Laser causes **absorption-stimulated emission** e.g. in Rabi cycle – let's use the latter

Potential new applications of photon source causing deexcitation

Like [Rabi cycle](), [STED microscope]()

apply/test macro CPT symmetry

CT scan of emission coefficient

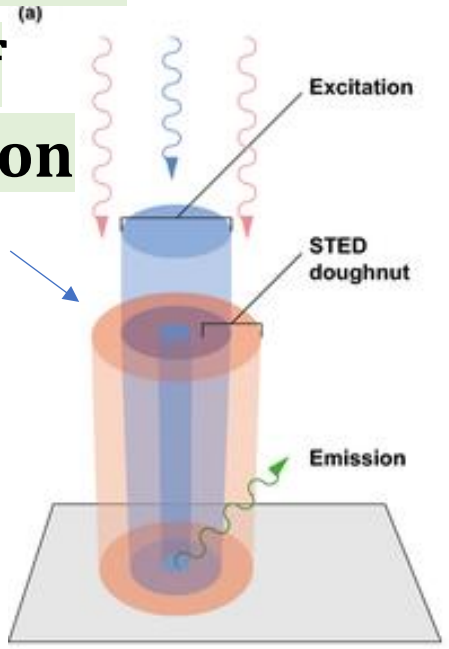
CPT analog of absorption CT,

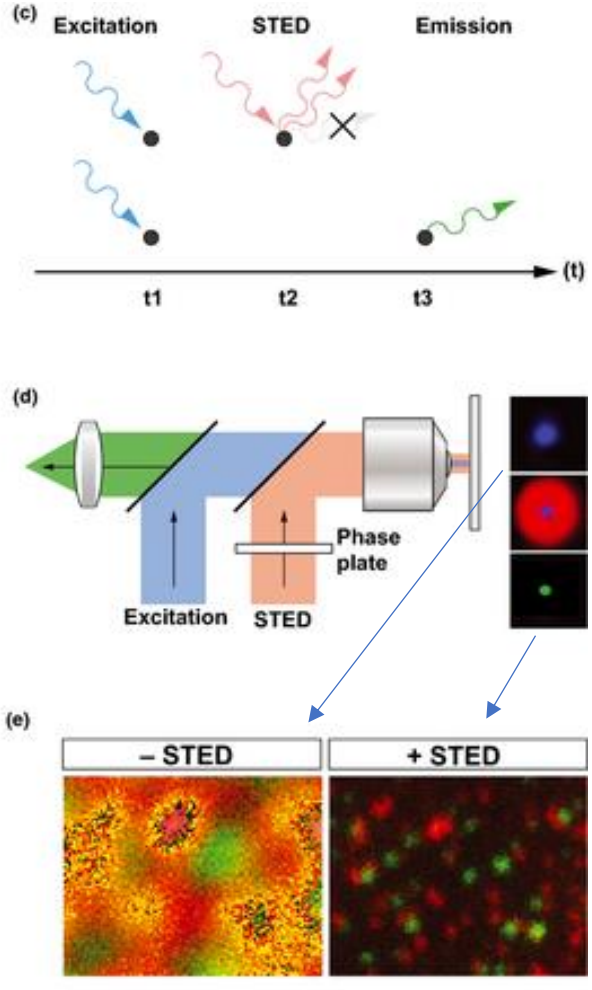
radiotherapy to starve tumor,

computational e.g. **2WQC**:

two-way quantum computers

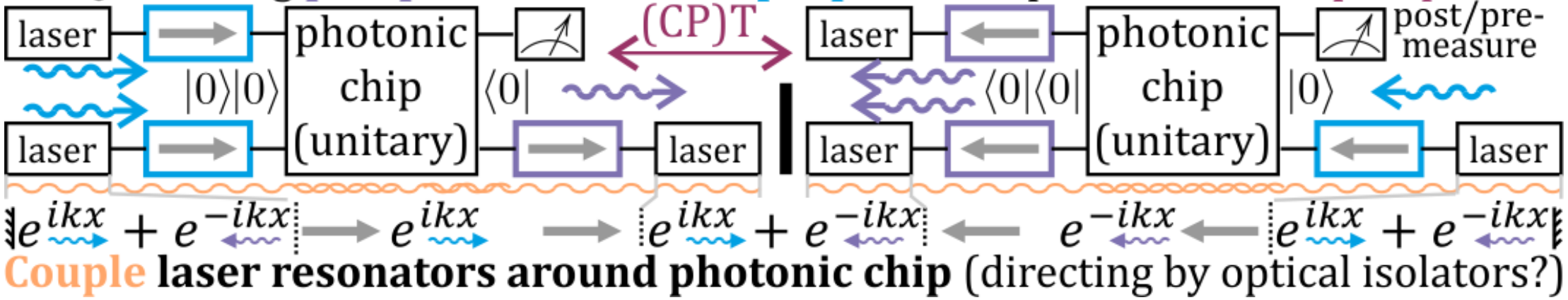
$$\langle\psi_f|U|\psi_i\rangle \overset{\text{CPT}}{\longleftrightarrow} \langle\psi_i|U^\dagger|\psi_f\rangle$$





Jarek Duda, [recording](), [arXiv:2409.15399]() + [2WQC]()

2WQC: adding **postparation** as state **preparation** process in CPT perspective



Couple **laser resonators around photonic chip** (directing by optical isolators?)

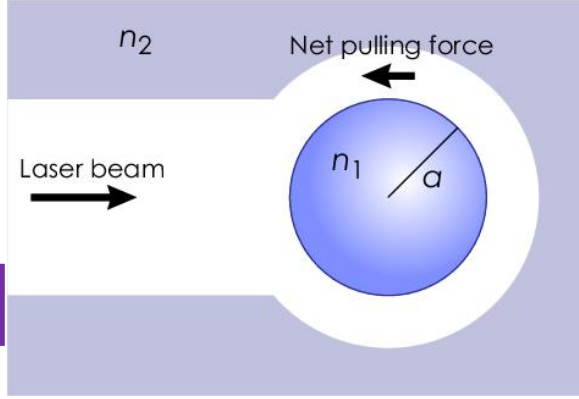
EM & hydrodynamics governed by nearly the same equations

optical heating-cooling, pushing-pulling, also tweezers

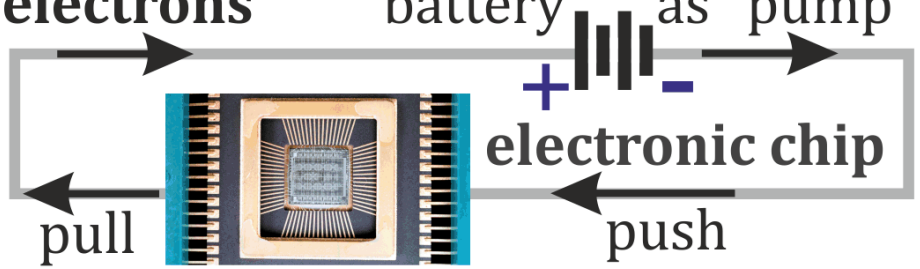
Radiation pressure is a vector: $\vec{p} = \langle \vec{E} \times \vec{H} \rangle / c$ (source)

Positive: toward surface, **outward: negative radiation pressure**

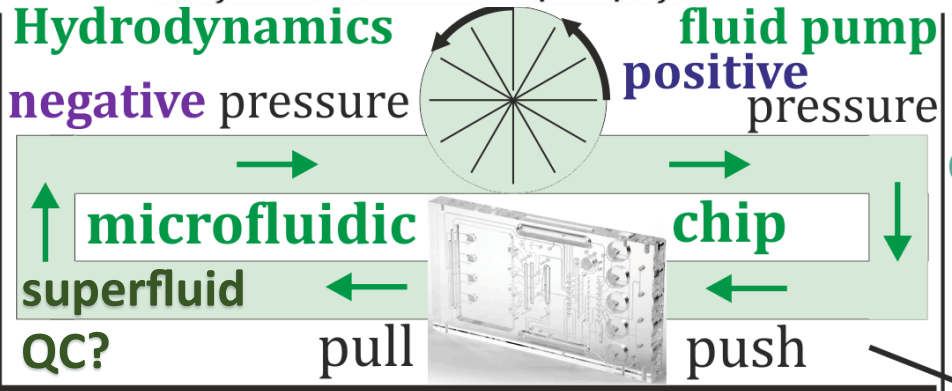
'two-way' symmetric computing, **2WQC**: $\langle \psi_f | U | \psi_i \rangle \overset{\text{CPT}}{\longleftrightarrow} \langle \psi_i | U^\dagger | \psi_f \rangle$



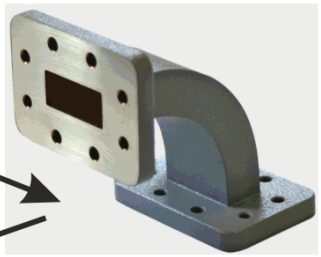
Push&pull for better flow control

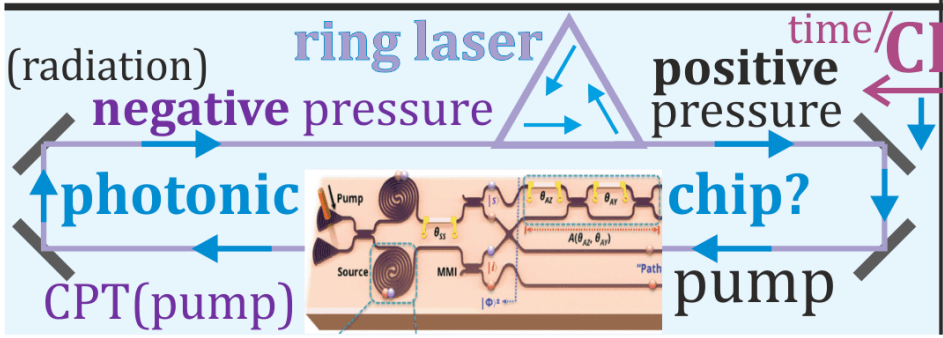


Hydrodynamics

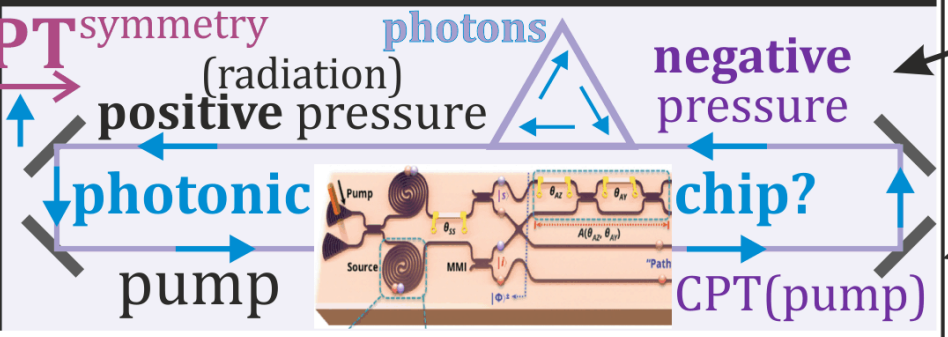


microwave waveguide quant. chip?





time/CPT symmetry



EM field (photons?) nearly the same equations as **superfluid** (mechanical vibrational qubits?)

CPT(process used for state preparation) to influence the final state

setting	Gauge fields	Circulation	Gauge condition	Matter field
Electro-dynamics	φ , $\vec{A}$ four-potential	$\vec{B} = \vec{\nabla} \times \vec{A}$ magnetic f.	$\vec{\nabla} \cdot \vec{A} + \frac{1}{c^2} \frac{\partial \varphi}{\partial t} = 0$	$\vec{E}_e = -\frac{\partial \vec{A}}{\partial t} - \vec{\nabla} \varphi$
Hydro-dynamics	$\chi = v^2/2, \vec{v}$ flow velocity	$\vec{\omega} = \vec{\nabla} \times \vec{v}$ vorticity	$\vec{\nabla} \cdot \vec{v} + \frac{1}{c_s^2} \frac{\partial \chi}{\partial t} = 0$	$\vec{E}_h = -\frac{\partial \vec{v}}{\partial t} - \vec{\nabla} \chi$

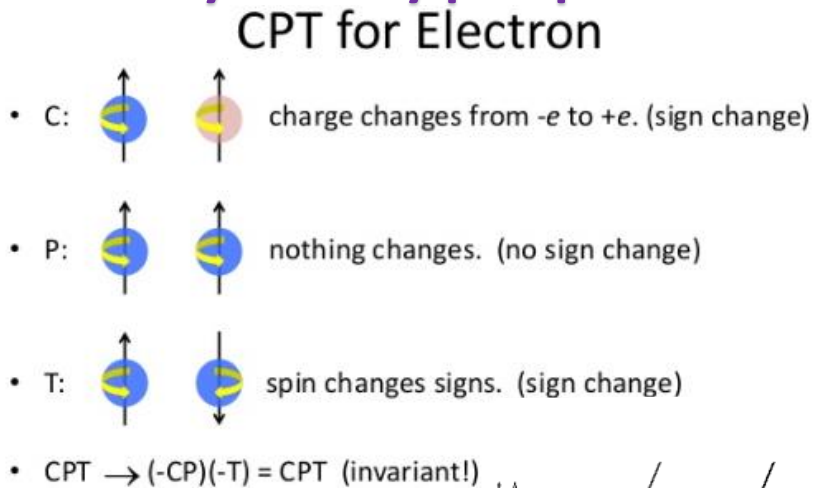
Physics should be governed by the same equations in CPT symmetry perspective

C – charge conjugation, P – parity, **T - time**

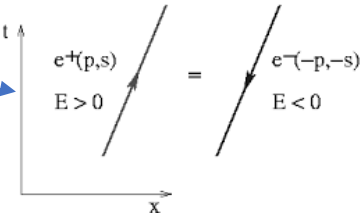
"The CPT theorem says that CPT symmetry holds for all physical phenomena (...)" (link)

any Lorentz invariant local quantum field theory with a Hermitian Hamiltonian **must have CPT symmetry**"

"CPT Violation Implies Violation of Lorentz Invariance"



Feynman–Stueckelberg: "antiparticles travel backward in time"



Many **microscopic confirmations**: "Data Tables for Lorentz and CPT Violation"

Macroscopic tests? ... applications like 2WQC?

CPT symmetry in equations governing physics

Can be violated in solutions e.g. 2nd law of thermodynamics

Big Bang as 'the rock'? Everything localized: low entropy

presentism

~~CPT~~ **presentism**

directional evolution

like wave propagation

3D local: past→future **evolution**

particle: moving point

„hidden" evolving state

Kolmogorov 3rd axiom ⇒ Bell inequalities

X V

CPT eternalism, block universe GR, QFT

symmetric boundary conditions

static e.g. Ising model, **4D spacetime**

4D local: past↔future **equilibrium**

„4D jello" minimizing tension

particle: its trajectory

Born rule ⇒ Bell violation

$\varphi \rightarrow$ S-matrix $= \langle\varphi|U(t_f,t_i)|\psi\rangle \leftarrow \psi$

TSVF, $G_{\mu\nu} \propto T_{\mu\nu}$

eternalism

Rabi cycle: coupled resonators, e.g. atoms

stimulated emission

Rabi cycle

absorption

laser

absorption

CPT

stimulated emission

$$\frac{\partial N_2}{\partial t}^{\text{excited}} = -\frac{\partial N_1}{\partial t}^{\text{ground}} = B_{12}\,\rho(\nu)\,N_1^{\text{usually } \sim N}$$

absorption

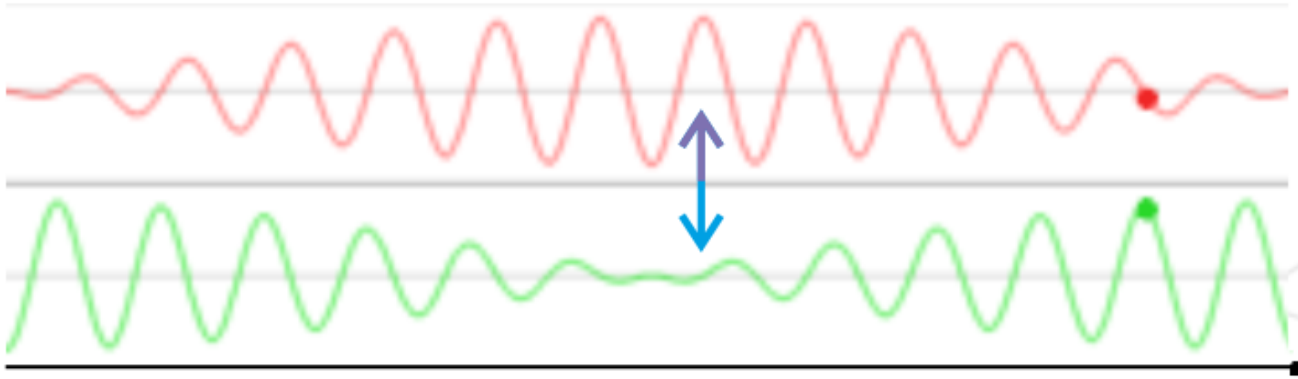
$$\frac{\partial N_2}{\partial t}^{\text{excited}} = -\frac{\partial N_1}{\partial t}^{\text{ground}} = -B_{21}\,\rho(\nu)\,N_2^{\text{usually } \sim 0}$$

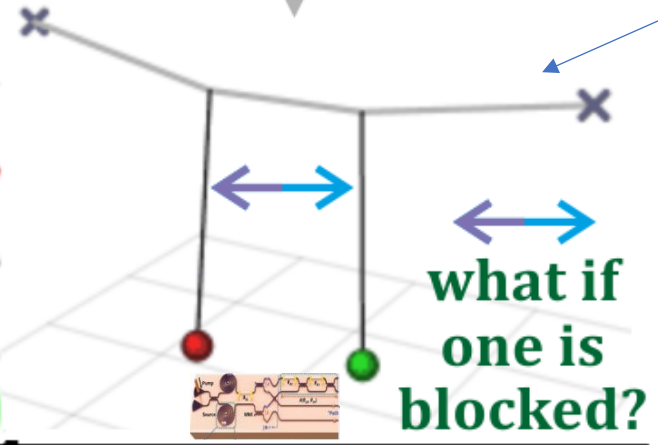
stimulated emission

$$|\psi(t)\rangle \propto e^{-\frac{iE_+t}{\hbar}}|E_+\rangle + e^{-\frac{iE_-t}{\hbar}}|E_-\rangle$$

$$\begin{pmatrix} u_1 \\ u_2 \end{pmatrix} = \mathrm{Re}\left(c_1 \begin{pmatrix} 1 \\ 1 \end{pmatrix} e^{i\omega_1 t} + c_2 \begin{pmatrix} 1 \\ -1 \end{pmatrix} e^{i\omega_2 t}\right)$$

Rabi: coupled resonators exchanging energy





what if one is blocked?

(de)excite with fan?

"as laser"

hydrodynamical Rabi cycle

standing wave

laser as resonator

same in **CPT** perspective

particle

momentum transfer by **positive**/**negative** pressure

$\vec{p} = \langle \vec{E} \times \vec{H} \rangle / c$ **radiation pressure** - **positive** (toward surface) or **negative** (outward)

Stream vs coupling?

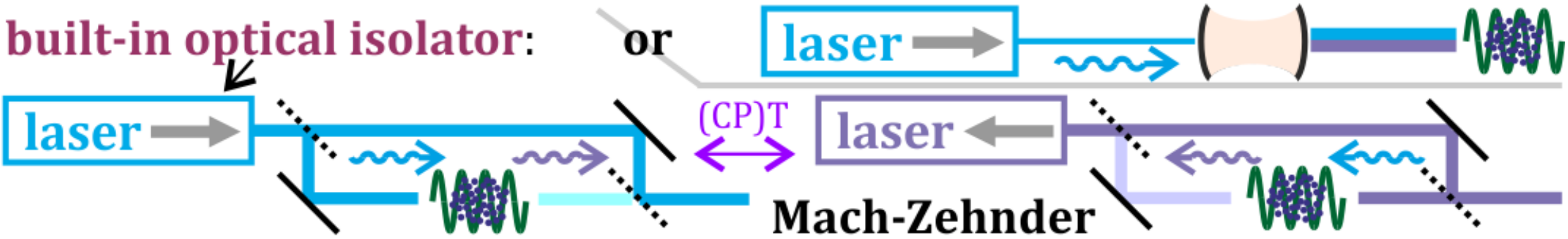
Rabi cycle needs photon exchange in both directions, easy for microwaves

what about lasers? – turns out **most have built-in optical isolator**

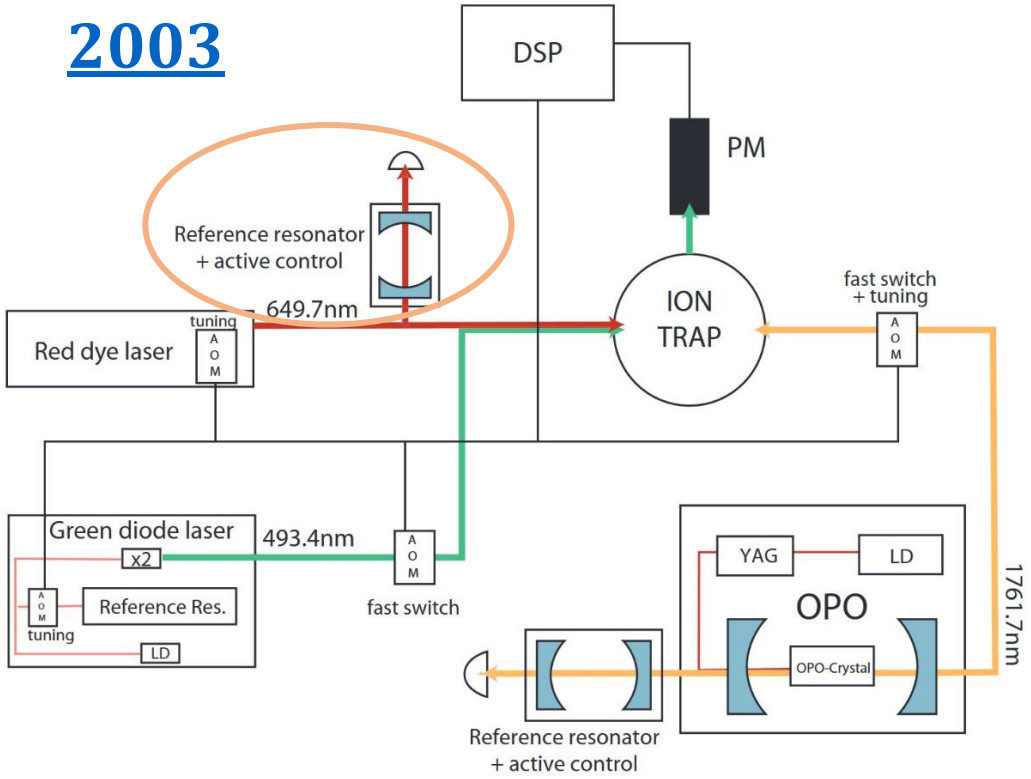
Natural **Rabi realization** (?):
just coupling, also microwaves

Literature as **most lab lasers have built-in optical isolator**:

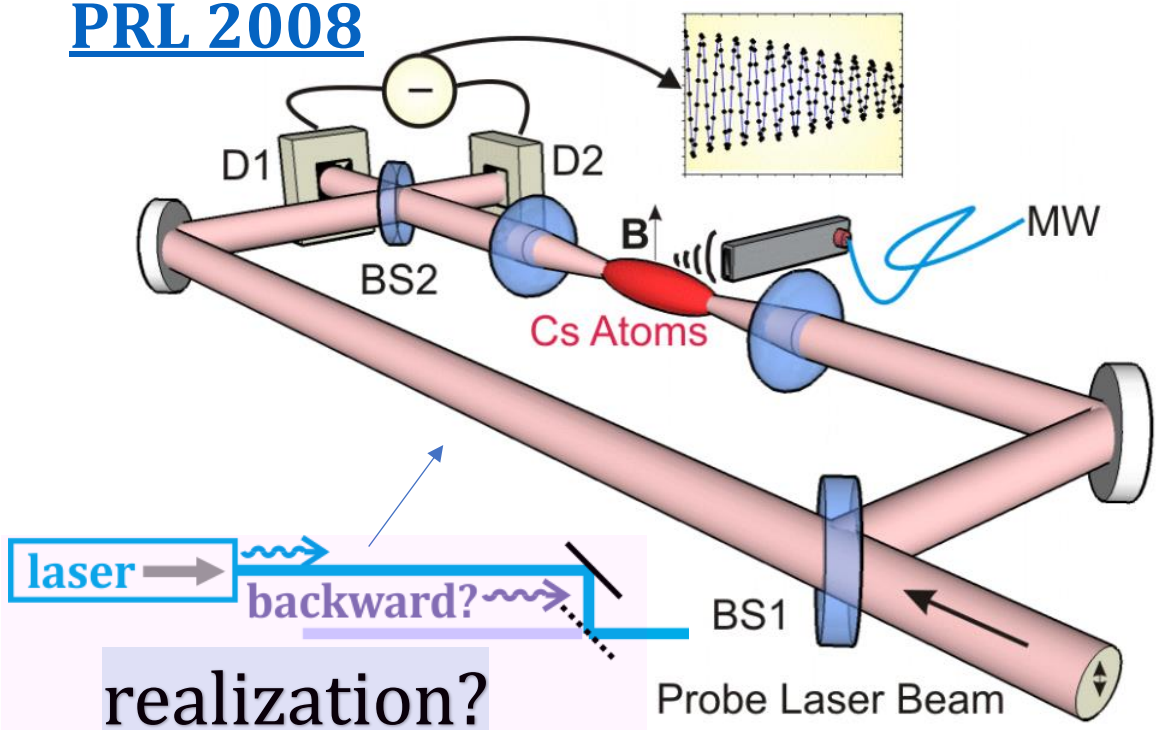
or add **resonator**



2003



PRL 2008



realization?

Electrons in atoms...

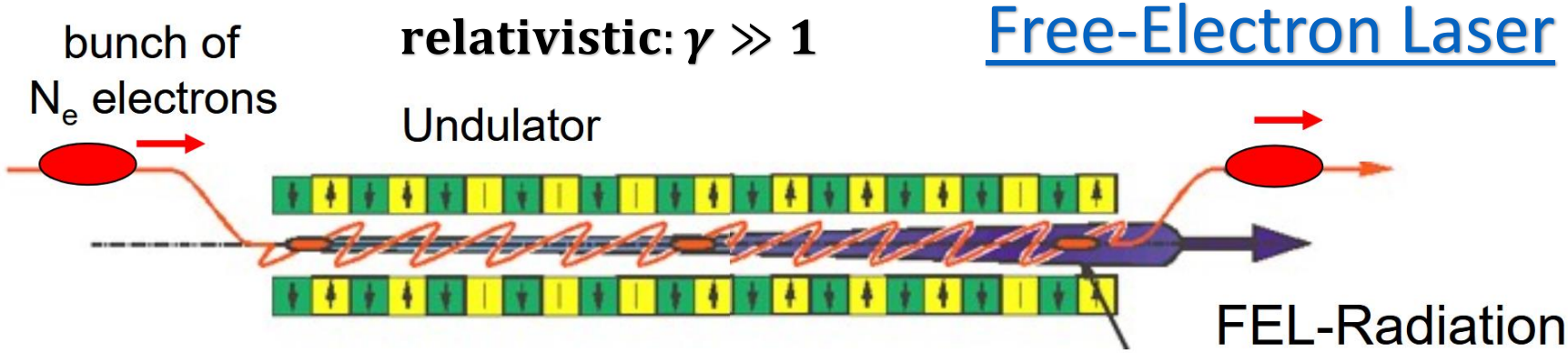
From **Synchrotron** Radiation to **FEL**-Light

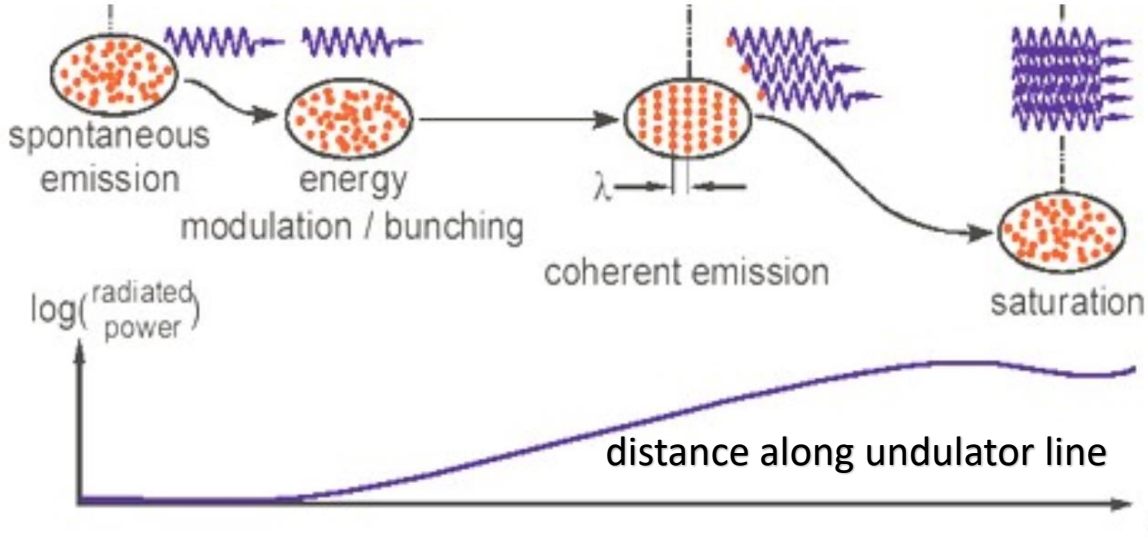
Free electrons:

Synchrotron radiation:
statistical
~spontaneous
emission: $P \propto N_e$

relativistic: $\gamma \gg 1$

Free-Electron Laser





CPT
symmetry
photons?

Coupled electrons
form bunches:
SASE in FEL, $P \propto N_e^2$
laser: **absorption↔**
stimulated emission
switched in CPT

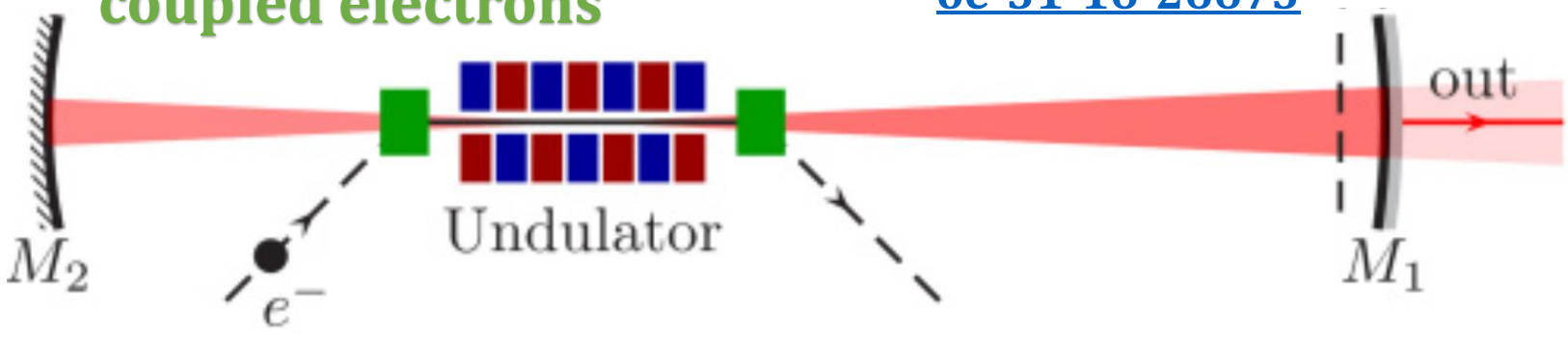
source

SASE: self-amplified spontaneous emission

... add mirrors
FEL oscillator
Superradiance
$P \propto N_e^2$ $T \propto N^{-1}$

coupled electrons

oe-31-16-26673



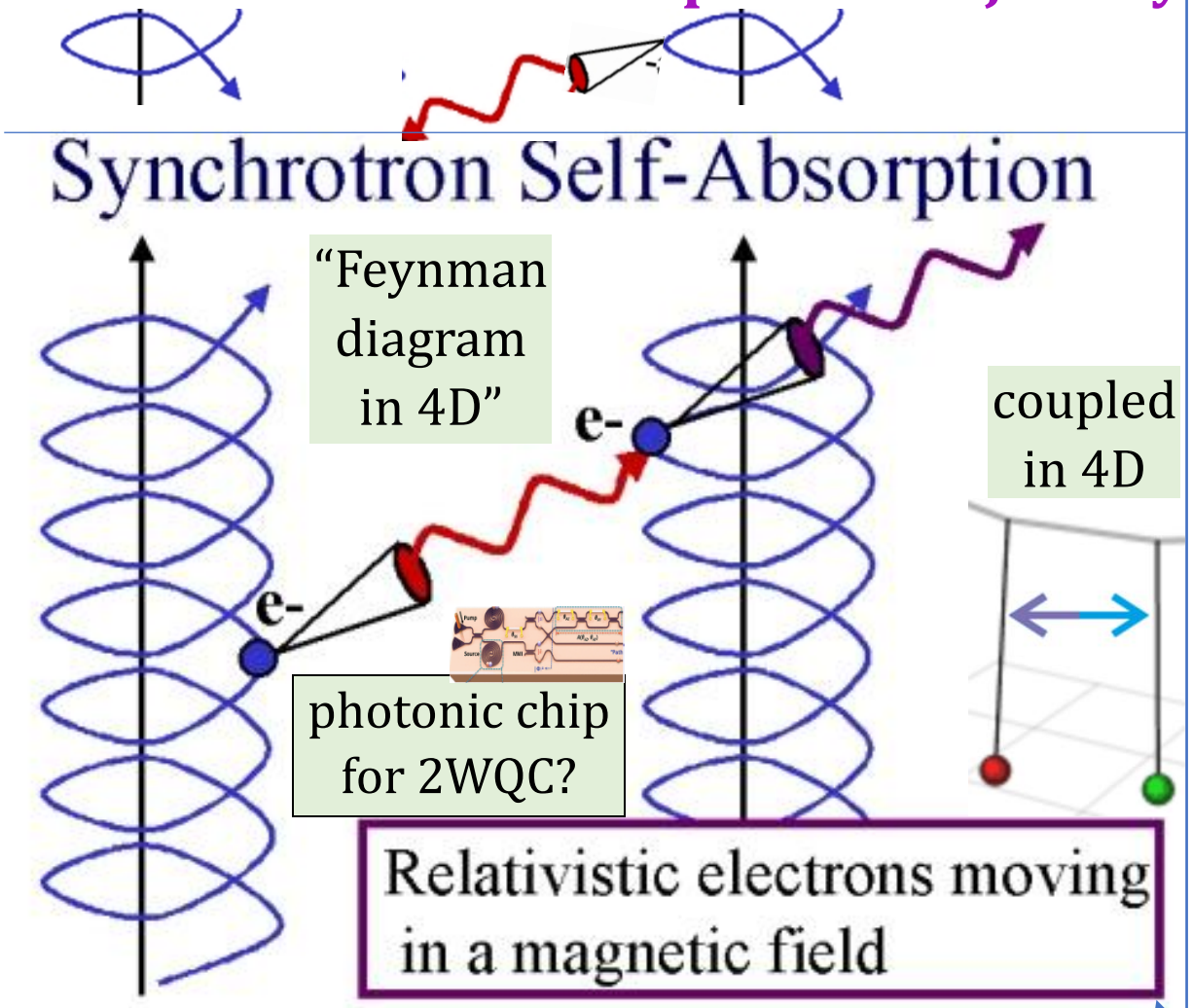
Synchrotron radiation by accelerating charge, also needed

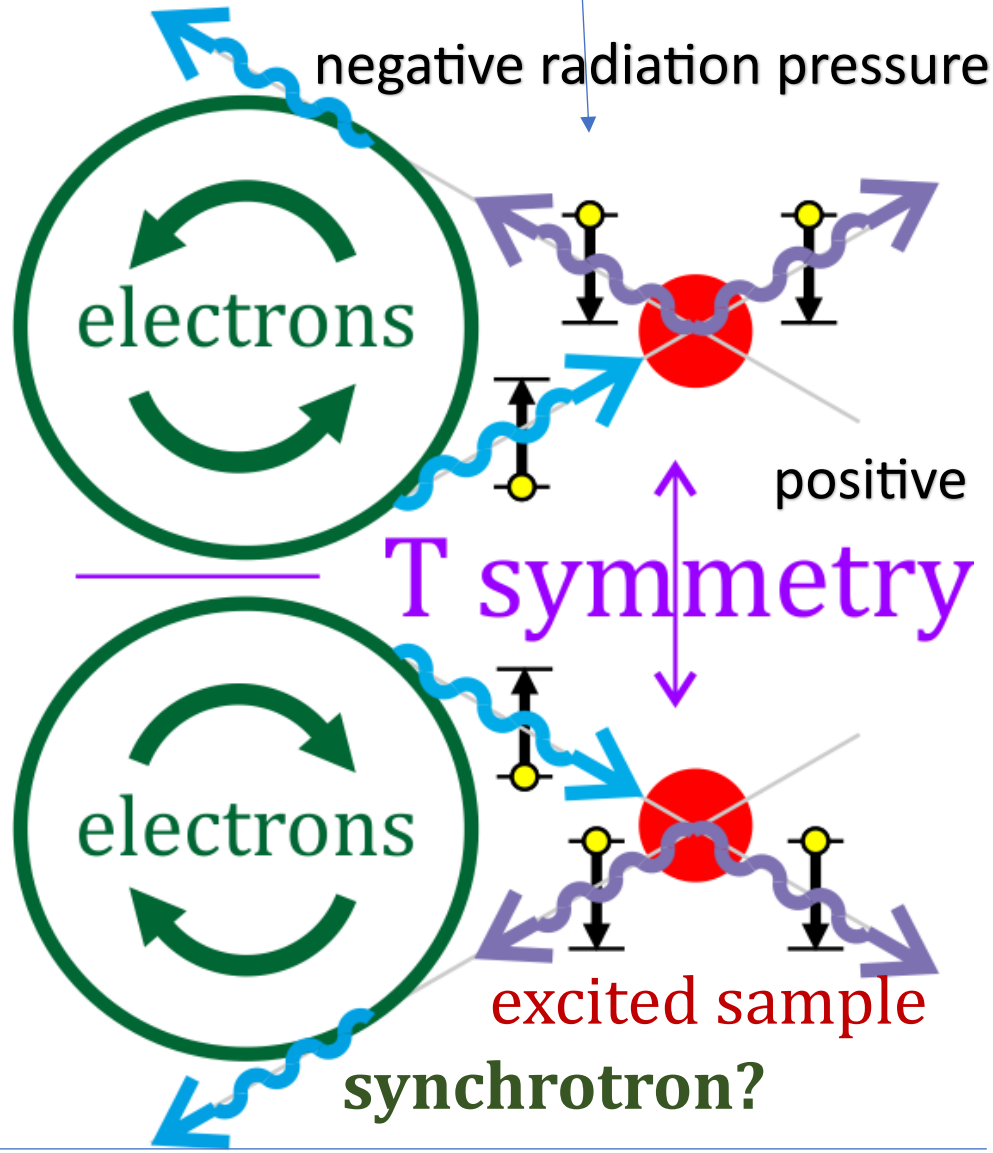
CPT symmetric synchrotron self-absorption, self-amplified SE

What about **causality**? In **EM** should be **the same in T perspective**

Is there really spontaneous emission? Or coupled with e.g. electron?

T: reversed electron+photon trajectory





astrophysics [1, 2, 3, 4, 5, 6, 7], **SASE** in FEL

https://www.mssl.ucl.ac.uk/www_astro/lecturenotes/hea/radprocess/sld028.htm

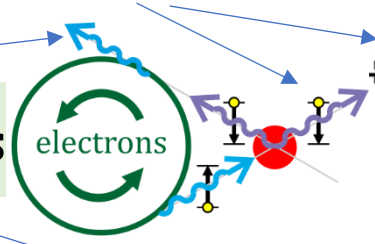
astrophysics example

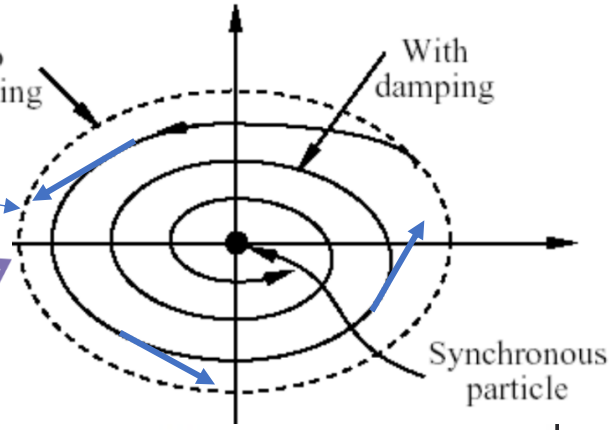
CPT symmetry?

Synchrotron radiation would both **emit** (damping) and **absorb** e.g. **CMB** photons if spectrum agrees

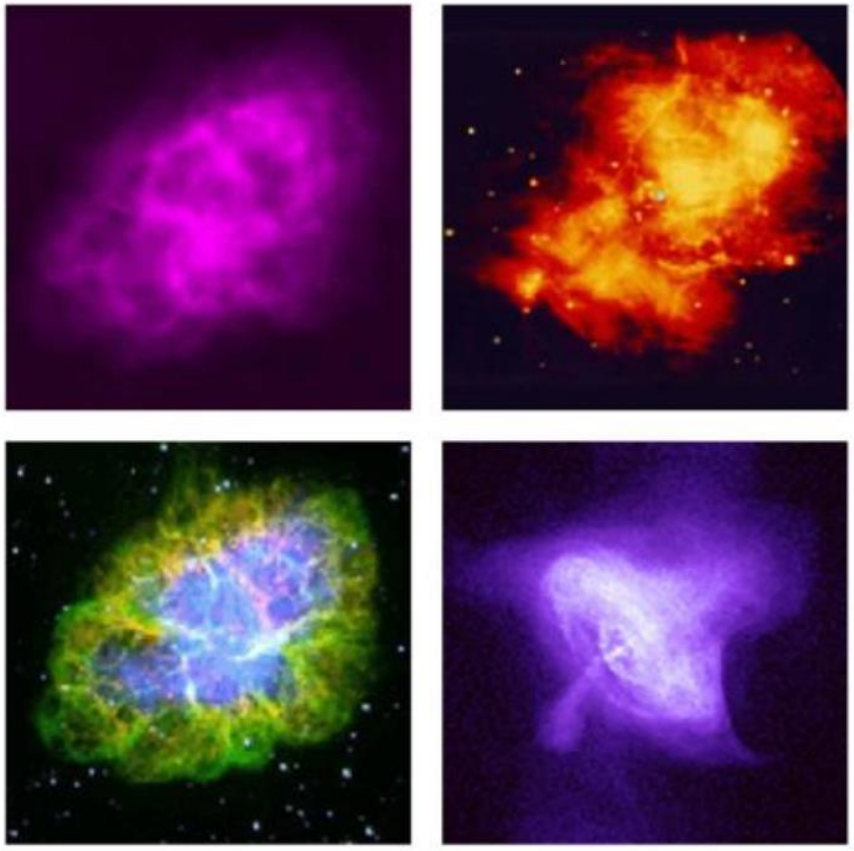
$$P_\gamma = \frac{q^2}{6\pi\epsilon_0 c^3} a^2\gamma^4 = \frac{q^2 c}{6\pi\epsilon_0}\frac{\beta^4\gamma^4}{r^4}$$ **power&energy loss**

https://people.sissa.it/~perrotta/lezioni_2023_2024/chapter6.pdf



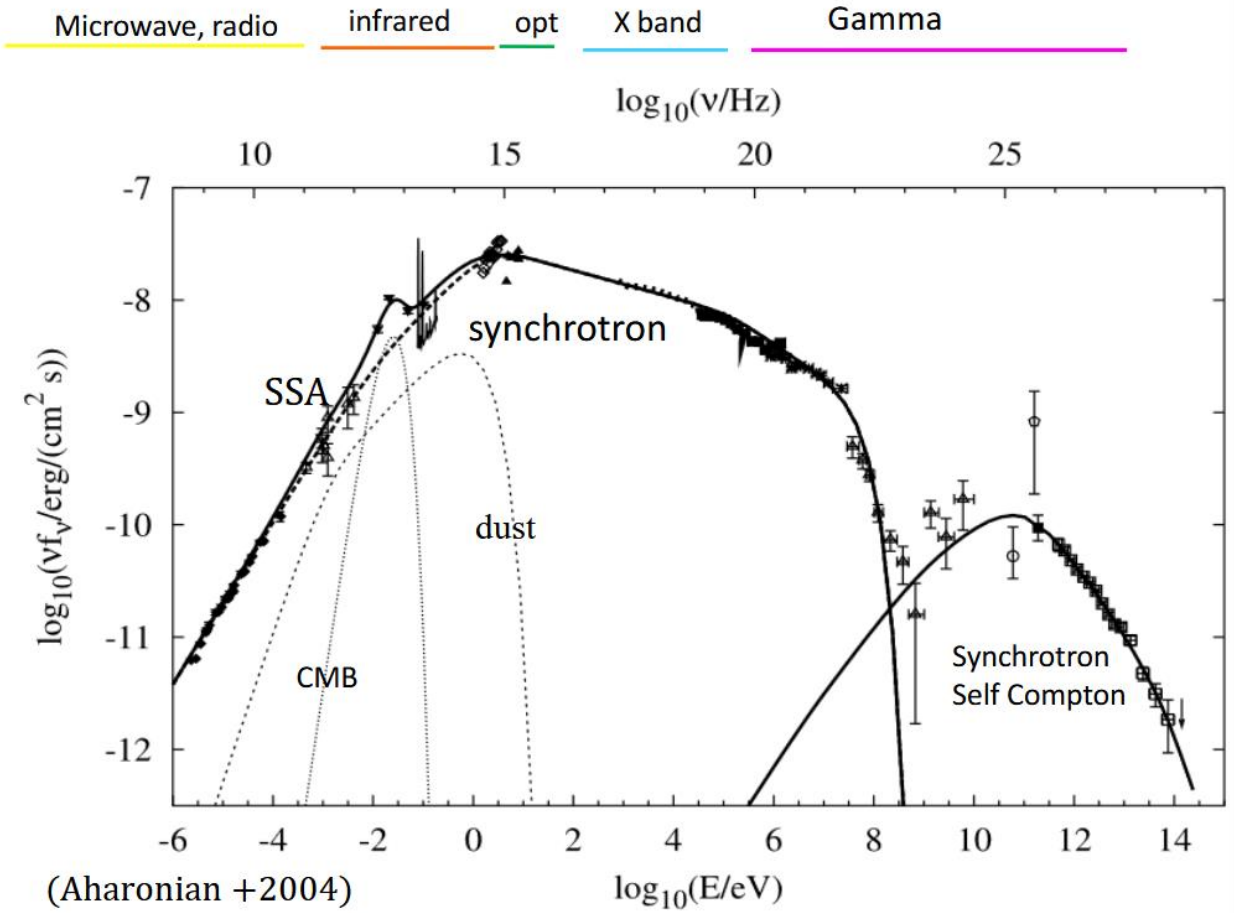


Crab nebula emits **from radio up to TeV Gamma rays**. Its synchrotron spectrum shows a turnover at about 100 keV. There is possibly a inverse-Comptonised spectrum at very high energies (10^{10}-10^{12}) eV. *(Compton scattering later in the course)*. The total luminosity of the Crab is L ~ 5 ×10^{38} erg sec^{-1} and the magnetic field is thought to be of order **10^{-4} Gauss**.



Images of the Crab in radio, infrared, optical and X-ray.
see http://chandra.harvard.edu/photo/0052/what.html.

resonators? atoms, nuclei, synchrotron?

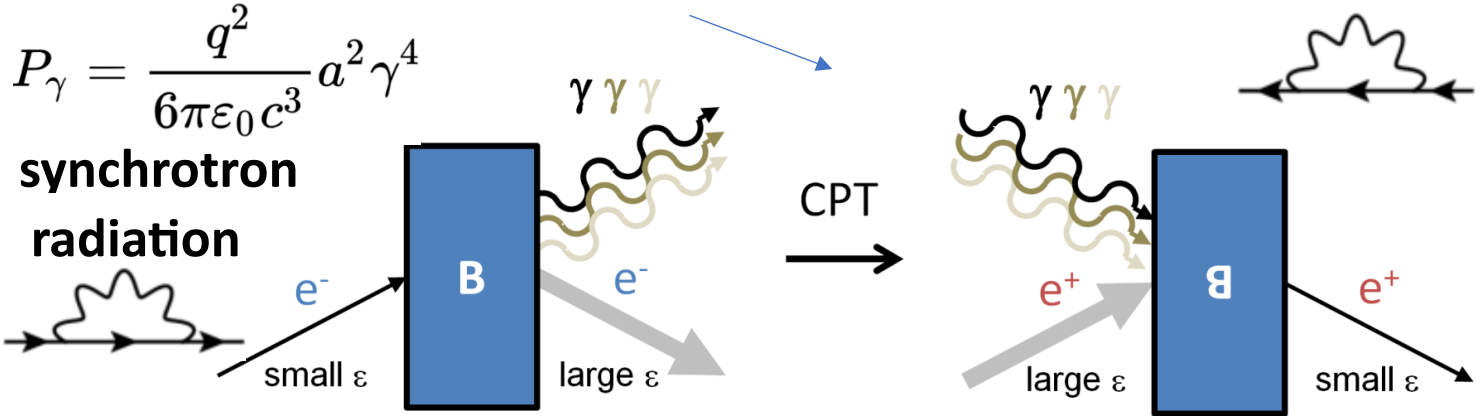


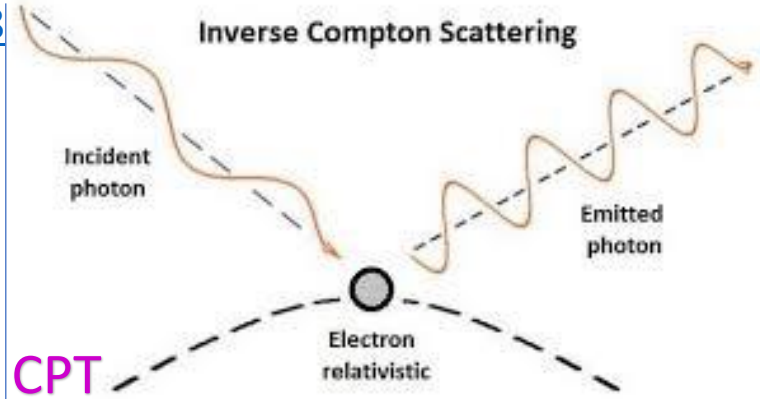
(Aharonian +2004)

Potential and Issues for Future Accelerators and Ultimate Colliders, Brooks, 2018

$$P_\gamma = \frac{q^2}{6\pi\varepsilon_0 c^3} a^2 \gamma^4$$

synchrotron radiation

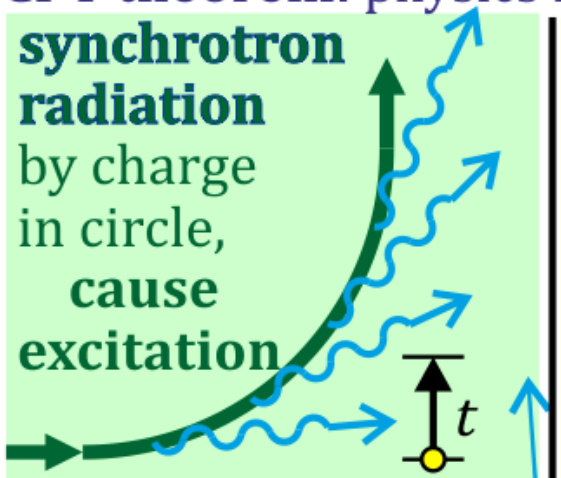




CPT (Inverse) Compton scattering

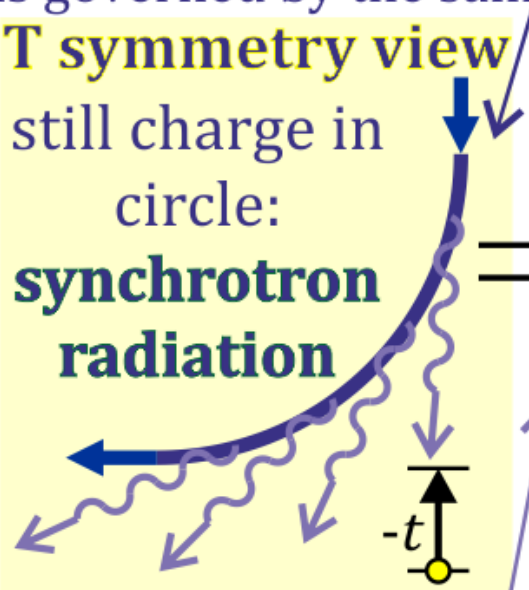
CPT theorem: physics is governed by the same equations in **CPT perspective**

synchrotron radiation by charge in circle, **cause excitation**

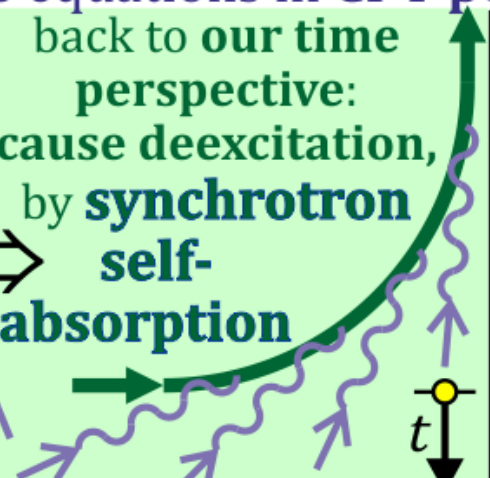


needs deexcited target $N_1>0$ for absorption

T symmetry view still charge in circle: **synchrotron radiation**



back to **our time perspective: cause deexcitation,** by **synchrotron self-absorption**



needs photon source, excited target $N_2>0$

~Compton scattering antenna

both if allowed e.g. 2.7K ~ 0.3 meV cosmic background radiation

UWB Circular Polari
Antenna R104

900MHz – 7GHz

link

cause absorption (if deexcited)

$$\frac{\partial N_2}{\partial t}^{\text{excited}} = -\frac{\partial N_1}{\partial t}^{\text{ground}} = B_{12}\,\rho(\nu)\,N_1$$

usually ~N — absorption

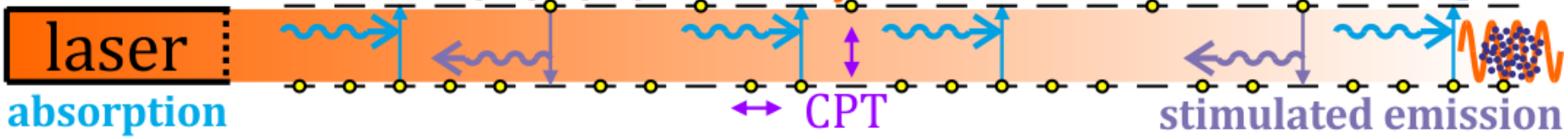
CPT

$$\frac{\partial N_2}{\partial t}^{\text{excited}} = -\frac{\partial N_1}{\partial t}^{\text{ground}} = -B_{21}\,\rho(\nu)\,N_2$$

usually ~0 — stimulated emission

cause stimulated emission **if excited** (resonator)

stimulated emission — Rabi cycle — absorption



absorption — CPT — stimulated emission

object moving in fluid creates also **negative pressure**, **EM ~superfluid**

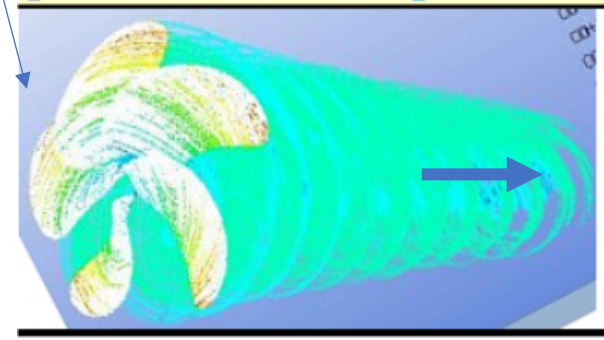
!

negative pressure → positive pressure

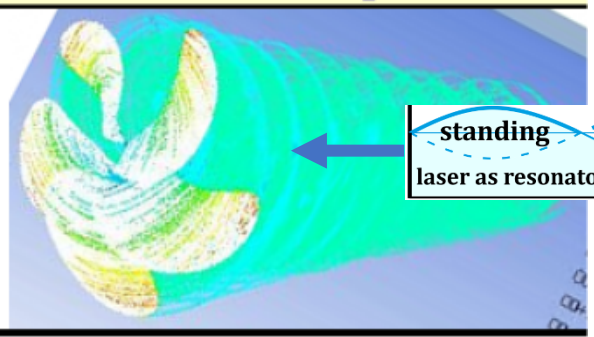
object moving in fluid

positive pressure ← negative pressure

(CP)T symmetry view



photon carries **energy**,
± momentum/pressure,
± angular momentum
like **swirl-like wave**
behind marine propeller



send/ receive
UWB Circular Antenna R104

900MHz – 7GH

to/from resonator

synchrotron radiation in **CPT symmetry view?** **negative pressure?**

positive pressure
accelerating electrons/ ions e.g. in magnetic field

absorption ← **(CP)T** → **stimulated emission**

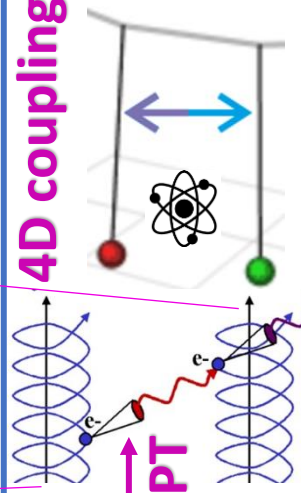
reversed electron/ion trajectory,
produce photons toward -time,
exctiting **target** toward -time,
deexicting toward +time

accelerating charged particle

$-t$

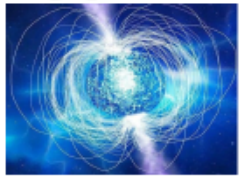
target needs to be excited: $N_2 > 0$

(arXiv:2409.15399)

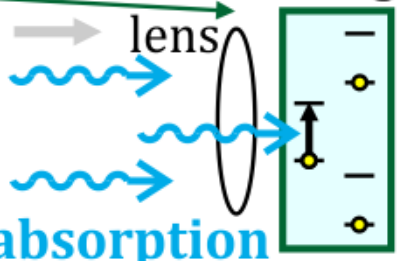


camera focused on being excited, **backward camera** on being deexcited?

e.g. pulsar



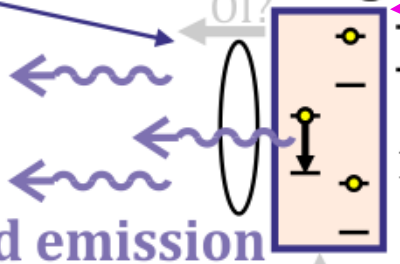
lens



absorption

cooled **detectors** monitoring population

or?



stimulated emission

pumped **detectors** monitoring population

see absorption

see stimulated emission

standard observations

(CP)T ↔ **synchrotron, no thermal? delay?**

$\vec{p} = \langle \vec{E} \times \vec{H} \rangle / c$ **radiation pressure** - **positive** (toward surface) or **negative** (outward)

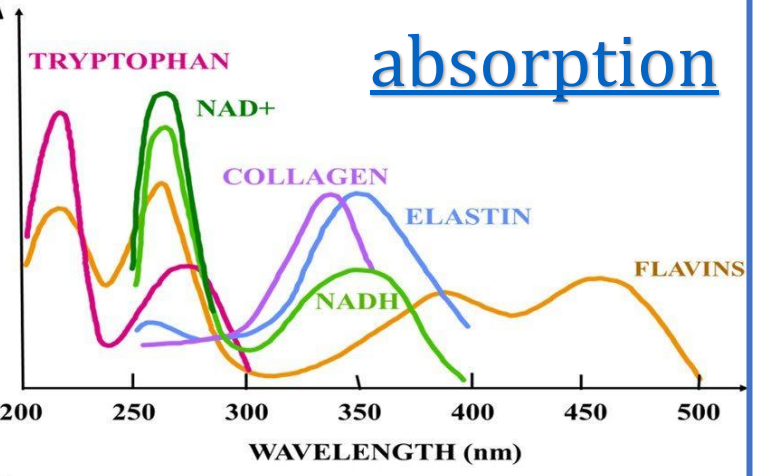
Mapping emission coefficient? e.g. in human body, brain

Separation+

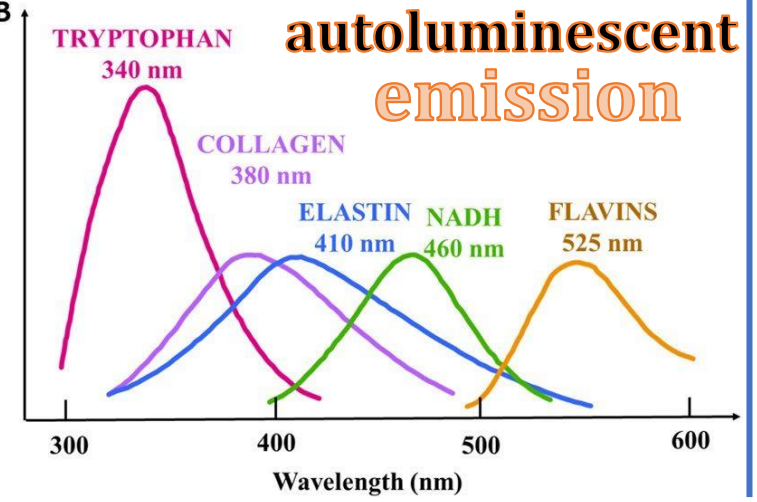
transparency?

time, space resolution

absorption



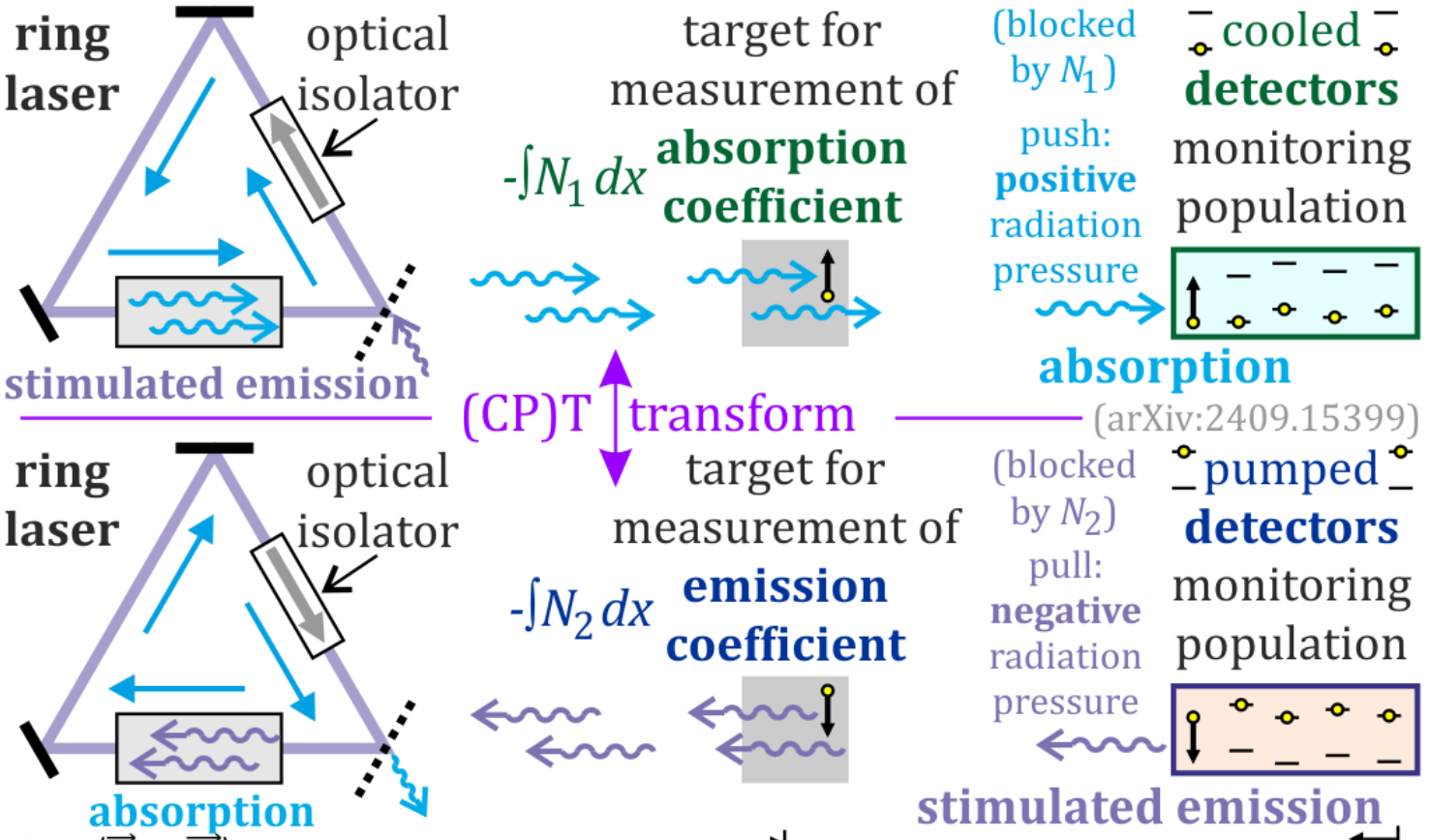
autoluminescent emission



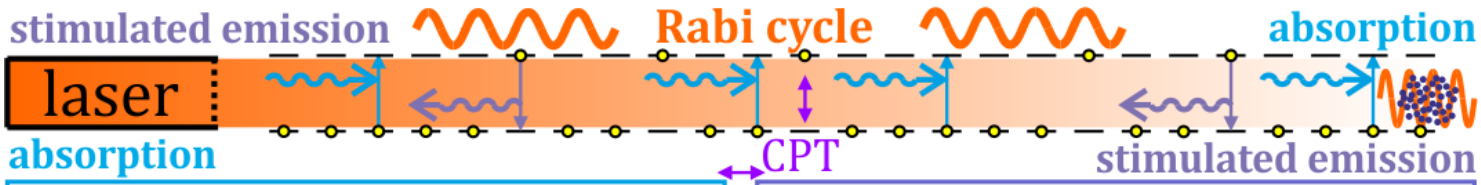
CT scan of emission coeffcient for 3D map of e.g.

tryptophan ~340nm, NADH ~460nm, flavins ~525nm emission

should have **much better transparency** as usually $N_2 << N_1$



$\vec{p} = \langle \vec{E} \times \vec{H} \rangle / c$ radiation pressure - positive (toward surface) or negative (outward)



$$\frac{\partial N_2}{\partial t}_{\text{excited}} = -\frac{\partial N_1}{\partial t}_{\text{ground}} = B_{12}\,\rho(\nu)\,N_1 \quad \text{usually } \sim N$$

absorption

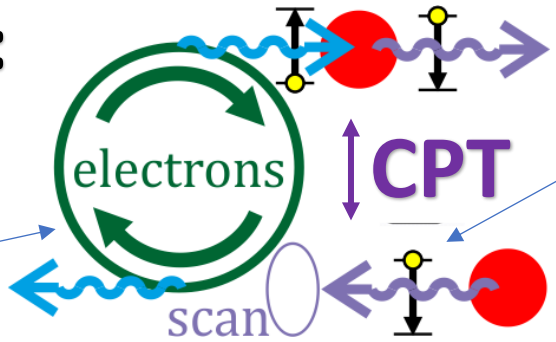
$$\frac{\partial N_2}{\partial t}_{\text{excited}} = -\frac{\partial N_1}{\partial t}_{\text{ground}} = -B_{21}\,\rho(\nu)\,N_2 \quad \text{usually } \sim 0$$

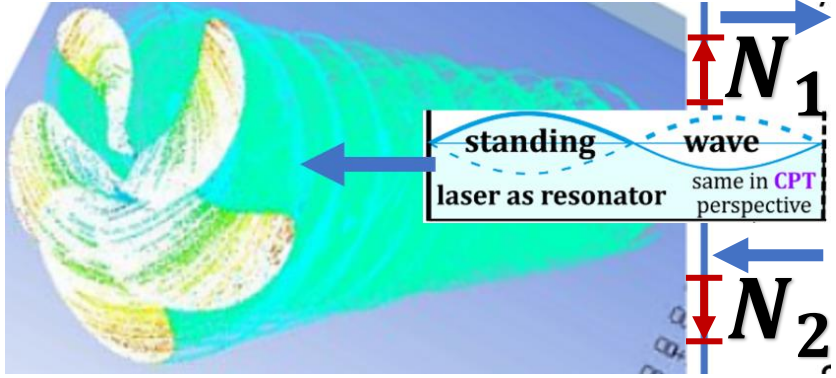
stimulated emission

Just cause deexcitation:

STED microscopy …

without photobleaching?





separation(positive/negative pressure)

transparency: blocked by N_2 not N_1

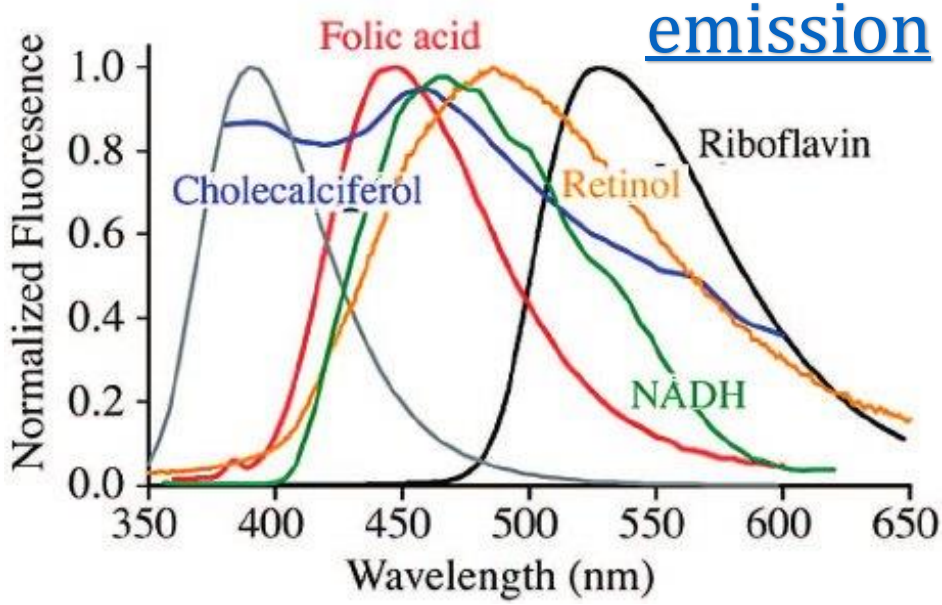
2WQC, reversed photolithography, chemistry, nuclear, neuro, medicine?

e.g. degrade NADH to starve cancer?

(precise, non-ionizing)

Lower dose for intermediate tissues

[emission](#)



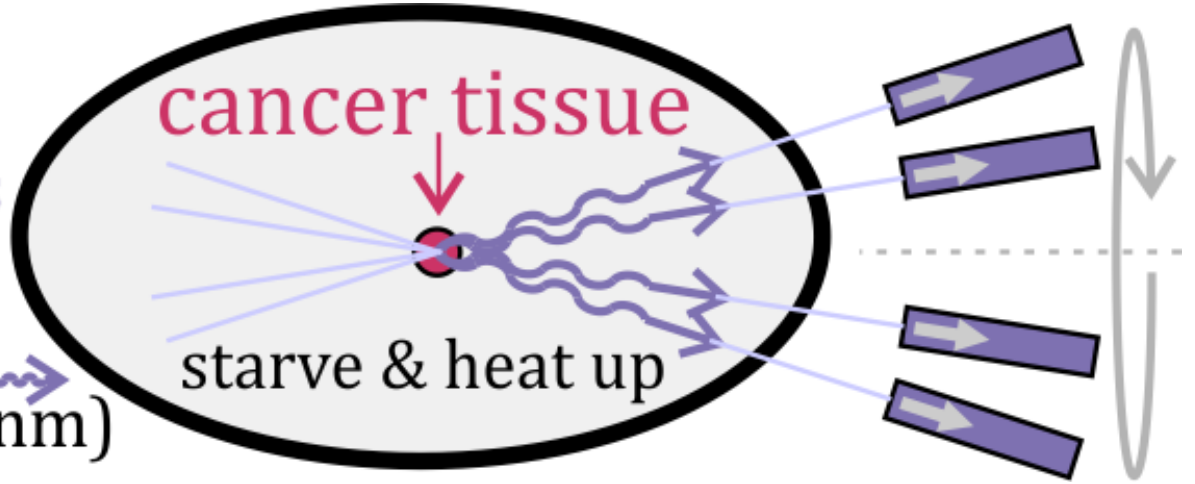
Metabolic issues? (toxic) [singlet oxygen](#) ~1280nm IR emission? …

Backward ASE radiotheraphy?

amplify chosen photon emission by intersecting **backward beams**

e.g. stimulate NADH degradation to starve, release energy heating

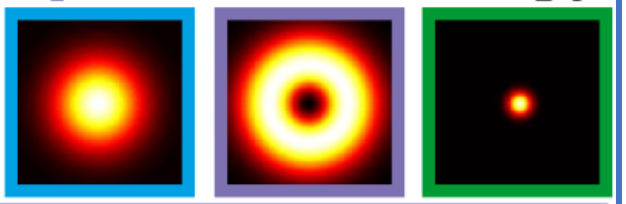
$NADH \rightarrow NAD^+ + H^+ + 2e^- + \gamma$ (~460nm)



Induced gamma emission e.g. gamma-ray laser

popular **STED:** stimulated emission depletion **microscopy**

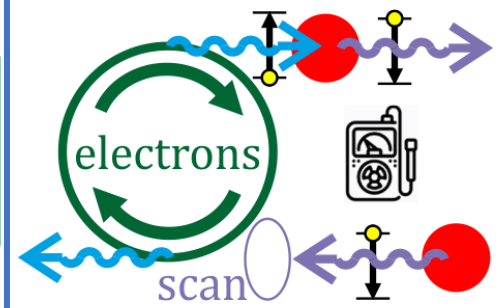
excite in small dot with **excitation laser**,
deexcite in doungnut with **depletion laser**,
getting **tiny excited dot**: better resolution



$$\frac{\partial N_2}{\partial t}^{\text{excited}} = -\frac{\partial N_1}{\partial t}^{\text{ground}} = B_{12}\,\rho(\nu)\,N_1 \quad \text{absorption} \quad \text{usually } \sim N$$

CPT

$$\frac{\partial N_2}{\partial t}^{\text{excited}} = -\frac{\partial N_1}{\partial t}^{\text{ground}} = -B_{21}\,\rho(\nu)\,N_2 \quad \text{stimulated emission} \quad \text{usually } \sim 0$$



(arXiv:2409.15399)

STED-like depletion for nuclei?

"shake nuclei" **to speedup decay by e.g. synchrotron?**

direction?

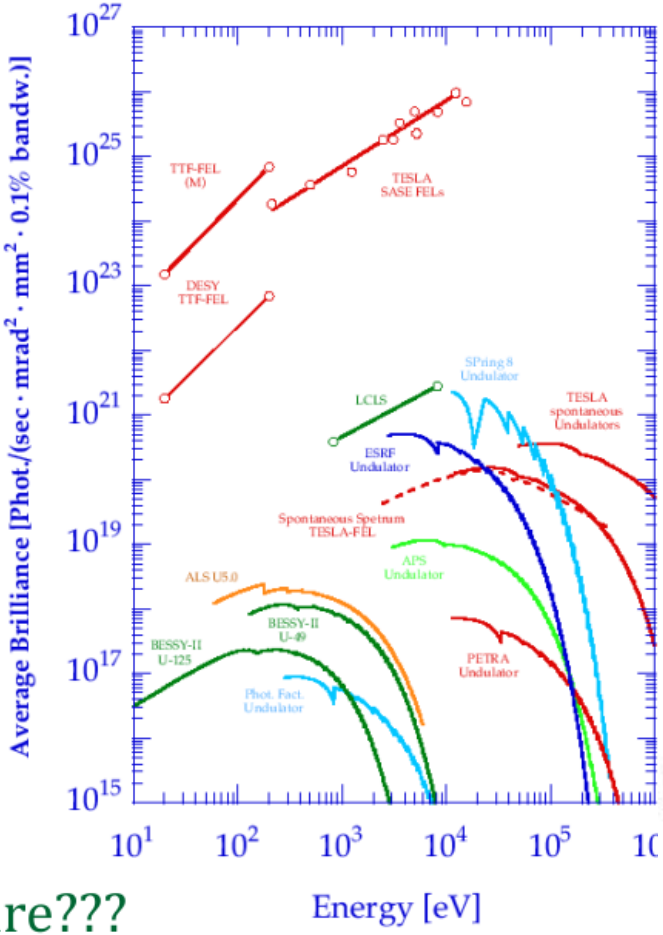
Astrophysics?

Decay modes?

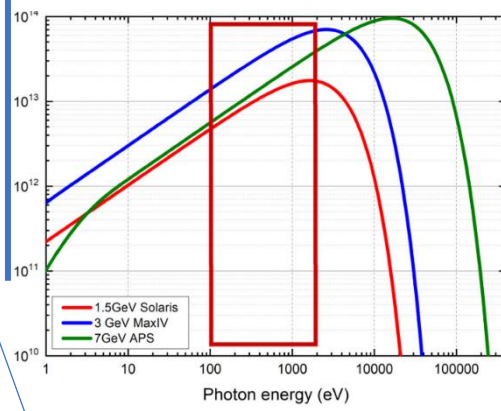
IT: isomeric?

Alpha/Beta??

Electron Capture???



E(keV)	Intensity	Nuclide
6.24(2)	1.031	W-181 (EC 121.2 D)
7.133(10)	4.95	Er-160 (EC 28.58 H)
8.41031(19)	0.158	Er-169 (B- 9.40 D)
12.327(6)	1.531	Ba-133m (IT 38.9 H)
12.47	3.000e-06	Ca-45 (B- 162.61 D)
13.263(15)	8.900e-02	As-73 (EC 80.30 D)
13.52(2)	1.6	Ra-228 (B- 5.75 Y)
16.2(1)	0.72	Ra-228 (B- 5.75 Y)
16.207(30)	0.159	Hg-195m (IT 41.6 H)
19.394(2)	13.69	Lu-171 (EC 8.24 D)
21.543(3)	3.140e-02	Sm-151 (B- 90 Y)
23.870(8)	16.1	Sb-119 (EC 38.19 H)

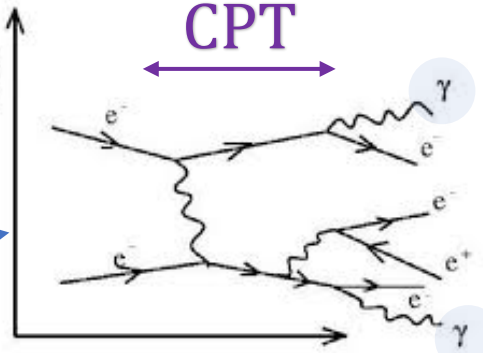


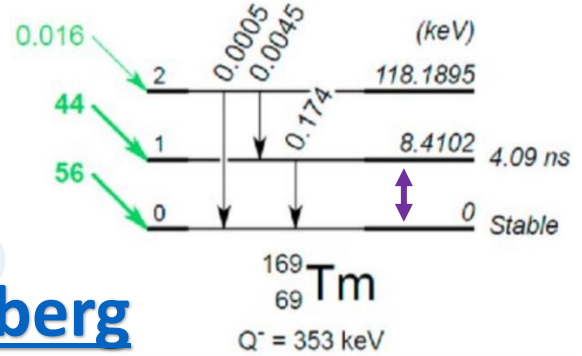
e.g. **Er-169**

9 days e^- 351 keV

4 ns γ 8.4 keV

pumped for backward camera?





Increase rate of Feynman diagrams emitting chosen energy photons?

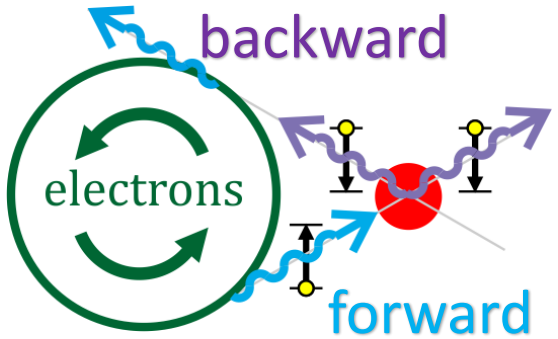
Feynman–Stueckelberg

How to generate negative radiation pressure?

Can we separate causation of excitation/deexcitation?

Physics governed by the same equation in CPT perspective

Just reverse optical isolator? Or ring laser, synchrotron? wiggler/ undulator?



ring laser: unidirectional photon trajectories, reversed in CPT symmetry

external **stimulated emission**

target in CPT perspective

backward beam

external (stimulated) **absorption**

standard **target**

forward beam

photons

ring laser

optical isolator

laser crystal + pump

stimulated emission & absorption

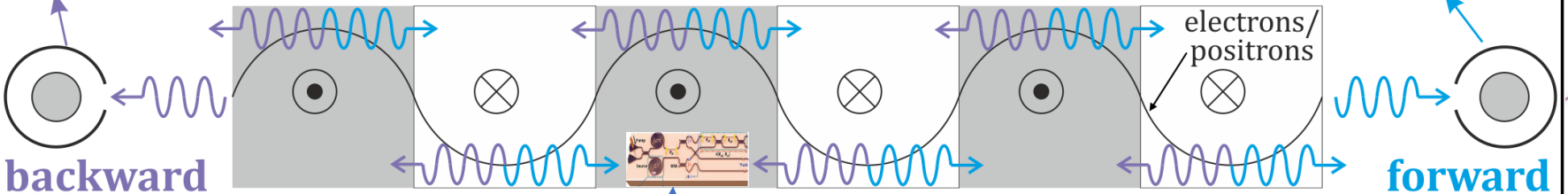
CPT CPT

emission ← **CPT** → **absorption**

stimulated Einstein: $B_{12} = B_{21}$

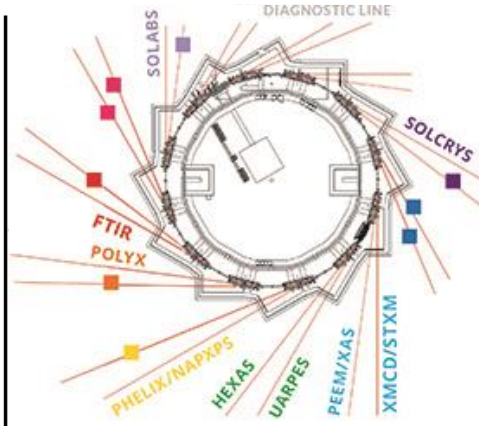
$$\frac{\partial N_2}{\partial t}^{\text{excited}} = -\frac{\partial N_1}{\partial t}^{\text{ground}} = -B_{21}\,\rho(\nu)\,N_2 \quad \text{usually } \sim 0$$

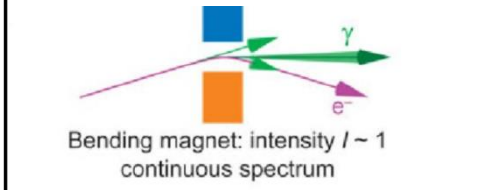
$$\frac{\partial N_2}{\partial t}^{\text{excited}} = -\frac{\partial N_1}{\partial t}^{\text{ground}} = B_{12}\,\rho(\nu)\,N_1 \quad \text{usually } \sim N$$



backward **forward**

wiggler/undulator/synchrotron: in CPT reversing electron & photon trajectory





Bending magnet: intensity $I \sim 1$
continuous spectrum

Wiggler: intensity $I \sim N$
continuous spectrum

Undulator: intensity $I \sim N^2$
discrete lines in energy

Opposite in CPT … **photonic chip for 2WQC?** **SASE**

Causing excitation and deexcitation … if possible: $N_2 > 0$

ASE – amplified spontaneous emission (**SASE**: self-)

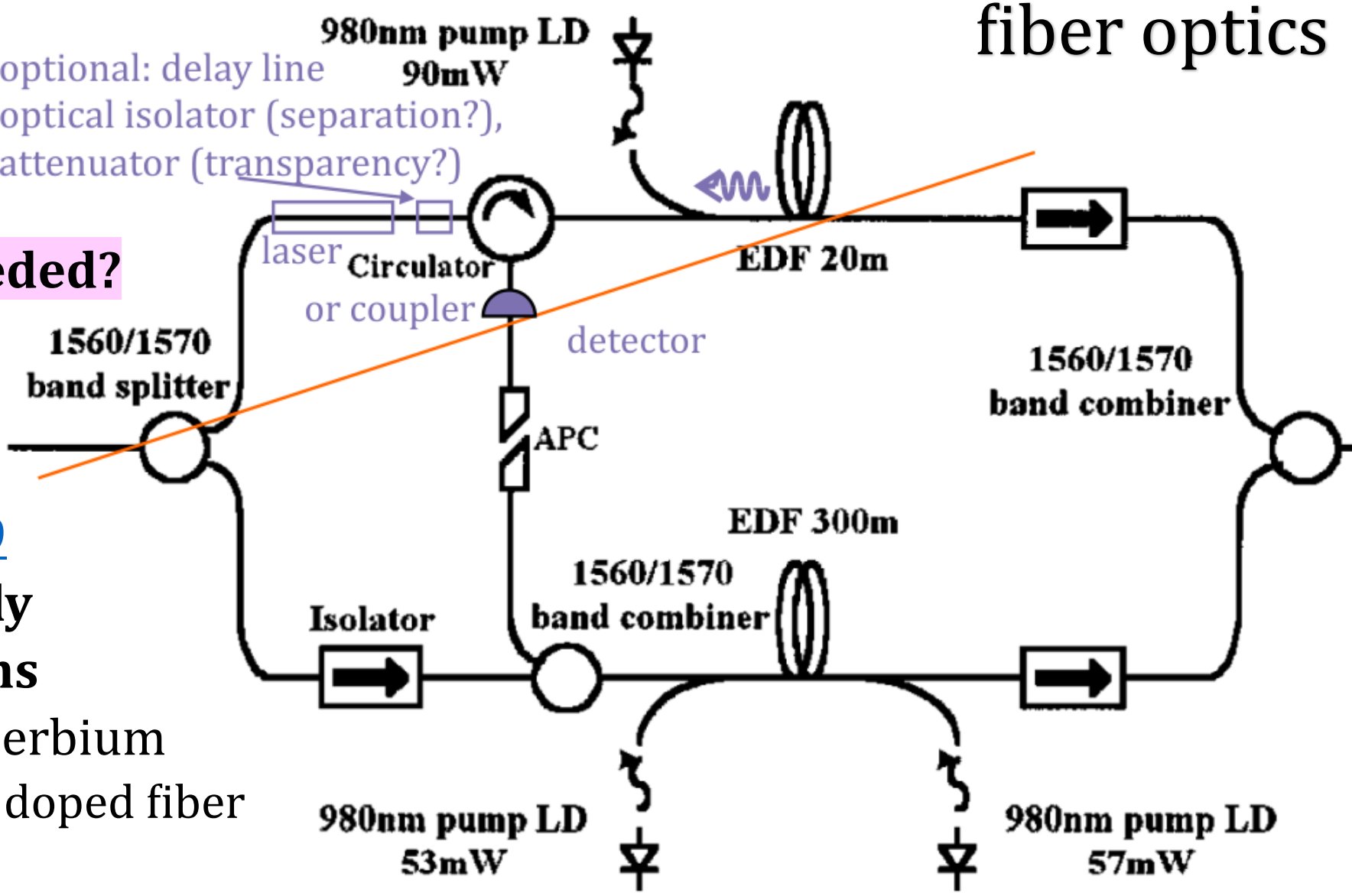
backward ASE prevented by forward optical isolator: photons '→'

CPT? **forward ASE prevented by backward optical isolator? '←' ?**

forward/backward ASE ~ positive/negative radiation pressure

fiber optics

Can we separate them??? Impulse needed? Coupling?



Black from IEEE:841259

laser literally pulls photons

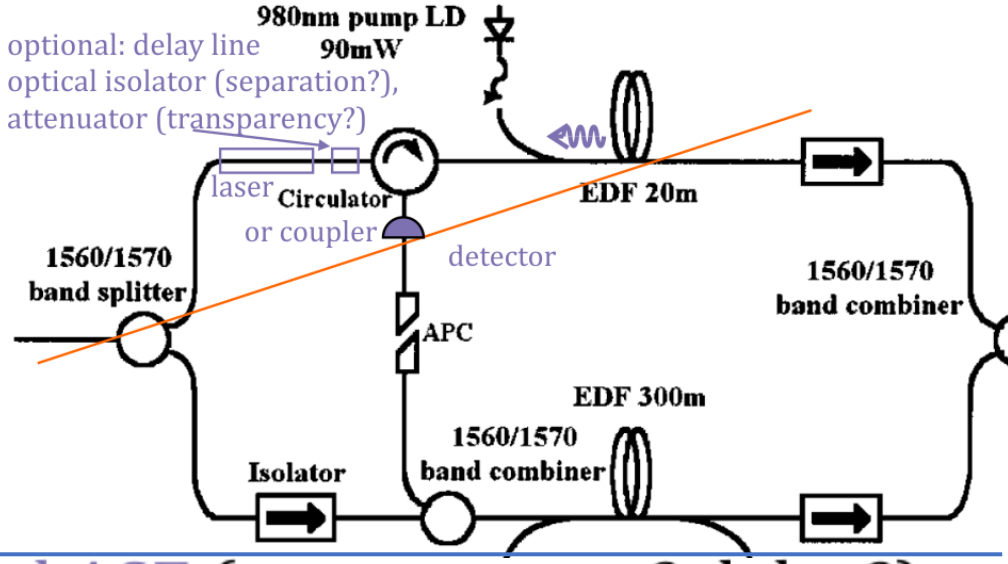
from excited erbium

EDF – erbium doped fiber

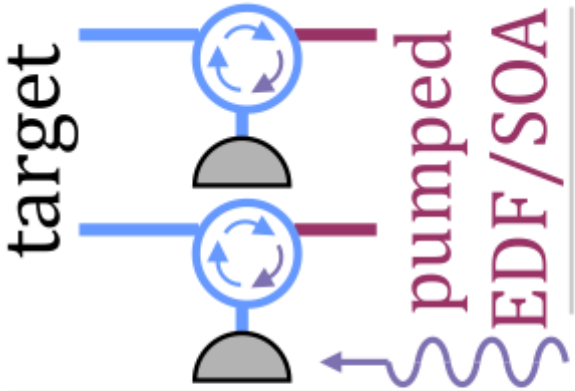
(of negative radiation pressure)

Backward camera? e.g. for emission CT, astronomy e.g. [pulsar synchrotron radiation](#)?

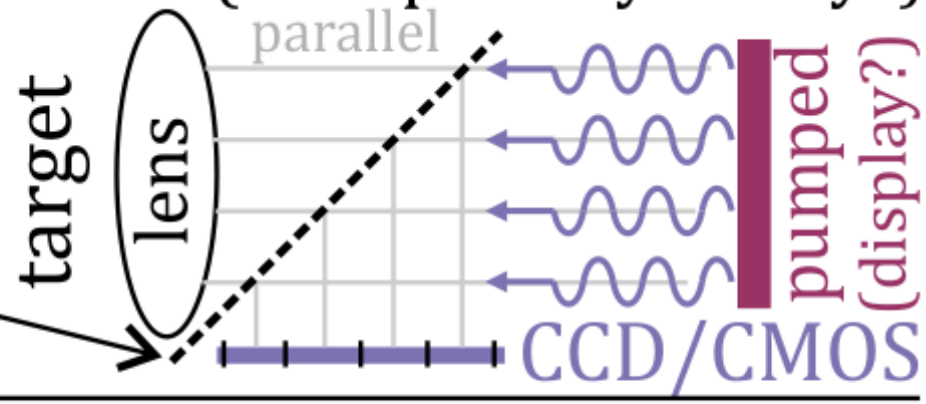
Backward lighted camera? amplify target deexcitation e.g. thermal, nuclear, attacks on e.g. [BB84](#) "pulling more photons"



Backward camera: of target's backward ASE (transparency? delay?)



e.g. multimode optical fiber or semi-transparent mirror (coupler)



synchrotron?

(backward) **transmission scanning**: of (N_2)N_1 atoms/molecules:

(map of) target **emission spectrum** (CP)T target **absorption spectrum**

Backward lighted camera: causing backward ASE of target (BB84?)

Amplifies target's directional emission

e.g. of BB84 transmission laser (+CNOT)

Observed negative delays

Matthew, **Science** 2003

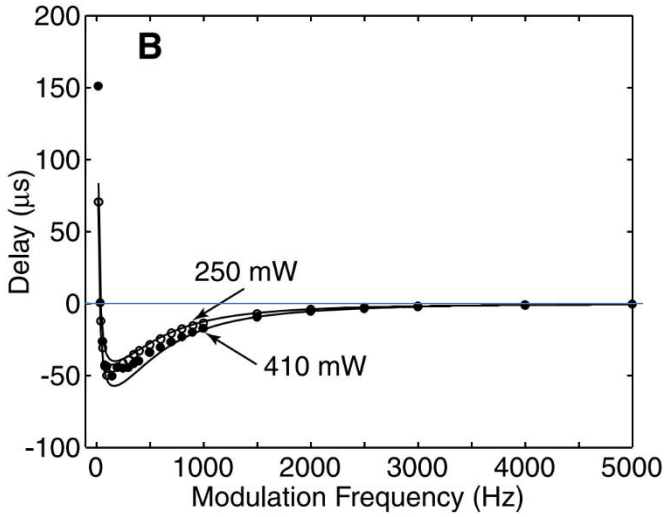
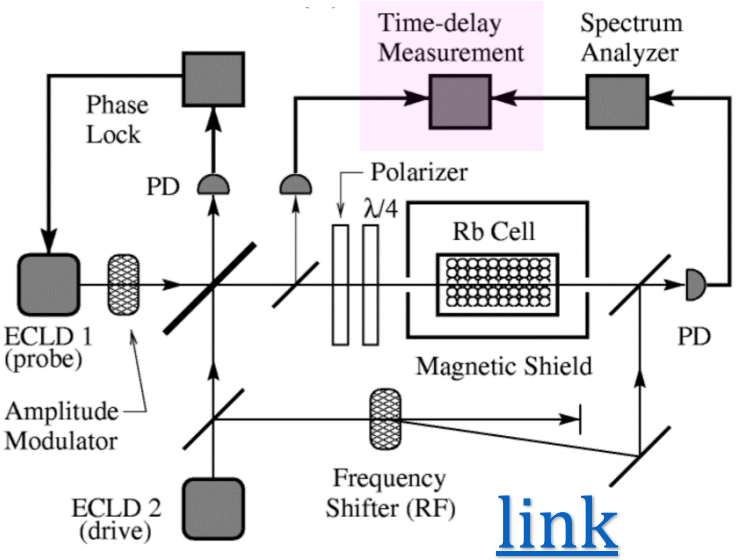


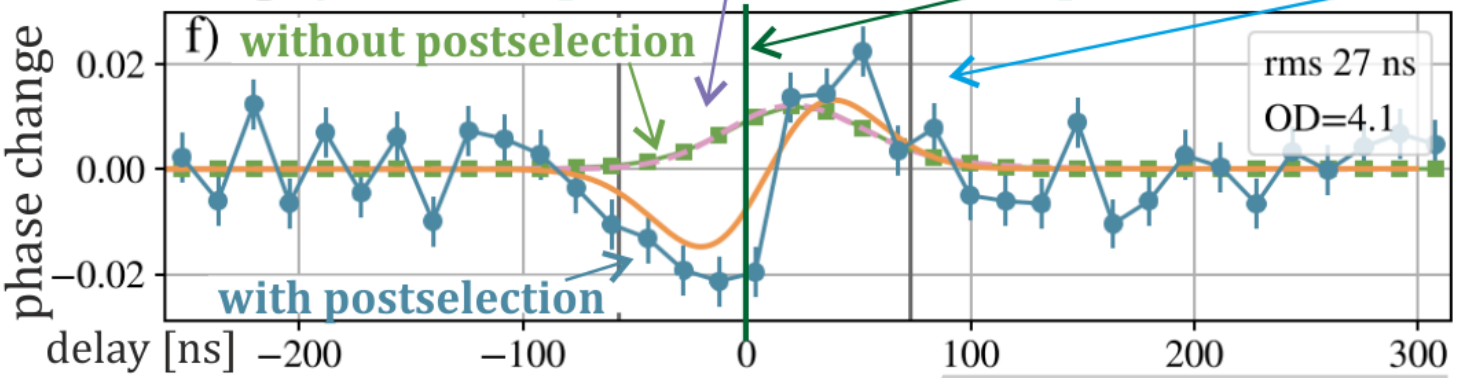
Fig. 2. (**A**) Relative modulation attenuation and (**B**) time delay measured for a 4-cm-long alexandrite crystal at a wavelength of 476 nm with pump powers of 250 and 410 mW. The observed negative time delay corresponds to superluminal propagation. The solid lines indicate the results of our theoretical model.

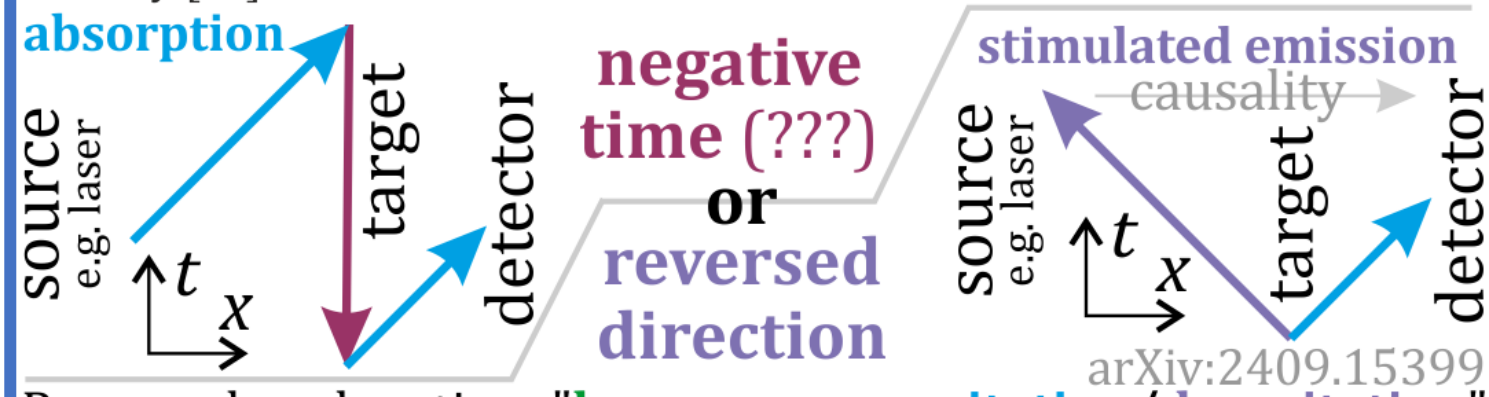


link

'Negative time evidence' Steinberg et al., arXiv:2409.03680

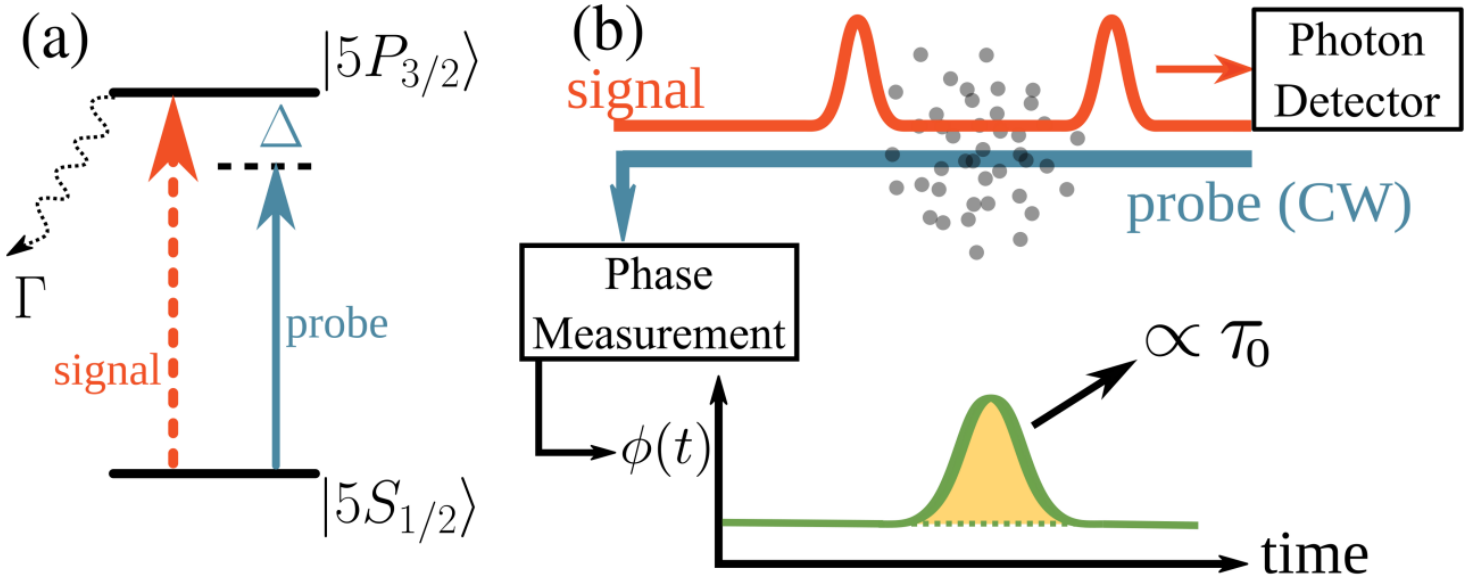
observing system response before the impulse and after





arXiv:2409.15399

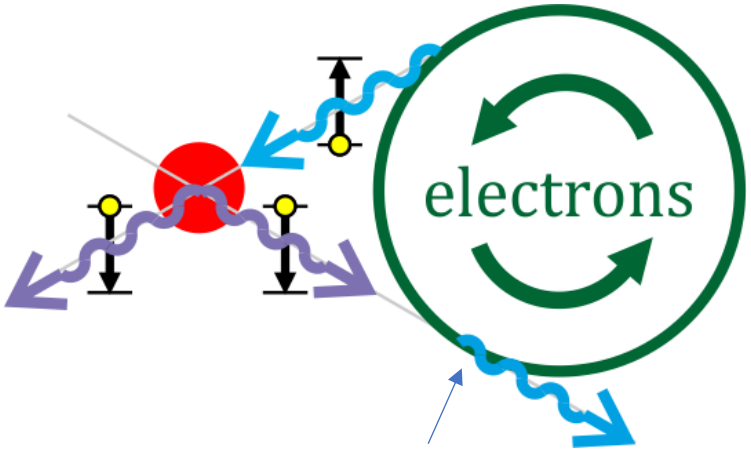
Proposed explanation: "**laser causes excitation/deexcitation**" are **CPT symmetry analogs**: **should have opposite delay sign**



Is absorption/ stimulated emission in agreement with CPT symmetry?

If not: **can we show macro CPT violation?**

Many **micro** CPT tests

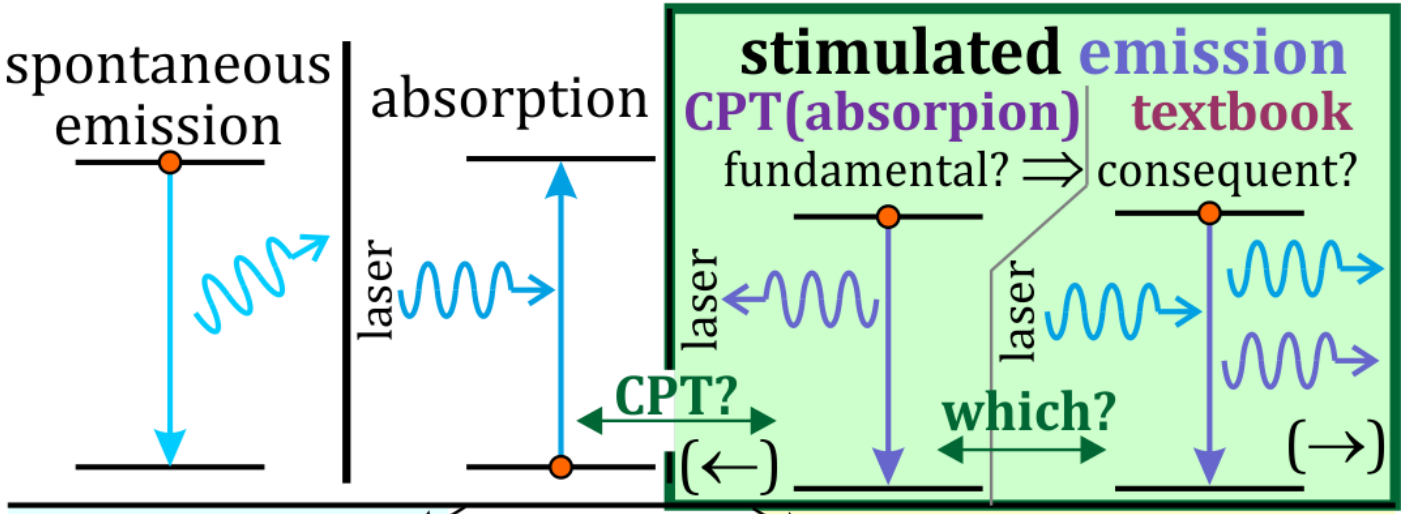


positive/negative radiation pressure:

tendency to emit photons →/←

(carried by photons?)

CT scanner modifications



laser causes — **CPT transform** — CPT(**laser**) causes

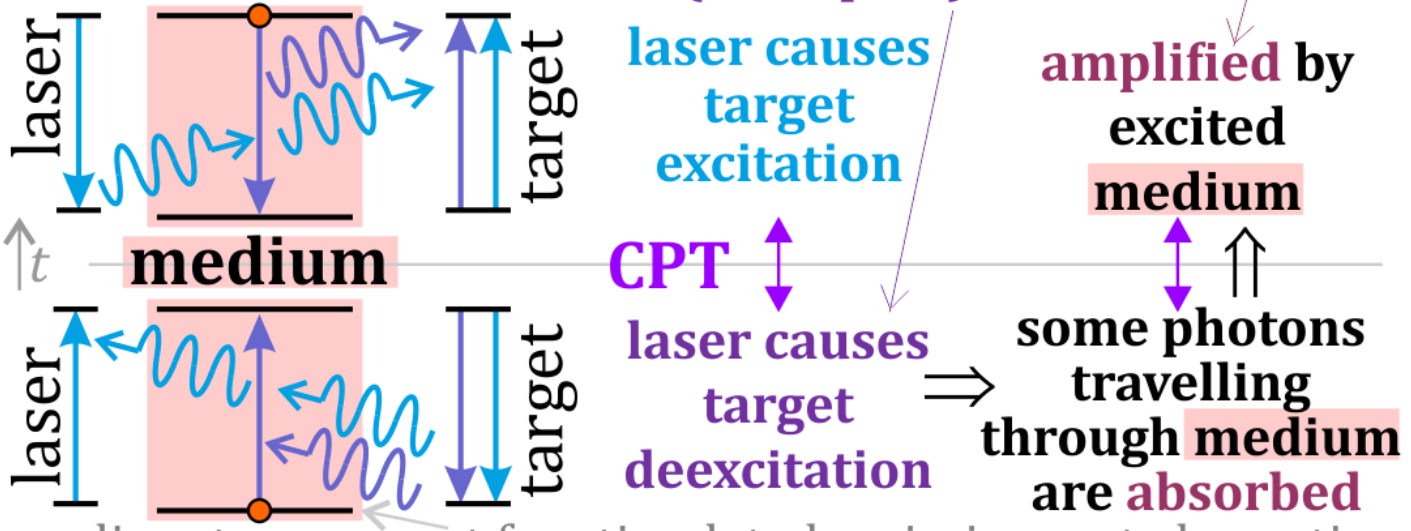
target excitation — CPT(**target**) deexcitation

Einstein: $B_{12} = B_{21}$

$$\frac{\partial N_2}{\partial t}^{\text{excited}} = -\frac{\partial N_1}{\partial t}^{\text{ground}} = B_{12}\,\rho(\nu)\,N_1 \quad \text{usually } \sim N \text{ (absorption)}$$

$$\frac{\partial N_2}{\partial t}^{\text{excited}} = -\frac{\partial N_1}{\partial t}^{\text{ground}} = -B_{21}\,\rho(\nu)\,N_2 \quad \text{usually } \sim 0 \text{ (stimulated emission)}$$

transparent if $N_1 = 0$ $\neq!$ $N_2 = 0$ (no target)



Let's speedup quantum supremacy! (e.g. solve NP, better error correction)

CPT symmetry: having $|0\rangle$, there is also $\langle 0|$

Jarek Duda, www.qaif.org/2wqc

2WQC: two-way quantum computers

adding $\langle 0|$ postparation:
CPT(state preparation)
Acts as **postselection**, but with **higher success rate**

In CPT symmetry perspective use state preparation process

e.g. **low temperature**: $|0\rangle \leftrightarrow \langle 0|$

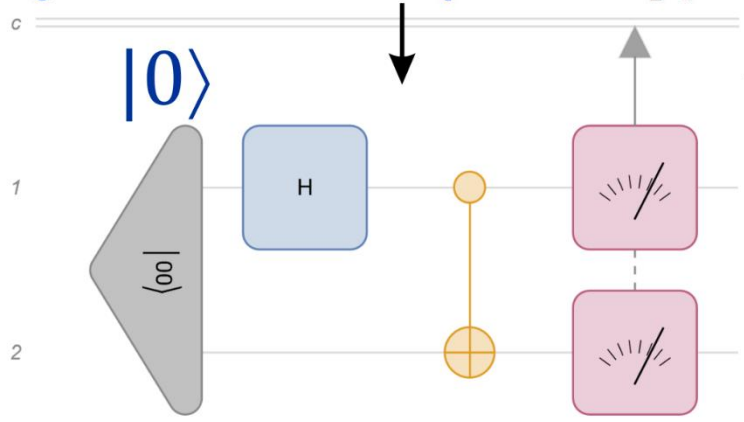
$$\langle\psi_f|U|\psi_i\rangle \overset{\text{CPT}}{\longleftrightarrow} \langle\psi_i|U^\dagger|\psi_f\rangle$$

Evolve forward $\leftrightarrow$ backward

~~1~~2WQC


```
QuantumCircuitOperator[{"00", "H" → 1, "CNOT", {1, 2}}]
```

Wolfram Quantum Framework




```
qc[]["ProbabilityPlot"]
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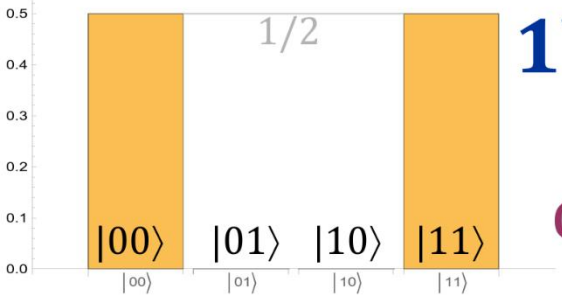
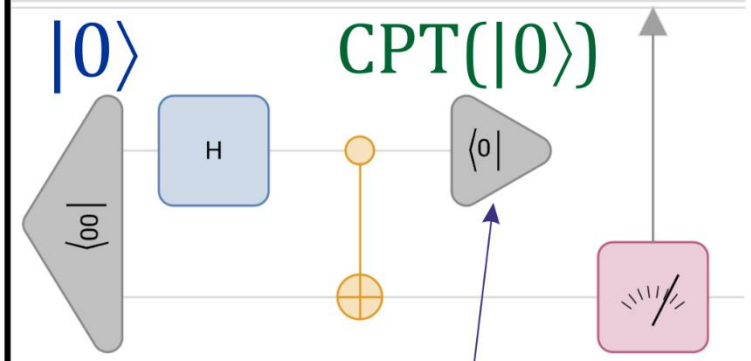
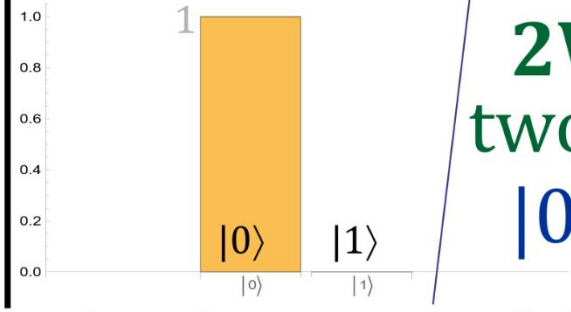


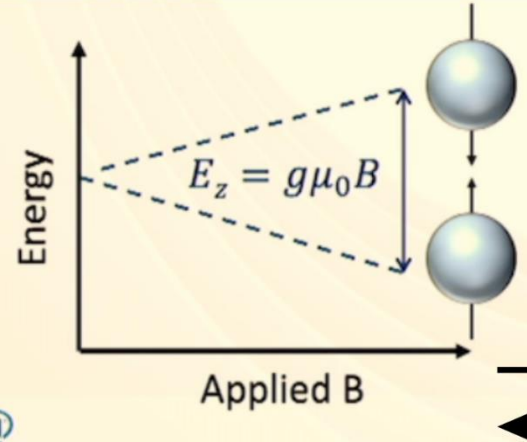
1WQC
$|0\rangle$
only



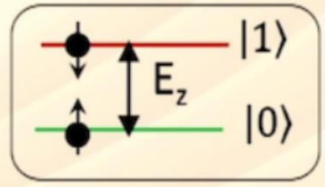


2WQC
two-way
$|0\rangle, \langle 0|$

```
QuantumCircuitOperator[{"00", "H" → 1, "CNOT", SuperDagger["0"], {2}}]
```



e.g. silicon quantum dots (Intel)



Apply Magnetic Field

strong B just before: preparation $|\uparrow\rangle$
strong B just after: postparation $\langle\uparrow|$
switched in CPT perspective

Fundamental physics: QFT Feynman ensembles – CPT symmetric

Past and future are fundamentally very similar … can we apply it?

Pre: https://en.wikipedia.org/wiki/**Maximal_entropy_random_walk**, *arXiv:0910.2724*

2023: *arXiv:2308.13522* "Two-way quantum computers adding CPT analog of state preparation"

2024: **2WQC XPRIZE team**, **~40 QInterns** … **NP solver, better error correction**

G. Czelusta, **Grover's algorithm** on two-way quantum computer, *arXiv:2406.09450*

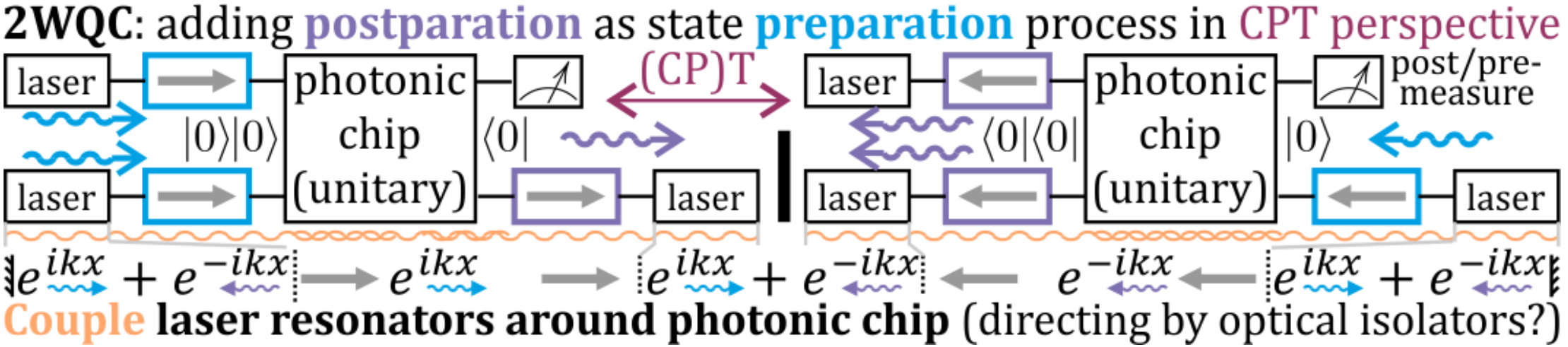
M. Noor, J. Duda, **No-cloning theorem** for 2WQC and postselection, *arXiv:2407.15623*

J. Duda, **3-SAT solver** for two-way quantum computers, *arXiv:2408.05812*

A. Linden, B. Gül, Optimization of **postselection** … 2WQC approach, *arXiv:2409.03785*

J. Duda, Testing stimulated emission photon direction, *arXiv:2409.15399*

Many arguments, no counter? **search for help with experimental confirmation**

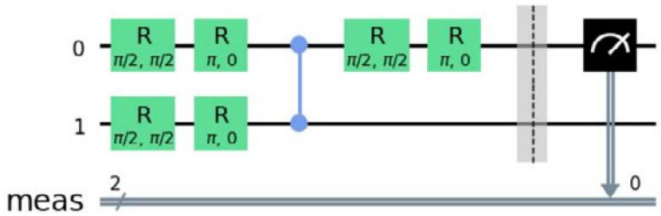


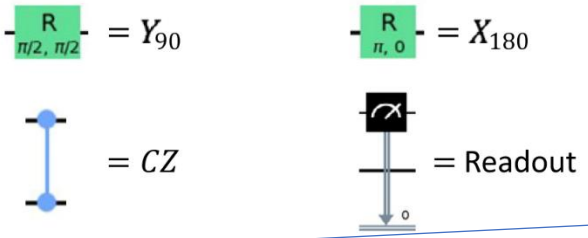
Superconducting QC e.g. IQM

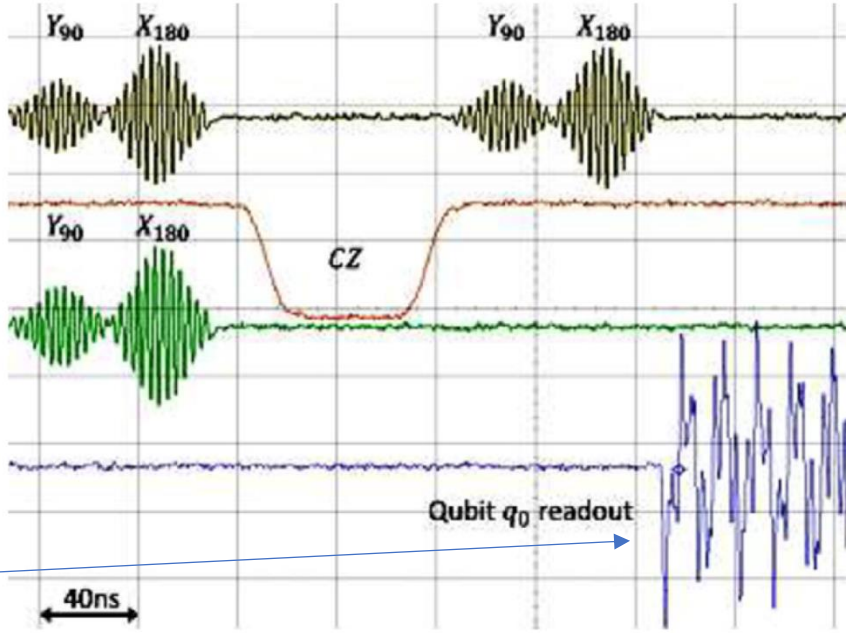
Measurement/ readout by coupling with resonator (**invasive,** reverse? $V(t) \rightarrow V(-t)$?)

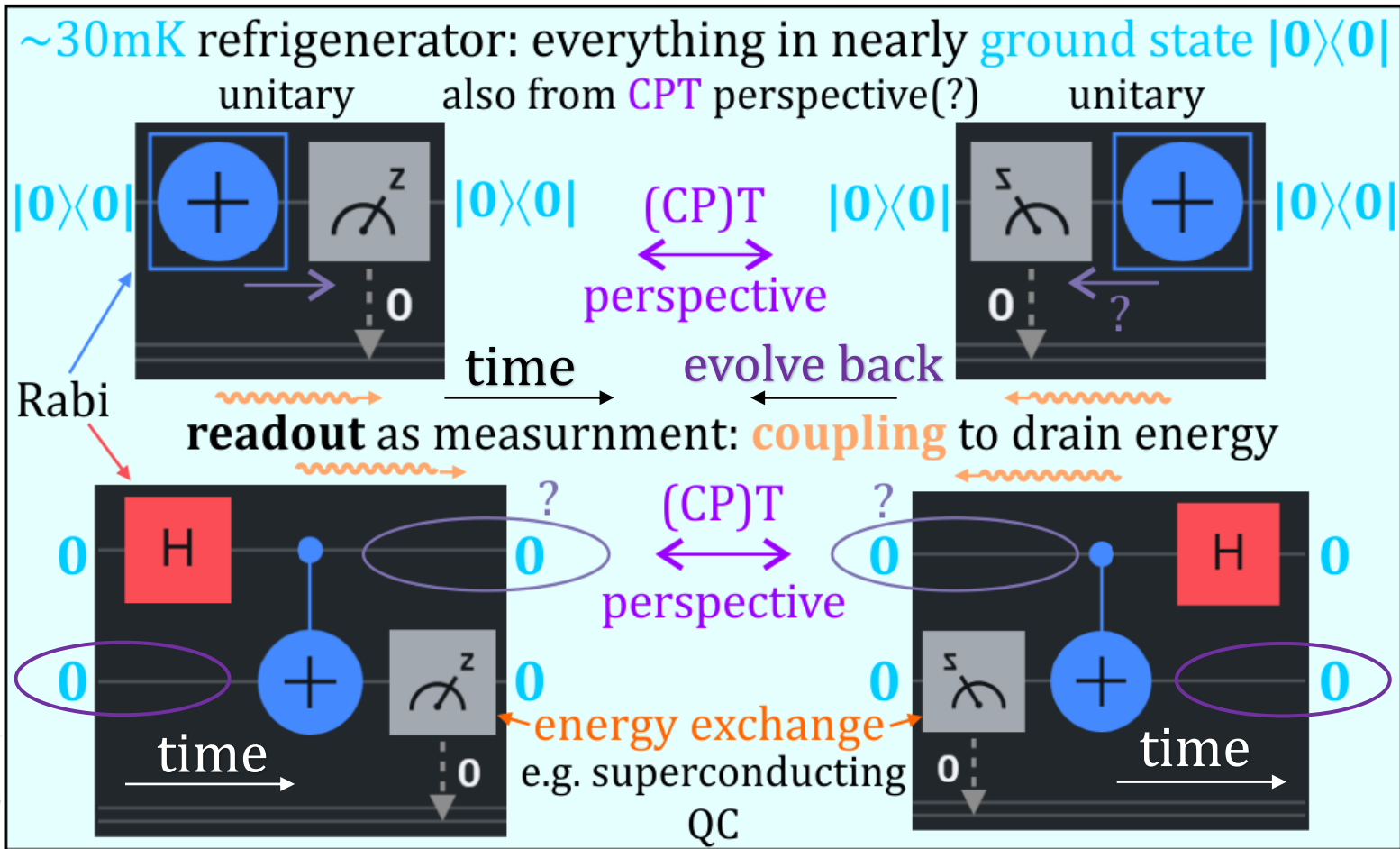
State preparation by reset or lowering temperature - conserved by **CPT symmetry** $|0\rangle\langle 0|$?- also **postparation**? (if no readout/delay, exchanging energy)

$$\langle\psi_f|U|\psi_i\rangle \overset{\text{CPT}}{\longleftrightarrow} \langle\psi_i|U^\dagger|\psi_f\rangle$$

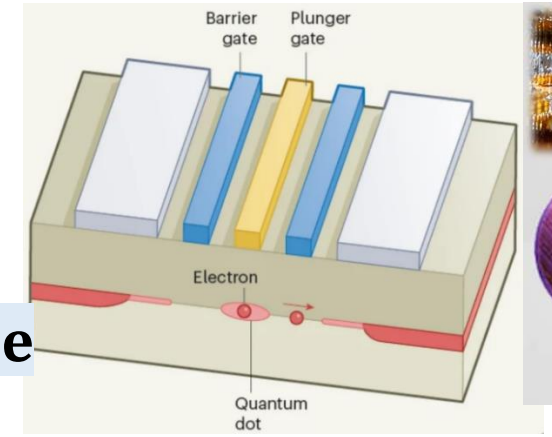


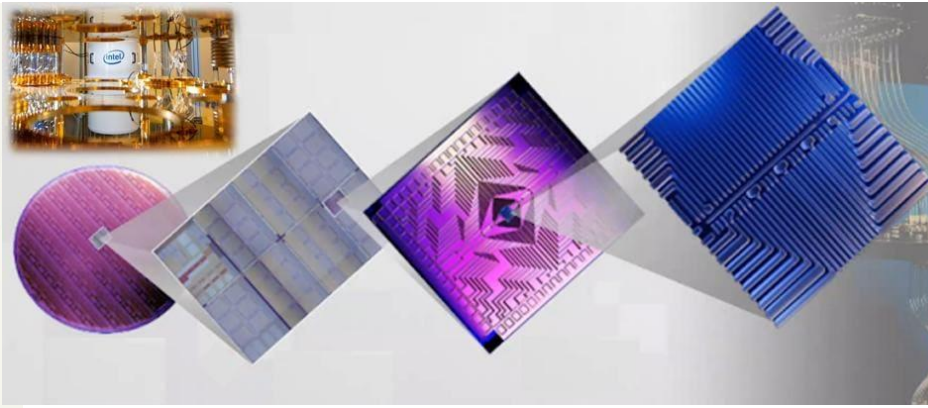




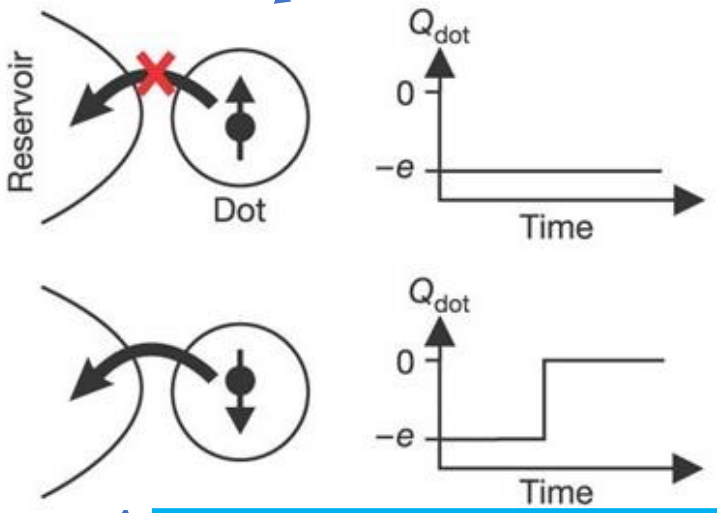


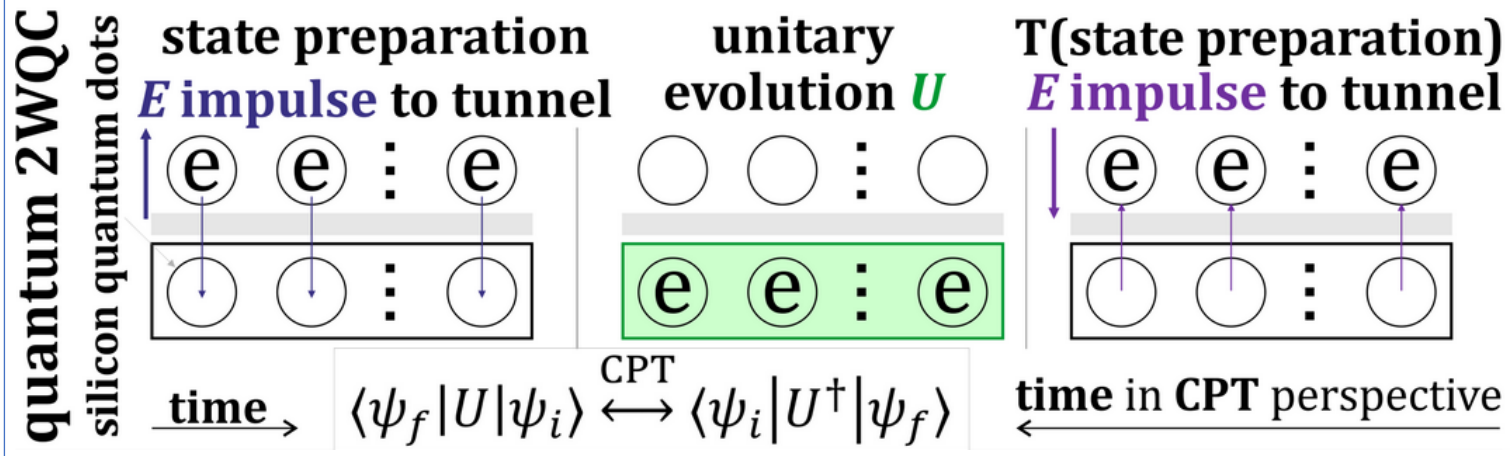
Silicon quantum dots
e.g. Intel 12 qubit





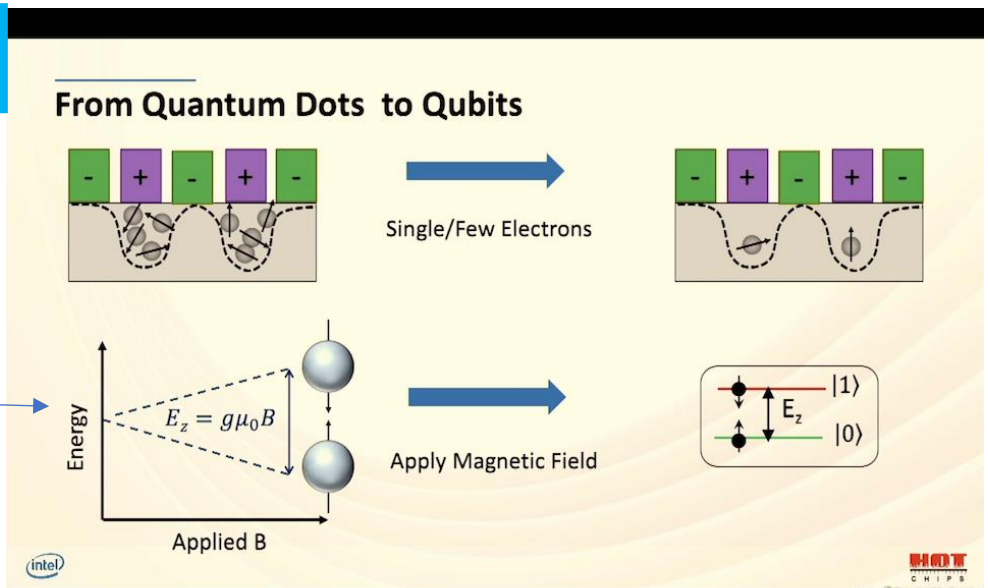
All operations with EM fields – easy to reverse spin or position qubits





reverse applied impulse: $V(t) \leftrightarrow V(-t)$

Elzerman readout: only ↓ spin can tunnel **in Intel 2024 article for state preparation**



Or use magnetic field to enforce spin direction

before for $|0\rangle$, opposite after for $\langle 0|$

NP problem: find input satisfying polynomial time verifier

+⟨0| postparation 2WQC in theory allows NP solvers, e.g. **cipher breaking (resistant PQC???) global optimizers** like **drug design** ... Also 2WQC allows **better stability, error correction**

for example 3-SAT problem, like finding $x_1, x_2, \ldots, x_n \in \{0,1\}$:

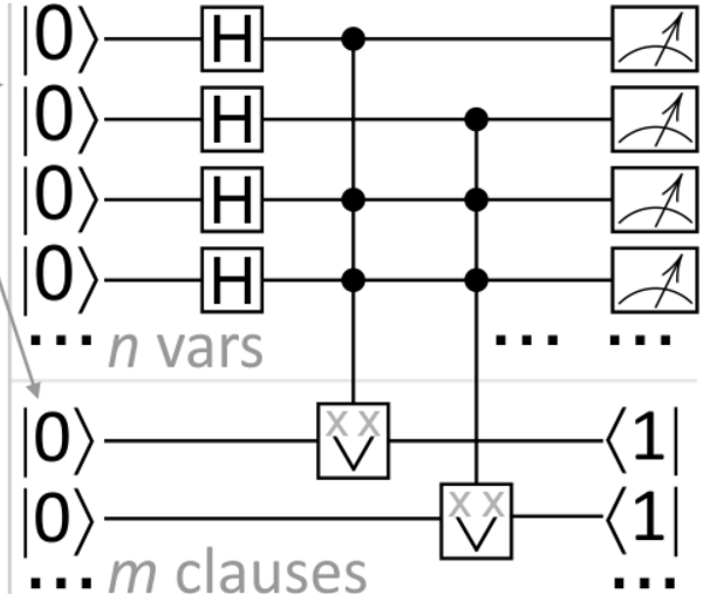
$$\exists_{x_1 x_2 \ldots} (x_1 \vee \neg x_2 \vee x_3) \wedge (\neg x_4 \vee x_2 \vee \neg x_3) \wedge (x_5 \vee \neg x_4 \vee x_2) \wedge \ldots ?$$

basic 3-SAT setting:

***n* variables** used up to 4 times,

***m* clauses** using 3 variables

- prepare ensemble of 2^n inputs
- calculate C-ORs with NOTs:
- enforce all C-ORs to 1 with ⟨1|
- measure inptut qubits



Shor quantum routine, measurement restricts to $\{b: y^b \bmod N = m\}$:

$$|\mathbf{00}\rangle \xrightarrow{H_{\mathrm{I}}^{\otimes n}} \sum_{a=0}^{2^n-1} |a\rangle|\mathbf{0}\rangle \xrightarrow{\text{classic}} \sum_a |a\rangle|y^a \bmod N\rangle \xrightarrow{\text{meas}_{\mathrm{II}}} \sum_b |b\rangle|m\rangle \xrightarrow{\text{QFT}_{\mathrm{I}},\text{meas}_{\mathrm{I}}} |c\rangle|m\rangle$$

3-SAT attack (NP), $\langle \mathbf{1}|_{\mathrm{II}}$ restricts ensemble to $\{b: \mathrm{SAT}(b) = \text{true}\}$

$$|\mathbf{00}\rangle \xrightarrow{H_{\mathrm{I}}^{\otimes n}} \sum_{a=0}^{2^n-1} |a\rangle|\mathbf{0}\rangle \xrightarrow{\text{SAT?}} \sum_a |a\rangle|\mathrm{SAT}(a)\rangle \xrightarrow{\langle \mathbf{1}|_{\mathrm{II}}} \sum_b |b\rangle|\mathbf{1}\rangle \xrightarrow{\text{meas}_{\mathrm{I}}} b$$

for imperfect $\langle \mathbf{1}|$ would leave exponential number of false solutions

Post-quantum cryptography (PQC): now focused on Shor, Grover

What if better algorithms, upgrades like 2WQC are there/coming?

NP solver verifier: does decryption with given key lower entropy?

Are some of current PQC already resistant? (NP-hard is not enough)

Building nextgen PQC: immune/resistant to quantum NP solver?

E.g. **require initialization**: large calculations based on cryptographic key before proper decoding (tough for key superposition)

Maybe based on **higher class like PSPACE** (private/public key?)

https://en.wikipedia.org/wiki/PSPACE-complete

e.g. formal languages, **3-SAT +** ∀ quantifier $\left(\forall_{x,\ldots}\exists_{y,\ldots}(\vee\vee)\wedge\ldots\right)$,

reconfiguration: find path satisfying constraints (~arXiv:1204.5317),

puzzles/games: multiple-interaction cryptography (before low entropy)

https://en.wikipedia.org/wiki/**Non-orientable_wormhole**

Thought provoking gedankenexperiment allowed by general relativity

E.g. **Klein-bottle-like wormhole** applying T symmetry to a rocket

For external observer:

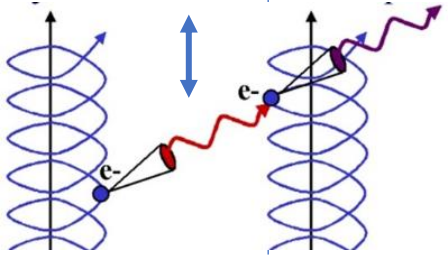
- **entropy decreases**, e.g. egg unscrambles,
- Reversed 1WQC,
- state preparation $|0\rangle$ ↔ **postparation** $\langle 0|$,
- **pre-measurement**,
- **CT emission scan**,
- **laser** causes deexcitation/**negative radiation pressure**,

absorption↔emission

stimulated?

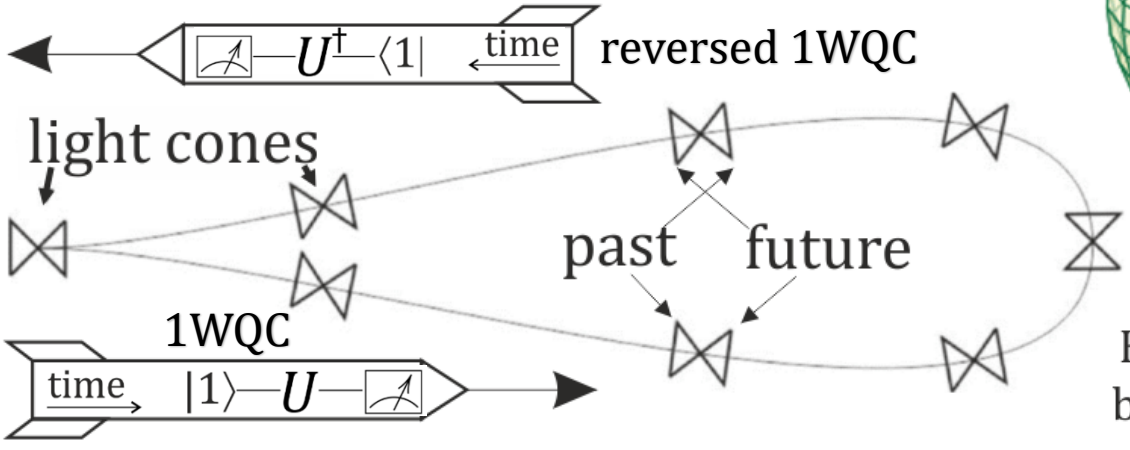
spontaneous?

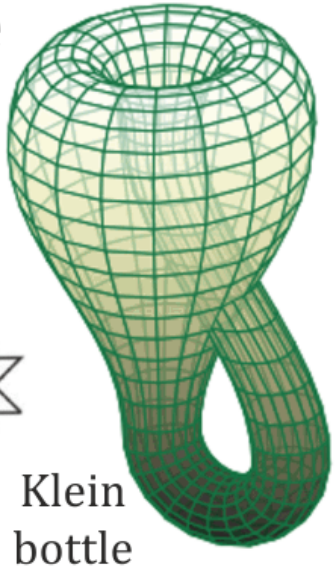
(absorption)

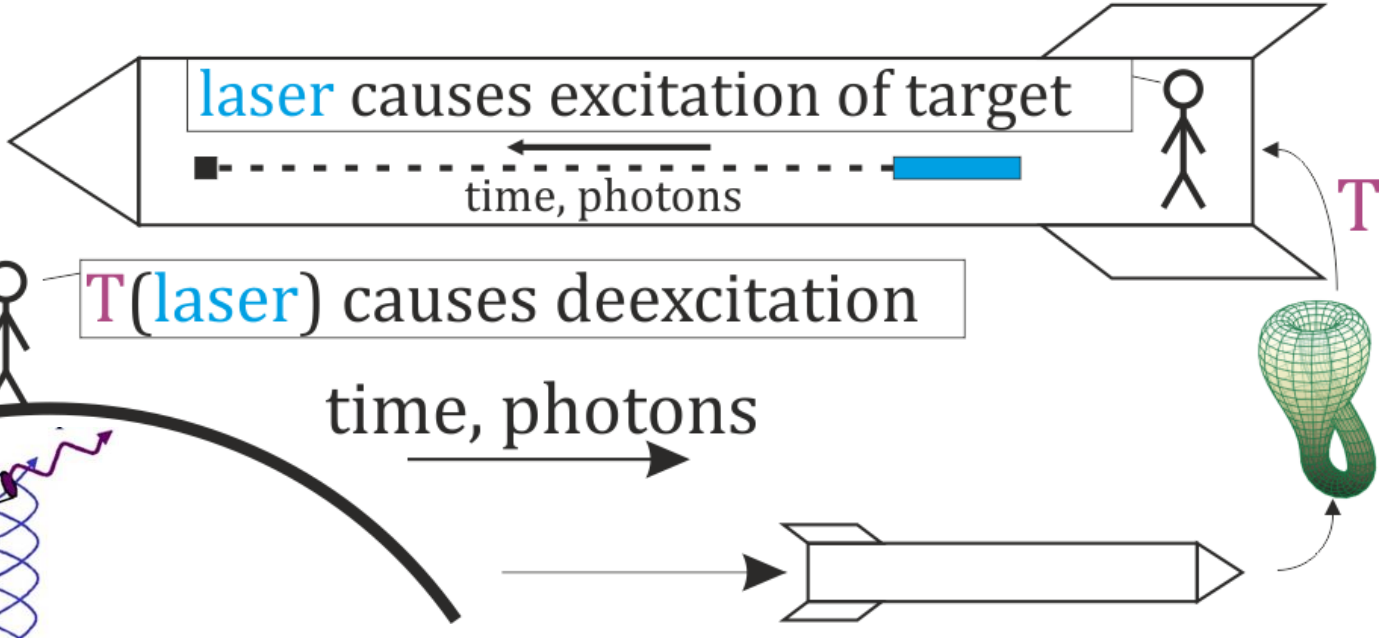


non-orientable wormhole

applying T (or P) transform



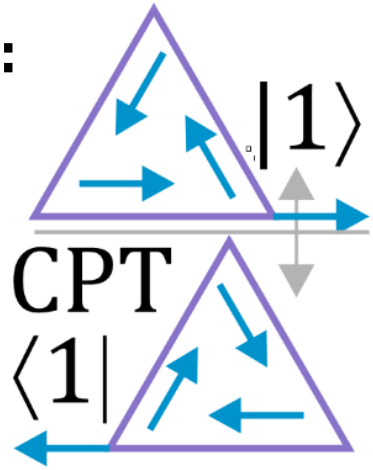




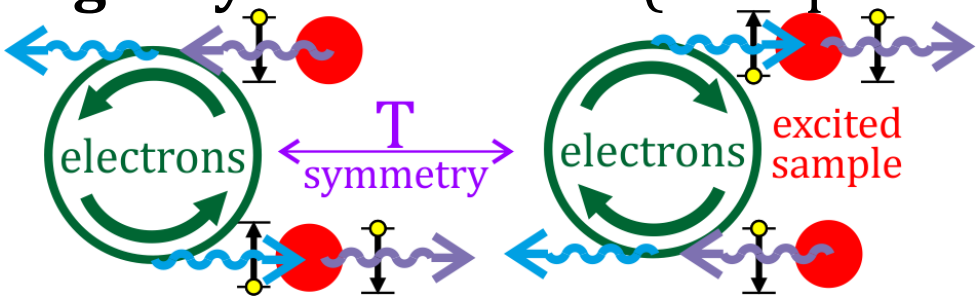
How to generate and measure **negative radiation pressure**?

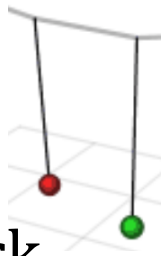
Is CPT symmetry still valid in macroscopic case?

No – we need to modify physics, Yes – many new applications:



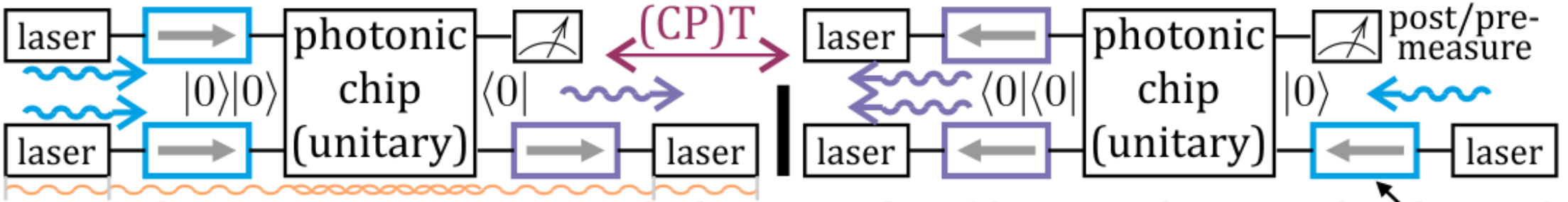
- **Backward beam causing only deexcitation** (transparency?)
  reversed isolator?
  ring laser?
  synchrotron?





- **Direct Rabi** removing OI, **STED without bleaching** by reversing OI?
- **Causing deexcitation:** radiotherapy, photolithography, nuclear …
- **Backward camera:** of target's backward beam, e.g. astronomy, Sun?
- **Backward lighted camera** enhancing target deexcitation, BB84 attack,
- **Emission CT**: backward beam + backward camera: medical, geology?
- **2WQC: two-way quantum computer:** solving NP, better error correction

2WQC: adding **postparation** as state **preparation** process in CPT perspective



Couple laser resonators around photonic chip (directing by optical isolators?)

Potential directions e.g. in synchrotron Solaris?

- **speedup of nuclear deexcitation e.g. Er-169 (forward/backward)?**
- **Linac: forward/backward window in new bending magnet?**
- **Contact with preferably visible spectrum e.g. betatron ... FEL?**