

# METEOR SCATTER COMMUNICATIONS: THE SCIENCE BEHIND THE PINGS

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HUNTSVILLE HAMFEST AUGUST 2017

# OUTLINE

- What is a meteor?
- What scatters my signal?
- Where does my signal go?
- When is the best time to operate?
- What equipment should I use?
- What software and mode should I use?
- What does a QSO look and sound like?
- Tools to help make contacts
- Summary
- An operating event announcement
- Links

} Science part

} Radio part

# WHAT IS A METEOR?

- Consist of small pieces (grain of sand, particle of dust) of mostly cometary (90%) or asteroidal (10%) material
- Meteoroids – bits in space
- Meteors – bits burning up in the atmosphere
- Meteorites – hit the ground
- Visible light from a meteor comes mostly from the ionization of the atmosphere
- The free electrons from the ionization can scatter radio signals
- Sporadic meteors come from all over the sky (mostly), all the time but are most numerous near sunrise when we are on the front bumper of Earth
- Shower meteors appear to come from a point on the sky called the radiant
  - This is a perspective effect – like looking down a railroad track

# ALL SKY CAMERA VIEW OF PERSEID 12 AUG 2017





# LEONIDS 1999



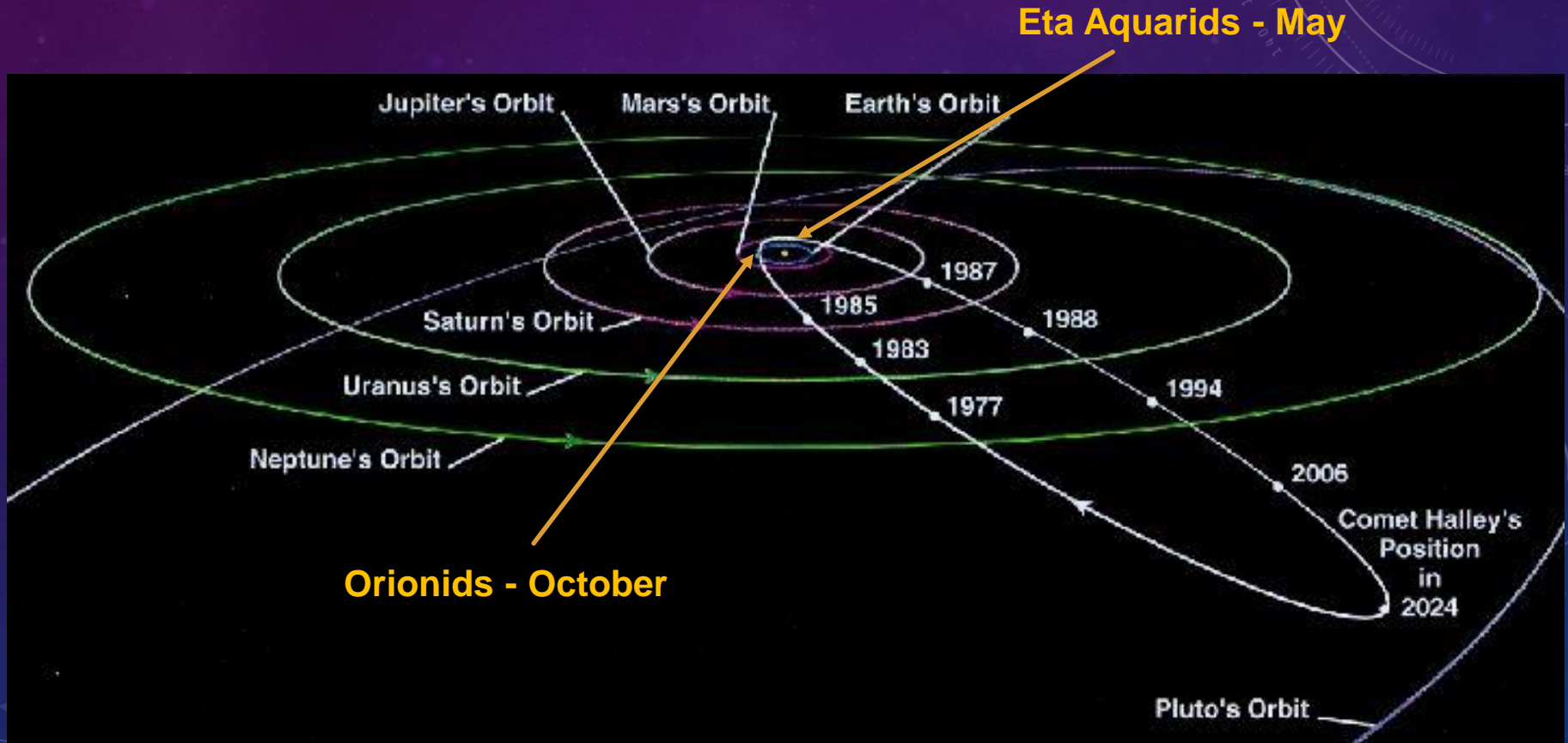
# 90% OF METEOROIDS COME FROM COMETS



Comet Halley 1986

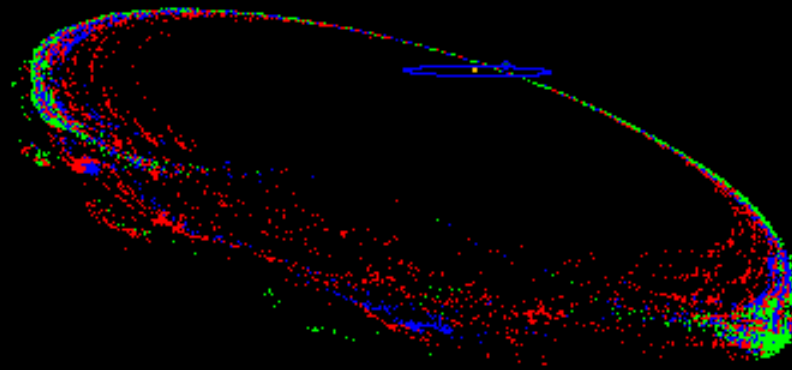
# COMET HALLEY

- Halley particles are responsible for 2 meteor showers every year



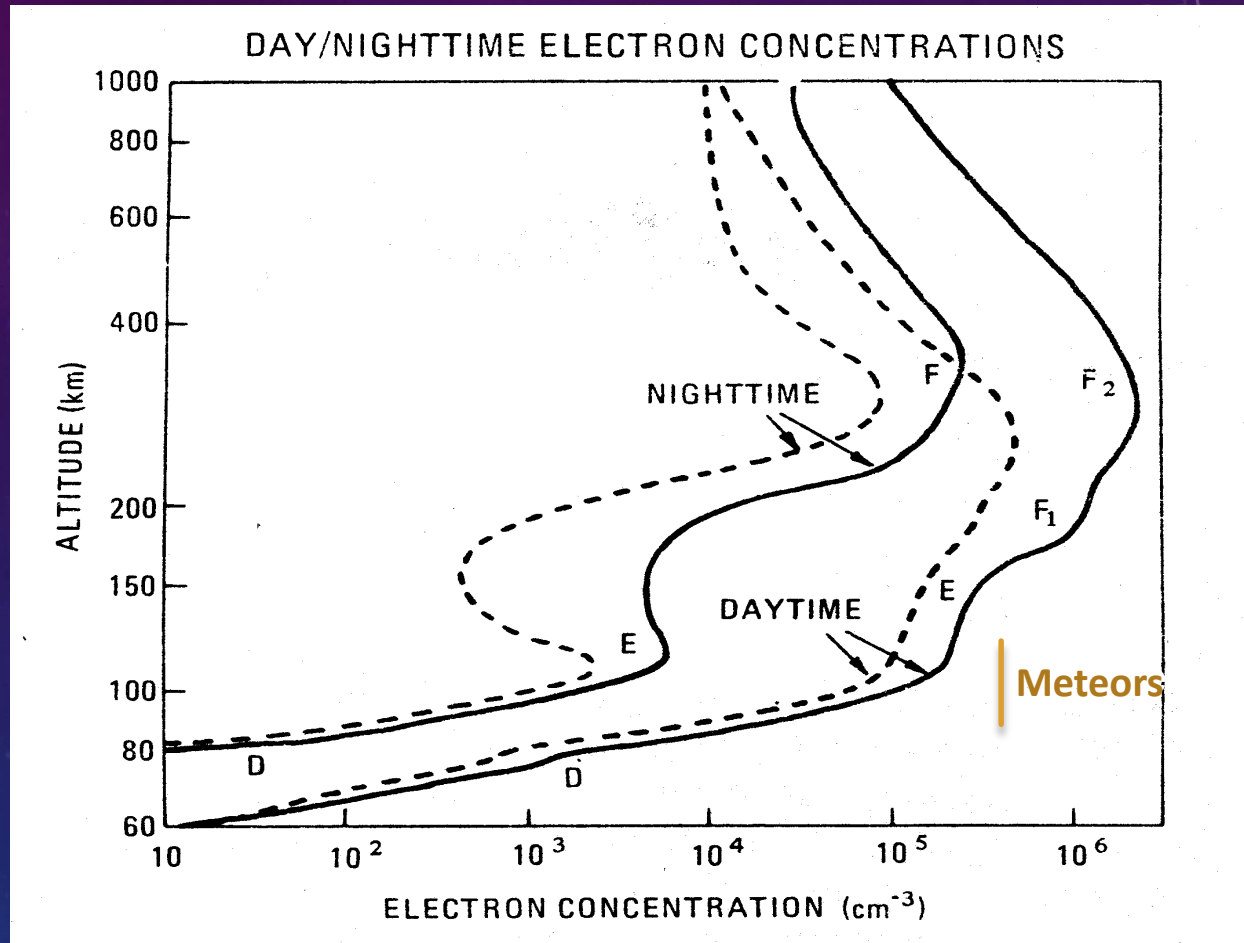
# COMPUTER MODEL OF LEONID STREAM

ClearSky : 1699 Data - Outer View  
Copyright 1998 David L. Clark  
1998/11/03 10:52:39 EST





# IONOSPHERE

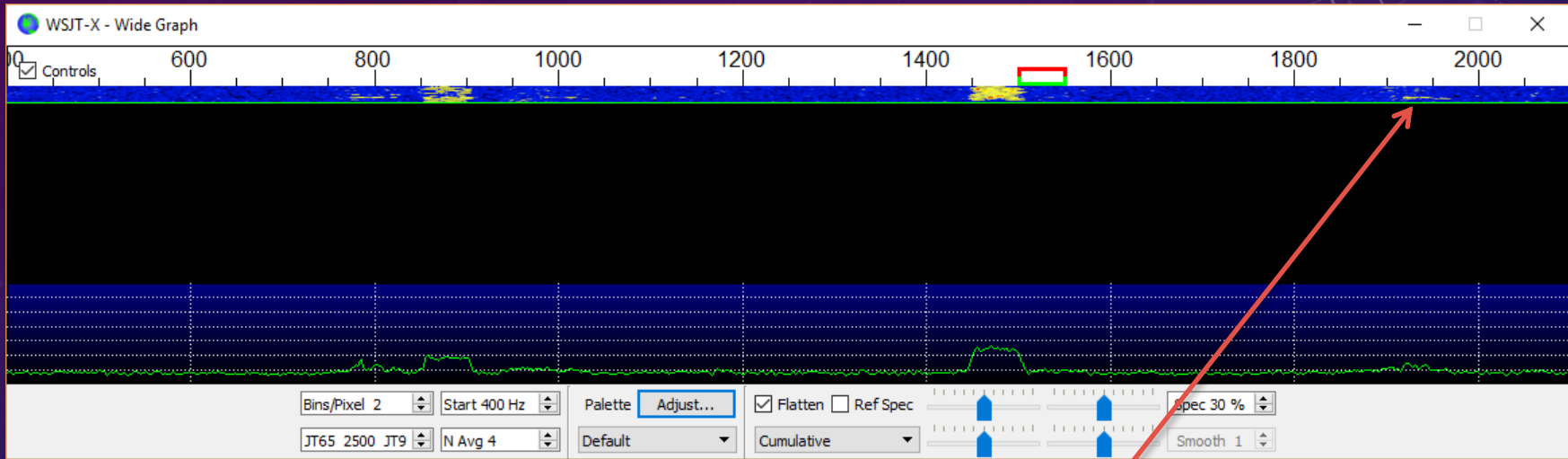


# WHAT SCATTERS MY SIGNAL?

- As the meteoroid enters the atmosphere at high speed (15 – 70 km/s) it ionizes the oxygen and nitrogen molecules generating ions and free electrons which scatter the RF (also makes light)
- This occurs between about 100 and 80 km, near the same altitude as sporadic E (Es)
  - The only relationship between Es and meteors is that the electrons responsible for Es are thought to come from metals deposited in the atmosphere from meteor ablation.
  - But Es is not correlated with meteor showers
  - During summer you may work Es while attempting meteor scatter QSOs
    - Es gives longer-lasting signals

# 6m FT8 Meteor Ping

7 August 2017 02:45:15

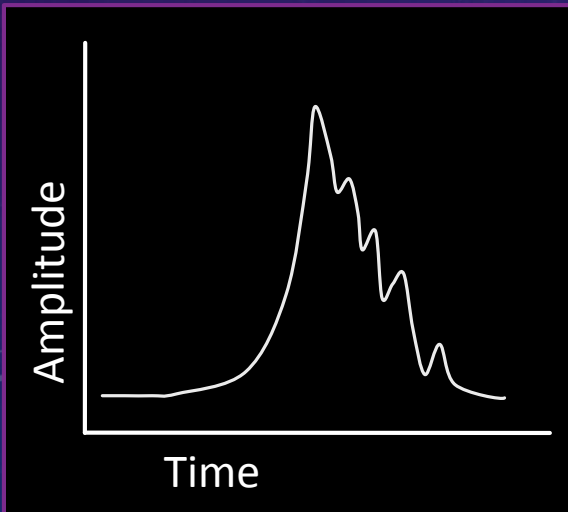
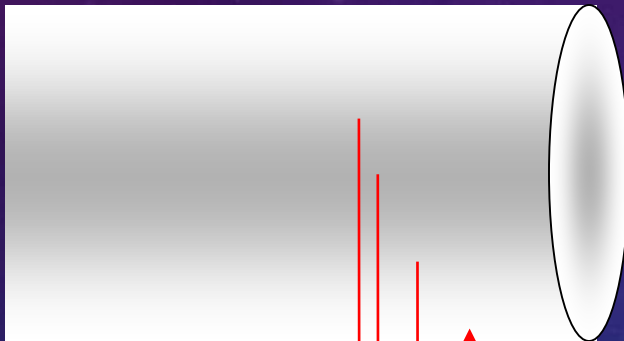


170807\_024515.wav

# TWO TYPES OF METEOR TRAILS

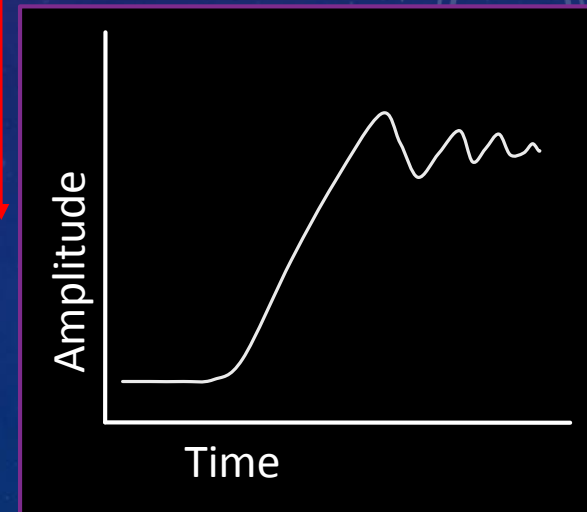
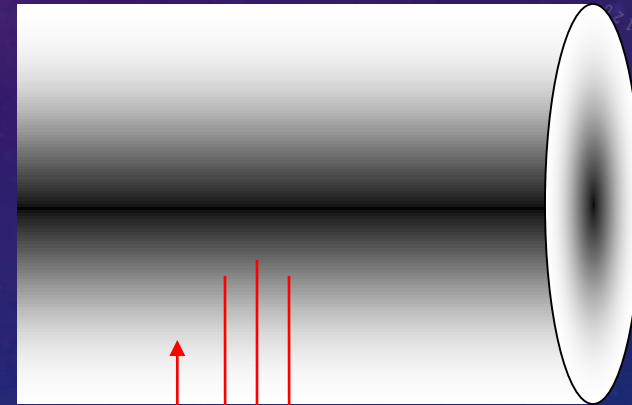
## Underdense

- Weak echoes
- Short-lived (<1 second)
- Electron density is so low that individual electrons don't interact with each other)
- Scattering geometry must be specular



## Overdense

- Strong echoes
- Long-lived (many seconds)
- Electrons act in concert like a metal tube
- Scattering geometry must be specular but upper atmospheric winds can "crinkle the tube"



From P. Brown, Univ. of Western Ontario



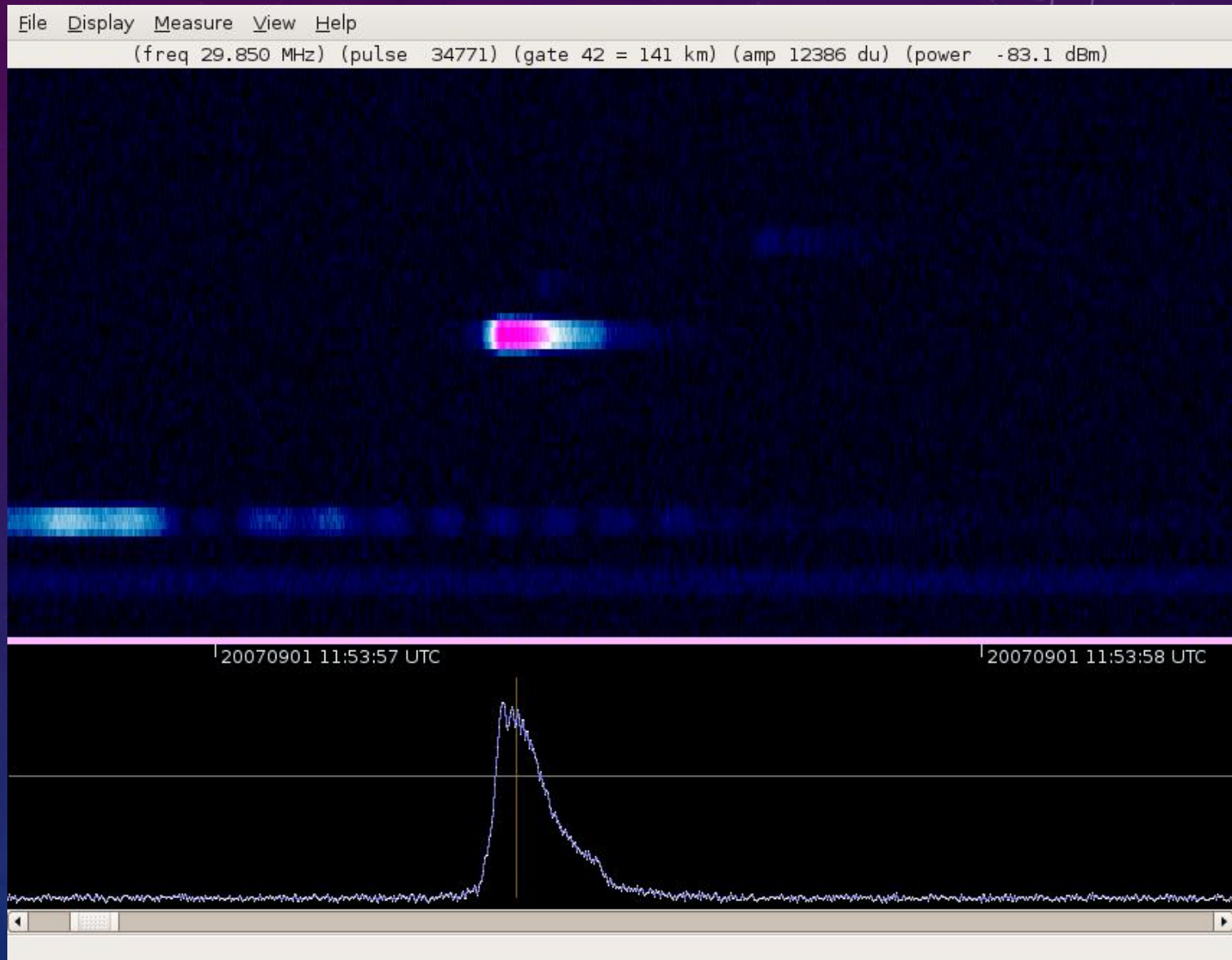
# UNDERDENSE EXAMPLE



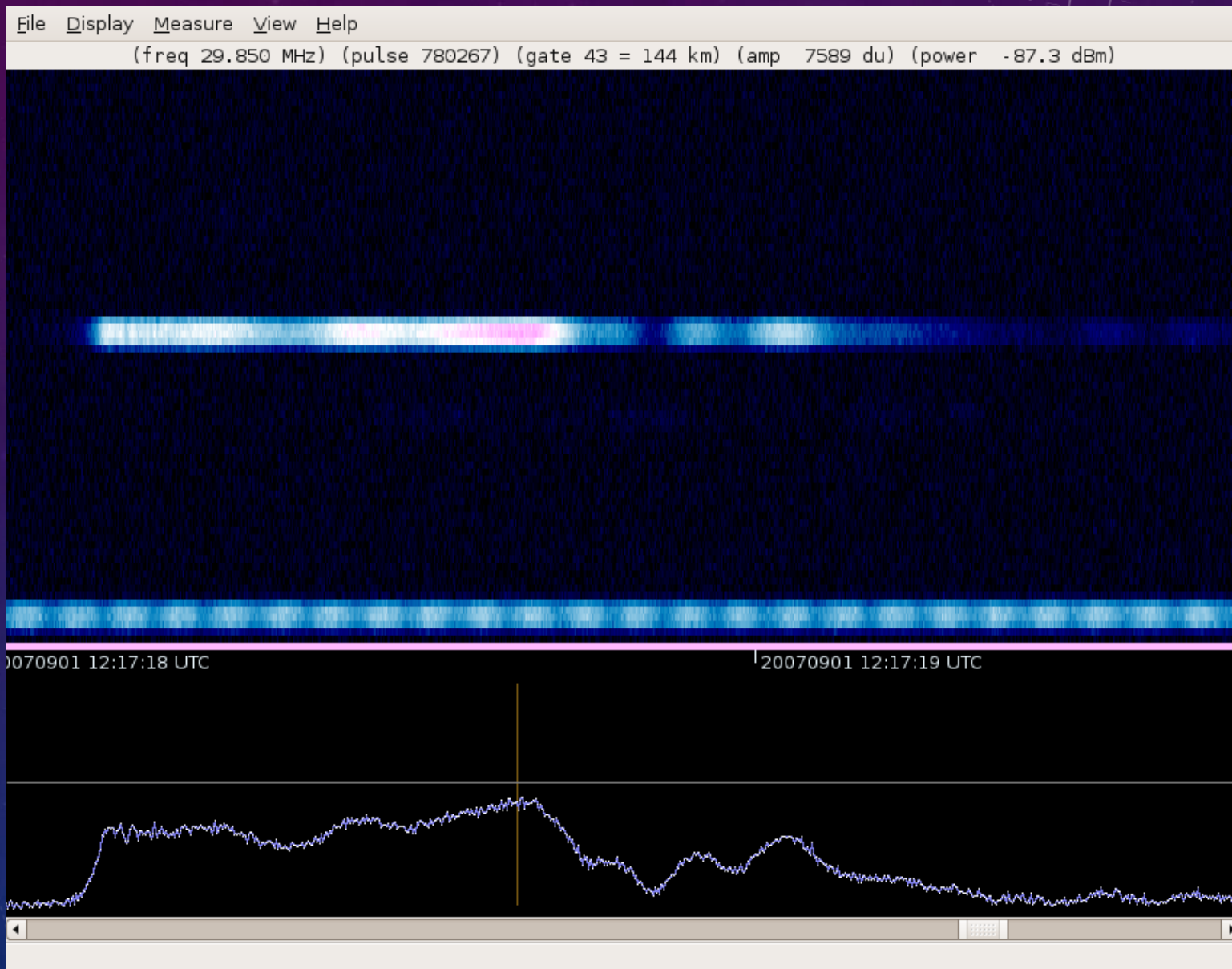
# ANOTHER LEONID



# Underdense echo

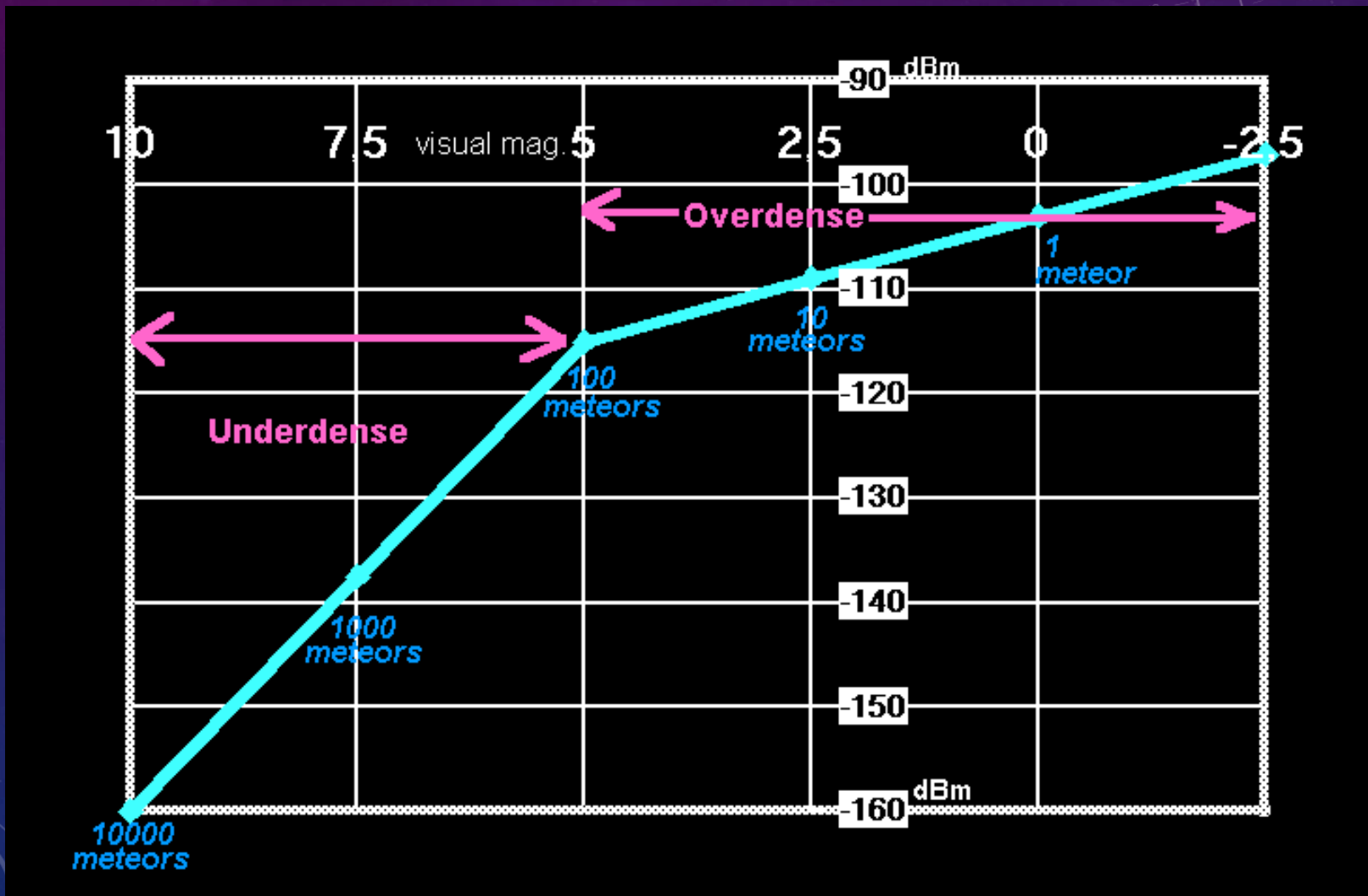


# Overdense echo





# APPROXIMATE HOURLY METEOR RATES



# RETURN POWER

Important point is that the signal strength goes as the cube of the wavelength,  $\lambda$ , and the square of the electron line density,  $q$

$$P_R = \frac{P_T G_T G_R \lambda^3 \sigma_e}{64\pi^3} \frac{q^2 \sin^2 \gamma}{(R_1 R_2)(R_1 + R_2)(1 - \sin^2 \phi \cos^2 \beta)}$$
$$= 5 \times 10^{-32} \frac{P_T G_T G_R \lambda^3 q^2 \sin^2 \gamma}{(R_1 R_2)(R_1 + R_2)(1 - \sin^2 \phi \cos^2 \beta)} \quad \text{watts}$$

You want to use the longest wavelength (lowest frequency) possible. If you get into HF bands, ionospheric effects can dominate so lower VHF (40 – 100 MHz) is best. From McKinley, 1961.

# FREQUENCY DEPENDENCE

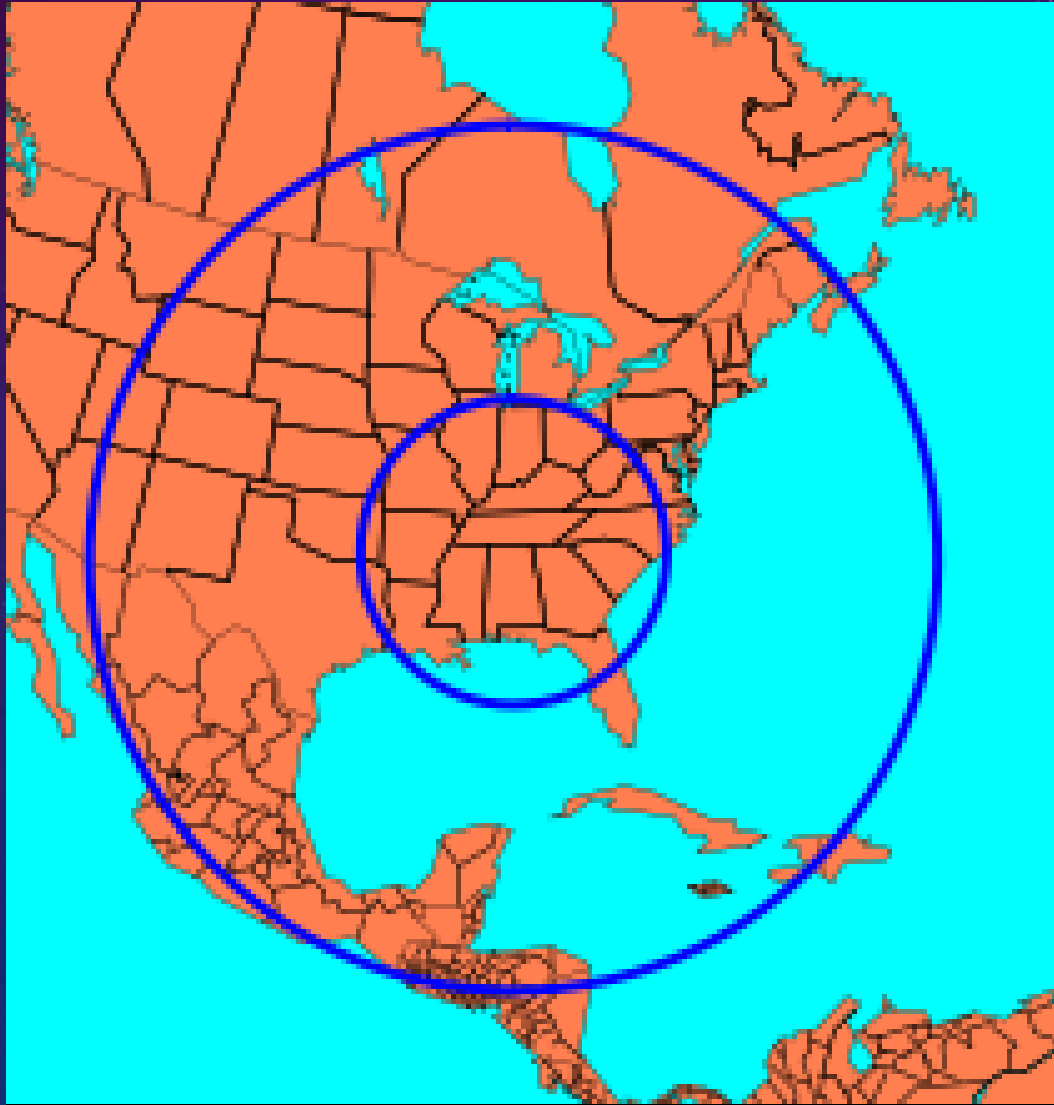
- Since scattered power is proportional to the wavelength<sup>3</sup> or 1/frequency<sup>3</sup> let's compare 2m to 6m

$$P \approx (144.2 / 50.26)^3 = 23.6 \text{ or } 13.7 \text{ dB, more than 2 S units}$$

- But antenna gain is slightly easier at 2m
  - 3 element 6m yagi is 8 dBi (5 element ~ 16 dBi)
  - 11 element 2m yagi ~ 15 dBi
- But most HF rigs have 6m
- So 6m is favored especially if you don't already have the antennas and amplifier for 2m
- 10m should also work but is not typically used – beware signaling rate limitations (1200 baud – 10m) below VHF

# WHERE DOES MY SIGNAL GO?

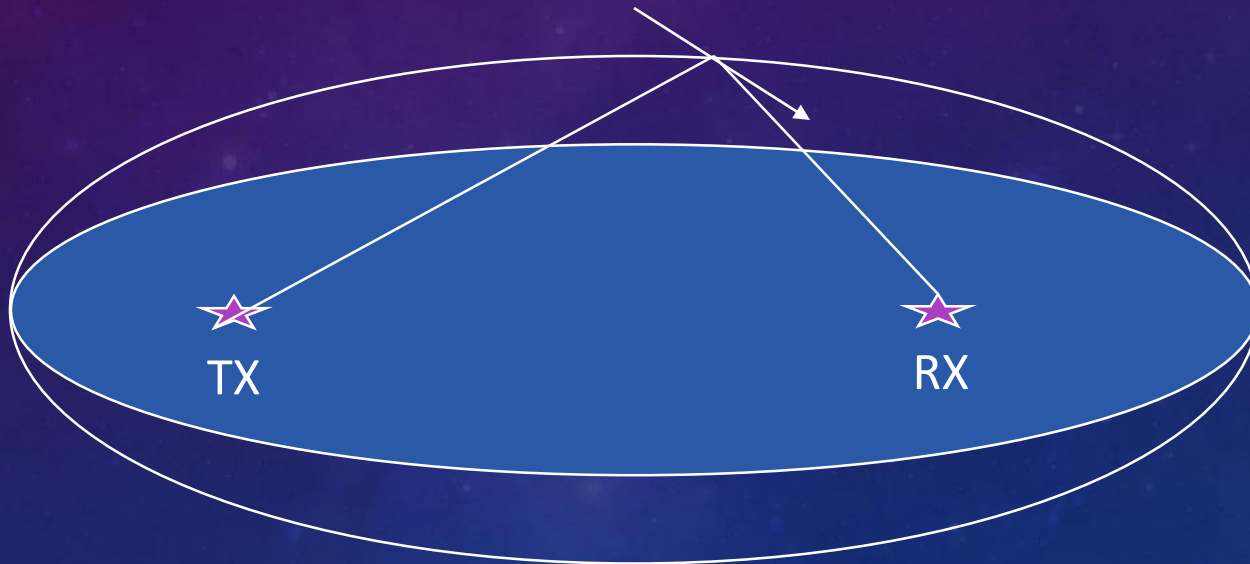
TYPICAL RANGE: 800 – 2300 KM (500 – 1400 MI)





# WHERE DOES MY SIGNAL GO?

- Meteor must lie tangent to an ellipsoid with the transmitter and receiver at the foci
- This geometry favors certain path directions as the shower radiant moves across the sky
- The vast majority of meteors don't satisfy this "specular" condition and can't be used for communications

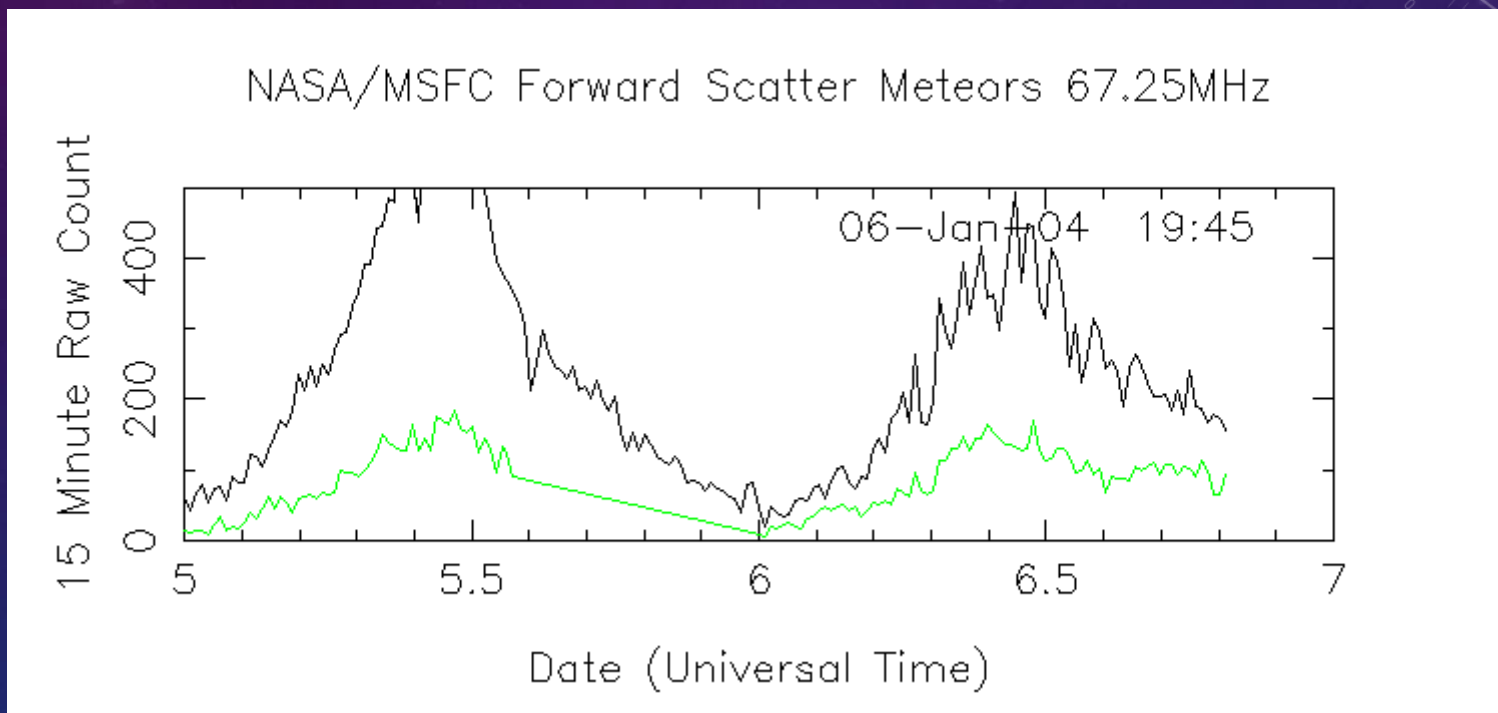


# WHAT IS THE BEST TIME TO OPERATE?

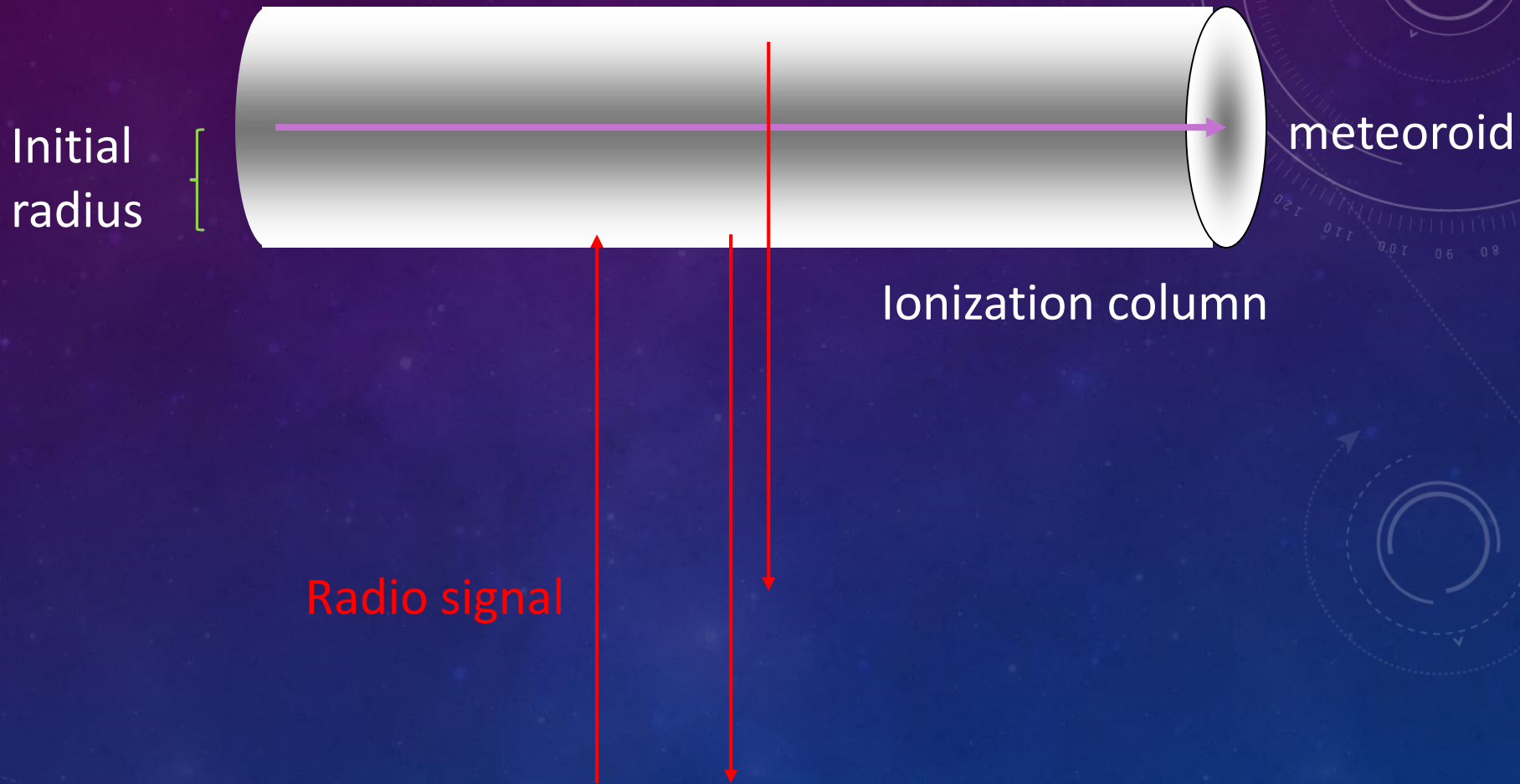
- Morning – diurnal variation – like bugs on a windshield
  - Car (Earth) going 30 km/s
  - Bugs (meteoroids) going up to 40 km/s around the sun, some head-on
  - Impact speed is vector sum of these – all hit windshield, only really fast ones hit rear window
- There are fewer meteors in the spring, +/- 20% annual variation
- During meteor showers – there are more large meteors

Name	Peak Dates	Approx. Meteors/hour	Speed
Quadrantids	Jan. 3	120	43 km/s
Arietids	Jun. 9 (daytime)	45	41
Eta Aquariids	May 6	60	66
Perseids	Aug. 11-13	90	60
Orionids	Oct. 20-22	20	67
Geminids	Dec. 12-13	120	36

# 2004 QUADRANTID METEOR SHOWER



# Initial radius – why fast meteors don't work as well

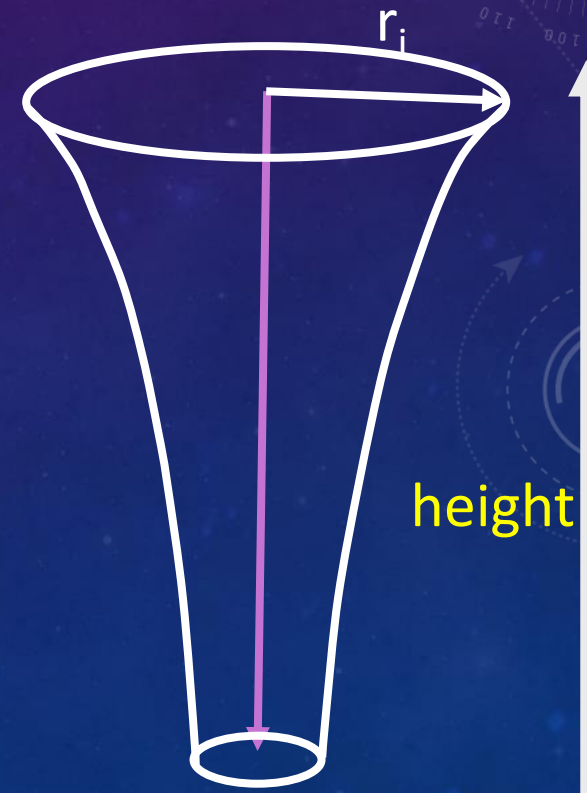
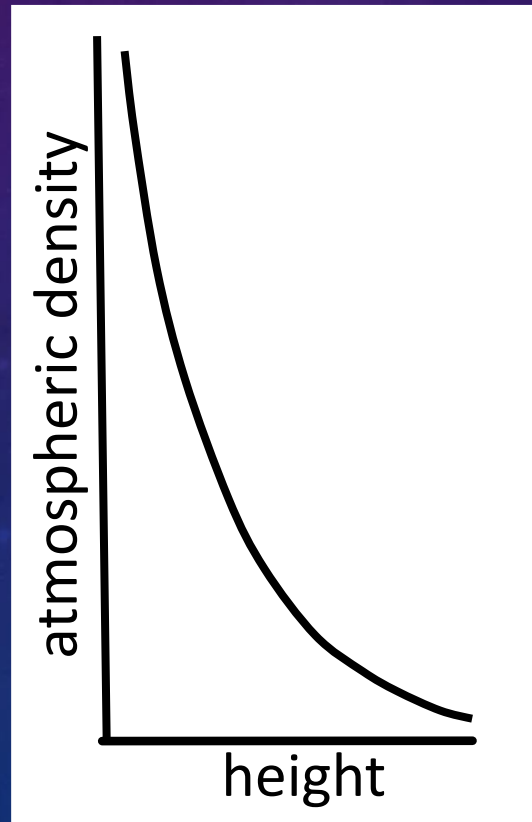


# Initial radius

When the radius of an underdense trail is of the order of the radar wavelength, there is significant attenuation

Initial radius varies with height

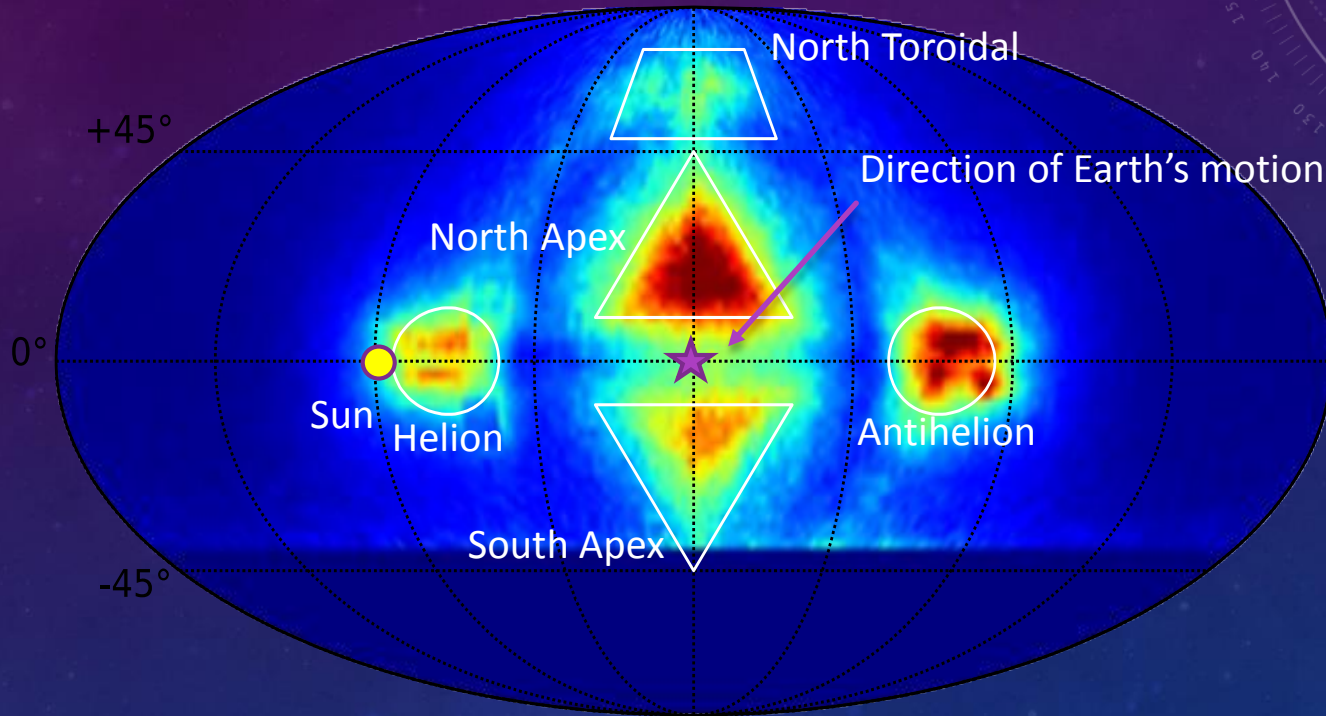
Since meteor ablation heights vary with speed (faster meteoroids ablate higher), the initial radius effect biases radio against fast meteors.



From P. Brown, Univ. of Western Ontario



# SPORADIC SOURCE RADIANTS FROM RADAR



Meteoroid Flux as a function of direction as observed by Canadian Meteor Orbit Radar. Observational biases have been taken into account and results have been weighted by a constant limiting kinetic energy. Coordinate system is Earth-centered ecliptic.

# WHAT EQUIPMENT SHOULD I USE?

- Most modern HF rigs include 6m
  - Throttle back from max power for high duty cycle like MSK144 (50 - 75%)
- Antenna gain helps – 5 element beam on 6m is good
  - An amplifier and mast-mounted preamp help
  - It is possible to make contacts with attic-mounted dipoles – be patient and make a sched with a big gun
- Most modern computers have adequate processing power
  - May need to reduce Frequency Tolerance (FTOL below 200 Hz)
- Need a soundcard interface
  - Many new rigs have this built-in
  - Signalink is very popular
  - Homebrew is fairly simple

# WHAT SOFTWARE AND MODE SHOULD I USE?

- WSJT-X has the MSK144 mode which is the standard
  - Available for Windows, Mac and Linux
  - 15 second cycle is typically used, messages are 72 msec
  - Offset quadrature phase shift keying (minimum shift keying)
  - PC clock should be set accurately, within a second or so
  - The WSJT Yahoo group is excellent but READ THE MANUAL FIRST
- Previous versions of WSJT had the FSK441 mode which has faded from use
- Longer format modes like JT65 and FT8 are too slow
  - Recall that most “pings” are a second or two
- CW and SSB are possible but are more difficult

# WHAT DOES A QSO LOOK AND SOUND LIKE?

- MSK144 sounds more like a grunt than a ping
- The QSO sequence looks just like JT65/JT9/FT8
- Operators' choice whether exchanging signal reports or grid squares
- Auto Sequence mode of MSK144 makes the QSO easy

# LOCAL CONTACT USING MSK144

WSJT-X v1.7.0 by K1JT

File Configurations View Mode Decode Save Help

Band Activity

UTC	dB	T	Freq	Message	
132500	1	7.1	1459	& N2LEE KK4TJP RRR	1
132530	5	0.6	1418	& N2LEE KK4TJP RRR	1
1326	-10	0.4	1414	# CQ KOTAZ EM09	
----- 6m					
1328	-17	0.4	1414	# CQ KOTAZ EM09	
133415	5	0.7	1542	& KB5EZ KK4TJP EM64	1
133445	6	0.7	1541	& KB5EZ KK4TJP R+09	1
133515	5	0.8	1542	& KB5EZ KK4TJP 73	1

Tx Messages

UTC	dB	T	Freq	Message	
132230	Tx		1500	& CQ KB5EZ EM64	
132300	Tx		1500	& CQ KB5EZ EM64	
1326	-10	0.4	1414	# CQ KOTAZ EM09	
1327	Tx		1414	# KOTAZ KB5EZ EM64	
1328	-17	0.4	1414	# CQ KOTAZ EM09	
133104	Tx		1500	& CQ KB5EZ EM64	
133130	Tx		1500	& CQ KB5EZ EM64	
133200	Tx		1500	& CQ KB5EZ EM64	
133230	Tx		1500	& CQ KB5EZ EM64	
133300	Tx		1500	& CQ KB5EZ EM64	
133330	Tx		1500	& CQ KB5EZ EM64	
133400	Tx		1500	& CQ KB5EZ EM64	
133415	5	0.7	1542	& KB5EZ KK4TJP EM64	1
133430	Tx		1500	& KK4TJP KB5EZ +05	
133500	Tx		1500	& KK4TJP KB5EZ RRR	
133530	Tx		1500	& KK4TJP KB5EZ 73	

Log QSO
Stop
Monitor
Erase
Decode
Enable Tx
Halt Tx
Tune

6m

32.3 dB

50.291 000

Tx even/1st

Rx 1500 Hz

F Tol 200

Report 5

T/R 15 s

Tx CQ 280

Sh  Auto Seq

Calling CQ

Answering CQ

CQ

Grid

dB

R+dB

RRR

73

CQ KB5EZ EM64  Gen msg

73 15W DPL  Free msg

Pwr

2017 Jun 18  
13:37:53

Receiving 41%
MSK144
Last Tx: KK4TJP KB5EZ 73
8/15 WD:6m



WSJT-X v1.8.0-rc1 by K1JT

File Configurations View Mode Decode Save Tools Help

Band Activity					Tx Messages				
UTC	dB	T	Freq	Message	UTC	dB	T	Freq	Message
125930	2	7.5	1550	& CQ K6EID EM73	131600	Tx	1500	& N2LEE KB5EZ EM64	
125930	3	7.5	1550	& CQ K6EID EM73	131630	Tx	1500	& N2LEE KB5EZ EM64	
130000	2	1.9	1553	& CQ N4ASF FM27	131700	Tx	1500	& N2LEE KB5EZ EM64	
130945	-1	13.8	1529	& CQ N2LEE FM18	131730	Tx	1500	& N2LEE KB5EZ EM64	
131045	1	10.3	1525	& CQ N2LEE FM18	131800	Tx	1500	& N2LEE KB5EZ EM64	
131145	0	3.6	1547	& CQ N2LEE FM18	131815	6	3.7	1536	& KB5EZ N2LEE -02
131415	2	6.1	1533	& CQ N2LEE FM18	131815	7	9.0	1537	& KB5EZ N2LEE -02
131815	6	3.7	1536	& KB5EZ N2LEE -02	131830	Tx	1500	& N2LEE KB5EZ R+07	
131815	7	9.0	1537	& KB5EZ N2LEE -02	131845	5	0.8	1537	& KB5EZ N2LEE RRR
131845	5	0.8	1537	& KB5EZ N2LEE RRR	131845	6	1.0	1535	& KB5EZ N2LEE RRR
131845	6	1.0	1535	& KB5EZ N2LEE RRR	131845	7	3.8	1537	& KB5EZ N2LEE RRR
131845	7	3.8	1537	& KB5EZ N2LEE RRR	131900	Tx	1500	& N2LEE KB5EZ 73	
131915	5	1.1	1537	& KB5EZ N2LEE 73	131915	5	1.1	1537	& KB5EZ N2LEE 73
131915	6	6.3	1538	& KB5EZ N2LEE 73	131915	6	6.3	1538	& KB5EZ N2LEE 73
131915	7	9.6	1539	& KB5EZ N2LEE 73	131915	7	9.6	1539	& KB5EZ N2LEE 73

Log QSO Stop Monitor Erase Decode Enable Tx Halt Tx Tune  Menu

6m ● **50.255 000**  Tx even/1st

Rx 1500 Hz F Tol 50 Report 7 T/R 15 s Tx CQ 280

Sh  Auto Seq  SWL

DX Call: N2LEE FM18 Az: 61 B: 48 El: 8 601 mi

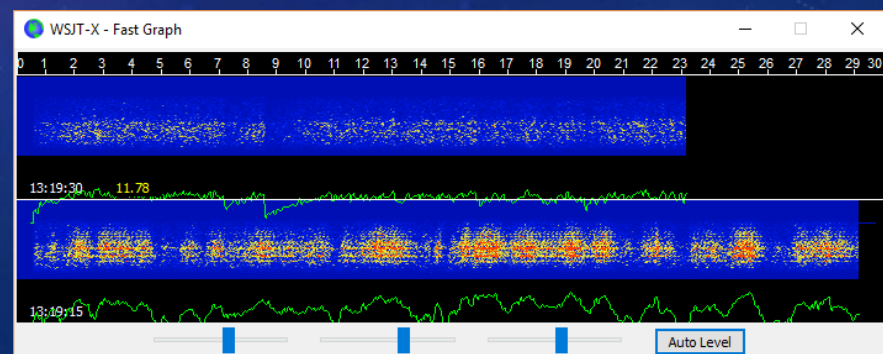
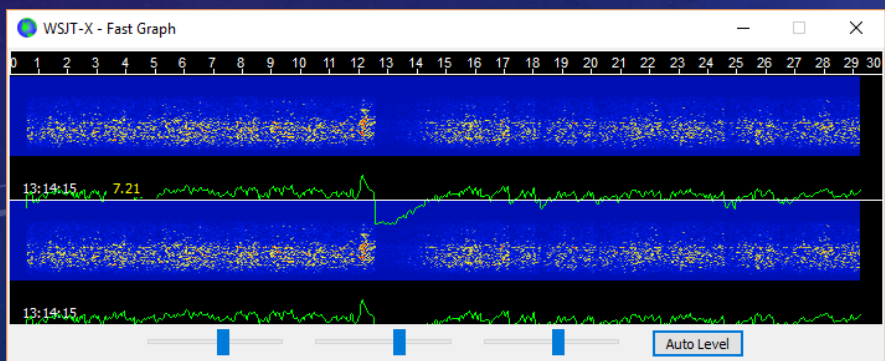
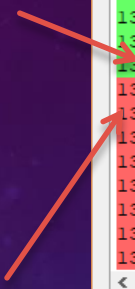
2017 Aug 12 13:19:26

Calling CQ: CQ dB: RRR Answering CQ: Grid R+dB: 73

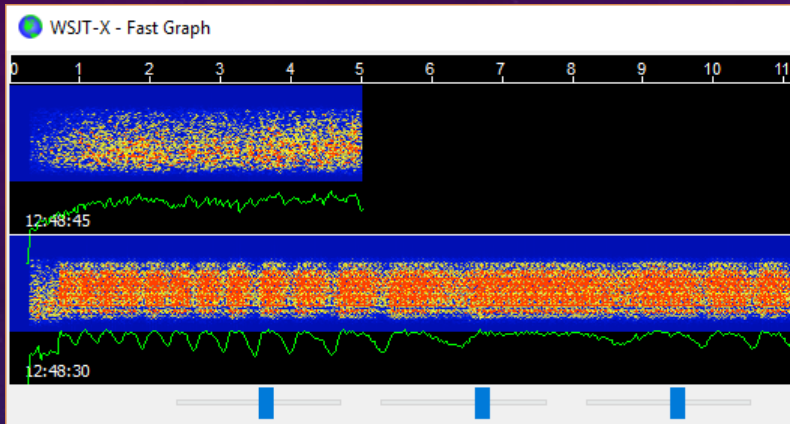
N2LEE KB5EZ 73  Gen msg

5W DPL 73  Free msg

Receiving 8% MSK144 Last Tx: N2LEE KB5EZ 73 11/15 WD:6m



# KG4Q AIRCRAFT SCATTER 12:48 29 MAY



WSJT-X v1.7.0 by K1JT

File Configurations View Mode Decode Save Help

Band Activity							Rx Frequency				
UTC	dB	T	Freq	Message			UTC	dB	T	Freq	Message
123930	9	1.0	1481	& W0VD KG4Q EM64	1						
123930	10	0.9	1481	& W0VD KG4Q EM64	1						
124000	-1	0.8	1481	& W0VD KG4Q EM64	1						
124000	0	1.3	1479	& W0VD KG4Q EM64	1						
124030	2	0.7	1479	& W0VD KG4Q EM64	1						
124100	0	0.7	1479	& W0VD KG4Q EM64	1						
124100	1	0.8	1480	& W0VD KG4Q EM64	1						
124700	2	8.0	1636	& N3RG KG4Q EM64	1						
124700	3	8.2	1583	& N3RG KG4Q EM64	1						
124700	4	10.6	1472	& N3RG KG4Q EM64	1						
124730	2	0.8	1481	& N3RG KG4Q EM64	1						
124730	3	1.3	1481	& N3RG KG4Q EM64	1						
124800	3	0.8	1481	& N3RG KG4Q EM64	1						
124830	3	0.8	1481	& N3RG KG4Q EM64	1						
124830	4	1.1	1481	& N3RG KG4Q EM64	1						
124900	4	0.7	1479	& N3RG KG4Q EM64	1						

Log QSO Stop Monitor Erase Decode Enable Tx Halt Tx Tune

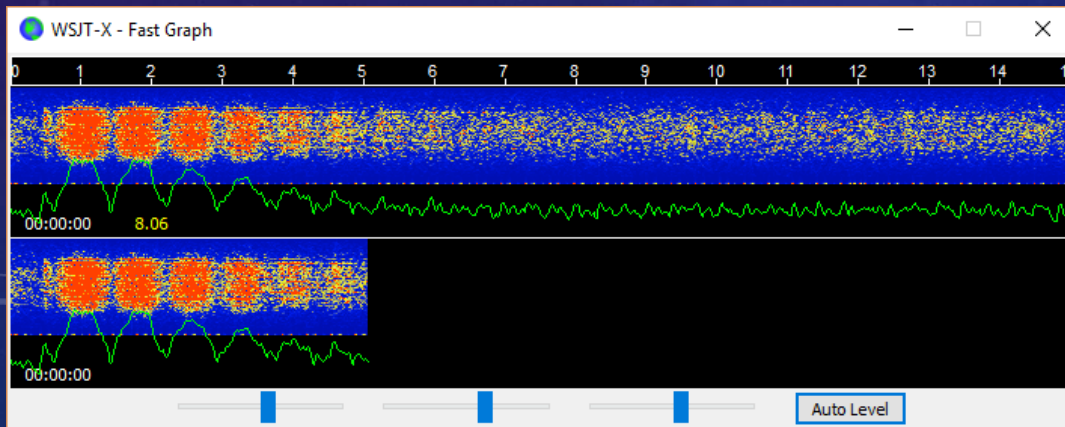
6m 50.281 000

DX Call: UT7QF, DX Grid: KN77, Rx: 1500 Hz, F Tol: 200, Report 0, T/R: 15 s, Tx CQ: 280

2017 May 29 12:50:02

Calling CQ: CQ, Answering CQ: Grid, dB: R+dB, RRR: 73, Gen msg: CQ KB5EZ EM64, Free msg: 73 15W DPL

Receiving: 86%, MSK144, Last Tx: CQ KB5EZ EM64, 3/15 WD:6m



# TOOLS TO HELP MAKE CONTACTS

- Pingjockey.net
  - Great way to setup a contact
    - Agree on frequency and timing
    - DO NOT post info during the QSO if you want it to “count”
- University of Western Ontario radar site
  - Indicates which showers are active
  - 15 kW radar at 17.45, 29.85, and 38.15 MHz
  - The system can't see meteors from radiants directly overhead
  - It loses sensitivity for higher speed meteors (initial trail radius)

# PINGJOCKEY.NET

← → ↻ ⓘ www.pingjockey.net/cgi-bin/pingtalk

Apps Balun 4:1 Ham radio Bible study MSFC Automated Lun Rasp Pi Keeping it Clean: CPAI

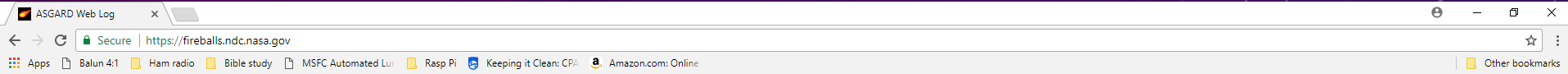
To have your callsign and locator automatically appended to each message that you send, an html cookie can be stored by your web browser. The information that is stored in the cookie is your callsign, firstname, and Maidenhead grid locator. To enable this feature, please press the "Update User details" button shown above.

Enter your message here

```
DDMMM UTC
23Apr 12:29 ~ QRV ~ 144140 ~ (K0TPP Larry mo EM48rj 71.11.138.45)
23Apr 12:29 RR (W5ZFP Ron LA EL49vw 162.203.219.199)
23Apr 12:29 CQ Stopped (W5SAT Brad NV DM26kc 72.193.208.187)
23Apr 12:29 OK R0n - I'm with you now. (K1JT/7EL700W Joe NJ FN20qi 173.71.96.3)
23Apr 12:27 Tnx QSO Ken (K1JT/7EL700W Joe NJ FN20qi 173.71.96.3)
23Apr 12:26 K1JT Joe, 122545 18 12.5 1488 & W8KEN K1JT RRR 2 0 0.0 - in the log, 73, ken (W8KEN/6/2 Ken OH EN91im 184.59.132.46)
23Apr 12:26 Thanks Ron 122430 12 0.7 1492 & WA4PGM W5ZFP 73 1 0 0.3 122430 13 5.1 1498 & WA4PGM W5ZFP 73 1 0 0.2 (W
23Apr 12:25 K1JT CALLING (W5ZFP Ron LA EL49vw 162.203.219.199)
23Apr 12:25 kn4jx Tommy, What is your station setup PSE? (N0KK/6/2/ORO Kirk MN EN35ha 97.116.169.177)
23Apr 12:24 122415 5 6.0 1516 & W5ZFP WA4PGM RRR 1 (W5ZFP Ron LA EL49vw 162.203.219.199)
23Apr 12:24 TU Kirk (KN4JX Tommy MO EM37wn 72.160.171.43)
23Apr 12:23 122245 4 12.7 1470 & N0KK KN4JX RRR 1 4 -0.4 TU QSO! (N0KK/6/2/ORO Kirk MN EN35ha 97.116.169.177)
23Apr 12:23 K1JT Joe, GM Joe - Tnx New Contact - 73, Ken (W8KEN/6/2 Ken OH EN91im 184.59.132.46)
23Apr 12:22 RR Ron (K1JT/7EL700W Joe NJ FN20qi 173.71.96.3)
23Apr 12:20 K1JT when you finish (W5ZFP Ron LA EL49vw 162.203.219.199)
23Apr 12:16 Nice signals up here, Ron (N8OC Dave MI EN83ao 75.133.95.71)
23Apr 12:15 121445 0 12.3 1484 & W5ZFP N8OC 73 3 thanks (W5ZFP Ron LA EL49vw 162.203.219.199)
23Apr 12:14 CQ 2nd 50.280 North (W5SAT Brad NV DM26kc 72.193.208.187)
23Apr 12:12 Tnx Tom: (I guess 74 is more than 73, hi.) (K1JT/7EL700W Joe NJ FN20qi 173.71.96.3)
23Apr 12:11 Hi, Jay. Nice to wrok you this AM. (W7XU Arliss SD EN13lm 72.106.201.17)
23Apr 12:11 W7XU TNX for QSO Arliss (K4NKT/6/2/100W/ Jay AL EM64rp 68.35.12.202)
23Apr 12:08 K1JT Tnx for QSO Ken (K1JT/7EL700W Joe NJ FN20qi 173.71.96.3)
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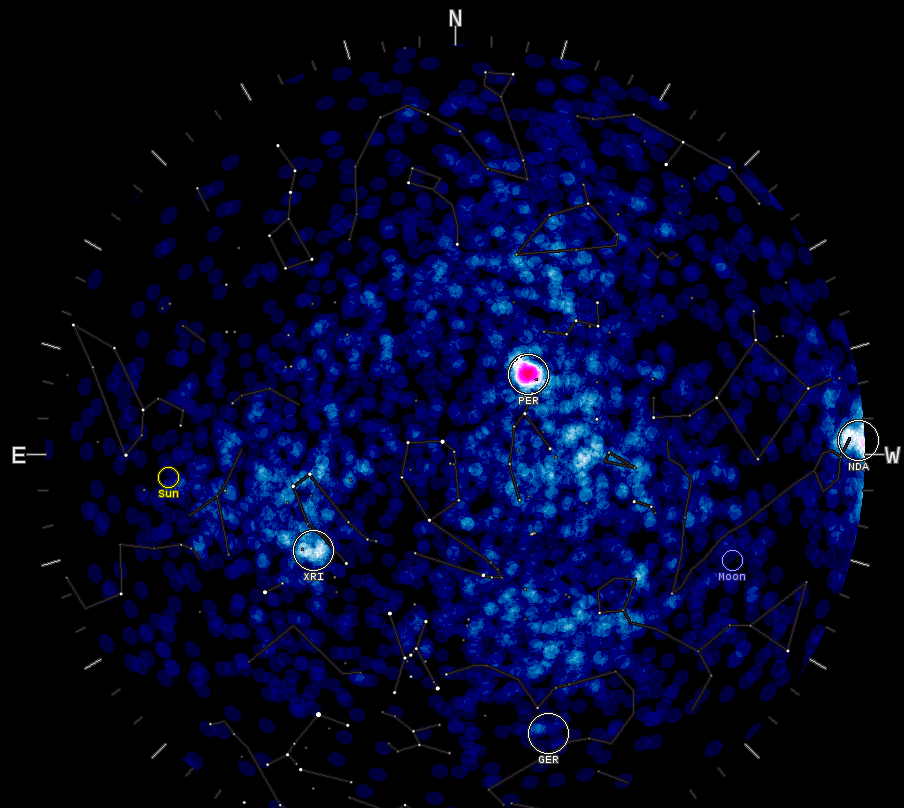


# UWO RADAR SITE – FIREBALLS.NDC.NASA.GOV



20170812 13:00:01 UTC  
lat 43.265 lon -80.772 lra 4.00 V  
4647 radiant/s

- radar
- liveview
- 20170811
- 20170810
- 20170809
- 20170808
- 20170807
- 20170806
- 20170805
- 20170804
- 20170803
- 20170802
- 20170801
- 20170731
- 20170730
- 20170729
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- 20170725
- 20170724
- 20170723
- 20170722



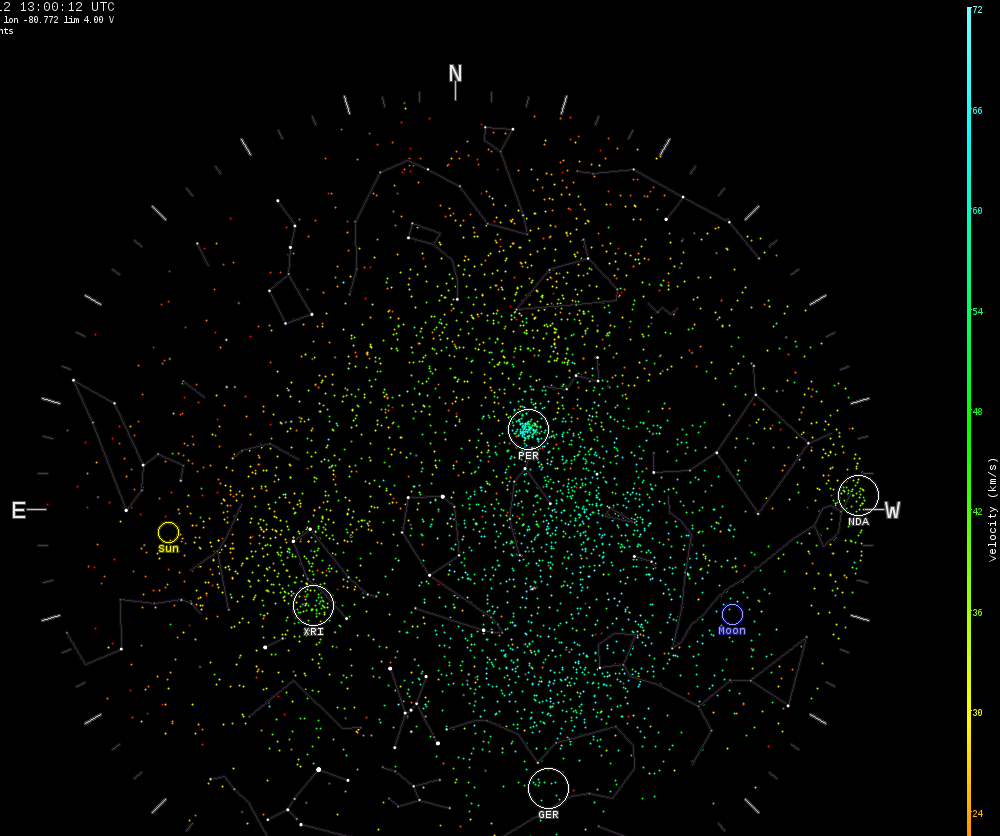
## Perseids 12 August 2017



# Perseids 12 August 2017

20170812 13:00:12 UTC  
lat 43.265 lon -80.772 Lim 4.00 V  
4647 radiant

- radar
- liveview
- 20170811
- 20170810
- 20170809
- 20170808
- 20170807
- 20170806
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- 20170724
- 20170723
- 20170722



# SUMMARY

- Meteor scatter communications is easier than ever thanks to digital modes
- You can make meteor scatter contacts anytime but they are easier during meteor showers and during the morning hours
- You don't need a super station but antenna gain, a preamp, and transmit power make it easier
  - Try it even if you are running 50w to a dipole
- Don't be afraid to ask for help on the Pingjockey and WSJT groups but do a little homework first
  - Get some experience with JT65, JT9 or especially FT8 on HF to get the feel for digital contacts and checkout your rig interface
- Give it a try and ponder what is happening when you hear a "ping" – some dust particle has been wandering around the solar system for hundreds or thousands of years and then meets its fiery end to help you make a QSO

# AN ANNOUNCEMENT – NASA ON THE AIR EVENT

- Beginning this December, 13 club stations at NASA centers and facilities will be participating in a year long event: NASA On The Air
- Points can be accumulated by working these club stations on various bands and modes, a web-based system will allow points tracking
- A downloadable certificate will be available at the end of the event in December 2018
- Various special events will also be celebrated including:
  - December 2017 – 45<sup>th</sup> anniversary of Apollo 17 last lunar landing
  - June 2018 – 60<sup>th</sup> anniversary of NASA
  - October 2018 – 20<sup>th</sup> anniversary of International Space Station
  - December 2018 – 50<sup>th</sup> anniversary of Apollo 8 lunar orbiting mission
- Stay tuned to QST and [nasaontheair.wordpress.com](http://nasaontheair.wordpress.com) for further details

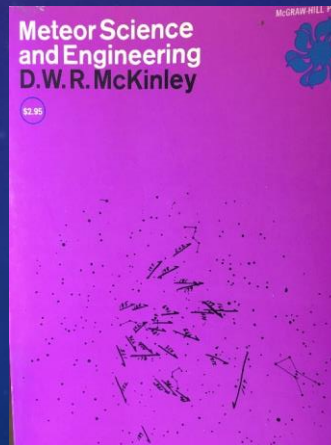
# NASA CENTERS AND FACILITIES – PARTICIPATING CLUBS





# LINKS AND ADDITIONAL RESOURCES

- <https://www.pingjockey.net/cgi-bin/pingtalk>
- <https://fireballs.ndc.nasa.gov>
- <https://physics.Princeton.edu/plulsar/k1jt/wsjtx.html>
- International Meteor Organization radio observation info  
<http://www.imo.net/radio/index.html>
- Check NASA Technical Report Server for these slides
  - <https://www.sti.nasa.gov/>
- Meteor Science and Engineering by D. W. R. McKinley – 1961



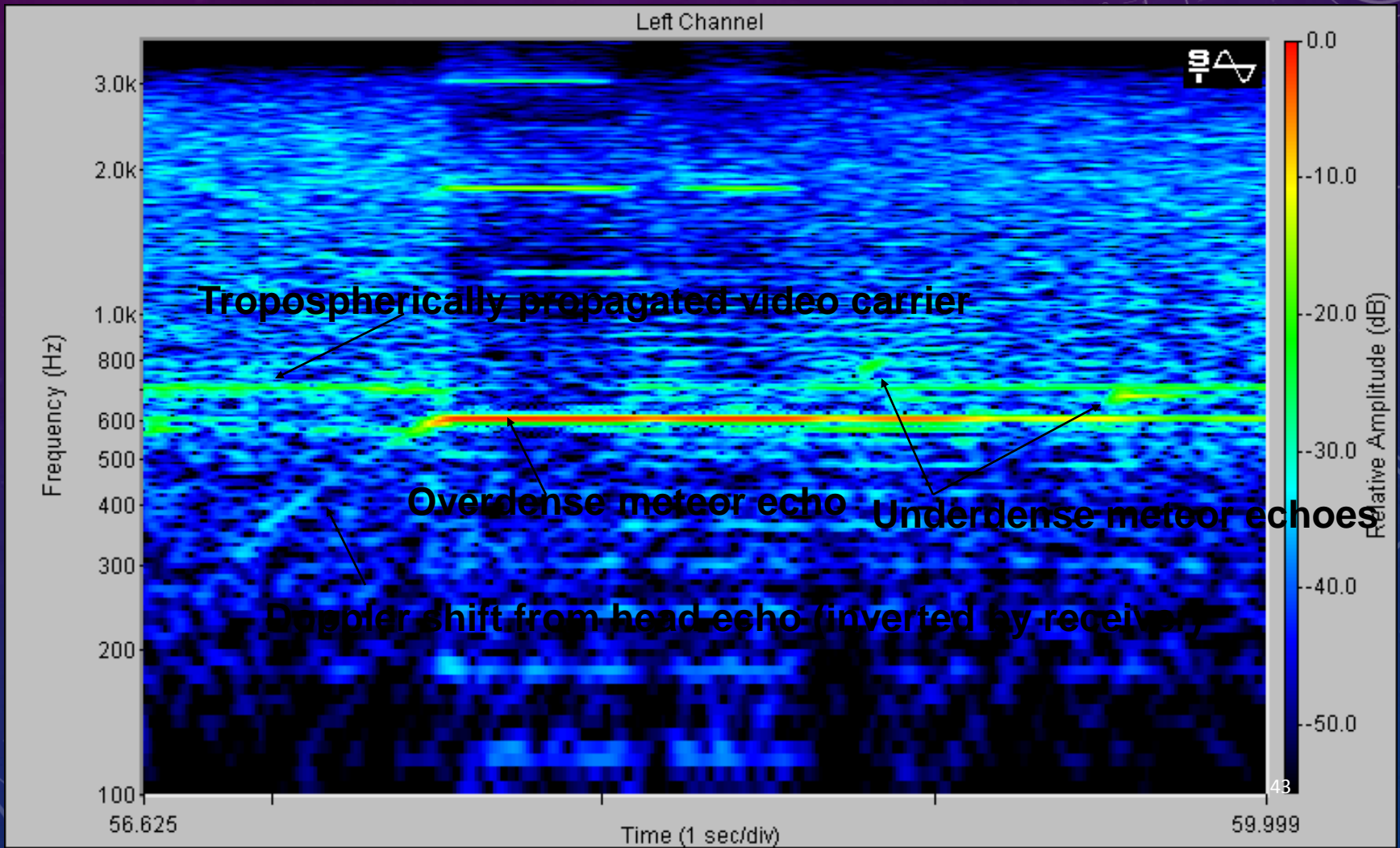


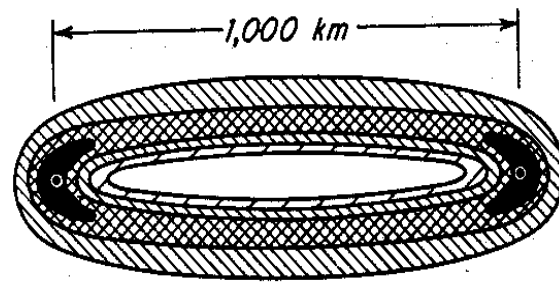
# BACKUP

# PARTICIPATING CLUBS

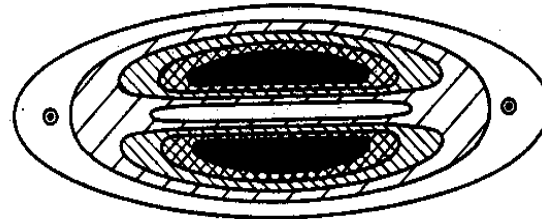
- Ames Research Center – ARC – NA6MF - California
- Armstrong Flight Research Center – AFRC – NA6SA - California
- Glenn Research Center – GRC – NA8SA- Ohio
- Goddard Space Flight Center – GSFC – WA3NAN – Maryland
- International Space Station – ISS – NA1SS, etc. – earth orbit
- Jet Propulsion Laboratory – JPL – W6VIO – California
- Johnson Space Center – JSC – W5RRR – Texas
- Kennedy Space Center – KSC – N1KSC – Florida
- Langley Research Center – LARC – KG4NJA – Virginia
- Marshall Space Flight Center – MSFC – NN4SA – Alabama
- Stennis Space Center – SSC – N5SSC (to be requested) – Mississippi
- Wallops Flight Facility – WFF – W4WFF – Virginia
- White Sands Complex/White Sands Test Facility – WSCTF – TBD – New Mexico

# Spectrogram of “Bright” and “Faint” Meteors

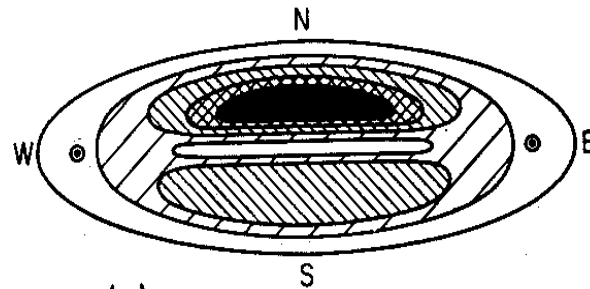




(a)



(b)



(c)

FIG. 9-6. (a) The relative number density of forward-scatter echoes, projected on a horizontal plane at a height of 100 km above the stations; (b) the relative duration density of forward-scatter echoes for a uniform radiant distribution; (c) the relative duration density for a radiant distribution concentrated in the south.

# FORWARD SCATTER GEOMETRY

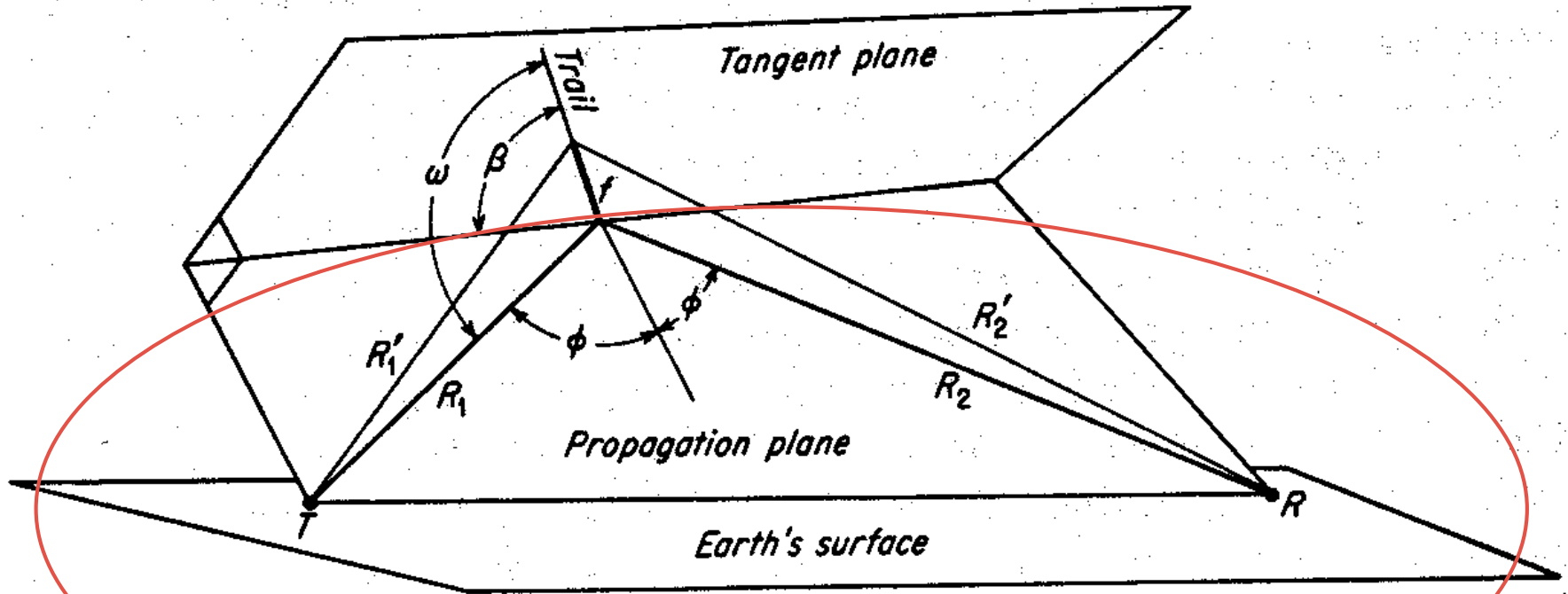


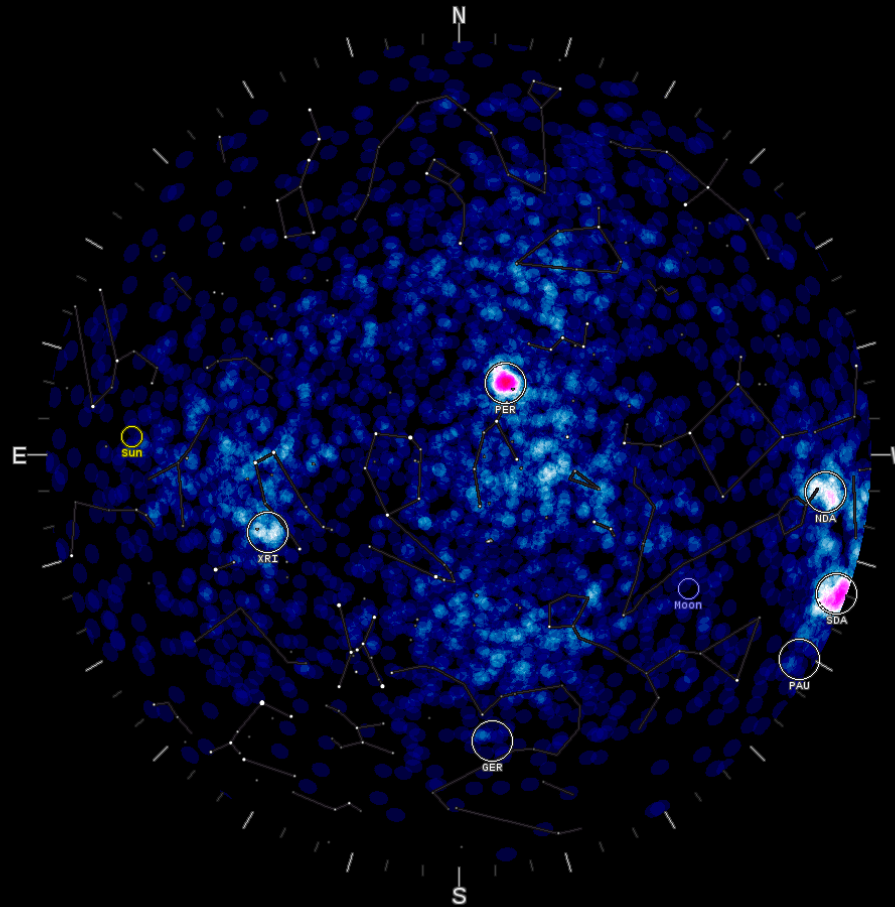
FIG. 9-1. The geometry of forward-scatter involved in the calculation of  $f$ , the length of one-half of the first Fresnel zone.

From "Meteor Science and Engineering", D.W.R. McKinley



# Perseids 12 August 2017

ASGARD Web Log x  
Secure | https://fireballs.ndc.nasa.gov  
Apps Balun 4:1 Ham radio Bible study MSFC Automated Lur Rasp Pi Keeping it Clean: CP Amazon.com: Online Other bookmarks



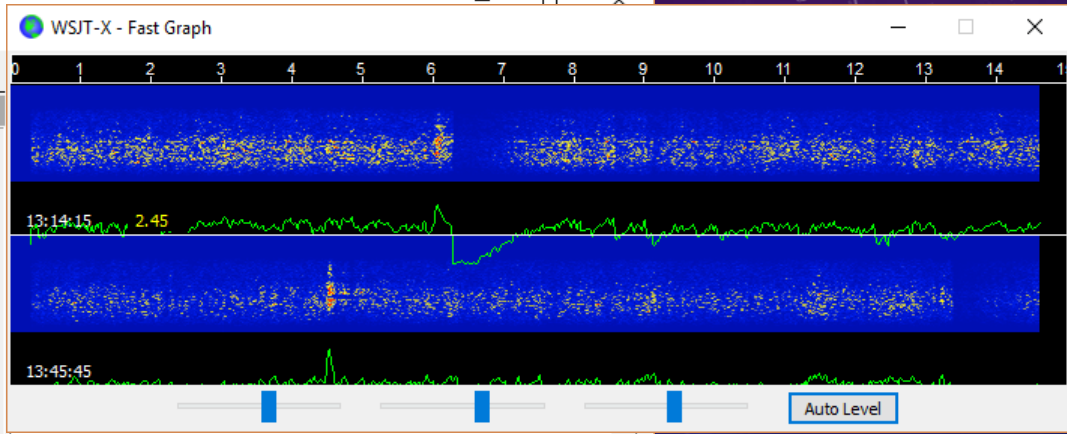
- radar  
liveview
- 20170811
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  - 20170809
  - 20170808
  - 20170807
  - 20170806
  - 20170805
  - 20170804
  - 20170803
  - 20170802
  - 20170801
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  - 20170725
  - 20170724
  - 20170723
  - 20170722

WSJT-X v1.8.0-rc1 by K1JT

File Configurations View Mode Decode Save Tools Help

Band Activity

UTC	dB	T	Freq	Message	
134500	1	0.9	1517	& NX4E KC5WX 73	3
131415	2	6.1	1533	& CQ N2LEE FM18	1



Log QSO Stop Monitor Erase Decode Enable Tx Halt Tx Tune  Menus

6m ● 50.260 000  Tx even/1st

Calling CQ	Answering CQ
CQ	Grid
dB	R+dB
RRR	73

Sh  Auto Seq  SWL  
 Gen msg  Free msg  
5W DPL 73

56 dB

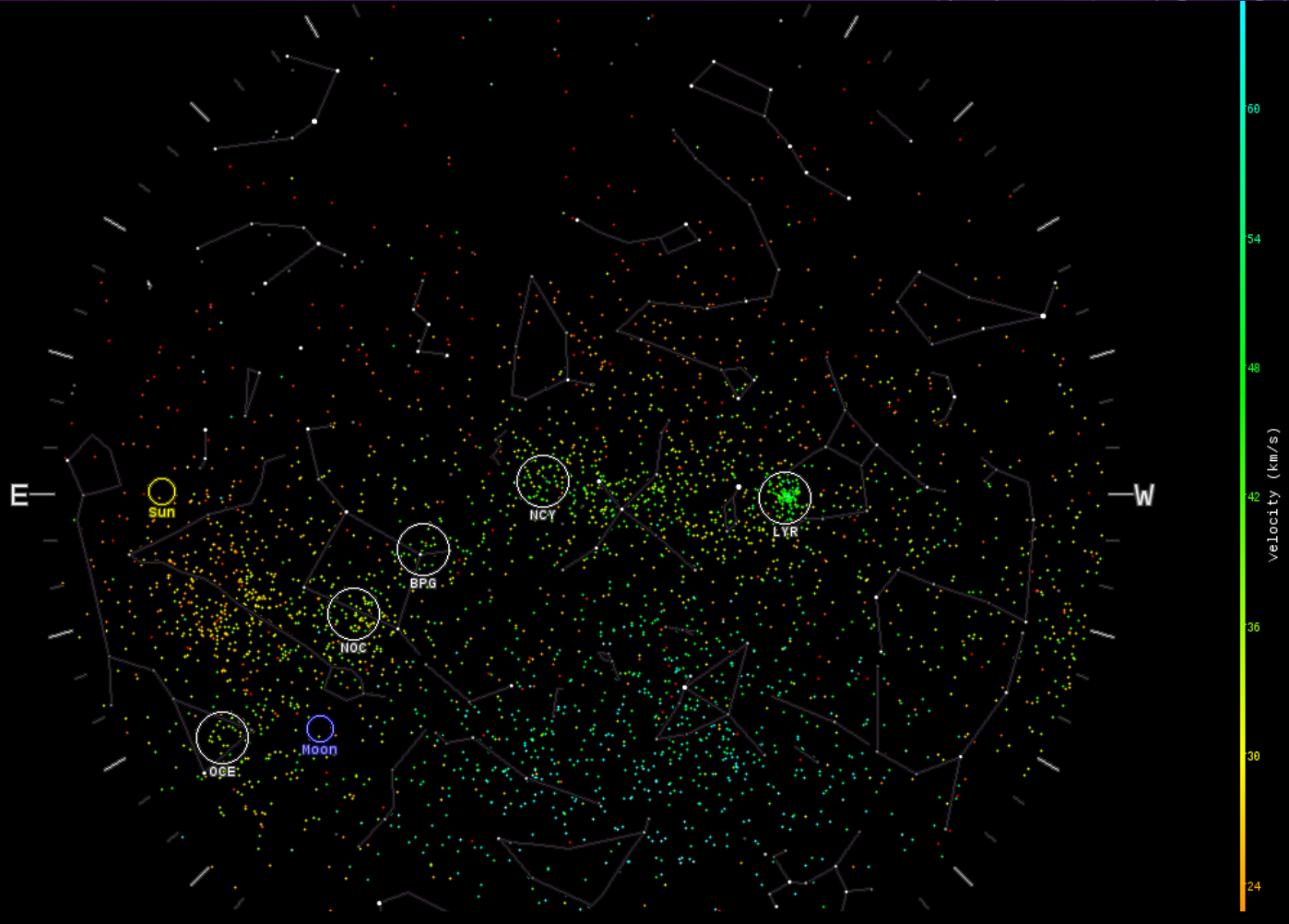
Az: 37 A: 51 El: 11 509 mi

Look Add

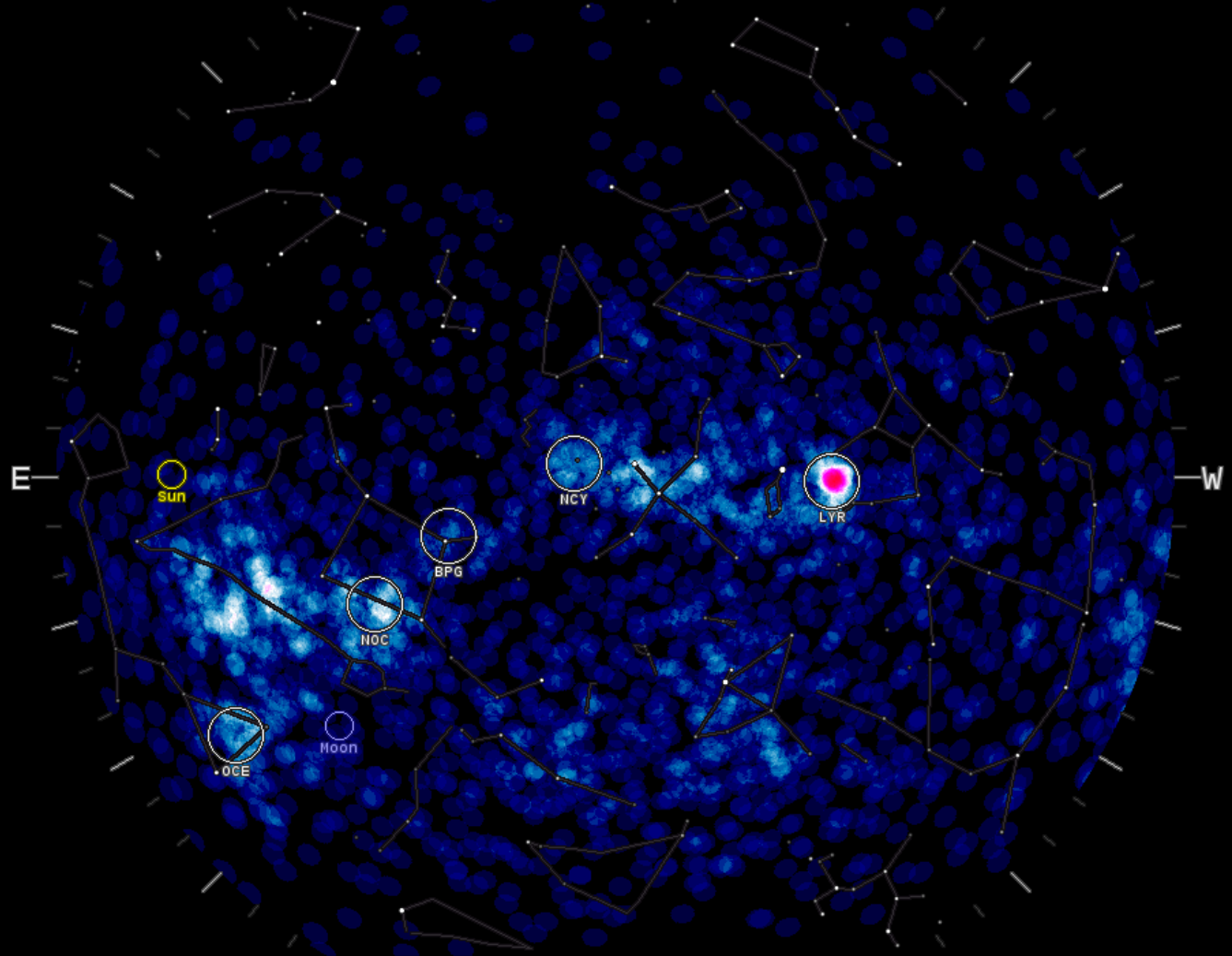
Rx 1500 Hz F Tol 100 Report 0 T/R 15 s Tx CQ 280

# UWO RADAR SITE - SPEEDS

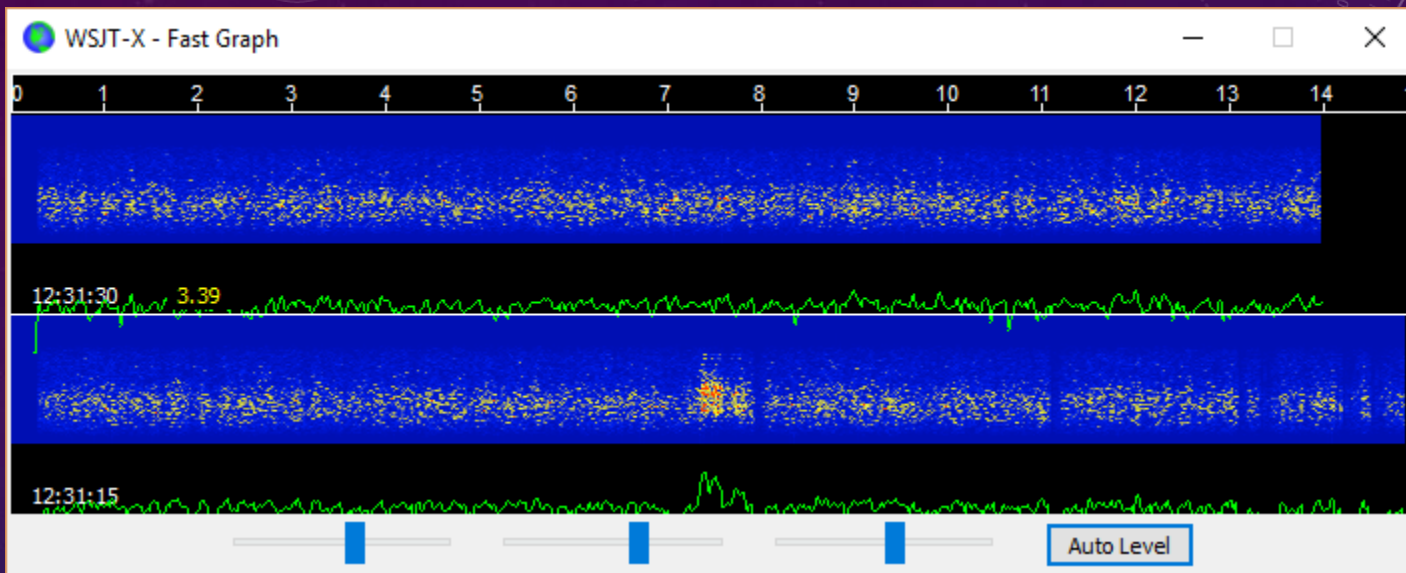
- radar  
liveview
- 20170422
  - 20170421
  - 20170420
  - 20170419
  - 20170418
  - 20170417
  - 20170416
  - 20170415
  - 20170414
  - 20170413
  - 20170412
  - 20170411
  - 20170410
  - 20170409
  - 20170408
  - 20170407
  - 20170406
  - 20170405
  - 20170404
  - 20170403
  - 20170402



# UWO RADAR SITE – FIREBALLS.NDC.NASA.GOV



- radar  
liveview
- [20170422](#)
  - [20170421](#)
  - [20170420](#)
  - [20170419](#)
  - [20170418](#)
  - [20170417](#)
  - [20170416](#)
  - [20170415](#)
  - [20170414](#)
  - [20170413](#)
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  - [20170407](#)
  - [20170406](#)
  - [20170405](#)
  - [20170404](#)
  - [20170403](#)
  - [20170402](#)



Log QSO Stop Monitor Erase Decode Enable Tx Halt Tx Tune  Menus

6m **50.255 000**  Tx even/1st

DX Call DX Grid Rx 1500 Hz

KF4FCO EM70 F Tol 200

Az: 160 A: 181 El: 18 307 mi Report 0

Lookup Add T/R 15 s

**2017 Aug 13**  
**12:32:52**

Sh  Auto Seq  SWL

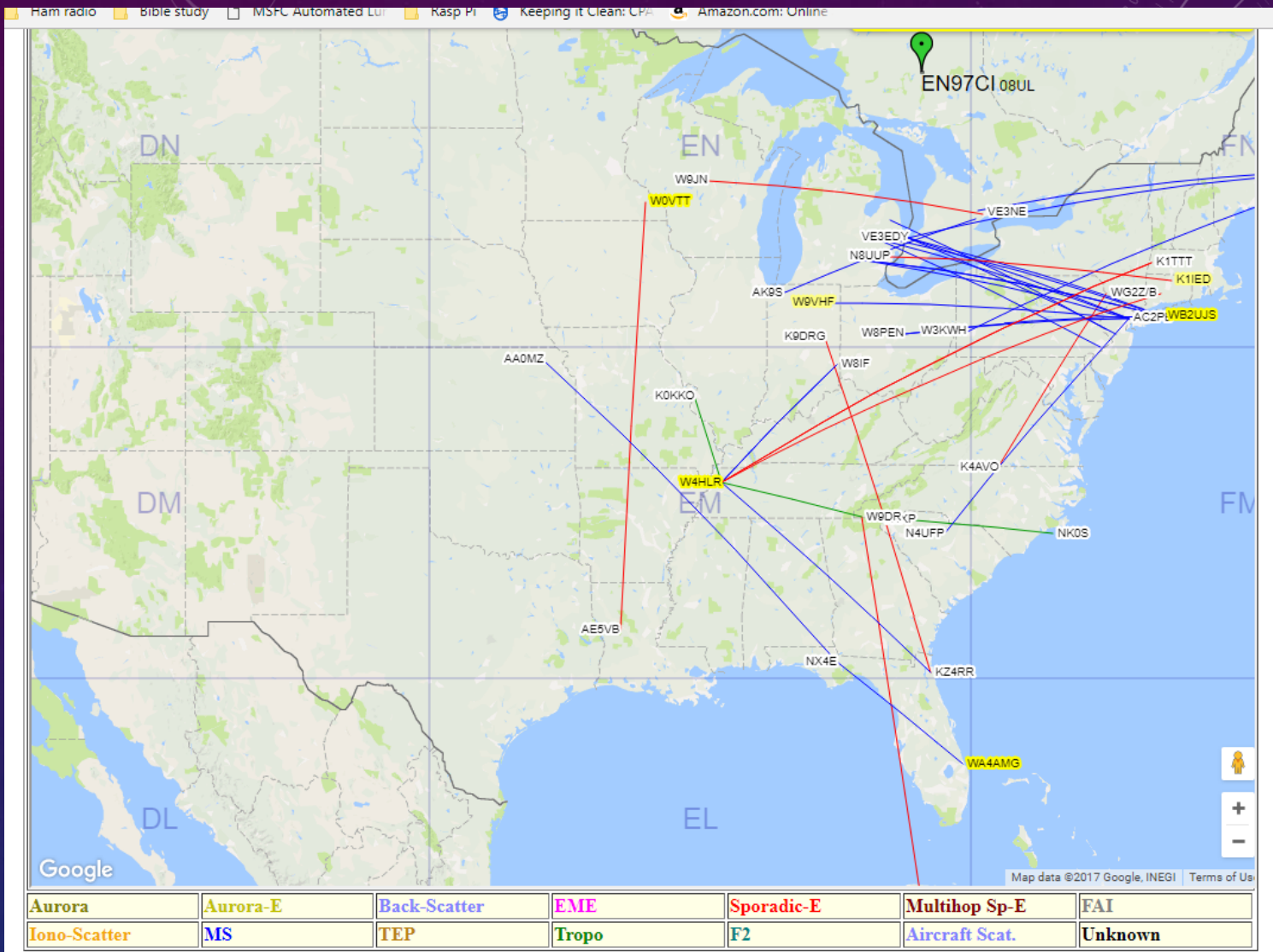
Calling CQ	Answering CQ
CQ	Grid
dB	R+dB
RRR	73

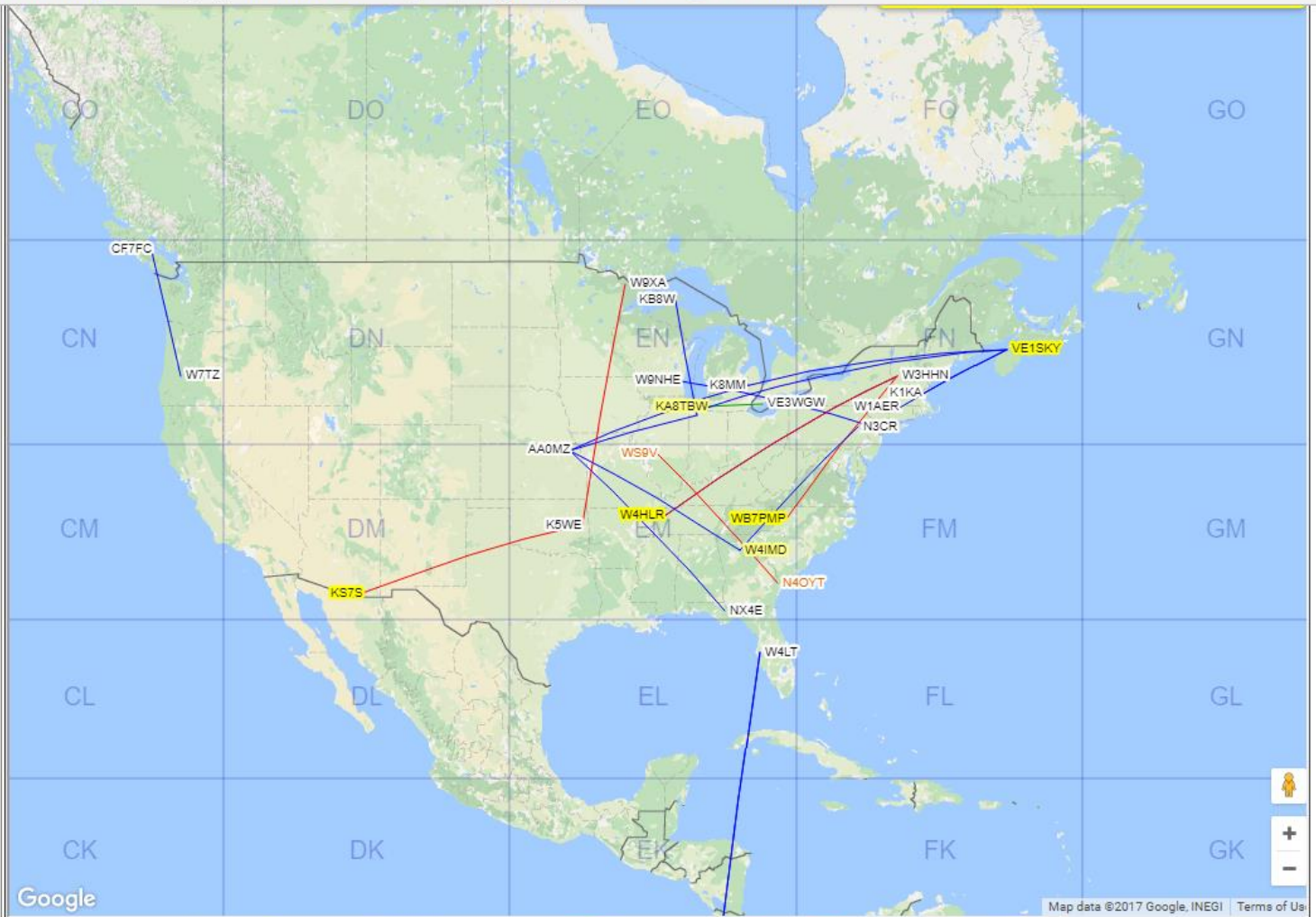
Gen msg

SW DPL 73  Free msg

Receiving 18% MSK144 7/15 WD:6m





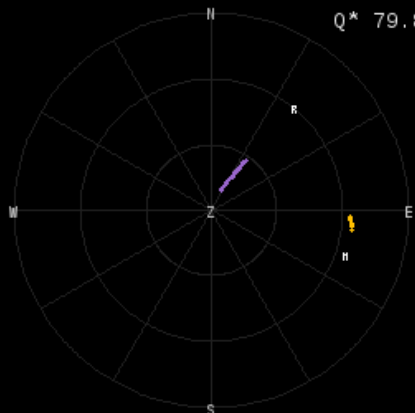


Aurora	Aurora-E	Back-Scatter	EME	Sporadic-E	Multihop Sp-E	FAI
Iono-Scatter	MS	TEP	Tropo	F2	Aircraft Scat.	Unknown

20170812 05:14:32 UTC

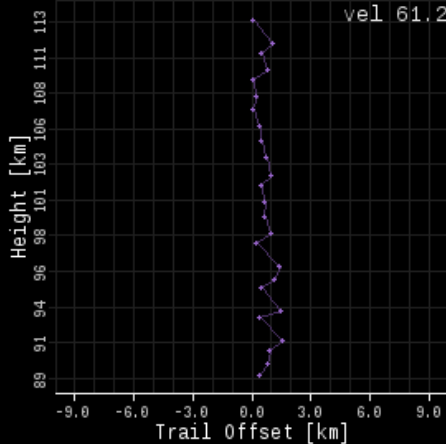
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17

PER

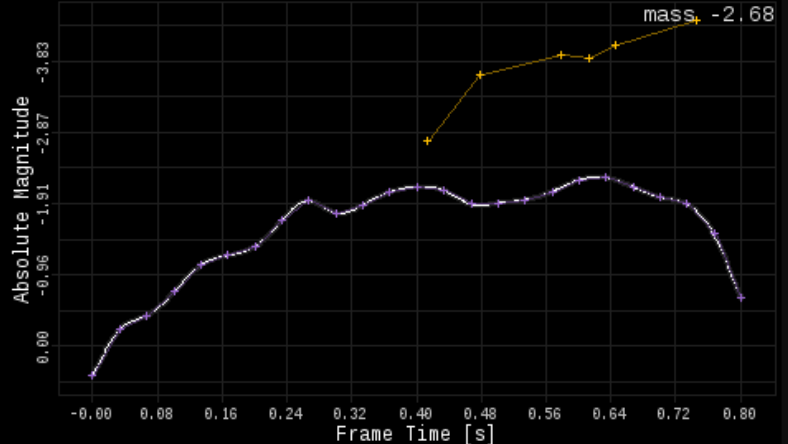


Atmospheric Position [deg]

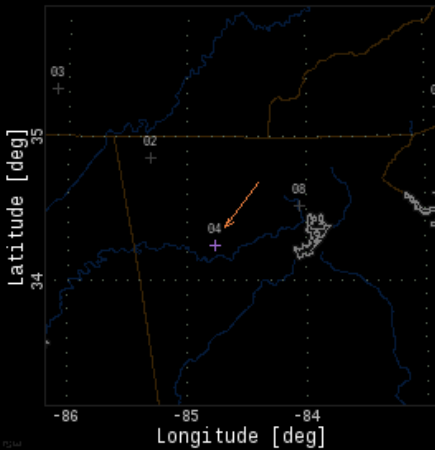
$Q^* 79.8$



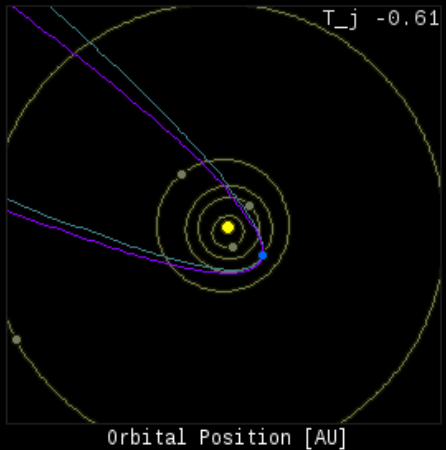
vel 61.2



mass -2.68

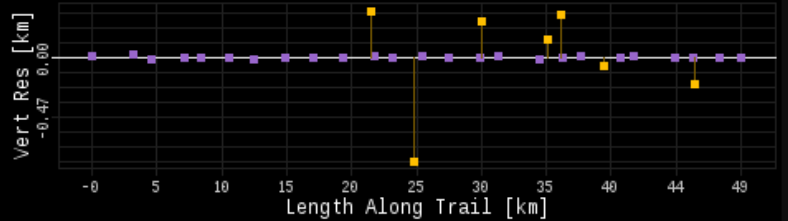
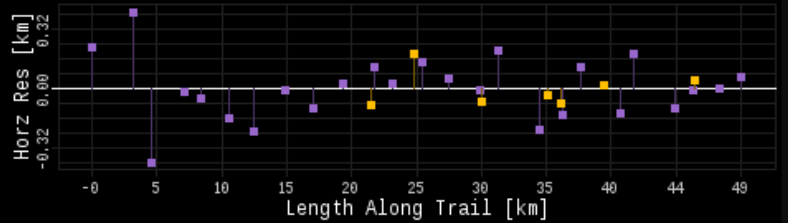


Longitude [deg]



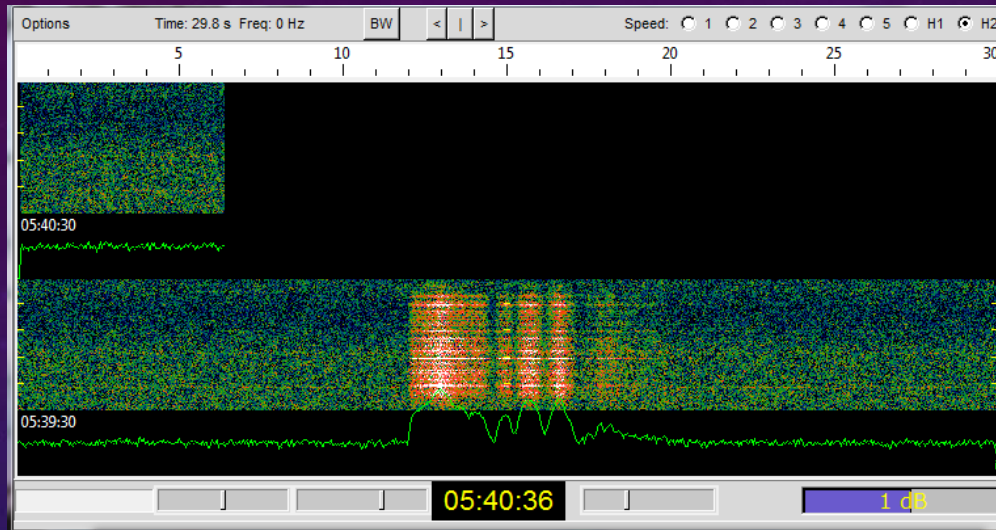
$T_j -0.61$

Orbital Position [AU]





# FSK 441 GEMINID 2014 CONTACT



WSJT 9.7 r3639 by K1JT

File Setup View Mode Decode Save Band Help

FileID	T	Width	dB	Rpt	DF	Time (s)	KB5EZ_141214_053930	Freq (kHz)
053930	14.9	20	-4	00	-30	R27		
053930	11.7	2590	12	37	-24	KR# 2J 6C6 ZMF ? 8HM.FA Z8F 8H FA	1	
053930	12.0	20	0	00	-30	R27	1	
053930	13.4	20	2	00	-30	R27	1	
053930	14.0	20	0	00	-30	R27	1	
053930	14.4	2490	9	36	-25	Z9!8 2 U R3. UEZM36,N5TIM KB5EZ 26 N5TIM	1	
053930	17.2	1920	3	36	-25	36 MZ?F 8H/ VA* Z8 C 8K RB 4 Z*	1	
053930	22.3	20	-7	00	-63	R26	1	

Log QSO Stop Monitor Decode Erase TxStop

To radio: KB5EZ Lookup  
Grid: EM64pr Add

Hot A: 68 Az: 55 El: 8 628 mi

2014 Dec 14 05:40:36

S -4 Zap KB5EZ N5TIM Tx1  
Tol 200 Rx ST KB5EZ N5TIM 26 Tx2  
Tx First Tx ST R26 Tx3  
Rpt: 26 RRR Tx4  
Gen Msgs Auto is ON 73 Tx5



# Ping Jockey Central.



<a href="#">Relief page</a>	<a href="#">Skeds in-progress</a>	<a href="#">CQ Announcements</a>	<a href="#">JT65 Link</a>
<a href="#">Refresh</a>	<a href="#">Look back</a>	<a href="#">Distance/Bearing Locator</a>	<a href="#">Who's Earwigging?</a>
<a href="#">Update User details</a>	<a href="#">AAIYN Callsign database</a>	*** UNREGISTERED USER - POSTS DISABLED ***	
			Refreshed 12Aug 13:20

Due to recent abuse of this system, you will be unable to post any messages until you complete the [User Details](#) page  
 This page is to be used only for the purposes of discussing matters related to amateur radio meteor scatter communications. Any non-meteor scatter use is strictly prohibited.

That means **DO NOT USE THIS PAGE TO WORK JT65 or for General chit-chat.**

Remember, in North America, 50.260MHz and 144.140MHz are calling not operating frequencies.

Exchanging any contact details on here before you're complete, invalidates the contact, and, if it's not HIGH-SPEED METEOR SCATTER, it doesn't belong here!

To have your callsign and locator automatically appended to each message that you send, an html cookie can be stored by your web browser.  
 The information that is stored in the cookie is your callsign, firstname, and Maidenhead grid locator.  
 To enable this feature, please press the "Update User details" button shown above.

Enter your message here

DDMMU UTC  
 12Aug 13:20 AC0RA use TOL 200 as I am higher than u. (WA4COG Dale AL EM72fo 71.91.59.70)  
 12Aug 13:20 KG5CCI any chance for me (WA5ZFP Ronald LA EL491l 162.203.219.199)  
 12Aug 13:20 \*\*\*\*\* CQ 144.146, west, 2nd, SH=on \*\*\*\*\* (KUBY/50THRU432 Ken MI EN61uw 104.5.18.255)  
 12Aug 13:20 RR Gary,,Tnx try... (WSLDA Larry OK EM15xu 192.169.27.149)  
 12Aug 13:20 kc5wx 1469 1441 (N0KK/6/2/KW Kirk MN EN35ha 97.116.188.174)  
 12Aug 13:20 KB0ZOM Ben, Thanks for a new grid on two! 73 (KUBY/50THRU432 Ken MI EN61uw 104.5.18.255)  
 12Aug 13:20 KC8YJB Not decoding you. Your CW ID FB. (K5VMW Orville TX EL29fq 45.29.161.39)  
 12Aug 13:20 even got ur cw id! (KB0ZOM Ben NE EN00tn 24.159.170.45)  
 12Aug 13:20 FM19 1 6 -0.6132015 8 2.2 1506 & CQ W3IP FM19 1 1 1 -0.2132015 10 5.2 1471 & CQ W3IP FM19 (K0TPP Larry mo EM48rj 71.11.138.45)  
 12Aug 13:20 131815 4 5.6 1474 & CQ W3IP FM19 1 5 -0.4131815 6 5.8 1474 & CQ W3IP FM19 1 0 0.3131915 0 4.4 1441 & CQ W3IP FM19 2 13 -1.4131945 0 9.2 1471 & CQ W3IP (K0TPP Larry mo EM48rj 71.11.138.45)  
 12Aug 13:20 W7XU Arliss RR see you then (K1OR John NH FM42ir 24.91.109.215)  
 12Aug 13:20 W5LDA-Larry, ni here too. Tnx very much for try. 73. (N2AMC Gary NV FN30iv 70.214.77.187)  
 12Aug 13:20 N04E - actually getting some pings on you. (W5TN David TX EM00wf 38.97.13.36)  
 12Aug 13:20 wa4cag running gl (AC0RA/2M Wyatt IA EN421l 69.63.8.198)  
 12Aug 13:20 KUBY - tnx sir! (KB0ZOM Ben NE EN00tn 24.159.170.45)  
 12Aug 13:20 CQ 50.263 Beaming north.. first taker I can hear.. (KG5CCI Dave AR EM34st 107.77.198.225)  
 12Aug 13:20 AC0RA just as we want to stop - great rocks, Murphy has his way (KC4PX Ivars FL EL98qg 107.145.146.138)  
 12Aug 13:19 kc5wx One way rocks..I guess.. (N0KK/6/2/KW Kirk MN EN35ha 97.116.188.174)  
 12Aug 13:19 131818 Tx 1500 & KB5EZ N2LEE -02 On .255 (N2LEE Lee VA FM18hx 108.48.202.194)  
 12Aug 13:19 K1OR -- How about 0400 UTC tonight? Will meet you on here. (W7XU Arliss SD EN13lm 72.104.230.244)  
 12Aug 13:19 RR Andy.... (WSLDA Larry OK EM15xu 192.169.27.149)  
 12Aug 13:19 AC0RA good QSO (KC4PX Ivars FL EL98qg 107.145.146.138)  
 12Aug 13:19 KG5CCI - Tnx for hanging in there Dave, Tnx new Grid... 73 (K5ME Jeff OK EM25ex 75.89.6.23)  
 12Aug 13:19 W5LDA would like to try when available -- good pings here (N2NT/6/2/222 Andy NJ FN20s1 108.53.188.123)  
 12Aug 13:18 QRV 2m (M4OGN Tor MS EM53nk 104.8.40.200)  
 12Aug 13:18 ~CQ 144.153 pointing NE 1st~ (W4YZJ Jeff AL EM64ru 173.26.104.239)  
 12Aug 13:18 kc4px tnx that was tough one (AC0RA/2M Wyatt IA EN421l 69.63.8.198)  
 12Aug 13:18 K1OR -- Found reference that says NE-SW best 0100-0300, 0900-1100 LOCAL times. Not sure for E-W. (W7XU Arliss SD EN13lm 72.104.230.244)  
 12Aug 13:18 kc4px sweet. log it (AC0RA/2M Wyatt IA EN421l 69.63.8.198)  
 12Aug 13:18 N2AMC Gary..Not looking too promising at this distance... (WSLDA Larry OK EM15xu 192.169.27.149)  
 12Aug 13:18 W7XU Arliss need to leave now for charity car show. Pse send me an email on what you wud like to try. Completly open my end (K1OR John NH FM42ir 24.91.109.215)  
 12Aug 13:18 N0KK Kirk, Have not heard or seen anything..... (K5SHX Gene TX EM13rs 69.92.1.15)  
 12Aug 13:18 N1JZ Thanks Mike (M4ZY Peter NJ FN20qj 98.221.128.44)