PPKTP

PPKTP	wavelength	Refractive index				Group index
nz	1064	1.8297	Type 0 e-ray d33	Type II e-ray d24		1.8718
ny	1064	1.7455		Type II o-ray d24		1.7768
nx	1064	1.7379				1.7672
nz	532	1.7779	Type 0 e-ray d33		e=e+e	2.0587
ny	532	1.7887		Type II o-ray d24	o=o+e	1.9127
nx	532	1.8887				1.8909
nz	1550	1.8158	Type 0 e-ray d33	Type II e-ray d24		1.8515
ny	1550	1.7349		Type II o-ray d24		1.7629
nx	1550	1.7282				1.7539
nz	775	1.8468	Type 0 e-ray d33		e=e+e	1.9178
ny	775	1.7581		Type II o-ray d24	o=o+e	1.8102
nx	775	1.7497				1.7983

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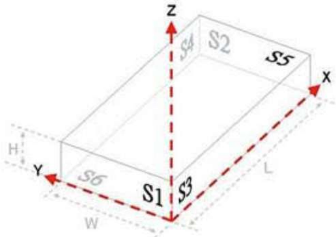
Absolute scale of second-order nonlinear-optical coefficients

Crystal	d_{il}	Wavelength $\lambda = 1.064\ \mu m$ n^{ω}	$n^{2\omega}$
KTP	d_{33}	1.8296	1.8868
	d_{31}	1.7475	1.8868
	d_{32}	1.7399	1.8868
	d_{15}	n_X 1.74754	1.78968
		n_Y 1.73988	
		n_Z 1.82963	
	d_{24}	n_X 1.74754	1.77905
		n_Y 1.73988	
		n_Z 1.82963	

這裡的nx ny跟其它文獻顛倒



< Type 0 >

o + o = o → Y + Y = Y → $d_{22} = 0$

e + e = e → x or z + x or z = x or z → $d_{11} = 0$

d_{33}

d_{31}

d_{15}

$d_{35} = 0$

$d_{13} = 0$

Transparency Range:
350 - 4500 nm, See Transparency Curve

Refractive Indices:

Wavelength	n_x	n_y	n_z
1064 nm	1.7377	1.7453	1.8297
532 nm	1.7780	1.7886	1.8887

這個nx ny比較多人使用

Type 0最好使用d33 就選ne = nz =1.8297 @1064nm
ne = nz =1.8887@532nm

$$[d] = \begin{pmatrix} 0 & 0 & 0 & 0 & d_{15} & 0 \\ 0 & 0 & 0 & d_{24} & 0 & 0 \\ d_{31} & d_{32} & d_{33} & 0 & 0 & 0 \end{pmatrix}$$

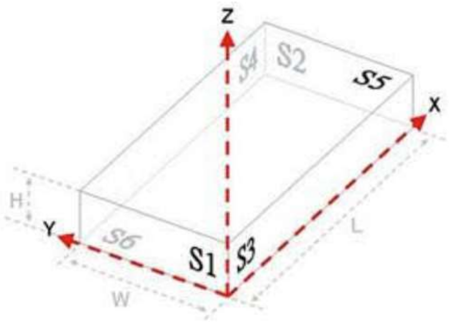
KTP 只有
e-> e+e d33=16.9pm/V
e-> o+o d32= 2.7 pm/V
o -> o+e d24 = 3.64pm/V @ 1064nm

$$\begin{bmatrix} P_x(2\omega) \\ P_y(2\omega) \\ P_z(2\omega) \end{bmatrix} = 2\epsilon_0 \begin{bmatrix} d_{11} & d_{12} & d_{13} & d_{14} & d_{15} & d_{16} \\ d_{21} & d_{22} & d_{23} & d_{24} & d_{25} & d_{26} \\ d_{31} & d_{32} & d_{33} & d_{34} & d_{35} & d_{36} \end{bmatrix} \begin{bmatrix} E_x(\omega)^2 \\ E_y(\omega)^2 \\ E_z(\omega)^2 \\ 2E_y(\omega)E_z(\omega) \\ 2E_x(\omega)E_z(\omega) \\ 2E_x(\omega)E_y(\omega) \end{bmatrix}$$

Optical Properties of KTP:

Transmitting Range:	350nm ~ 4500nm			
Phase Matching Range:	984nm ~ 3400nm			
Refractive Indices:	@1064nm	1.7377(n_x)	1.7453(n_y)	1.8297(n_z)
	@532nm	1.7780(n_x)	1.7886(n_y)	1.8887(n_z)
Sellmeier Equations: (λ in μm)	$N_x^2 = 3.0065 + 0.03901 / (\lambda^2 - 0.04251) - 0.01327\lambda^2$			
	$N_y^2 = 3.0333 + 0.04154 / (\lambda^2 - 0.04547) - 0.01408\lambda^2$			
	$N_z^2 = 3.3134 + 0.05694 / (\lambda^2 - 0.05658) - 0.01682\lambda^2$			
Therm-Optic Coefficient:(10^{-5}/°C)	$dn_x/dT=1.1$		$dn_y/dT=1.3$	$dn_z/dT=1.6$
Absorption Coefficient:	a<1%/cm @1064nm and 532nm			
Nonlinear Optical Coefficients and Equation:	@1064nm	d_{31}=2.54pm/V	d_{32}=4.35pm/V	d_{33}=16.9pm/V
		d_{24}=3.64pm/V	d_{15}=1.91pm/V	
	$d_{eff}(II)=(d_{24}-d_{15})\sin2\phi\,\sin2\theta - (d_{15}\sin^2\phi + d_{24}\cos^2\theta)\sin\theta$			
Electro-optic coefficients:	Low Frequency(pm/V)		High Frequency(pm/V)	
r_{13}	9.5		8.8	
r_{23}	15.7		13.8	
r_{33}	36.3		35.0	
r_{51}	7.3		6.9	
r_{42}	9.3		8.8	
Dielectric constant:	$\varepsilon_{eff}=13$			

o ray垂直 光軸 (例如z) 與傳播方向(例如x)
所以是平行Y (通常晶體平放時是水平偏振)
所以如果平行x 或 z就會是e ray (垂直偏振)



<Type II>

e + o = e → $\frac{X}{Z}$ + Y = $\frac{X}{Z}$ → $d_{16}=0$, $d_{14}=0$, $d_{36}=0$, $d_{34}=0$

e + o = o → $\frac{X}{Z}$ + Y = Y → $d_{26}=0$, $d_{24}=d_{24}$

所以Type II PPKTP應該是: 網頁版

$n_e = n_z = 1.8297$ @1064nm

$n_o = n_Y = 1.7455$ @1064nm

$n_o = n_Y = 1.7886$ @532nm

Type II (o + e = o)	y + x = y y + z = y	d_{26} d_{24}

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A miniature ultrabright source of temporally long, narrowband biphoto

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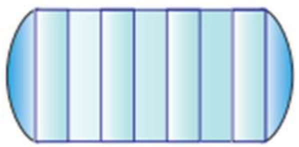
We demonstrate a miniature source of long biphotons utilizing the cluster effect and double-pass pumping in a monolithic doubly resonant parametric down-converter. We obtain a biphoton correlation time of 17.1 ns with a generation rate of 1.10×10^5 biphotons/(s mW) and an estimated linewidth of 8.3 MHz. © *2012 American Institute of Physics*. [http://dx.doi.org/10.1063/1.4740270]

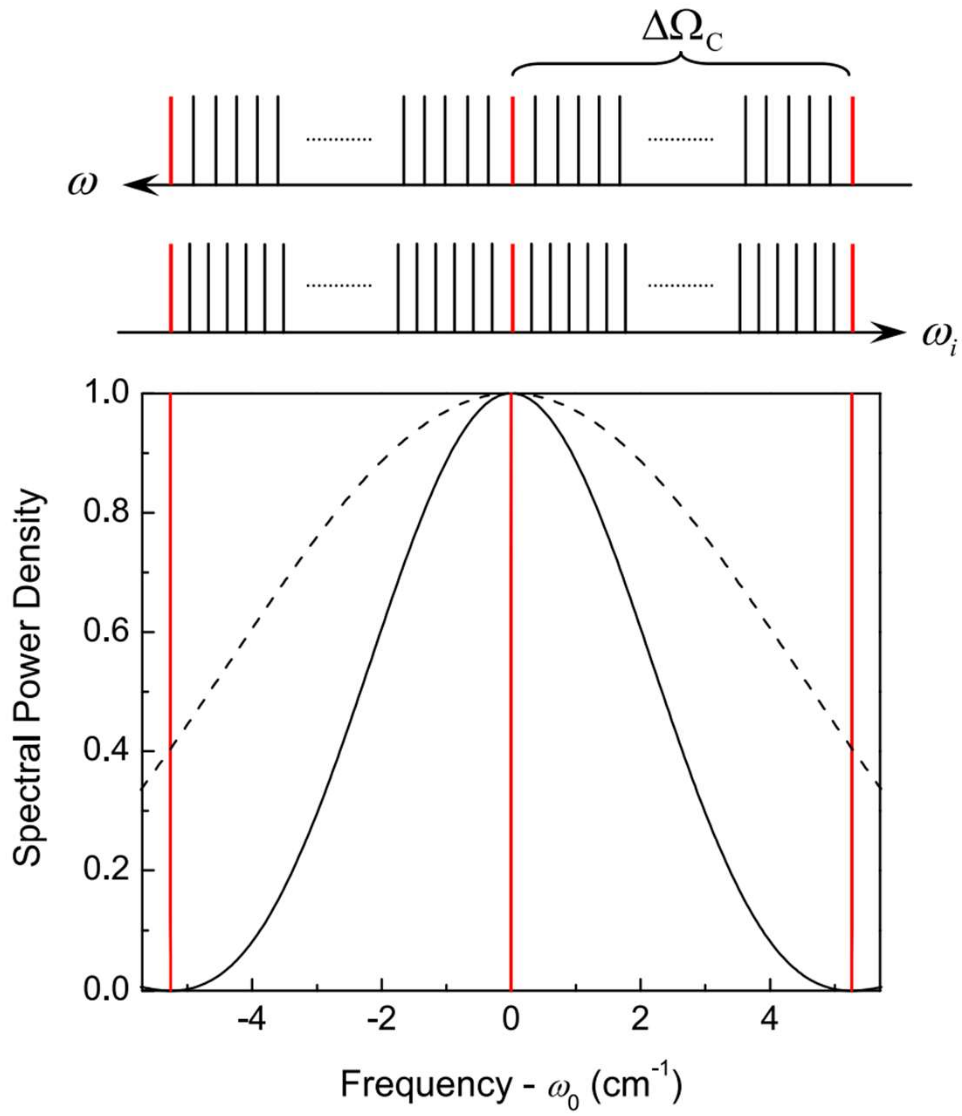
Monolithic



s與i下一次相遇的頻率:

cluster spacing:

$$\Delta\Omega_C \cong \frac{\Delta_s \, \Delta_i}{\Delta_s - \Delta_i}.$$



The bandwidth of the biphotons is determined by the phase matching condition and thus the gain linewidth of the parametric interaction. For non-degenerate photons, it is

光子對的bandwidth: $$\Delta\omega_G = 1.77\pi/(|v_s^{-1} - v_i^{-1}|L)$$

, where v_s and v_i are the group velocities of the signal and idler photons and L is the length of the nonlinear crystal. For a KTP crystal with a length of 10 mm and type-II phase matching, the gain linewidth is about 4.66 cm^{-1} or 140 GHz.

$$\Delta\Omega_C \cong \frac{\Delta_s \Delta_i}{\Delta_s - \Delta_i}. \qquad (1)$$

Following the earlier literature,19 we term the frequency spacing of these doubly resonant modes as the cluster spacing $\Delta\Omega_C$.

With the approximation that the mode spacing at the signal Δ_s and the idler frequency Δ_i are independent of frequency (no group velocity dispersion), the mode spacings of the signal and idler modes are related to their group velocities $v_{s,i}$ and the cavity length l by

$$\Delta_{s,i} = (2\pi)v_{s,i}/(2l)$$

The cluster spacing is obtained by noting that since the difference of the mode spacings at the signal and idler is ($\Delta_s - \Delta_i$), then a doubly resonant mode will occur after N idler modes, where

$$N \cong \Delta_s/(\Delta_s - \Delta_i)$$

The cluster spacing at the signal frequency is then $N\Delta_i$ or

$$\text{cluster spacing:} \quad \Delta\Omega_C \cong \frac{\Delta_s \Delta_i}{\Delta_s - \Delta_i}. \tag{1}$$

wavelength (nm)		1064		
c (m/s)	光速	299792458		
ngs	signal group index	1.8718		
ngi	idler group index	1.7768		
vs	c/(ngs*2*PI)	160162655.2		
vi	c/(ngi*2*PI)	168726057		
l (m)	cavity length	0.01		
Δs (Δωs)	2*PI*vs/(2*L)	50316582095	50.3165821	GHz
Δi (Δωi)	2*PI*vi/(2*L)	53006854100	53.0068541	GHz
|Δs-Δi|		2690272005	2.690272005	GHz
ΔΩc=Δs*Δi/|Δs-Δi|		9.91396E+11	991.3955617	GHz

Group index

$n_g = 1.8718$

Group index

$n_g = 1.7768$

$$n_g = \frac{c}{v_g}$$

Vs= c/n_{gs}

FSR(Vs)= $c/n_{gs}*2L$

$$\Delta_{s,i} = (2\pi)v_{s,i}/(2l)$$

cluster spacing: $$\Delta\Omega_C \cong \frac{\Delta_s \Delta_i}{\Delta_s - \Delta_i}. \qquad (1)$$

簇間距為5.26 cm^{-1}換算Δv = 157.7 GHz 換算Δω=990.8 GHz

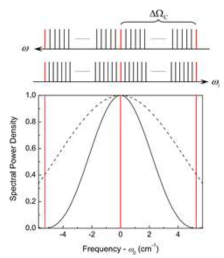
wavelength (nm)		1064		
c	光速	299792458		
n_{gs}	signal group index	1.8718		
n_{gi}	idler group index	1.7768		
vs	=c/n_{gs}	160162655.2		
vi	=c/ngi	168726057		
L(m)	length of the nonlinear crystal	0.02	double pass pump	
ΔωG	=1.77*PI*vs*vi/[(vs-vi)*L*2]	8.77385E+11	877.3851	GHz

$$\Delta\omega_G = 1.77\pi/(|v_s^{-1} - v_i^{-1}|L)$$

對於長度為 10 mm 且 II 型相位匹配的 KTP 晶體，增益線寬約為 4.66 cm^{-1} 或 140 GHz (這個值應該是Δv_G,如果是$\Delta\omega_G$ = 2π Δv = 877.8 GHz) 且L要帶20mm 因為是double-pass pump

必須要再除2才能對上2012的值, 所以我猜褚老師用到原本 0.885*Pi 的公式

C	λ (nm)	v (GHz)	Wavenumber (1/cm)	Δk(1/cm)	Δv(GHz)	Δω (GHz)
299792458	1064	281759.8289	9398.496241			
299792458	1063.472705	281899.5322	9403.156241	4.66	139.7032854	877.7816304
299792458	1063.404851	281917.5198	9403.756241	5.26	157.6908329	990.8007244



Monolithic PPKTP 安全線寬評估

c (m/s)	光速	299792458		
ngs	signal group index	1.8718		
ngi	idler group index	1.7768		
vs	c/ngs	160162655.2		
vi	c/ngi	168726057		
L (m)	crystal length	0.01		
Δs	vs/(2*L)	8008132760	8.00813276	GHz
Δi	vi/(2*L)	8436302848	8.436302848	GHz
|Δs-Δi|		428170087.9	0.428170088	GHz
Δs*Δi/|Δs-Δi|		1.57786E+11	157.7855042	GHz
N		19.70315789		

cluster spacing:

$$\Delta\Omega_C \cong \frac{\Delta_s \Delta_i}{\Delta_s - \Delta_i}.$$

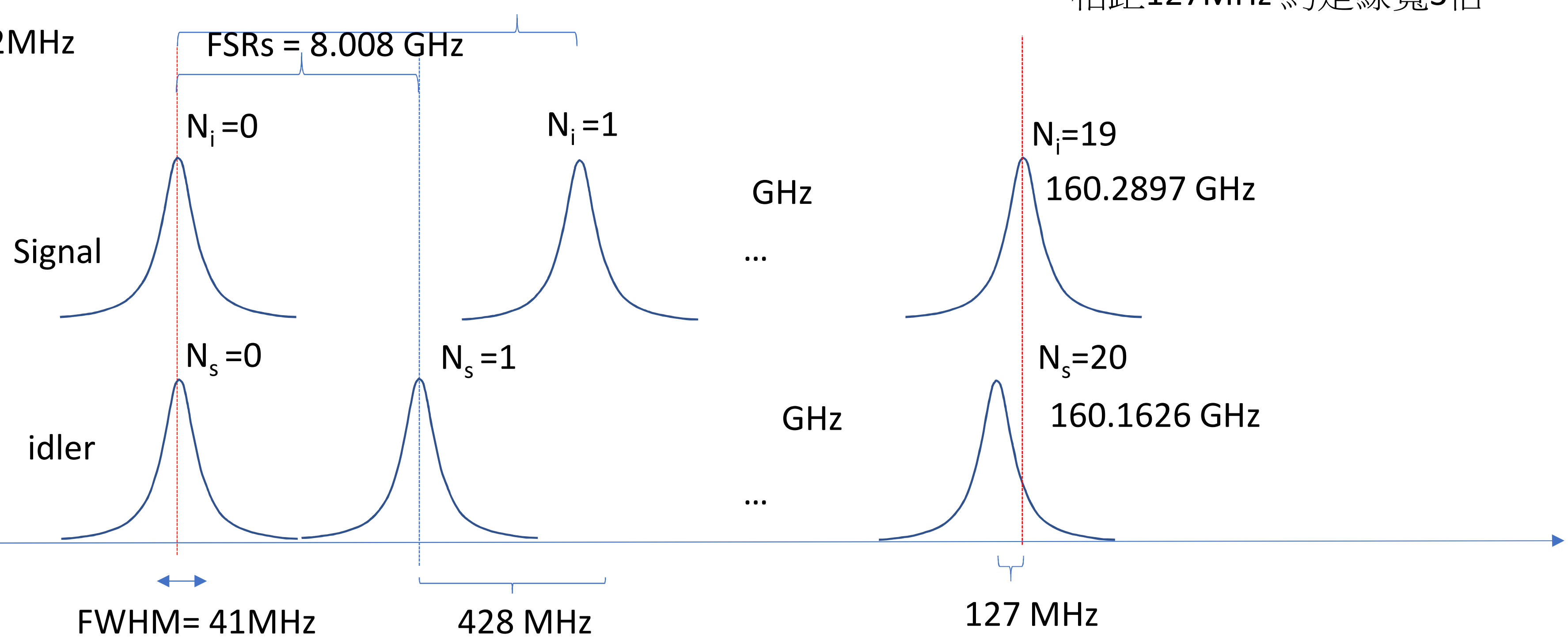
N	ν_{Ns}	ν_{Ni}	$\|\nu_{Ns} - \nu_{Ni}\|$	$\|\nu_{Ni} - \nu_{(N+1)s}\|$
1	8.00813	8.4363	0.42817	
2	16.01626	16.8726	0.85634	
17	136.1382	143.4171	7.27889	-0.72924
18	144.1463	151.8534	7.70706	-0.30107
19	152.1545	160.2897	8.13523	0.1271
20	160.1626	168.726	8.5634	0.55527
21	168.1707	177.1623	8.99157	0.98344

Δν = 157.7 GHz 換算Δω=990.8 GHz

下次約在160.16GHz最靠近,
相距127MHz 約是線寬3倍

SPDC FWHM Δν=41~42MHz

N= Δi/|Δs-Δi| = 19.7



PPKTP

用群速度算N

N	vNs	vNi	|vNs -vNi|	|vNi -v(N+1)s|
1	8.00813	8.4363	0.42817	
2	16.01626	16.8726	0.85634	
3	24.02439	25.3089	1.28451	
4	32.03252	33.7452	1.71268	
5	40.04065	42.1815	2.14085	
6	48.04878	50.6178	2.56902	
7	56.05691	59.0541	2.99719	
8	64.06504	67.4904	3.42536	
9	72.07317	75.9267	3.85353	
10	80.0813	84.363	4.2817	
11	88.08943	92.7993	4.70987	
12	96.09756	101.2356	5.13804	
13	104.1057	109.6719	5.56621	
14	112.1138	118.1082	5.99438	-2.01375
15	120.122	126.5445	6.42255	-1.58558
16	128.1301	134.9808	6.85072	-1.15741
17	136.1382	143.4171	7.27889	-0.72924
18	144.1463	151.8534	7.70706	-0.30107
19	152.1545	160.2897	8.13523	0.1271
20	160.1626	168.726	8.5634	0.55527
21	168.1707	177.1623	8.99157	0.98344
22	176.1789	185.5986	9.41974	1.41161
23	184.187	194.0349	9.84791	1.83978
24	192.1951	202.4712	10.27608	2.26795
25	200.2033	210.9075	10.70425	2.69612
26	208.2114	219.3438	11.13242	3.12429
27	216.2195	227.7801	11.56059	

用折射率算N

N	vNs	vNi	|vNs -vNi|	|vNi -v(N+1)s|
1	8.19239	8.58758	0.39519	
2	16.38478	17.17516	0.79038	
3	24.57717	25.76274	1.18557	
4	32.76956	34.35032	1.58076	
5	40.96195	42.9379	1.97595	
6	49.15434	51.52548	2.37114	
7	57.34673	60.11306	2.76633	
8	65.53912	68.70064	3.16152	
9	73.73151	77.28822	3.55671	
10	81.9239	85.8758	3.9519	
11	90.11629	94.46338	4.34709	
12	98.30868	103.051	4.74228	
13	106.5011	111.6385	5.13747	
14	114.6935	120.2261	5.53266	
15	122.8859	128.8137	5.92785	
16	131.0782	137.4013	6.32304	
17	139.2706	145.9889	6.71823	
18	147.463	154.5764	7.11342	
19	155.6554	163.164	7.50861	-0.68378
20	163.8478	171.7516	7.9038	-0.28859
21	172.0402	180.3392	8.29899	0.1066
22	180.2326	188.9268	8.69418	0.50179
23	188.425	197.5143	9.08937	0.89698
24	196.6174	206.1019	9.48456	1.29217
25	204.8098	214.6895	9.87975	1.68736
26	213.0021	223.2771	10.27494	2.08255
27	221.1945	231.8647	10.67013	

$\Delta\omega G$= 140 GHz

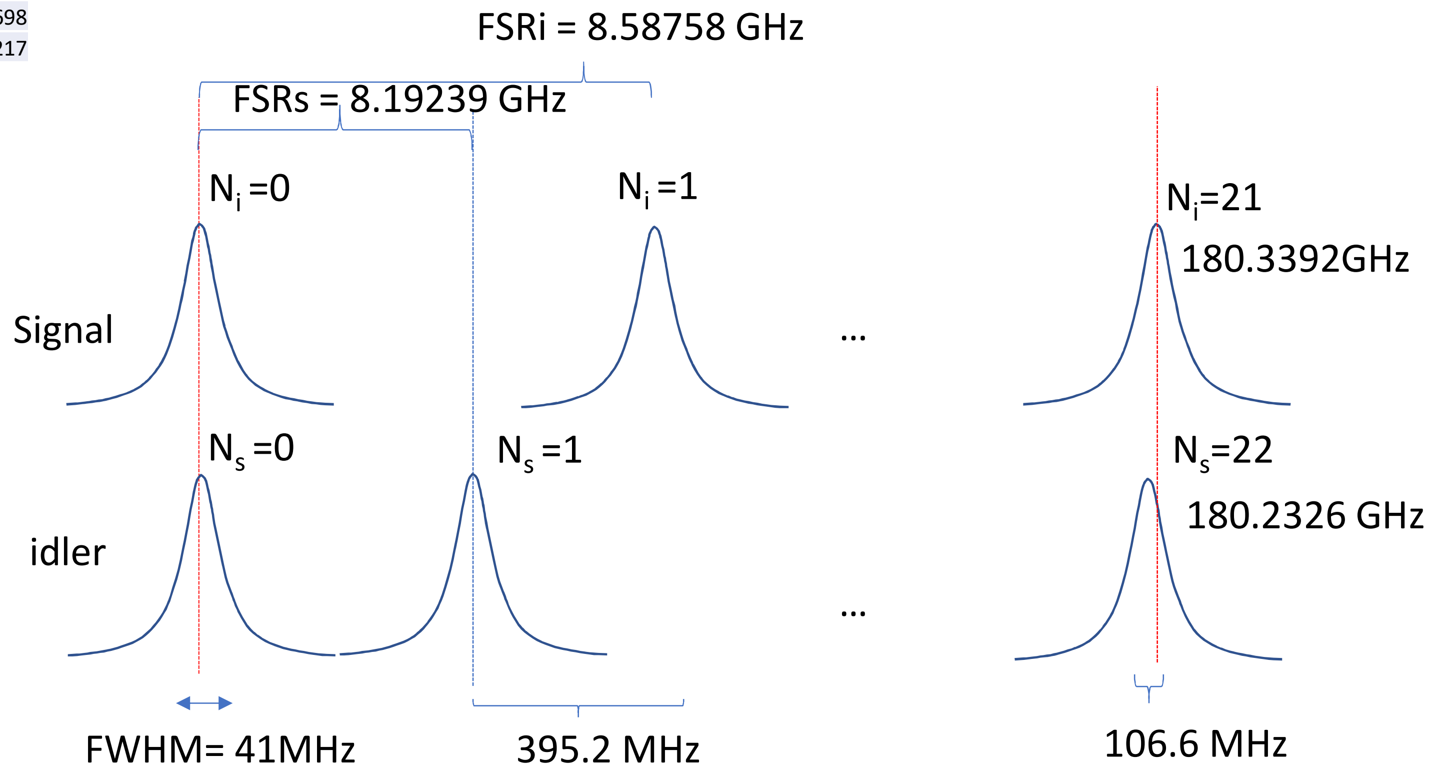
無論用群速度 還是中心頻率的折射率, 雖然估算N會相差2, 但下次最接近的頻率差都約127MHz, 所以安全的線寬應該是127MHz/3 =42MHz

PPKTP用折射率算FSR

	n	M1	M2	Finesse	FSR (GHz)	FWHM (MHz)
e-ray	1.8297	HR=99.9%	PR=97%	199.7	8.19239	41
o-ray	1.7455	HR=99.9%	PR=97%	199.7	8.58758	43

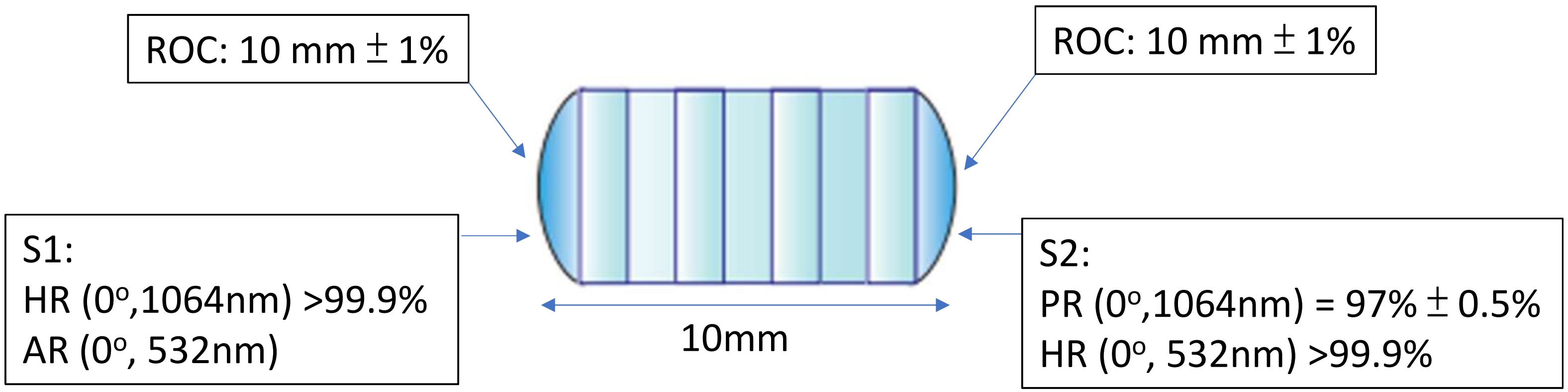
N	vNs	vNi		|vNs - v(N-1)i|
1	8.19239	8.58758	0.39519	
2	16.38478	17.17516	0.79038	
19	155.6554	163.164	7.50861	-0.68378
20	163.8478	171.7516	7.9038	-0.28859
21	172.0402	180.3392	8.29899	0.1066
22	180.2326	188.9268	8.69418	0.50179
23	188.425	197.5143	9.08937	0.89698
24	196.6174	206.1019	9.48456	1.29217

無論用群速度 還是中心頻率的折射率, 雖然估算N會相差1, 最接近的頻率差106.6MHz, 所以安全的線寬應該是106.6MHz/3 更保險是/4



評估coating

Type II PPKTP or MgO:PPLN



WxHxL: 1mm x 1mm x 10mm

O-ray是heralding e-ray是加光子

	n	M1	M2	Finesse	FSR (GHz)	FWHM (MHz)
Mono o-ray	1.7455	HR=99.9%	PR=97%	199.7	8.587	43
Mono e-ray	1.8297	HR=99.9%	PR=97%	199.7	8.192	41
BT OPO e-ray				33.4	1.052	31.5
If Mono e-ray	1.8297	HR=99.9%	PR=97.8%	270.3	8.192	30.3 MHz
If Mono e-ray	1.8297	HR=99.9%	PR=90%	59.1	8.192	138.7 MHz

Mono下次最接近的頻率差約127MHz, 所以安全的線寬應該是127MHz/3 =42MHz

需要思考 如何調到s與i跟squeezed light雙共振, 同時又是在最佳Phase Matching的溫度
改變晶體溫控同時會改變Phase Matching 、折射率與熱膨脹導致晶體長度改變，
另外雷射的波長精準值大約是1064.5nm (波長可調範圍約±0.05nm)
所以要計算一下這些參數隨溫度改變的情況, 如何達成s與i雙共振, 再決定是否能用monolithic結構

Type II PPKTP應該是: 網頁版

$n_e = n_z = 1.8297$ @1064nm

$n_o = n_Y = 1.7455$ @1064nm

FSR=c/2nL

$n_e * L = q\lambda_0/2$

$n_o * L = q\lambda_0/2$

$$kd = q\pi$$

只要滿足半波長的整數倍 就可以同時共振

在計算sq入射光 1064nm 且s與p光子要同時共振的條件, 應該要使用Refractive index 因為此時的SPDC 應該算是stimulated PDC

而在計算Cluster spacing 的時候, 因為涵蓋的波長範圍大 所以應該用group index會比較準? 因為此時的SPDC 屬於 spontaneous PDC, 單光子有頻寬分布, 屬於群速度管轄

晶體長度增加 ?um 可達到下次同時共振, 再換算溫度要增加多少(需同時考慮改變長度與折射率), 還要考慮雷射波長的誤差

KTP 溫度導致折射率變化

$$\Delta n(\lambda, T) = n_1(\lambda)(T - 25\ °C) + n_2(\lambda)(T - 25\ °C)^2. \quad (2)$$

$$n_{1,2}(\lambda) = \sum_{m=0}^{3} \frac{a_m}{\lambda^m}. \quad (3)$$

	KTP			
	z-axis		*y*-axis	
	n_1 $[10^{-6}]$	n_2 $[10^{-8}]$	n_1 $[10^{-6}]$	n_2 $[10^{-8}]$
a_0	9.9587	−1.1882	6.2897	−0.14445
a_1	9.9228	10.459	6.3061	2.2244
a_2	−8.9603	−9.8136	−6.0629	−3.5770
a_3	4.1010	3.1481	2.6486	1.3470

Z-axis (ne)	n1 a0	n1 a1	n1 a2	n1 a3	n2 a0	n2 a1	n2 a2	n2 a3	wavelength(um)	n1	n2	T (deg.C)	Δn
	9.96E-06	9.92E-06	-8.96E-06	4.10E-06	-1.19E-08	1.05E-07	-9.81E-08	3.15E-08	1.064	1.48E-05	2.59E-08	26.00	1.48E-05

n_e 每增加 1°C 會增加 $1.48*10^{-5}$

y-axis (no)	n1 a0	n1 a1	n1 a2	n1 a3	n2 a0	n2 a1	n2 a2	n2 a3	wavelength(um)	n1	n2	T (deg.C)	Δn
	6.29E-06	6.31E-06	-6.06E-06	2.65E-06	-1.44E-09	2.22E-08	-3.58E-08	1.35E-08	1.06	9.06E-06	-9.52E-10	26.00	9.06E-06

n_o 每增加 1°C 會增加 $9.06*10^{-6}$

(n_e-n_o) 每增加1°C 的差異變化是 $5.74*10^{-6}$

KTP 熱膨脹係數

Table 1. Thermal Expansion Coefficients of KTP and KTA

Material	α [°C^{-1}]	β [°C^{-2}]
KTP	$(6.7 \pm 0.7) \times 10^{-6}$	$(11 \pm 2) \times 10^{-9}$
KTA	$(7.6 \pm 0.6) \times 10^{-6}$	$(8.4 \pm 1.2) \times 10^{-9}$

$$L = L_0[1 + \alpha(T - 25\ ^\circ\text{C}) + \beta(T - 25\ ^\circ\text{C})^2]. \quad (1)$$

ΔL (um)	ΔL (mm)	L (mm)	L0 (mm)	α	β	T
0.06711	6.711E-05	10.00007	10	6.70E-06	1.10E-08	26
0.33775	0.00033775	10.00034	10	6.70E-06	1.10E-08	30

以10mm KTP晶體為例 , 每增加1°C 長度會增加 0.06711um

1064 laser tuning range:

Table 2-1. General Specifications of the Mephisto Product Line

Thermal tuning coefficient laser crystal / GHz/K	- 3
Thermal tuning range laser crystal / GHz	30

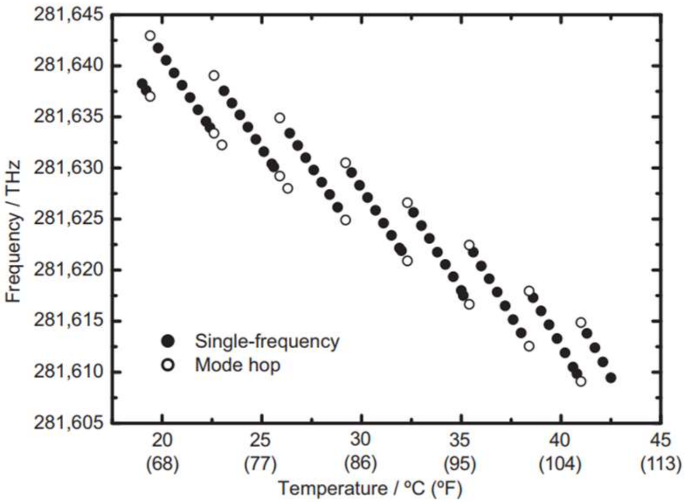


Figure 4-1. Typical Frequency Tuning by Crystal Temperature

By applying an analog voltage signal in the range - 10 V to + 10 V to the modulation input labeled “Temperature Laser Crystal”, the temperature of the laser crystal can be changed by + 1 K/V, corresponding to a frequency change of about - 3 GHz/V at 1064 nm.

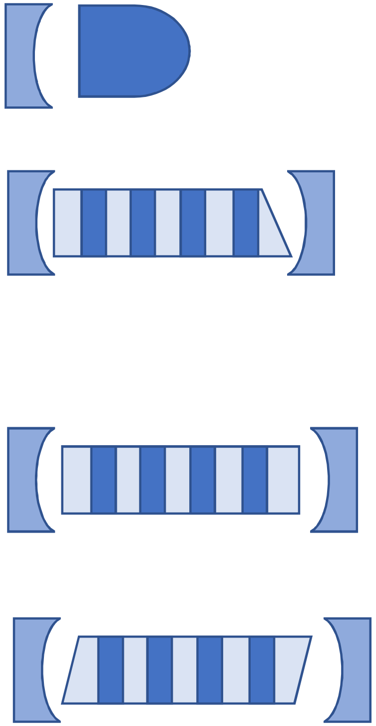
雷射溫度 每度C改變 -3GHz 約等於改變 0.0113 nm

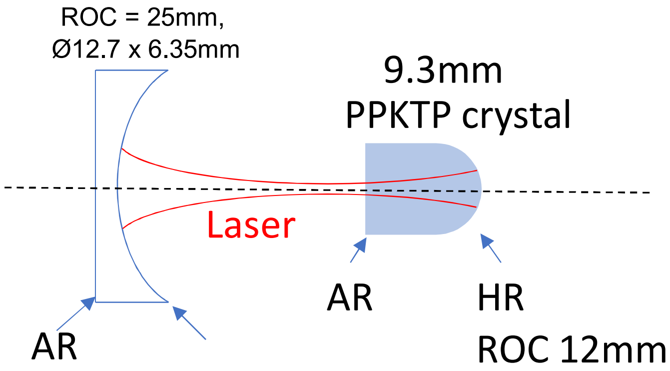
雷射 30^{o}C 的時候 281,627 THz => 1064.5 nm
25^{o}C 的時候 281,632 THz => 1064.483 nm

C	λ (nm)	ν (GHz)	ν (THz)
299792458	1064	281759.8289	281.7598289
299792458	1064.5	281627.4852	281.6274852
299792458	1064.483	281631.9828	281.6319828

如果很不容易調到雙共振(針對雷射波長可調範圍)

則可以考慮cavity結構改用





備用資料

When the doubly resonant biphoton source is compared to a non-resonant SPDC of the same crystal length and pumping power, the generation rate is increased by a factor of η_r where

$$\eta_r \approx \frac{8\mathcal{F}}{\pi r^{1/2}} \frac{|v_s - v_i|}{(v_s + v_i)}, \tag{5}$$

and $\mathcal{F} \approx \pi r^{1/2}/(1-r)$ is the finesse of both cavities. The spectral brightness is increased by a factor of $\eta_b = \eta_r \Delta\omega_G/\Delta\omega$. For the present experiment the cavity has a finesse of $\mathcal{F} \approx 660$, and the enhancement, as compared to a non-resonant down-converter is $\eta_r \cong 40$ for the generation rate and $\eta_b \cong 16,000$ for the spectral brightness.

奕如算的

wavelength_s	1.0635E-06	vs	2.55E+07	ngs	1.8718	1.60E+08
wavelength_i	1.0649E-06	vi	2.69E+07	ngi	1.7768	
L	0.01	Δ_s	8.01E+09	finesse	602.58	
$\Delta\omega_G$	2.79E+11	Δ_i	8.44E+09	R	1.10E+05	
$\Delta\omega_G$	279.47	Γ_s	8.83E+07	η_r	40.06	
	3.58E-12	Γ_i	7.52E+07	η_b	214408.83	17062.11
	5.26 cm^{-1}	Δ_ω	5.22E+07	r	0.9948	
		Tc	1.71E-08			
		$\Delta\Omega_c$	-1.58E+11			
		R/Δ_ω	2.11E-03			

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and the bandwidth of the generated biphotons is $\Delta\omega = [(\sqrt{\Gamma_s^4 + 6\Gamma_s^2\Gamma_i^2 + \Gamma_i^4} - \Gamma_s^2 - \Gamma_i^2)/2]^{1/2}$. With r denoting the mirror reflectivity and $\xi_{s,i}$ as the single-pass power loss of the crystal, the output coupling rates are $\gamma_{s,i} = \Delta_{s,i}(1-r)$ and the total cavity decay rates are $\Gamma_{s,i} = 2\xi_{s,i}\Delta_{s,i} + \gamma_{s,i}$. κ is the parametric coupling constant and $\Omega_q = q\pi v_s/l$ is the cold cavity frequency, where q is an integer.

A typical measurement of the correlation function is shown in Fig. 3, where we use a pump power of 700 μW. By fitting the measured curve with two asymmetric exponential decays for $\tau < 0$ and $\tau > 0$, we find $1/\Gamma_s = 11.33 \pm 0.12$ ns and $1/\Gamma_i = 13.29 \pm 0.14$ ns (the probable reason for the different decay times is the different reflectivity for the orthogonal polarizations). The correlation time (full width at half maximum) is then $T_c = 17.07 \pm 0.13$ ns. Using Eq. (2), the bandwidth of the generated biphotons is $\Delta\omega \cong 2\pi \cdot 8.3$ MHz.

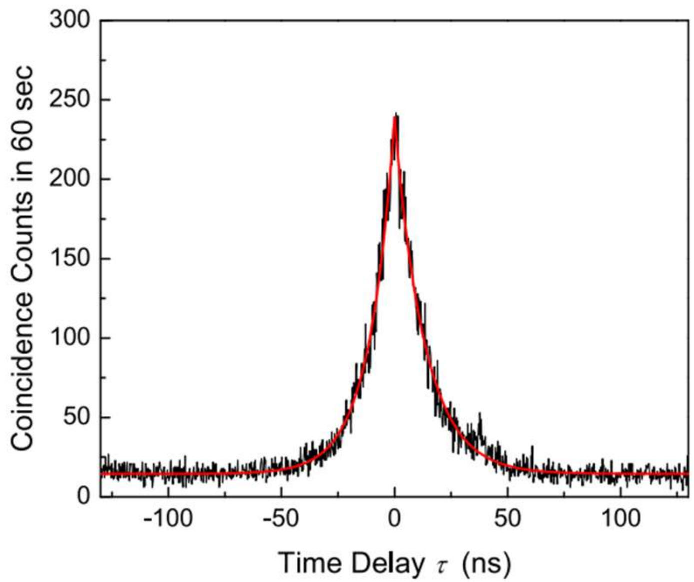

FIG. 3. Glauber correlation function of the signal and idler photons. The coincidence counts (black) are measured as a function of the time delay between the signal and idler photons at a pump power of 700 μW. The red curve (theoretical) is a fit using two exponential decays with decay constants of $1/\Gamma_i = 13.29 \pm 0.14$ ns and $1/\Gamma_s = 11.33 \pm 0.12$ ns for τ greater than or less than zero. The full width at half maximum, or the correlation time, is $T_c = 17.07 \pm 0.13$ ns.

Furusawa

	f_{FSR}	f_{HWHM}	γ
OPO	1.0012 GHz	10 MHz	1/16 ns
separator	1.00 GHz	5.3 MHz	1/30 ns
filter 1	75 GHz	72 MHz	1/2.2 ns
filter 2	52 GHz	50 MHz	1/3.2 ns

Furusawa	Length (mm)		Finess e	FSR (GHz)	f_{FWHM} (MHz)
OPO	46.3	HR, HR , 86%		1.0012	20
Separator	299.8	96.73% , HR, 9673%	94.3	1	10.6
Filter 1	1.998	99.4% , 99.4%	522	75	144
Filter 2	2.89	99.4% , 99.4%	522	52	100

我們

我們	Length (mm)		Finesse	FSR (GHz)	f_{FWHM} (MHz)
OPO PPKTP	285	HR, HR , 83%, 99.85%	33.4	1.052	31.5
SPDC PPLN	285	HR, HR , 83%, 99.85%	33.4	1.052	31.5
MC	420	95% , HR, 95%	61.18	0.7138	11.67
FC1	300	95% , HR, 95%	61.18	0.999	16.33
FC2	2.01	99.4% , 99.4%	522	74.57	142.8
FC3	2.86	99.4% , 99.4%	522	52.41	100.4

奕如的紀錄

	C	299792458							
	Rin	R2	R3	Rout	r	finesse	L (m)	FSR	Line width
SHG_1064	0.9	0.999	0.999	0.9985	0.9470	57.71	0.285	1.052E+09	1.82E+07
SHG_532	0.03	0.999	0.999	0.9985	0.1729	1.58	0.285	1.052E+09	6.66E+08
OPO_1064	0.83	0.999	0.999	0.9985	0.9094	33.09	0.285	1.052E+09	3.18E+07
OPO_532	0.73	0.999	0.999	0.9985	0.8529	19.72	0.285	1.052E+09	5.33E+07
SPDC_1064	0.83	0.999	0.999	0.9985	0.9094	33.09	0.285	1.052E+09	3.18E+07
SPDC_532	0.73	0.999	0.999	0.9985	0.8529	19.72	0.285	1.052E+09	5.33E+07
SPDC(532不共振)_1064	0.9	0.999	0.999	0.9985	0.9470	57.71	0.285	1.052E+09	1.82E+07
SPDC(532不共振)_532	0.03	0.999	0.999	0.9985	0.1729	1.58	0.285	1.052E+09	6.66E+08
doubleMC	0.95			0.95	0.95	61.24	0.3	9.99E+08	1.63E+07
FP1	0.994			0.994	0.994	522.03	2.2E-03	6.81E+10	1.31E+08
FP2	0.994			0.994	0.994	522.03	2.85E-03	5.26E+10	1.01E+08