High-Resolution Laser Spectroscopy and Laser Frequency Standards

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High-Resolution Spectroscopy of Methane

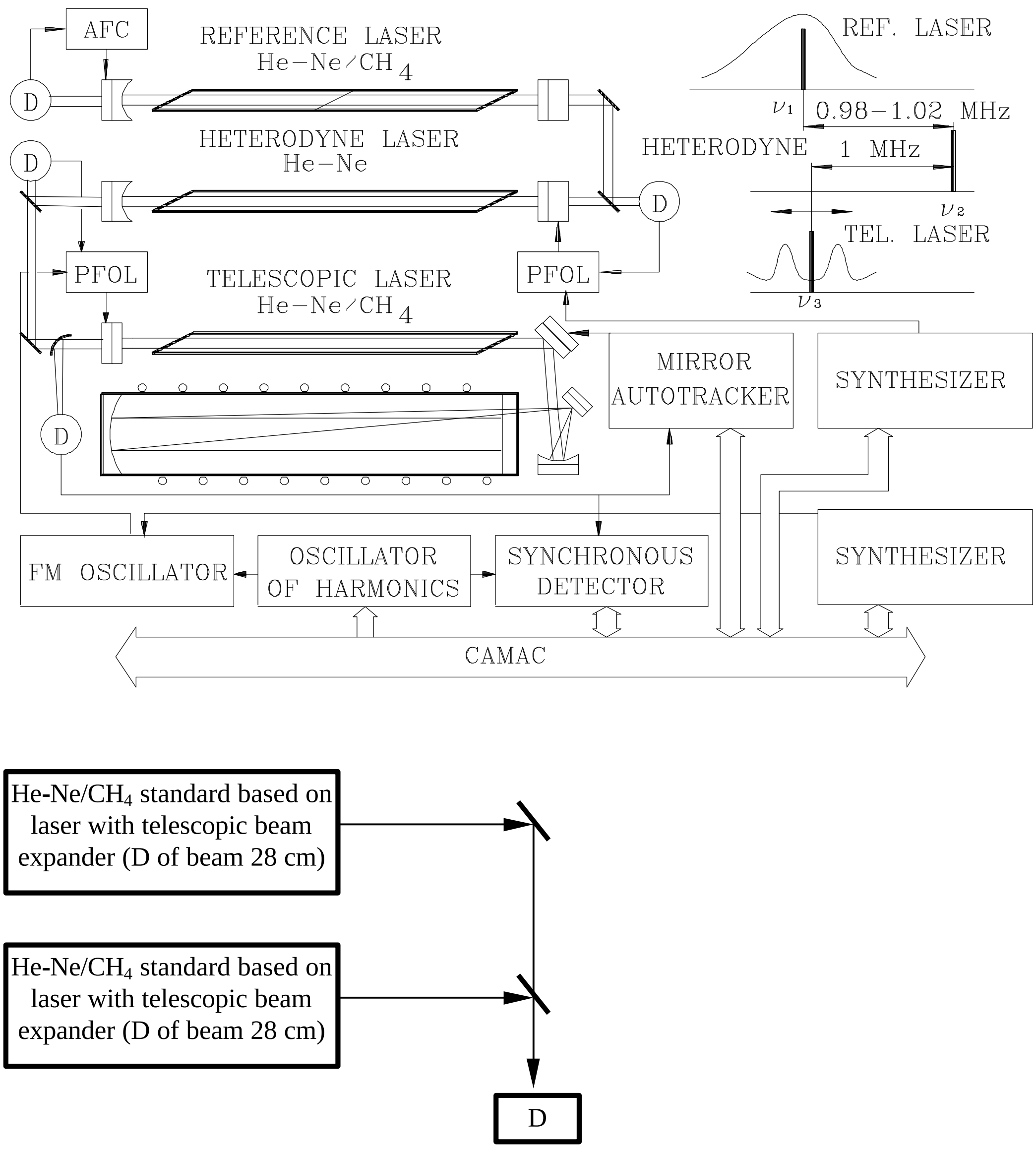


Fig.1. Experimental setup.

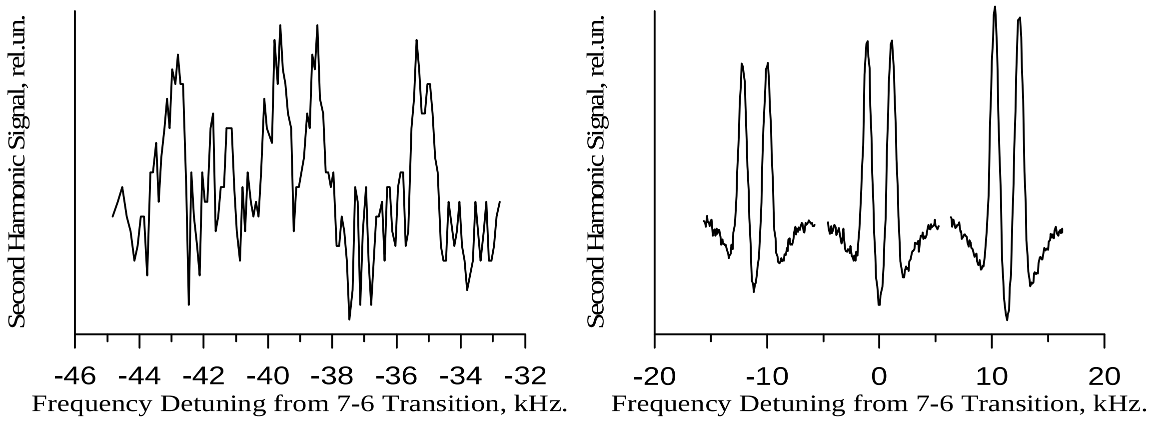


Fig.3. Record of the nonlinear resonances at DF= -1 transitions and crossings on the $F_2^{(2)}$ methane line.

Tab.1. Relative frequency positions and intensities of three mane resonances of the $F_2^{(2)}$ line.

Transitions	Frequency detuning from 7→6 transition, (kHz).		
(n_3=0,J=7,F_1)→(n_3=1,J=6,F_2)	[2]	[3]	Our results
8→7	11.4±0.3	11.34±0.05	11.336±0.018
7→6	0	0	0
6→5	-10.8±0.3	-11.06±0.05	-11.081±0.022
Transitions	Relative intensity		
(n_3=0,J=7,F_1)→(n_3=1,J=6,F_2)	Theory	[2]	Our results
8→7	1.168	1.20±0.10	1.18±0.02
7→6	1	1	1
6→5	0.874	0.90±0.05	0.86±0.02

Tab.2. Relative positions of crossings of the $F_2^{(2)}$ methane line.

Crossings between the *DF*=*DJ*=-1 and *DF*=0 transitions.	Frequency detuning from 7→6 transition, (kHz).	
	[3]	Our results
7→6,6→6	-35.3±0.5	-35.18±0.05
6→5,6→6	-38.7±0.5	-38.52±0.07
8→7,7→7	-39.7±0.5	-39.59±0.07
7→6,7→7	-43.2±0.5	-43.00±0.08

Tab.3. Hyperfine frequency intervals of the $F_2^{(2)}$ methane line.

E(n₃,J,F)-E'(n₃,J,F')	Hyperfine splitting of levels, (kHz).		
	Theory [6,7]	[3]	Our results
E(1,6,5)-E(1,6,6)	53.3±0.8	57.32±1.00	57.12±0.16
E(1,6,6)-E(1,6,7)	84.3±0.9	88.56±1.00	88.26±0.20
E(0,7,6)-E(0,7,7)	68.36±0.74	68.44±1.00	68.16±0.17
E(0,7,7)-E(0,7,8)	99.71±0.83	99.88±1.00	99.50±0.27

The hyperfine energies of rotational levels in the ground vibrational state of $^{12}CH_4$ can be written in the following form:

$$E = h_0 D_t + [-c_a + h_1 c_d](\frac{1}{2}C) + + h_2 d[\frac{3}{4}C(C+1) - I(I+1)J(J+1)]/J(J+1),$$

Yi, Ozier and Ramsey: (in kHz) c_a= +(10.4±0.1), c_d= +(18.5±0.5), d= +(20.9±0.3),

Our value for the scalar spin-rotation coupling constant is

c_a = 10.38±0.04 kHz.

Shifts of the Recoil Doublet due to the Magnetic Field.

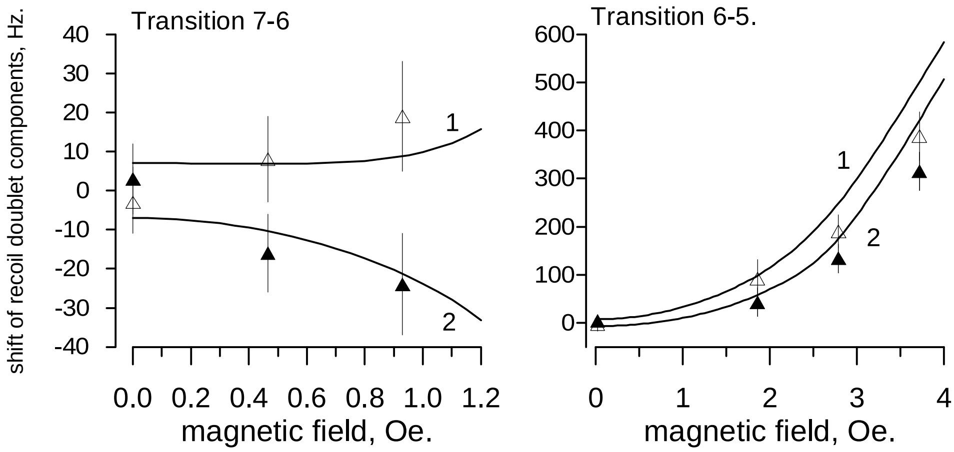


Fig.6. Shifts of the recoil components in magnetic fields (1 is the high-frequency and 2 is low-frequency component).

Shifts of the Recoil Doublet in the Transit Region due to the Second-Order Doppler Effect.

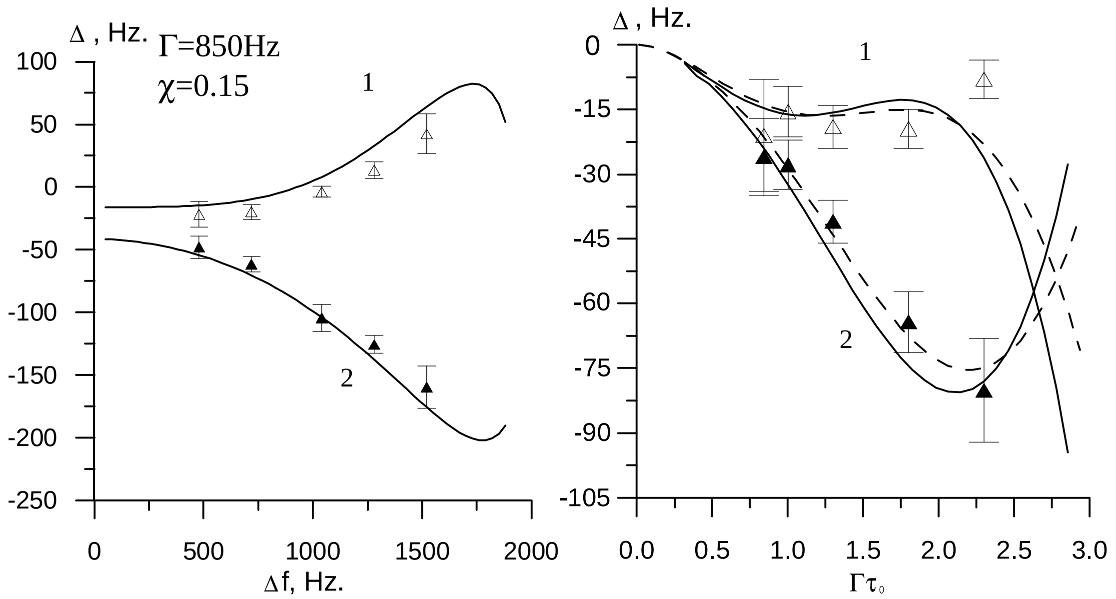
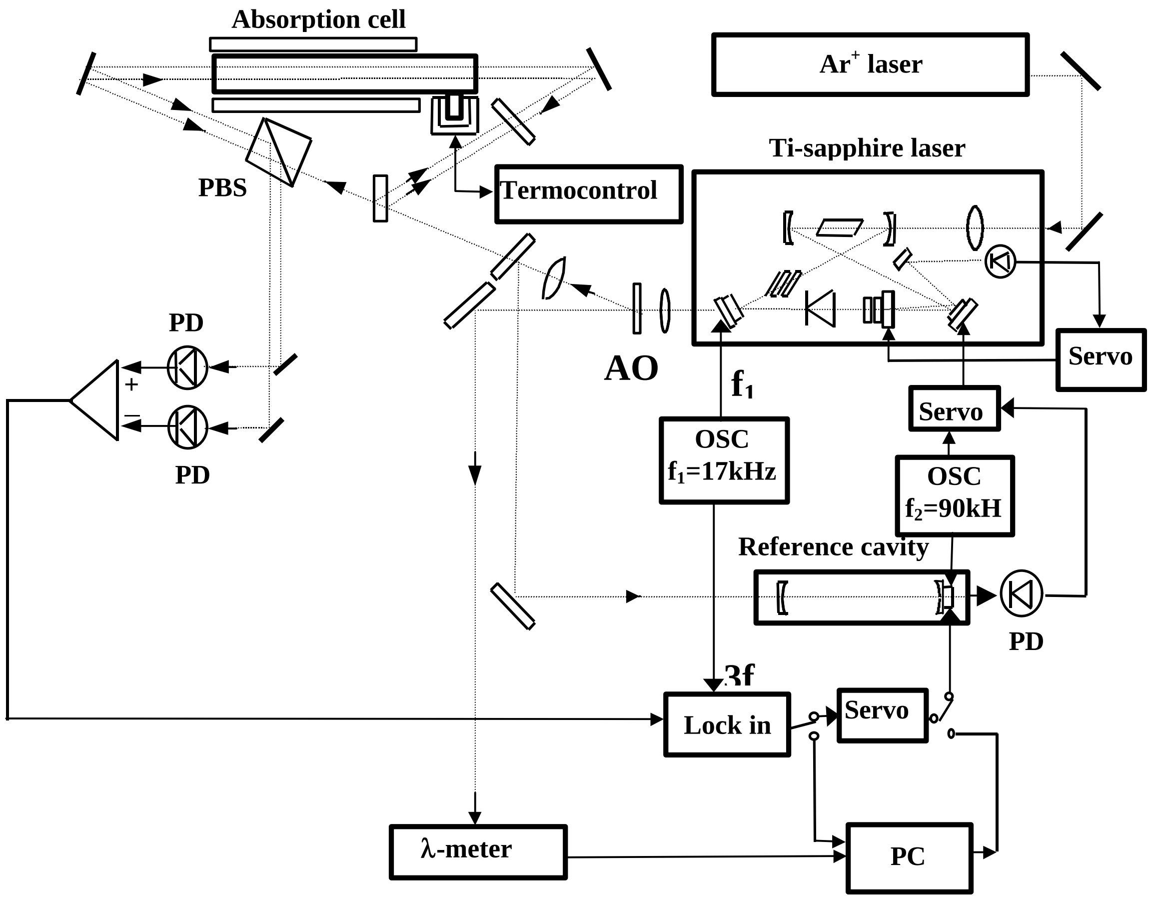
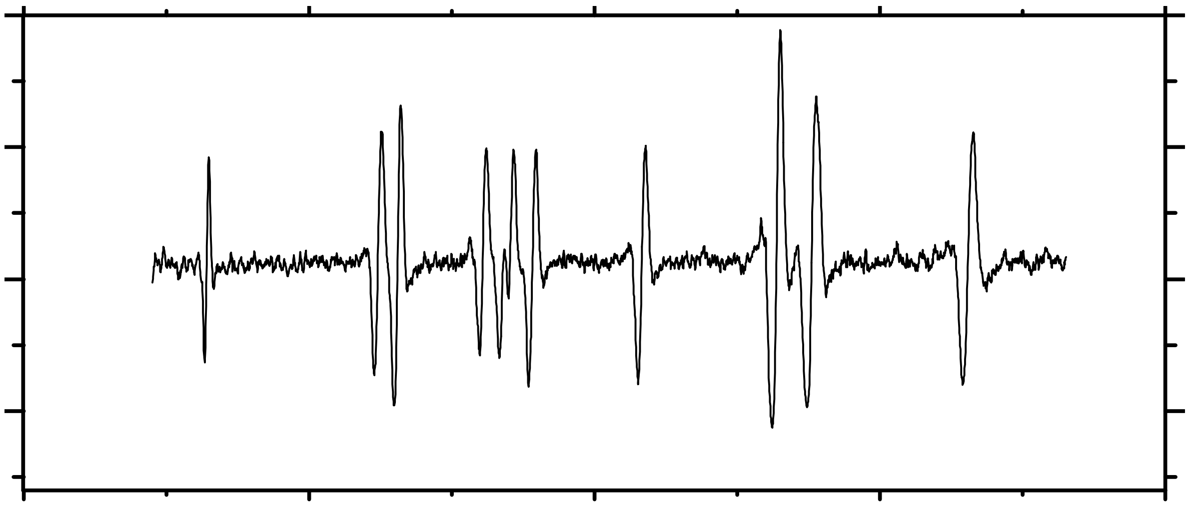


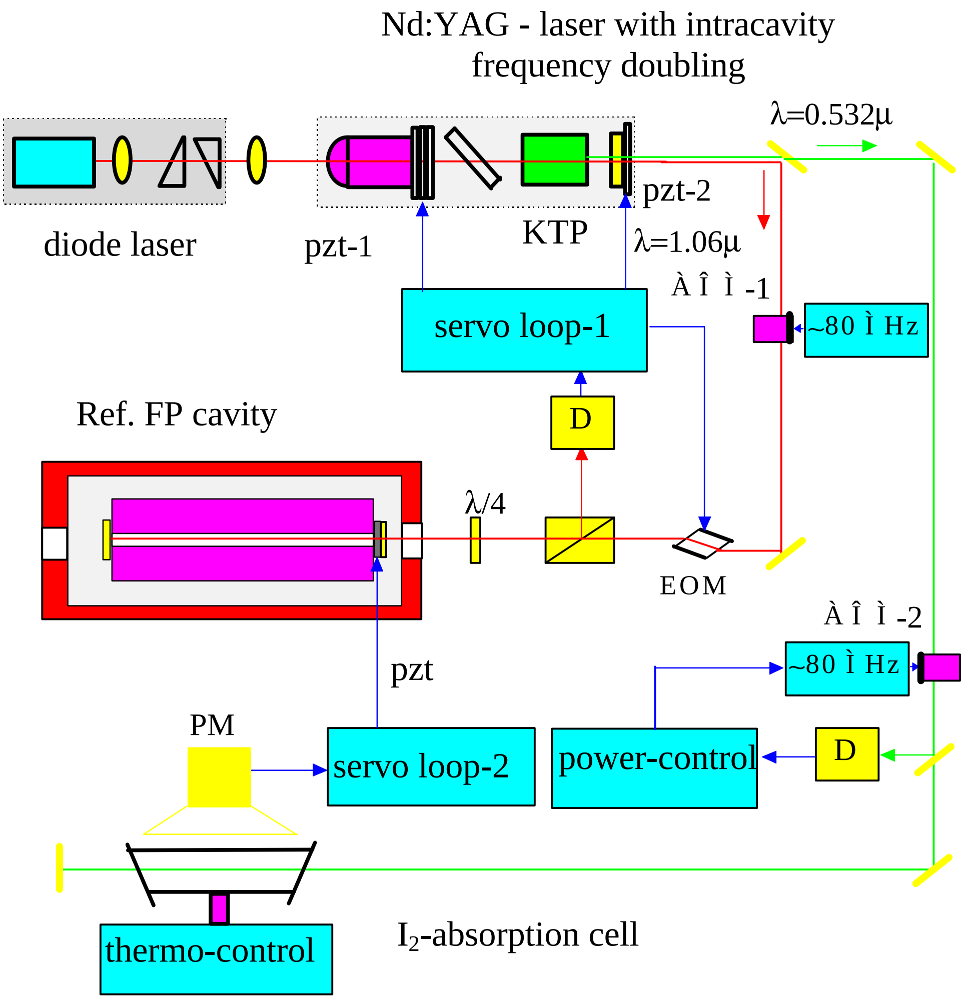
Fig.7. Frequency shifts of the recoil doublet components under deviation change.
Fig.8. Frequency shifts of the recoil doublet components under methane pressure change.

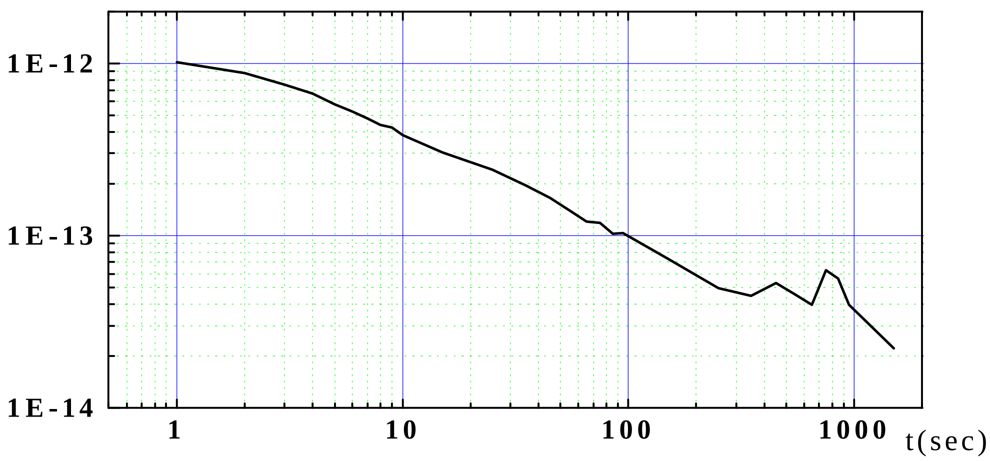
Saturated absorption spectra of the hyperfine components of the R(26) 5-13 $^{127}I_2$ line.



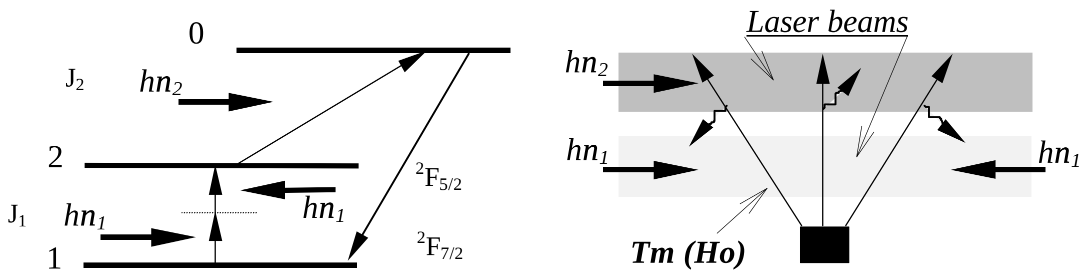


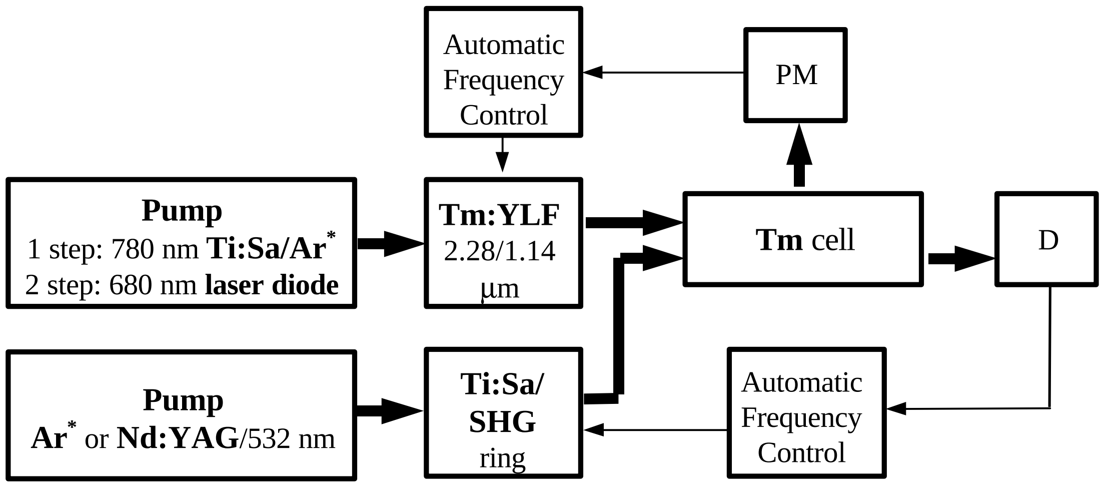
High-Resolution Spectroscopy of Iodine

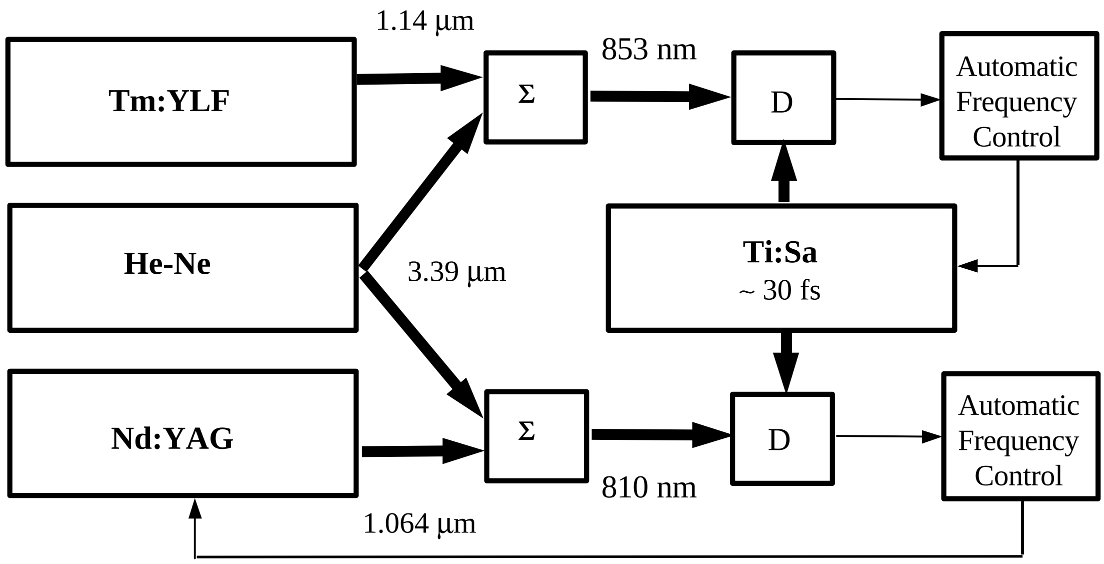




Spectroscopy of Rare - Earth elements







Note 1, Linda Turner, 12/08/98 02:23:39 PM
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