

Searching for sub-GeV scale hidden-sector particles exploiting DESY's electron beams

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in collaboration with

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Axel Lindner, Carsten Niebuhr, Yuri Soloviev**



**2. Beschleuniger-Ideenmarkt
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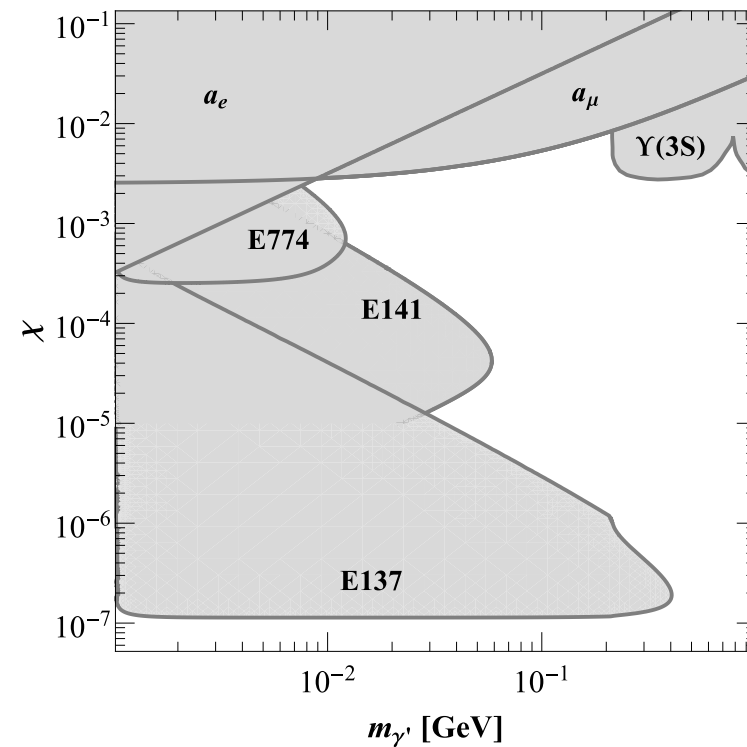
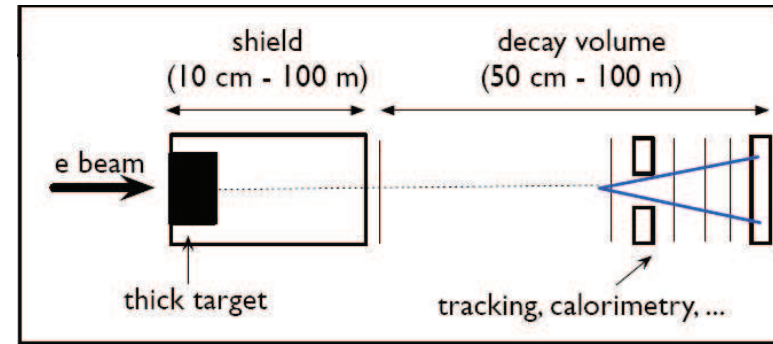
MeV-GeV scale hidden or dark photon γ' :

- Occurs in well-motivated extensions of standard model, e.g. in SUSY
 - May explain
 - $(g - 2)_\mu$ anomaly [Pospelov '08]
 - DM anomalies [Arkani-Hamed *et al.* '08; Pospelov, Ritz '08;...]
 - * in direct detection (DAMA, CoGeNT vs. CDMS, XENON) and
 - * cosmic rays (PAMELA, FERMI)if DM charged under hidden U(1)
 - Can be checked in beam dump and other fixed-target experiments with intense electron beams [Reece, Wang '09; Bjorken, Essig, Schuster, Toro '09]
- ⇒ New experiments commissioned/funded/proposed/designed at DESY (HIPS), MAMI (A1 Collaboration), and JLab (APEX, DarkLight, HPS)

• Past beam dumps:

[Bjorken, Essig, Schuster, Toro '09]

- **SLAC E137:**
30 C, 20 GeV, 200 m, 200 m
- **SLAC E141:**
.3 mC, 9 GeV, 10 cm, 35 m
- **Fermilab E774:**
.8 nC, 275 GeV (p), 30 cm, 7 m

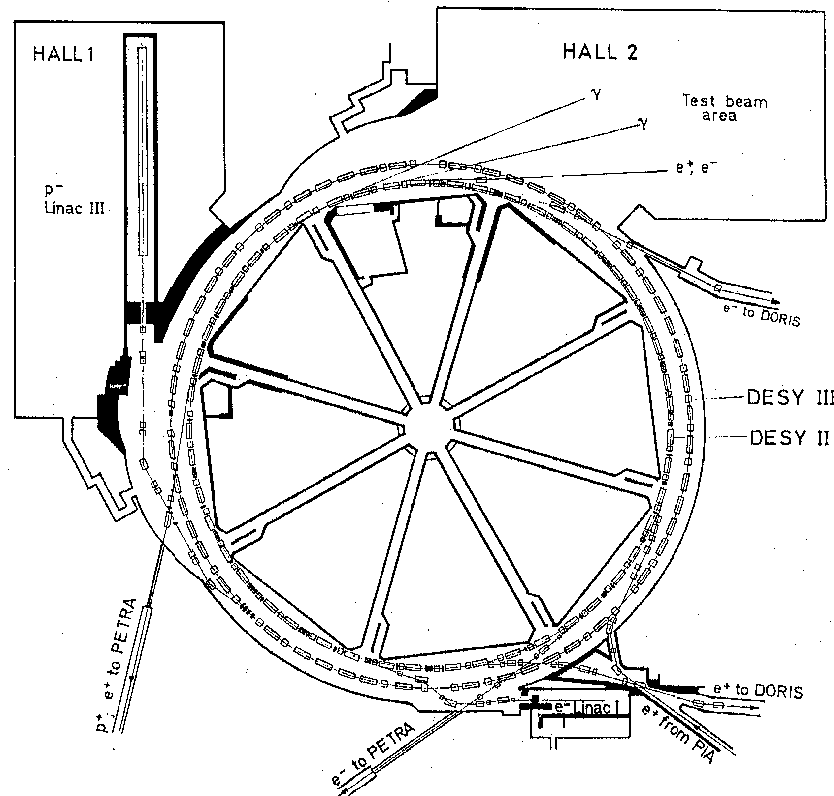


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- **HIPS** (HIdden **P**article **S**earch):
a new **beam dump** experiment at **DESY II** (10 nA, .45–7 GeV); funded
by LEXI and SFB 676

[Andreas,Bechtle,Ehrlichmann,Garutti,Lindner,Niebuhr,AR,Soloviev]

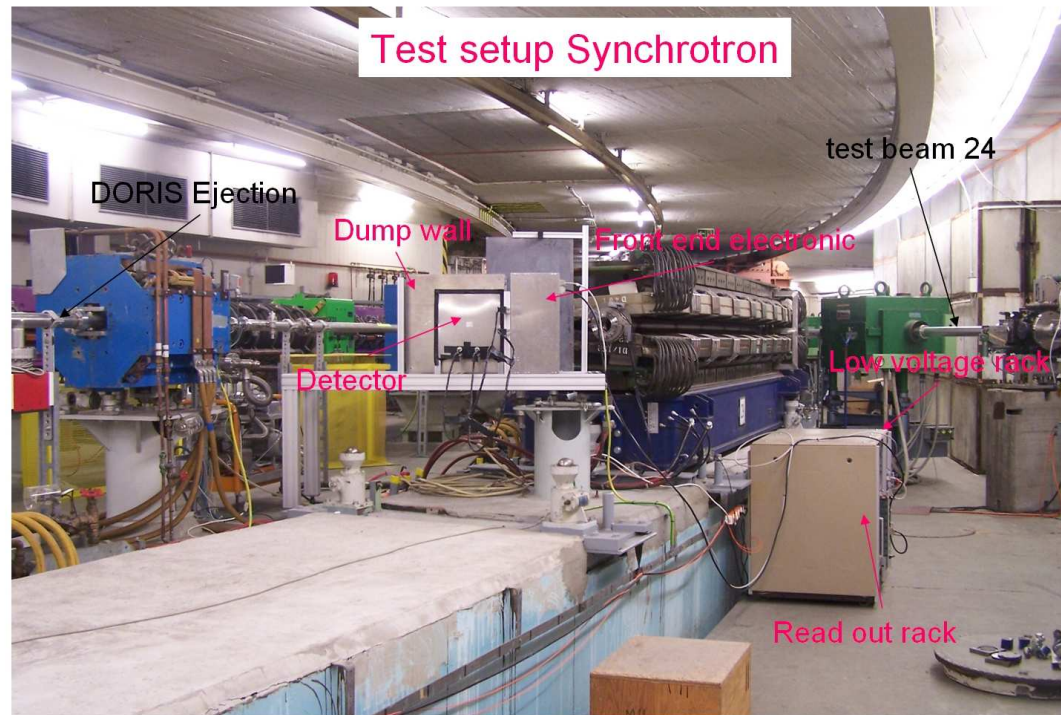


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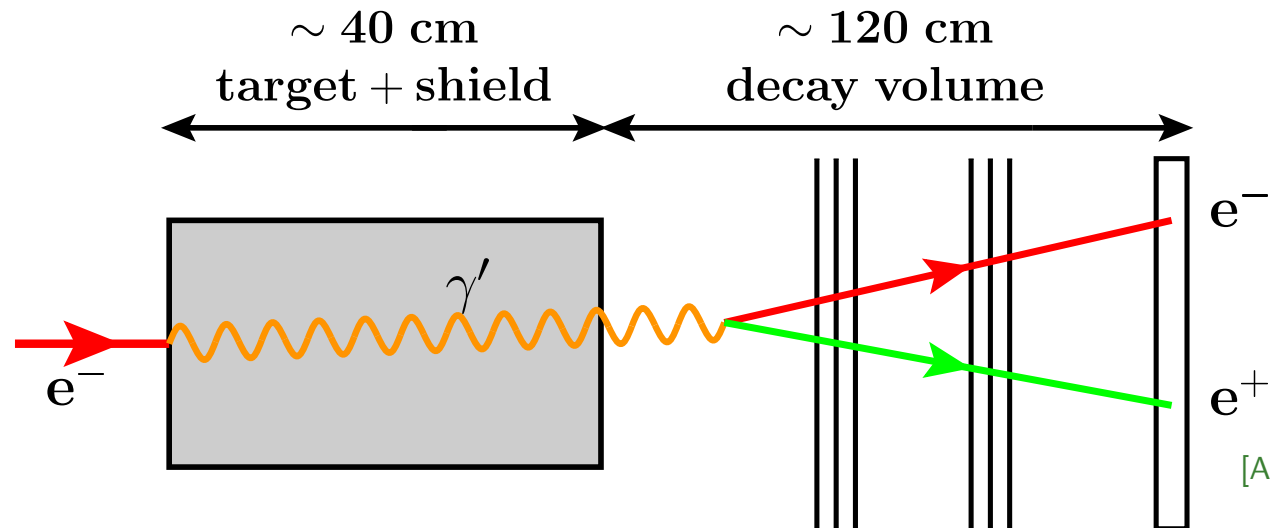
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Current situation:

- several scintillator counters installed for background studies
- simulations for background, signal and sensitivity ongoing
- plans for 2011:
 - * install beam line in January
 - * install ZEUS MVX detector and CALICE ECAL
 - * take data

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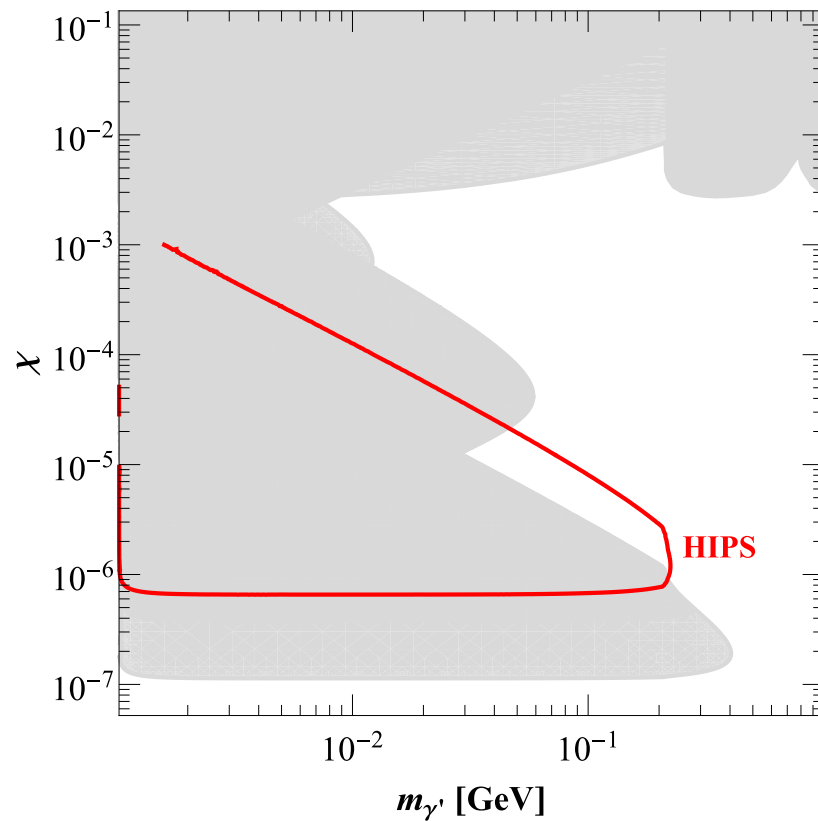
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[Andreas,AR '10]

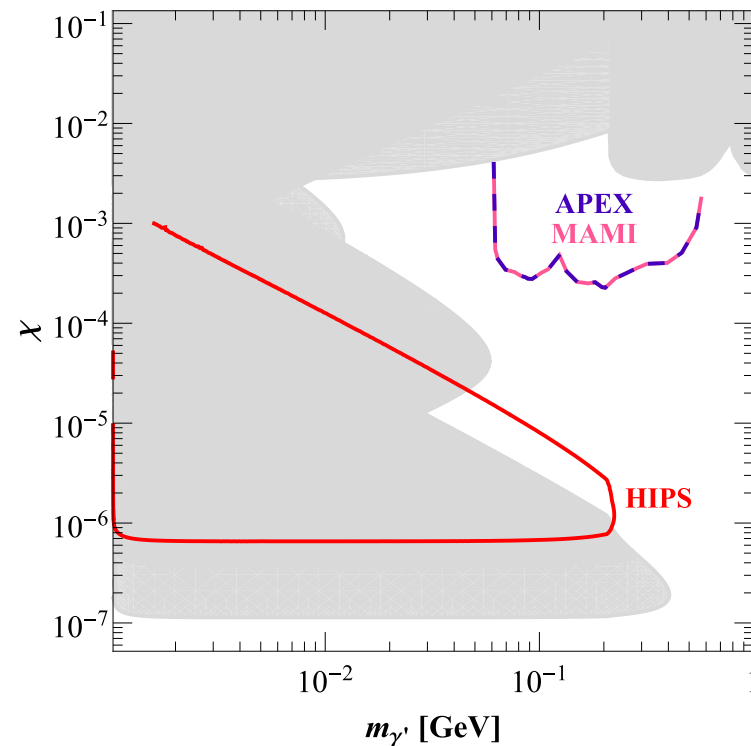
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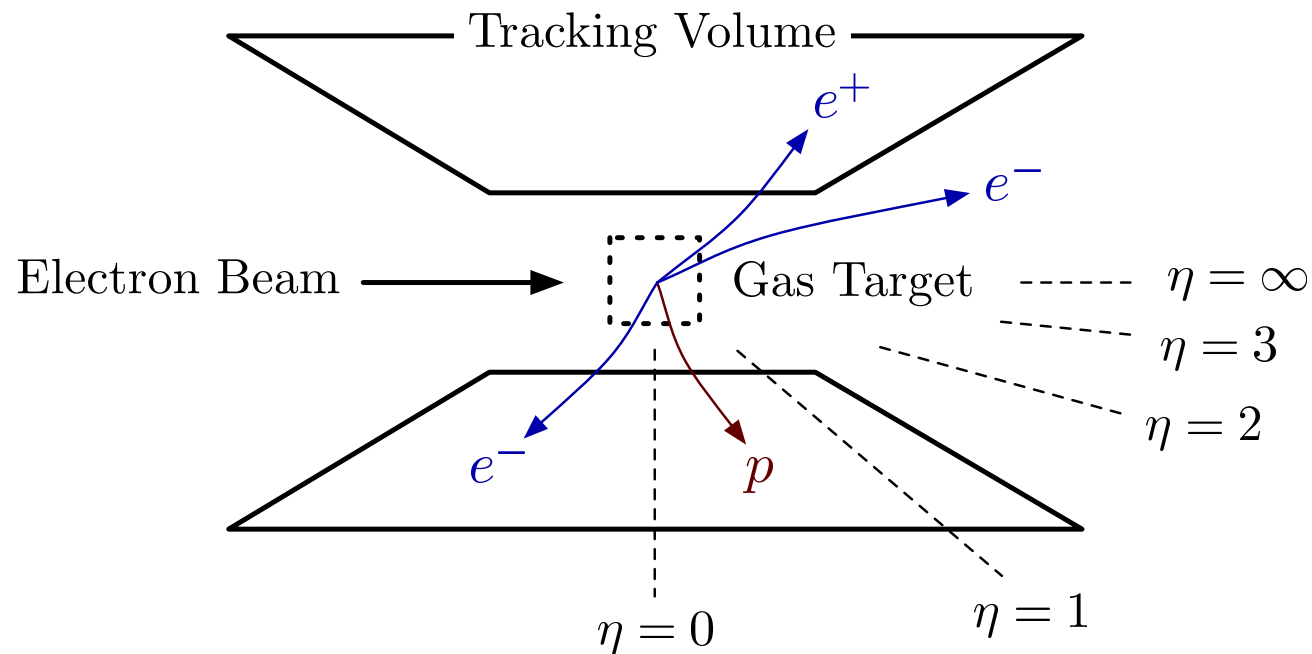
[Andreas,AR '10]

- **APEX** at **JLab** and dark photon search by the A1 collaboration (**MAMI**): **bump hunts** exploiting currents in 100 μA , (multi-)GeV range, and high resolution spectrometers to search for a peak in the e^+e^- invariant mass distribution (pilot runs already took place)



[Andreas, AR '10]

- **Proposals:** JLab: HPS at CEBAF; DarkLight at FEL (10 mA; $E_{\text{max}} = 140$ MeV); Mainz internal gas experiment at proposed MESA facility

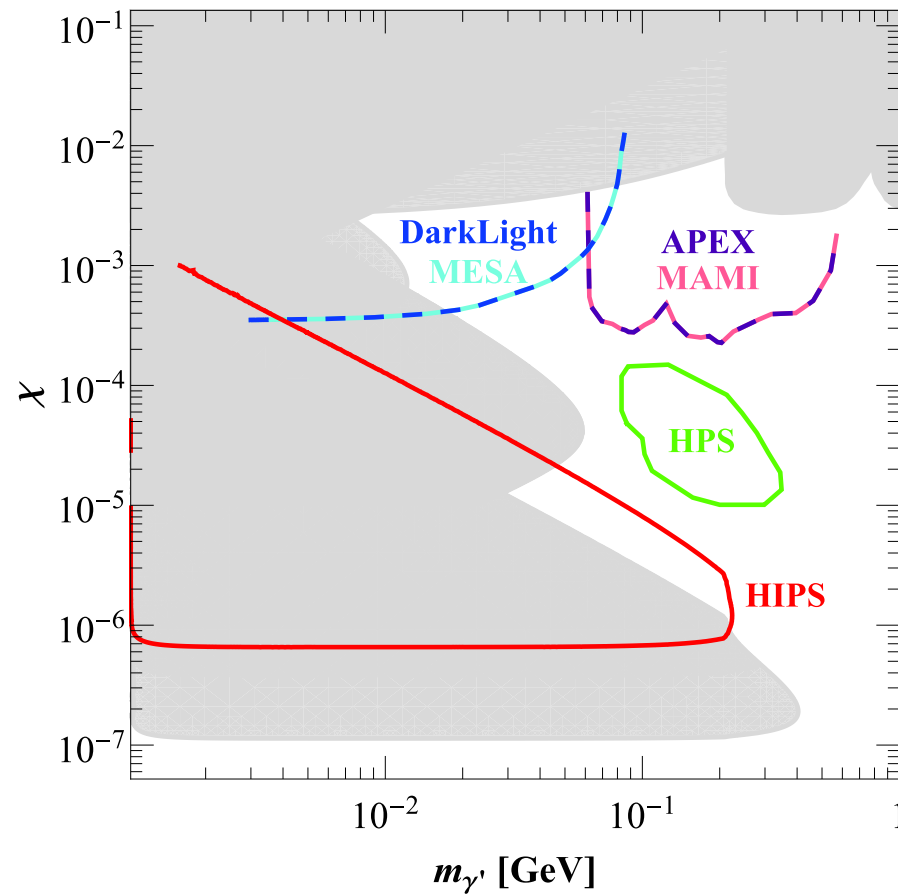


[Freytsis, Ovanesyan, Thaler '09]

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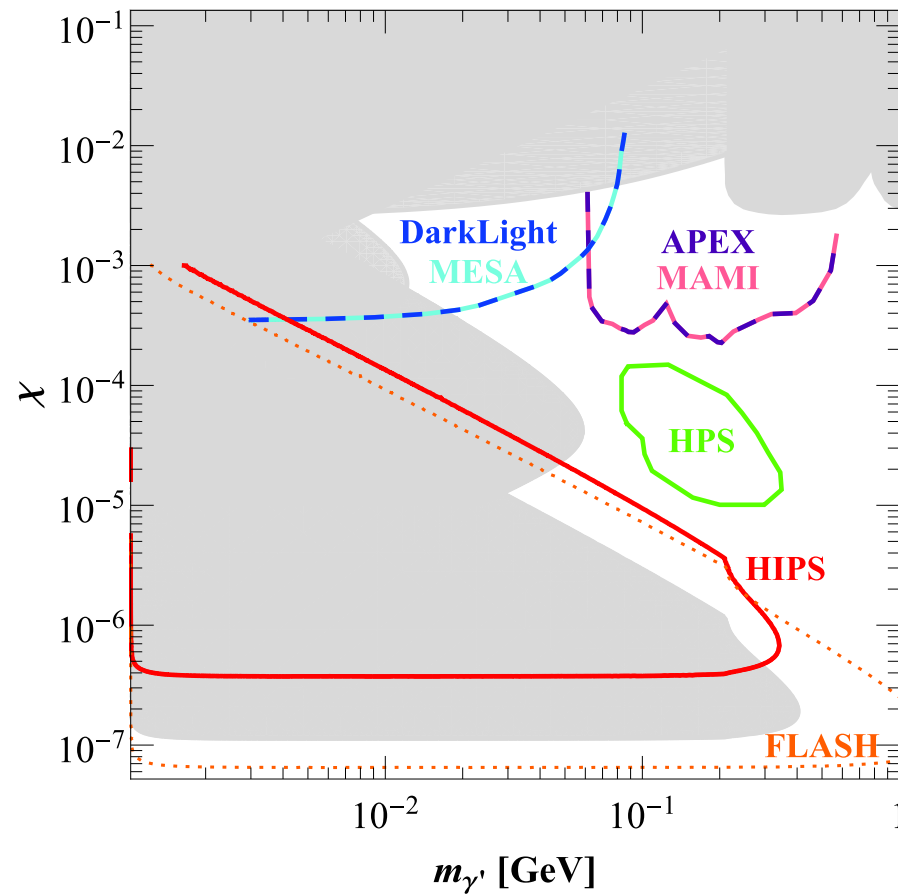
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[Andreas, AR '10]

- Parasitic beam dump experiment exploiting **FLASH** e -beam (30 μA ; 1.2 GeV) enlarges discovery potential (not foreseen at JLab; in Mainz)



[Andreas, AR '10]

Conclusions

- **HIPS** at **DESY II** on a good track to **attack dark forces** in a region of parameter space complementary to the one probed in **Mainz** and at **JLab**
- Discovery potential enlarged if a similar beam dump experiment could be installed at one of the electron dumps of **FLASH**
 - Bury a maintenance free detector system (tracker plus calorimeter) together with the beam dump (“beam dump monitor”)?
 - Combination with “Hochbelastungstests für Targets”?

