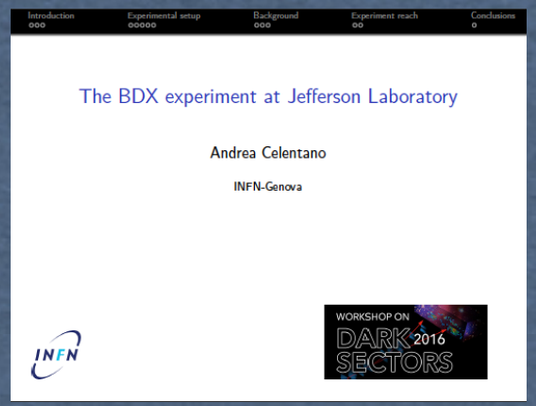
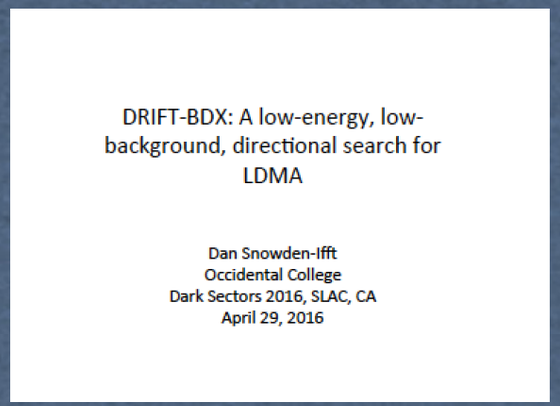
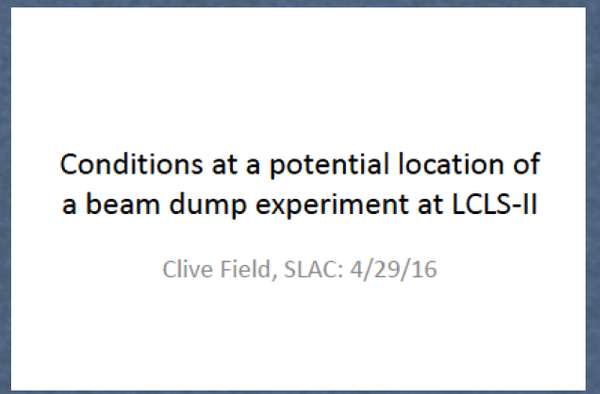
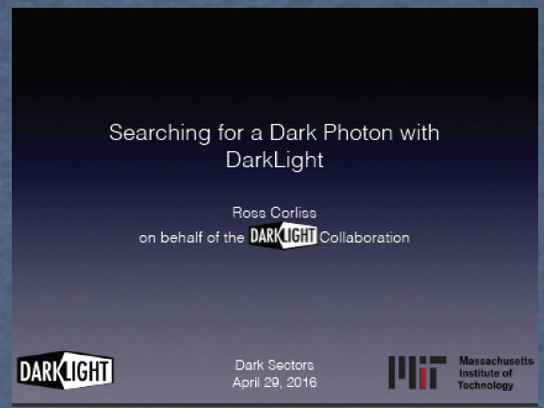
DMA
Electron beams Session Summary

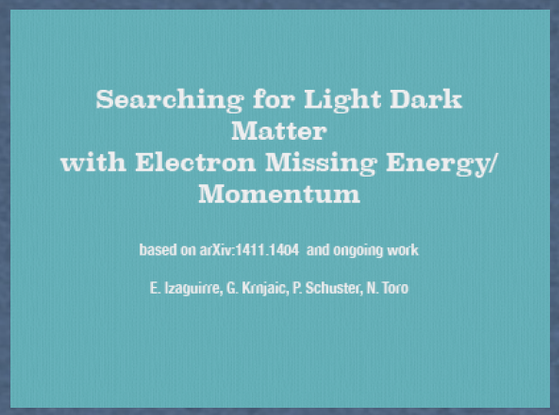
J.Alexander, M.Battaglieri, E.Izaguirre, G.Krnjaic, M.Perelstein, R.Van de Water

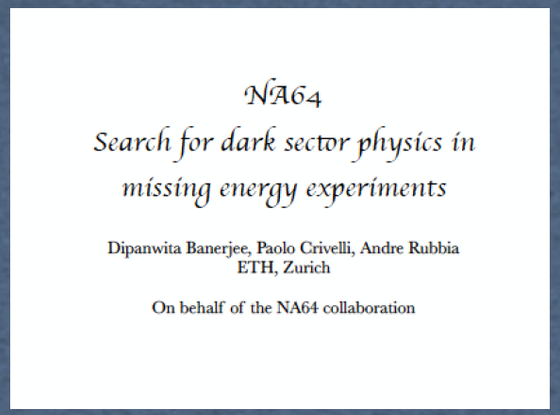


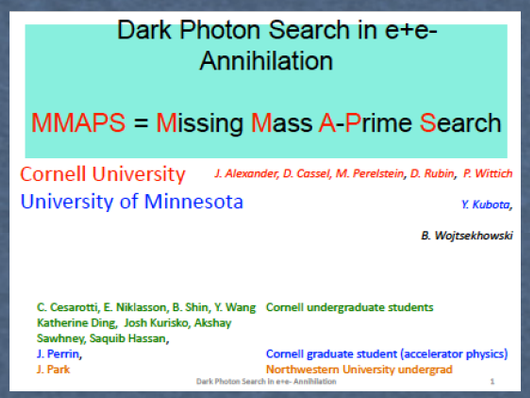


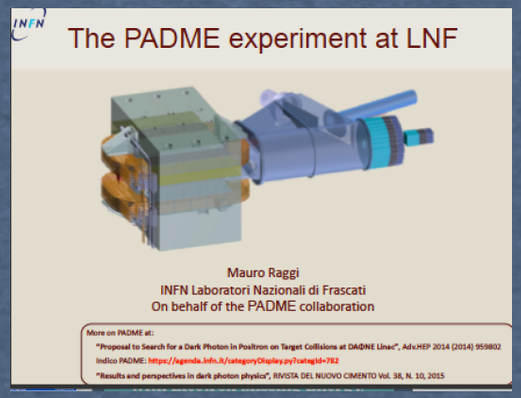






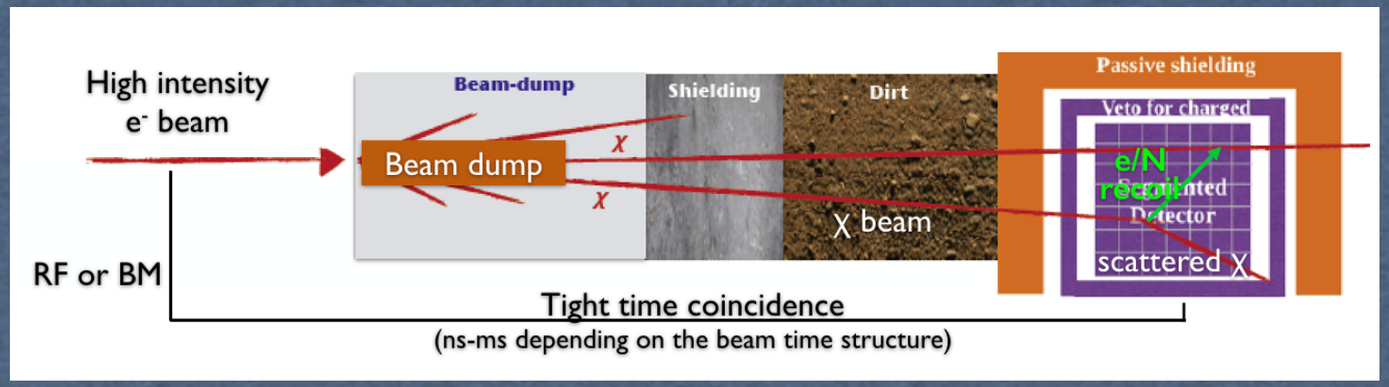




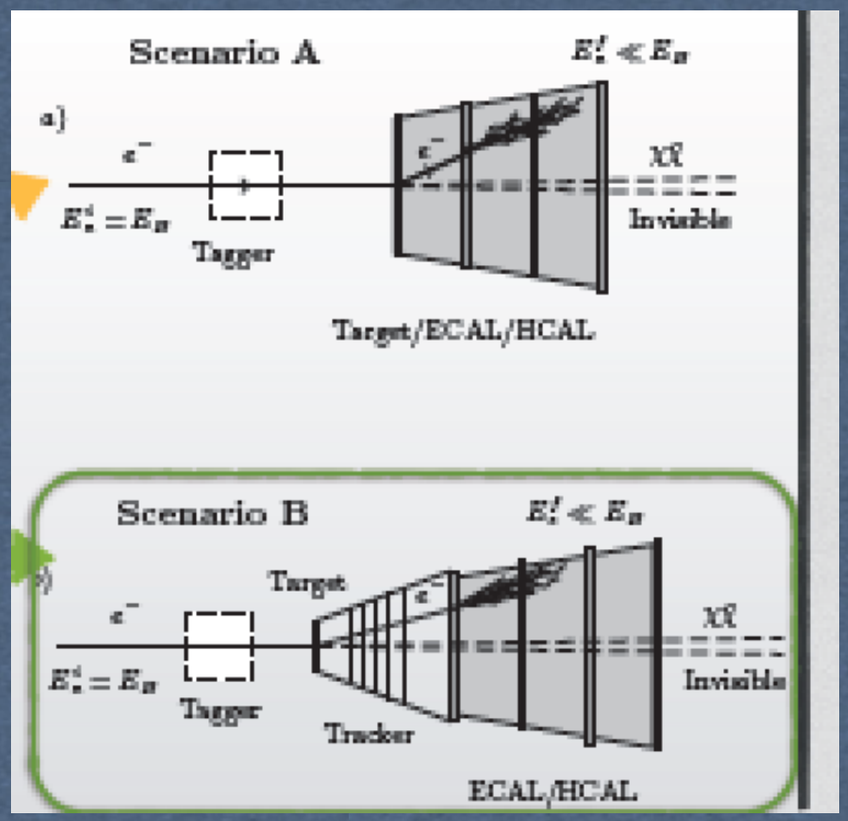


DMA/Visible joint session

Three different techniques in Invisible search

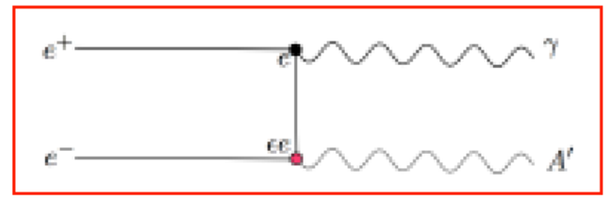


- Beam dump

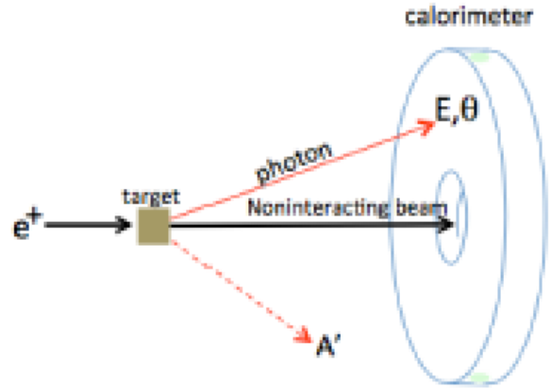


- Missing momentum
- Missing Mass

Process of interest:



Hardware:



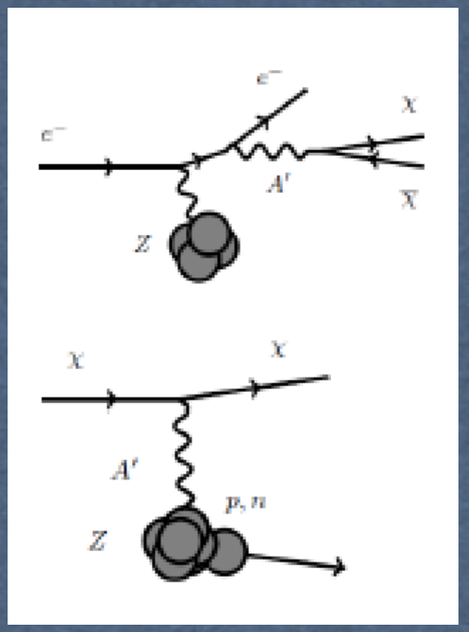
Beam dump

★ Sensitivity to nucleon (Tn>5 MeV) and electron scattering (Ee>500 MeV)

★ Calorimeter (reuse of existing crystals) + passive + active veto

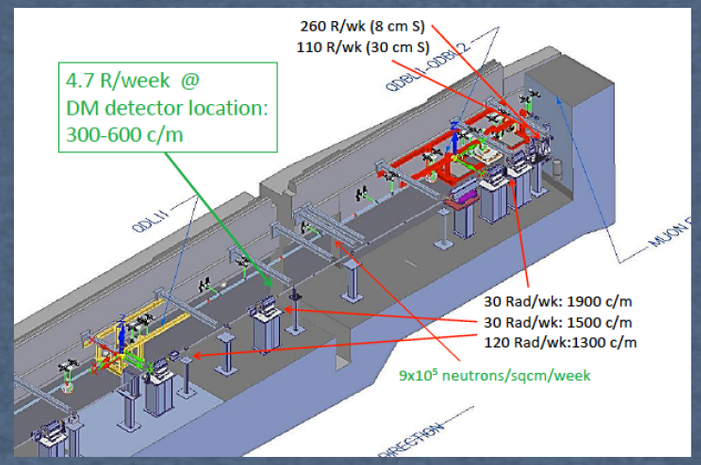
★ Cosmic bg → measurable but the ultimate limit for the sensitivity

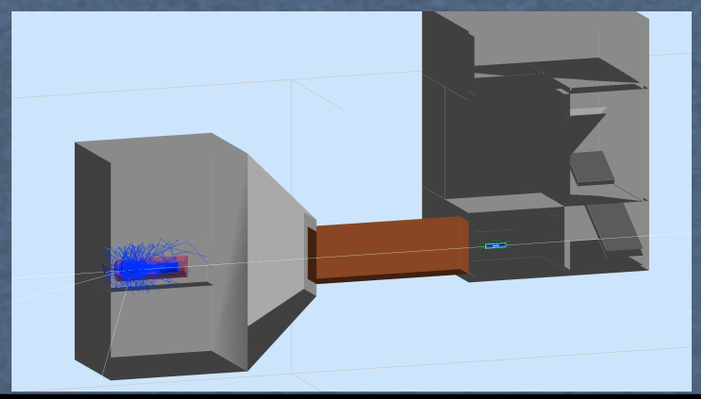
- CW (JLab) vs PULSED (SLAC)
- Fast detector (how fast? costs?)?
- Require real measurement
- Shielding

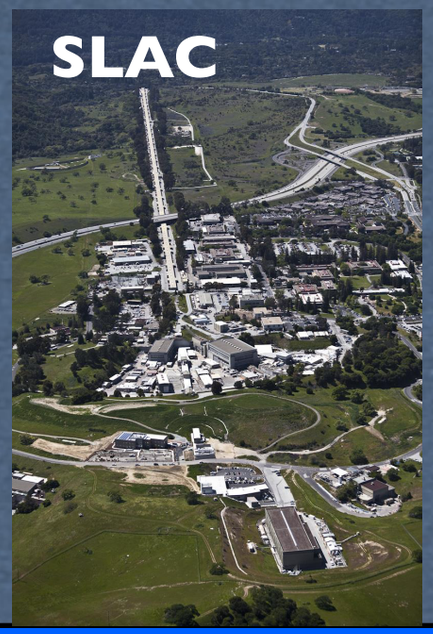


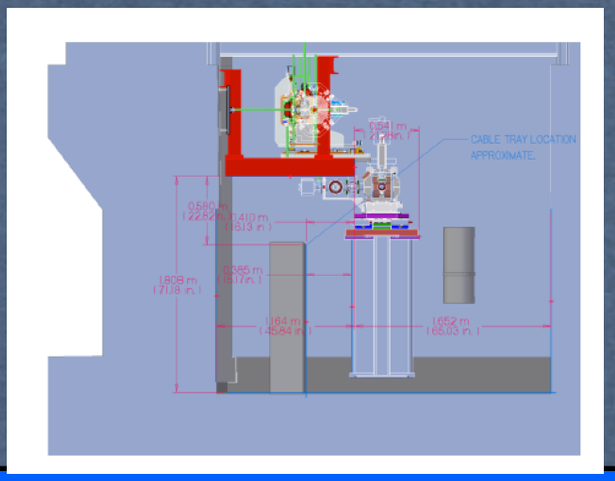
★ Beam related bg → reducible (?) but unmeasurable (??)

- Full G4 simulations unrealistic → alternative: FLUKA, MCNP
- All processes included?
- In-situ characterization
- Bg shield staged to validate MC and demonstrate tha the experiment is bg-free





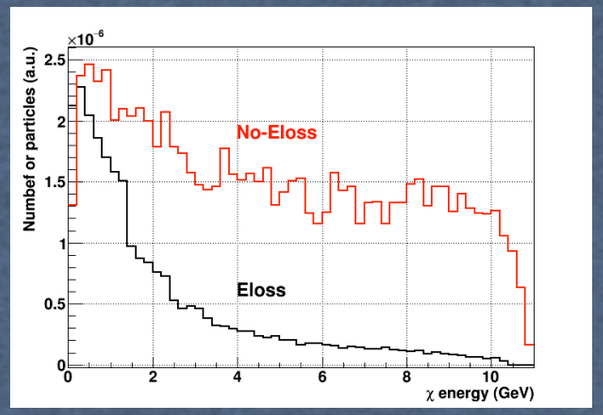


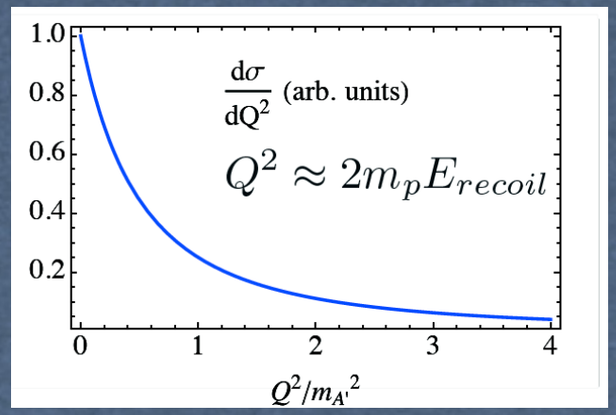


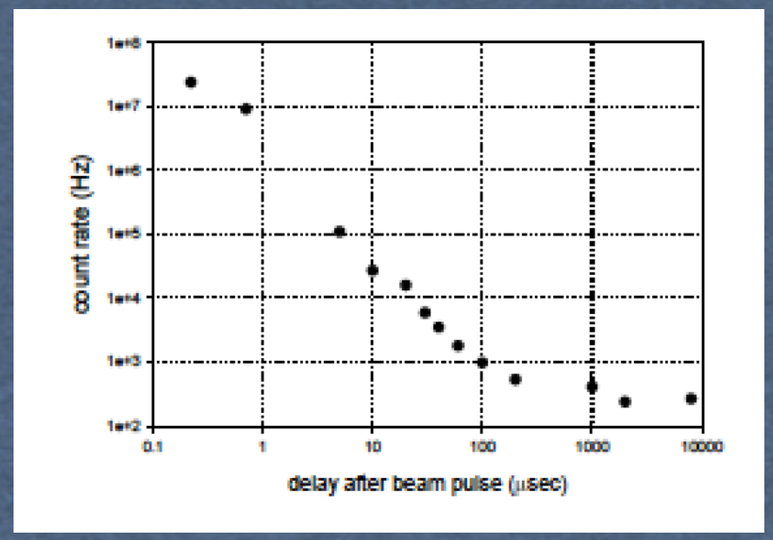
Beam dump

★ How to validate the BG model (cosmic and beam-related) to trust the measurement?

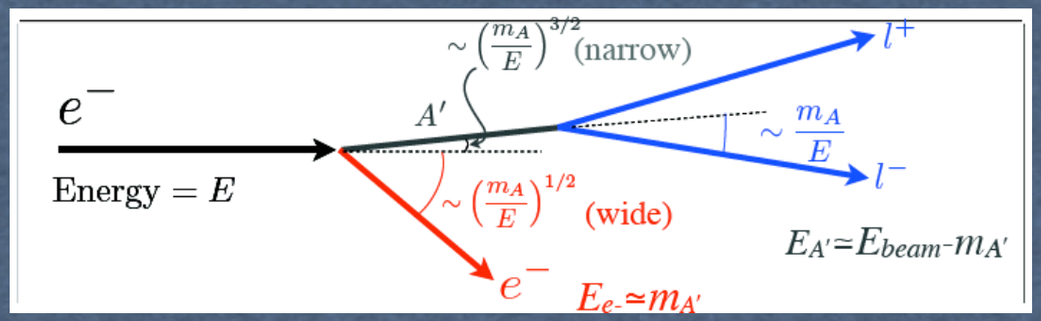
★ DM production and scattering are under control?



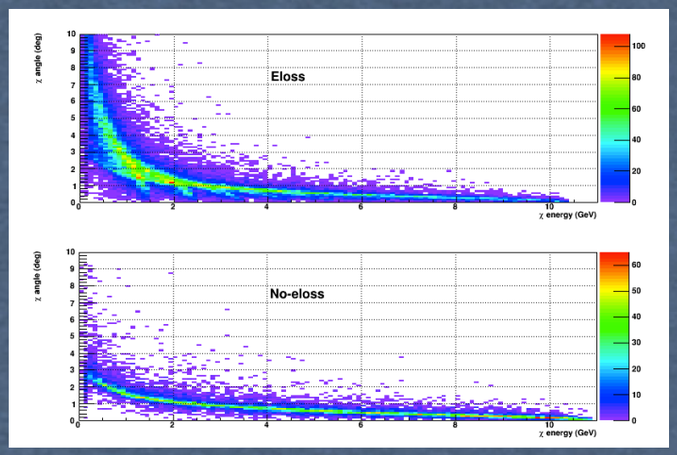




★ Is the collinear approximation valid?

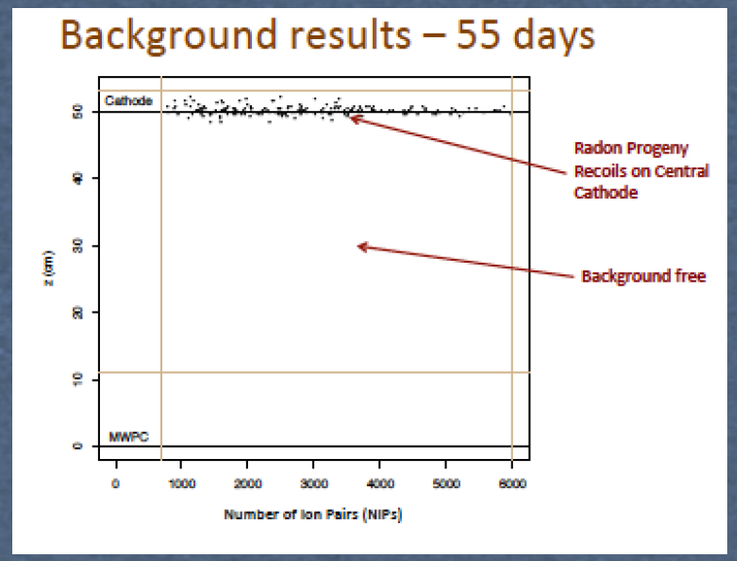


★ How it affects the procedures to assess systematics?



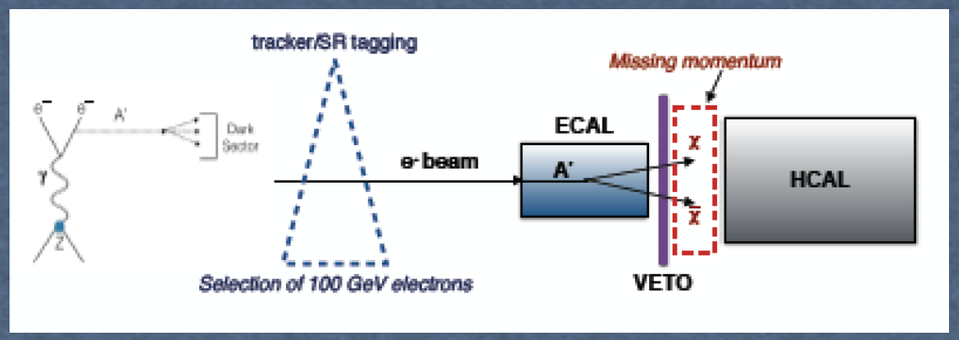
★ May we use different experimental techniques to optimise the reach and the cross check the results?

Eg: DRIFT-BDX:unconventional use of a DD detector for a beam dump experiment

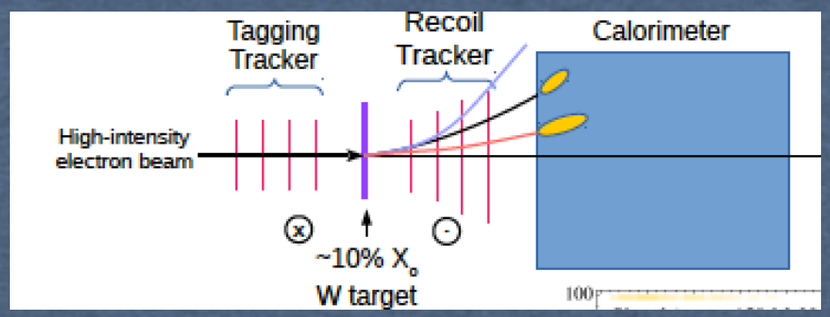


Missing momentum

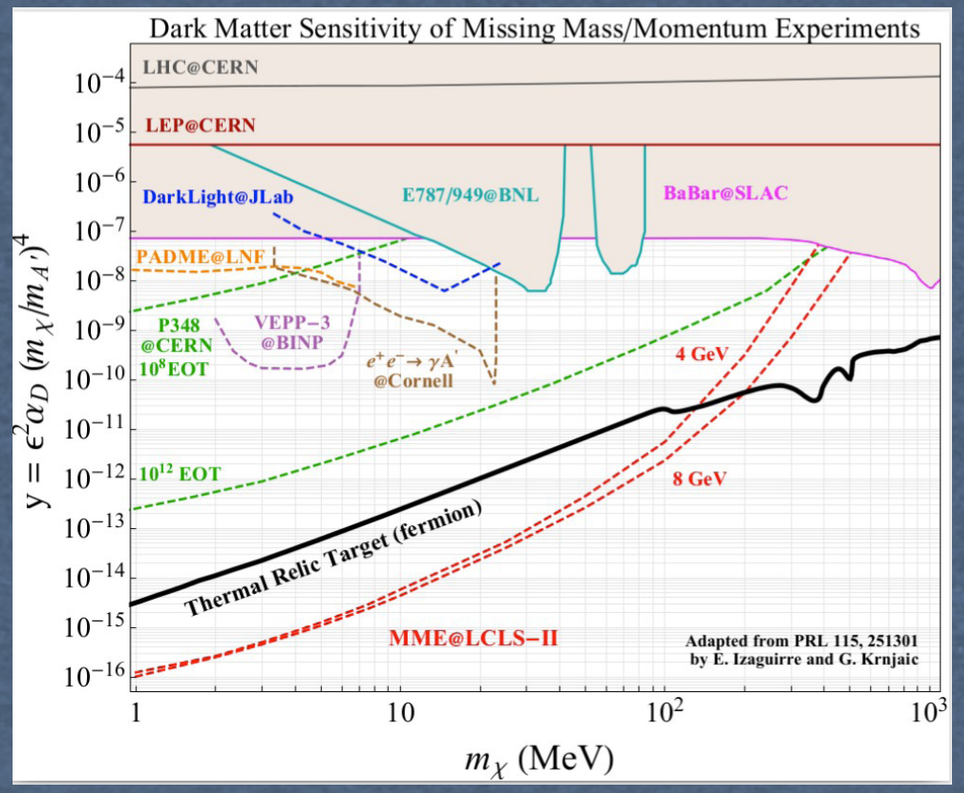
★ Two options:



The detector is the target



Target/detector are different

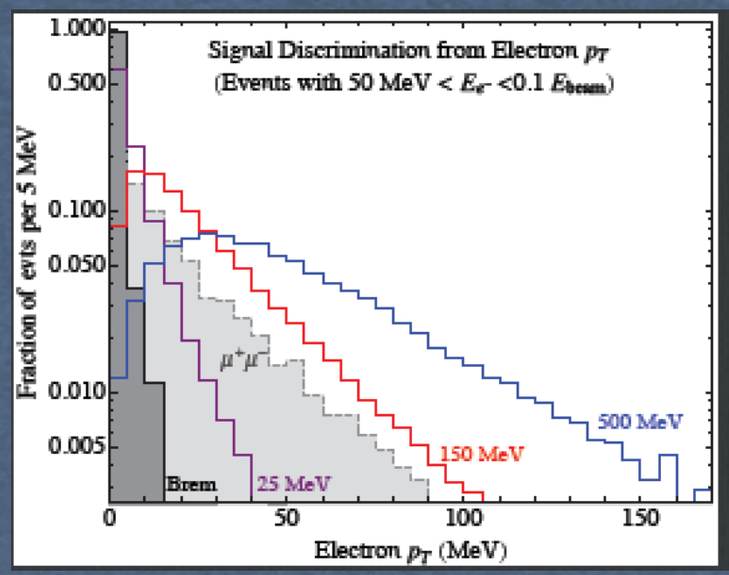


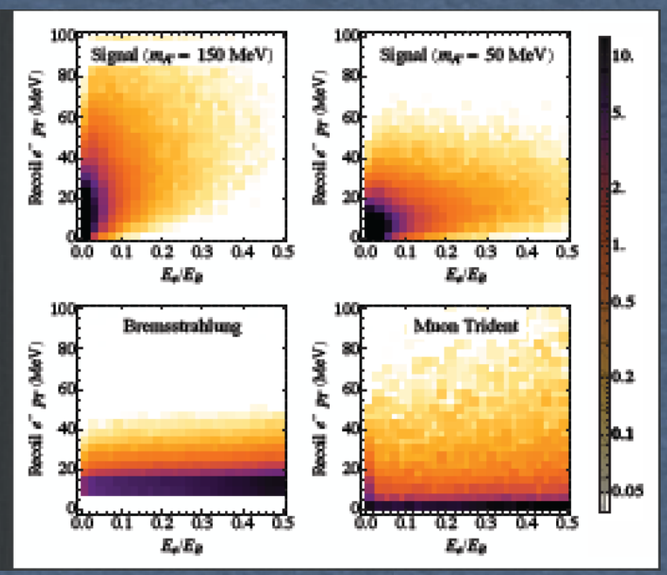
★ Best reach in a given time (no extra ε^2 to pay for detection!)

★ Is the MC parametrisation of "all possible" processes trustable?

★ Reaction kinematic allows to separate signal from BG (?)

★ Different kind of BG: physics (brem, neutron and K_L) and instrumental (pile-up)





Missing momentum

★ Technical challanges:

- How to control a low-current beam (~100pA)?
- Is the ~1 GHz detector-rate operation trustable at the required level?
- What is the time scale to reach 10^{16} EOT in 1y run?
- State-of-the art detector technology

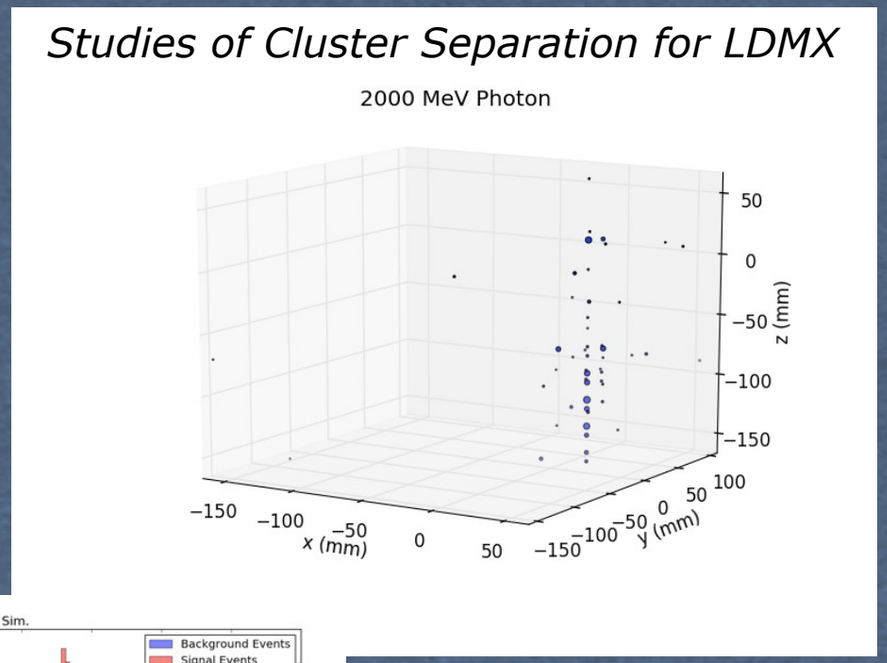
★ What is the best energy regime to run the perfect LDMX?

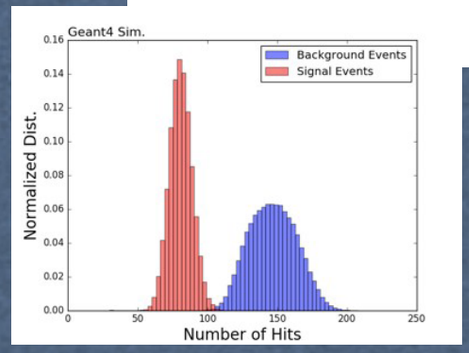
- 100 GeV (CERN) vs 4 GeV (SLAC)
- Clean environment vs Calorimeter resolution

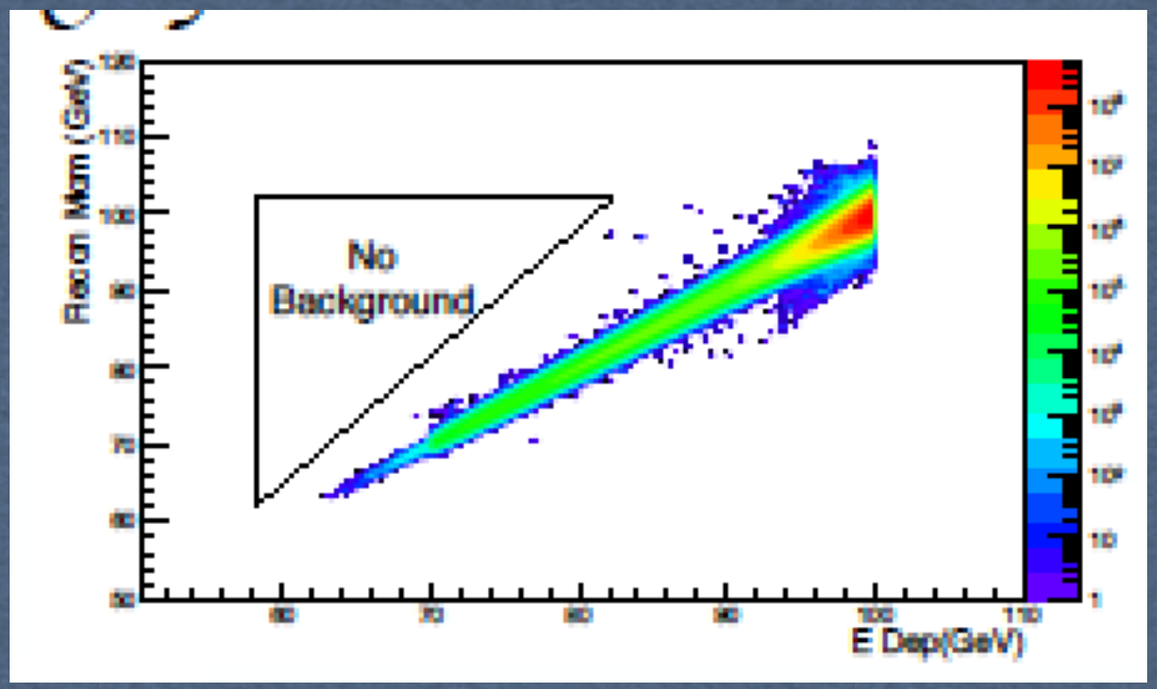
★ Missing momentum is a perfect exclusion experiment but what we need to convince ourselves in case of positive finding?

★ NA64 test results look promising

★ Eager to see results from the full run





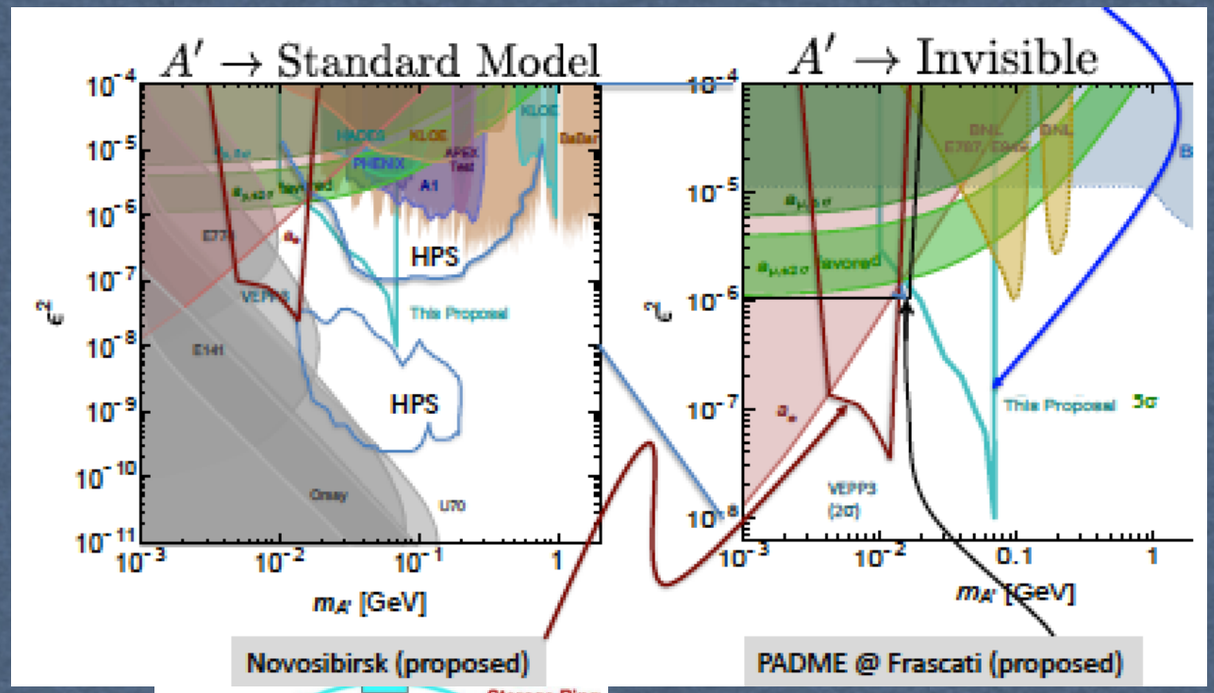


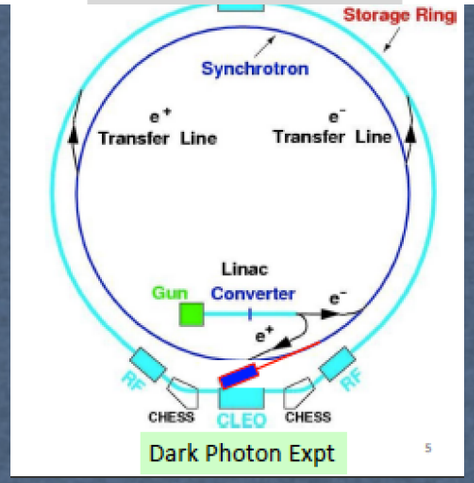
Missing mass

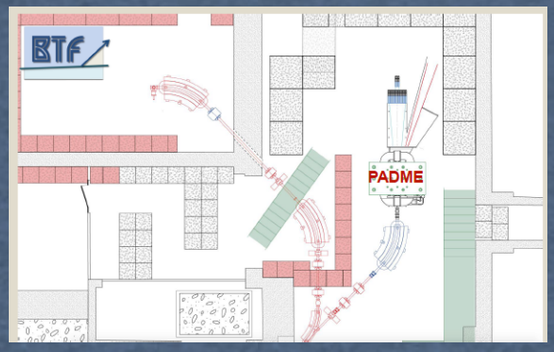
★ Advantages:

- Reduce the models dependence
- Provide a clear signature in case of positive result
- Reuse of many components (detector-wise)

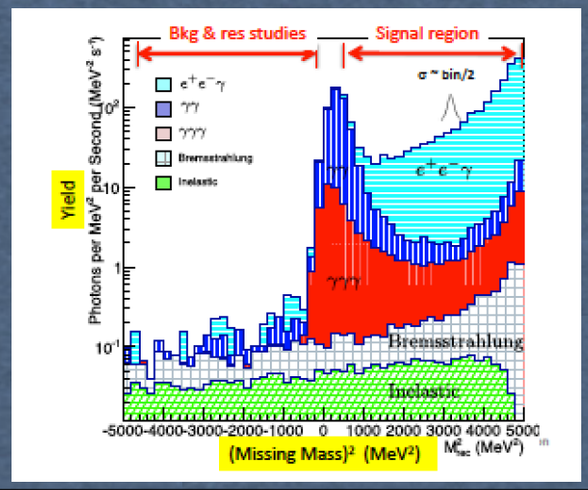
★ (almost) on-shell experiments:
MMAPS@Cornell and PADME@Frascati

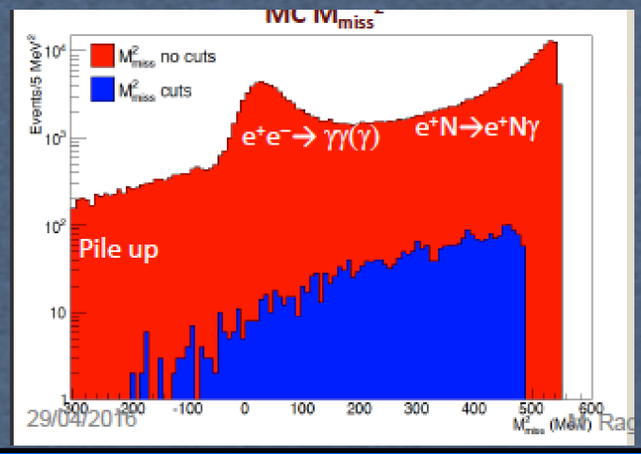






★ BG parametrization well controlled (based on many years of collider's experience)





Missing mass

★ Limited parameter space sensitivity
★ Difficult to scale to larger A' mass (~sqrt(E))
★ Costly infrastructure (see Cornell NSF proposal)
★ Both experiments require a supporting collaboration
★ A wider physics program would help

★ What is required to make the discovery trustable?

- Measure both ε^2 and the A' mass ⇒ Allow immediate cross check of the result
- Control of the background
  - PADME can run with electrons to get beam background from data sample
  - In electron runs any peak of annihilation production should disappear
  - Low energy beam allows few possible final state easy to simulate
  - Can profit by bunched beam to study beam-off background detector related
- Variable LINAC beam energy:
  - If any excess is observed we can enhance the cross section by setting the beam energy in the resonant production $M_{A'}=\mathrm{sqrt}(2m_eE_{beam})$
  - Or we can reduce the beam energy below the production threshold peak should disappear!