

Name of reaction and stage (if applicable):	Incidence (at 15.7mm degrees):	Reagent 1:	Reagent 2:	Reagent 3:	Product 1:	Product 2:	Product 3:	Annihilates exogenous 1:	Annihilates endogenous 1:	MeV:	Temperatures (in megakelvin):	Half-life (in seconds):
The proton-proton chain (stage 1, net reaction):		1 proton	1 proton	1 electron	1 Deuterium-2	1 electron neutrino		1 electron	1 positron	1.44		4-15
The proton-proton chain (stage 2):		1 Deuterium-2	1 Protium-1		1 Helium-3	1 gamma ray				5.49		4-15
The p-p I branch (stage 1):	83.30%	1 Helium-3	1 Helium-3		1 Helium-4	2 Protium-1				12.86		4-15
The p-p II branch (stage 1):	16.68%	1 Helium-3	1 Helium-4		1 Beryllium-7	1 gamma ray				1.59		18-25
The p-p II branch (stage 2):	16.68%	1 Beryllium-7	1 Helium-4		1 Beryllium-7	1 electron neutrino				0.81		18-25
The p-p II branch (stage 3):	16.68%	1 Lithium-7	1 Protium-1		2 Helium-4					17.35		18-25
The p-p III branch (stage 1):	0.02%	1 Helium-3	1 Helium-4		1 Beryllium-7	1 gamma ray				1.59		25+
The p-p III branch (stage 2):	0.02%	1 Beryllium-7	1 Protium-1		1 Boron-8	1 gamma ray						25+
The p-p III branch (stage 3, net reaction):	0.02%	1 Boron-8	1 electron		1 Beryllium-8	1 electron neutrino		1 electron	1 positron	4.15		25+
The p-p III branch (stage 4):	0.02%	1 Beryllium-8			2 Helium-4							25+
The p-p IV (Hep) branch (stage 1, net reaction):	0.00%	1 Helium-3	1 Protium-1	1 electron	1 Helium-4	1 electron neutrino		1 electron	1 positron	1.00	0.3 ppm in the Sun	
The PEP reaction:	0.21%	1 Protium-1	1 electron	1 Protium-1	1 Deuterium-2	1 electron neutrino				-	1:400 ratio with p-p reaction	
CNO-I (stage 1):	about 1%	1 Carbon-12	1 Protium-1		1 Nitrogen-13	1 gamma ray				1.95		15-17
CNO-I (stage 2):	about 1%	1 Nitrogen-13			1 Carbon-13	1 electron neutrino		1 electron	1 positron	1.20		15-17
CNO-I (net reaction):	about 1%	1 Nitrogen-13			1 Carbon-13	1 electron neutrino		1 electron	1 positron			15-17
CNO-I (stage 3):	about 1%	1 Carbon-13	1 Protium-1		1 Nitrogen-14	1 gamma ray				7.54		15-17
CNO-I (stage 4):	about 1%	1 Nitrogen-14	1 Protium-1		1 Oxygen-15	1 gamma ray				7.35		15-17
CNO-I (stage 5, net reaction):	about 1%	1 Oxygen-15			1 Nitrogen-15	1 electron neutrino		1 electron	1 positron	1.73		15-17
CNO-I (stage 6):	about 1%	1 Nitrogen-15	1 Protium-1		1 Carbon-12	1 Helium-4				4.96		15-17
CNO-II (stage 1):	0.04%	1 Nitrogen-15	1 Protium-1		1 Oxygen-16	1 gamma ray				12.13		15.7+
CNO-II (stage 2):	0.04%	1 Oxygen-16	1 Protium-1		1 Fluorine-17	1 gamma ray				0.60		15.7+
CNO-II (stage 3, net reaction):	0.04%	1 Fluorine-17	1 electron		1 Oxygen-17	1 electron neutrino		1 electron	1 positron	2.76		15.7+
CNO-II (stage 4):	0.04%	1 Oxygen-17	1 Protium-1		1 Nitrogen-14	1 Helium-4				1.19		15.7+
CNO-II (stage 5):	0.04%	1 Nitrogen-14	1 Protium-1		1 Oxygen-15	1 gamma ray				7.35		15.7+
CNO-II (stage 6, net reaction):	0.04%	1 Oxygen-15	1 electron		1 Nitrogen-15	1 electron neutrino		1 electron	1 positron	2.75		15.7+
CNO-III (stage 1):	massive stars	1 Oxygen-17	1 Protium-1		1 Fluorine-18	1 gamma ray				5.61		
CNO-III (stage 2, net reaction):	massive stars	1 Fluorine-18	1 electron		1 Oxygen-18	1 electron neutrino		1 electron	1 positron	1.66		6586.26
CNO-III (stage 3):	massive stars	1 Oxygen-18	1 Protium-1		1 Nitrogen-15	1 Helium-4				3.98		
CNO-III (stage 4):	massive stars	1 Nitrogen-15	1 Protium-1		1 Oxygen-16	1 gamma ray				12.13		
CNO-III (stage 5):	massive stars	1 Oxygen-16	1 Protium-1		1 Fluorine-17	1 gamma ray				0.60		
CNO-III (stage 6, net reaction):	massive stars	1 Fluorine-17	1 electron		1 Oxygen-17	1 electron neutrino		1 electron	1 positron	2.76		
CNO-IV (stage 1):	massive stars	1 Oxygen-18	1 Protium-1		1 Fluorine-19	1 gamma ray				7.99		
CNO-IV (stage 2):	massive stars	1 Fluorine-19	1 Protium-1		1 Oxygen-16	1 Helium-4				8.11		
CNO-IV (stage 3):	massive stars	1 Oxygen-16	1 Protium-1		1 Fluorine-17	1 gamma ray				0.60		
CNO-IV (stage 4, net reaction):	massive stars	1 Fluorine-17	1 electron		1 Oxygen-17	1 electron neutrino		1 electron	1 positron	2.76		64.49
CNO-IV (stage 5):	massive stars	1 Oxygen-17	1 Protium-1		1 Fluorine-18	1 gamma ray				5.61		
CNO-IV (stage 6, net reaction):	massive stars	1 Fluorine-18	1 electron		1 Oxygen-18	1 electron neutrino		1 electron	1 positron	1.66		6586.26
HCNO-I (stage 1):	novae and x-ray bursts	1 Carbon-12	1 Protium-1		1 Nitrogen-13	1 gamma ray				1.95		
HCNO-I (stage 2):	novae and x-ray bursts	1 Nitrogen-13	1 Protium-1		1 Oxygen-14	1 gamma ray				4.63		
HCNO-I (stage 3, net reaction):	novae and x-ray bursts	1 Oxygen-14	1 electron		1 Nitrogen-14	1 electron neutrino		1 electron	1 positron	5.14		70.641
HCNO-I (stage 4):	novae and x-ray bursts	1 Nitrogen-14	1 Protium-1		1 Oxygen-15	1 gamma ray				7.35		
HCNO-I (stage 5, net reaction):	novae and x-ray bursts	1 Oxygen-15	1 electron		1 Nitrogen-15	1 electron neutrino		1 electron	1 positron	2.75		122.24
HCNO-I (stage 6):	novae and x-ray bursts	1 Nitrogen-15	1 Protium-1		1 Carbon-12	1 Helium-4				4.96		
HCNO-II (stage 1):	novae and x-ray bursts	1 Nitrogen-15	1 Protium-1		1 Oxygen-16	1 gamma ray				12.13		
HCNO-II (stage 2):	novae and x-ray bursts	1 Oxygen-16	1 Protium-1		1 Fluorine-17	1 gamma ray				0.60		
HCNO-II (stage 3):	novae and x-ray bursts	1 Fluorine-17	1 Protium-1		1 Neon-18	1 gamma ray				3.92		
HCNO-II (stage 4, net reaction):	novae and x-ray bursts	1 Neon-18	1 electron		1 Fluorine-18	1 electron neutrino		1 electron	1 positron	4.44		1.672
HCNO-II (stage 5):	novae and x-ray bursts	1 Fluorine-18	1 Protium-1		1 Oxygen-15	1 Helium-4				2.88		
HCNO-II (stage 6, net reaction):	novae and x-ray bursts	1 Oxygen-15	1 electron		1 Nitrogen-15	1 electron neutrino		1 electron	1 positron	2.75		122.24
HCNO-III (stage 1):	higher mass novae and x-ray bursts	1 Fluorine-18	1 Protium-1		1 Neon-19	1 gamma ray				6.41		
HCNO-III (stage 2, net reaction):	higher mass novae and x-ray bursts	1 Neon-19			1 Fluorine-19	1 electron	1 electron neutrino	1 electron	1 positron	3.32		17.22
HCNO-III (stage 3):	higher mass novae and x-ray bursts	1 Fluorine-19	1 Protium-1		1 Oxygen-16	1 Helium-4				8.11		
HCNO-III (stage 4):	higher mass novae and x-ray bursts	1 Oxygen-16	1 Protium-1		1 Fluorine-17	1 gamma ray				0.60		
HCNO-III (stage 5):	higher mass novae and x-ray bursts	1 Fluorine-17	1 Protium-1		1 Neon-18	1 gamma ray				3.92		
HCNO-III (stage 6, net reaction):	higher mass novae and x-ray bursts	1 Neon-18			1 Fluorine-18	1 electron	1 electron neutrino	1 electron	1 positron	4.44		1.672
Triple-alpha process (stage 1):		1 Helium-4	1 Helium-4		1 Beryllium-8					-0.09		100
Triple-alpha process (stage 2):		1 Beryllium-8	1 Helium-4		1 Carbon-12	2 gamma rays				7.37		100
Triple-alpha process (stage 2a):		1 Carbon-12	1 Helium-4		1 Oxygen-16	1 gamma ray				7.16		100
Alpha process (stage 1):		1 Carbon-12	1 Helium-4		1 Oxygen-16	1 gamma ray				7.16		
Alpha process (stage 2):		1 Oxygen-16	1 Helium-4		1 Neon-20	1 gamma ray				4.73		

Name of reaction and stage (if applicable):	Incidence (at 15.7mm degrees):	Reagent 1:	Reagent 2:	Reagent 3:	Product 1:	Product 2:	Product 3:	Annihilates exogenous 1:	Annihilates endogenous 1:	MeV:	Temperatures (in megakelvin):	Half-life (in seconds):
Alpha process (stage 3):		1 Neon-20	1 Helium-4		1 Magnesium-24	1 gamma ray				9.32		
Alpha process (stage 4):		1 Magnesium-24	1 Helium-4		1 Silicon-28	1 gamma ray				9.98		
Alpha process (stage 5):		1 Silicon-28	1 Helium-4		1 Sulfur-32	1 gamma ray				6.95		
Alpha process (stage 6):		1 Sulfur-32	1 Helium-4		1 Argon-36	1 gamma ray				6.64		
Alpha process (stage 7):		1 Argon-36	1 Helium-4		1 Calcium-40	1 gamma ray				7.04		
Alpha process (stage 8):		1 Calcium-40	1 Helium-4		1 Titanium-44	1 gamma ray				5.13		
Alpha process (stage 9):		1 Titanium-44	1 Helium-4		1 Chromium-48	1 gamma ray				7.70		
Alpha process (stage 10):		1 Chromium-48	1 Helium-4		1 Iron-52	1 gamma ray				7.94		
Alpha process (stage 11):		1 Iron-52	1 Helium-4		1 Nickel-56	1 gamma ray				8.00		
Lithium burning (stage 1):		1 proton	1 Lithium-6		1 Beryllium-7							unstable
Lithium burning (stage 2):		1 Beryllium-7	1 electron		1 Lithium-7	1 electron neutrino						
Lithium burning (stage 1):		1 proton	1 Lithium-7		1 Beryllium-8							unstable
Lithium burning (stage 2):		1 Beryllium-8			2 Helium-4							
Carbon burning (stage 1):		1 Carbon-12	1 Carbon-12		1 Neon-20	1 Helium-4				4.62		
Carbon burning (stage 2):		1 Carbon-12	1 Carbon-12		1 Sodium-23	1 Protium-1				2.24		
Carbon burning (stage 3):		1 Carbon-12	1 Carbon-12		1 Magnesium-23	1 neutron				-2.60		
Carbon burning (stage 1):		1 Carbon-12	1 Carbon-12		1 Magnesium-24	1 gamma ray				13.93		
Carbon burning (stage 2):		1 Carbon-12	1 Carbon-12		1 Oxygen-16	2 Helium-4				-0.11		
Neon burning (stage 1):		1 Neon-20	1 gamma ray		1 Oxygen-16	1 Helium-4						
Neon burning (stage 2):		1 Neon-20	1 Helium-4		1 Magnesium-24	1 gamma ray						
Neon burning (stage 1):		1 Neon-20	1 neutron		1 Neon-21	1 gamma ray						
Neon burning (stage 2):		1 Neon-21	1 Helium-4		1 Magnesium-24	1 neutron						
Oxygen burning (stage 1):		1 Oxygen-16	1 Oxygen-16		1 Silicon-28	1 Helium-4				9.59		
Oxygen burning (stage 2):		1 Oxygen-16	1 Oxygen-16		1 Phosphorus-31	1 Protium-1				7.68		
Oxygen burning (stage 3):		1 Oxygen-16	1 Oxygen-16		1 Silicon-31	1 neutron				1.46		
Oxygen burning (stage 4):		1 Oxygen-16	1 Oxygen-16		1 Silicon-30	2 Protium-1				0.38		
Oxygen burning (stage 5):		1 Oxygen-16	1 Oxygen-16		1 Phosphorus-30	1 Deuterium-2				-2.41		
Oxygen burning (stage 1):		1 Oxygen-16	1 Oxygen-16		1 Silicon-32	1 gamma ray				16.54		
Oxygen burning (stage 2):		1 Oxygen-16	1 Oxygen-16		1 Magnesium-24	2 Helium-4				-0.39		
Silicon burning (stage 1):		1 Silicon-28	1 Helium-4		1 Silicon-32							
Silicon burning (stage 2):		1 Sulfur-32	1 Helium-4		1 Argon-36							
Silicon burning (stage 3):		1 Argon-36	1 Helium-4		1 Calcium-40							
Silicon burning (stage 4):		1 Calcium-40	1 Helium-4		1 Titanium-44							
Silicon burning (stage 5):		1 Titanium-44	1 Helium-4		1 Chromium-48							
Silicon burning (stage 6):		1 Chromium-48	1 Helium-4		1 Iron-52							
Silicon burning (stage 7):		1 Iron-52	1 Helium-4		1 Nickel-56							
sub-total:	284	73	66	3	73	67	2	18	18	377.51	4-50	14,021.64