I listed the persons who gave talks or comments at discussion sessions, party and/or coffee breaks.
I would add all others who attended to the discussion session
So if someone is missing, please let me know.

Summary of Group C

B. Barish, F. Boruzmati, A. Cohen, M. Endo, K. Fujii, M. Ibe, A. Ishikawa, S. Kanemura, E. Kato, R. Kitano, J. Lykken, M. Nojiri, T. Sanuki, M. Spiropulu, Y. Sumino, J. Tian, H. Yamamoto, H. Yokoya, K. Yokoya

And all the participants to Group C

Mission of Group C

- Estimate sensitivities of Higgs, top, EW and direct BSM searches at the ILC
- Give combined constraints on BSM models.
- Compare them with the (HL-)LHC

- This is too high target for one week program.
  - We need full 3 months program of Tohoku Forum for Creativity

- So I would summarize the what ILC can do which LHC cannot from the talks and discussions.
- And then, I would summarize home works.

Talks

- Thank you very much for giving nice talks in Group C
  - Higgs in BSM Models -- Shinya Kanemura
  - Higgs Measurements at the ILC -- Junping Tian
  - BSM searches at the ILC – Eriko Kato
  - New physics at Colliders – Mihoko Nojiri
  - Top theory at e+e- colliders -- Hiroshi Yokoya
  - Top quark measurements at the ILC -- Akimasa Ishikawa

- And important talks in other groups, especially
  - Probing SUSY Contributions to Muon g-2 at LHC and ILC -- Motoi Endo
  - Energy Extendability of ILC – Kaoru Yokoya

ILC

- CM Energy is tunable.
  - Threshold scan to determine mass and spin
  - Endpoint analysis to determine the masses in the reactions with missing particles
- Beam polarization of P(e-,e+) = (+-80%, +-30%) is possible
  - Chiral structure
  - Distinguish hypercharge and weak isospin
- Model independent analysis
  - No assumptions on cross section
  - All data are taken (triggerless operation)

We should use the above weapons that LHC does not have

Energy Extendability of the ILC

- Natural extension to 1.5TeV with 67km.
- Aggressive extension scenario to 3.0TeV! (not guaranteed)

Conclusion

K. Yokoya

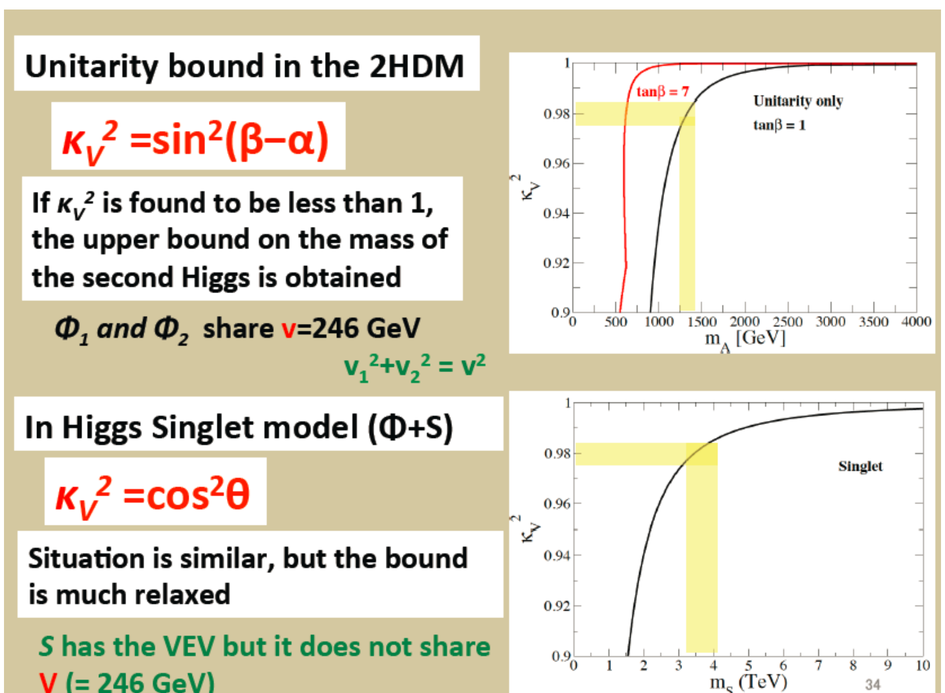
- ILC can be certainly extended to ~1TeV by a natural extension of the present technology of niobium cavity
  - Can be 1.5TeV with full use of 67km site
- Even higher energy might be reached (3TeV?) using a new SC technology such as thin film
- Obviously, quantitative studies are needed including the luminosity estimation, etc.
- CLIC technology allows to reach ~3TeV in the prepared Kitakami site (~50km)
- Plasma accelerator technology may bring about even higher energy (after several tens of years)

Higgs

- Model independent precise measurements of Higgs couplings to vector bosons and fermions are possible (Tian).
- Coupling to vector bosons is the window of BSM (Kanemura).
- Higgs self-coupling (Tian, Kanemura)

κ_V

- If κ_V is less than unity, we can determine the energy scale of new scalar
- $\delta\kappa_V / \kappa_V$ > 0.992@95%CL if κ_V=1.
  - We even



Model independent

coupling $\Delta g/g$	Baseline			LumiUP		
	250 GeV	+ 500 GeV	+ 1 TeV	250 GeV	+ 500 GeV	+ 1 TeV
HZZ	1.3%	1.0%	1.0%	0.61%	0.51%	0.51%
HWW	4.8%	1.2%	1.1%	2.3%	0.58%	0.56%
Hbb	5.3%	1.6%	1.3%	2.5%	0.83%	0.66%
Hcc	6.8%	2.8%	1.8%	3.2%	1.5%	1.0%
Hgg	6.4%	2.3%	1.6%	3.0%	1.2%	0.87%
Hττ	5.7%	2.3%	1.7%	2.7%	1.2%	0.93%
Hγγ	18%	8.4%	4.0%	8.2%	4.5%	2.4%
Hμμ	-	-	16%	-	-	10%
Htt	-	14%	3.1%	-	7.8%	1.9%
Γ_0	11%	5.0%	4.6%	5.4%	2.5%	2.3%
Br(Inv)	<0.95%	<0.95%	<0.95%	0.44%	0.44%	0.44%
HHH	-	83%	21%	-	46%	13%

Yukawa

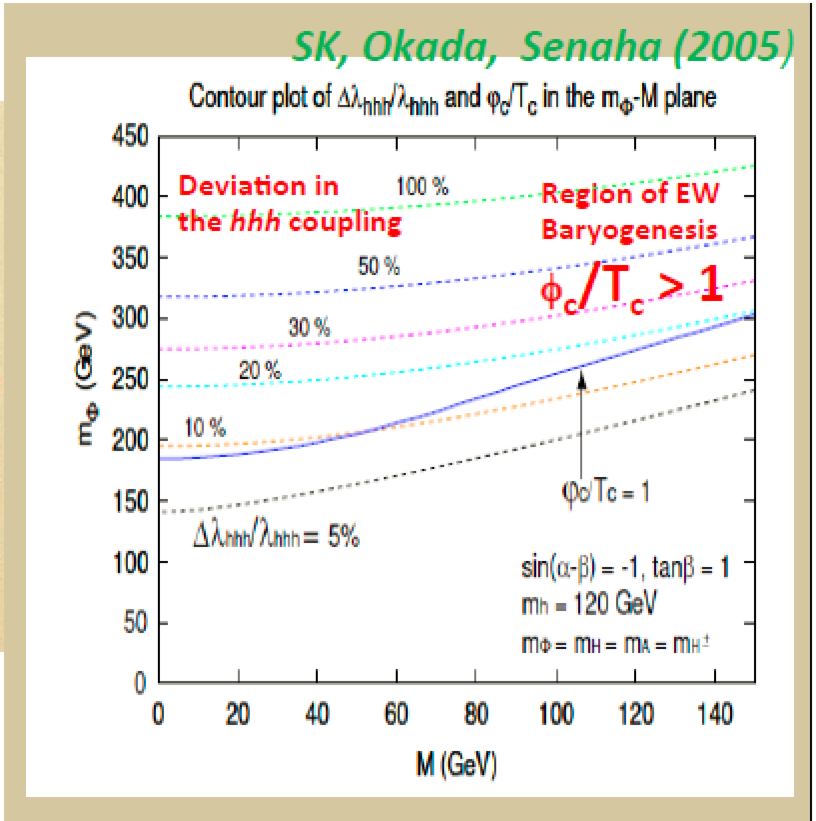
- Finger printing

Higgs self-coupling

- Window to EW Baryogenesis
- 13% sensitivity at 1TeV.
- (20%～30% deviation, we can discriminate models)

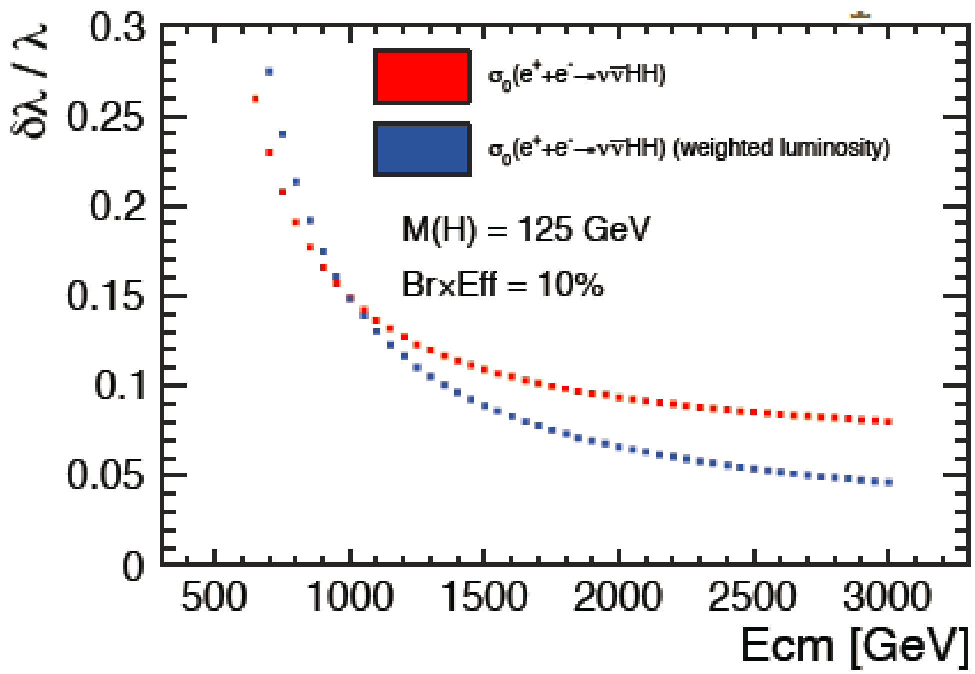
$\Delta\lambda_{HHH}/\lambda_{HHH}$	500 GeV			500 GeV + 1 TeV		
Scenario	A	B	C	A	B	C
Baseline	104%	83%	66%	26%	21%	17%
LumiUP	58%	46%	37%	16%	13%	10%

Scenario A: HH-->bbbb, full simulation done
Scenario B: by adding HH-->bbWW*, full simulation ongoing, expect ~20% relative improvement
Scenario C: color-singlet clustering, future improvement, expected ~20% relative improvement (conservative)



Higgs self-coupling at Energy Extended ILC

- 13% sensitivity at 1TeV.
- 9% at 1.5TeV (assuming luminosity is scaled by energy but site power limits the lumi.)



BSM

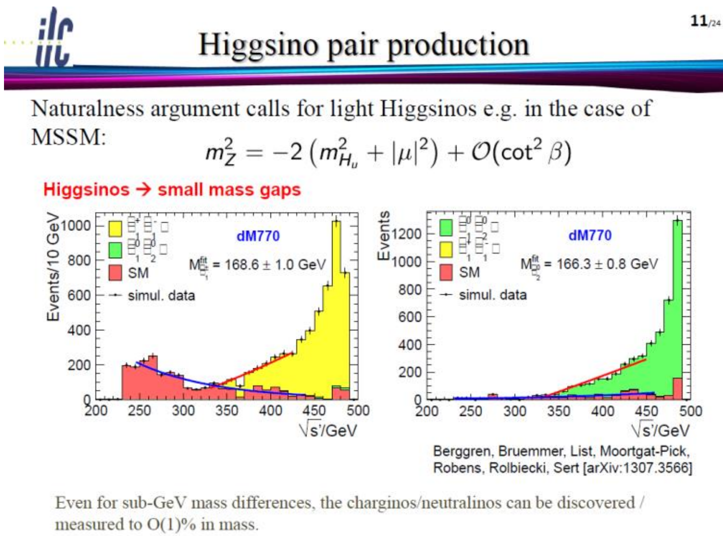
- Small mass splitting (Kato, Nojiri)
- Slepton (Kato, Endo)
- Higgsino and stop (Kato, Kitano)

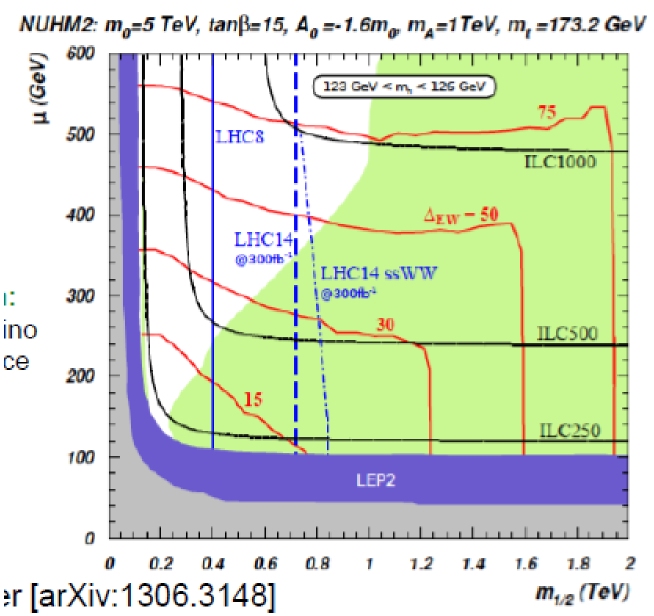
- (Model discrimination, SUSY, LHT and inert Higgs)
- (Other than SUSY Scinarios should be added)

Small Mass Splitting Case

Kato

- Small mass splitting
  - Even the splitting is Sub-GeV
  - Higgsino LSP
    - Naturalness strategy
  - Wino LSP
    - Anomaly mediation
  - Stop NLSP, Bino LSP
  - (Wino, Higgsino discrimination using pol)
- Mass reach is about √s/2





Stau and Smuon LR mixing

Smuon LR Mixing

LR mixing is measured by the relation:

$$m^2_{\tilde{\mu}LR} = \frac{m_\mu}{m_\tau} m^2_{\tilde{\tau}LR}, \quad m^2_{\tilde{\tau}LR} = \frac{1}{2}(m^2_{\tilde{\tau}1} - m^2_{\tilde{\tau}2}) \sin 2\theta_{\tilde{\tau}}$$

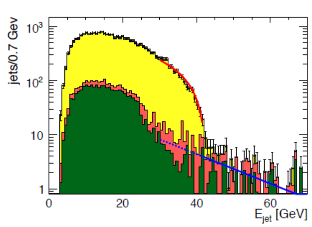
Measurement of stau mass: endpoint of tau (-jet) energy

$$\begin{cases} \delta m_{\tilde{\tau}1}/m_{\tilde{\tau}1} \sim 0.1\,\% \\ \delta m_{\tilde{\tau}2}/m_{\tilde{\tau}2} \sim 3\,\% \end{cases}$$

Based on detailed study at

$\sqrt{s} = 500\,\text{GeV}, \ \mathcal{L} = 500\,\text{fb}^{-1}$

$(P_{e+}, P_{e-}) = (-0.3, +0.8)$

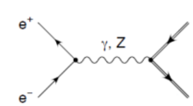


[Bechtle,Berggren,List,Schade,Stempel]

Smuon LR Mixing contd.

Measurement of stau mixing angle: cross section of stau

Cross section depends on the angle via s-channel Z exchange



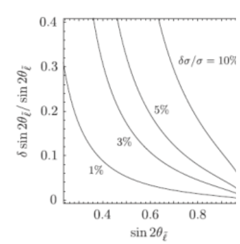
$\longrightarrow \ \sigma(e^+e^- \to \tilde{\tau}_1^+ \tilde{\tau}_1^-)$

$\delta\sigma(\tilde{\tau}_1)/\sigma(\tilde{\tau}_1) = 3.4\,\%$ [500fb^{-1}]

after some discussions

$$\delta \sin 2\theta_{\tilde{\tau}} / \sin 2\theta_{\tilde{\tau}} = 9\,\%$$

$$\text{at } \sin 2\theta_{\tilde{\tau}} = 0.67$$



Smuon LR Mixing contd.

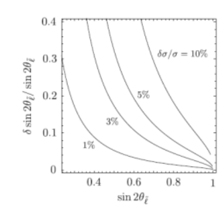
LR mixing is measured by the relation:

$$m^2_{\tilde{\mu}LR} = \frac{m_\mu}{m_\tau} m^2_{\tilde{\tau}LR}, \quad m^2_{\tilde{\tau}LR} = \frac{1}{2}(m^2_{\tilde{\tau}1} - m^2_{\tilde{\tau}2}) \sin 2\theta_{\tilde{\tau}}$$

From stau productions, [500fb-1]

$$\boxed{\delta m^2_{\tilde{\mu}LR}/m^2_{\tilde{\mu}LR} = 12\,\%}$$

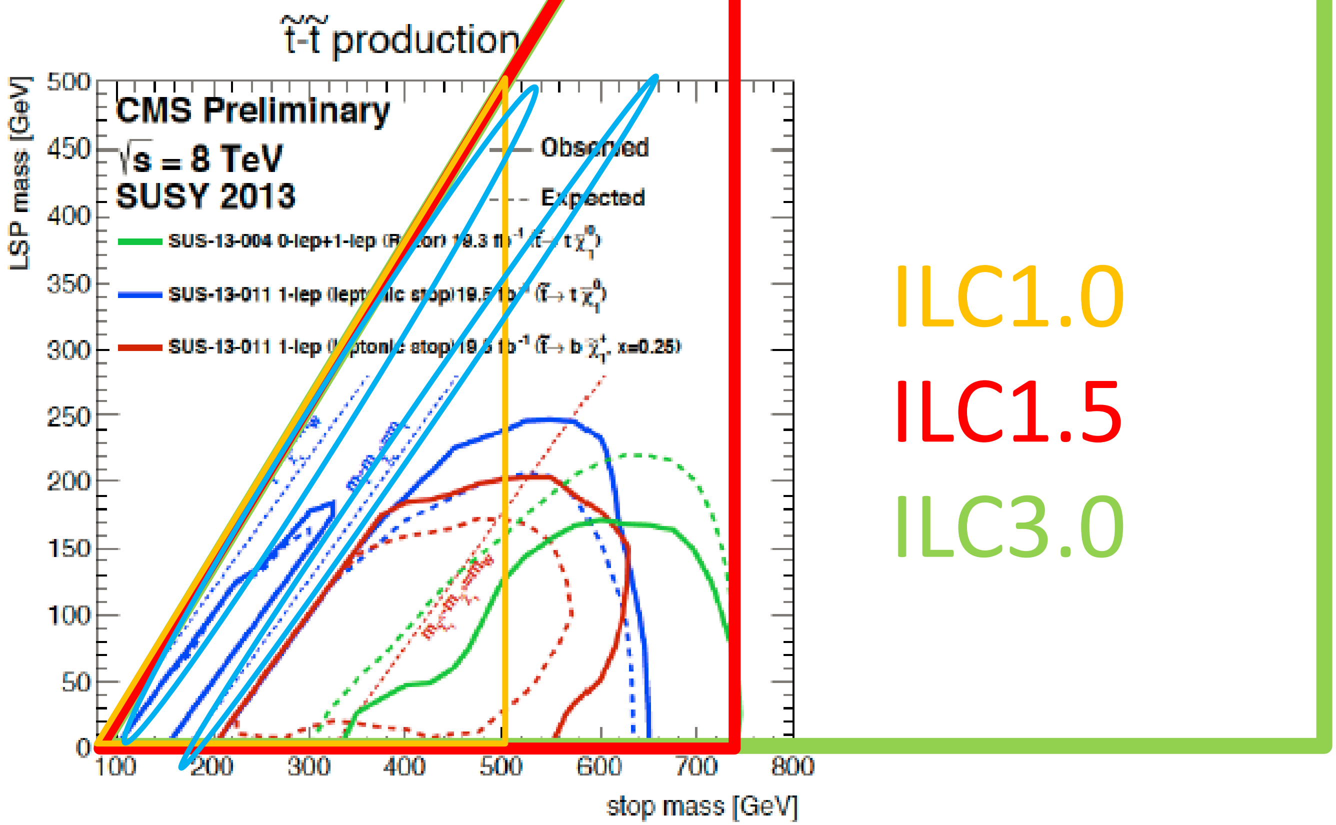
Note that $\sigma(e^+e^- \to \tilde{\tau}_1\tilde{\tau}_2)$ is very sensitive to mixing, though there is no study



Light Stop

Kitano

- Skyblue region is the loop hole of the LHC
- ILC1000 can search/observe upto $m_{\tilde{t}}$ =500GeV



Top Quark

- Precise mass determination with tiny QCD uncertainty for the test of vacuum stability in the SM (Lykken, H. Yokoya, Ishikawa).
- Search for CP Violating couplings is important (H. Yokoya)

- Forward-backward Asymmetry and top momentum measurements

Vacuum Stability

- Top mass in running mass scheme is quiet important for the fate of our universe (in the SM)

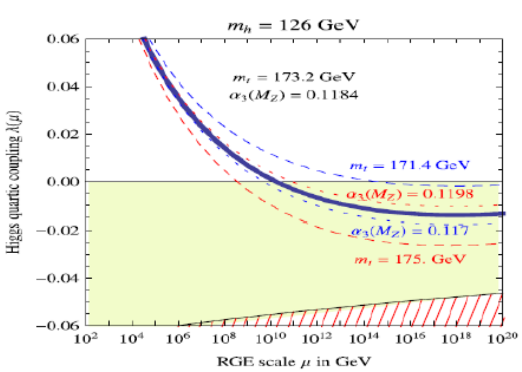
Tohoku Forum for Creativity, Oct. 23 2013, Hiroshi YOKOYA 12

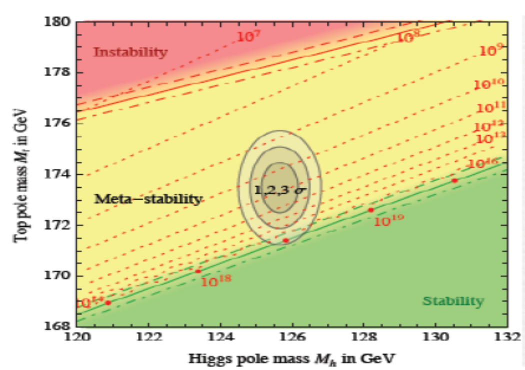
SM vacuum stability

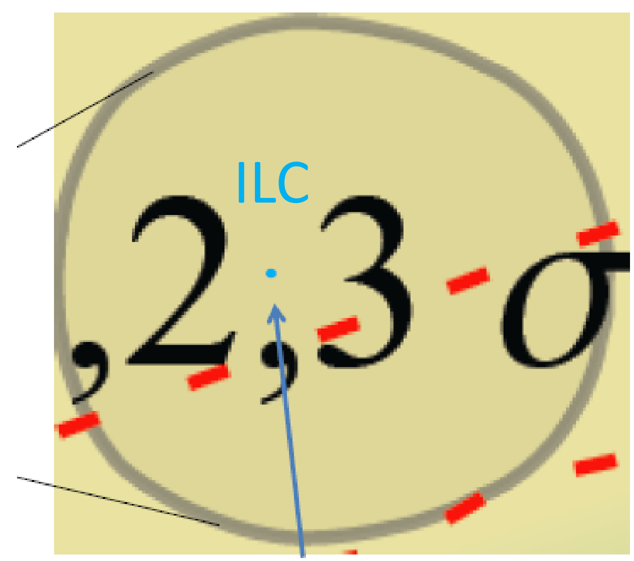
- RGE of Higgs quartic coupling $$16\pi^2\mu\frac{d\lambda}{d\mu} = 24\lambda^2 - 6y_t^4 + \cdots$$

Top-quark mass is crucial for higher-scale behavior of the SM vacuum

Is it accidental or not? We need more accurate input of the top-quark mass







$\Delta M_H = \pm 37$ MeV

$\Delta m_t^{pole} = \pm 17$MeV

Only Stat error.

Electroweak

- This is missing item in the Group C.

- Two fermion (ee → ff) measurements at ILC from 250GeV to 1TeV and beyond.
- Vector boson scattering at energy extended ILC.
  - Longitudinal component
- Runnings at WW threshold and Z pole.

- This is our home work.

Home works to Group C

- Higgs CP mixture
- Higgs coupling calculation in one loop level in BSM models

- Stau1stau2 pair production
- Light stop

- Theoretical calculation of vacuum instability.
  - Scheme dependence
- Top CP violating coupling

- EW measurements

- Can ILC run at WW threshold and Z pole with reasonable luminosity and polarization. (Group D)

- Reduction of theory uncertainty.
  - Ex. Top yukawa at threshold.
- Measurement of luminosity spectrum for threshold studies

Summary

- ILC
  - CM Energy is tunable.
  - Beam polarization of P(e-,e+) = (+-80%, +-30%) is possible
  - Model independent analysis

- Even after the LHC, ILC can perform what LHC cannot do.

- Energy extendability is one of the key issue for
  - BSM searches
  - Higgs self-coupling
  - $W_L W_L$ scattering to test Higgs mechanism.

- We need ILC

- Energy spread of the ILC
  - Hard to improve because positron is produced from electron
  - Improve the dumping ring -> 10% or 20%
  - Determine the luminosity spectrum by bahbah scattering

  - 1.5TeV with 300MW