Widmo światła i jego pomiary.

Fale niemonochromatyczne

Zasada superpozycji:

Jeśli $u_i\left(\vec{r},t\right)$ są rozwiązaniami równania falowego, to $\sum_i u_i\left(\vec{r},t\right)$ również jest rozwiązaniem tego równania.

Każde pole $u_i\left(\vec{r},t\right)$ można zapisać jako superpozycję fal monochromatycznych

$$U\left(\vec{r},\omega\right)=\int_{-\infty}^{+\infty} u\left(\vec{r},t\right)e^{-i\omega t}dt$$

$$u\left(\vec{r},t\right)=\int_{-\infty}^{+\infty} U\left(\vec{r},\omega\right)e^{i\omega t}d\omega$$

Fale niemonochromatyczne - przykłady

Superpozycja płaskich fal monochromatycznych – impuls światła

$$U(\vec{r},t)=\int_0^\infty A(\omega)e^{-ikz}e^{i\omega t}d\omega \underset{k=\omega/c}{=} \int_0^\infty A(\omega)e^{i\omega\left(t-\frac{z}{c}\right)}d\omega$$

$$U(\vec{r},t)=f\left(t-\frac{z}{c}\right)\quad,\quad f(x)=\int_0^\infty A(\omega)e^{i\omega x}dx$$

$t=0$ $\qquad$ $t=\tau$

paczka falowa

uwaga na $n(\omega)$

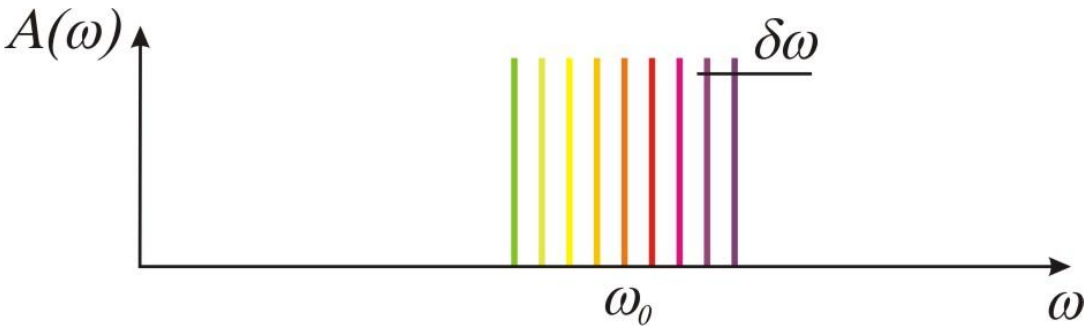
Fale niemonochromatyczne – przykłady

Superpozycja M fal monochromatycznych w czasie –
– synchronizacja modów (*mode-locking*)

$$\omega_n = \omega_0 + n\delta\omega$$

$$n = -L, -L+1, \ldots, L-1, L$$

$$M = 2L+1$$



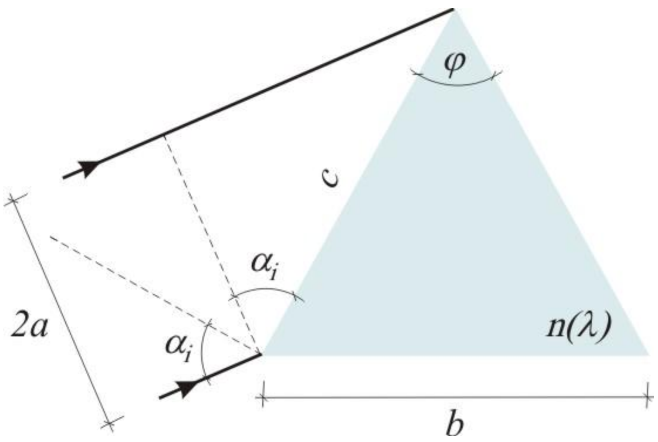
pomijamy zależność od **r**

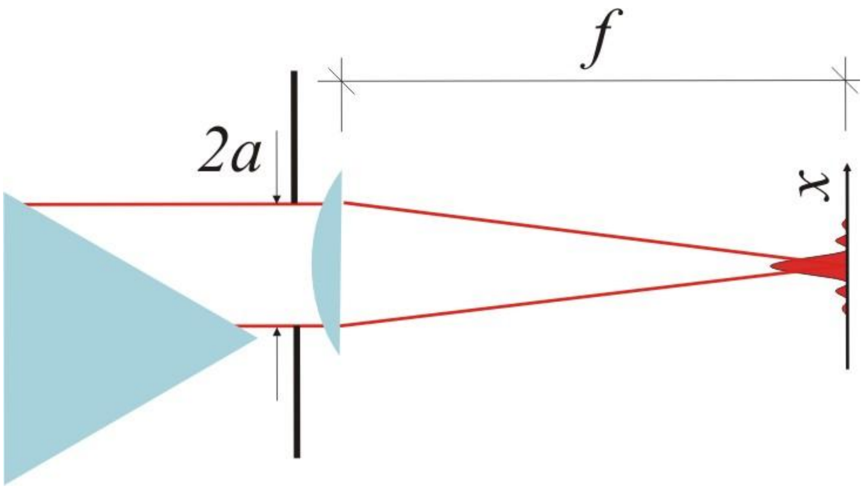
$$U(t) = \sum_{n=-L}^{L} \sqrt{I_0} e^{i(\omega_0 + n\delta\omega)t} = \sqrt{I_0} e^{i\omega_0 t} \sum_{n=-L}^{L} \left[e^{i\delta\omega t} \right]^n$$

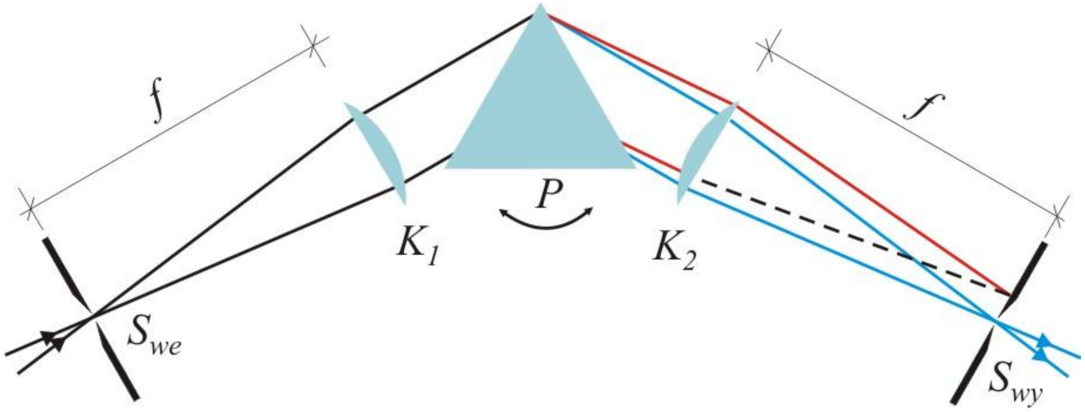
szereg geometryczny

$$I(t) = |U(t)|^2 = I_0 \left[\frac{\sin(M\delta\omega t)}{\sin(\delta\omega t)} \right]^2$$

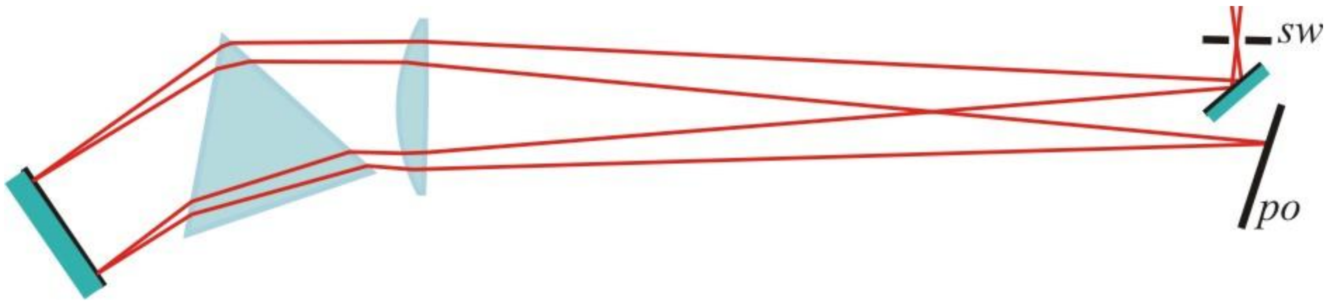
Monochromator pryzmatyczny

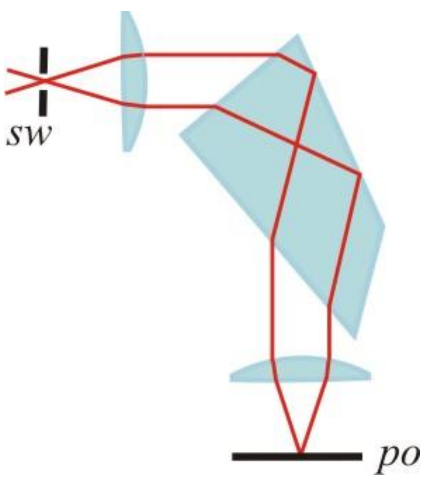


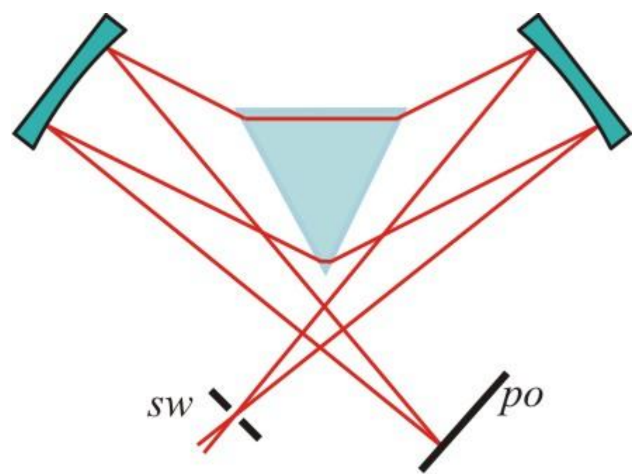




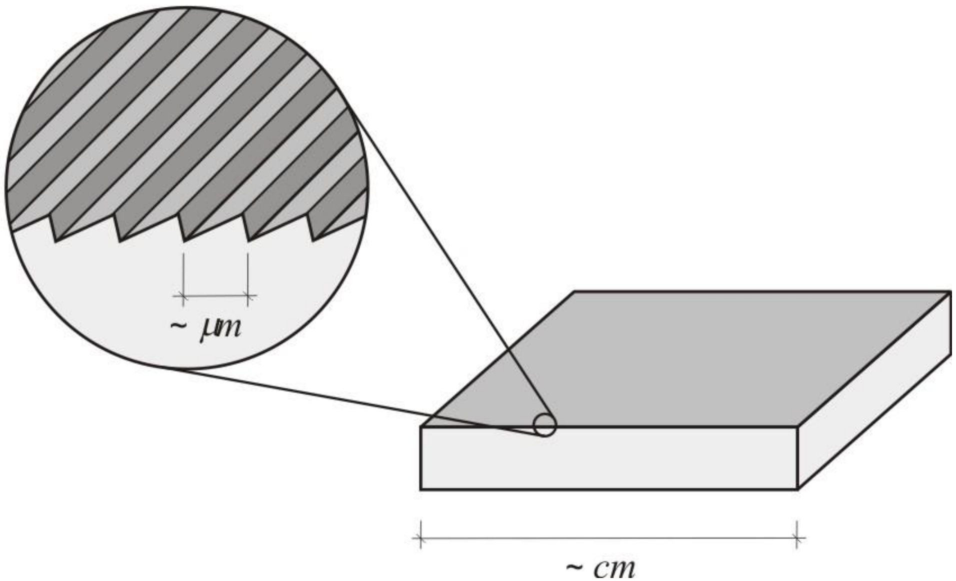
Spektrometry – przykłady realizacji

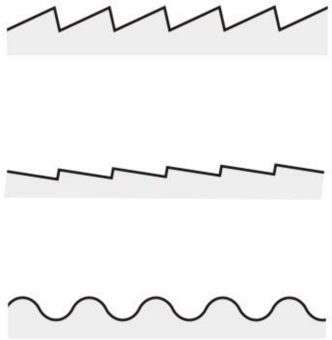






Odbiciowa siatka dyfrakcyjna





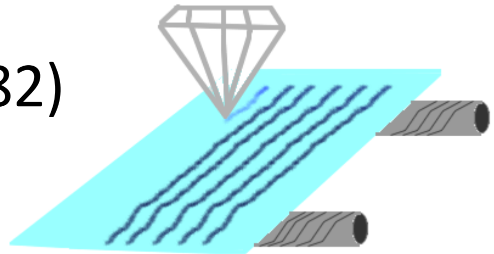
Parametry:

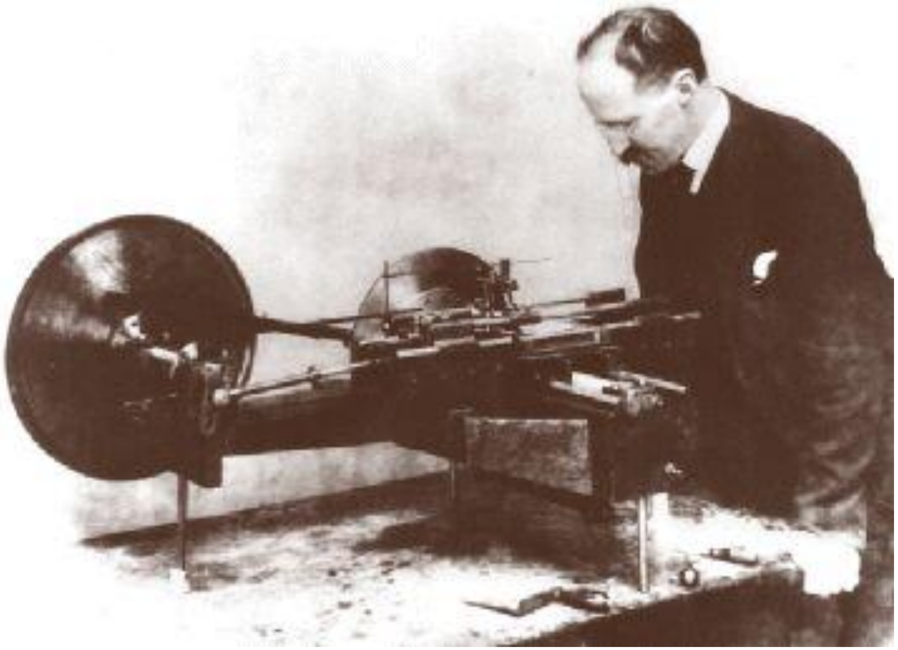
- rozmiary siatki,
- liczba linii (rys) / mm (najczęściej kilkaset – kilka tysięcy),
- profil rys,
- wydajność, *blazing*

Siatki dyfrakcyjne - technologia

Siatki nacinane

H. Rowland (1882)



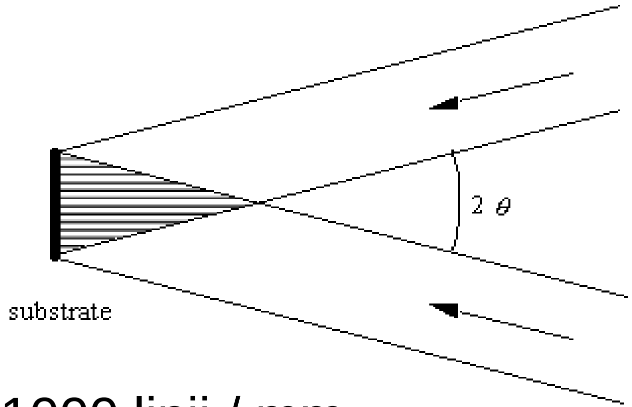


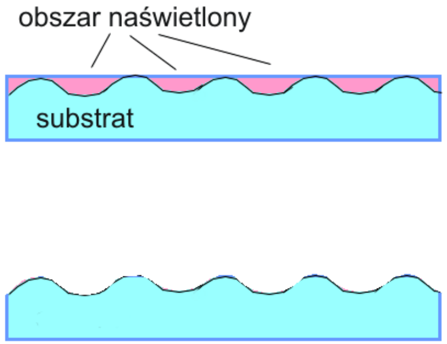
Do 4 700 linii / mm

repliki

Siatki holograficzne

lata 1960'

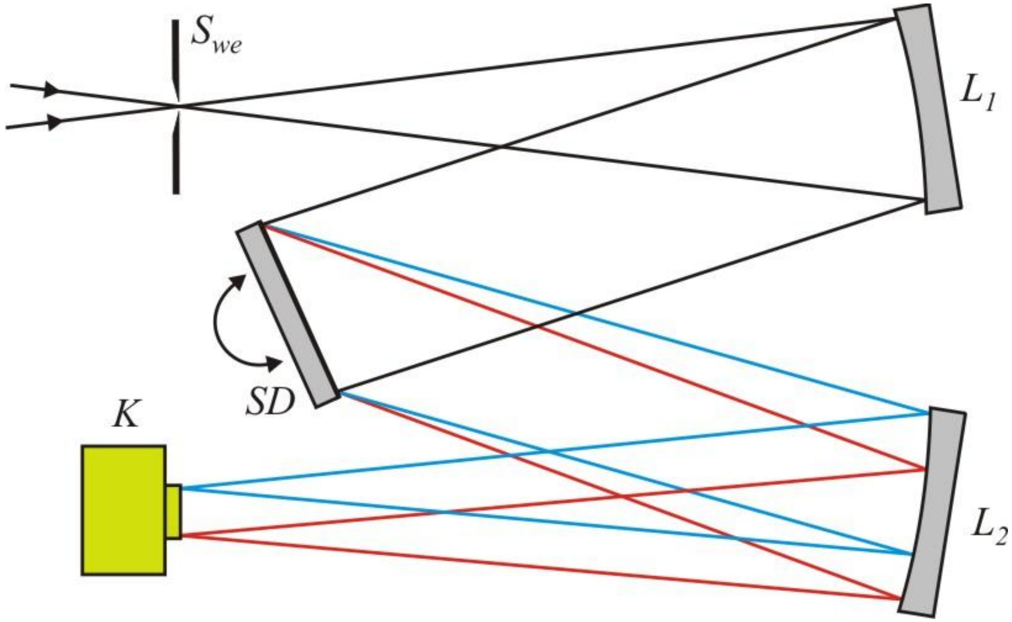


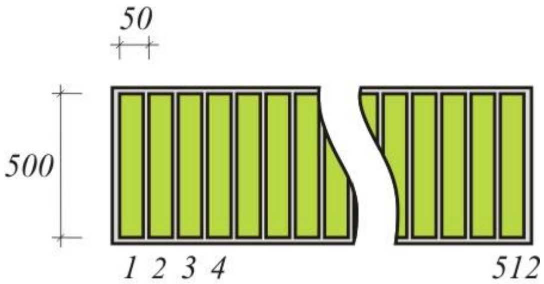


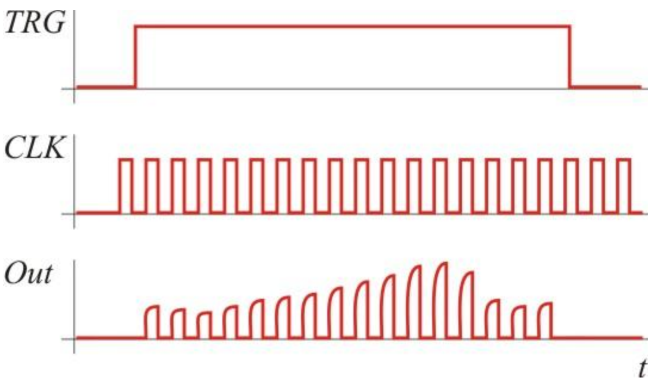
Do ok. 1000 linii / mm

Spektrometr siatkowy z kamerą CCD

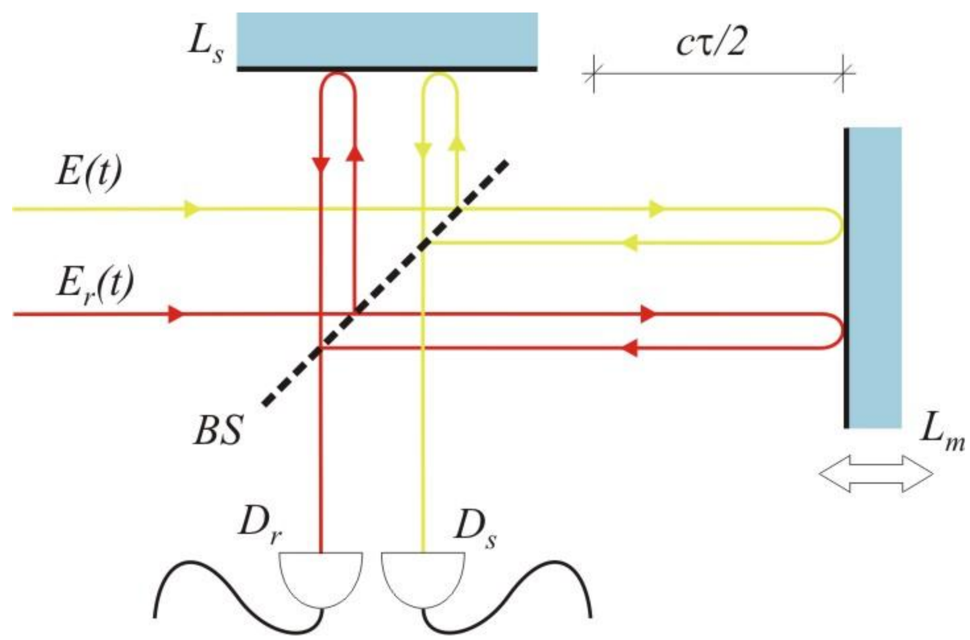
- kolimatory zwierciadlane
  (aberracje chromatyczne)
- nastawna siatka
  (często kilka siatek),
- kamera CCD
  (Si, GaAs, kilkaset pikseli),
- czułość,
- rozproszenia



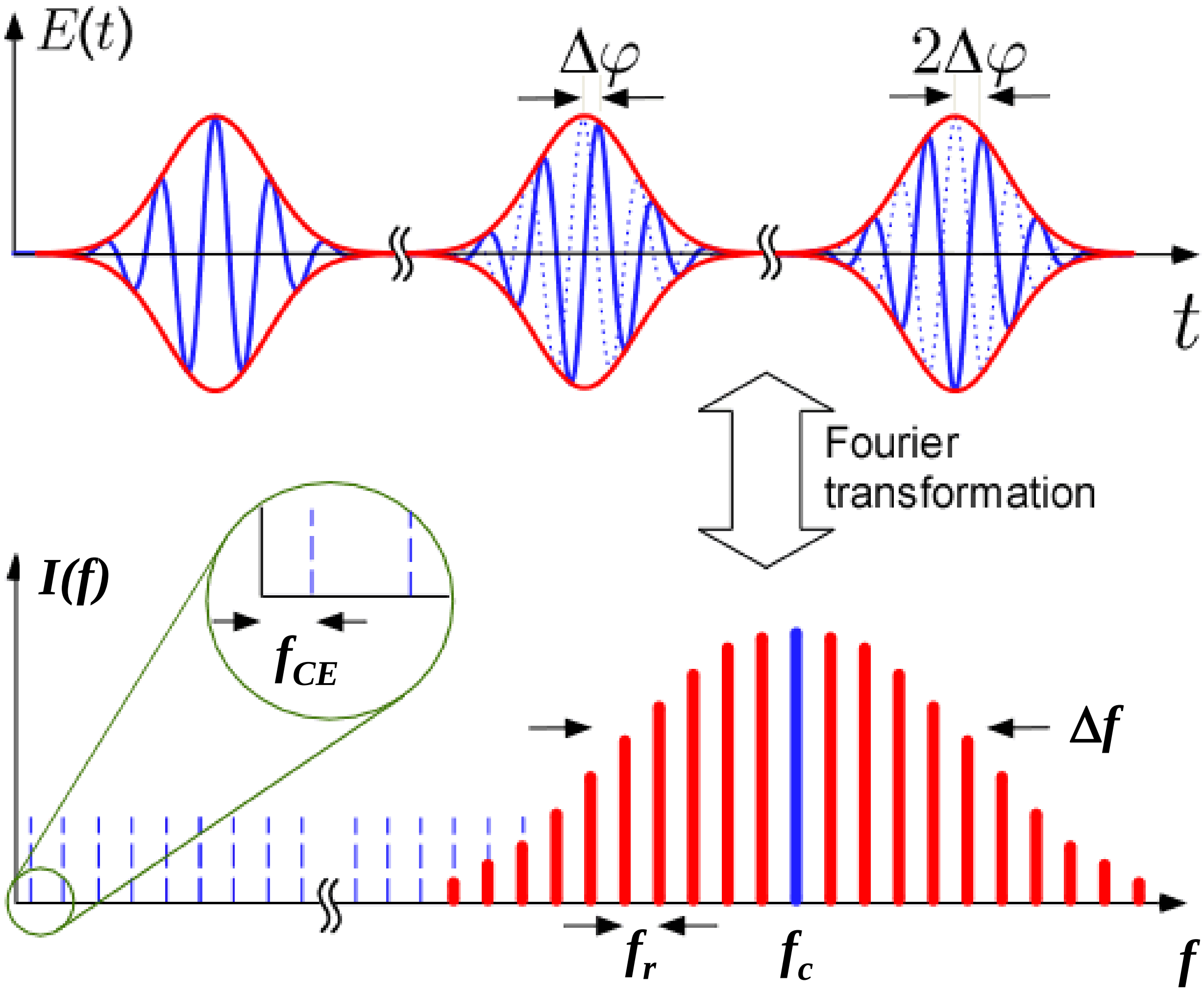




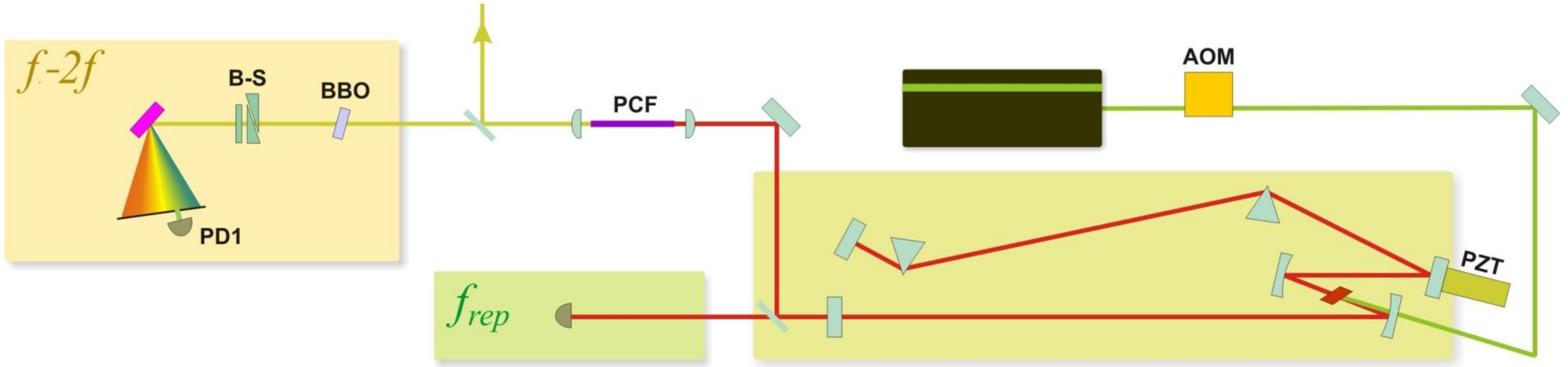
Spektrometr fourierowski – zupełnie inne podejście

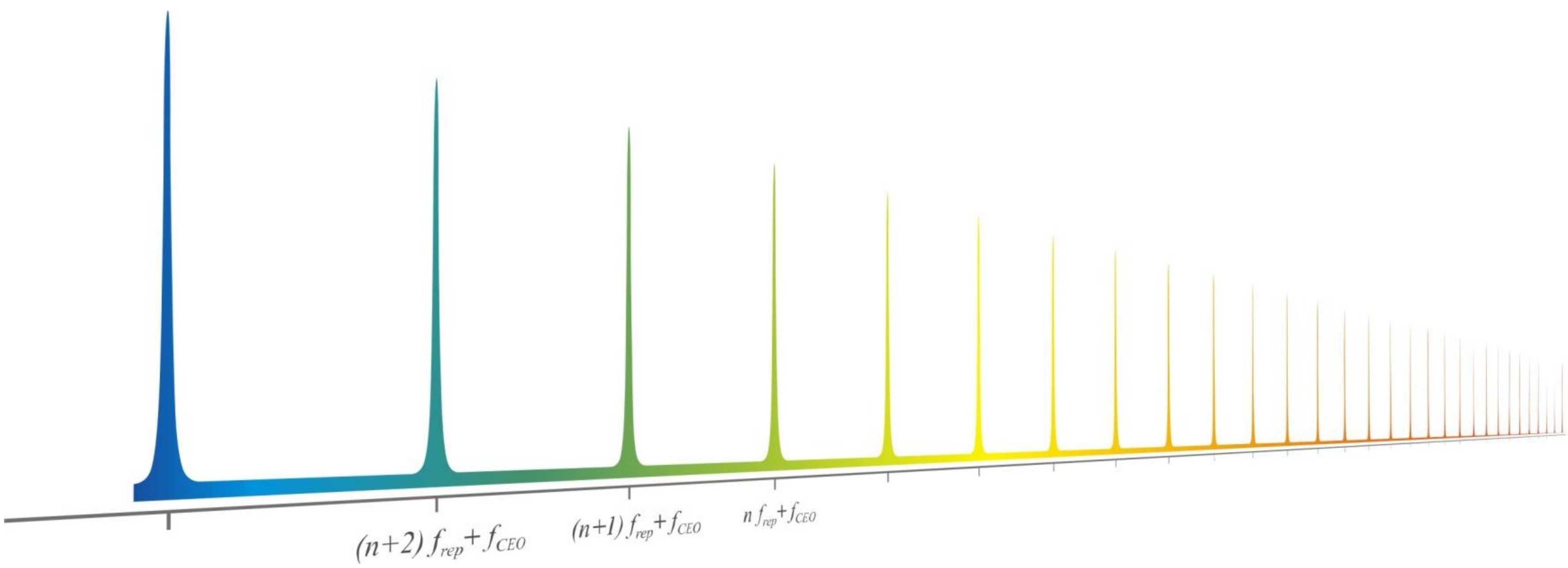


Technology focus – Optical Frequency Comb



Technology focus – Optical Frequency Comb





Physics 2005 - Mozilla Firefox

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Zakupy do laserów światłowodowych | FUW SquirrelMail | American Journal of Physics -- January ... | Physics 2005

Physics

The Nobel Prize in Physics 2005

"for his contribution to the quantum theory of optical coherence"

"for their contributions to the development of laser-based precision spectroscopy, including the optical frequency comb technique"

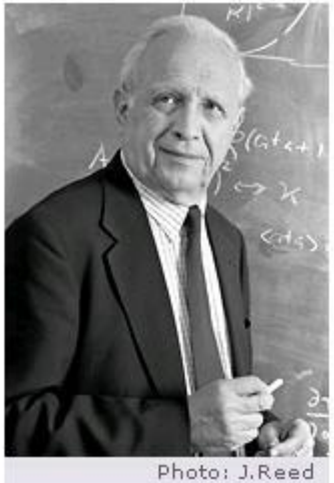

Photo: J.Reed

Roy J. Glauber

1/2 of the prize

USA

Photo: Sears.P.Studio

John L. Hall

1/4 of the prize

USA

Photo: F.M. Schmidt

Theodor W. Hänsch

1/4 of the prize

Germany

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The Nobel Prize in Physics 2005

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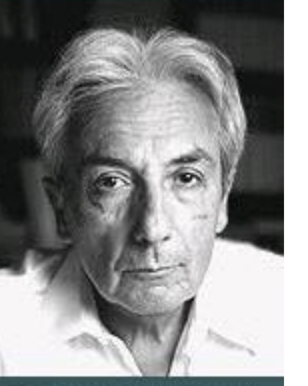

Documentary about Albert Fert

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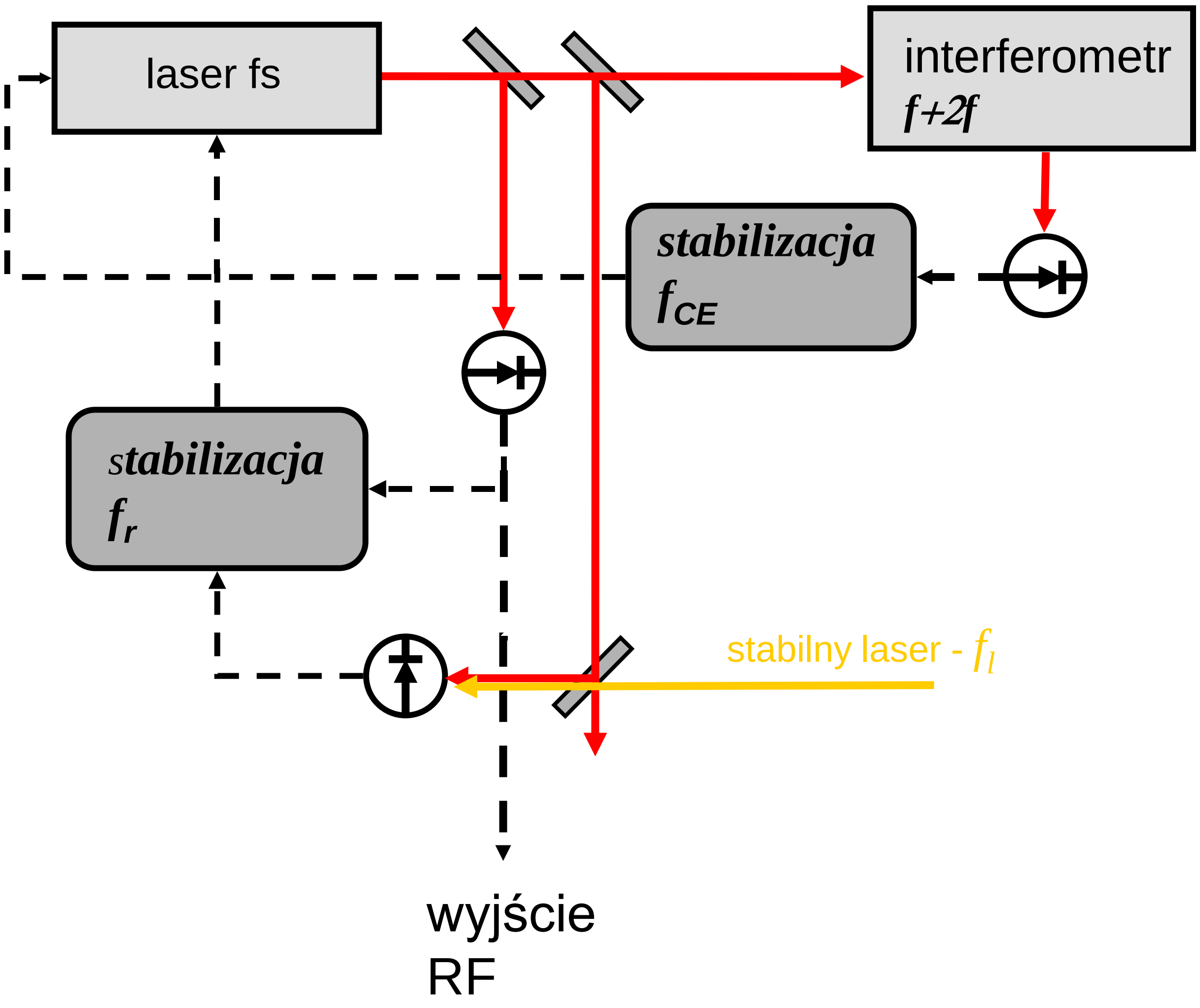
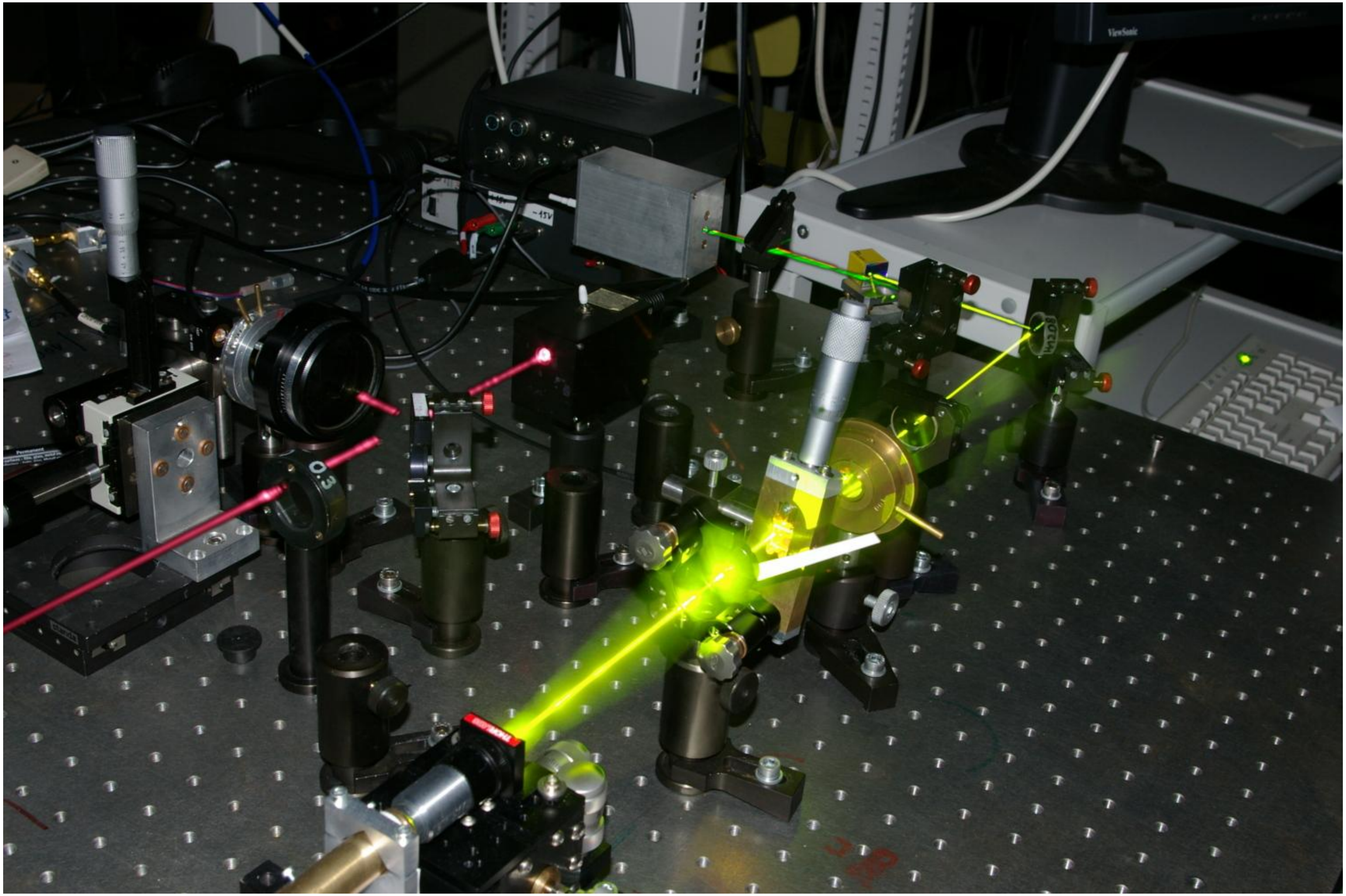
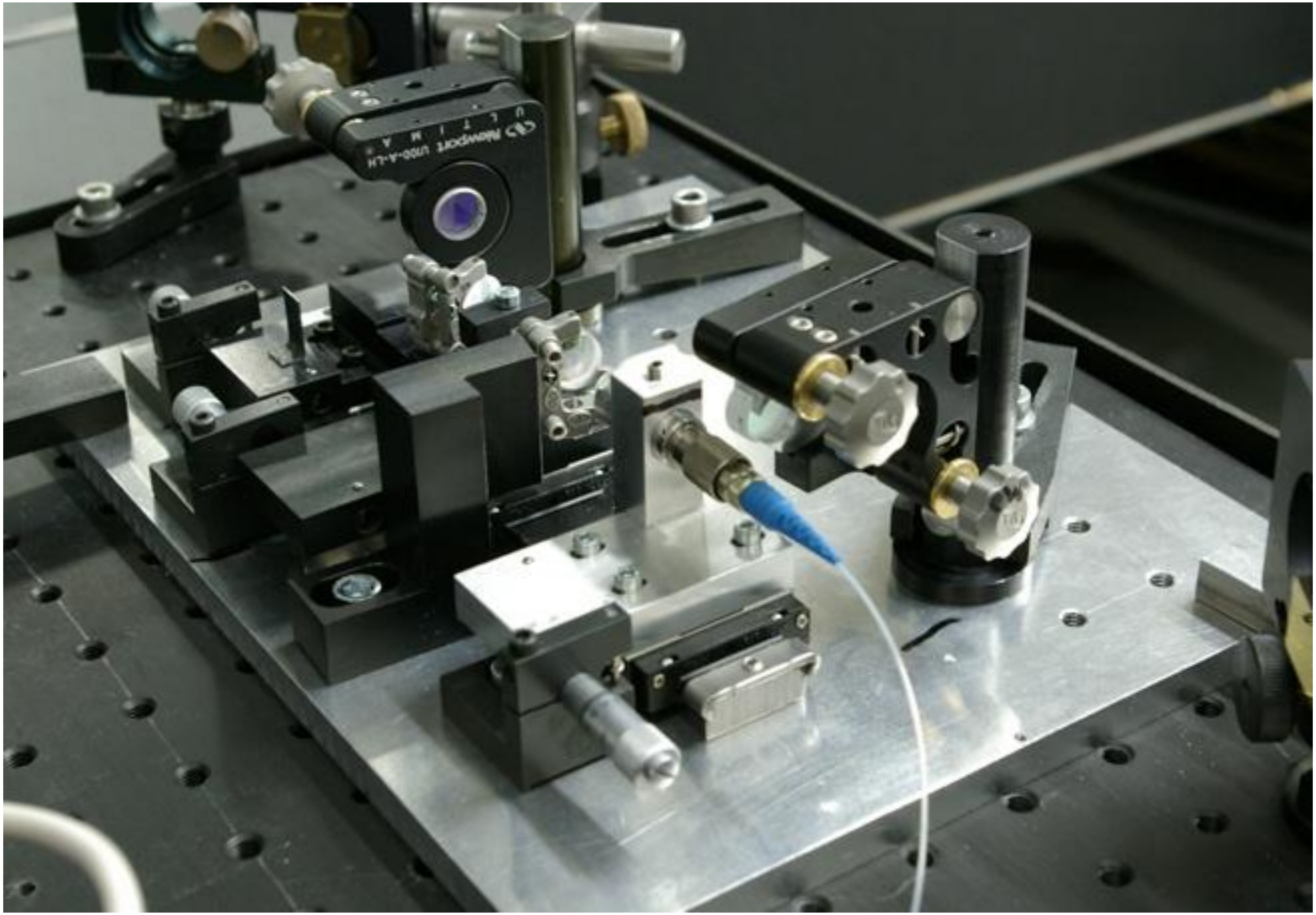
Optical Frequency Comb – part of the atomic clock



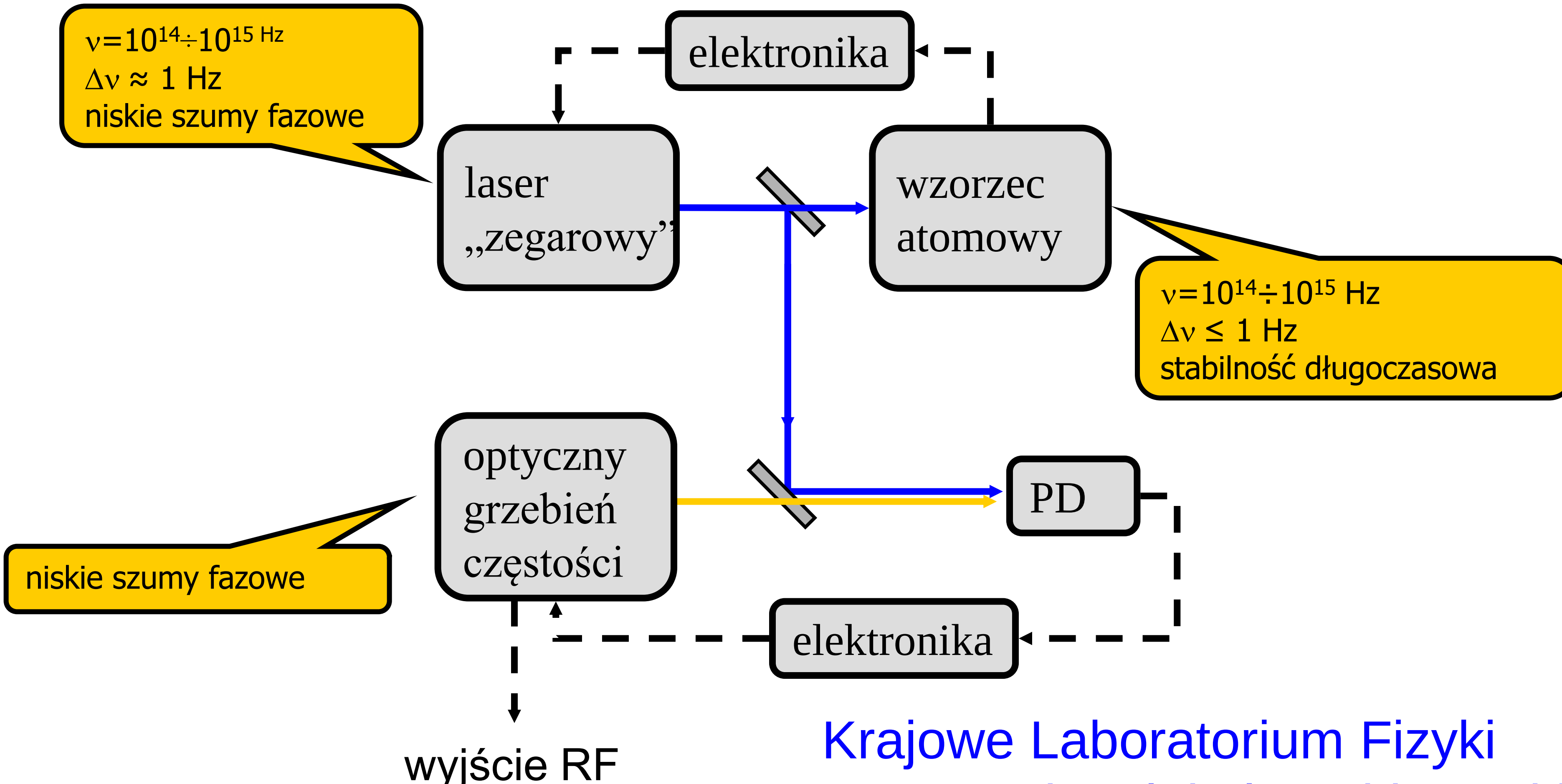
Technology focus – Optical Frequency Comb



Technology focus – Optical Frequency Comb



Optical Frequency Comb – real optical atomic clock architecture



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