Memories of Jean-Paul Villain: His Contributions to SuperDARN, STARE and Ionospheric Radar Research

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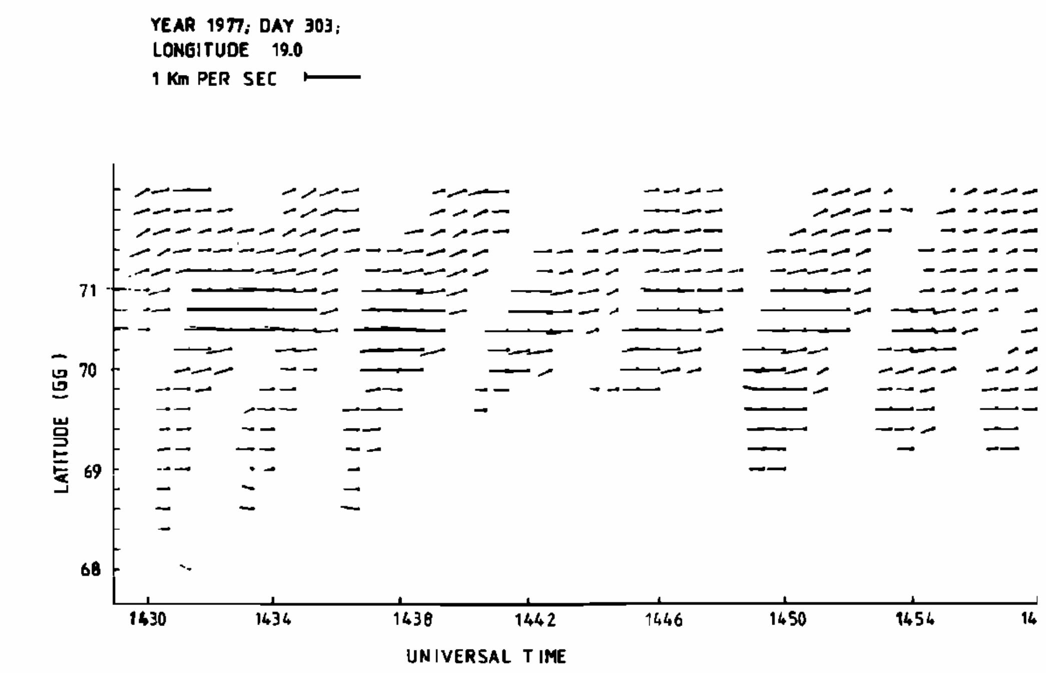
Jean-Paul and Maryannick in Lindau, ca 1978

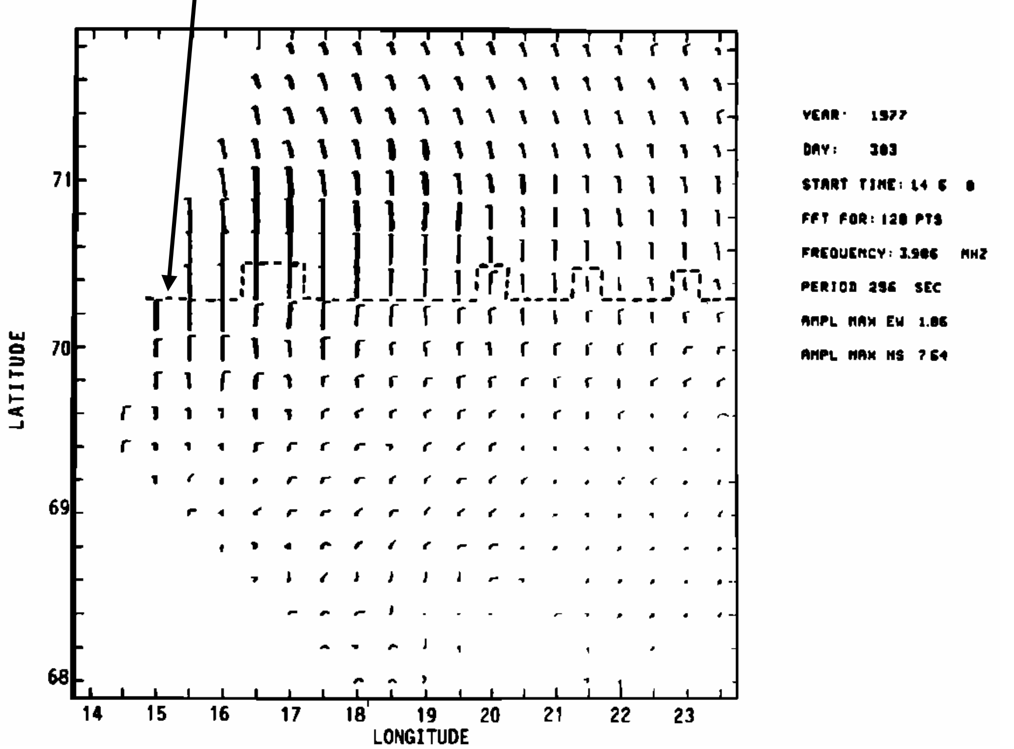
STARE Observations of Pc 5 Pulsation with Villain Polarization Analysis

Classic Pc 5 Pulsation observed with STARE from Walker et al., 1979



Characteristics of Pc 5 micropulsations as determined with the STARE experiment, Villain, J. Geophys. Res., 1982.

Dashed line marks location of polarization reversal.



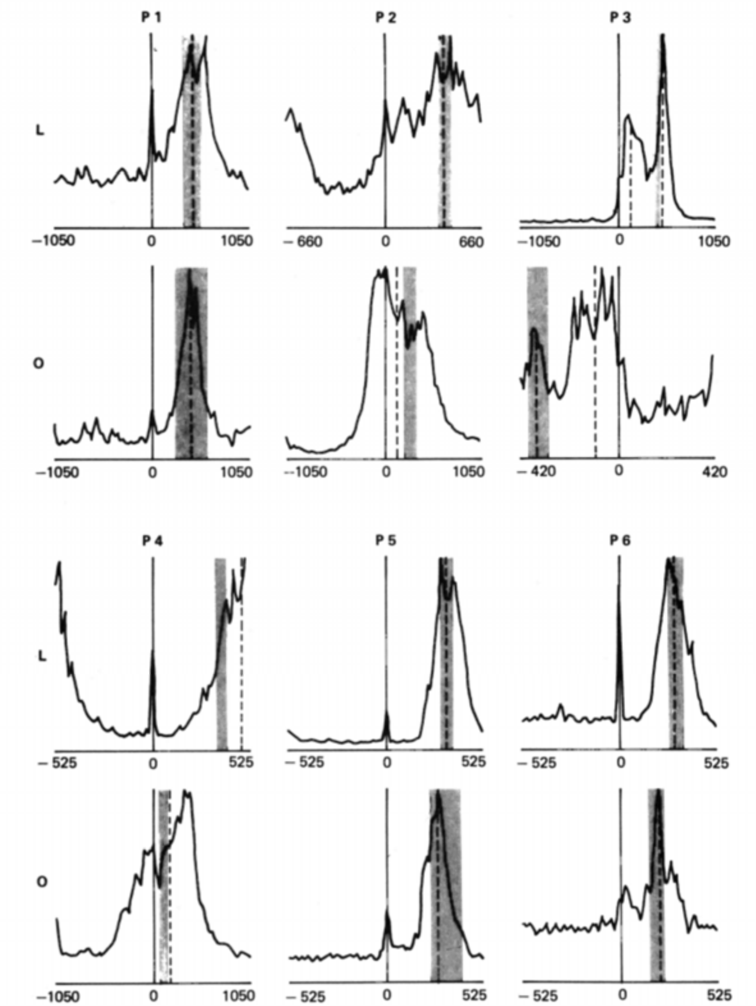
Villain [1982] Polarization Analysis

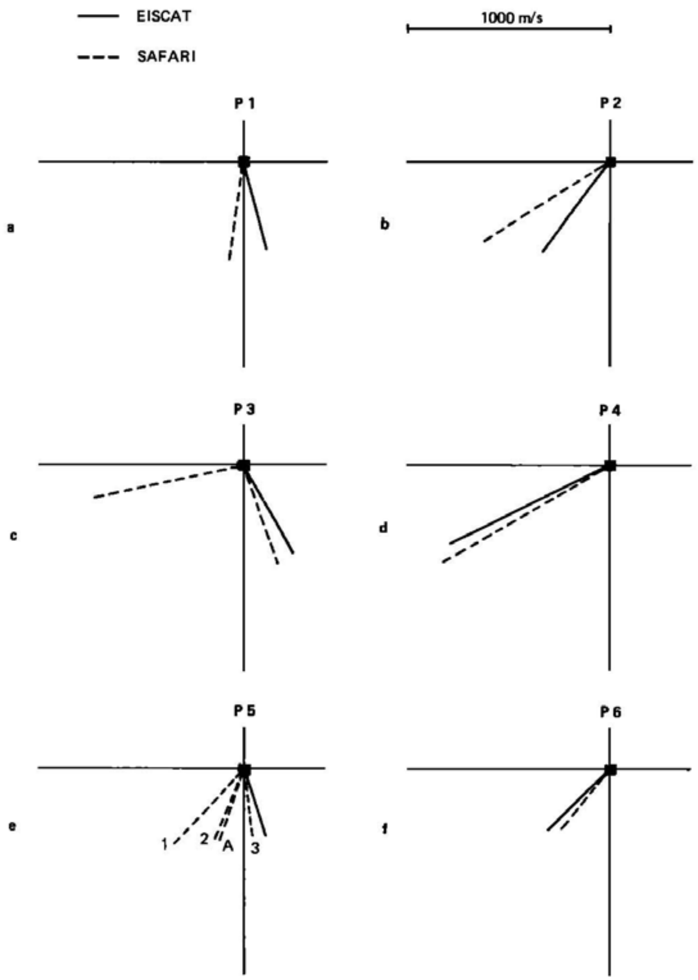
First Application of Multipulse Techniques to HF Radar

- Jean-Paul and I went to Alaska in late 1981, to use NOAA ionosonde as an oblique HF radar.
- Planned spectral technique was variable lag double pulse.
  - Did not work!!!
- On the return flight from Anchorage, we spent several hours discussing alternatives and came up with the first multipulse pattern for HF radars
  - 2 1 4 6 2 1
- This pattern used for first ten years.

Two Methods for Comparing Eiscat Plasma Drifts and Safari Irregularity Drifts

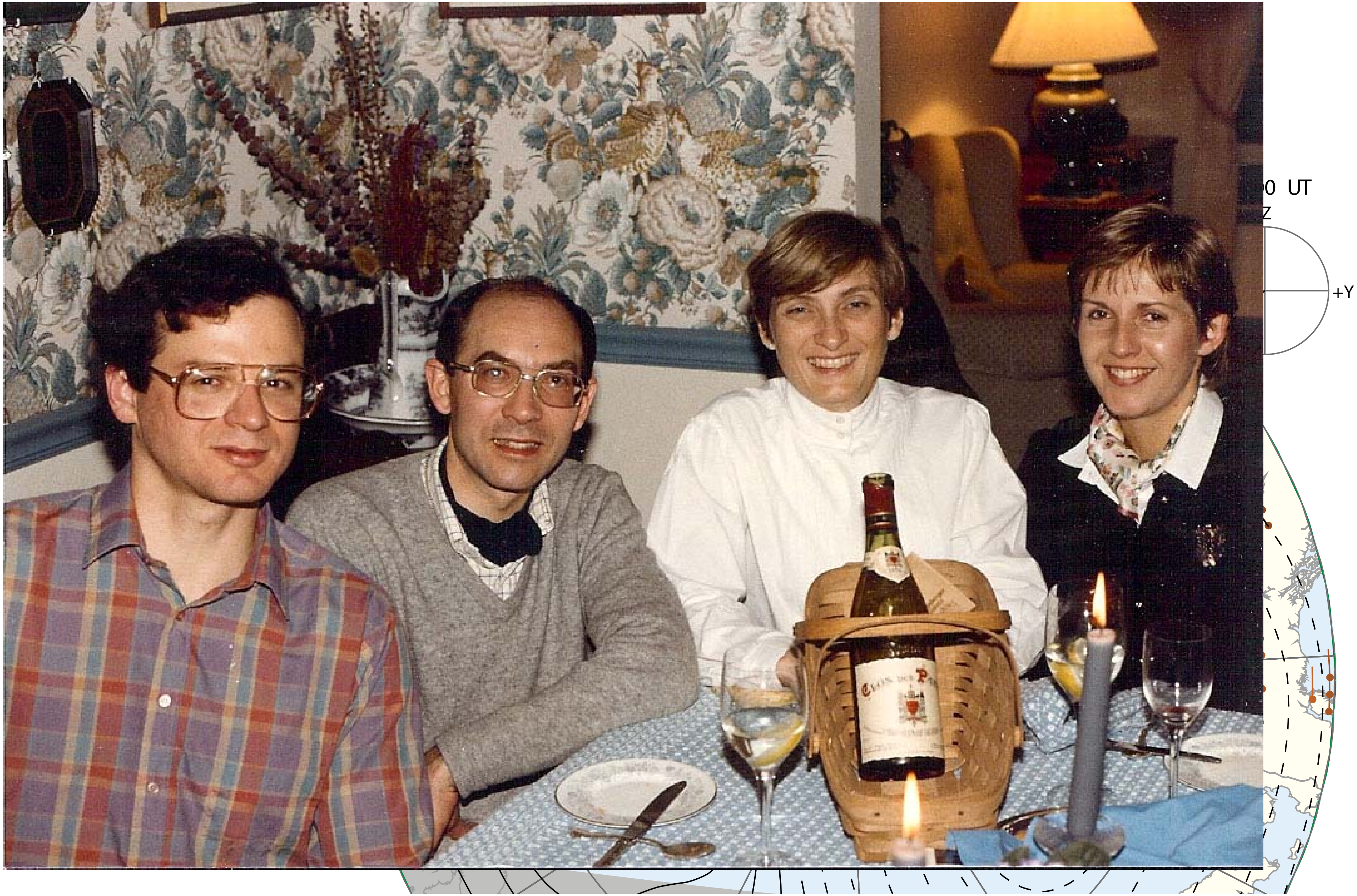
Data from December 10, 1983 1800-1936 UT





A Safari-EISCAT comparison between the velocity of F-region small scale irregularities and the ion drift, Villain et al., J. Geophys. Res., 1985.

Gathering with Friends ca 1987



Electrostatic Ion Cyclotron Waves in Topside E-Region

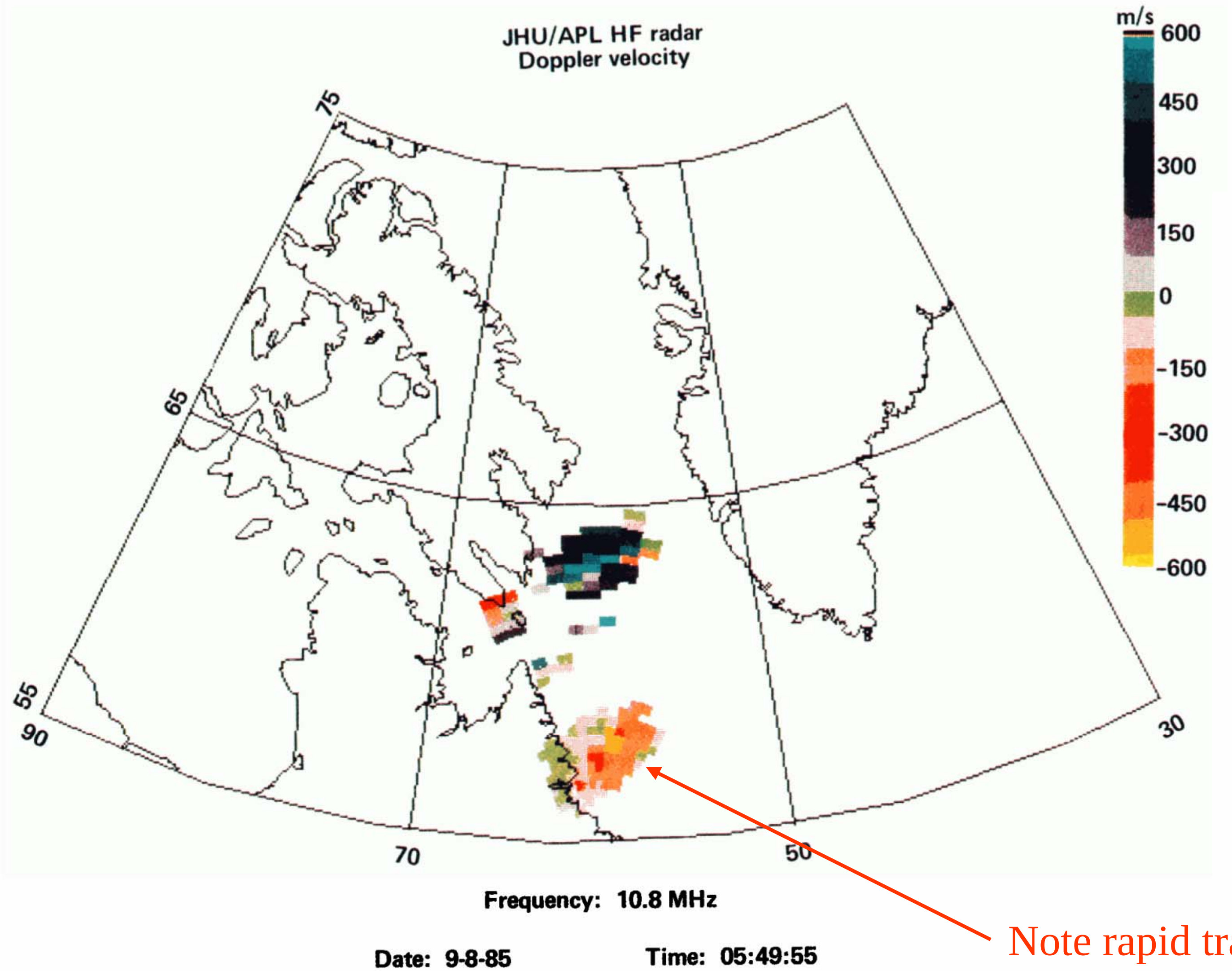


Plate 2. Doppler velocity color map for September 8, 1985, 0549:55–0550:15 UT. We discuss the lower region of scatter. The velocity scale is now −600 to 600 m/s. The velocity variation from west to east remains the same as in Plate 1, but a localized region of high Doppler velocity near 500 m/s appears near the center of the scattering region.

Other Examples

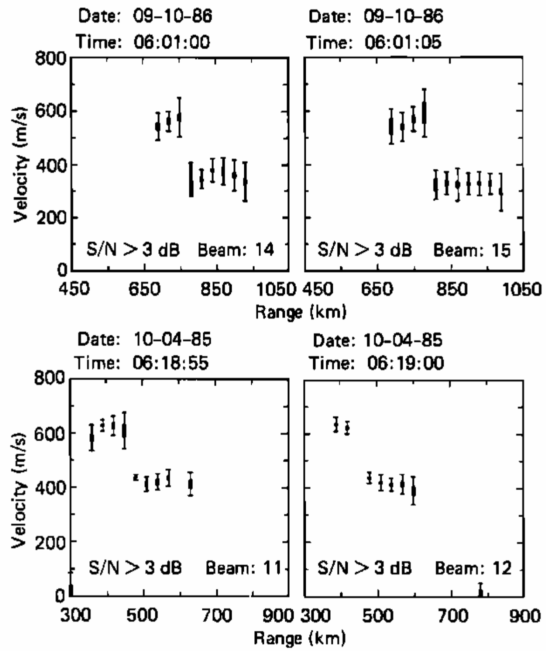


Fig. 7. Example of transition between both kinds of high Doppler velocities observed as looking along a single beam. The absolute value of the velocity is plotted as a function of range from the radar for the selected beam. Range gates are separated by 30 km. The conventions to plot the velocity with its error and the half-power are the same as for Figures 3, 4, and 6.

Note rapid transition to high velocities.

Two components are present.

Electrostatic Ion Cyclotron Waves in Topside E-Region

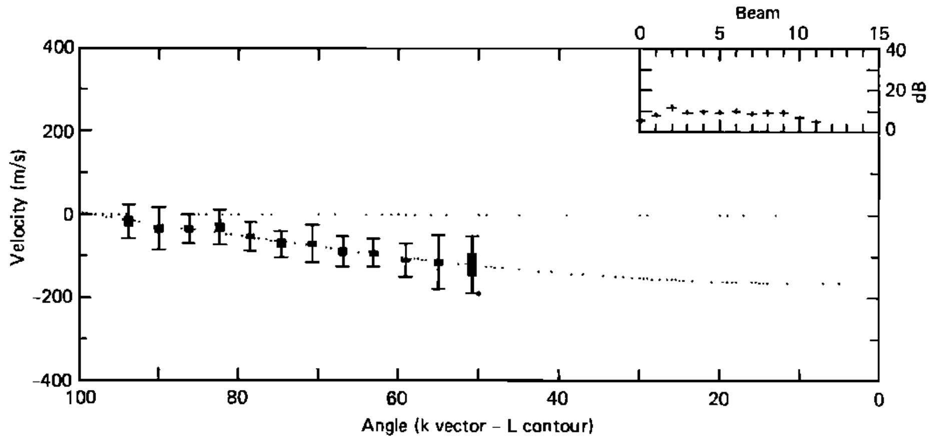


Fig. 3. Doppler velocity variation as a function of the angle between the radar k vector and the L contour. The dark bar represents the Doppler velocity with its error bar, and the bracketed region corresponds to the half-power width. The ranges selected for each beam direction in order to follow the $L = 6.4$ contour are shown at the top of the figure. The dotted line is the cosine least squares fit on the velocity estimates. The computed values of plasma drift parallel and perpendicular to the L contour are -161 and -24 m/s, respectively. The snr in decibels is plotted in the small frame in the upper right corner as a function of the beam number. Data are plotted only if snr > 3 dB and V error < 200 m/s.

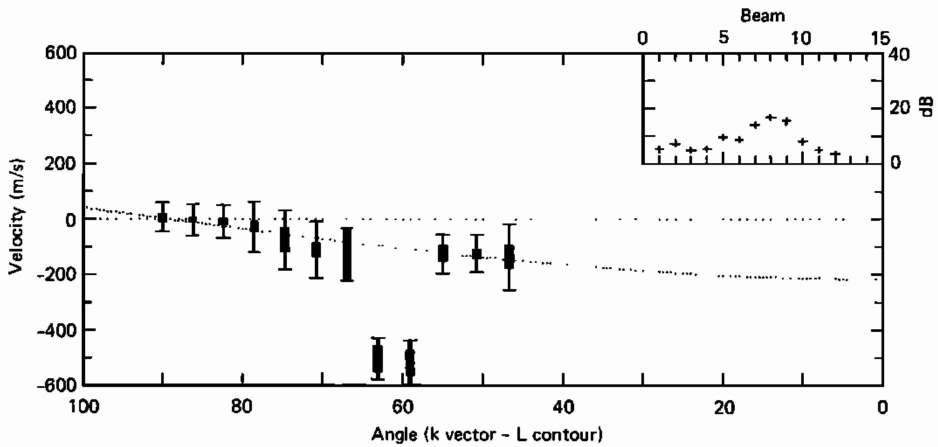


Fig. 4. Same as Figure 3 but for the color map of Plate 2. This plot shows clearly the presence of high Doppler velocity signals near -500 m/s on beams 8 and 9, superposed on the ambient background of low Doppler signals which follow a cosine law as a function of the angle between radar k vector and L contour. The snr reaches values near 20 dB where the high Doppler velocity signals are present. The computed values of plasma drift parallel and perpendicular to the L contour are -217 and 3 m/s, respectively.

HF radar observations of *E*-region plasma irregularities produced by oblique electron streaming, Villain et al., J. Geophys. Res., 1987.

Electrostatic Ion Cyclotron Waves in Topside E-Region

Date: 09-10-86 Start time: 05:51:35 Freq: 12.4 MHz

Beam:	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
Range:	09	09	09	09	09	09	10	10	11	11	12	13	14	16	17	20

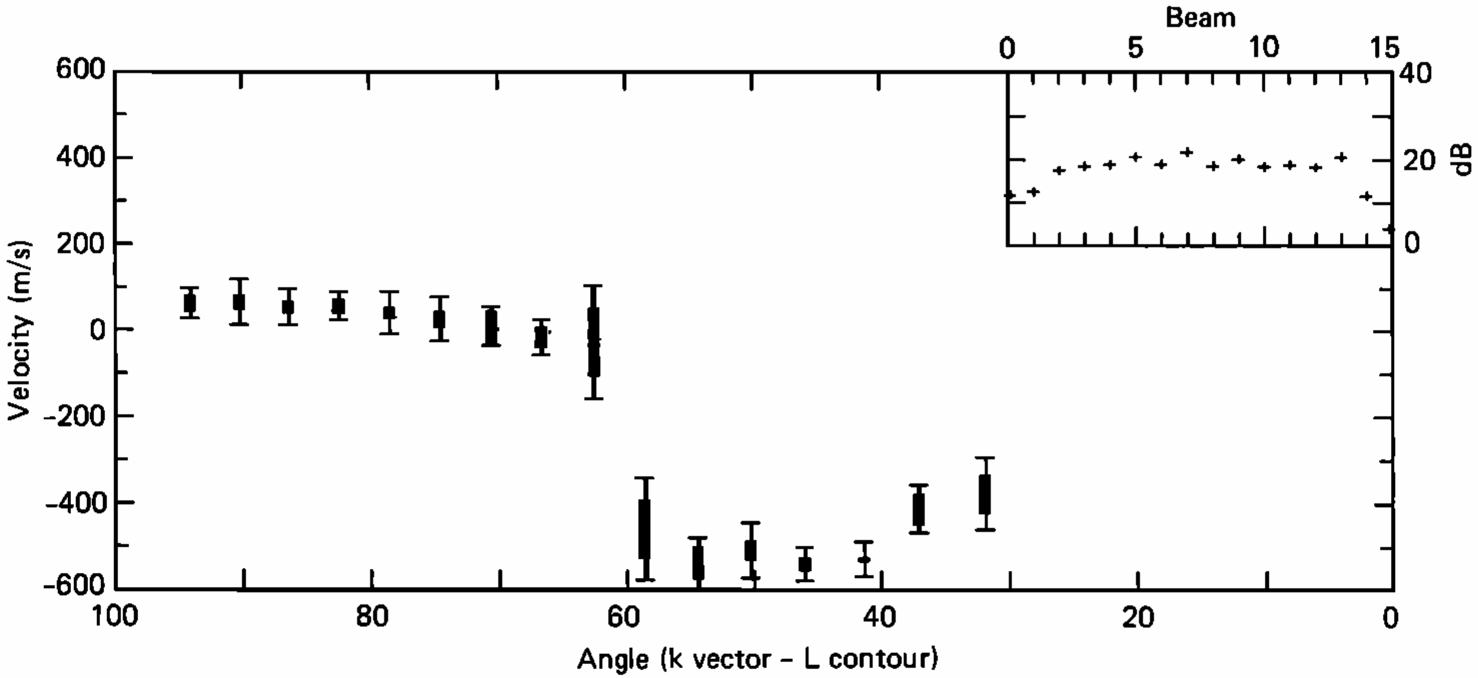


Fig. 6. Same as for Figures 3 and 4 but for the color map of Plate 3. Beams 0 to 8 show the low Doppler velocity signals with cosine variation. Beams 9 to 13 exhibit a constant Doppler velocity near −530 m/s, and beams 14 and 15 a velocity near −400 m/s. Beams 8 and 9 in the transition region have a larger error due to superposition of signals with different Doppler shifts. The computed values of plasma drift parallel and perpendicular to the *L* contour are −16 and 65 m/s, respectively.

Electrostatic Ion Cyclotron Waves in Topside E-Region

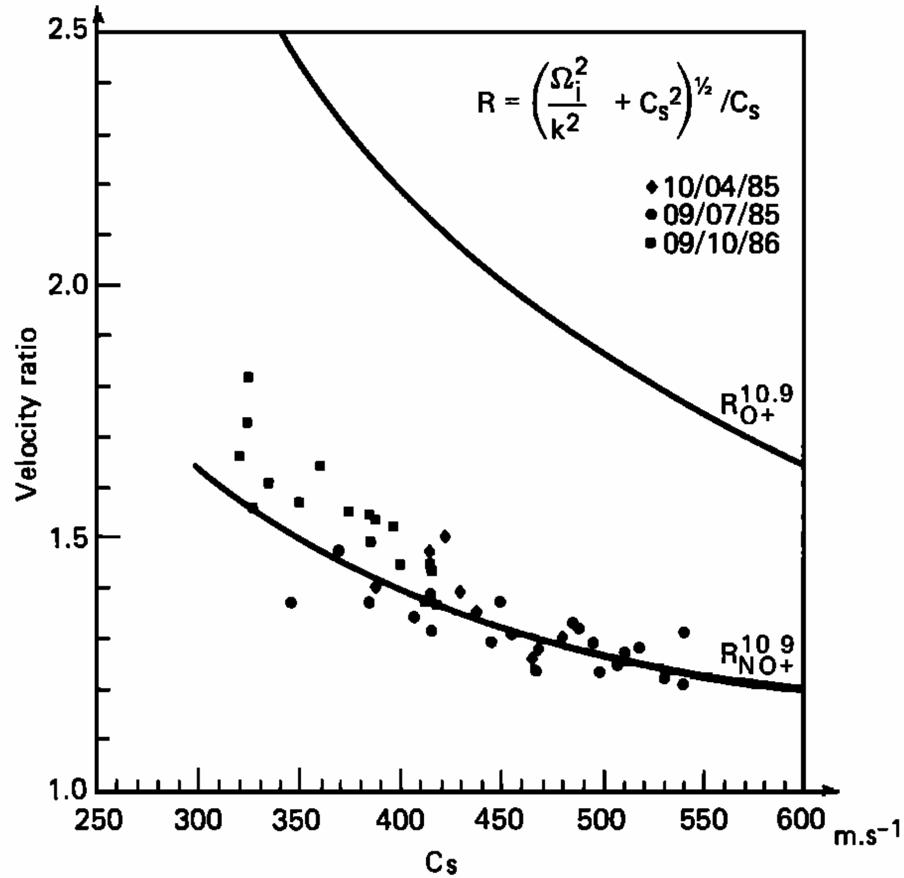
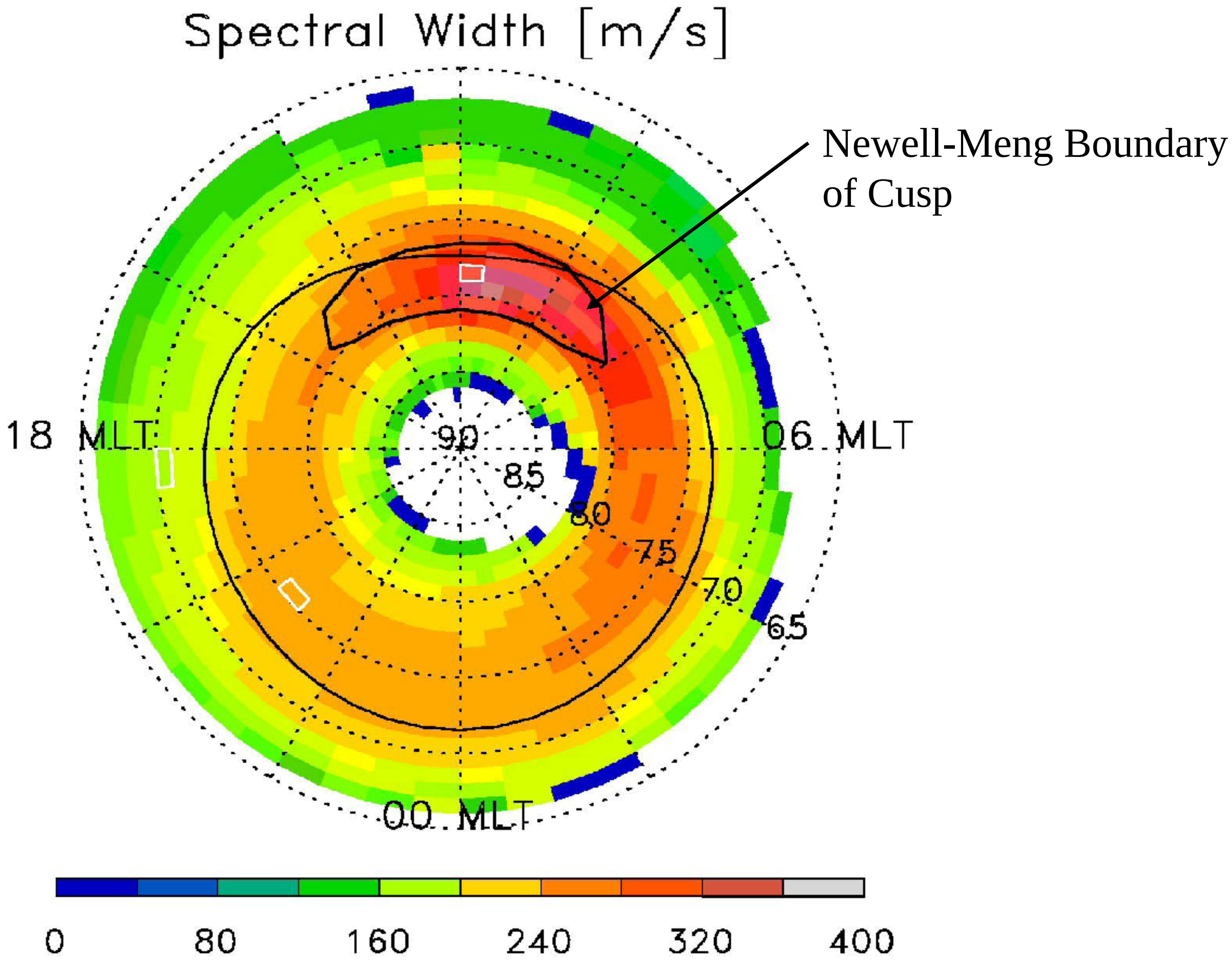


Fig. 9. Ratio between the velocity observed on each side of the gaps, plotted as a function of the lower velocity, assumed to be C_s. The theoretical ratio computed for $k = 0.46$ ($\lambda = 13.75$ m, radar frequency = 10.9 MHz) is plotted for O^+ and NO^+ ions. Excellent agreement is observed between the experimental data points and the NO^+ theoretical curve. Theoretical curves for N_2^+ and O_2^+ would be similar and very close to the NO^+ curve.

Summary Comments

- EIC Waves first reported by the Cornell group. They observed the waves at the ion cyclotron frequency with VHF radars. Their interpretation was based on kinetic theory. They subsequently retracted their claim.
- We did observe some evidence of EIC waves due to O^+ ions

Statistical Identification of Large Spectral Width in the Cusp



A statistical study of the Doppler spectral width of high-latitude ionospheric F-region echoes recorded with SuperDARN coherent HF radars, Villain et al., Annales Geophysicae, 2002

Two Quick Stories About Jean-Paul

- Jean-Paul: Snow Cat Driver
- Jean-Paul: General

Snow Cat at Goose Bay

The SuperDARN ERA

Stokkseyri, Iceland

50 Ft, 15 m
Which is greater?

Jean-Paul at Stokkseyri

SuperDARN 1996

Jean-Paul, Jean Baptiste, & Pat in Carnac

Summary

- Jean-Paul was a great colleague.
- He was enthusiastic, intelligent, careful, creative, and willing to undertake difficult jobs.
- He contributed to the scientific success of STARE and SuperDARN.
- He contributed to the development of important HF technology and to many of the analysis techniques that are still used in SuperDARN.
- He will be sorely missed.