D2 Target Density in Run78

2019/06/07

Liquid D2 density vs temp.

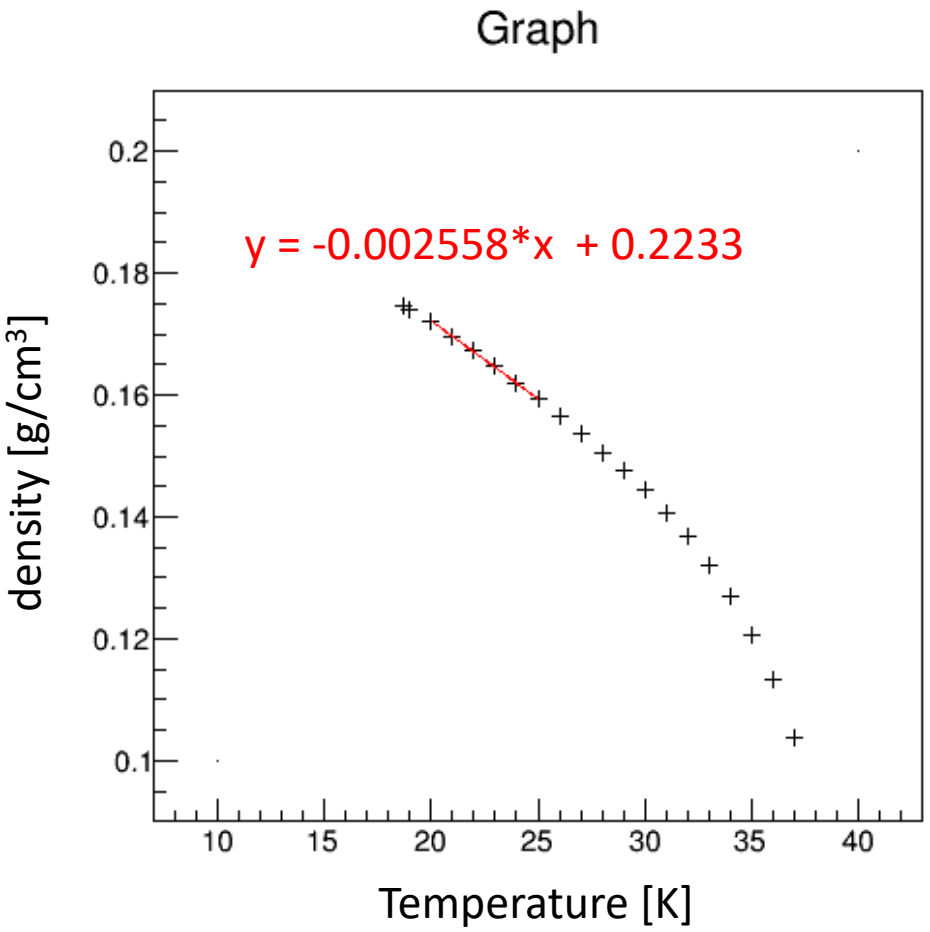


Table 5.24. Thermodynamic Properties of Saturated Deuterium

Temperature (K)	Pressure (MPa)	Density (kg/m³)	Enthalpy (kJ/kg)	Entropy (kJ/kg-K)	C_v (kJ/kg-K)	C_p (kJ/kg-K)	Velocity of sound (m/s)
18.710	0.019462	174.68	−165.72	1.4187	3.485	5.567	1085.
		0.49652	159.43	18.784	2.610	4.337	257.
19.000	0.022087	174.08	−164.05	1.5027	3.433	5.502	1075.
		0.55422	161.18	18.614	2.581	4.295	259.
20.000	0.033264	171.97	−158.34	1.7846	3.522	5.679	1024.
		0.79246	167.20	18.065	2.480	4.154	267.
21.000	0.048254	169.69	−152.39	2.0725	3.808	6.187	968.
		1.0979	173.11	17.573	2.382	4.031	274.
22.000	0.067757	167.24	−145.87	2.3736	4.136	6.794	919.
		1.4786	178.84	17.129	2.294	3.936	280.
23.000	0.092491	164.64	−138.68	2.6861	4.433	7.366	883.
		1.9432	184.29	16.725	2.219	3.880	287.
24.000	0.12319	161.96	−130.92	3.0060	4.670	7.847	859.
		2.5022	189.37	16.352	2.161	3.871	293.
25.000	0.16060	159.22	−122.72	3.3297	4.839	8.240	843.
		3.1693	193.99	16.002	2.125	3.920	298.
26.000	0.20548	156.42	−114.16	3.6546	4.944	8.584	830.
		3.9619	198.07	15.667	2.111	4.041	303.
27.000	0.25864	153.57	−105.26	3.9790	4.993	8.922	818.
		4.9025	201.48	15.341	2.126	4.253	307.
28.000	0.32092	150.63	−95.990	4.3023	4.997	9.295	802.
		6.0191	204.09	15.018	2.172	4.588	311.
29.000	0.39326	147.57	−86.298	4.6254	4.965	9.746	781.
		7.3461	205.75	14.692	2.257	5.087	313.
30.000	0.47670	144.32	−76.107	4.9505	4.906	10.32	755.
		8.9251	206.29	14.360	2.386	5.814	315.
31.000	0.57235	140.77	−65.307	5.2817	4.830	11.10	723.
		10.807	205.54	14.018	2.569	6.853	316.
32.000	0.68138	136.79	−53.717	5.6247	4.743	12.18	683.
		13.053	203.38	13.661	2.813	8.299	316.
33.000	0.80480	132.18	−41.095	5.9854	4.661	13.68	635.
		15.742	199.72	13.286	3.125	10.24	316.
34.000	0.94318	126.82	−27.232	6.3676	4.609	15.60	577.
		18.983	194.51	12.890	3.510	12.71	315.
35.000	1.0961	120.60	−12.102	6.7700	4.626	17.90	512.
		22.936	187.63	12.467	3.974	15.93	314.
36.000	1.2619	113.44	4.3179	7.1923	4.762	21.48	437.
		27.897	178.52	12.002	4.527	21.34	309.
37.000	1.4374	103.80	24.025	7.6874	5.140	40.12	338.
		34.581	165.05	11.451	5.212	41.70	297.
38.000	1.6168	75.227	70.197	8.8649	6.991	42.80	254.
		46.455	136.27	10.581	6.263	−61.20	268.
38.340	1.6653	69.797	82.220	9.1714			

Liquid D2 temperature in Run78

- Temperature

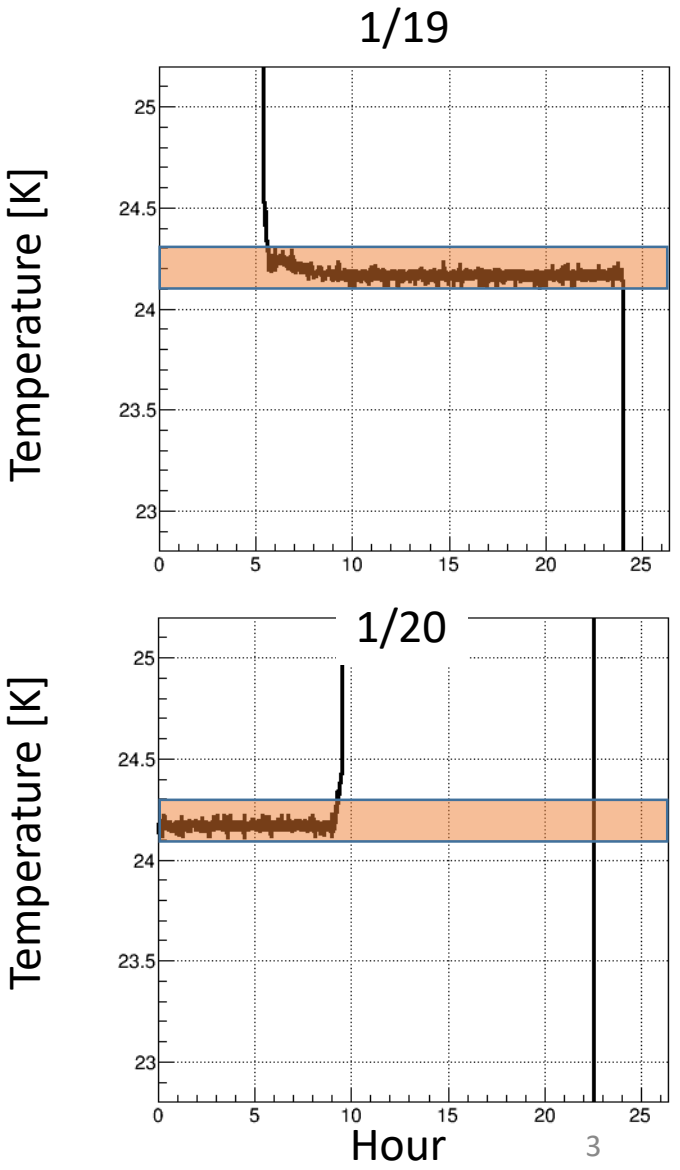
  Target cell thermometer

  PtCo (CHINO R800-6) ;Tolerance; ±0.5 K

- Date: 2018/01/19~20
- run#: 100~133
- Temp.: 24.1~24.3 [K]
- Fluctuation ~±0.1[K]
- fluc + tolerance = ~±0.6[K]

- Density: 0.1613 [g/cm^3]
  ±0.0015 [g/cm^3]

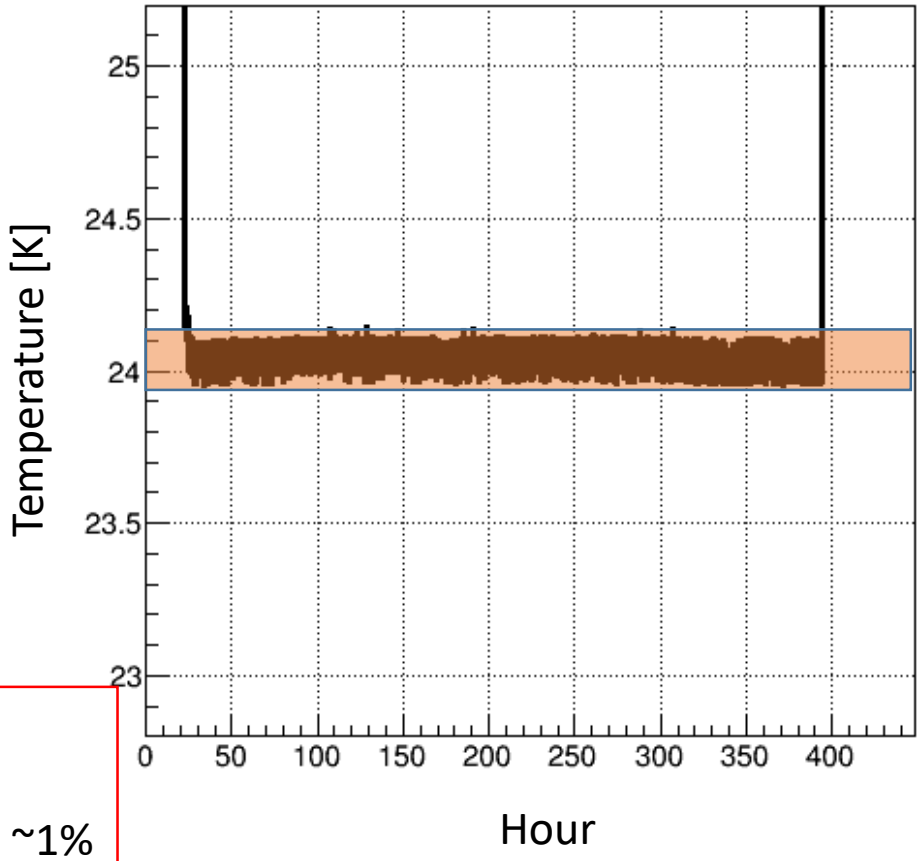
4.819×10^{23}
$\pm 4.58 \times 10^{21}$ [/cm^2] ~1%



Density x 6.02 x 10^{23} [N/mol]/4.032[g/mol] x 2 x 10[cm] (fiducial length)

- Date: 2018/01/25~02/10
- run#: 134~562
- Temp.: 23.95~24.15 [K]
- Fluctuation ~±0.1
- fluc + tolerance = ~±0.6[K]

- Density: 0.1617 [g/cm^3]
  ±0.0015 [g/cm^3]

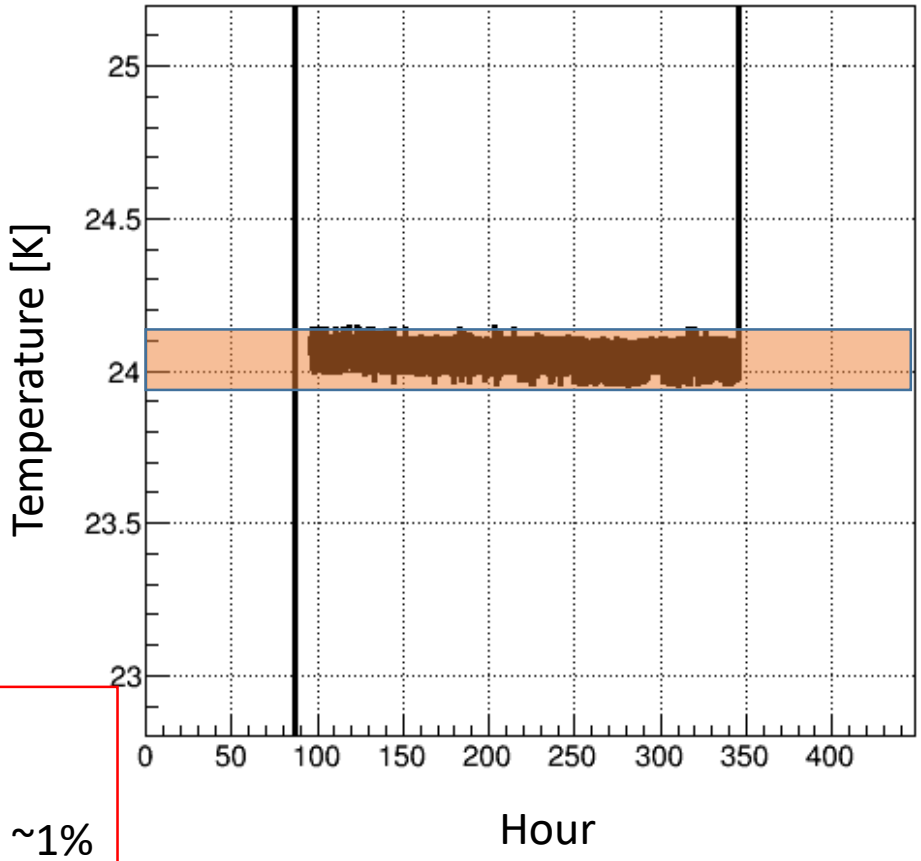


4.830×10^{23}
$\pm 4.58 \times 10^{21}$ [/cm^2] ~1%

Density x 6.02 x 10^{23} [N/mol]/4.032[g/mol] x 2 x 10[cm] (fiducial length)

- Date: 2018/02/15~25
- run#: 563~812
- Temp.: 23.95~24.15 [K]
- Fluctuation ~±0.1
- fluc + tolerance = ~±0.6[K]

- Density: 0.1617 [g/cm^3]
  ±0.0015 [g/cm^3]



4.830×10^{23}
$\pm 4.58 \times 10^{21}$ [/cm^2] ~1%

Density x 6.02 x 10^{23} [N/mol]/4.032[g/mol] x 2 x 10[cm] (fiducial length)

Summary

Target D2 density

5.60×10^{23} [/cm2]

$4.819 \times 10^{23} \pm 4.58 \times 10^{21}$ [/cm2] (run#100~133)
$4.830 \times 10^{23} \pm 4.58 \times 10^{21}$ [/cm2] (run#134~562)
$4.830 \times 10^{23} \pm 4.58 \times 10^{21}$ [/cm2] (run#563~812)
Δ~1%