# European Strategy for Particle Physics

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# Objective

- **Starting from the Strategy established in 2006, make an update in light with the latest findings in the fields**

- **This Strategy is to be established by the CERN Council, in its role as the coordination European Body for Particle Physics**

**“The Organization shall provide for collaboration among European States in nuclear research of a pure scientific and fundamental character, and in research essentially related thereto.”**

# Procedure

**A European Strategy Preparatory Group (ESPG) shall be nominated by the CERN council and mandated for:**

- **Collecting the inputs from the community**
- **Developing a Briefing Book, summarizing the status of the Field and the input received from the community**
- **Organizing all the logistics needed to achieve the Strategy**

**With these inputs, a European Strategy Group (ESG) mandated by the Council shall write the Strategy for Particle Physics during a dedicated meeting of the Strategy Group**

**The Strategy shall be submitted to the Council for ratification**

# Timeline

***September 2011:***

**Nomination of the PG and ESG by the CERN Council**

***January 2012:***

**Establishment of the website for the Strategy http://europeanstrategygroup.web.cern.ch/EuropeanStrategyGroup/**

***February 1, 2012:***

**Call for Submissions on scientific issues from the community**

***July 31, 2012:***

**Submission deadline for open symposium**

***September 10-12, 2012:***

**Open symposium in Krakow**

# Timeline (cont'd)

***October 15, 2012:***

**Submission deadline for being included in the BB**

***January 2013:***

**BB ready and provided to the ESG**

***January 21-26, 2013:***

**Strategy Group meeting to draft Update of Strategy in Erice**

***March, 2013:***

**Finalizing Update of Strategy by CERN Council**

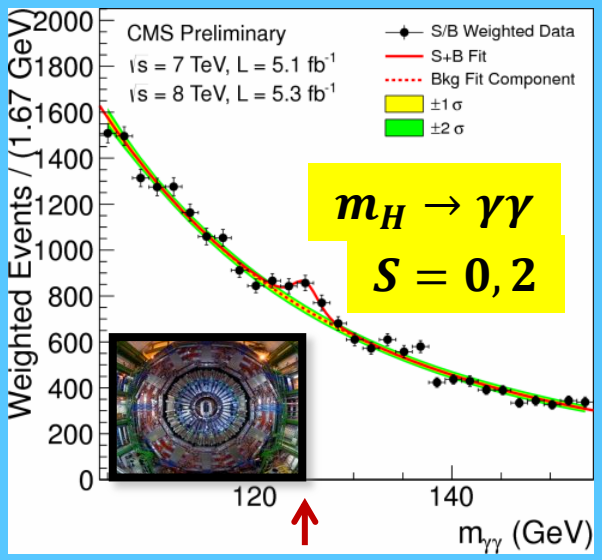
***May/June, 2013:***

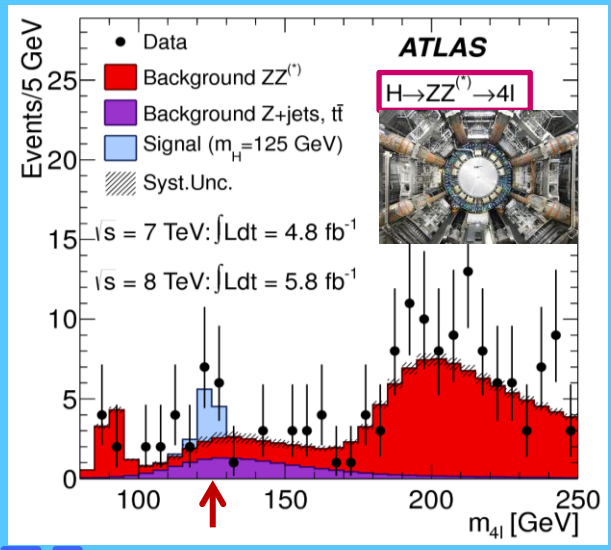
**Special Council Session to adopt Update of European Strategy in Brussels**

# BACK TO THE FUTURE

## July 4th:

## the Day H came to Geneva

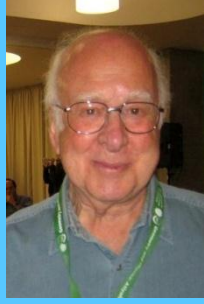




**$m_H = 125.7 \pm 0.5$ GeV**


H

# WHAT IS THIS NEW PARTICLE?



*Is it SM Higgs?*

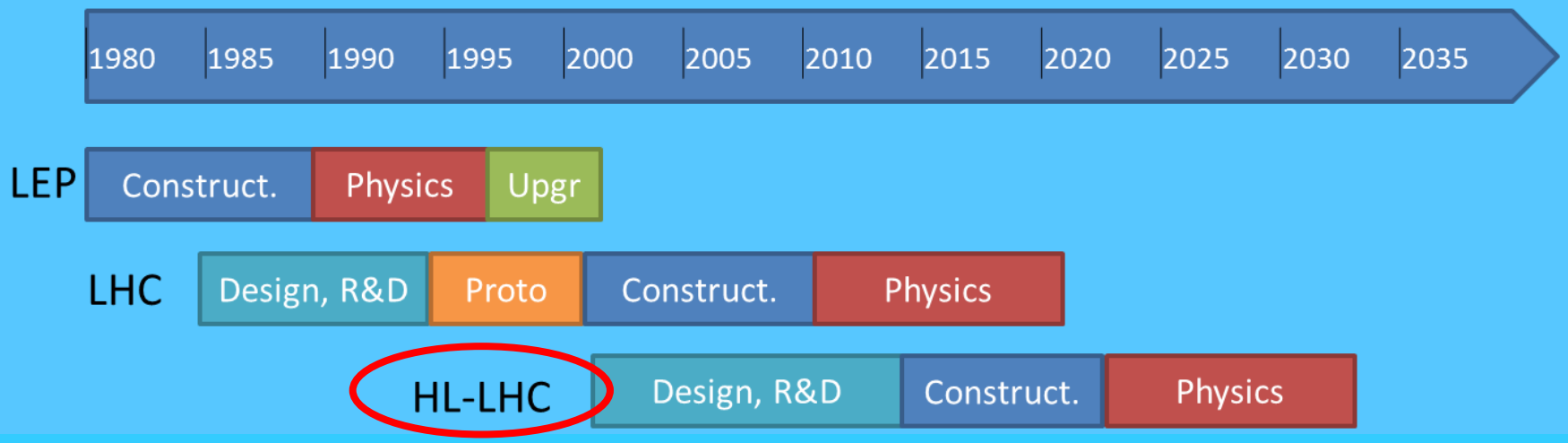

**Or is it a mystery one mimicking the SM Higgs?**


**Are its mass and its properties consistent with the SM?**

**Do we have the technology to Study precisely Higgs properties**

1. **Upgrade LHC luminosity (by factor ~10)**
   - **Improve current and focussing**
2. **Build a dedicated « Higgs factory »**
   - **e+e- linear or circular collider**

# The super-exploitation of the CERN complex: Injectors, LEP/LHC tunnel, infrastructures




- **Increase beam current ⇨ protect SC dipole (diffracted protons)**

  **8T-15m ⇨ 11T-11m dipoles**

- **Reduce beam size at IP ⇨ Stronger focussing quads near IP**

  **Change Quadrupole Triplets ⇨ 140T/m, 150mm (13T, 8m)**

- **Protect Electrical Distribution Feedbox's (DFBX)**

  **⇨ 2×100 kA ~500m *HTS links***

- **Improve and adjust the luminosity with beam overlap control**

  **⇨ SC RF «Crab» Cavity, for p-beam rotation at fs level!**

# The super-exploitation of the CERN complex: Injectors, LEP/LHC tunnel, infrastructures

1980 | 1985 | 1990 | 1995 | 2000 | 2005 | 2010 | 2015 | 2020 | 2025 | 2030 | 2035

LEP: Construct. | Physics | Upgr

LHC: Design, R&D | Proto | Construct. | Physics

HL-LHC: Design, R&D | Construct. | Physics

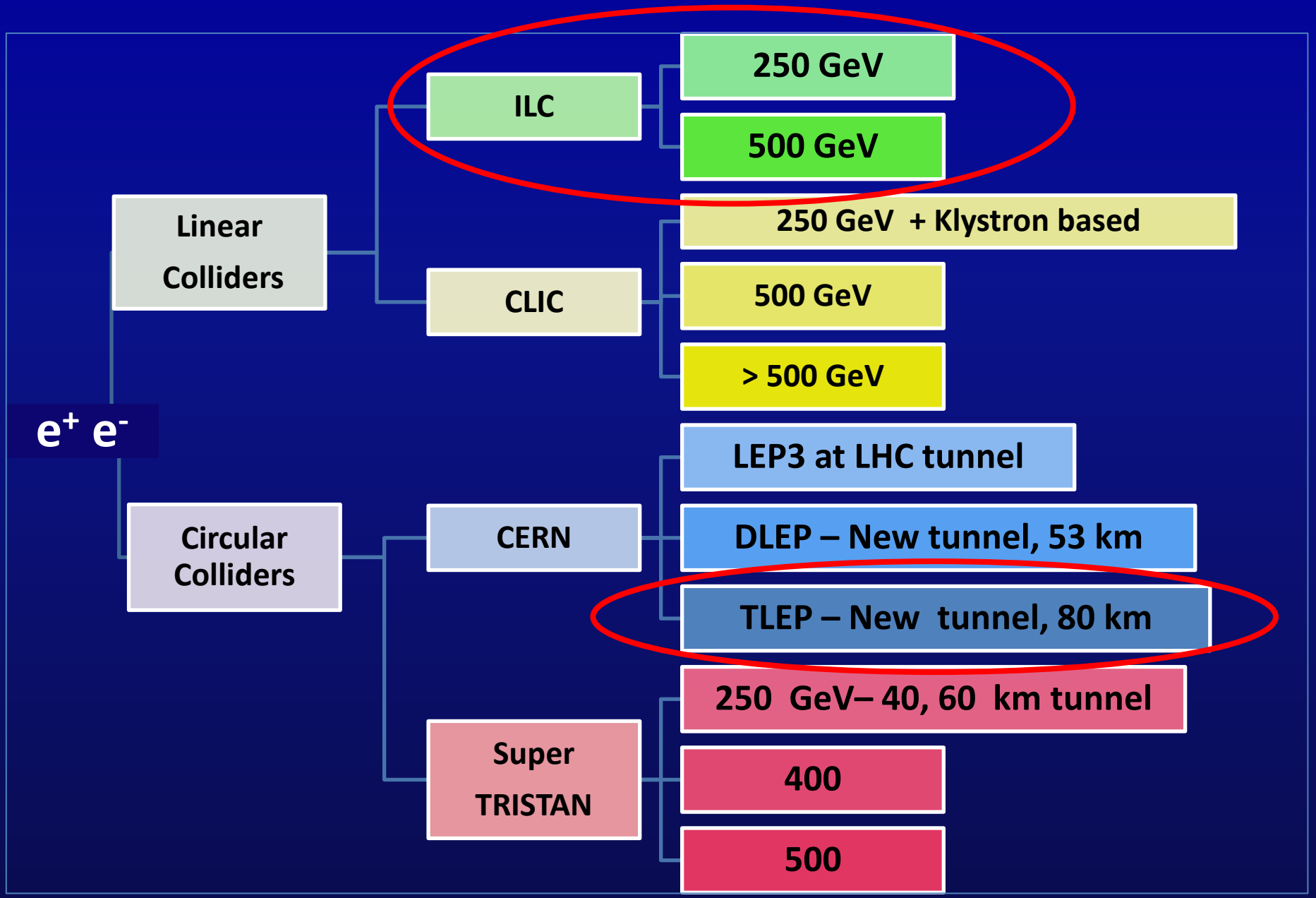
HE-LHC: Design, R&D | Proto | Construct. | Physics

**Either using existing LEP/LHC tunnel to reach 26-32 TeV collisions**

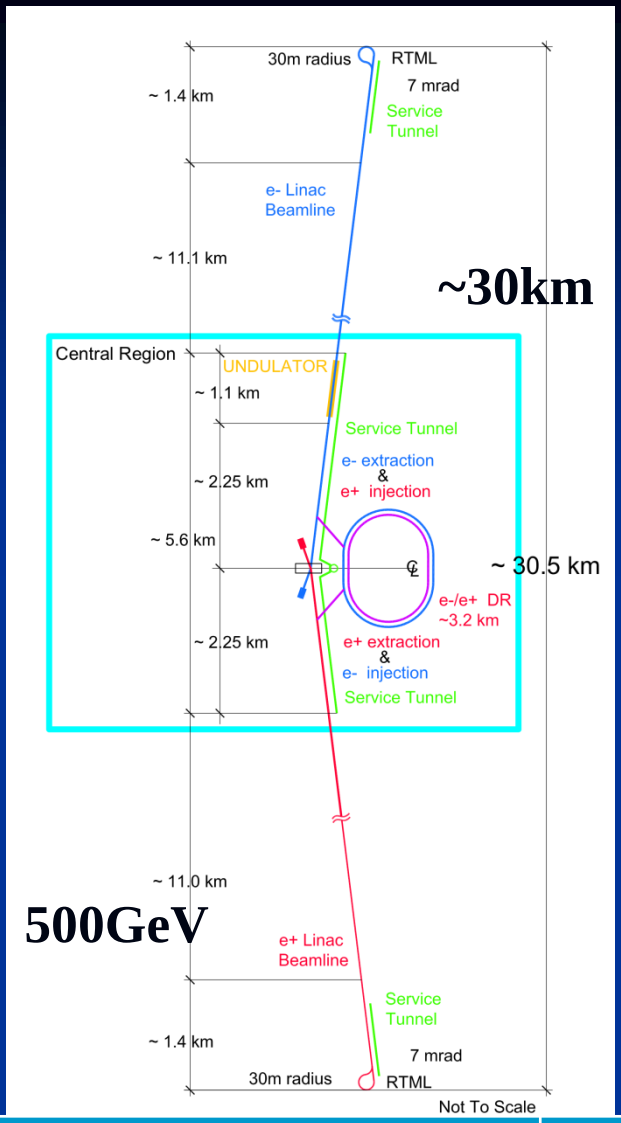

**Or build (or reuse) a 80km tunnel to reach 80-100 TeV collisions**

**In both cases, SC challenge to develop 16-20 Tesla magnets!**

# $e^+e^-$ colliders «clean HIGGS FACTORIES»

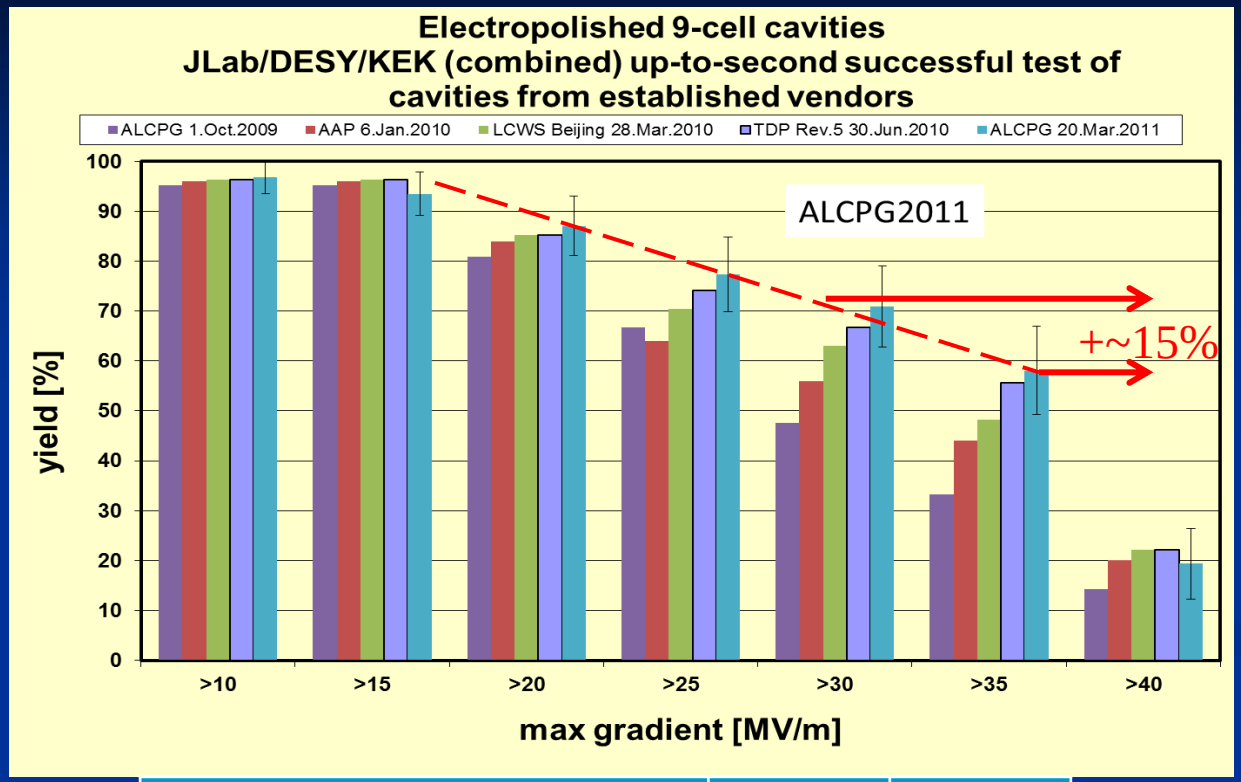


# ILC




| Cavity Gradient (MV/m) | 31.5 |
|---|---|
| #9-Cell cavities | ~16000 |
| #Cryomodules (2K) | ~1800 |
| #RF units (10MW Kly) | ~560 |

## Gradient Range Yield Gain




| Energy CM (GeV) | 250 | 500 |
|---|---|---|
| Luminosity ($x10^{34}cm^{-2}s^{-1}$) | 0.75 | 1.8 |
| Beam size ($\sigma_x/\sigma_y$ nm) | 730/8 | 470/6 |
| Pulse duration (ms) | 0.75 | 0.75 |
| Beam power (MW) | 5.2 | 10,5 |
| Total AC power (MW) | 128 | 162 |

# *TLEP Ring $e^+e^-$ collider:* Primary Cost Driver

## Tunnel: ~70% cost

**Building on existing technologies and experience (LEP, KEKB, PEPII…)**

**Using SC cavities**

**Could cover a wide range of energy up to 350 Gev collision energy.**


| Energy CM (GeV) | 90 | 240 | 350 |
|---|---|---|---|
| Luminosity ($x10^{34}cm^{-2}s^{-1}$) | 100 | ~5 | ~0.7 |
| Cavity Gradient (MV/m) | 20 | 20 | 20 |
| #5-cell SC cavities | 100 | 300 | 600 |
| Total AC power (MW) | 100 | 100 | 100 |

# Open Symposium in Krakow

High Energy Frontier

- Discovery of Higgs-like state is a landmark for the field (and a triumph for the LHC)
- Plethora of SM measurements with increasing precision (QCD,t,W,Z,VV,...)
- Searches for NP leading to o(TeV) limits on new particles

- Excellent prospects (much increased NP reach!) for 14 TeV LHC (300 $fb^{-1}$)
- Higgs measurements & WW unitarity require HL-LHC 3000 $fb^{-1}$ upgrade (detectors + machine)

- Excellent physics case for the study of „Higgs" state (+top, EW) in depth with high precision and complementary to LHC in $e^+e^-$ ($\gamma\gamma$?, ep??)
- Announcement from Japanese community to aim hosting ILC (250-500 GeV) as global project
- Assess which machine best suited for this program (linear vs. circular)
- Time matters – technical readiness also

- In absence of direct evidence for NP and strong theoretical guidance too early to decide on post-LHC facility for HEF (CLIC, HE-LHC(33), UHE-LHC(50+), µC, Plasma??, ...)
- Maintain critical R&D and feasibility studies

# Accelerator Science & Technology Session

**LHC & high-energy hadron collider**

- LHC operating successfully (a huge technology success!)
- technology to go to 13-14 TeV and HL-LHC at hand with some development needed
- possibility to go to 26-33 TeV with 16-20 T magnets (HE-LHC), but substantial R&D needed ; higher energy requires a new tunnel (80 km → 80-100 TeV)

**High-Energy lepton collider**

- great progress in SRF for ILC makes project possible ; very advanced proposal
- CLIC could be alternative, esp. if one wants to go to 3 TeV with still significant R&D
- new ideas for circular or $\gamma\gamma$ colliders; more studies needed on performance reach
- SRF ERL/RLA technology is attractive for many applications (LHeC, $\gamma\gamma$)
- to go to much higher energy using leptons requires muon collider, dielectric acceleration or plasma acceleration with increasing complexity and R&D needed

**High-Intensity beams**

- high power linacs being constructed (ESS,IFMIF,Project-X?); technology in hand
- improving neutrino beams with optimized existing infrastructures is possible
- high-intensity $\nu$ beam requires $\nu$ factory , with intense R&D
- technology for very-high luminosity flavor factories exists

**Many R&D topics common for various accelerators including other fields,** ex. high-field magnets, RF structures & sources, particle sources, alignment & stabilization

# Briefing Book and main sessions of the Open Symposium

*7 main sections/sessions + 1 on general aspects:*

- **Accelerator Physics**
- **Astroparticle Physics, Gravitation & Cosmology**
- **Flavour Physics and Symmetries**
- **Physics at High Energy Frontier**
- **Physics of Neutrinos**
- **Strong Interaction Physics**
- **Theory and Phenomenology**
- **General Facilities, Infrastructure & Support**

***January 21-26, 2013:***
***Strategy Group meeting to draft Update of Strategy in Erice***

***Our "Bunga-Bunga" party***

***Broad Upheaval for New General Agreement***
***Building/Upgrading New Giant Accelerators***

# Conclusion

- **An update of the European Strategy for Particle Physics will be made by 2013**
- **The LHC will tell us much more**
  - **with present on-going run at 8 TeV**
  - **But also with the 13-14 TeV operation in 2015**
- **Whatever happens, the R&D for HL-LHC is of prime importance, not only for Higher Luminosity but also for Higher Energy**

**We count on the work done in HiLumi**