Summary of Gamma-Gamma session

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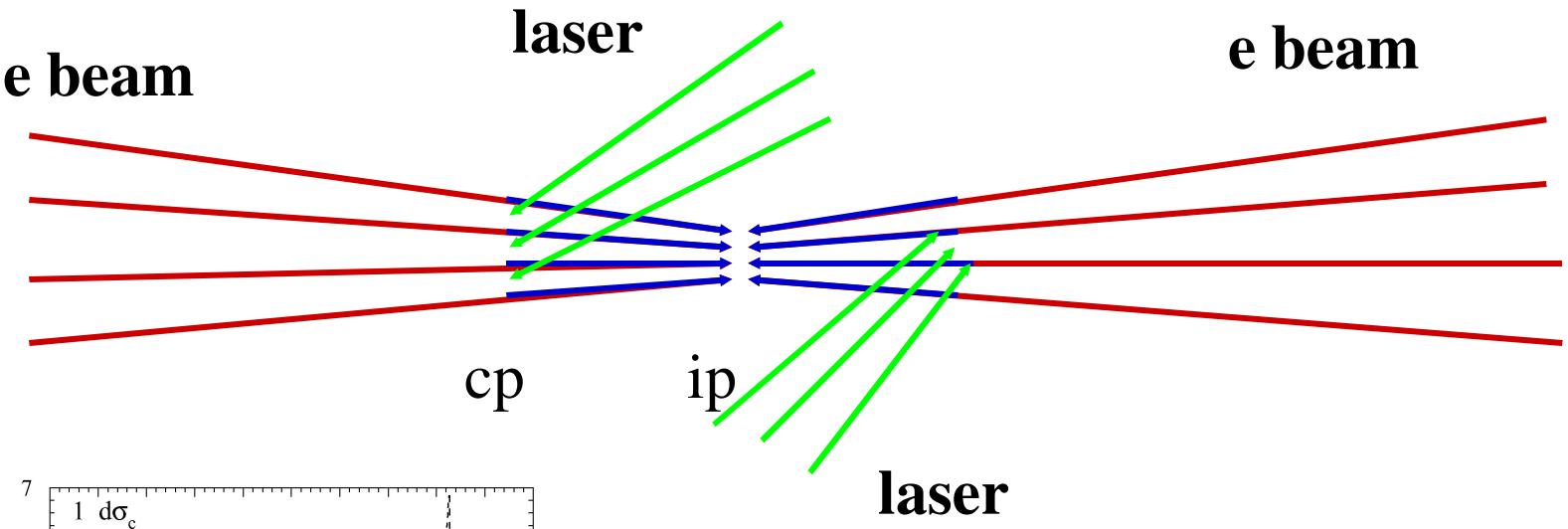
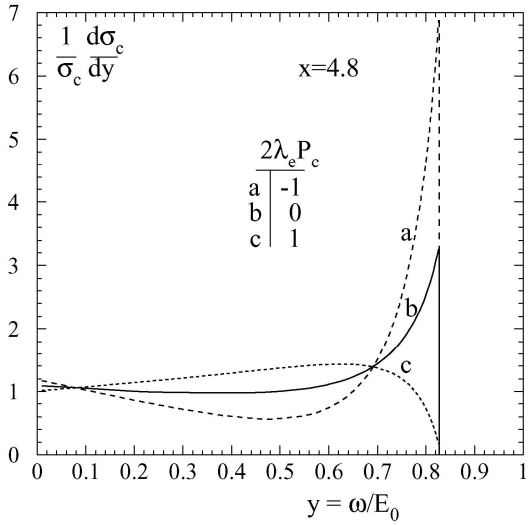
Hiroshima University

Mar 29. 2009
LCWS10/ILC10

Principle of γγ Collider





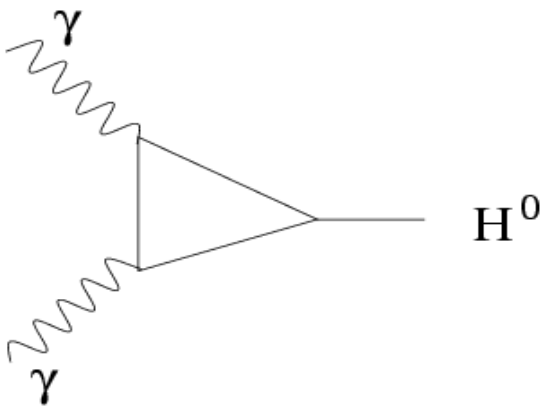
- γ spectrum depend on laser and electron polarization
- polarized photon beam

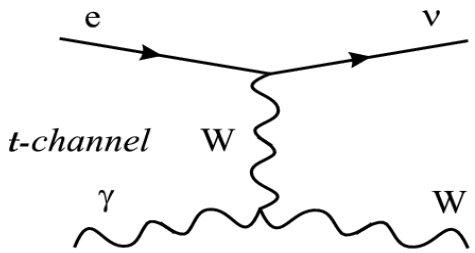
~90's ~ Mid00's

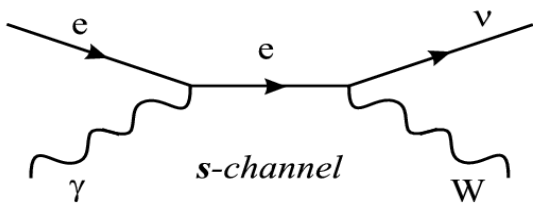
Extensive studies on Physics case and Technical Issues

Basic Physics Case for a Low Energy & High Energy PLC already stablish

M.Velasco
LCWS08







Low Energy E_{ee} ~150 GeV

- M_h=120 GeV
  - $\Gamma_{h\to\gamma\gamma}$ **Br**$_{H\to bb}$ → **2%**
- Eγ→Wν
  - Γ_W **& M** $_W$

High Energy

- M_A & M_H
  - **Accessible in low tan β not accessible to LHC and ILC**
  - **Turn ODD and EVEN states with linear polarization**
- Eγ→Wν
  - **Gauge coupling K_γ & λ_γ more precise than at the LHC**

After Mid 2000s

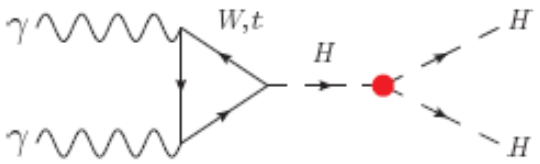
- Toward the realization of photon colliders
  - Technical R&D
    - Laser and optics
    - higher geometric luminosity
- Physics case
  - Beyond basic cases
    - rare processes w/ ultimate luminosity

In This workshop

- One Physics talk (another one submitted to Higgs session) ,,, joint w/ Higgs/EWSB
  - Higgs pair production in gamma gamma collier
    - K. IKEMATSU (KEK)
- Three Technical related talks joint w/ BDS/MDI
  - The design of the cavity laser
    - B. Stuart (LLNL)
  - Status of the optical resonant cavity development
    - Tohru Takahashi

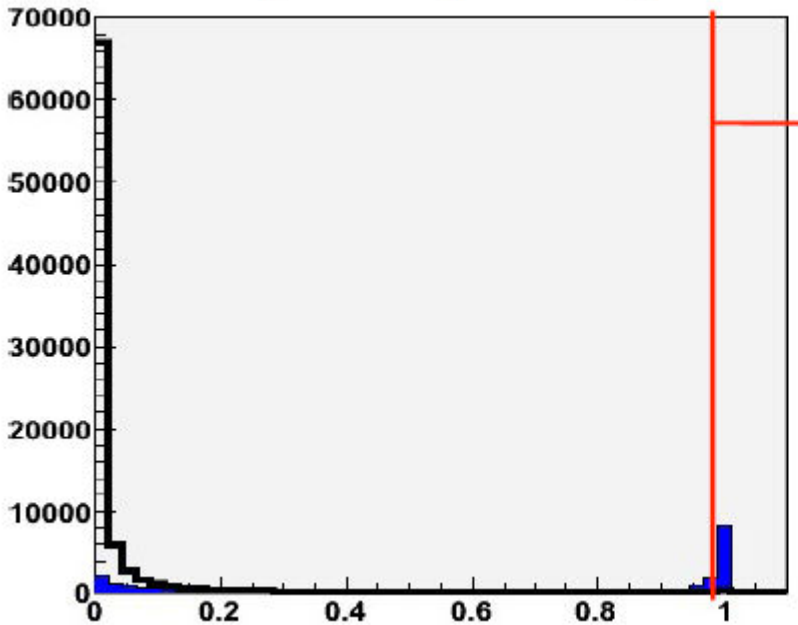
Higs pair in γγ colliders

Measurement of Higgs self-coupling constant $\lambda = \lambda_{SM}(1 + \delta\kappa)$ using γγ->HH process



and other diagrams

- Theoretical works by
  - **Jikia, Belusevic**
  - **Asakawa, Harada, Kenemura, Okada, Tsumura**



NNout > 0.98

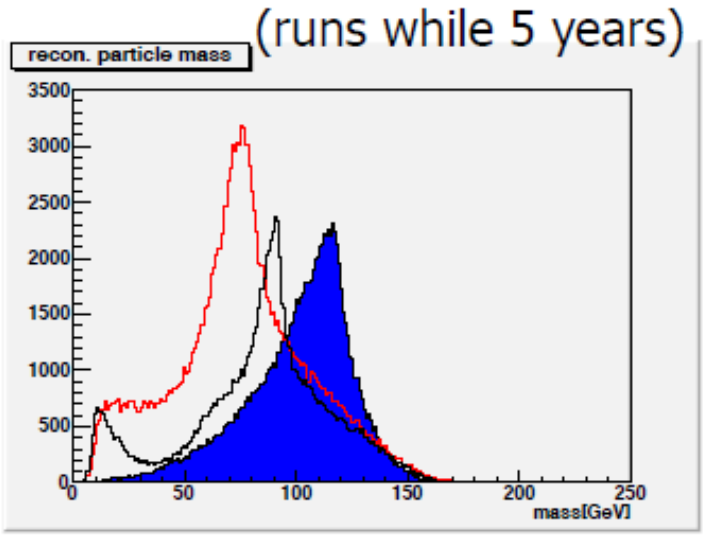
$$\eta_{Sig} = \frac{8205}{5.0\times10^{4}} = 0.164$$

$$\eta_{BG} = \frac{206}{7.5\times10^{7}} = 2.74\times10^{-6}$$

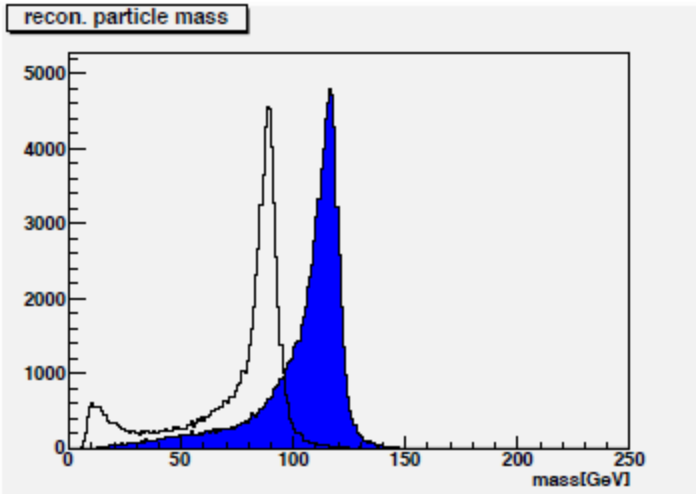
Huge WW BGs are eliminated!

γγ->ZZ showed up

γγ->ZZ->bbbb has the same final state with γγ->HH->bbbb



Current jet mass resolution



w/ ideal jet finder

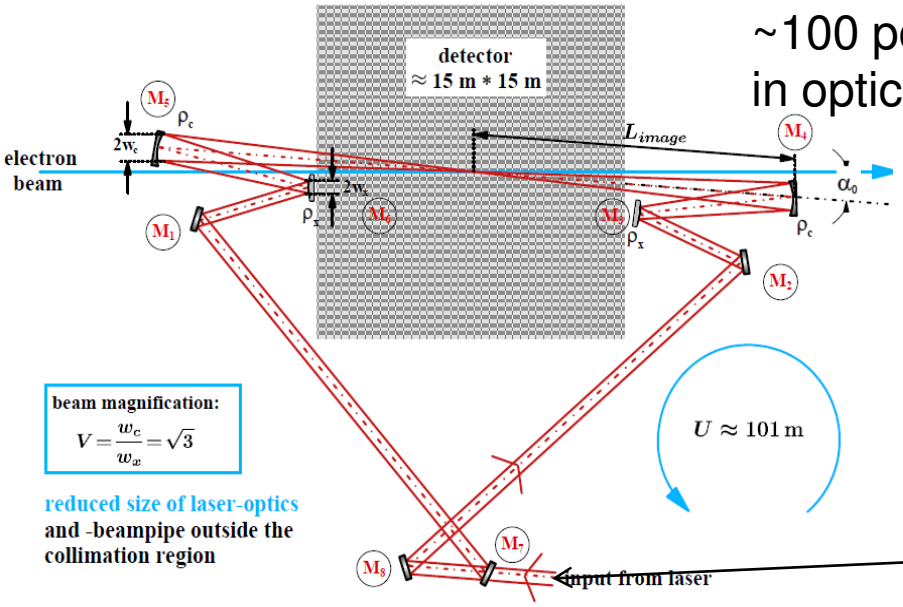
Significance ~5 (5 years) can be obtained

observation of gg->HH
may be feasible with better jet finder (vertex info. et.)

Laser for gamma collider

- 5~10J/pulse,
- wave length ~1μm, focus: a few to 10μm,
- synchronize with electron bunches

➡ 3000 pulses in 1ms



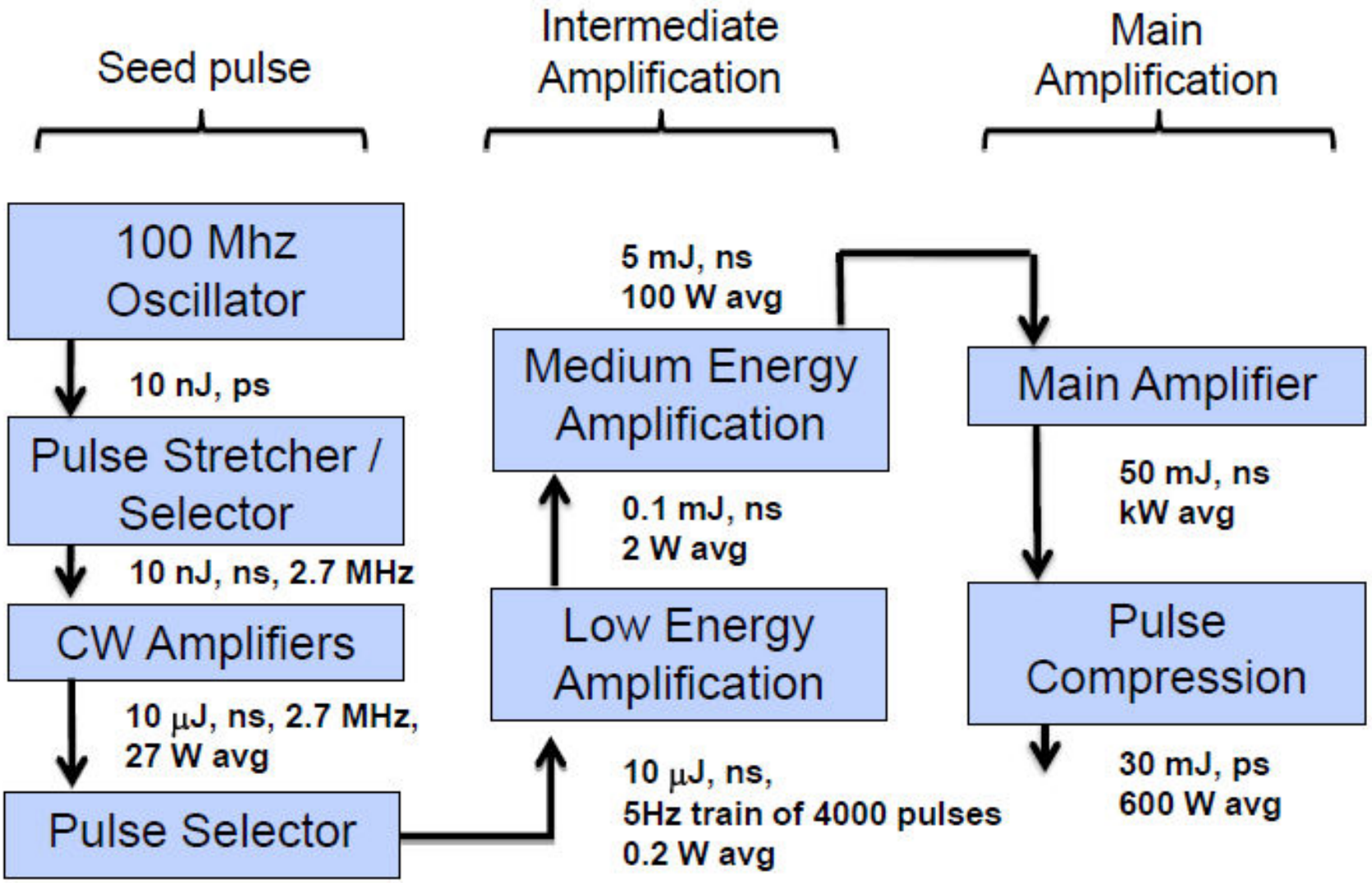
~100 power enhancement in optical resonant cavity

50~100mj/pulse

Drive Laser

Laser system concept

B. Stuart



Laser system concept

Seed pulse

Intermediate Amplification

Main Amplification

KM Labs pulse stretcher/compressor

Lasermetrics Pockels cell and driver

Cutting Edge Optronics' slab pumphead, the Whisper MiniSlab™

Cutting Edge Optronics RBA PowerPULSE

pulses

Main Amplifier

50 mJ, ns
kW avg

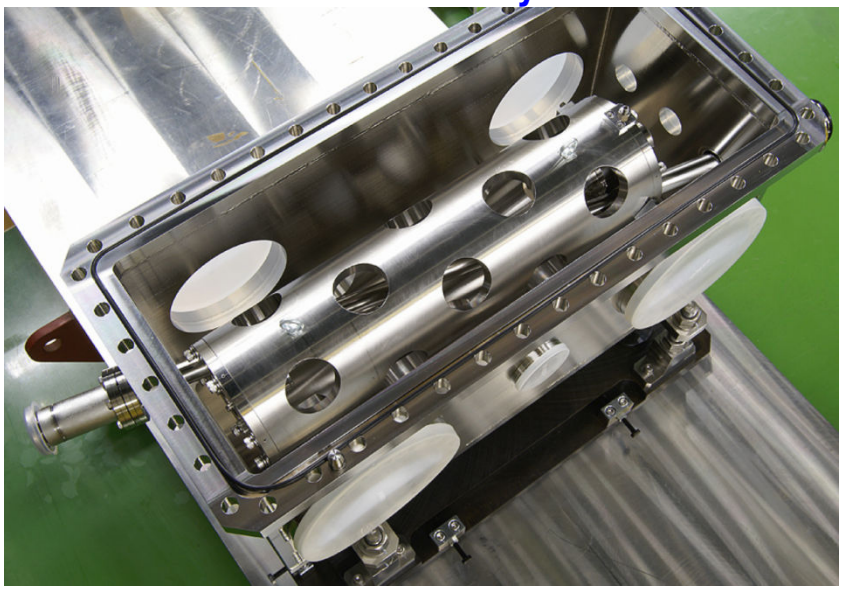
Pulse Compression

30 mJ, ps
600 W avg

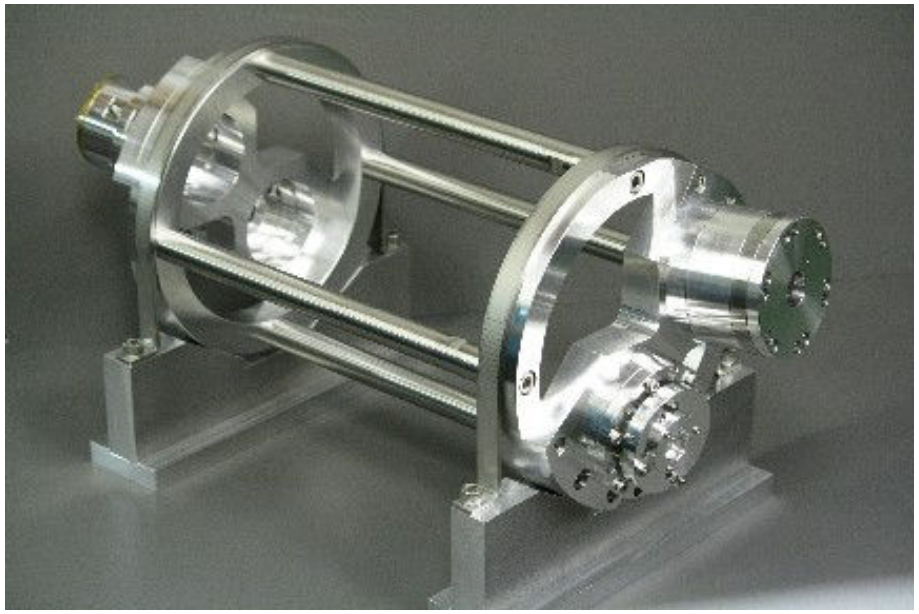
Conceptual design at LLNL by 2010

Nor for gamma collider but laser compton has wide comunity

2-mirror cavity (Hiroshima / Weseda / Kyoto / IHEP / KEK)



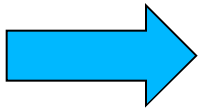
4-mirror cavity



moderate enhancement
moderate spot size
simple control

high enhancement
small spot size
complicated control

demonstration of γ ray gen.
accum. exp. w/ cavity and acc.



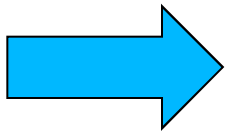
intense γ ray generation

Optical Cavity

- good experience and γ ray demonstration at the ATF with 2 mirror cavity

setp by step and steady improvement

- progress understanding of 4 mirror ring cavity through prototype construction and calculation

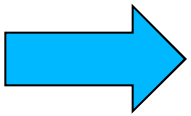


more complicated but interesting feature of 3D cavity

- In near future
  - •bunch by bunch information more g ray with 2 M cavity
  - •4M cavity in the ATF ring from LAL this summer

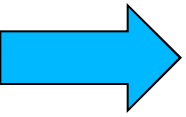
Summary

- We see progress in both technical and physics case study
- personal view
  - physics case of the ILC depends on the LHC
  - physics case of the gamma collider depend on the LHC and the ILC e+e-



We do need case study but
too many “if” to discuss how we could implement
it in the ILC program at this moment

  - need more technical R&D toward the gamma collider



Key technology(= laser compton scattering) has application
in wider community (industrial, medical,,,,)
working with wide community is a way to keep it on track