SoLid: Search for oscillations at short distance of the BR2 research reactor
N. Ryder, A. Vacheret* and A. Weber for the SoLid collaboration

Physics Motivations
A few anomalies at a similar L/E have emerged in oscillation data:
• The LSND and MiniBooNE appearance results [1-2]
• The so-called reactor anomaly [3] after a recent re-evaluation of anti-neutrino spectra [4]
• The Gallium anomaly from re-analysis of SAGE and Gallium calibration runs [5]

A possible explanation for this is a light neutral particle (called sterile neutrinos) which only couples to other standard model neutrinos via oscillation at short distance (mass around –1 eV). Recent Planck 2013 data [6] leaves some possibility for an additional neutral candidate but with mass around ~ 0.2-0.4 eV

Search for a new oscillation phenomenon at short baseline (5-10 m) of a research reactor to cross-check previous short baseline results and test sterile neutrino hypothesis

Sensitivity to small oscillations can be maximised by:
• use of a compact source (research reactor)
• use a highly segmented detector with good energy reconstruction

SoLid detector technology
Move away from traditional approach (LS+Gd):
• Better neutron ID
• Localise more precisely antineutrino interaction

Experimental set up
2.88 tonne segmented solid scintillator detectors at 6.8m from reactor core
• low background condition and B-12 mwe overburden

SoLid sensitivity to new oscillations
• 416 ν/day/ton
• Target detector efficiency 41%
• Energy resolution ΔE/E ~ 22% at 1 MeV
• 300 days running (140 d/year) starts in 2016
• Flux, power & efficiency systematics in contour

Voxelisation of target volume
• Add precise spatial information of
• Potential for direction reconstruction
• Unique strategy to unfold unknown backgrounds

SoK•CEN BR2
MTR research reactor
BR2 is a tank-in-pool research reactor licenced to operate up to 100 MW
• twisted compact core geometry
• Be Matrix, HEU fuel elements
• cycles of 20-25 days, 150 d/year

Detector design
• Detector cell 5cm x 5cm WLS fibre network for 3D localisation
• 3 mm x 3 mm MPPC photosensors

Staged R&D
1. NEMENEX 8 kg prototype: validation of detector response at BR2
2. Detector plane Mock-up: validation of detector design
3. Large scale system SM1 to be built and tested in October 2014

Electronics & Trigger
Fast digitiser electronics
• MPIC signal amplification and stabilisation
• 65 M/0.12 bit ADC 64x ch.
• FPGA pulse processing
• charge injection
• Trigger using n signature

Summary
The SoLid experiment will search for new oscillations at short distance from BR2 reactor:
• unique detector technology
• low background environment at BR2 for maximum sensitivity in 2 years running (2016-2017)