Physics and Detectors at the International Linear Collider

Daniel Jeans
IPNS / KEK
daniel.jeans@kek.jp
Cosmic Microwave Background: imprint of inflation, dark energy, dark matter, ...

Electro-weak physics
imprint of deeper symmetries, dark sector, very high energy physics
Electro-weak transition

Higgs potential

Higgs particle: excitation of Higgs field

different to all other SM particles not “matter”, not “force”, no spin

we’ve observed all particles of the Standard Model

BUT…

they describe only a small fraction of our universe
Higgs as a gateway

Could it be... a composite particle? or one of many Higgs particles? or exactly as predicted by today's theory?

- **pMSSM**
- **2HDM-Y**
- **LHT-6**

Precision Higgs measurements → "fingerprint" of new physics
International Linear Collider

* electron – positron collider (polarised beams)
* initial energy: 250 GeV (centre of mass)
* initial luminosity: $1.35 \times 10^{34}$ cm$^{-2}$ s$^{-1}$
* future upgrades in energy and luminosity
  $\rightarrow \sim 1$M Higgs bosons
based on superconducting RF acceleration

3 km of “ILC-like” technology
European XFEL @ DESY
Detectors for ILC

two international collaborations developing
next-generation detectors for ILC

challenging requirements
to maximise physics harvest

→ efficiency, identification, resolution
→ hadronic jet resolution
→ angular coverage

technological advances

→ new technologies
→ low power, integrated electronics
→ compact devices

detector concepts with unprecedented precision
to enable ILC physics program
ILC-related Detector R&D in Japan & KEK: examples

Vertex Detector
- Fine pixel CCD
- Soli technology

Time Projection Chamber
- GEM readout module

Calorimeters
- Highly integrated readout electronics

Aggressive detector designs, possible thanks to modern technologies

"ILC" R&D achievements find applications in other experiments:
- Calorimeter upgrades @ CMS/LHC
- DEPFET vertex detector @ Belle II

We welcome contributions on these and other new technologies!
precision on Higgs boson couplings based on realistic simulation and analysis

compared to HL-LHC

model independent fit possible at ILC

Higgs coupling to ...

LCC Physics WG

Model Dependent EFT / $\kappa$ Fit ($\Gamma_{\text{BSM}}=0$ & no anom. hZZ/hWW coupl.)

Model Independent EFT Fit

LCC Physics WG

Model Independent EFT Fit

HL-LHC arXiv:1902.00134
S1: CMS, S2: ATLAS/CMS
HL-LHC @ ILC250
HL-LHC @ ILC250 @ ILC500
dark/light: S1:/S2

$\times 1/2$

$\times 1/20$

$\times 1/3$

$\times 1/10$

Precision of Higgs boson couplings [%]

Precision of Higgs boson couplings [%]

arXiv:1903.01526
ILC facility

unique $e^{-}$ & $e^{+}$ beams
high intensity
high energy
high quality

→ potential for studies beyond Higgs, beyond particle physics

further ideas and suggestions welcome!
<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>Global Design Effort</td>
</tr>
<tr>
<td>2013</td>
<td>Linear Collider Collab.</td>
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<tr>
<td>2020</td>
<td>Internl. Develp. Team</td>
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<tr>
<td>~2 y</td>
<td>ILC pre-lab.</td>
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<tr>
<td>~4 y</td>
<td>ILC laboratory</td>
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<tr>
<td>~9 y</td>
<td>Engineering design; set up pre-lab organisation</td>
</tr>
<tr>
<td>&gt;20 y</td>
<td>Construction</td>
</tr>
<tr>
<td></td>
<td>Operation &amp; upgrades</td>
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**THE TOHOKU REGION OF JAPAN**

**Strong support from world-wide particle physics community (US, Europe, Japan, ...)**

Japanese government considering whether to host ILC in Japan → ILC project review underway in MEXT