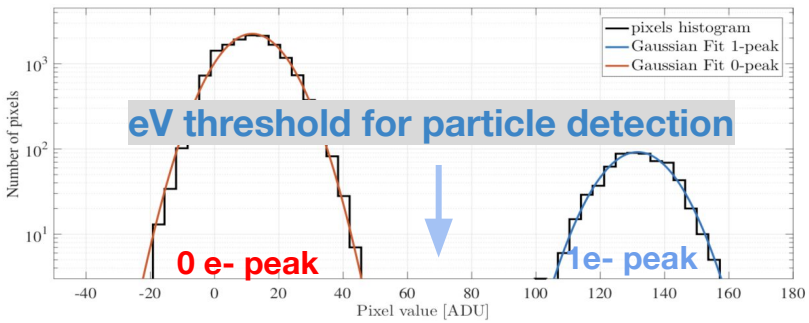
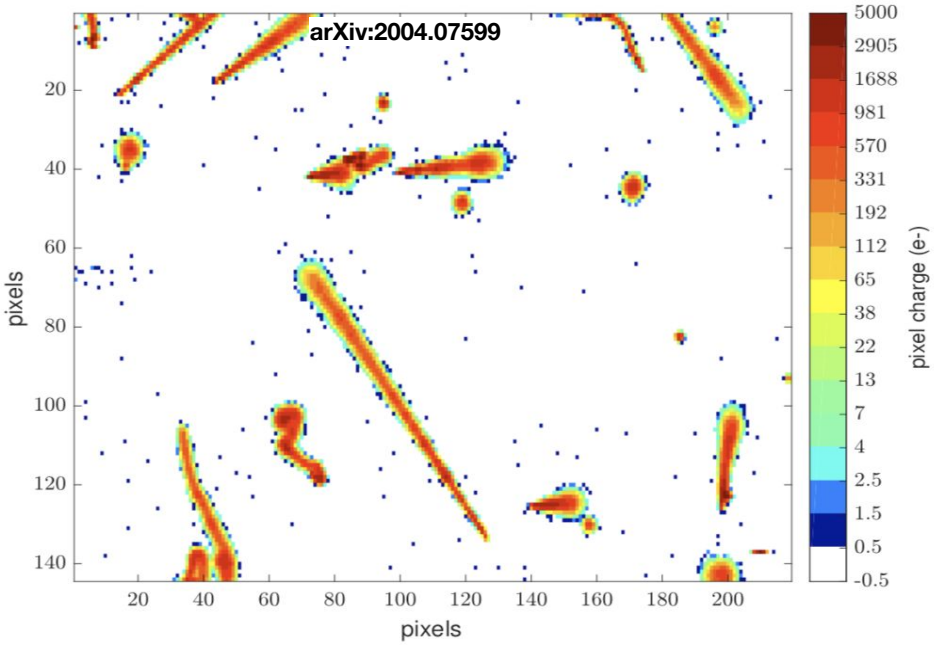
Short baseline neutrino experiment in nuclear reactors using Skipper CCD

July 4, 2020

Guillermo Fernandez Moroni *on behalf of vIOLETA*

We should prioritize Skipper CCD as a new technology for Latin America



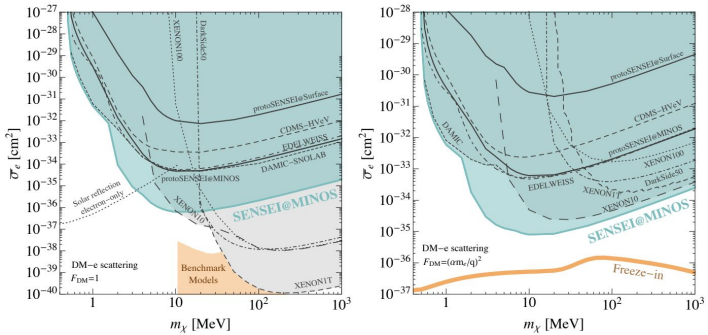


Summary

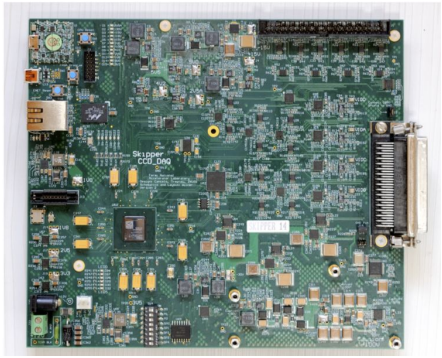
- eV interaction threshold
- Single charge/single photon counting capability from 0 to 100.000 e-.
- It allows to scale system of thousands of these devices.

A lot of expertise in Skipper already in Latin America. We should leverage this groups.

- Skipper CCD data analysis setting the most stringent limit for galactic light dark matter search (2020). (**arXiv:2004.11378**)



- Full design of the first readout electronics and data acquisition system for Skipper CCD (**arXiv:2004.07599**). Now being the new standard, used for Dark matter search (**SENSEI, DAMIC, OSCURA**), neutrino search (**vIOLETA, MINER, CONNIE**), Astronomy (**new spectrograph instrument at FNAL**), quantum imaging (**New quantum camera**), satellite missions (**Darkness**).



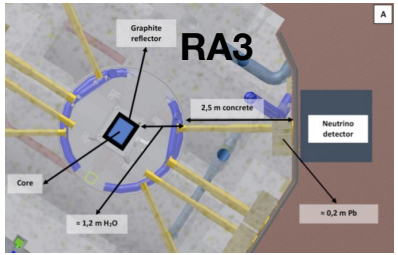
- Theory developments for energy absorption in silicon and neutrino interactions. (**arXiv:2001.06503**)
- Design of new Skipper sensors in CMOS processes
- Simulation development and testing at electron-volt energy deposition scale. (**arXiv:1906.02200**)

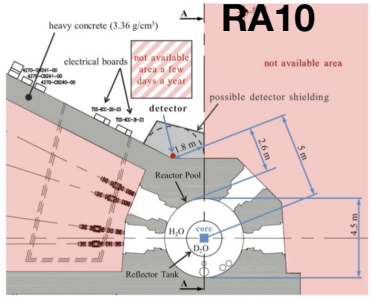
Reactor facilities and expertise available in Argentina

- Nuclear reactor are the largest neutrino sources on the Earth.
- Reactor neutrinos were not used in the past, because just a few technologies were able to see them. Now they are main stream in the community.
- Several groups and large experience in the operation and fabrication of nuclear reactors in Argentina.

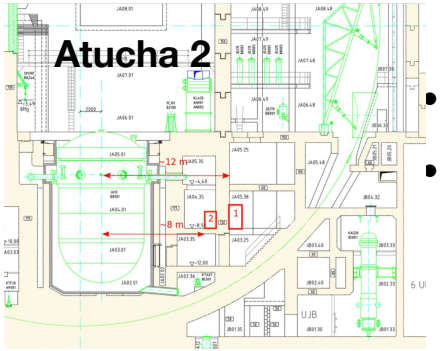
Research reactors for Skipper R&D

- More flexible access and operation important for new developments.





Power reactor (Atucha 2) for Skipper experiment

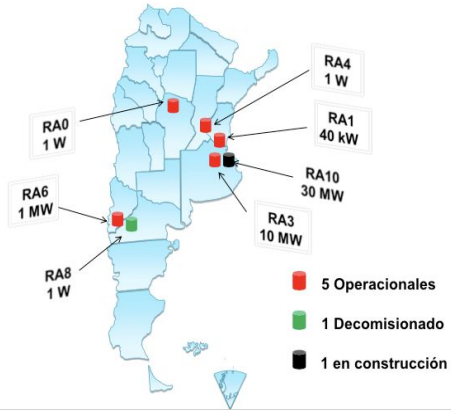


- Larger neutrino flux.
- Less cosmic background expected.

Poster #523, Neutrino 2020

Long history in the fabrication and operation of nuclear reactors in Argentina

Research and teaching reactors

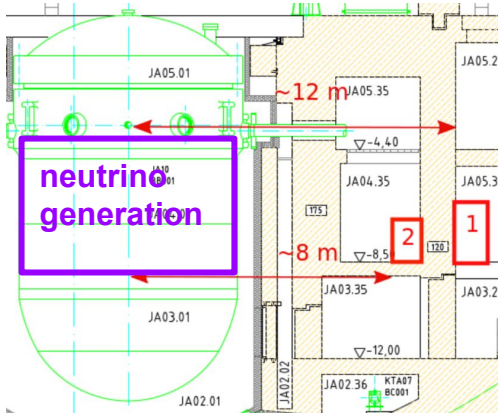


*v*IOLETA experiment (large community already behind this effort)

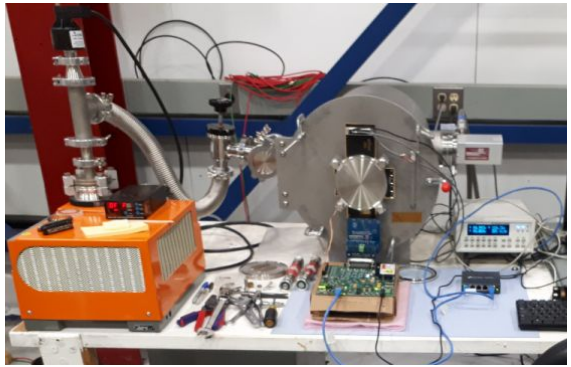
*v*IOLETA: Neutrino Interaction Observation with a Low Energy Threshold Array

- It is an experiment of multi-kilogram array of Skipper CCD in a nuclear reactor.
- It is a new collaboration amming the realization of a neutrino experiment in a reactor using Skipper CCD.
- The seed started in Argentina for the large experience in Skipper CCD and nuclear reactors.
- Now, it is a collaborative effort that involves many countries in America.
- Many expertise on neutrino, several collaborators are part of the CONNIE experiment (using regular CCDs).

*v*IOLETA location in Atucha

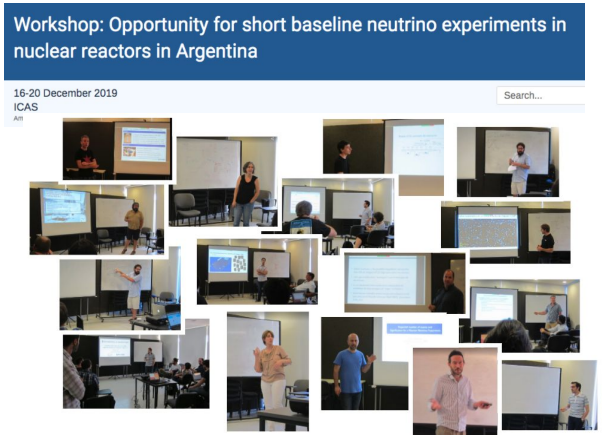


Prototype at FNAL



- 3.3 larger flux @ 12m than Angra lab.
- 7.4 larger flux @ 8m than Angra lab.

Workshop in 2019, Buenos Aires (Argentina).



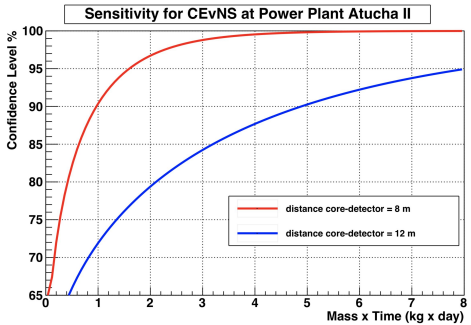
Weekly meetings

Physics goals

- We will have large sensitivity to the CE*v*NS channel.
- We can exploit the CE*v*NS channels for new physics search and SM.
- eV-threshold to access unexplored interaction energies.

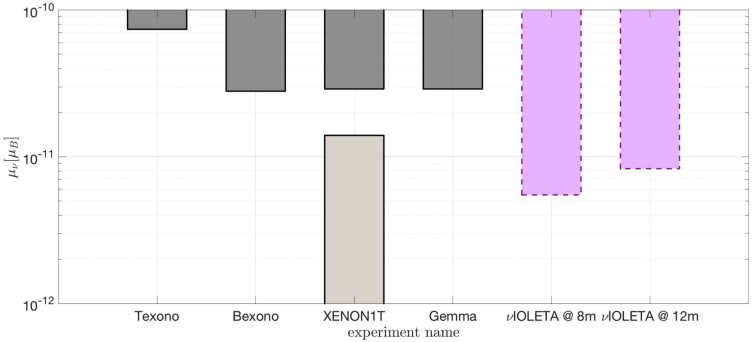
CEvNS detection

- Sensitivity to CE*v*NS process in a few days.

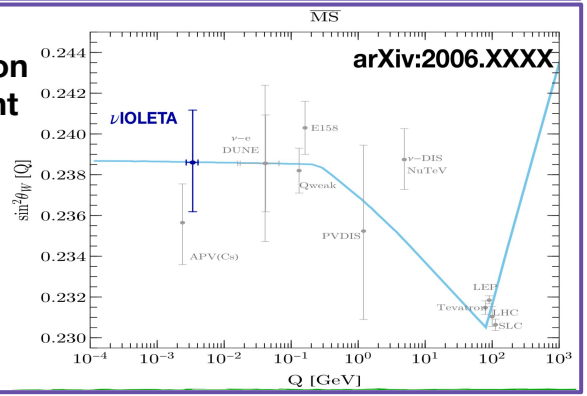


Poster #521
Neutrino 2020

Neutrino magnetic moment search

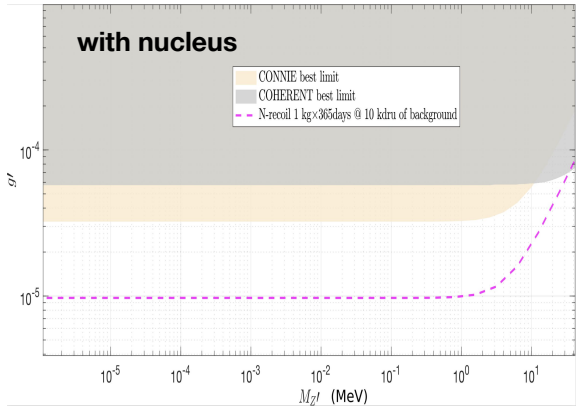


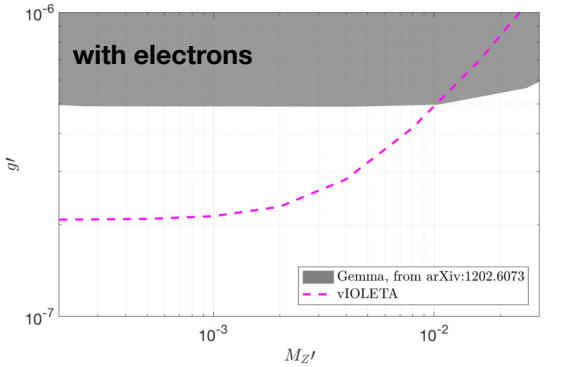
High precision measurement of the SM



Poster #508
Neutrino 2020

Light vector mediated interactions





- Will set new limits on new neutrino interaction from light mediators that are not accessible from accelerators experiments.
- Will set new limits on dark photons interactions (gB-L)
- Necessary for new low mass Dark Matter searches

Conclusions

- **We should support the development of Skipper CCD technology in Latin America.**
- **A lot of expertise in house. We should support those groups in a complementary way to maximize benefits.**
- **We have the largest neutrino sources in the planet (nuclear reactors), available in Latin America.**
- **We have a unique opportunity in Latin America to generate a long term program with high scientific impact 100% in Latin America:**

Nuclear reactor neutrinos + low threshold sensors.