生命科學研究課程介紹

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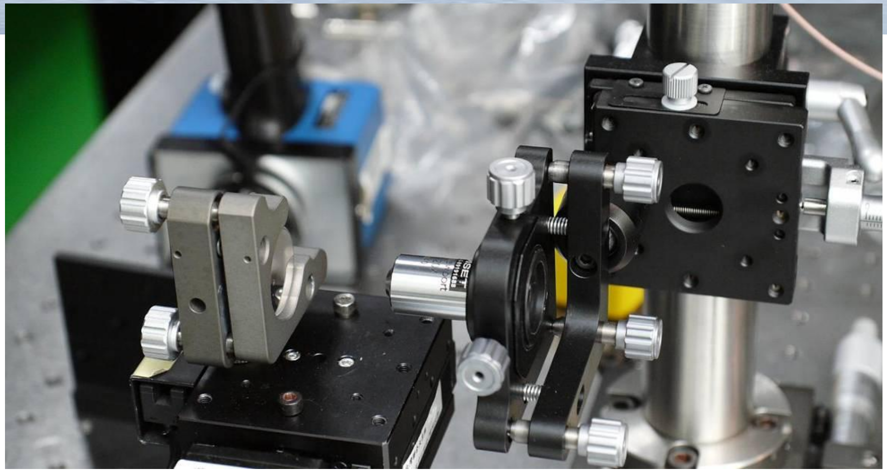

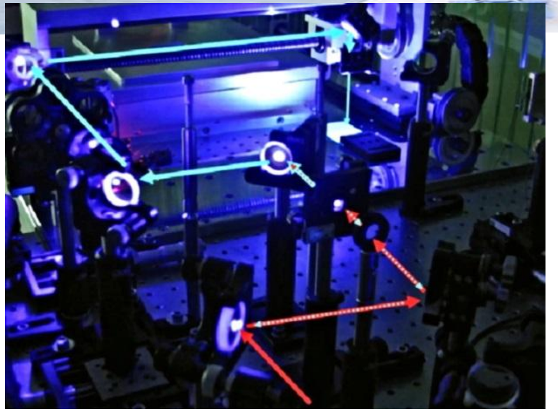

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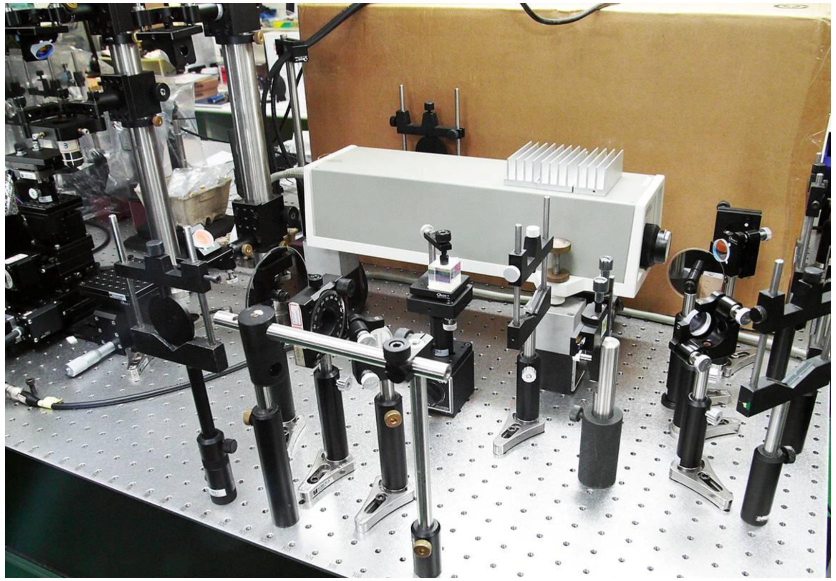

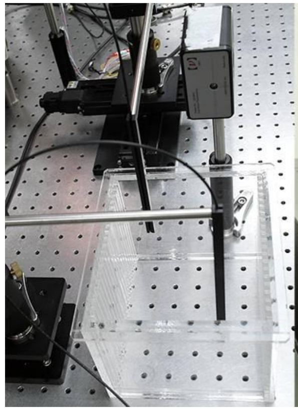

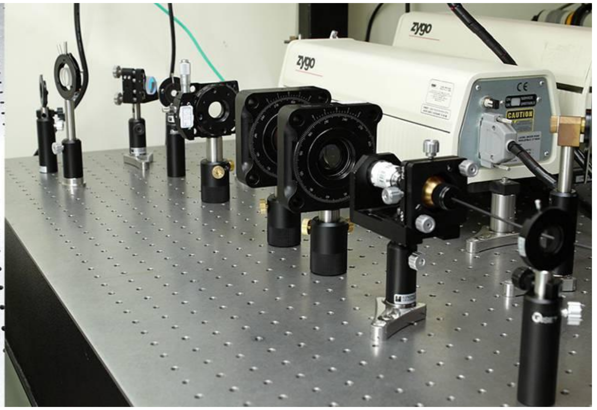

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進行物理模型演算及推導　同時做實驗應證自己理論的正確性
在醫學系畢業時以第一作者名義發表生涯第一篇生醫光電研究論文

Properties of a diffused photon-pair density wave in a multiple-scattering medium

Yi-Hsin Chan, Chien Chou, Jheng-Syong Wu, Hsiu-Fong Chang, and Hon-Fai Yau

A novel diffused photon-pair density wave (DPPDW) composed of correlated polarized photon pairs at different temporal frequencies and orthogonal linearly polarized states is proposed. A theory of DPPDWs is developed. A DPPDW selected by coherence gating and polarization gating that satisfies the diffusion equation has been verified experimentally. The sensitivity of amplitude and phase detection of the heterodyne signal has been improved by the properties of synchronized detection and common-path propagation of polarized pair photons in a multiple-scattering medium. Both reduced scattering coefficient μ_{2s}' and absorption coefficient μ_{2a} of the scattering medium in terms of the measured phase and amplitude of the heterodyne signal have been obtained. The detection sensitivity of μ_{2s}' and μ_{2a} and the properties of a DPPDW in a multiple-scattering medium are discussed and analyzed. © 2005 Optical Society of America

OCIS codes: 120.3180, 170.7050, 170.5270, 170.5280, 290.4210.

1. Introduction

Conventionally, to image an object in a scattering medium, one focuses on measurement of an absorption coefficient, such as with x-ray imaging based on the Beer–Lambert law.[1] This measurement results in a blurred image in a multiple-scattering medium in which the scattering effect is determined by a scattering coefficient. Generally this coefficient is absorbed into an effective absorption coefficient when the absorption coefficient is overcome to fit the Beer–Lambert law. However, in a multiple-scattering medium the scattering coefficient cannot be identified quantitatively by this approach. Deply *et al.*[2] developed a modified Beer–Lambert law, i.e., a direct time-of-flight method, for estimating the optical path length through tissue and for evaluating the optical properties of a multiple-scattering medium successfully. Welch and van Gemert[1] and Patterson *et al.*[3] proposed a time-resolved reflectance measurement in which they used a pulsed laser to determine absorption coefficient μ_a and reduced scattering coefficient μ_s' of a multiple-scattering medium by observing the time response of the laser pulse (4 ps). μ_a and μ_s' can be determined simultaneously by local time reflectance and the timing of the peak of the laser pulse's response.

In contrast, an intensity-modulated light source in the frequency domain produces diffused photon-density waves (DPDWs) in a multiple-scattering medium. A DPDW propagates spherically outward in a homogeneous multiple-scattering medium from a point source and satisfies the diffusion equation.[1,4,5] The phase delay and the attenuated demodulation amplitude of the DPDW have been measured.[1,5] An absorption coefficient and a reduced scattering coefficient can be obtained quantitatively by a DPDW. Therefore, one can determine correctly the absorption coefficient in the scattering medium without being influenced by the scattering effect. Besides, properties of a DPDW such as dispersion, diffraction, and interference have been studied.[4–6] Promising results have been observed.[7,8] Optical imaging in a clinical application based on a DPDW has been demonstrated successfully as well.[7]

In this paper we treat diffused photon-pair density waves (DPPDWs), with emphasis on the coherence properties of scattered polarized photon pairs (PPPs) propagating in a multiple-scattering medium.[9] The DPPDW proposed in this paper is generated by a Zeeman laser. It is composed of correlated PPPs with different temporal frequencies and orthogonal linearly polarized states. When a DPPDW propagates in a multiple-scattering medium, the scattered PPPs, which preserve the properties of spatial coherence and the degree of polarization, contribute an optical heterodyne signal. It is the coherence properties of the scattered PPPs propagating in a multiple-scattering medium that make it possible to measure the phase and the amplitude of a DPPDW by using a lock-in amplifier. In this paper the theory of the DPPDW is derived. Then the properties of a DPPDW in a multiple-scattering medium are measured. Finally, the theory of the DPPDW is verified and demonstrated by experiment.

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Received 20 December 2003; revised manuscript received 26 May 2004; accepted 3 November 2004.
0003-6935/05/081416-10$15.00/0

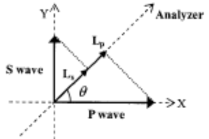

Fig. 1. Pair of parallel-polarized states (L_p, L_s) generated when P- and S-polarized waves are transmitted through an analyzer.

2. Theory

A pair of correlated orthogonal linearly polarized light waves, P and S waves, at temporal frequencies ω_1 and ω_2, respectively, is produced by a Zeeman laser. When the laser beam passes through an analyzer at a fixed azimuth angle (as shown in Fig. 1), the laser beam becomes a pair of parallel linearly polarized light waves (L_p and L_s). The light waves are heterodyned at the photodetector and then filtered by a bandpass filter whose central frequency is set at $\Delta\omega = \omega_1 - \omega_2$. Thus the heterodyne signal can be expressed as

$$I_{ac}(\Delta\omega t) = A_p A_s \gamma \sin 2\theta \cos(\Delta\omega t + \Delta\Phi), \qquad (1)$$

where A_p and A_s denote the amplitudes of the P- and S-polarized light waves, respectively. $\Delta\omega$ is the beat frequency of the pair of photons,[10,11] and $\Delta\Phi$ is the phase difference between the parallel polarized pair photons propagating in a multiple-scattering medium. γ denotes the optical heterodyne efficiency, which is characterized by $J_0(\alpha)$, a Bessel function of the first kind of zero order. α is the misaligned angle between two correlated polarized pair photons.[12] In a multiple-scattering medium, photon pairs, just like single photons, are scattered into a distributed angle in the medium. Therefore photon pairs scattered into a larger scattering angle would result in a lower heterodyne efficiency owing to degradation of the spatial coherence and the degree of polarization of the pair of photons. To derive the scattered polarized pair photons, which behave as DPDWs and satisfy the diffusion equation in a multiple-scattering medium in which the reduced scattering coefficient is larger than the absorption coefficient,[4–6] the time-dependent wave function $\tilde{\varphi}_j(r, t)$ of each polarized photon of the photon pair is assumed to be

$$\tilde{\varphi}_j(r, t) = \varphi_0\left[\frac{\exp(-k_r^j r)}{r}\right]^{1/2} \exp[i(k_i^j r - \omega_j t)]$$

$$(j = 1,\ 2), \qquad (2)$$

in which ω_j denotes the angular frequency of the jth polarized photon, k_r^j and k_i^j are the real and the imaginary parts, respectively, of the wave number of the jth polarized photon, and r is the distance between the source and the detector in the scattering medium. Therefore the output intensity of the optical heterodyne signal of the scattered PPP becomes

$$\begin{aligned} I(\Delta\omega t) &= |\tilde{\varphi}_1(r, t) + \tilde{\varphi}_2(r, t)|^2 \\ &= \varphi_0^2 \frac{\exp(-k_{2r} r)}{r} \cos(\Delta\omega t - \Delta\Phi) \\ &= \varphi_0^2 \frac{\exp(-k_{2r} r)}{r} \mathrm{Re}\{\exp[i(\Delta\omega t - \Delta\Phi)]\}, \qquad (3) \end{aligned}$$

where φ_0^2 is the radiant energy fluence rate of the DPPDW. Then

$$\Delta\Phi = [k_i^1(\omega_1) - k_i^2(\omega_2)] \times r, \qquad (4)$$

in which a phase difference between pair photons and $k_r^1 \simeq k_r^2 = k_{2r}$ is assumed. Equation (3) represents the heterodyne signal of the DPPDW that satisfies the diffusion equation.[5] To verify that a DPPDW can be converted into a continuous wave in a multiple-scattering medium, we replaced the Zeeman laser with a linearly polarized single-frequency laser such that the conditions $\omega_1 = \omega_2$, $k_i^1 = k_i^2 = k_{2i}$, and $k_r^1 = k_r^2 = k_{2r}$ are satisfied simultaneously. Hence the output intensity from Eq. (3) becomes $I_s = \varphi_0^2[\exp(-k_{2r} r)/r]$, which is similar to the result given by continuous-wave theory in the scattering medium. It is also identical to the dc component of the DPDW of the diffusion equation.[5] Thus

$$k_r^1 \simeq k_r^2 = k_{2r} = [3\mu_{2a}(\mu_{2s}' + \mu_{2a})]^{1/2} \qquad (5)$$

at zero beat frequency of the DPPDW when k_{2r} is defined as the real part of the wave number of the DPPDW. Based on the DPPDW, μ_{2s}' and μ_{2a} ($\mu_{2s}' \gg \mu_{2a}$) are defined as the reduced scattering coefficient and the absorption coefficient of a multiple-scattering medium, respectively.

Because there are many scattering events of PPPs in a multiple-scattering medium, the optical path of scattered PPPs traveling in the medium is different from the geometrical distance between the source and the detector. Most likely, the optical path of propagation of the scattered PPPs in the medium forms a banana shape in a reflection geometry.[13] According to the diffusion approximation, the average optical path length $\bar{r}$ of the continuous light wave traveling in a multiple-scattering medium[14,15] is

$$\bar{r} = \left(\frac{3\mu_{2s}'}{4\mu_{2a}}\right)^{1/2} \times r. \qquad (6)$$

Because two parallel-polarized photons of each photon pair behave similarly in the scattering medium, a common path of propagation of a pair of photons in the scattering medium is assumed. Therefore the average traveling distance of a photon pair becomes $\bar{r}$ in Eq. (4). Thus the phase difference between two parallel-polarized photons in the scattering medium becomes

$$\begin{aligned} \Delta\Phi &\simeq [k_i^1(\omega_1) - k_i^2(\omega_2)] \times \bar{r} \\ &= \frac{n\Delta\omega}{c}\left(\frac{3\mu_{2s}'}{4\mu_{2a}}\right)^{1/2} \times r \\ &= k_{2i} r, \qquad (7) \end{aligned}$$

$$k_{2i} = \frac{n\Delta\omega}{c}\left(\frac{3\mu_{2s}'}{4\mu_{2a}}\right)^{1/2}, \qquad (8)$$

$$\lambda_2 = \frac{2\pi}{k_{2i}} = \frac{2\pi c}{n\Delta\omega}\left(\frac{4\mu_{2a}}{3\mu_{2s}'}\right)^{1/2}, \qquad (9)$$

where k_{2i} is defined as the imaginary part of the wave number of the DPPDW, n is the refractive index of the scattering medium, c is the speed of light in vacuum, and λ_2 is the wavelength of the DPPDW. As a result, the phase velocity of the DPPDW becomes

$$V_{2p} = \frac{\Delta\omega}{k_{2i}} = \frac{c}{n}\left(\frac{4\mu_{2a}}{3\mu_{2s}'}\right)^{1/2}. \qquad (10)$$

This implies that the phase velocity of the DPPDW is independent of the beat frequency in the multiple-scattering medium. The phase velocity of the DPPDW is similar to that of a DPDW at a lower modulation frequency, whereas the phase velocity of the DPPDW is different from that of a DPDW at a higher modulation frequency (ω) where the phase velocity of the DPDW depends on $\sqrt{\omega}$.[5] In addition, Eq. (3) satisfies the diffusion equation at different beat frequencies, which yields a k_{2r} of Eq. (5) that is effective at different beat frequencies. Consequently the dispersion relations of both k_{2r} and k_{2i} of the DPPDW are different from those of the DPDW even though the two waves are similar at low modulation frequency. In addition, the DPPDW and the DPDW belong to the categories of optical interferometry and optical photometry, respectively. Thus the attenuation of the measured amplitude of the optical heterodyne signal from Eq. (3) is expressed by

Applied Optics 2006

在醫學系期間開發出生醫光電技術取得兩項美國技術專利

(12) **United States Patent**
Chou et al.

(10) **Patent No.:** **US 7,230,716 B2**
(45) **Date of Patent:** **Jun. 12, 2007**

(54) **METHOD FOR MEASURING THE ABSORPTION COEFFICIENT AND THE REDUCED SCATTERING COEFFICIENT OF A MULTIPLE SCATTERING MEDIUM**

(76) Inventors: **Chien Chou**, 5F, No. 37-3, Chuan-Yuan [illegible] Dist., Taipei City (TW); **Yi-Shin Chan**, 5F, No. 37-3, [illegible] Rd., Pei-Tou Dist., Taipei City (TW); **Jheng-Syong Wu**, 5F, No. 37-3, Chuan-Yuan Rd., Pei-Tou Dist., Taipei City (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 442 days.

(21) Appl. No.: **10/763,655**

(22) Filed: **Jan. 23, 2004**

(65) **Prior Publication Data**

US 2005/0162660 A1 Jul. 28, 2005

(51) **Int. Cl.**
G01B 9/02 (2006.01)

(52) **U.S. Cl.** **356/484**; 356/491

(58) **Field of Classification Search** 356/484, 356/485, 486, 487, 491, 492, 493
See application file for complete search history.

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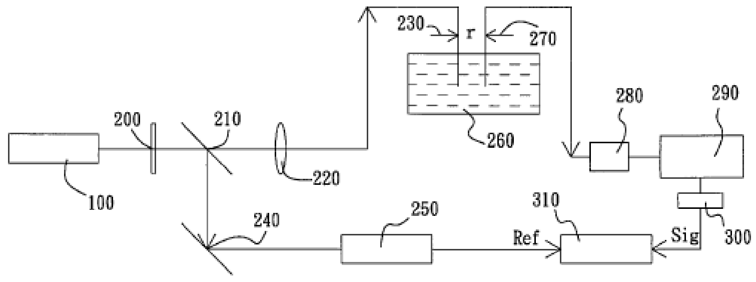
Primary Examiner—Gregory J. Toatley, Jr.
Assistant Examiner—Michael A. Lyons

(57) **ABSTRACT**

In a method for measuring absorption and reduced scattering coefficients of a multiple scattering medium, a coherent light beam is outputted. The coherent light beam includes linear polarized P and S wave components having mutually orthogonal polarizations and frequencies ωP and ωS, respectively. Then, the coherent light beam is split into a signal beam and a reference beam, which include the P wave and S wave components. The signal beam is subsequently projected into the medium. Optical interference signals of the reference beam and the signal beam penetrating the medium are respectively detected and converted into heterodyne interference electrical signals. Thereafter, the two heterodyne interference electrical signals are compared to obtain amplitude attenuation and phase delay of the signal beam penetrating the medium, from which the absorption and reduced scattering coefficients of the medium at a position where the signal beam penetrated the medium are inferred.

9 Claims, 6 Drawing Sheets



(12) **United States Patent**
Chou et al.

(10) **Patent No.:** **US 7,333,212 B2**
(45) **Date of Patent:** ***Feb. 19, 2008**

(54) **METHOD AND APPARATUS FOR MEASURING THE ABSORPTION COEFFICIENT AND THE REDUCED SCATTERING COEFFICIENT OF A MULTIPLE SCATTERING MEDIUM**

(75) Inventors: **Chien Chou**, 5F, No. 37-3, Chuan-Yuan [illegible] Dist., Taipei City (TW); **Yi-Shin Chan**, Taipei (TW); [illegible] Wu, Miao-Li Hsien (TW); **Li-Ping Yu**, Taipei (TW)

(73) Assignee: **Chien Chou**, Taipei (TW)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 221 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **11/250,685**

(22) Filed: **Oct. 14, 2005**

(65) **Prior Publication Data**

US 2006/0033928 A1 Feb. 16, 2006

Related U.S. Application Data

(63) Continuation-in-part of application No. 10/763,655, filed on Jan. 23, 2004, now Pat. No. 7,230,716.

(51) **Int. Cl.**
G01B 9/02 (2006.01)

(52) **U.S. Cl.** **356/484**; 356/491

(58) **Field of Classification Search** 356/484, 356/485, 486, 487, 491, 492, 493
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,428,447 A * 6/1995 Toida 356/601
6,526,298 B1 * 2/2003 Khalil et al. 600/310
7,230,716 B2 * 6/2007 Chou et al. 356/484

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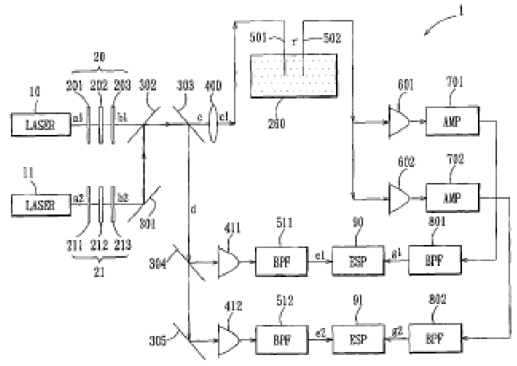
Primary Examiner—Michael A. Lyons

(57) **ABSTRACT**

In a method for measuring an absorption coefficient and a reduced scattering coefficient of a multiple scattering medium, a source light beam is outputted, and is transformed into a transformed light beam that includes a mutually parallel circularly polarized photon pair. The transformed light beam is split into a signal beam, which is focused and projected into the multiple scattering medium to produce a diffused polarized photon pair density wave, and a reference beam, which is converted into a reference heterodyne interference signal. The diffused polarized photon pair density wave is converted into a test heterodyne interference signal. Amplitude attenuation and phase delay of the signal beam that has propagated through the multiple scattering medium is obtained based on the reference and test heterodyne interference signals, from which the absorption coefficient and the reduced scattering coefficient of the multiple scattering medium are inferred.

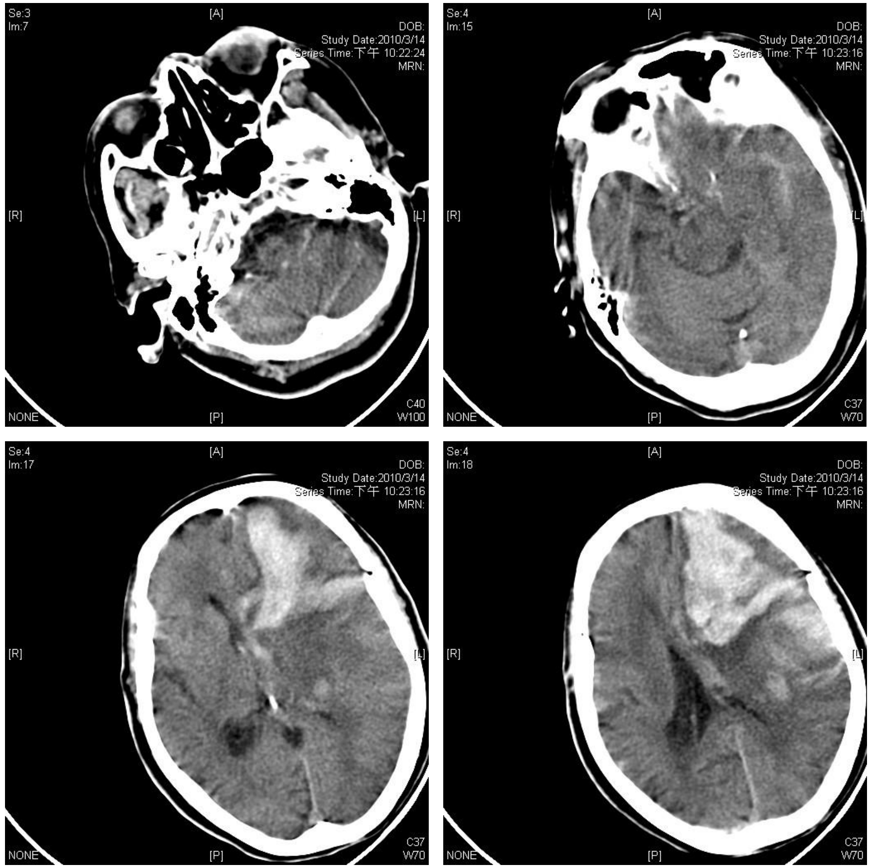
8 Claims, 7 Drawing Sheets



照顧的病人因抗凝血藥(warfarin)嚴重副作用而過世　下定決心朝此醫學領域奮戰

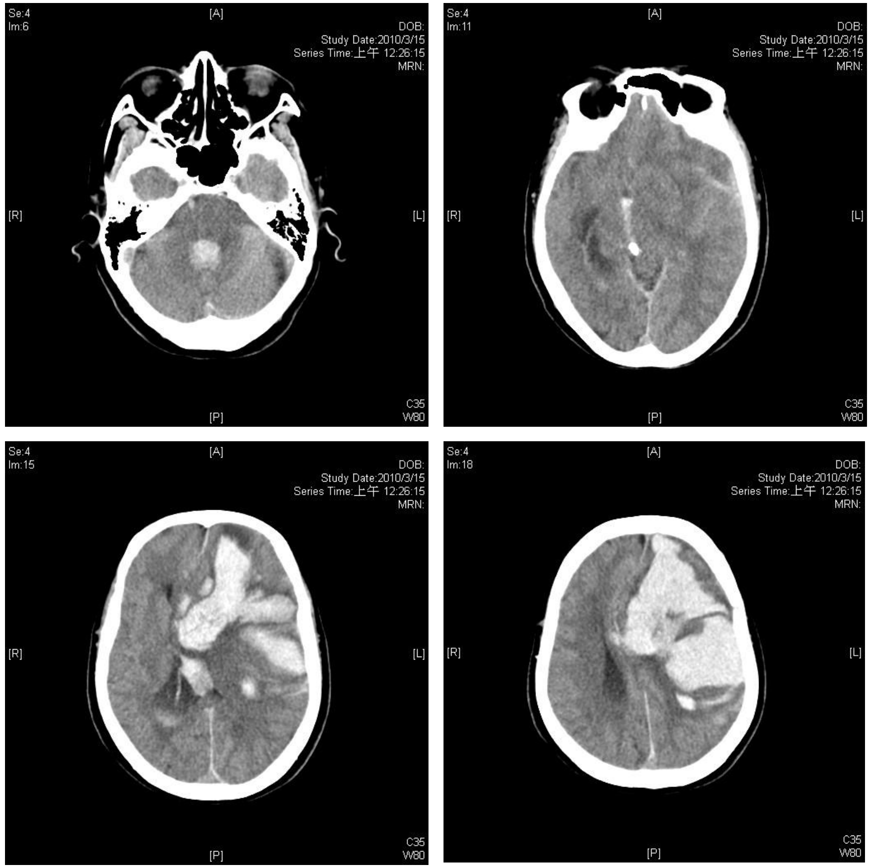
D1 in MER, INR=2.4

Vitamin K/FFP stat



D2 in ICU, INR=1.1

Still progression of ICH



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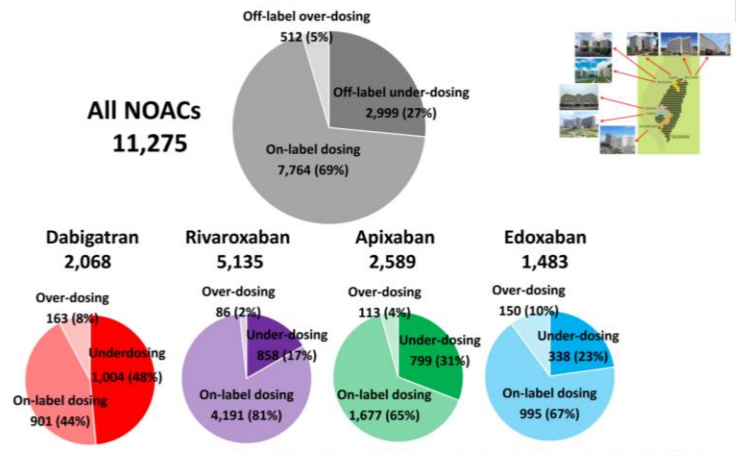
Proportions of different dosing groups of 4 NOACs in CGMH

The highest rate of on-label dosing was observed for rivaroxaban (81%), followed by edoxaban (67%), apixaban (65%) and dabigatran (44%).

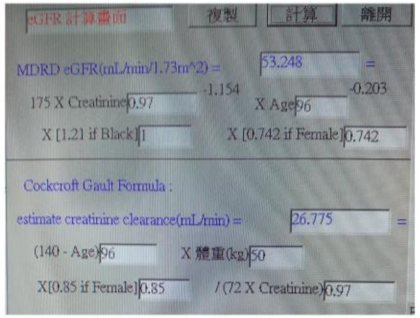


Chan YH and Chao TF*, Heart Rhythm 2020 Dec;17(12):2102-2110

The Modified Diet in Renal Disease (MDRD) based renal function estimation is automatically reported by most laboratories in clinical practice

But not for Cockcroft-Gault (CG) formula…….

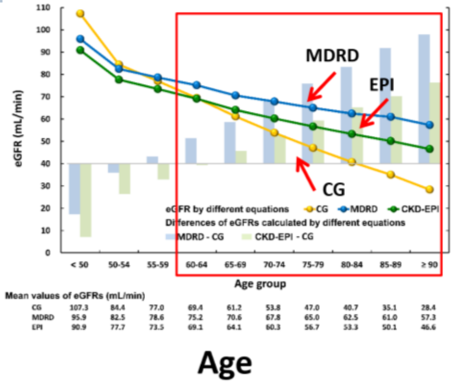
MDRD
53.2



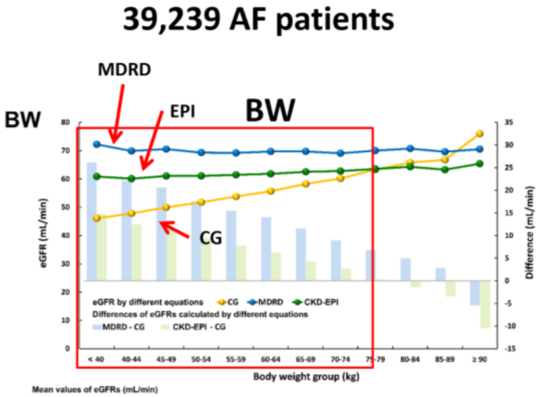
CG
26.8

Mean eGFRs and the differences between three equations in different age and BW strata

39,239 AF patients



Mean values of eGFRs (mL/min)	< 50	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85-89	≥ 90
CG	107.3	84.4	77.0	69.4	61.2	53.8	47.0	40.7	35.1	28.4
MDRD	95.9	82.5	78.6	75.2	70.6	67.8	65.0	62.5	61.0	57.3
EPI	90.9	77.7	73.5	69.1	64.1	60.3	56.7	53.3	50.1	46.6



Chan YH, Chao TF et al. JACC 2020 Oct 13;76(15):1808-1810

Only patients whose dosages of NOACs were "truly on-label" based on CG were associated with a lower risk of major bleeding compared to warfarin

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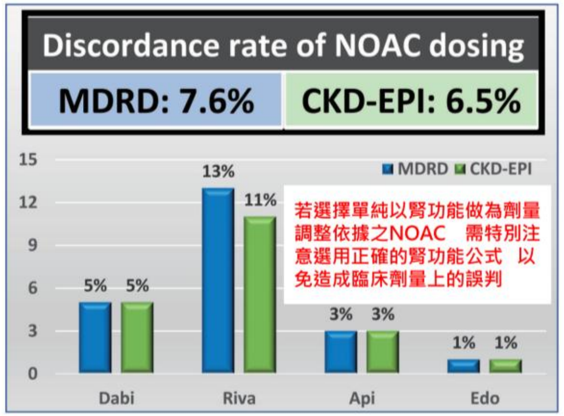

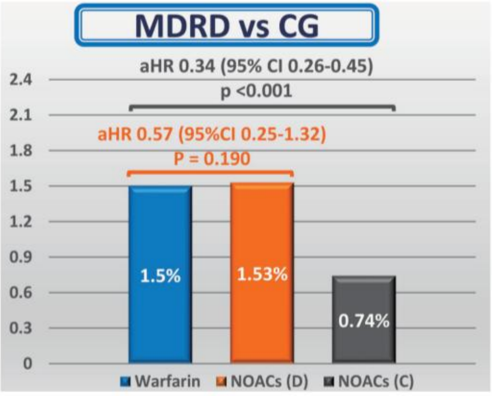

Chan YH and Chao TF. JACC: Asia. 2022 Feb, 2 (1) 46–58

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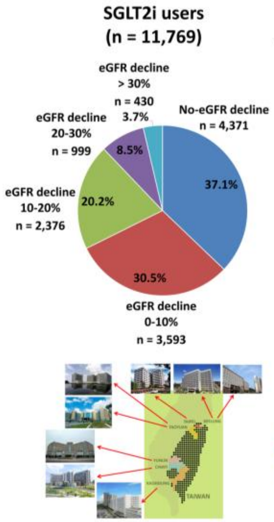
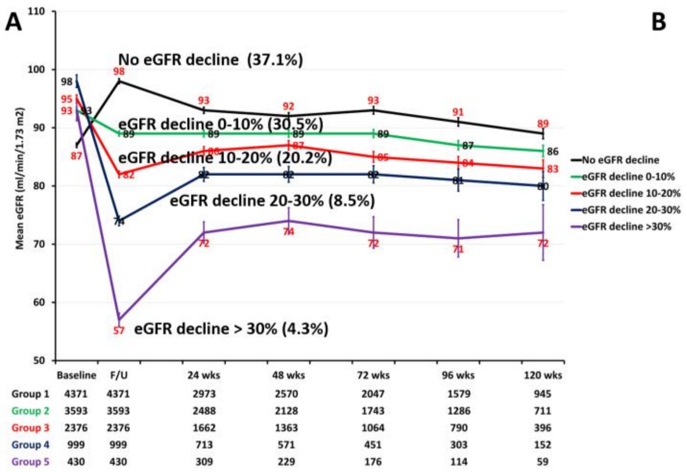
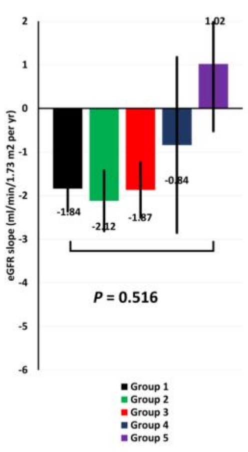
可以立即應用在病患的照護上　改善病患照護品質

病患使用SGLT2抑制劑後一般急性eGFR會下降2-3ml之後腎功能則長期穩定　但臨床觀察顯示約5%病人會發生急性eGFR大幅掉落(>30%)現象　若能釐清病患使用SGLT2抑制劑後發生eGFR大幅下降之可能危險因子或相關藥物　可改善病患用藥安全性

The mean eGFR remained stable from 6 months onward in all eGFR decline categories as well as in the subset with a pronounce eGFR dip of >30%



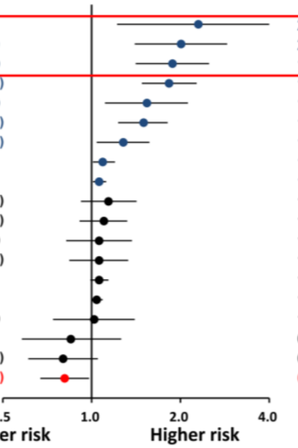




Chan YH, Chao TF et al., Diabetes Obes Metab. 2021 Sep;23(9):2077-2089.

Predictive baseline factors for a pronounced eGFR dip of >30% following SGLT2i treatment

	n/N (%) <30% decline	n/N (%) >30% decline	OR	95%CI	P value
Use of Thiazide	76/11339 (1)	10/430 (2)	2.30	[1.22-4.34]	0.010
Use of MRA	384/11339 (3)	49/430 (11)	2.01	[1.40-2.88]	<.001
Use of loop diuretics	877/11339 (8)	93/430 (22)	1.88	[1.41-2.50]	<.001
Use of insulin	1875/11339 (17)	133/430 (31)	1.83	[1.48-2.27]	<.001
Stroke	585/11339 (5)	43/430 (10)	1.54	[1.11-2.12]	0.009
Female	4633/11339 (41)	219/320 (51)	1.50	[1.23-1.81]	<.001
BMI < 25 kg/m^2	2953/11339 (26)	141/430 (33)	1.28	[1.04-1.57]	0.022
Age (per 10 y/o)	-	-	1.09	[1.01-1.20]	0.048
HbA1c (per 1%)	-	-	1.06	[1.01-1.12]	0.025
Use of ACEI/ARB/ARNI	6931/11339 (61)	293/430 (68)	1.14	[0.92-1.42]	0.222
High-dose SGLT2i	5755/11339 (51)	228/430 (53)	1.10	[0.91-1.32]	0.349
eGFR < 60 ml/min/1.73 m^2	1452/11339 (13)	86/430 (20)	1.06	[0.82-1.37]	0.675
Use of TZD	2749/11339 (24)	101/430 (23)	1.06	[0.84-1.33]	0.619
Heart rate (per 10 BPM)	-	-	1.06	[0.99-1.14]	0.089
SBP (per 10mmHg)	-	-	1.04	[1.00-1.09]	0.071
Gout	1152/11339 (10)	42/430 (10)	1.02	[0.74-1.40]	0.920
Congestive heart failure	520/11339 (5)	39/430 (9)	0.85	[0.58-1.26]	0.430
Use of metformin	10171/11339 (90)	358/430 (83)	0.80	[0.61-1.05]	0.107
Use of statin	6835/11339 (60)	250/430 (58)	0.81	[0.67-0.98]	0.031

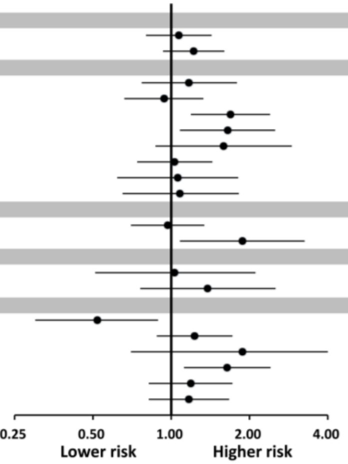


Chan YH Chao TF et al., Diabetes Obes Metab. 2021 Sep;23(9):2077-2089.

The Association of Background Medications on Initial eGFR Change (>30% dip) in Diabetic Patients Receiving SGLT2 Inhibitor

CJASN
Clinical Journal of American Society of Nephrology

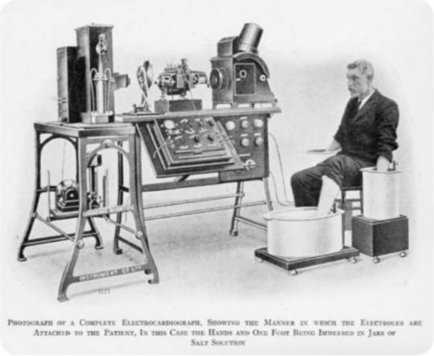
	n with event/N analyzed		HR	95% CI
SGLT2i				
Empagliflozin vs. Dapagliflozin	92/4008	86/4008	1.07	[0.80-1.43]
SGLT2i high dose vs. low dose	117/4378	97/4378	1.22	[0.93-1.60]
Cardiovascular drug				
RAS inhibitor (+) vs. (-)	48/2073	39/2073	1.17	[0.77-1.79]
Calcium channel blocker (+) vs. (-)	71/1695	68/1695	0.94	[0.66-1.33]
Thiazide diuretics (+) vs. (-)	83/1764	50/1764	1.69	[1.19-2.40]
Loop diuretics (+) vs.(-)	57/708	35/708	1.65	[1.08-2.51]
Mineralocorticoid receptor antagonist (+) vs. (-)	28/334	17/334	1.59	[0.87-2.91]
Beta blocker (+) vs. (-)	69/2370	67/2370	1.03	[0.74-1.44]
Vasodilator (+) vs. (-)	27/628	26/628	1.06	[0.62-1.81]
NSAIDs (+) vs. (-)	30/1118	28/1118	1.08	[0.65-1.82]
Lipid-lowering drug				
Statin (+) vs. (-)	73/2771	73/2771	0.97	[0.70-1.34]
Fenofibrate (+) vs. (-)	38/1043	19/1043	1.88	[1.08-3.26]
Urate-lowering drug				
Xanthine oxidase inhibitor (+) vs. (-)	15/264	15/264	1.03	[0.51-2.11]
Uricosuric agent (+) vs. (-)	26/466	18/466	1.38	[0.76-2.52]
Anti-diabetic drug				
Metformin (+) vs. (-)	20/827	38/827	0.52	[0.30-0.89]
Sulfonyurea (+) vs. (-)	77/2908	64/2908	1.23	[0.88-1.72]
Glinide (+) vs. (-)	12/332	6/332	1.88	[0.70-5.01]
Insulin (+) vs. (-)	67/1656	43/1656	1.64	[1.12-2.41]
TZD (+) vs. (-)	62/2537	52/2537	1.19	[0.82-1.72]
Acarbose (+) vs. (-)	65/2204	58/2204	1.17	[0.82-1.67]

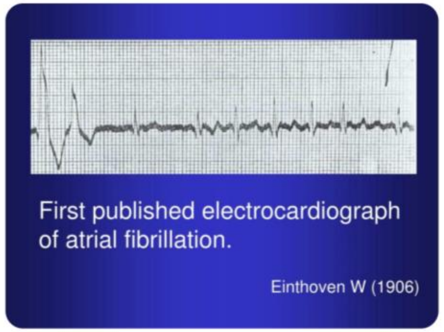


Chan YH*, Chao TF* et al., Clin J Am Soc Nephrol. 2023 Mar 31;18(7):858-68.

研究發表是將個人理念傳承給後世的最佳載體
文字有魔力，它能讓思想穿越死亡，在百年後重新綻放
當我讀到那些前輩的洞察時，我感受到他們的存在依然鮮活

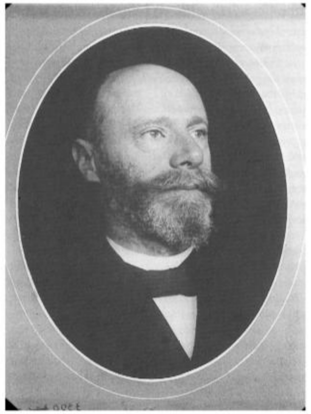
1906　心電圖診斷心房顫動





1906 心電圖發明

Einthoven W



1775 心臟用藥毛地黃

William Withering

Fig. 4. William Withering, discoverer of the medicinal use of digitalis, in 1775.

1909　科學文獻描述心房顫動

REPORT CXIX.

AURICULAR FIBRILLATION: A COMMON CLINICAL CONDITION.*

BY THOMAS LEWIS, M.D.LOND., D.SC.WALES.

(From the Research Laboratories of University College Medical School.)

[*A Preliminary Communication.*]

IT is well known that in the late stages of mitral stenosis, and in cases of general cardio-vascular degeneration, the pulse is frequently continuously and extremely irregular. The type of irregularity is remarkable in that in radial and cardiographic curves it defies analysis. The nature of the arterial curves has given rise to the term *pulsus irregularis perpetuus*, and it has been supposed that the rhythm of the heart producing it has its origin in the node of Tawara (hence the term "nodal rhythm"). The condition is extremely common.

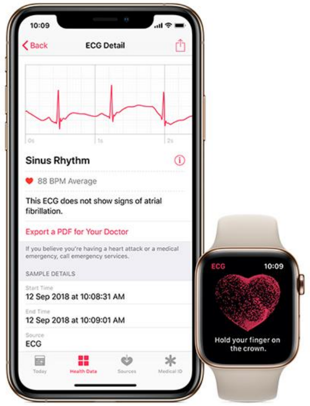
Facts are now at my disposal permitting of two conclusions:

I. That a rhythm arising in the neighbourhood of the node gives rise to a totally different clinical picture. This conclusion is based upon a detailed examination (polygraphic and electrocardiographic) of a case of paroxysmal tachycardia, in which it can be demonstrated that auricle

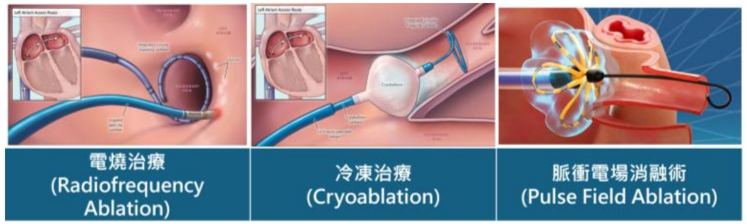
* The expenses connected with this work have been defrayed by grants from the British Medical Association and the Royal Society.

Lewis. BMJ. 2, 1528 (1909).

2025 APPLE WATCH 診斷心房顫動



2025　心房顫動治療



醫學系八大專業核心能力

(一) 病人照護與臨床技能
(Patient Care and Clinical Skills)

(二) 醫學知識
(Medical Knowledge)

(三) 自我學習與改進
(Practice-Based Learning and Improvement)

(四) 人際關係及溝通技巧
(Interpersonal and Communication Skills)

(五) 專業素養及倫理
(Professionalism)

(六) 制度下之醫療工作
(System-Based Practice)

(七) 生物醫學研究
(Bio-Medical Research)

(八) 人文與社會關懷
(Humanities and Social Care)

醫學生參與研究

選修生命科學研究

參與實驗室或研究計畫

大專生研究計畫與論文投稿與通過

四下醫學論文寫作必修(研究計畫或論文初探)

五下醫學論文寫作必修(研究計畫或論文參與)

醫師科學家
(MD-PhD)
培育計畫

醫師科學家(MD-PhD)培育計畫

- 培育醫學生研究創新的能力，以獲得醫學士-理學博士(MD-PhD)雙學位為具體目標。
- 修業年限：從正式進入該學程起比照該研究所碩士或博士修業年限辦理。
- 每學期皆有辦理招生甄選

招生說明會	每學期 第 2 週
招生報名	每學期 第 3~4 週
面試	每學期 第 6、7 週

- 相關資訊請洽醫學系網頁公告
- 窗口：醫學系辦公室陳小姐
  03-211-8800#5108 /chen1304@mail.cgu.edu.tw

第一階段

修習「生命科學研究」至少1 學分，並得進入指導教授實驗室，參與研究實習

第二階段

修畢一至四年級共128 學分後，考入本校研究所。

第三階段

獲得碩士或博士學位後回歸醫學系，完成後續課程及臨床訓練，獲得醫學士學位。

生命科學研究課程簡介

教學目標 & 教學方法

- 藉由**進入老師實驗室，動手做實驗**，與老師討論實驗的設計與執行，提高學生日後參與研究的興趣。

- 以各實驗室的老師為主要指導者、實驗室內的研究生為協助者，共同指導學生。學生可於寒暑假或學期中至老師實驗室學習及討論，**以培養醫學生主動尋找資料、訓練邏輯思考，以及訓練獨立解決問題的能力。**

研究領域 & 修課規定

- 包括醫學(含人文、哲學)、工學、管理和人工智慧。

- 課程以選修「生命科學研究」方式施行之，每一學期一學分。
  本課程不實施考試，學生每月需填寫簡易進度報告內容，學期末必須繳交報告一份，以提升對研究內容的了解。

修課步驟

1. 探索研究領域及指導教授
2. 填寫及繳交指導教授同意書
3. 參與研究論文閱讀、實作等
4. 繳交期末報告

1 探索研究領域及指導教授

路徑：醫學系首頁https://www.cgu.edu.tw/med/>教學研究>生命科學研究>指導老師相關研究領域

醫學系生命科學研究課程 指導老師 研究領域列表　　更新日：114/03/18

*此為近年有意願、或實際擔任指導老師之清單，僅供參考。

*長庚體系(大學、醫院)老師皆可當任本課程之指導老師。

	老師	分類	研究方向/研究專長	老師單位	老師MAIL
1	吳明忠	工程醫學	新世代太陽能電池、氫能材料與系統製造、拓樸材料與能帶理論計算、光電奈米元件開發	化工與材料工程學系	mingchungwu@mail.cgu.edu.tw
2	陳志平	工程醫學	生醫工程與生化工程、生醫材料、藥物輸送、組織工程、奈米醫學	化工與材料工程學系	jpchen@mail.cgu.edu.tw
3	陳祥和	工程醫學	生物力學、人因工程、醫材設計與測試	生物醫學工程學系	hchen@mail.cgu.edu.tw
4	吳旻憲	工程醫學	組織工程、微流體生物晶片技術、循環腫瘤細胞、創意醫材開發	生物醫學工程研究所	mhwu@mail.cgu.edu.tw
5	陳仁暉	工程醫學	多媒體、電腦視覺、物聯網、金融科技、知識圖、醫學影像	資訊工程學系	jhchen@gap.cgu.edu.tw
6	詹美齡	工程醫學	輻射偵檢成像、質子PET、康普吞相機、PET/SPECT/CT儀器、輻射成像處理	放射醫學研究中心	mljan@mail.cgu.edu.tw

2 填寫及繳交指導教授同意書

一、路徑：

1.醫學系首頁https://www.cgu.edu.tw/med/>教學研究>生命科學研究>學期課程時程表

2.修課後，至「E-Learning/生命科學研究課程:課程公告」

二、下載同意書，經由指導教授簽名後，逕送醫學系辦公室存檔

3 參與研究論文閱讀、實作等

4 繳交期末報告

一、路徑：

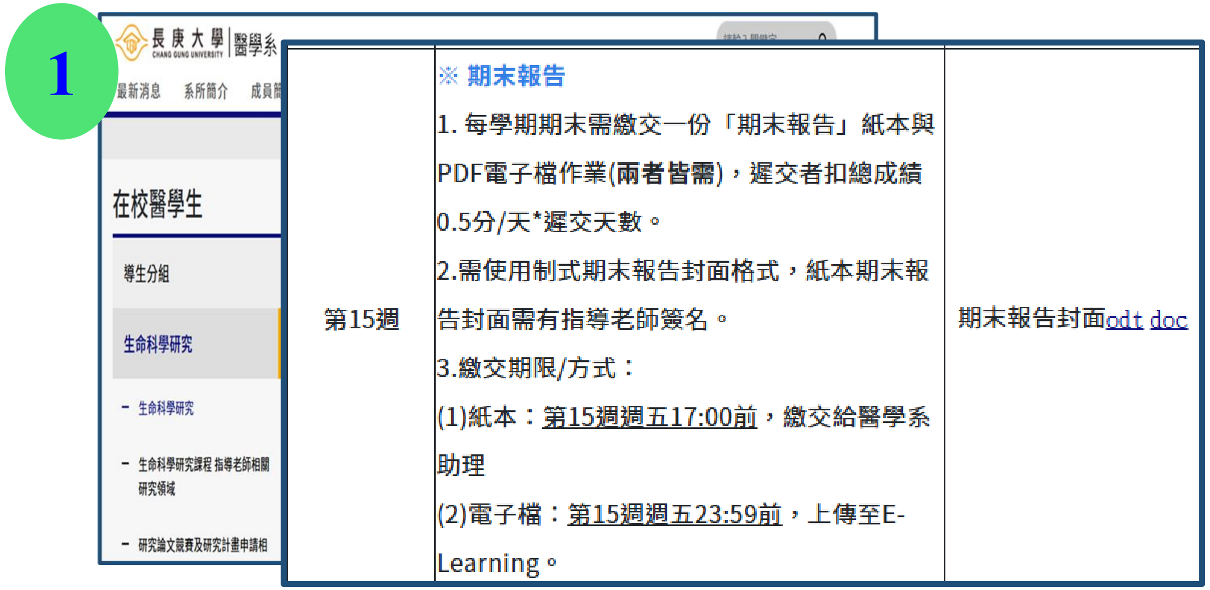
1.醫學系首頁https://www.cgu.edu.tw/med/>教學研究>生命科學研究>學期課程時程表

2.修課後，至「E-Learning/生命科學研究課程:課程公告」

二、撰寫格式可參考「報告範本」，完成期末報告後，須經指導教授簽名，

需同時繳交紙本、電子檔報告。

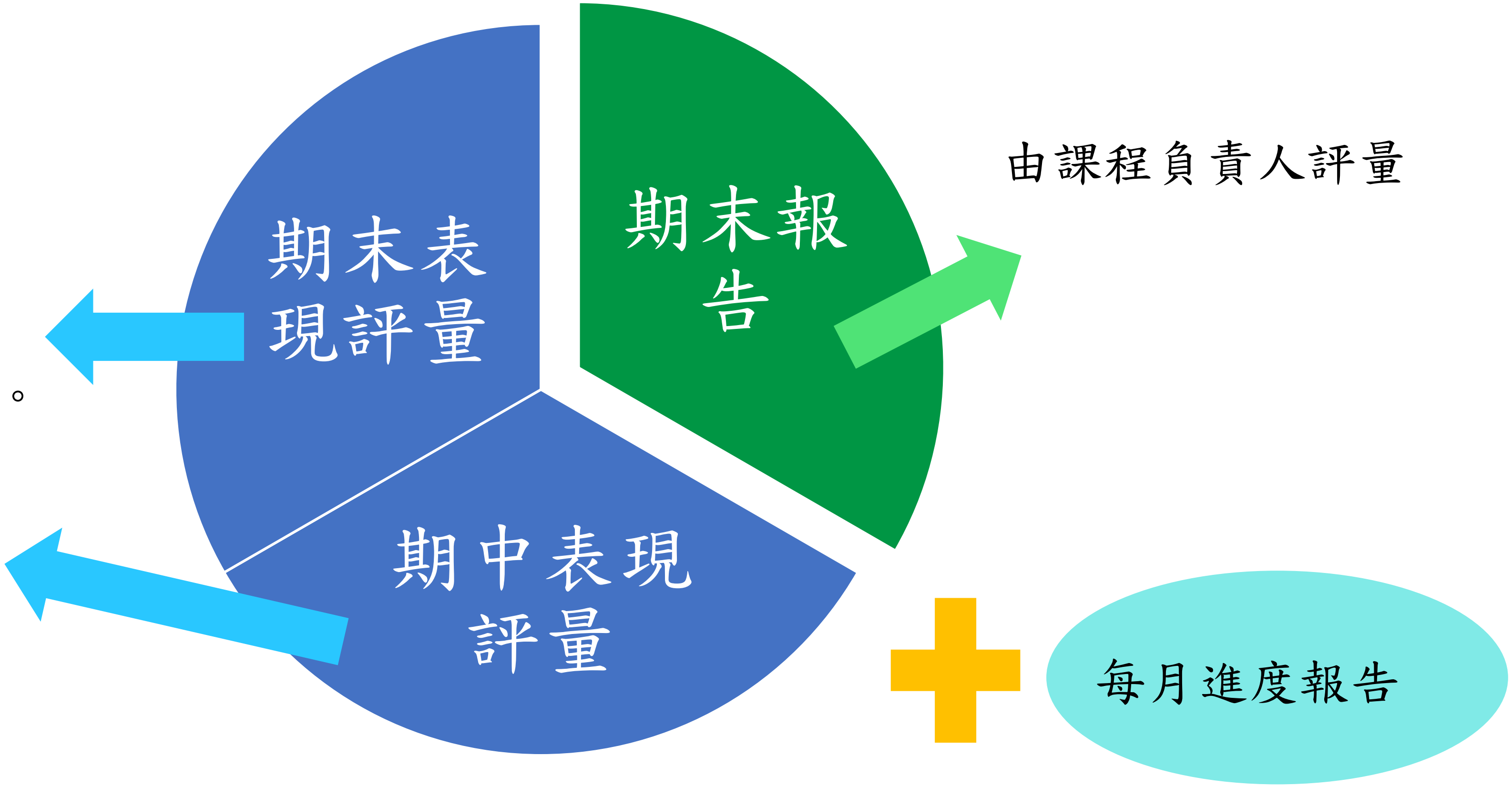
紙本報告繳交至醫學系辦公室、電子檔上傳至E-learning系統



課程成績計算方式

1.**期中、期末表現評量**及**期末報告**，三項分數之平均。
2.每月進度報告填報之加分。

由指導老師依據參與頻率、學習與工作態度、操作技巧、數據記錄、人際關係、研究成果…等進行評量。



其他–假期修課辦法

為鼓勵醫學生於寒暑假期間進入本校生物醫學相關實驗室研究，若學生可以於寒暑假期間(包含一些學期間的時間亦可)進入實驗室學習，每週多於20小時並且達3週以上；或是寒暑假加上部份學期內時間總計達60小時以上者，得於接下來的學期，選修並獲得這一門課的學分。

申請假期修課資料如下：

1.**指導教授同意書**
（修課／研究前繳交，同意書請至醫學系－教學研究下載）

2.**研究時數表**
（研究結束後繳交，需請指導教授簽名）

3.**報告**
（研究結束後繳交，報告封面請至醫學系－教學研究下載）

其他-研究論文競賽

國科會「大專生專題研究計畫」

每位學生每月補助研究助學金新臺幣6,000元，八個月計新臺幣48,000元

財團法人臺灣醫學發展基金會論文獎

具在學資格之醫學系學生從事學術研究，經老師推薦參選，獎勵方式設「特優」1名、「優等」至多3名、「佳作」至多5名，除發給獎牌，另有優渥獎金。

健康科學文教基金會論文獎

- 醫學系二年級以上在學生
- 研究計畫執行期間：每年七月一日起至同年九月三十日止
- 提交研究書面報告

補助金:

(1)學生依參與研究時程，每名每月新台幣 7,000元整。

(2)每年11月舉行口頭報告(英文)，前三名優良研究報告者核發獎狀及獎金；
冠軍新台幣 30,000元
亞軍新台幣 20,000元
季軍新台幣 10,000元

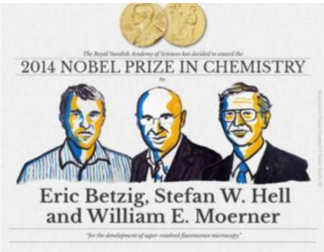
我們不只是在教授知識，而是在培養有溫度的科學家

人有溫度及熱情，AI則沒有

在實驗室重複實驗的執著，來自對生命的敬重

不知道怎麼做研究怎麼辦　加入就對了　不做怎麼知道呢

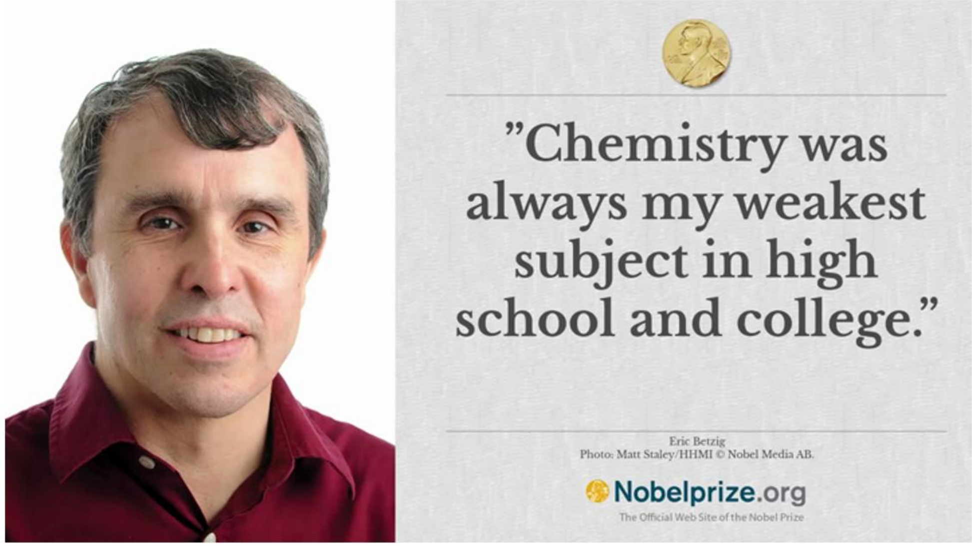
Nobel Prize in Chemistry in 2014
"for the development of super-resolved fluorescence microscopy"



Stefan W. Hell
1962-

Eric Betzig
1960-

William E. Moerner
1953-



Eric Betzig

2014諾貝爾化學獎

高中跟大學階段
化學是我最不在行的學科

~歡迎加入長庚基礎臨床研究體系大家庭~