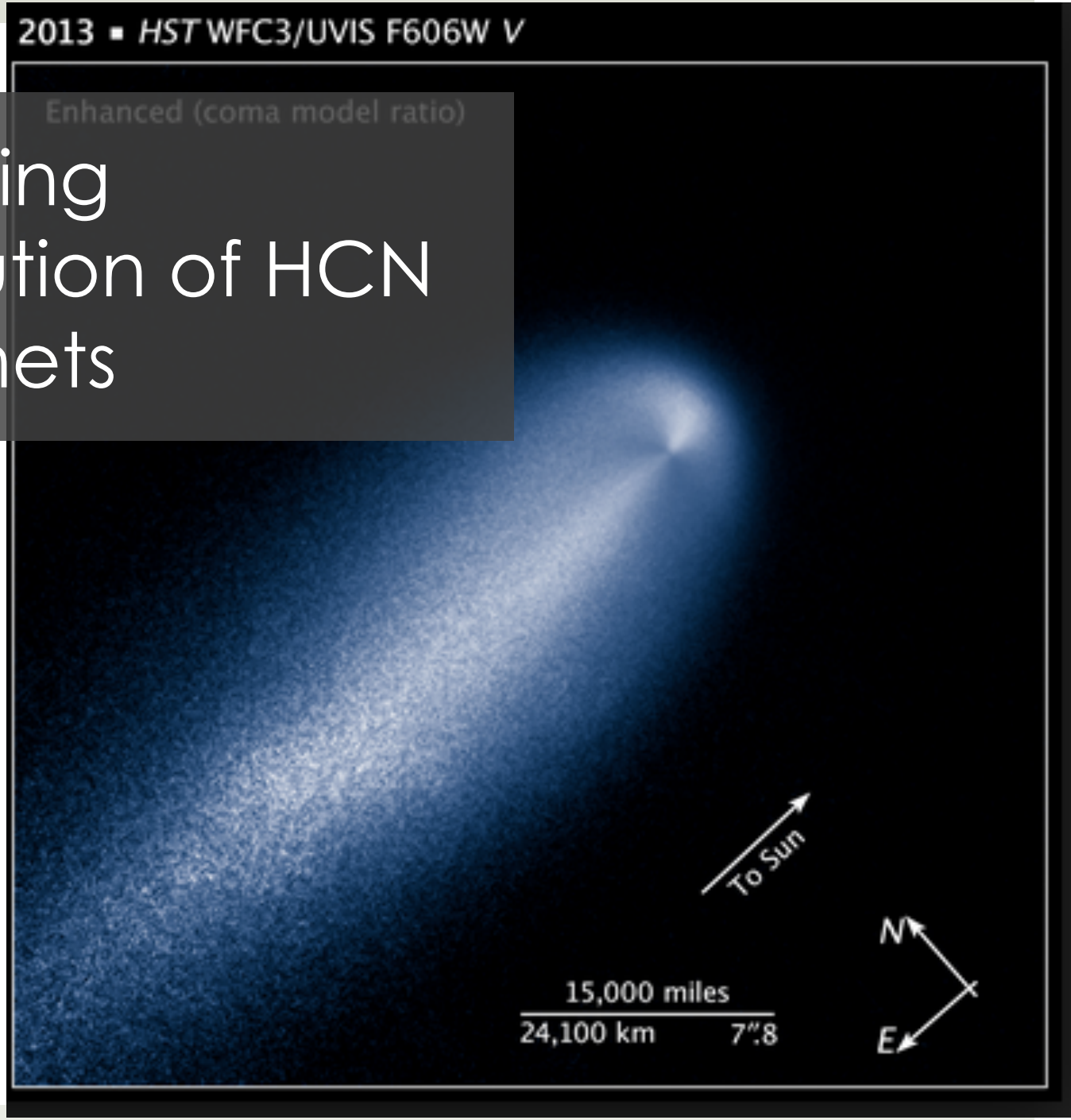
Modelling Distribution of HCN in Comets



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Haser Model (1957)

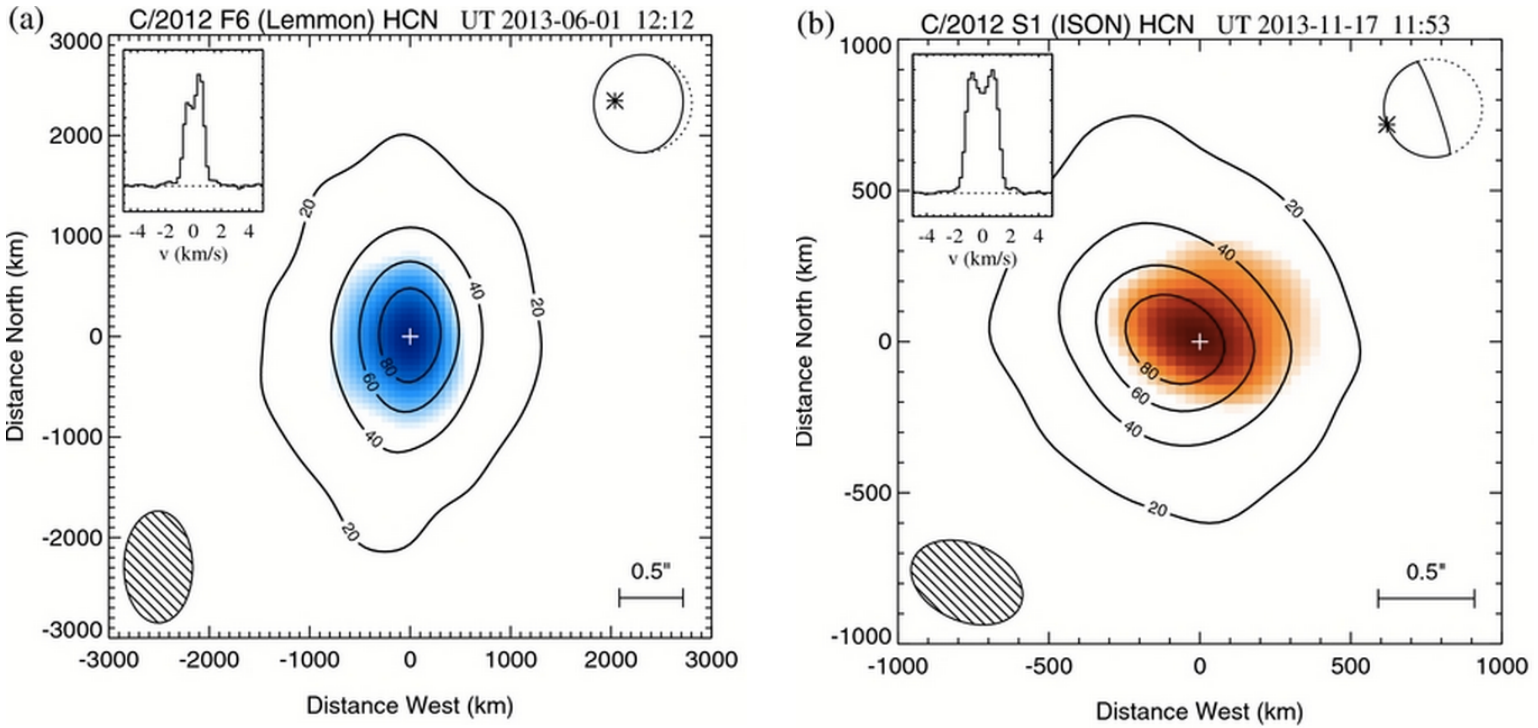
- Describes the distribution of gas species in cometary coma
- Assumes parent species evolve directly off the nucleus
- Isotropic radial outflow
- Parent species creates daughter species through photodissociation:

$$n(r) = \frac{Q}{4\pi v r^2} exp^{-r/l_p}$$

Q is the production rate (s^{-1})
r is the distance from the nucleus
v is the radial outflow speed
n is the number density of the parent species

lp is the parent scale length (analogous to life-time)

Applying Haser model to HCN



Cordiner et al. (2014)

- Integrate model along line of sight to derive predicted column density
- From observation – direct conversion from integrated flux to column density

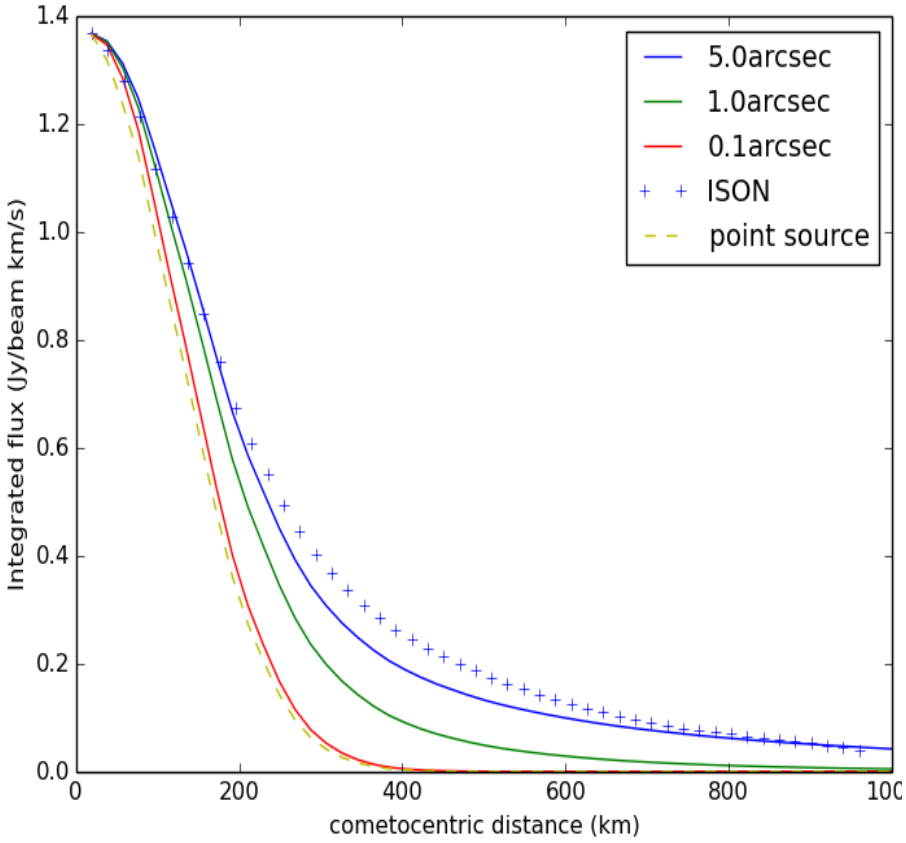
Observations

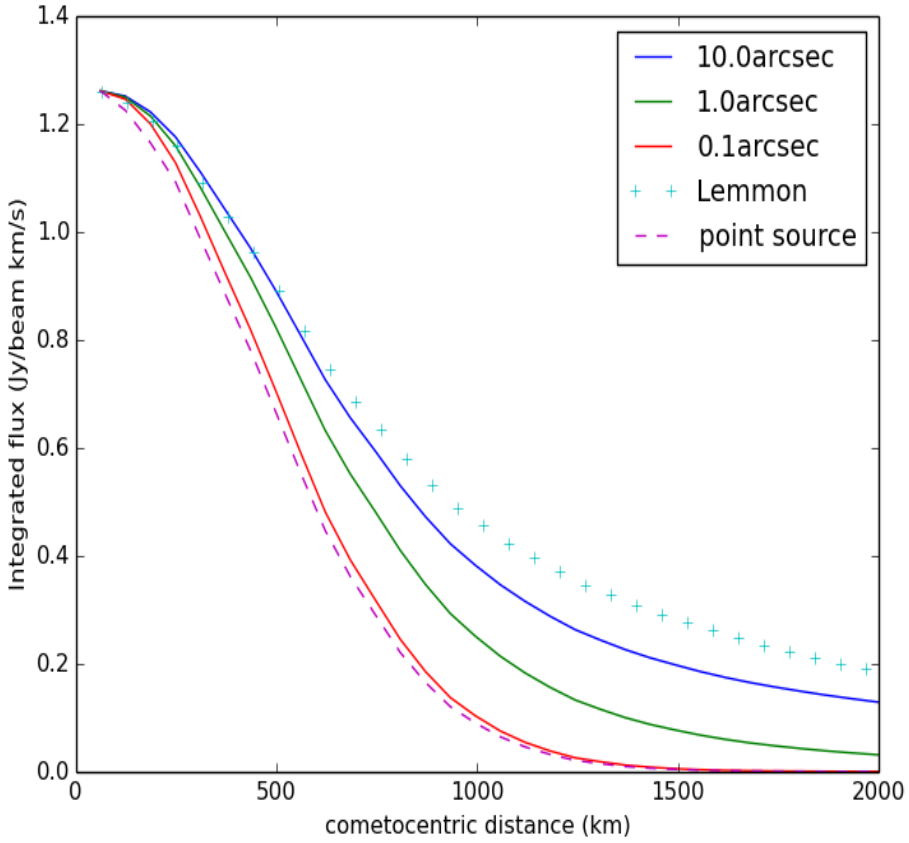
	Date	R_{helio}(AU)	R_{geo} Δ(AU)	Dust Mass (kg)	Kinetic Temp (K)	Outflow Velocity (km/s)
C/2012 F6 (Lemmon)	2013 Jun 1	1.47	1.75	2.3×10^9	55	0.7
C/2012 S1 (ISON)	2013 Nov 17	0.54	0.88	2.6×10^8	90	1.2

ALMA band 7 @354GHz
Spatial resolution: 0.4-0.9''
PSF FWHM ~ 0.7''

$$M_{dust} = \frac{S_\nu \Delta^2}{B_\nu(T)\kappa(\lambda)}$$

Radial profile of HCN





Radial profile of HCN

	Scale Length (km)	Production rate Q (1/s)	Q (1/s) from literature
Lemmon	12700	1.3E+26	2.3E+26
ISON	2000	9E+25	3.5E+26

- Power law of scale length:

$$l = l_p r_h^b$$

- b~1.8

- Scale length ~ 7.5×10^4 km in Hale-Bopp at R_{helio} = 0.92 AU (Snyder et al. 2001)
- Some HCN are released from dust grains at larger radii