Molecular complexity in space

2 atoms	3 atoms	4 atoms	5 atoms	6 atoms	7 atoms	8 atoms	9 atoms	10 atoms	11 atoms	12 atoms
H2	C3 *	c-C3H	C5 *	C5H	C6H	CH3C3N	CH3C4H	CH3C5N	HC9N	c-C6H6 *
AlF	C2H	l-C3H	C4H	l-H2C4	CH2CHCN	HC(O)OCH3	CH3CH2CN	(CH3)2CO	CH3C6H	C2H5OCH3 ?
AlCl	C2O	C3N	C4Si	C2H4*	CH3C2H	CH3COOH	(CH3)2O	(CH2OH)2	C2H5OCHO	n-C3H7CN
C2**	C2S	C3O	l-C3H2	CH3CN	HC5N	C7H	CH3CH2OH	CH3CH2CHO		
CH	CH2	C3S	c-C3H2	CH3NC	CH3CHO	C6H2	HC7N			
CH+	HCN	C2H2*	H2CCN	CH3OH	CH3NH2	CH2OHCHO	C8H		**12 atoms**	**>12 atoms**
CN	HCO	NH3	CH4 *	CH3SH	c-C2H4O	l-HC6H *	CH3C(O)NH2		c-C6H6 *	HC11N
CO	HCO+	HCCN	HC3N	HC3NH+	H2CCHOH	CH2CHCHO (?)	C8H–		C2H5OCH3 ?	C60 *
CO+	HCS+	HCNH+	HC2NC	HC2CHO	C6H–	CH2CCHCN	C3H6		n-C3H7CN	C70 *
CP	HOC+	HNCO	HCOOH	NH2CHO		H2NCH2CN			i-C3H7CN	
SiC	H2O	HNCS	H2CNH	C5N						
HCl	H2S	HOCO+	H2C2O	l-HC4H *						
KCl	HNC	H2CO	H2NCN	l-HC4N						
NH	HNO	H2CN	HNC3	c-H2C3O						
NO	MgCN	H2CS	SiH4 *	H2CCNH (?)						
NS	MgNC	H3O+	H2COH+	C5N–						
NaCl	N2H+	c-SiC3	C4H–							
OH	N2O	CH3 *	HC(O)CN							
PN	NaCN	C3N–	HNCNH							
SO	OCS	PH3 ?	CH3O							
SO+	SO2	HCNO								
SiN	c-SiC2	HOCN								
SiO	CO2 *	HSCN								
SiS	NH2	H2O2								
CS	H3+ *	C3H+								
HF	H2D+, HD2+									
HD	SiCN									
FeO ?	AlNC									
O2	SiNC									
CF+	HCP									
SiH ?	CCP									
PO	AlOH									
AlO	H2O+									
OH+	H2Cl+									
CN–	KCN									
SH+	FeCN									
SH	HO2									
HCl+										

- Around 180 molecules have been detected (few of them by I.R. spectroscopy)
- Largest are organic, straight chains (except fullerenes)
- Amino acids in meteorites (Elsila+07)
- Glycine in cometary samples (Elsila+09)

- ➢ Interstellar origin ?
- ➢ Which environments ?
- ➢ Common species in the ISM ?

This table from: http://www.astro.uni-koeln.de/cdms/molecules (09/2014)

Is there any limit for the molecular complexity in space?

- Observation
  - Strategy: multi-wavelength ? Which targets ?
  - Future needs: sensitivity ? Bandwidth ? Analysis tools
- Characterisation
  - Laboratory astrophysics: priorities ? Facilities ?
  - Theory: collisional excitation
- Chemical processes
  - Experiments: bonding energy ? Isotopic exchange ?
  - Models: rate equation vs stochastic processes