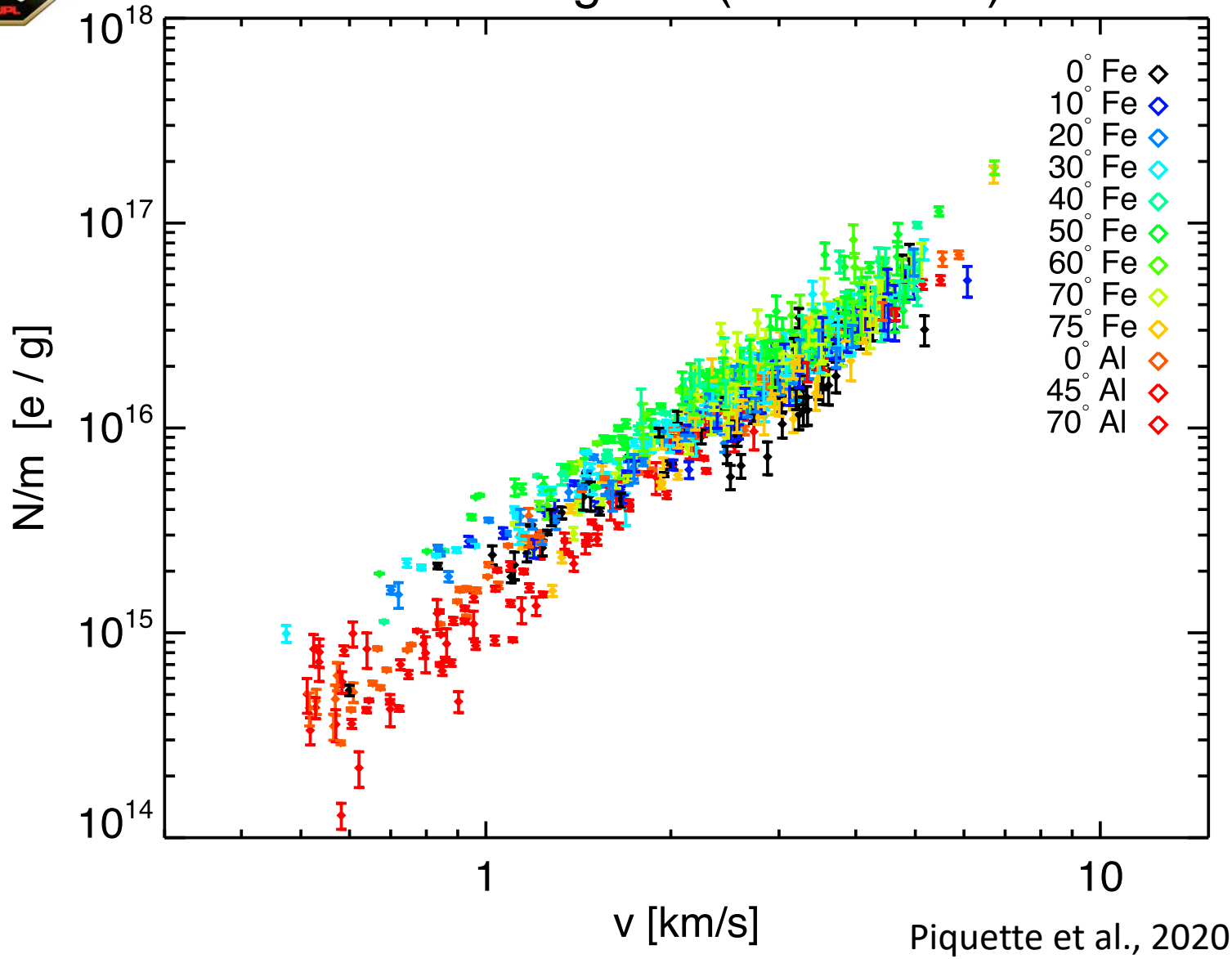


Mass: 1.6 kg

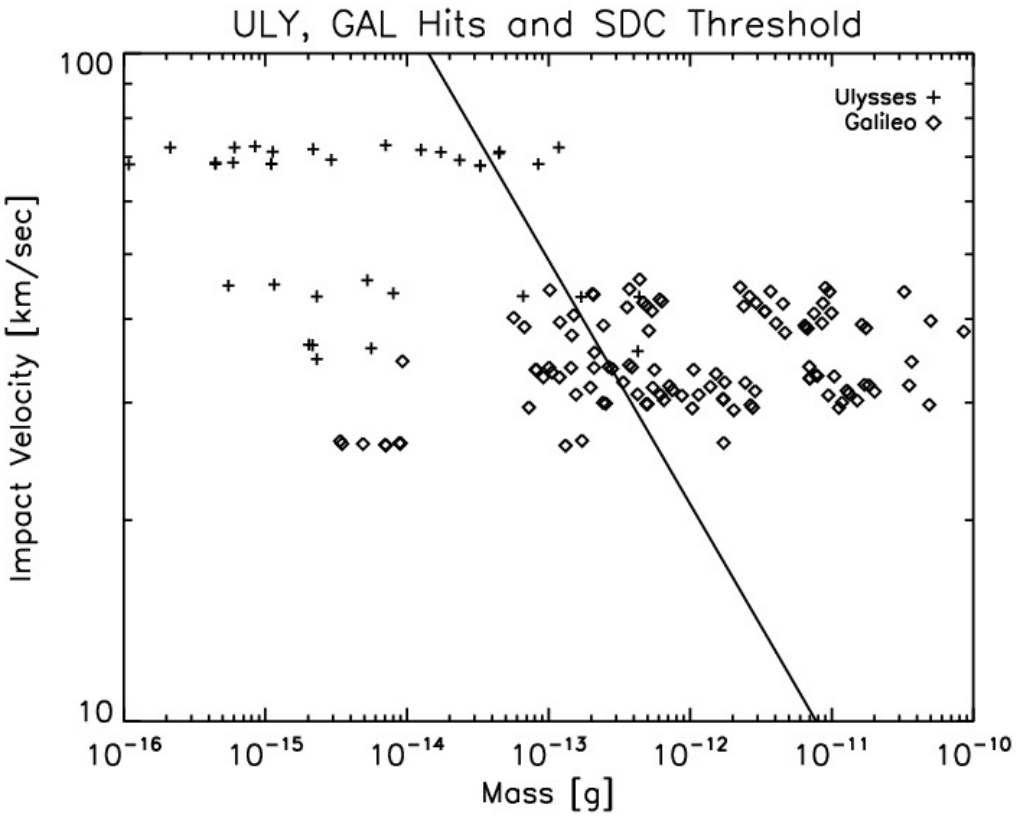
Power: 5 w

LASP

PVDF Signals (baseline fit)



Piquette et al., 2020

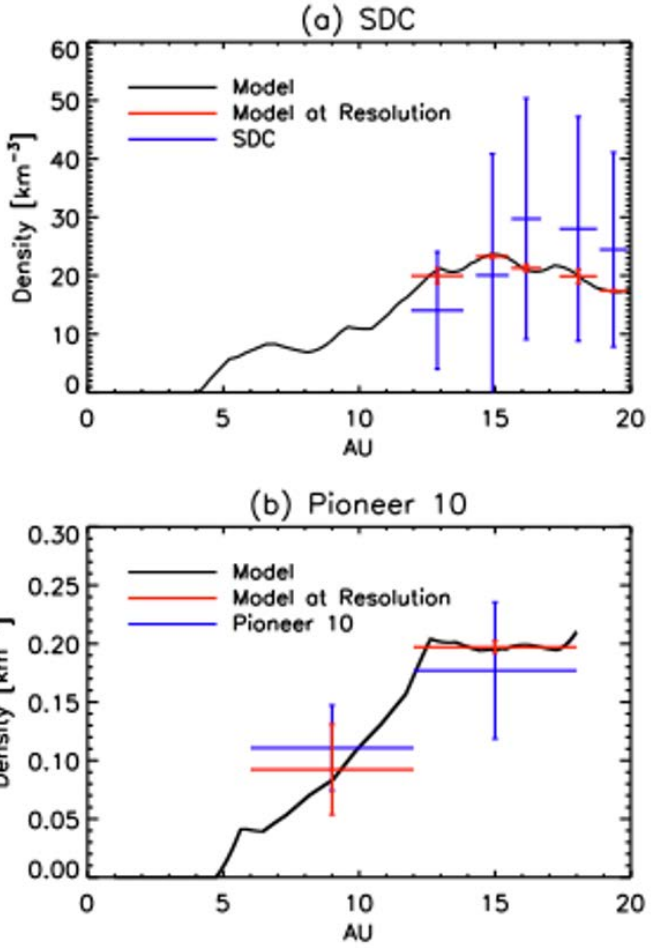


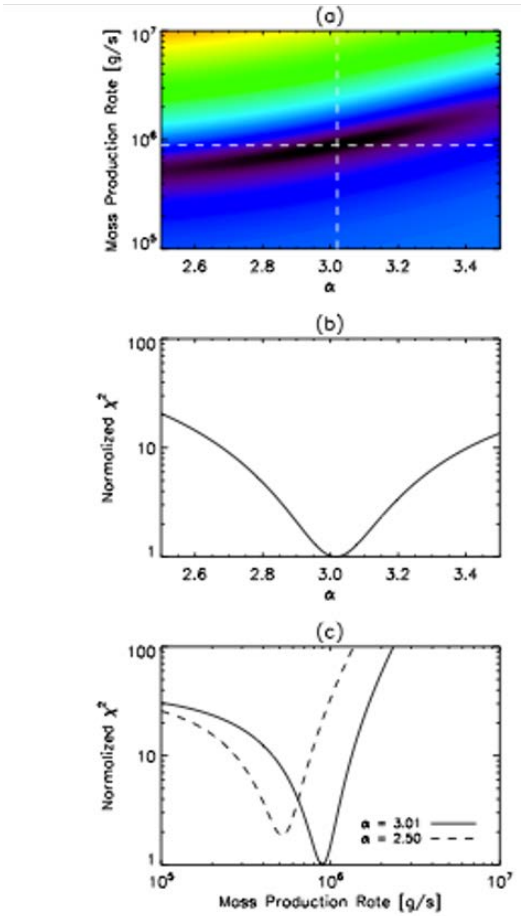
Distance (AU)	Ulysses	Galileo	SDC
2.66–3.55	$0.4^{1.2}_{0.0}$	$1.5^{1.8}_{0.7}$	$1.1^{3.2}_{0.0}$
3.99–4.67	$0.2^{0.7}_{0.0}$	$1.3^{1.7}_{0.3}$	$1.1^{4.1}_{0.0}$

[a] $m > 1.5 \times 10^{-12}$ g, [10^{-4} sec^{-1} m^{-2}].

Poppe et al., 2010

Dust production in the Kuiper Belt





Total EKB dust production in the size range of 0.5 – 10 μm:

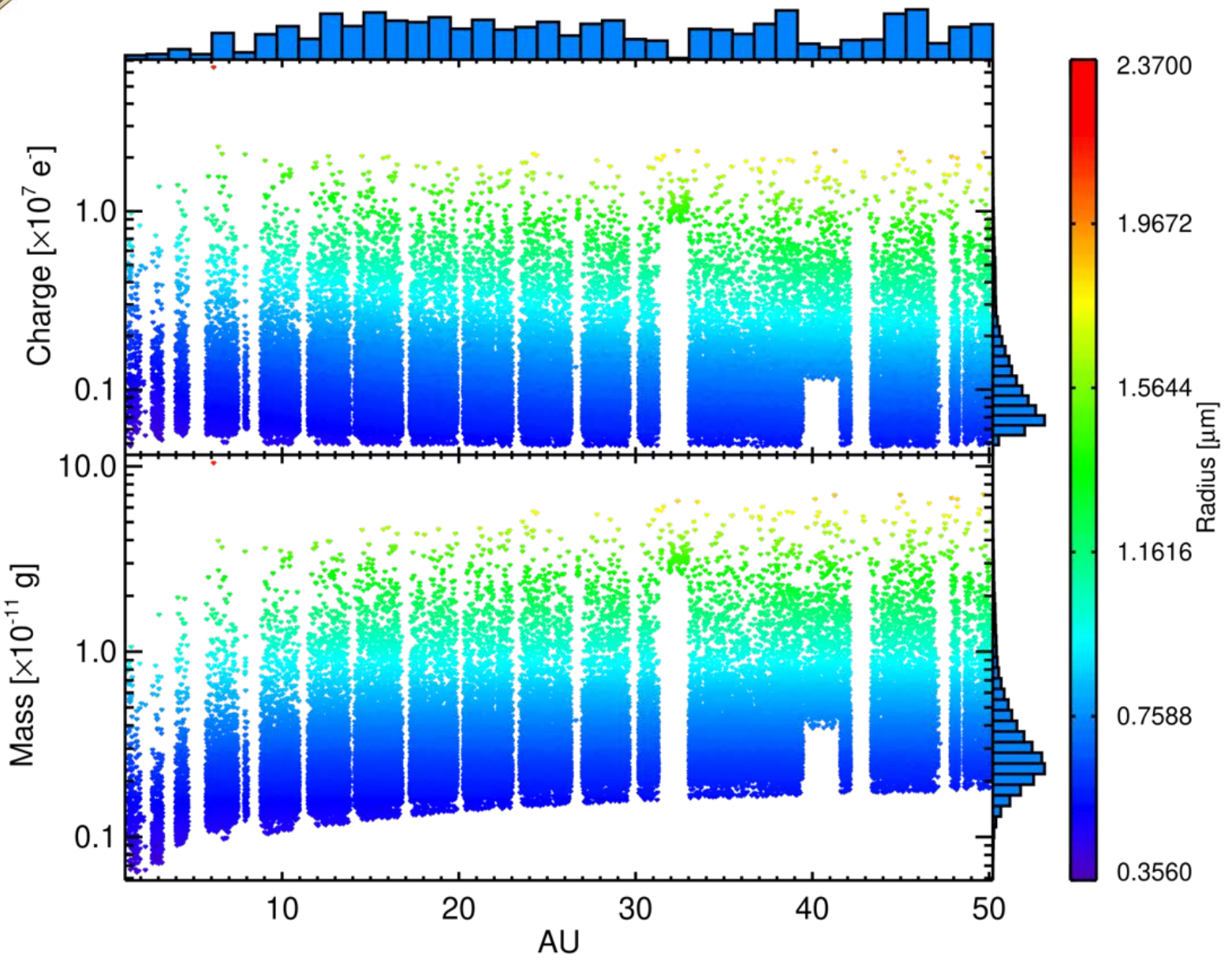
$(8.9 \pm 0.5) \times 10^5$ g/s

The production power-law index:

$d\dot{M}/dm = \dot{M}_o (m/m_o)^{-\alpha/3}$

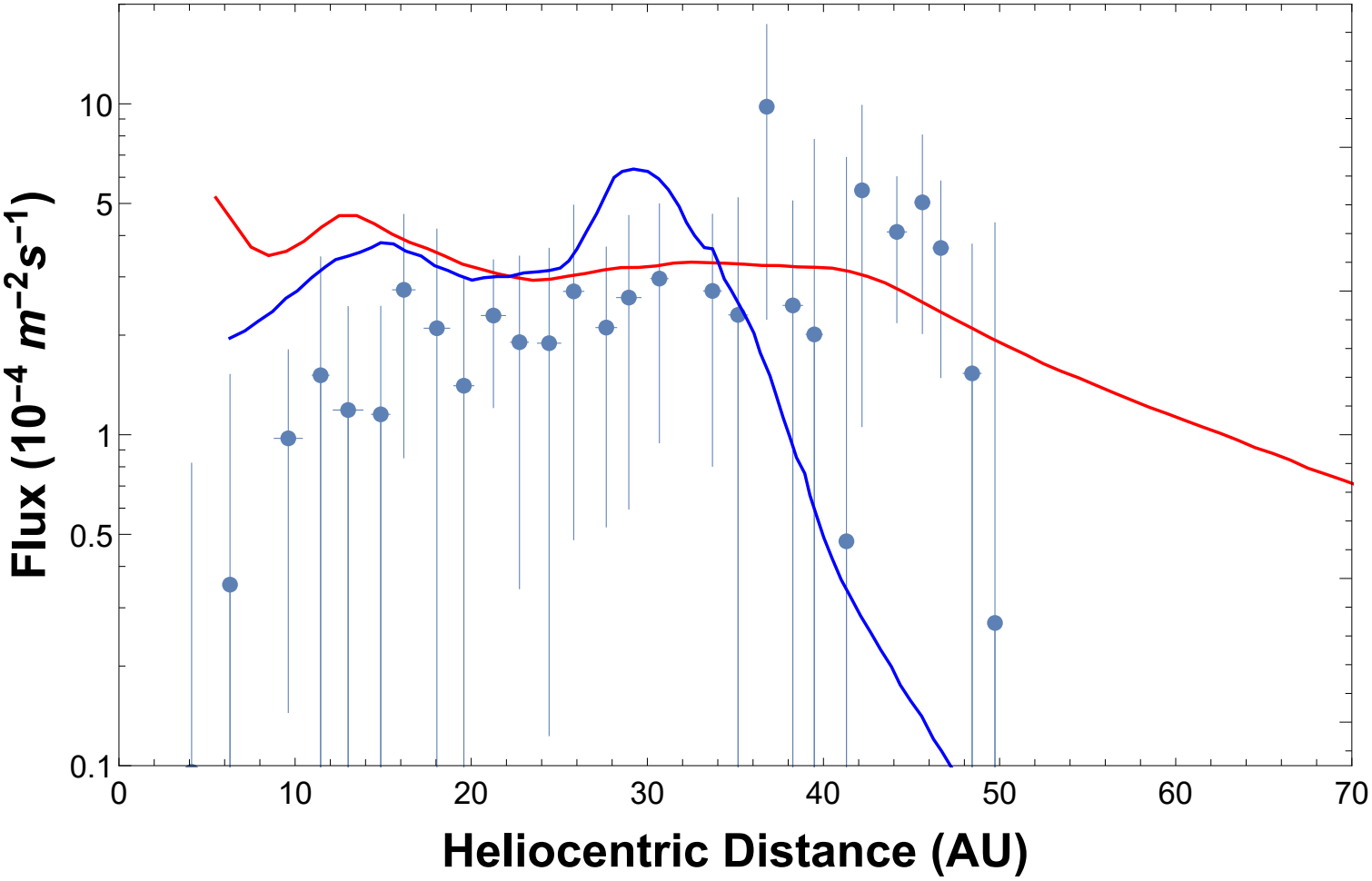
$\alpha = 3.02 \pm 0.04$

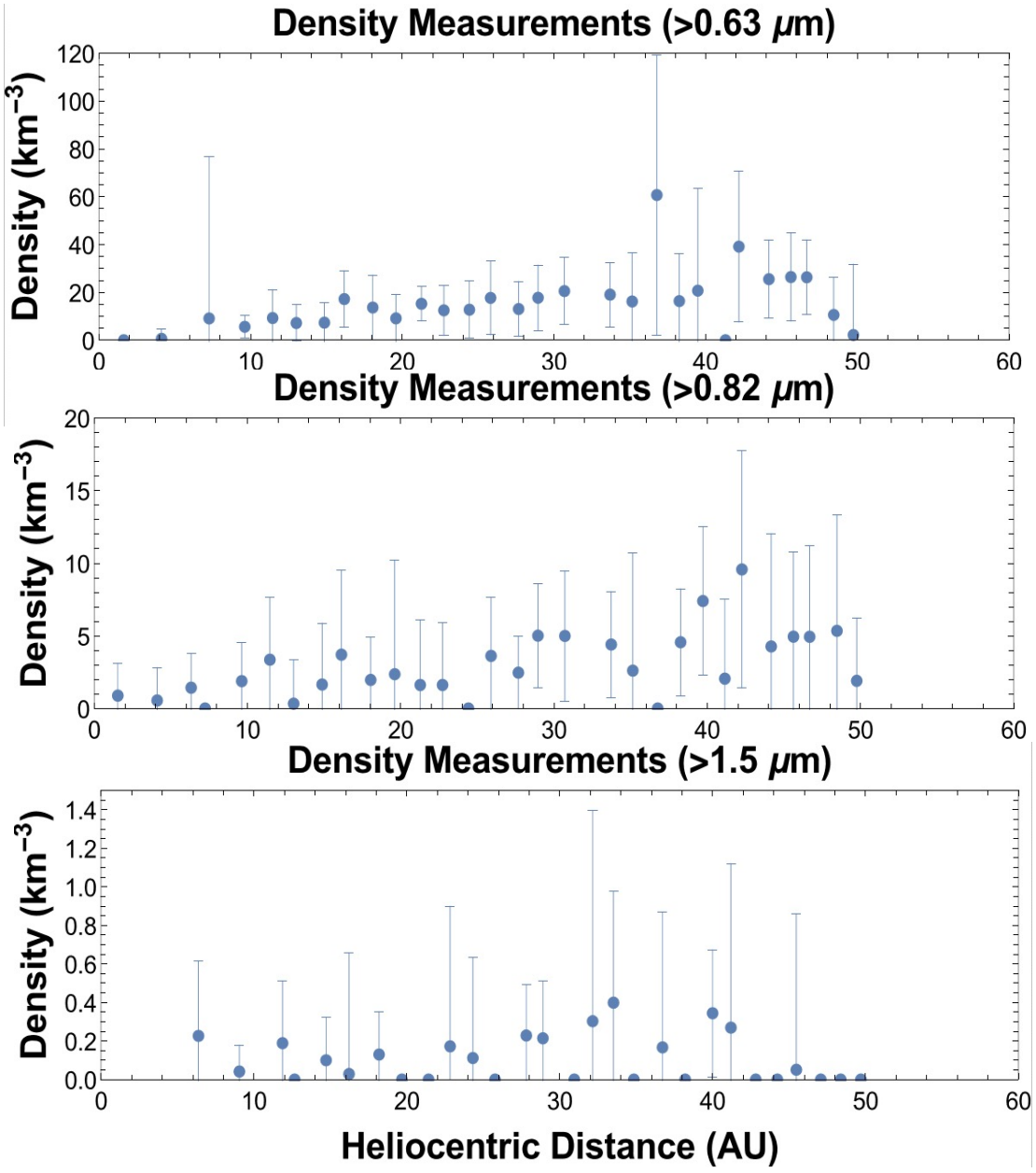
Han et al., GRL (2011)


Charge [×10^7 e^-]
1.0
0.1
Mass [×10^-11 g]
10.0
1.0
0.1
10
20
30
40
50
AU
2.3700
1.9672
1.5644
1.1616
0.7588
0.3560
Radius [μm]

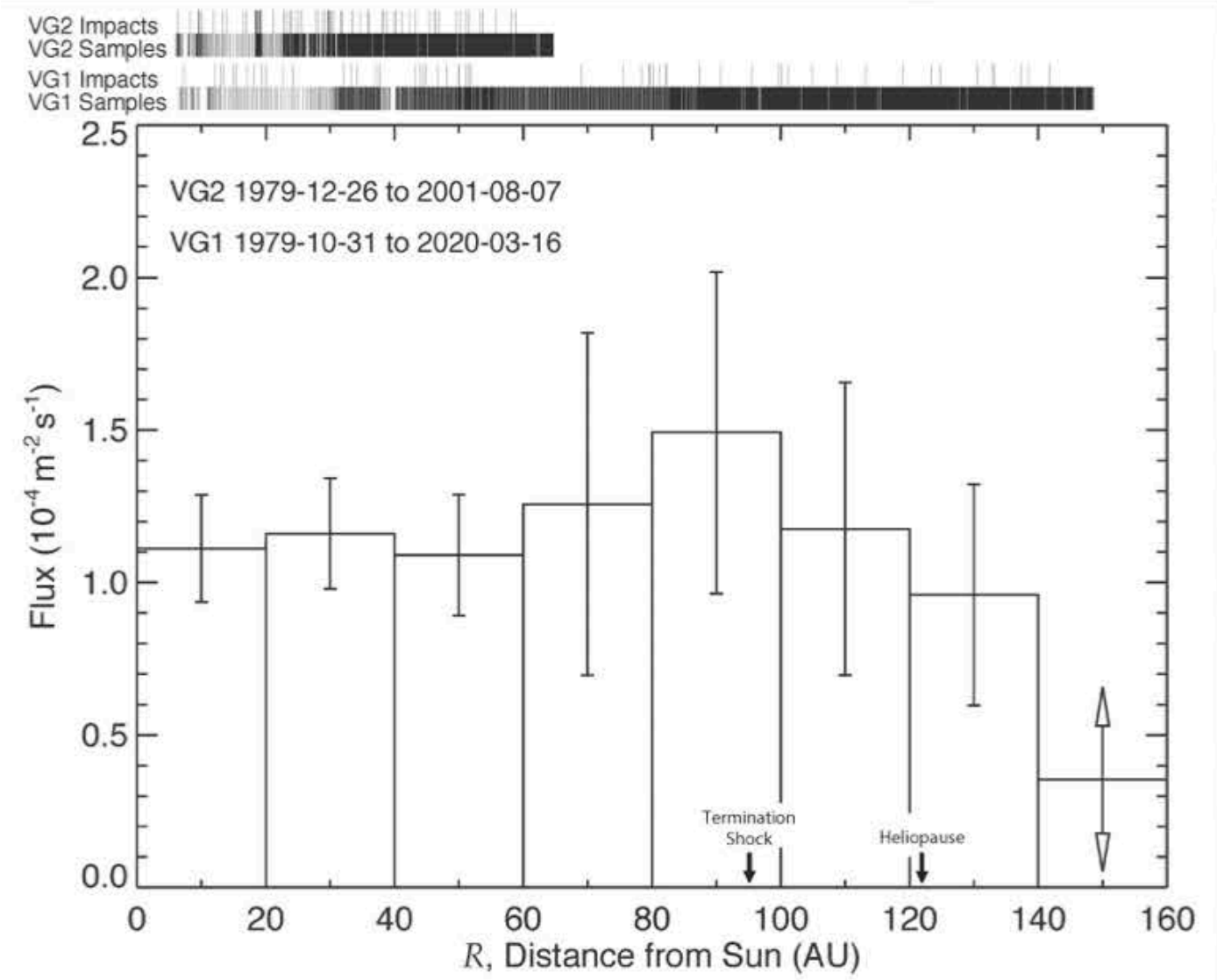
LASP

Flux Measurements (>0.63 μm)



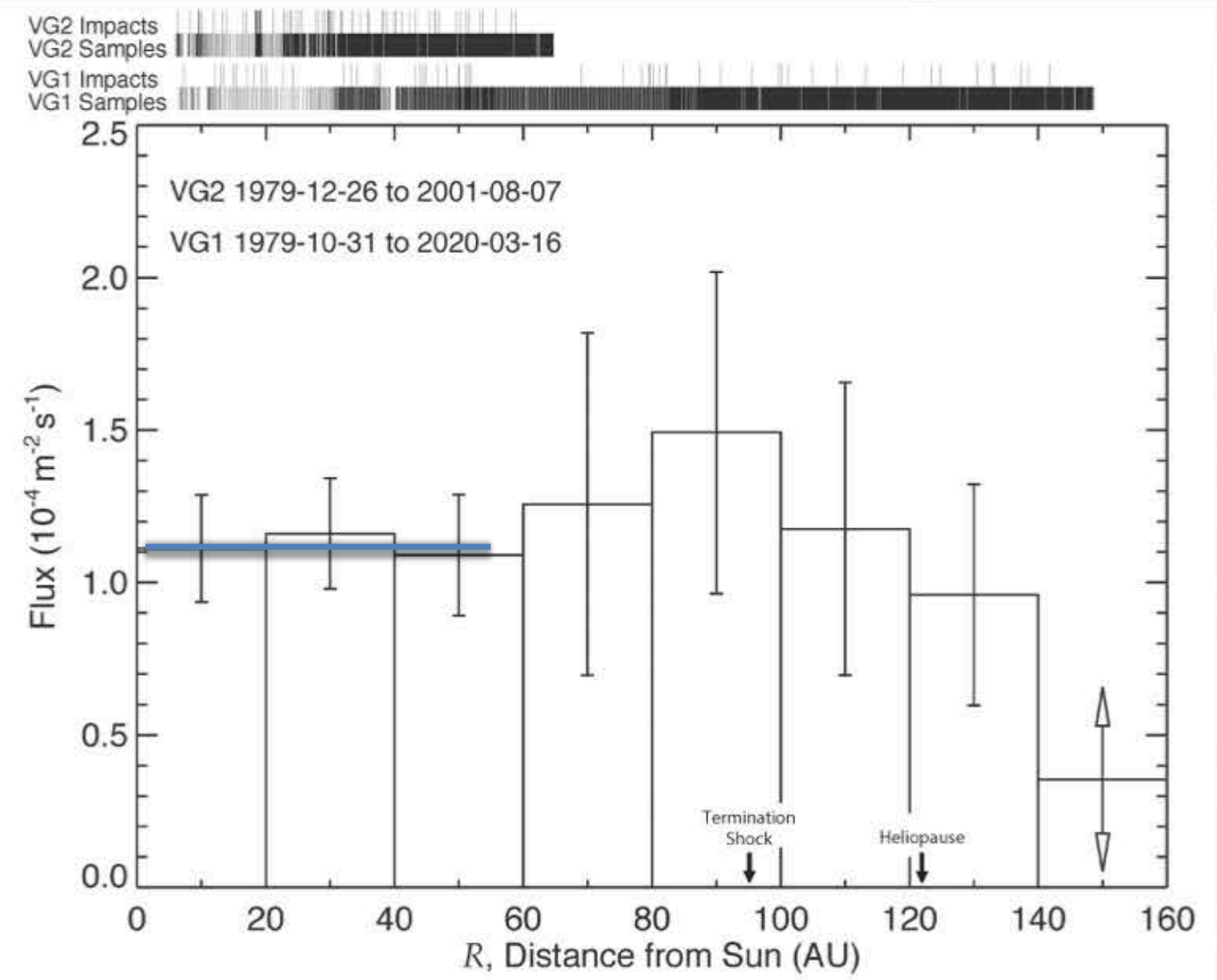

Density Measurements (>0.63 μm)
Density (km^{-3})
Density Measurements (>0.82 μm)
Density (km^{-3})
Density Measurements (>1.5 μm)
Density (km^{-3})
Heliocentric Distance (AU)

Voyager

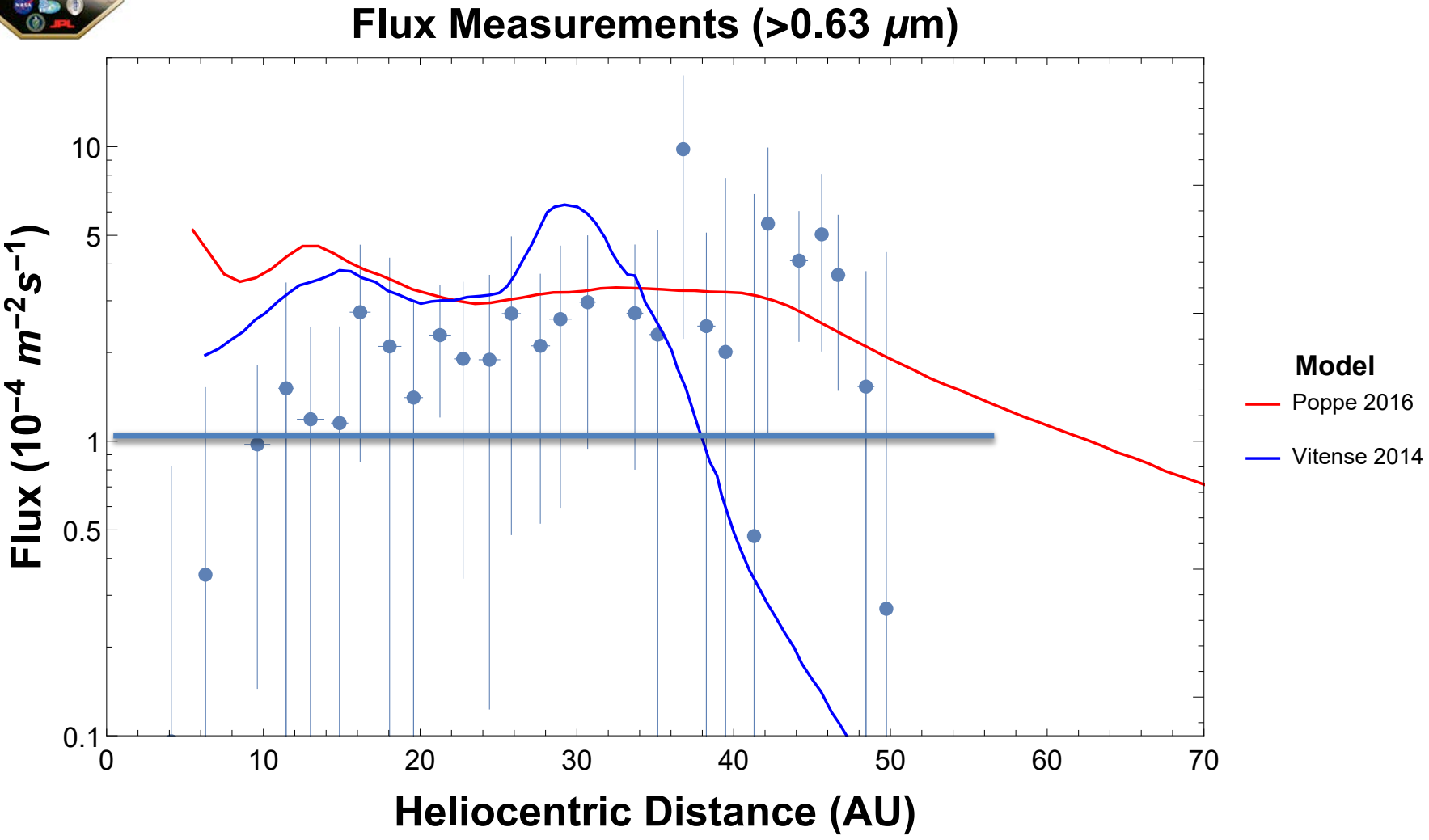


Janes, Gurnett, Kurth, Granroth, Persoon, 2020

Voyager

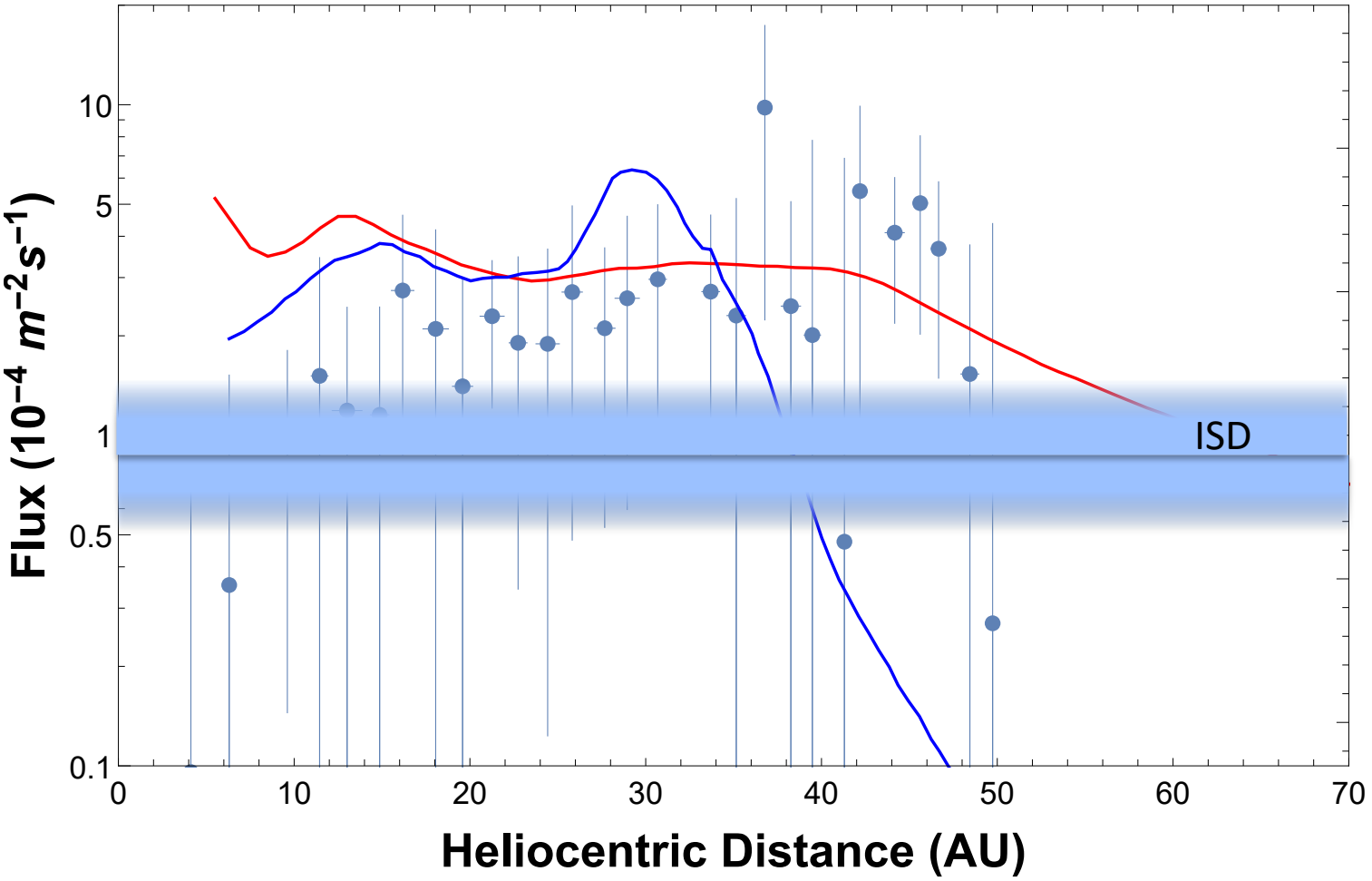


Janes, Gurnett, Kurth, Granroth, Persoon, 2020


Flux Measurements (>0.63 μm)
Flux (10^{-4} $m^{-2}s^{-1}$)
10
5
1
0.5
0.1
0
10
20
30
40
50
60
70
Heliocentric Distance (AU)
Model
Poppe 2016
Vitense 2014

LASP

Flux Measurements (>0.63 μm)



Conclusion

I. Heliospheric science goals

Continue mapping the dust size and density distributions
Support analysis and interpretation of IMAP/IDEX measurements of ISD
Support the development of ISP science goals/payload

II. Feasibility

Continuous operations of VBSDC
VBSDC is designed, via its autonomy rules & large memory, to remain standalone for > 2 years without s/c commands or data dumps (data volume: 100 Kbyte/year)

III. No flight or ground tests and/or flight software developments are needed

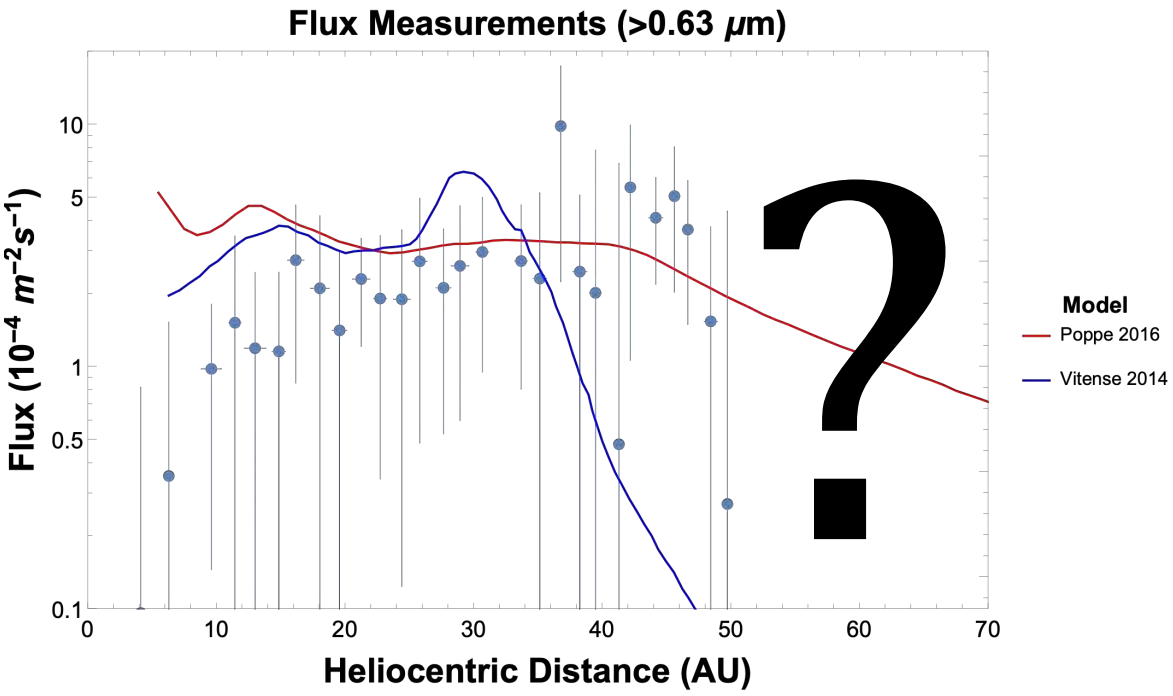
IV. Open issues:

lack of large (>> 1 micron radius) particle "seen" by the Pioneers

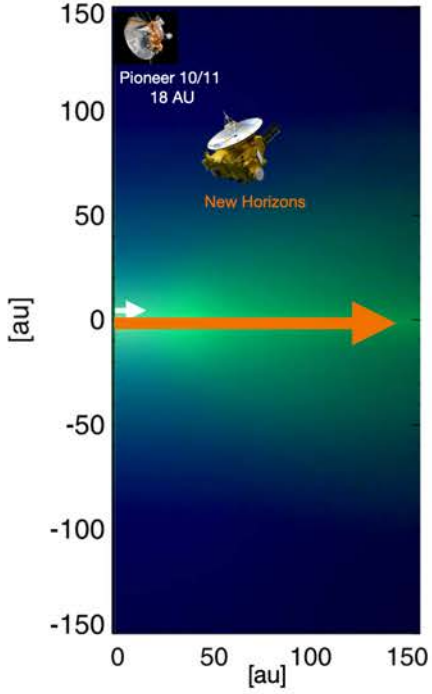
a) oblique impacts
(The response of varying particle density and incidence angle on Polyvinylidene Fluoride dust detector, M. Piquette et al., RSI, 2020)

b) revisit calibration/penetration of Pioneer beer can detectors

Conclusion


Flux Measurements (>0.63 μm)
Flux (10^{-4} $m^{-2}s^{-1}$)
10
5
1
0.5
0.1
0
10
20
30
40
50
60
70
Heliocentric Distance (AU)
?
Model
Poppe 2016
Vitense 2014


EKB
OCC
JFC


Pioneer 10/11
18 AU
New Horizons
150
100
50
0
-50
-100
-150
[au]
0
50
100
150
[au]