

Be-Target Design: Progress & Plans

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(for KLF Collaboration)



- Hall D beam line for KLF.
- MCNP transport code.
- Hall D setting.
- Be-target assembly.
- Biological dose rate.
- Where to go.

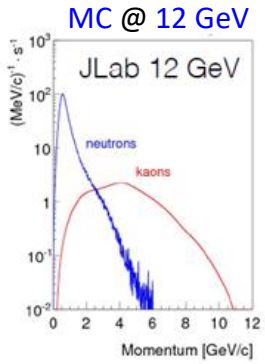




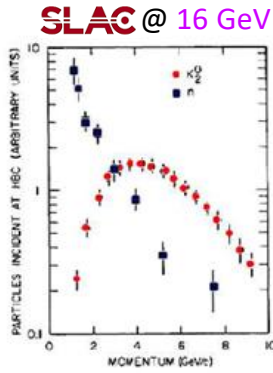
Hall D Beam Line for K-longs

- Electrons are hitting Cu-radiator @ CPS located in Tagger alcove.
- Photons are hitting Be-target located in collimator alcove.
- K_L s are hitting the LH_2/LD_2 target within GlueX setting.

K_L Beam Flux



$$N(K_L)/sec \sim 10^4$$



$$\frac{N(K_L)_{JLAB}}{N(K_L)_{SLAC}} \sim 10^3$$

North LINAC

e beam
12 GeV 5 μ A

No need in tagging photons

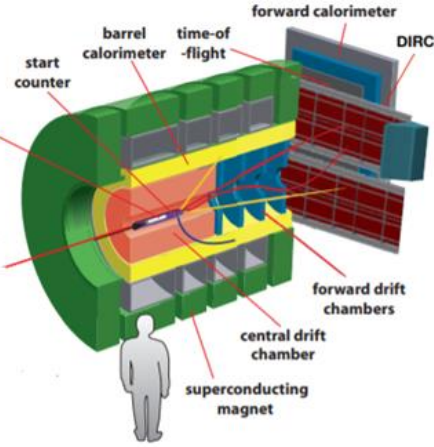
γ beam

Sweep Magnet

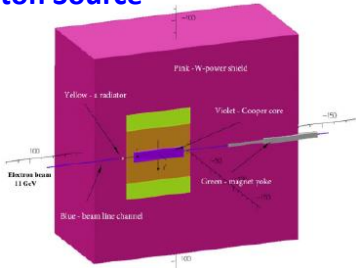
Pair Spectrometer

GlueX Spectrometer

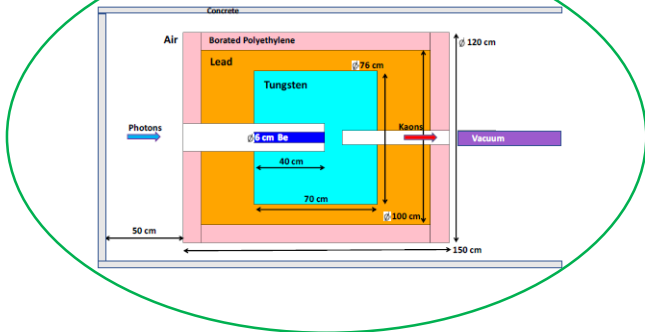
LH_2/LD_2



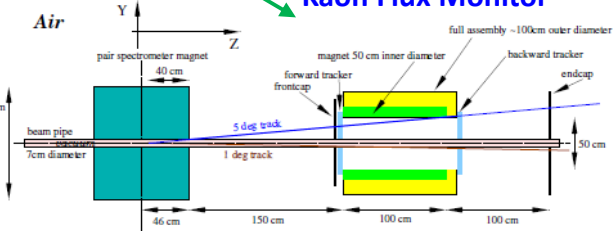
Compact Photon Source



Kaon Production Target



Kaon Flux Monitor



Gaby's Talk

Dan's Talk




9/28/2019

KLF-2019, Newport News, Virginia, October 2019

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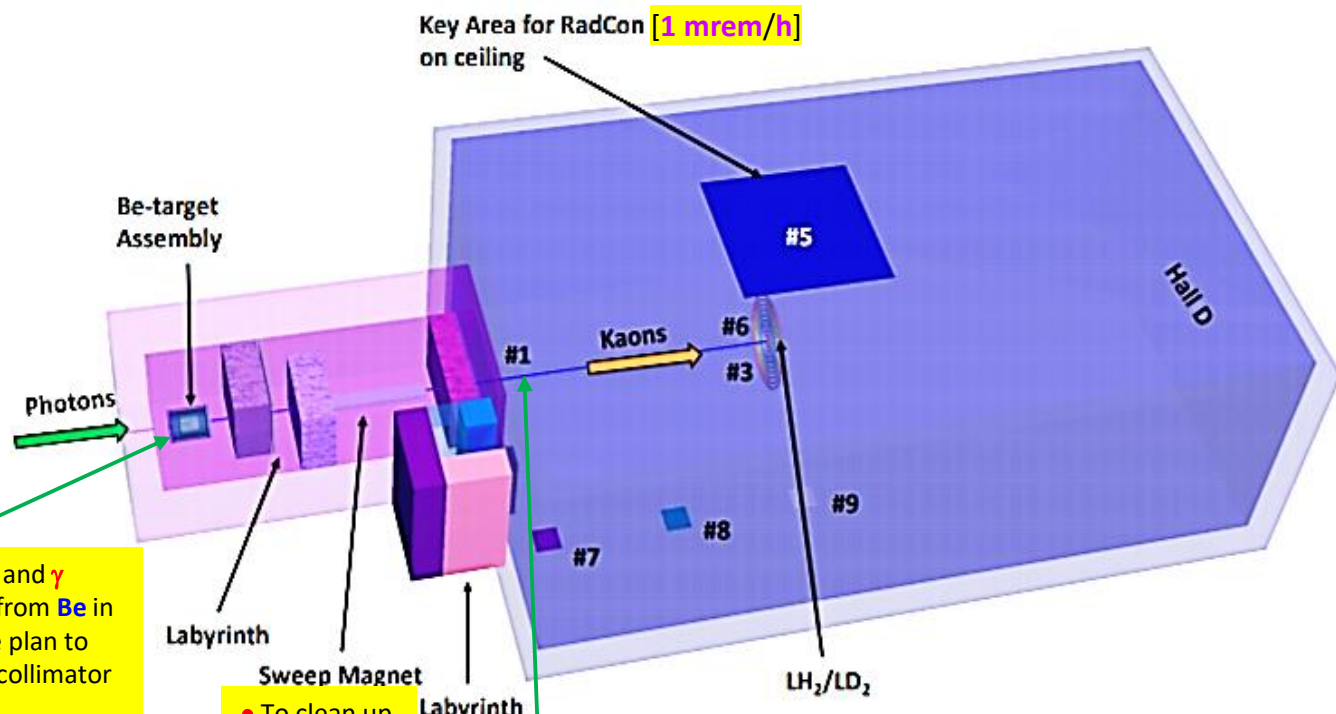




- Realism of MCNP simulations is based on advanced nuclear cross section libraries created and maintained in national laboratories of  complex.
- Physical models, implemented in MCNP6 code, take into account bremsstrahlung photon production, photonuclear reactions, neutron & photon multiple scattering processes.
- MCNP model simulates a 12 GeV 5 μ A electron beam hitting Cu-radiator inside CPS.
- Electron transport is traced in Cu-radiator, vacuum beam pipe for bremsstrahlung photons, & Be.
- Neutrons & gammas will be traced in all components of MCNP model.
- Media outside concrete walls of collimator alcove & bremsstrahlung photon beam pipe will be excluded from consideration to facilitate calculations. Additionally, we will ignore PS & KFM magnets but took into account 5 SEG-blocks around beam pipe in front of GlueX.
- For MCNP calculations (in terms of flux [part/s/cm^2] or biological dose rate [mrem/h]). Several tallies will be placed along beam & at Tagger alcove & experimental hall for neutron & gamma fluence estimation.



- For **neutron** & **gamma** calculations, we will use **MCNP6** transport code.



- To reduce effect of **n** and **γ** background, coming from **Be** in experimental hall, we plan to put **KPT** upstream in collimator alcove.
- Additional shielding is to minimize **n** & **γ** background in experimental hall

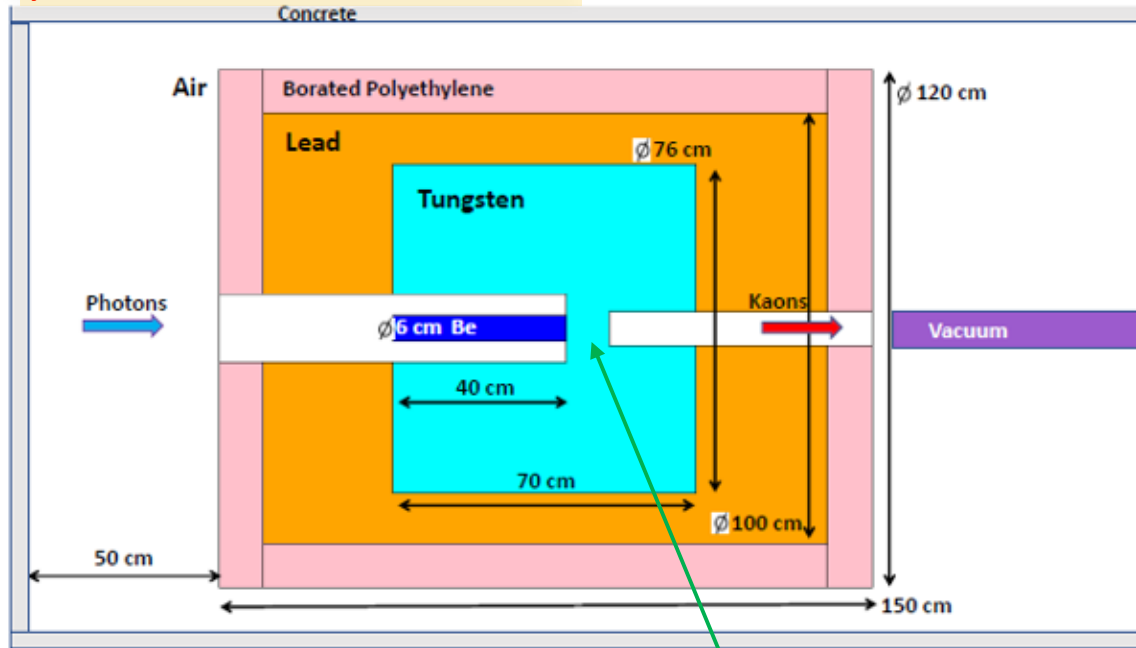
- To clean up **charged** component of beam.

- **Vacuum beam pipe** prevents neutrons **re-scattering** in air.

- Most important & unpleasant **background** for K_L comes from **neutrons**.

- Be-target assembly will weigh **14 tons** & has estimated cost of **\$1.2M**.

xy-cross section, x-dimension



- Collimator alcove has enough space (with 4.52 m width) for Be-target assembly to remain far enough from beamline.
- Water cooling would be required around Be & W-plug.

Cooling water, available in experimental hall, is sufficient to dissipate 6 kW of power delivered by photon beam to Be-target.

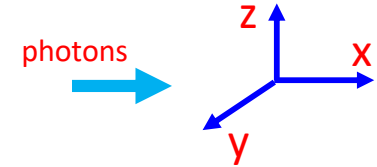
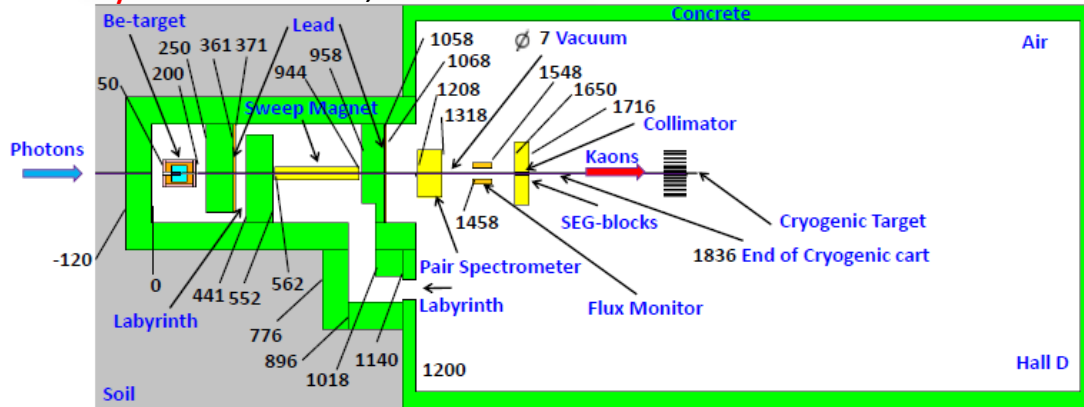
W-plug

Concrete walls are out of scale



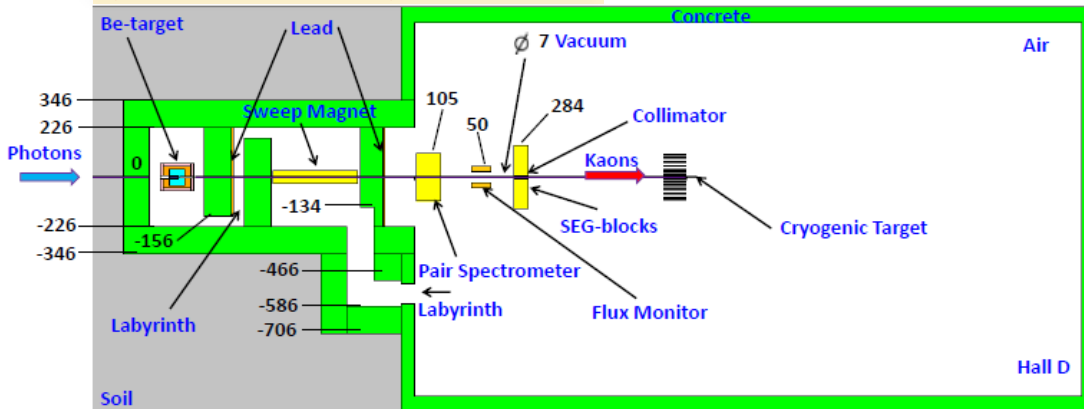
Collimator Alcove & Experimental Hall

xy-cross section, x-dimension

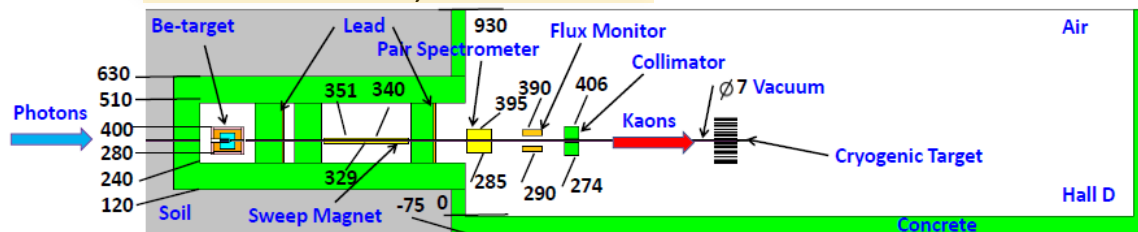


• Be-target assembly is cylinder, then there is no difference between x & y dimensions.

xy-cross section, y-dimension

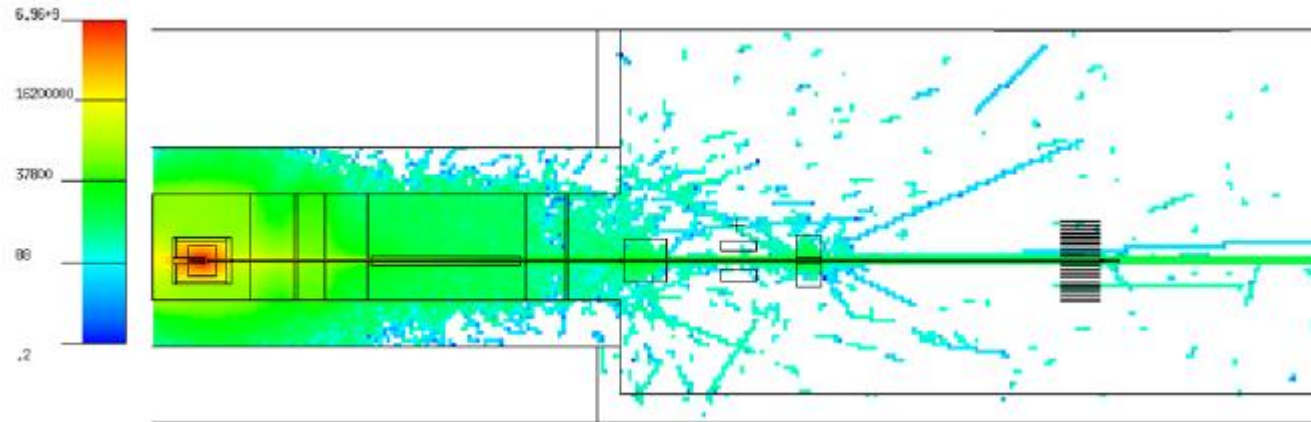


xz-cross section, z-dimension

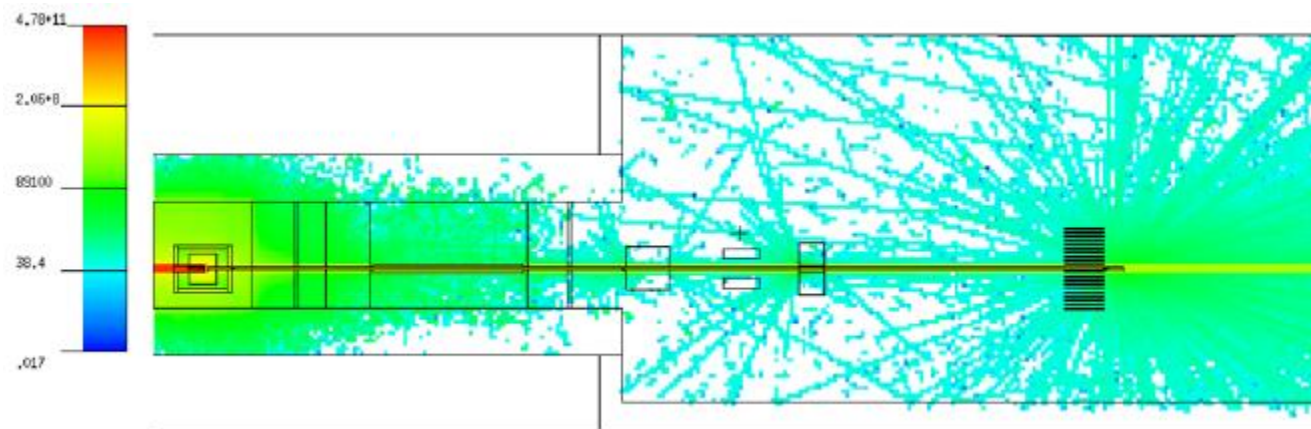




- **Vertical** cross section of **neutron** flux calculated using **MCNP**



- **Vertical** cross section of **gamma** flux calculated using **MCNP**

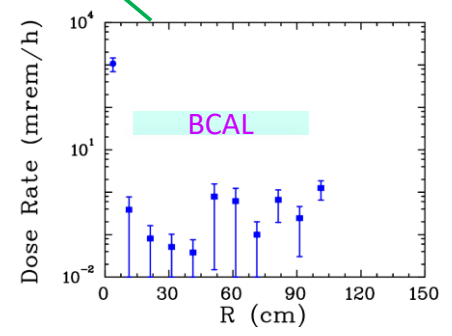
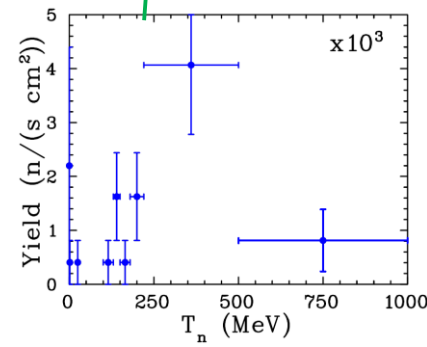
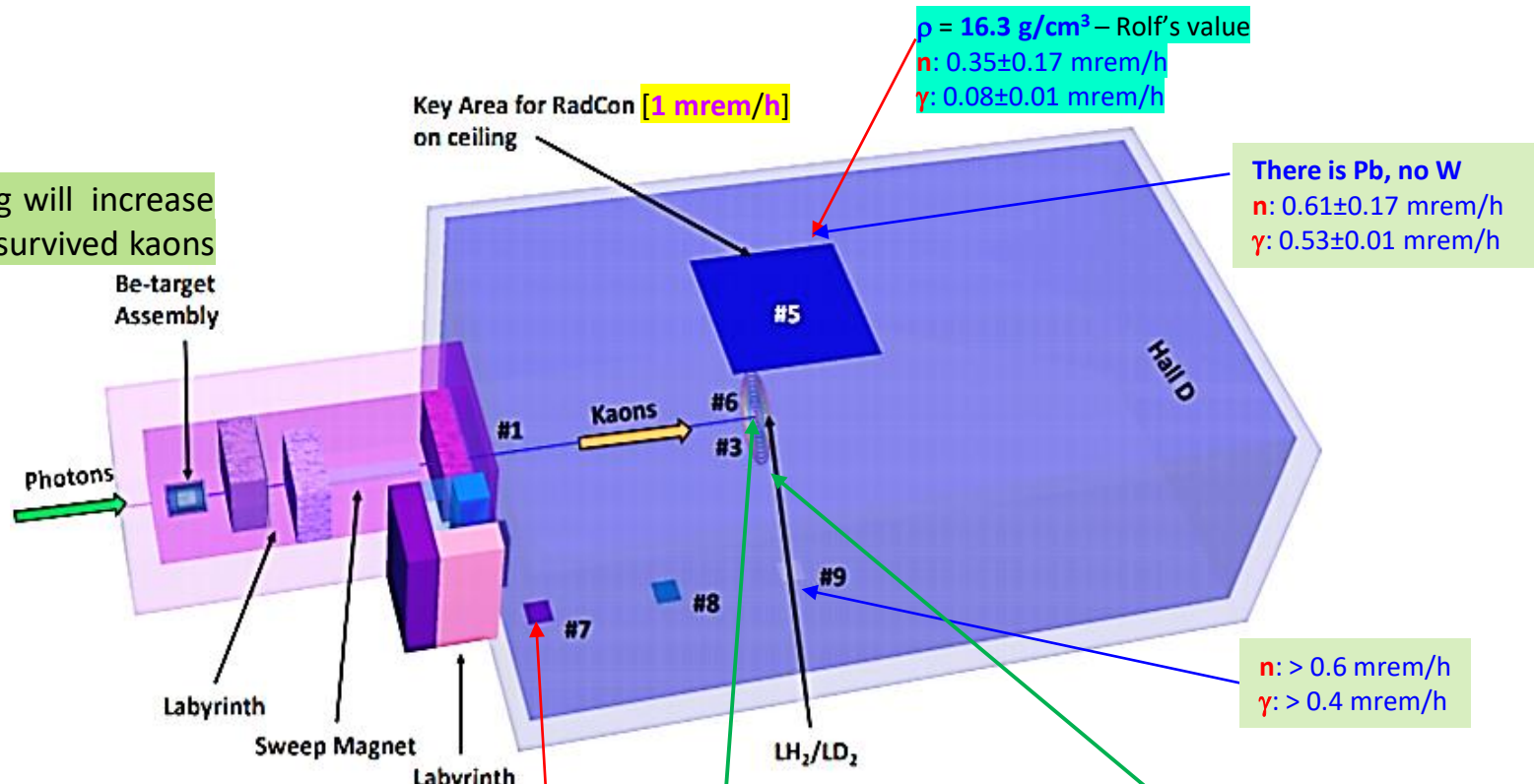




Hall D Setting & Dose Rate

- For neutron & gamma calculations, we will use MCNP6 transport code.

• Pb shielding will increase fraction of survived kaons by 20%.





- Calculations for **KPT** will be performed for different **shielding** configurations to **minimize** neutron & gamma **dose rate** & **reduce price** of **KPT**.
 - **Neutron** flux & **energy** distribution on face of **LH₂/LD₂** cryogenic target is important to validate **physical background** in case of **np** or **nd** interactions in cryogenic target.
 - **Neutron dose rate** for **SiPM** of Start counter, surrounded cryogenic **LH₂/LD₂** target, & **BCAL** is also important to study.
- Engineering design is in order ?

