Visible (+Invisible) Dark Photon sessions

10:00 – 12:00
Visible Dark Photon Searches: Session 3 (Almanor – SUSB 3rd floor)
Conveners: Maxim Perelstein (Cornell), Maxim Perelstein, James Alexander (Cornell)

10:00
VEPP-3 (remote speaker)
Speaker: Igor Rachek (liluder institute, Novosibirsk)
[Attached file: dsw16_vepp3.pdf]

10:30
ATLAS (remote speaker)
Speaker: James Beacham (Ohio State University, US)
[Attached file: Beacham_ATLAS_D.pdf]

11:00
Belle II
Speaker: Christopher Hearty (University of British Columbia)
[Attached file: Dark photons Belle II.pdf]

12:30 – 15:00
Visible Dark Photon Searches: Session 4 (Almanor – SUSB 3rd floor)
Conveners: Maxim Perelstein, James Alexander (Cornell University, US), Maxim Perelstein (Cornell)

13:30
5th Force
Speaker: Filip Tanedo (UC Irvine)
[Attached file: Flip_SLAC_DarkSector.pdf]

13:50
KLOE-2
Speaker: Enrico Graziani (INFN, Sezione Roma II)
[Attached file: graziani-kloe.pdf, graziani-kloe.pptx]

14:10
SeaQuest
Speaker: Susan Gardner (University of Kentucky)

14:30
Dark Pion Theory
Speaker: Keisuke Harigaya (s)
[Attached file: 2016SLAC.pdf]

15:00 – 17:30
Joint Visible/Accelerators Session: Session 1 (Kavli Auditorium)
Conveners: James Alexander (Cornell University, US), Maxim Perelstein, Gordan K. Eder Izaguirre, Marco Andrea Battaglieri (Universita e INFN (T)), Richard Van de Wa

16:00
Discussion

16:20
Cornell Experiment
Speaker: Jim Alexander (Cornell)
[Attached file: SLAC-MMAPS-alex... SLAC-MMAPS-alex...]

16:40
LNF Experiment
Speaker: Mauro Raggi (LNF INFN)
[Attached file: RaggiDarkSector20... RaggiDarkSector20...]

17:00
Discussion
Unconventional signatures as a window to dark / hidden sectors

- Prompt and displaced lepton-jets via dark photons
- Displaced, non-collimated leptons via dark photons and dark Zs
- Higgs-to-four-leptons via $Z_{\text{dark}}$
- Higgs-to-four-SM particles via intermediate (pseudo)scalars with prompt decays
- Displaced vertices / hadronic jets
- Emerging jets
- Long-lived, heavy neutral leptons
- Multi-charged particles

ATLAS searches not covered here:
- SUSY R-parity-violating scenarios that yield long-lived particles
- Dark matter / mono-X searches
Prompt and displaced lepton-...

**Displaced:**
- Expect to exceed Run 1 sensitivity with 3-4 fb\(^{-1}\) at 13 TeV
- New narrow-scan muon triggers greatly improve signal efficiency
- Recover muon reconstruction efficiency for nearby muons and extend mass reach higher
- Investigate non-prompt electron LJs reconstructed as converted photons

**Prompt:**
- Focus on larger dataset for an end-of-2016 result
Invisible A’ Searches at Belle II

Summary

- Goal is that the search for dark photon decaying invisibly will be one of the earliest Belle II measurements, possibly even during Phase 2 running starting in late 2017.

- The Belle II calorimeter and tracking are improvements over BaBar.

- Wider range of event generators (wrt BaBar) helps with projections.

- Our current focus is on developing the triggers to enable these measurements.
Dark forces at KLOE: summary and conclusions

- KLOE searched for a dark gauge U boson in six different processes:
  - $\phi$ meson decay: $\phi \rightarrow \eta U$ with $U \rightarrow e^+e^-$, $\eta \rightarrow \pi\pi\pi$  \hspace{1cm} Phys.Lett. B720 (2013) 111
  - $U\gamma$ associate production: $e^+e^- \rightarrow U\gamma \rightarrow \mu^+\mu^-\gamma$  \hspace{1cm} Phys.Lett. B736 (2014) 459
  - $U\gamma$ associate production: $e^+e^- \rightarrow U\gamma \rightarrow e^+e^-\gamma$  \hspace{1cm} Phys.Lett. B750 (2015) 633
  - $U\gamma$ associate production: $e^+e^- \rightarrow U\gamma \rightarrow \pi^+\pi^-\gamma$ arXiv:1603.06086, accepted by PLB
  - Higgsstrahlung: $e^+e^- \rightarrow Uh' \rightarrow \mu^+\mu^- + \text{missing energy}$  \hspace{1cm} Phys.Lett. B747 (2015) 365

- We found no evidence and set upper limits on the mixing parameter $\varepsilon^2 (\alpha_p e^2)$, as a function of the $U$ (and $h'$) mass, in the range $10^{-5} \div 10^{-7}$, depending on the process.

- All these measurements, performed with the KLOE data set, are statistically dominated, so...

- ... the increased DAΦNE-2 delivered luminosity and the presence of the new detectors in KLOE-2 are expected to improve these limits by a factor $\sim 2$ or better.

- New KLOE-2 run is well in progress. Stay tuned!
U boson search in $e^+e^- \rightarrow \mu^+\mu^-\gamma$

- undetected small angle photon $0<15^\circ$, $\theta<165^\circ$
- two opposite sign charged tracks $50^\circ<\theta<130^\circ$

**CL$_S$ technique**

Results based on only 240 pb$^{-1}$

Using the 2.5 fb$^{-1}$ full KLOE data set improves the sensitivity by a factor $\sim 3$

A further factor 2 in sensitivity expected from KLOE-2 experiment

Missing mass dark photon search at VEPP-3

BYPASS along the 4th straight section of VEPP-3 –
where the FEL was previously situated

- vacuum chamber with pumping system
- 3 dipole magnets
- 6 quadrupoles
- elements of beam diagnostics

length of bypassed segment of VEPP-3 = 1830 cm
Missing mass dark photon search at Cornell
Missing mass dark photon search at Frascati

- The PADME experiment has been endorsed from LNF scientific committee in early 2015
- The PADME experiment has been approved from INFN at the end of 2015
- The PADME experiment is financed by the “What Next” INFN program with 1.35M€ (2016-2018)
- The collaboration aims at completing the detector assembly by the end of 2017 and to accumulate 1E13 e⁺ on target by the end of 2018