Search for patterns in physics: from particles to Dark Matter

Josué Molina
El Zamorano University, Honduras

Advanced Workshop on Accelerating the Search for Dark Matter with Machine Learning
Trieste, Italia

April 11, 2019

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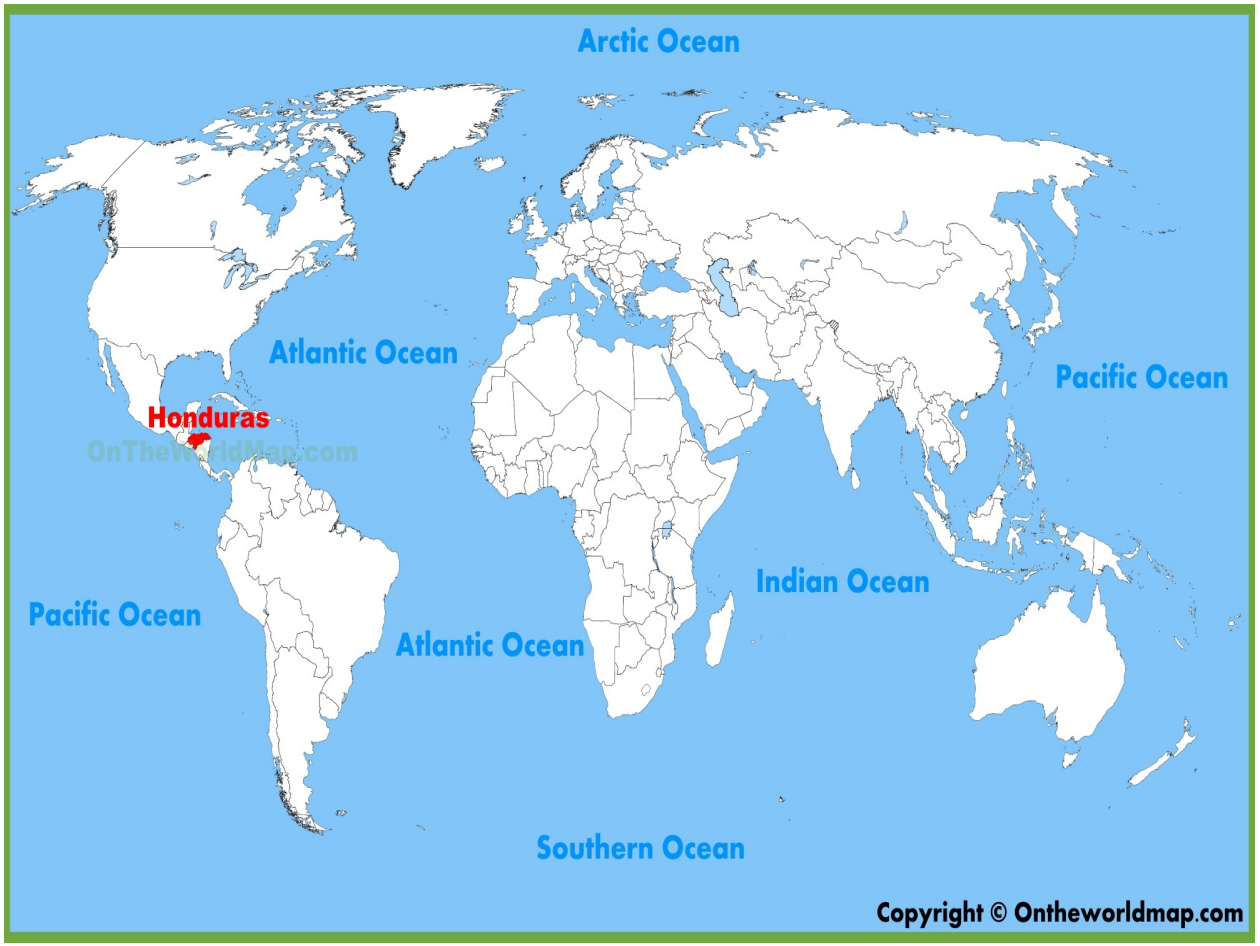
- I need to break this rule because I have some intriguing pictures to show you.

Viewers discretion is advised.

Honduras

A beautiful country in the middle of América



Honduras

... with normally distributed population skills

... and whell behaved wave functions (according to human SM).

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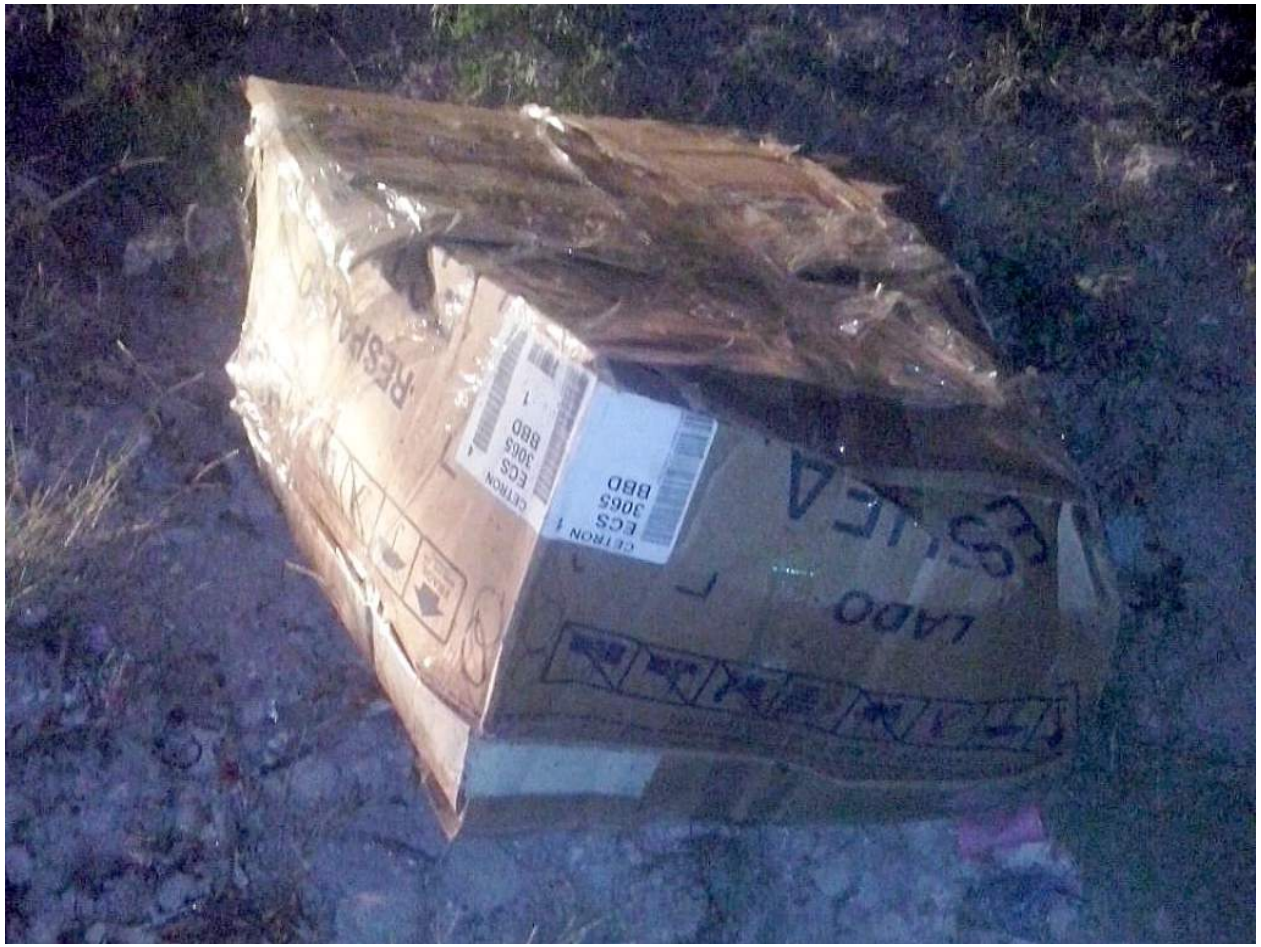

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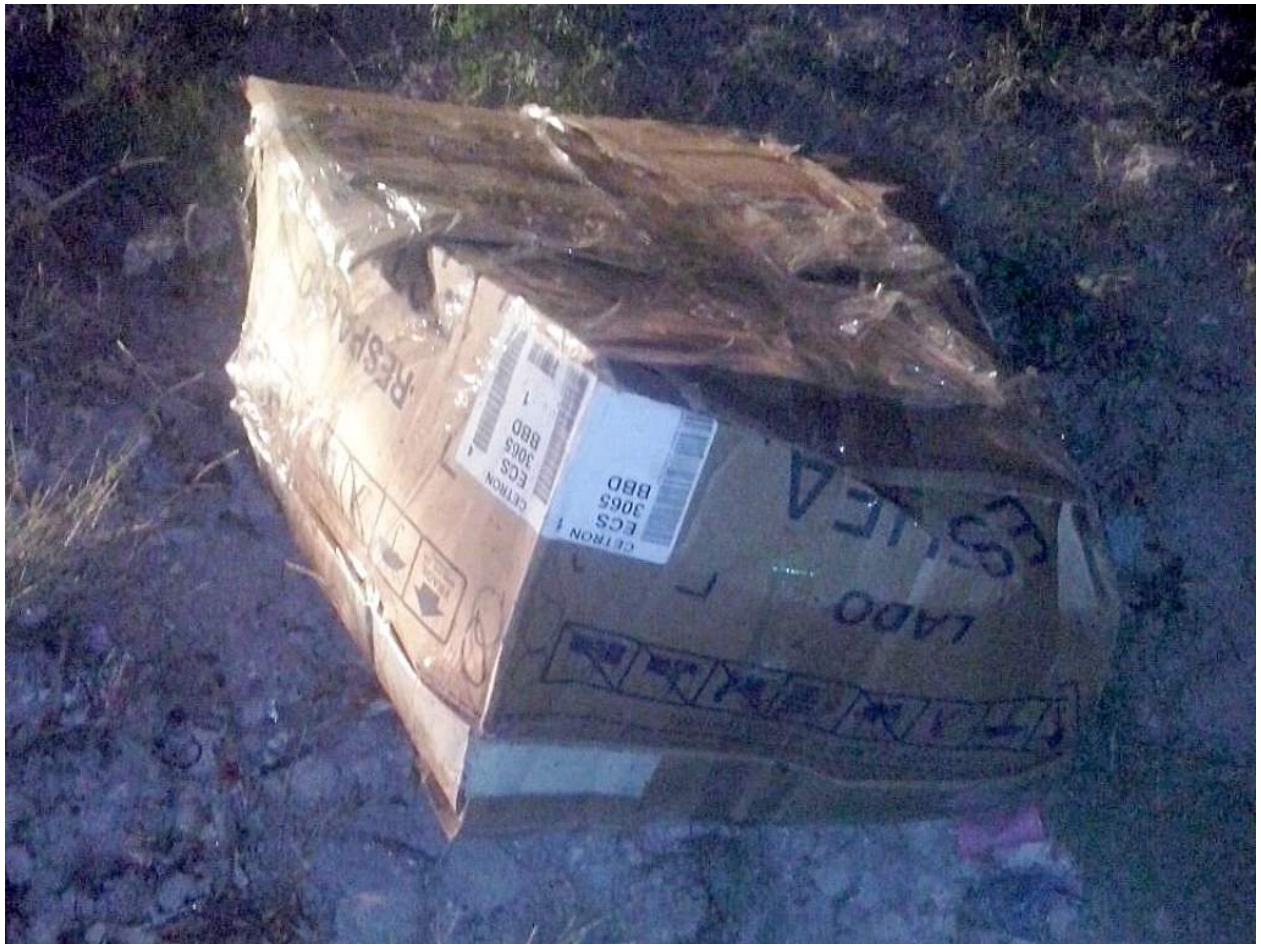

Guess the contents of the box ...

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But something must be done in order to have peace!

- **Education and science are urgently needed (and by the way, that is the only way we can collaborate).**

I am reinventing the wheel, I know...

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But, considering the exciting latest discoveries, I think it is ok to start in any condition.

Besides that, I heard a scientific revolution is coming... so I want to contribute.

---

* Hint: see Pascuale's talk on monday

From particles...

I have been involved in data analysis collected by the LHCb experiment since 2009.

- Search for CP Violation ($C\not{P}$) on hadronic charm 3-body decays:
  - Model independent: statistical comparison of the populations for particle and antiparticle in 2D intervals (bins) of DP (looking for local variations on the significance of the difference in the populations).
  - Direct measurement of weak relative phase: multidimensional fit to DP (full Dalitz plot analysis).
- $B \rightarrow$ pseudoscalar + vector: ACP measurement by CPT constraint (new model independent method).

[Phys.Rev.D94054028(2016)]

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- *Amplitude analysis of the decay* $D^+ \to \pi^-\pi^+\pi^+$ *with LHCb data.*
- Analysis made with full LHCb 2012 data, ∼600K events last analysis: CLEO-c ∼ 2K events. [Phys.Rev.D76012(2007)]
- Challenging model (It seemed impossible, so I liked it):
  - Very large samples → detailed studies of light meson spectroscopy:
    - Low & high mass scalars, $\rho(770)-\omega(782)$ interference, etc.
    - High levels of background → Multivariate Analysis.
  - Fit with isobar model (sum of interfering resonances): very challenging.
    - Binned and unbinned maximum likelihood fit.
  - Complicated structure of the S-wave.
    - MI-PWA fit implemented for the first time on this channel.

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Grazie per l'attenzione!

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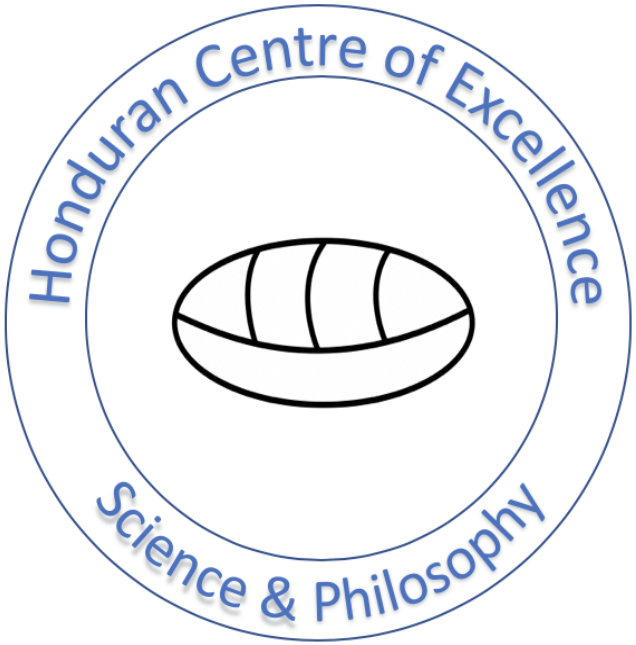

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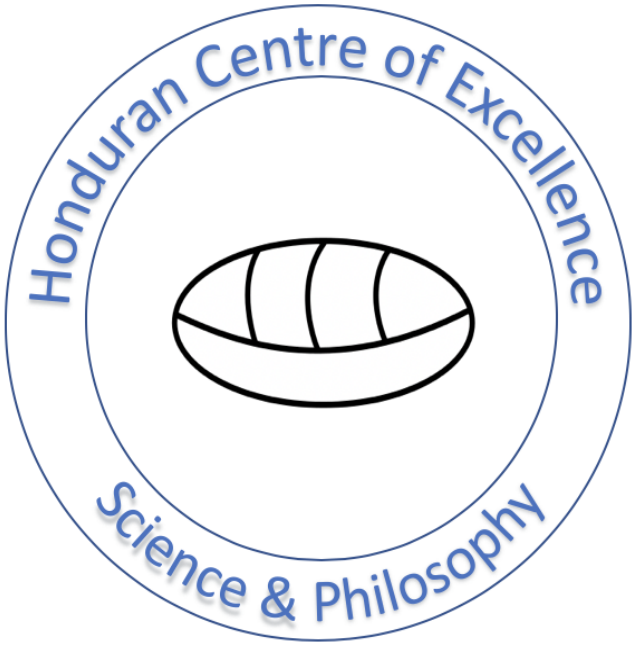

But we can join efforts to meet the "DREAMs whorkshop", to be held in Honduras (can not remember when that will be).

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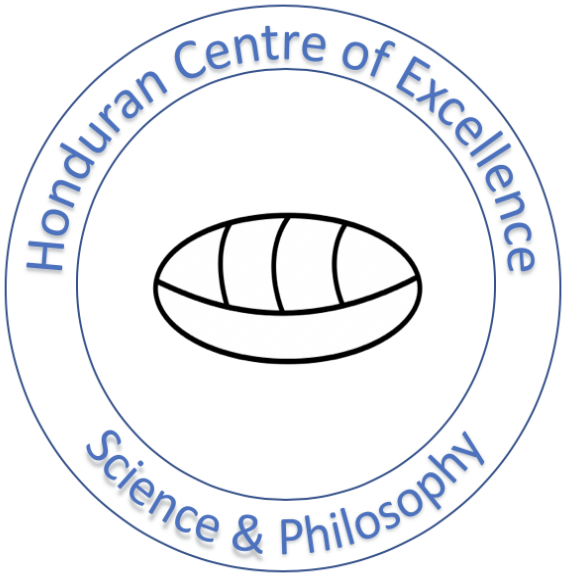

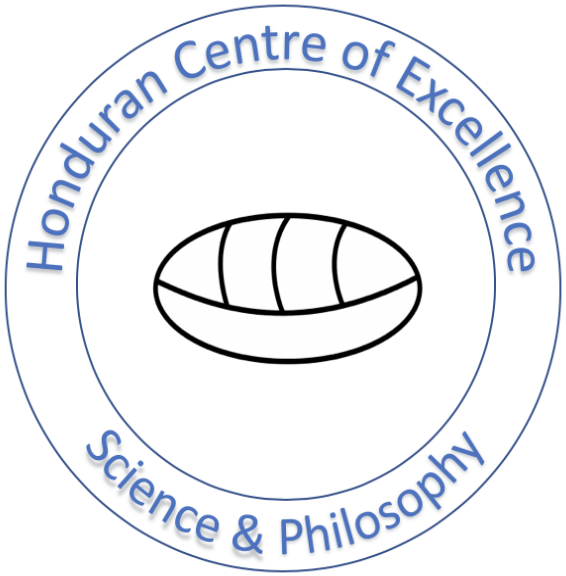

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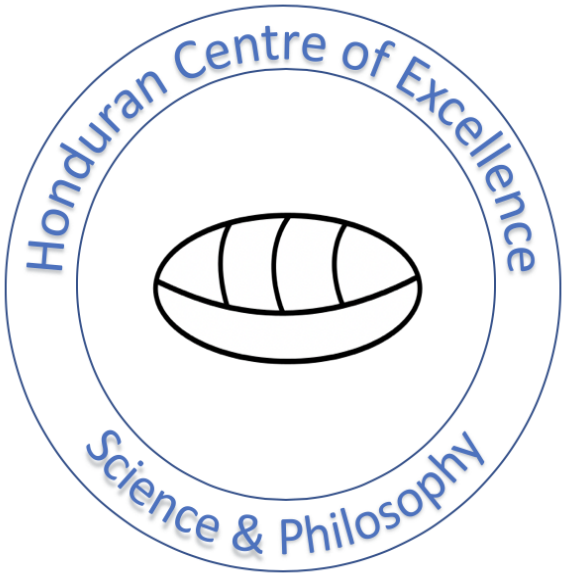

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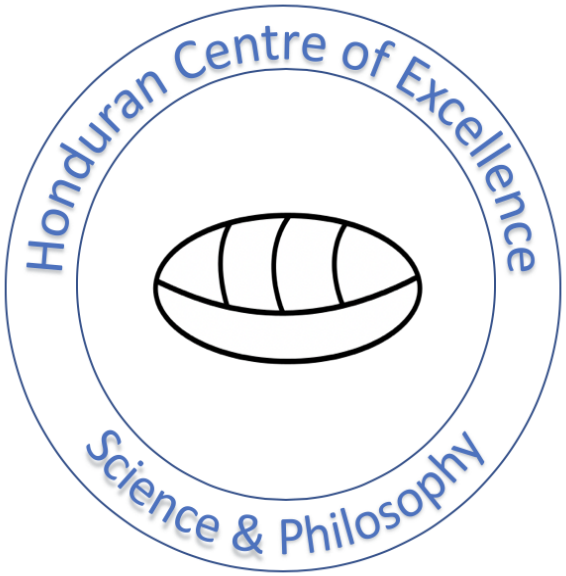

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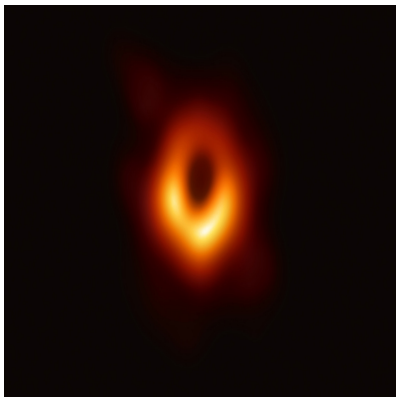

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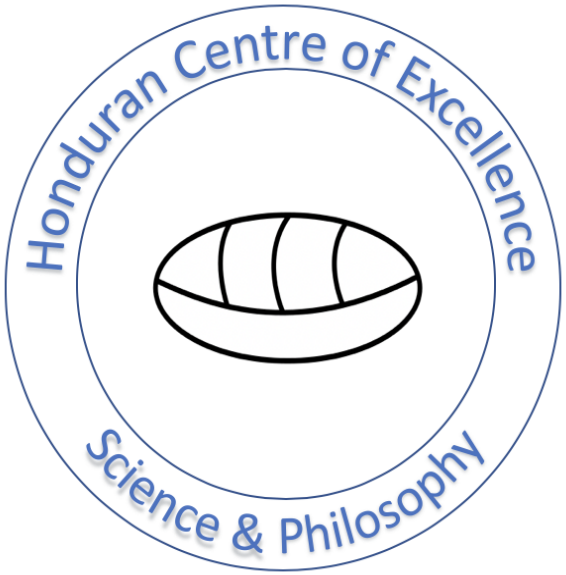

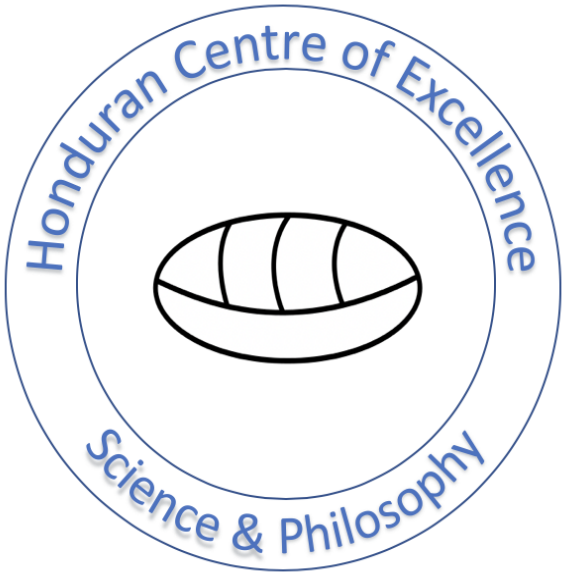

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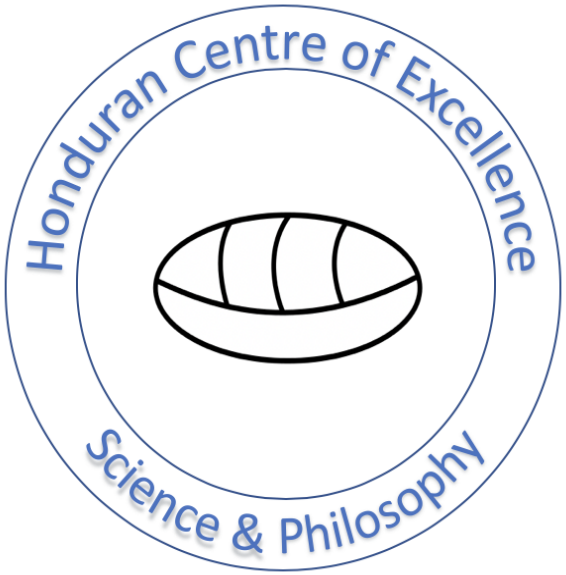

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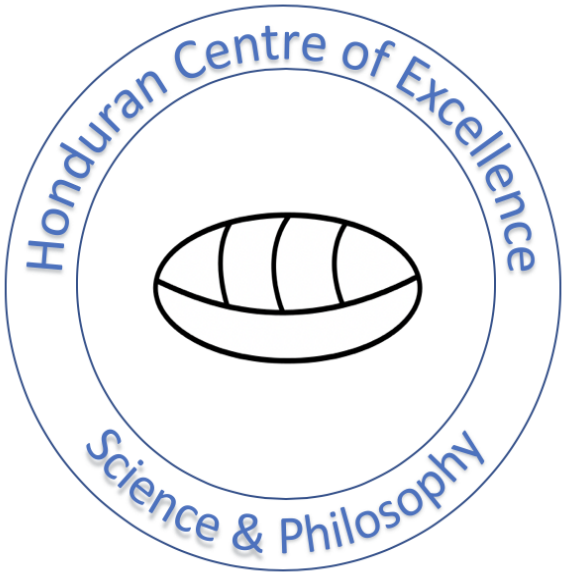

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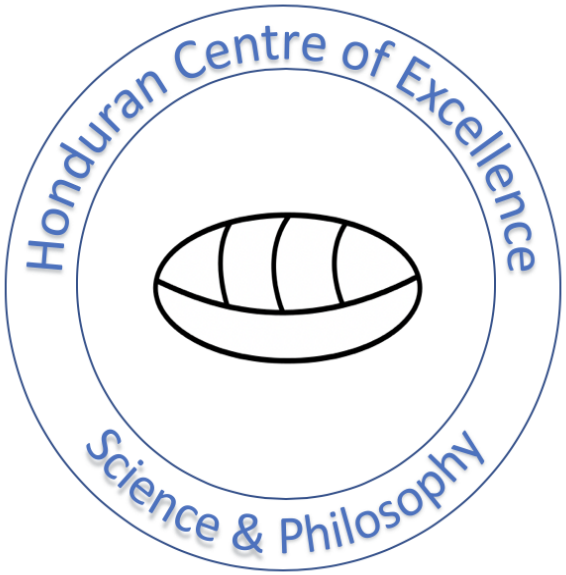

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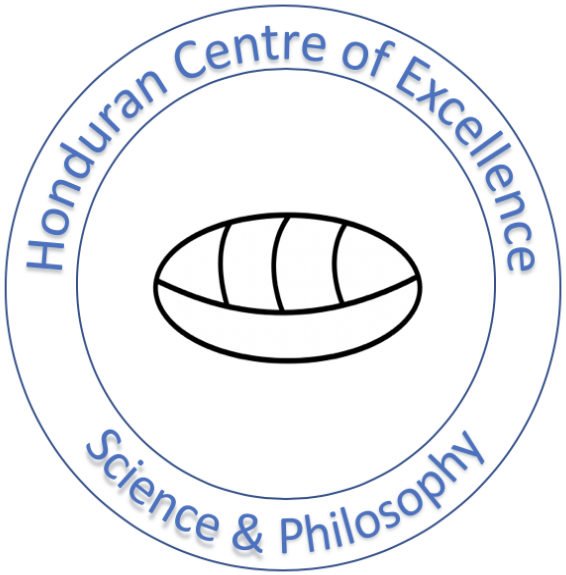

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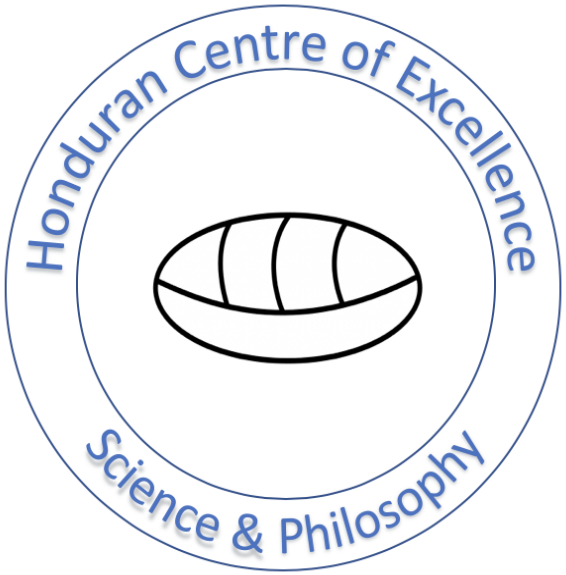

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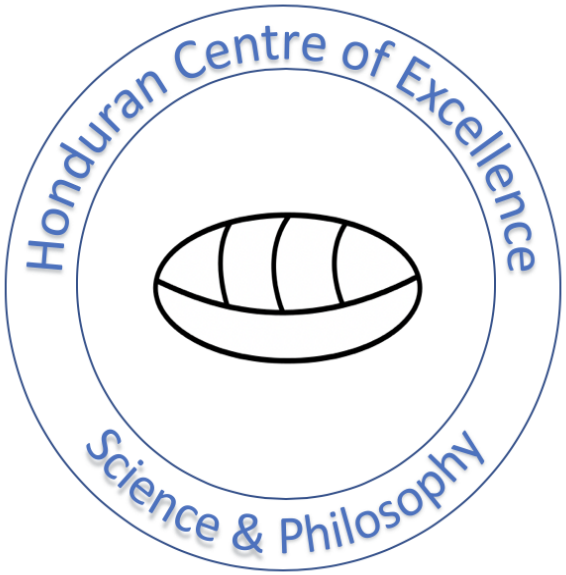

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Elementary, dear Watson...

Greetings from Honduras!

Come visit us!