Ionization Process   *See also the 4-pg Ken Larson KJ6RZ reference or the excellent 64-pg Bob Brown NM7M (SK) tutorial.*

Some high-speed photons, coming from the sun, collide with atoms in the ionosphere and knock electrons off leaving charged atoms (ions) and free electrons. This process is called ionization.

100-1000 Å ultra-violet (UV) photons ionize the F Layer.
10-100 Å Soft X-Rays ionize the E Layer and 1-10 Å Hard X-Rays ionize the D Layer.
Less frequently, .01Å gamma rays and also protons, ionize the D and E Layers.
[1 Ångstrom = .1 nanometre = .1 X 10^{-9} metres = 3 EHz] [1 PetaHertz = 10^{15} Hz] [1 ExaHertz = 10^{18} Hz]

Because it depends on emissions from the sun, the ionization process occurs mostly during sunlight hours.

Recombination Process

Some of the free electrons are eventually recaptured by the charged ions. The recombination process continues 24 hours a day. Because the atmosphere is denser, the ions are more populous at the lower altitudes, so recombination occurs more quickly. Free electrons up in the less dense F2 Layer may travel much longer without recombination, even after darkness begins.

Effect of Radio Waves

The incoming electric field of a radio wave causes free electrons to oscillate at the same frequency. Radio waves are thus re-radiated by those free electrons and bent back to Earth by progressive electron density gradients, or are absorbed by collisions with atoms and ions that have 20,000 times the mass of an electron. Absorption is the primary factor on 160M and the lower HF bands. Ionization is the primary factor on the upper HF bands and 6M in the unusual F2 6M propagation. The 30, 20 & 17M bands are affected by both.

Propagation References

"Understanding Solar Indices" by Ken Larson KJ6RZ –
http://www.cvarc.org/tech/solarindice.html

"NM7M's HF Propagation Tutorial" by Bob Brown, NM7M
www.astrosurf.com/luxorion/qsl-hf-tutorial-nm7m.htm

Propagation Software

VOACAP - http://www.voacap.com/

DXATLAS – Afreet Software - www.dxatlas.com/

HAMCAP v1.8 - Afreet Software - www.dxatlas.com/

IONOPROBE v1.39 - Afreet Software - www.dxatlas.com/ionoprobe/

GEOALERT EXTREME WIZARD (VOACAP Toolkit) –
ww.taborsoft.com/gawiz/

WINCAP WIZARD 3 - www.taborsoft.com/wwizard/

W6ELPROP (Windows) – www.qsl.net/w6elprop/

VOAPROP - www.g4ilo.com/voaprop.html

PROPLAB PRO - www.spacew.com/proplab/

DX TOOLBOX - Black Cat Software -
http://www.blackcatsystems.com/index.html