

# Electromagnetic Background Environment for the Interaction Point Feedback System

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**Philip Burrows**  
*John Adams Institute*  
*Oxford University*

G. Christian, **C. Clarke**, B. Constance, H. Dabiri Khah,  
**T. Hartin**, C. Perry, **C. Swinson**  
*John Adams Institute, Oxford University*

A. Kalinin, *Daresbury Laboratory*

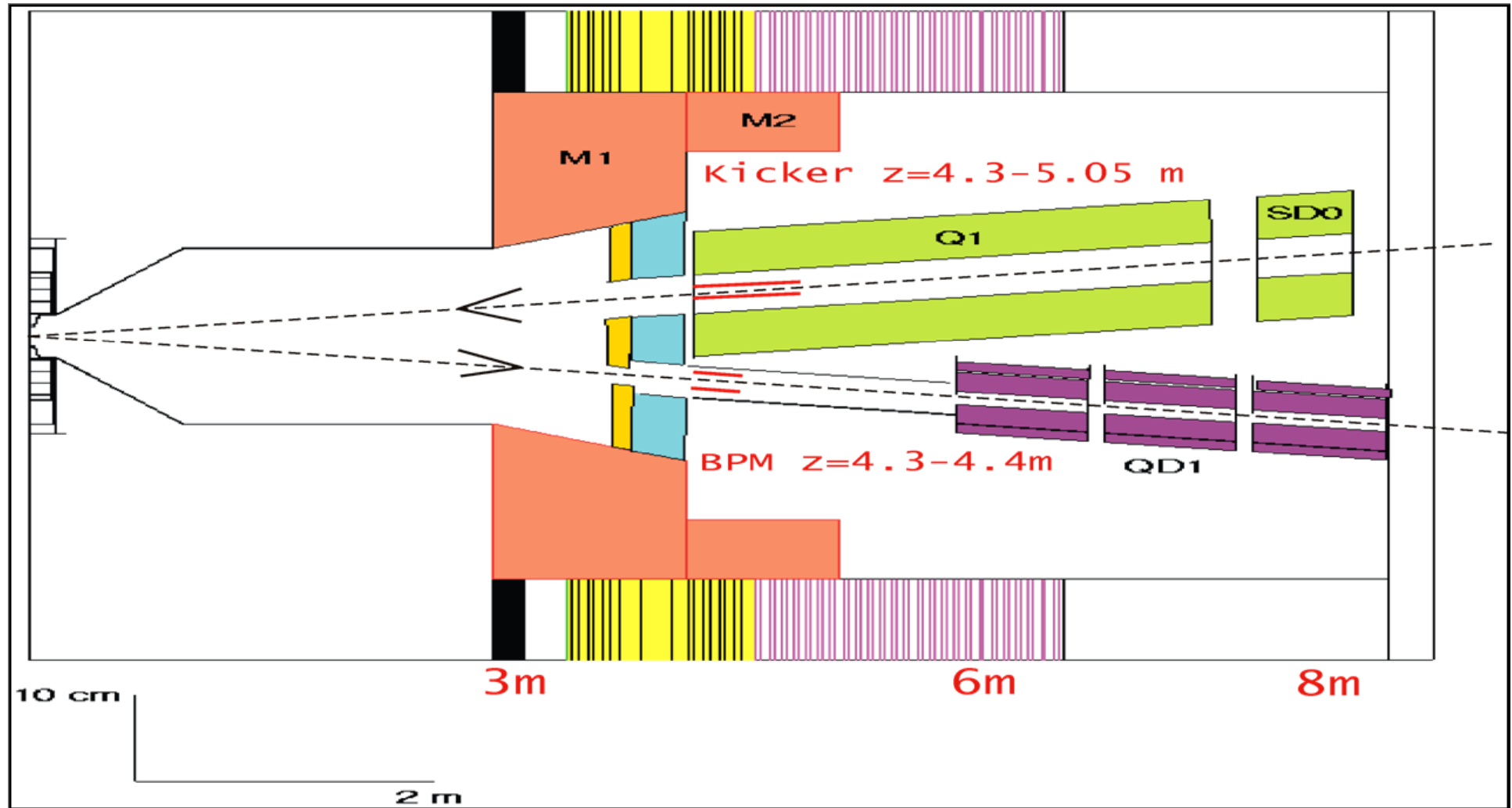
R. Arnold, S. Molloy, S. Smith, G.R. White, M. Woods, *SLAC*

# Outline

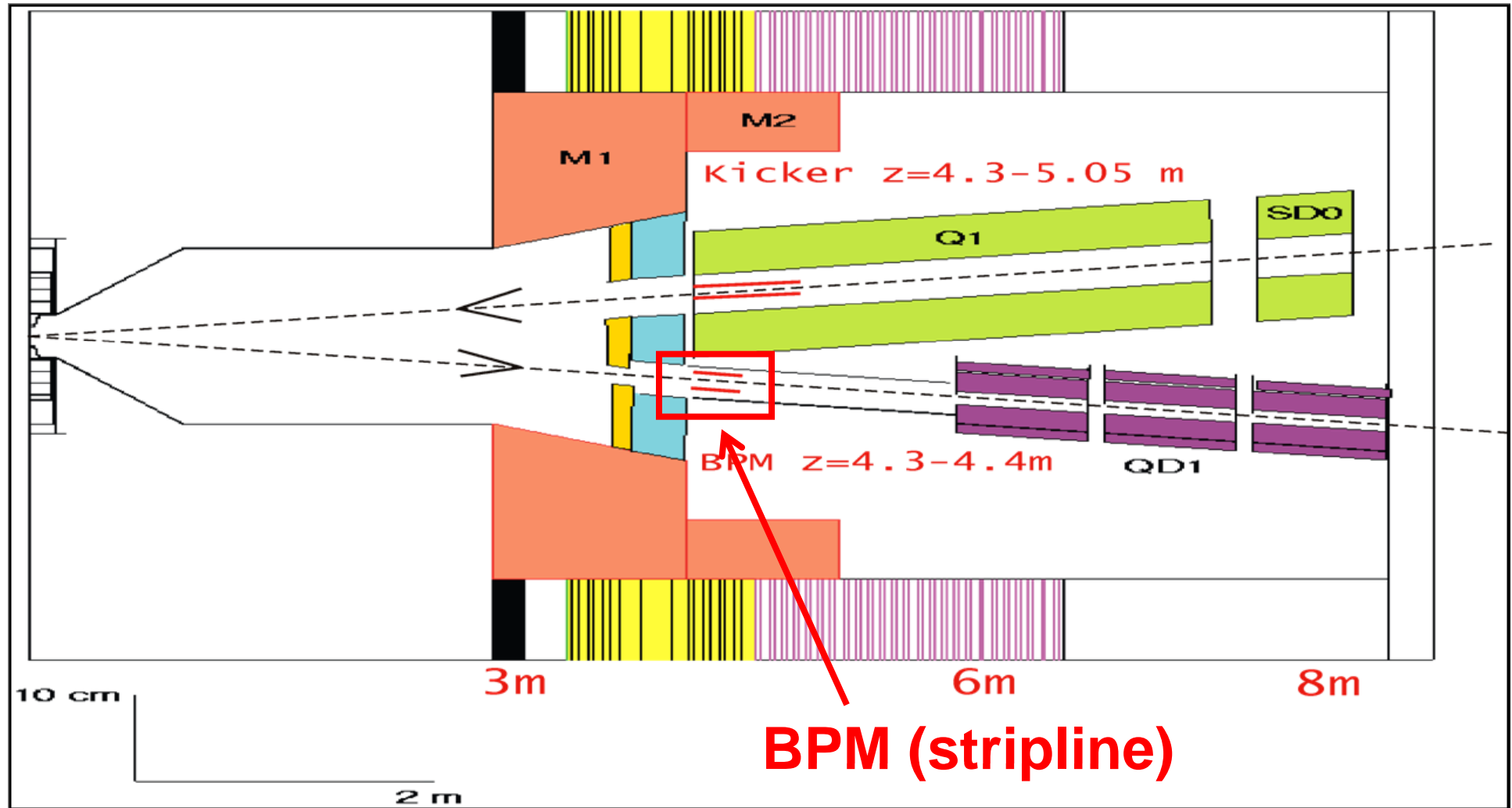
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- **Introduction**
- **ILC interaction point intra-train feedback system**
- **Beam-beam interaction and EM backgrounds**
- **T488 experiment at SLAC Endstation A**
- **Conclusions**

# ILC interaction region (schematic)

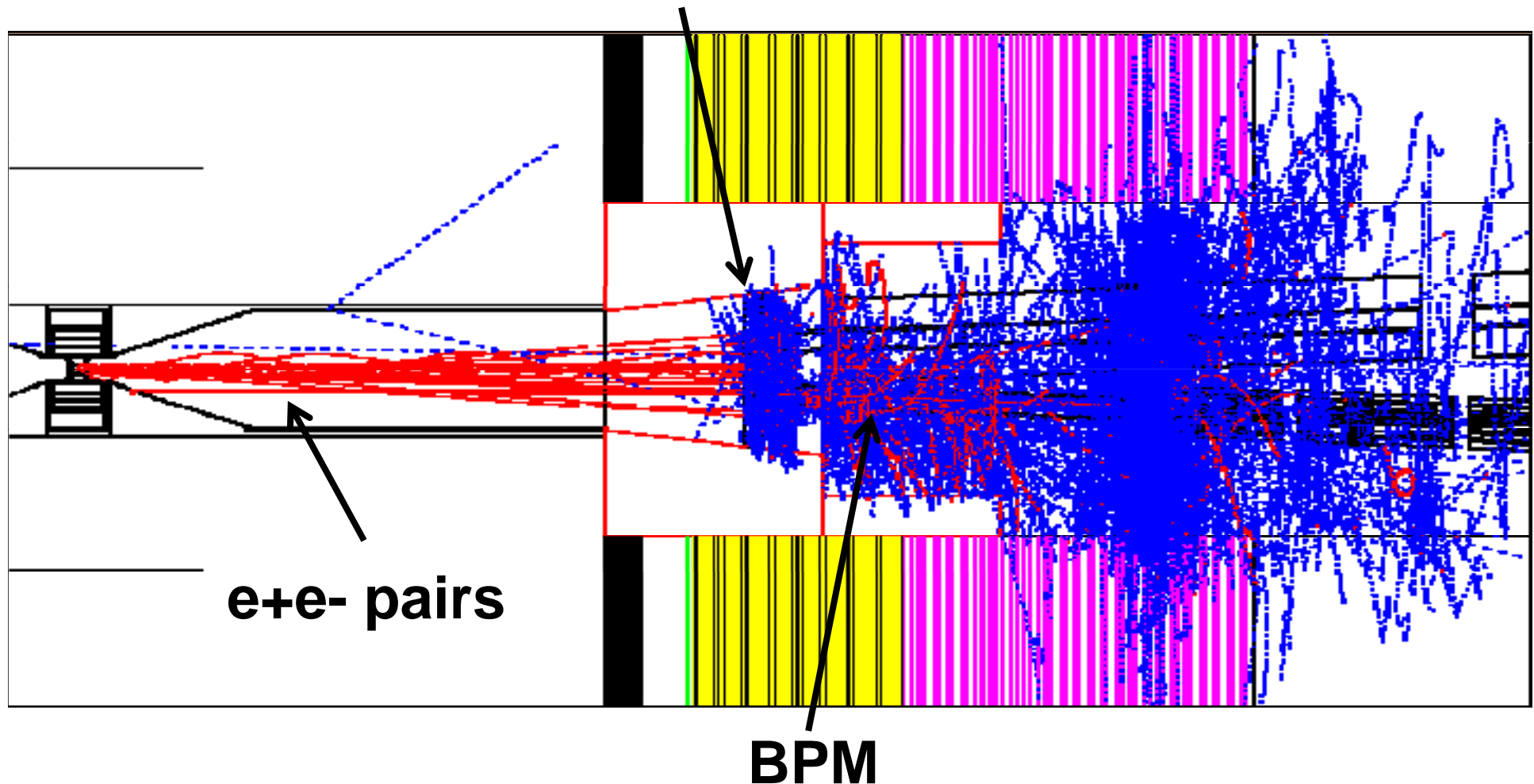


# Nominal IP feedback BPM location



# Pair-induced EM backgrounds

Low-Z mask + beamline calorimeter



# Backgrounds due to $e^+e^-$ pairs

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Beam Parameters Scheme	Number of Pair Particles	Average Energy (GeV)	BPM hits
Scheme 1	195652	10.8	5141
Scheme 2	164370	10.6289	4497
Scheme 3	121966	10.8947	3057
Scheme 4	49720	12.3421	1074
Scheme 5	124273	9.58301	2321
Scheme 6	272218	10.6636	9686
Scheme 7	320352	10.9809	12314
Scheme 8	193166	11.2826	5127
Scheme 9	237749	11.5317	8758
Scheme 10	192976	11.3083	6399
Scheme 11	85218	12.8034	2623
Scheme 12	247683	10.1212	9287
Scheme 13	500457	13.8549	25016
Scheme 14	678811	15.5845	80443

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Parameter space for 500 GeV ILC

Parameter space for 1 TeV ILC

# Backgrounds due to e+e- pairs

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**Primaries  
per bunch  
crossing:  
50 – 700k**



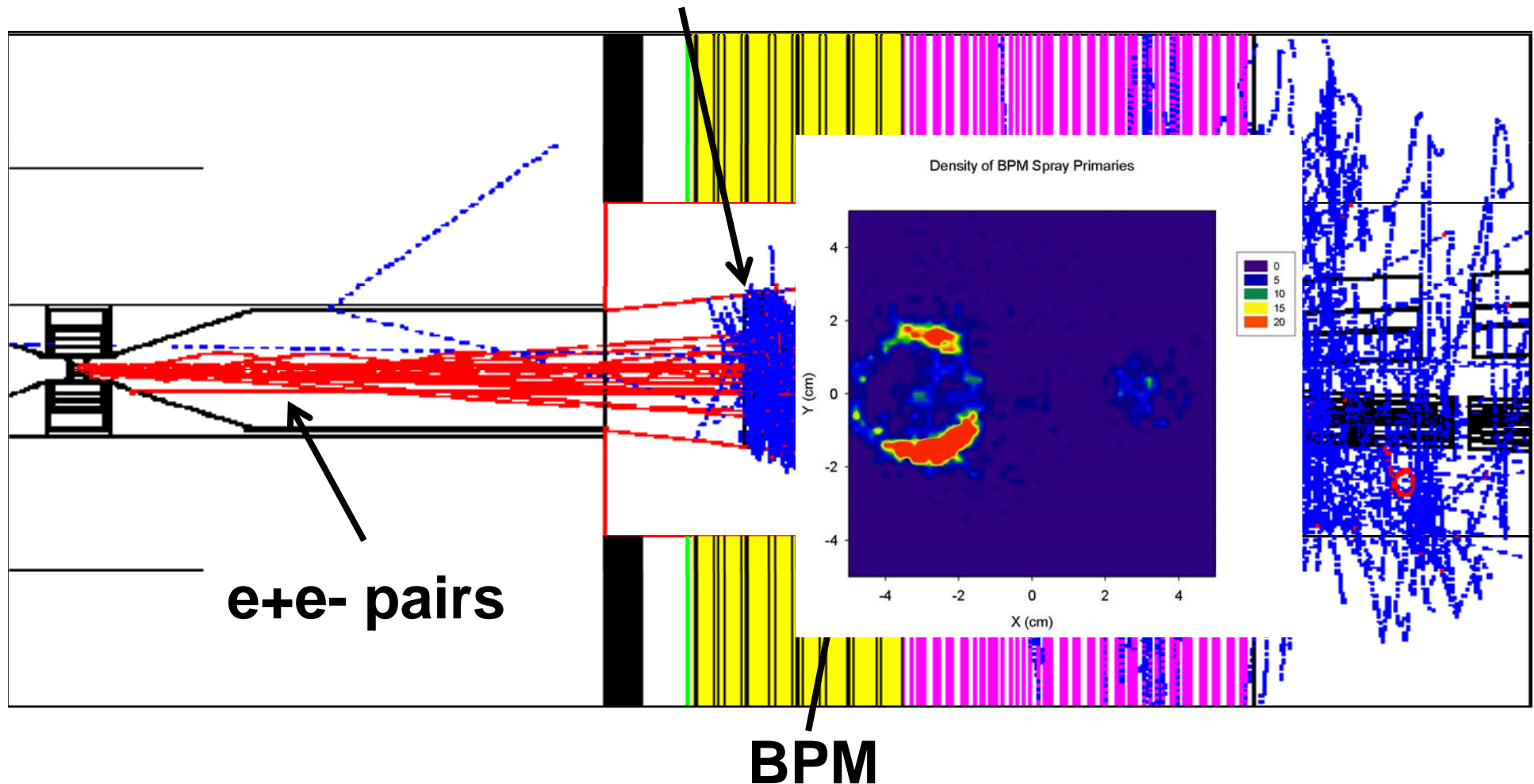
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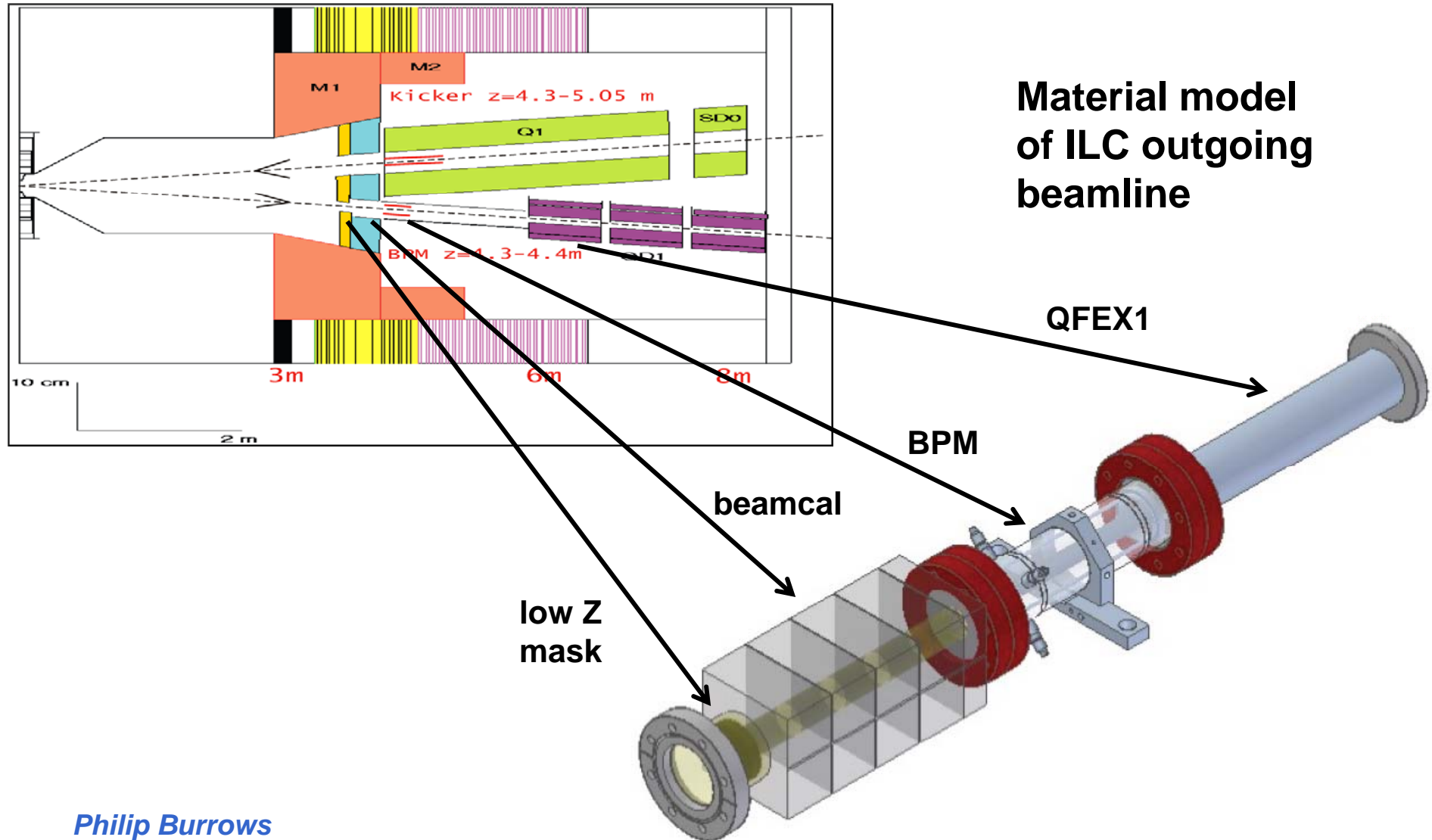
**BPM hits  
per bunch  
crossing:  
1 = 80k**

# Pair-induced EM backgrounds

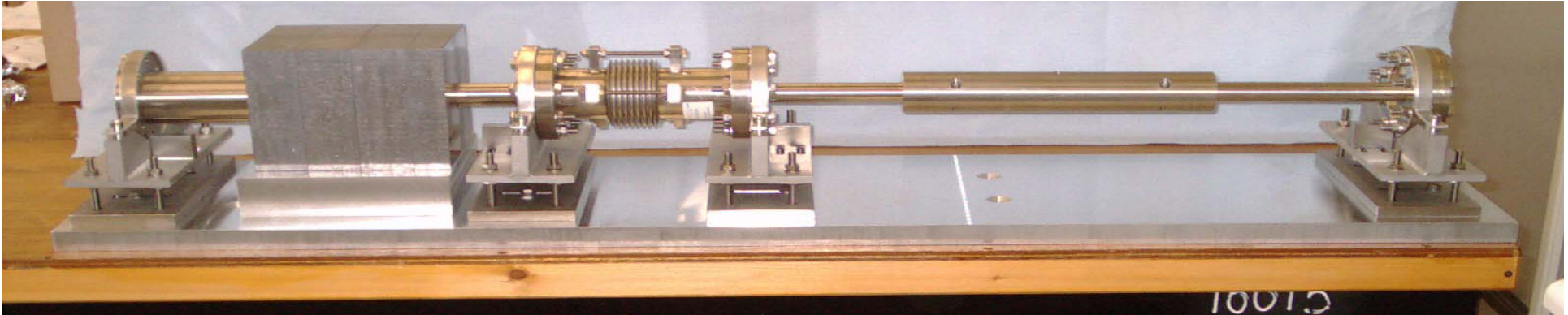
Low-Z mask + beamline calorimeter



# FONT Test Module for ESA

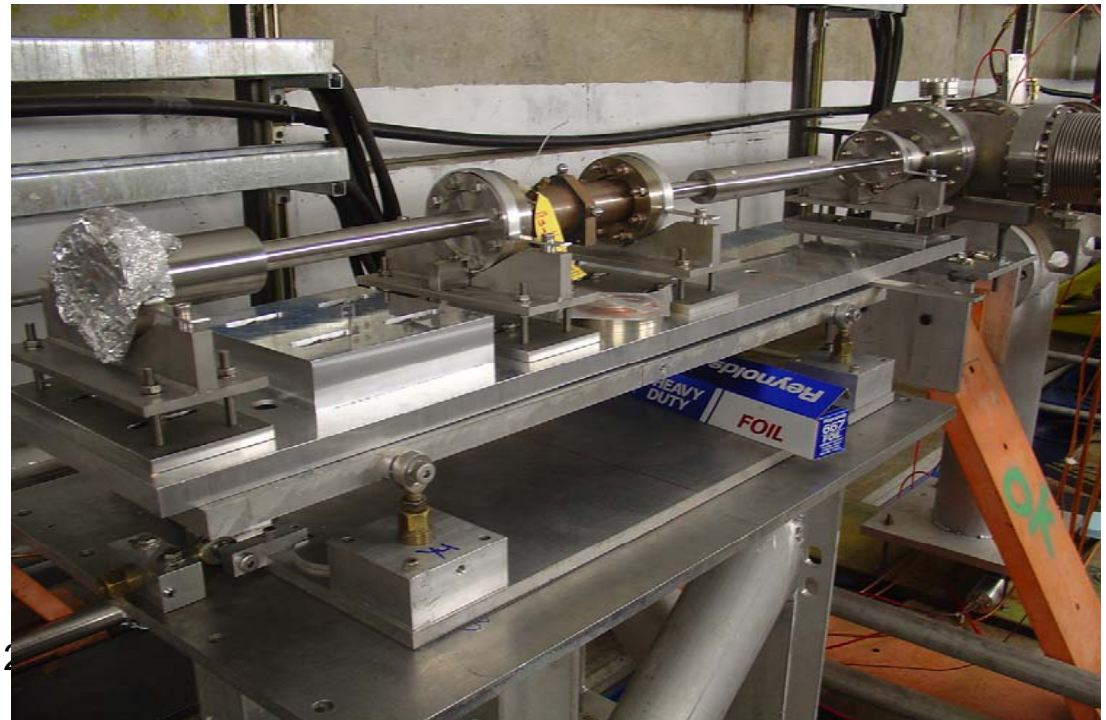


# FONT Test Module (T-488)



Installation  
at ESA

Beam →



# Overview of T-488 Experiment

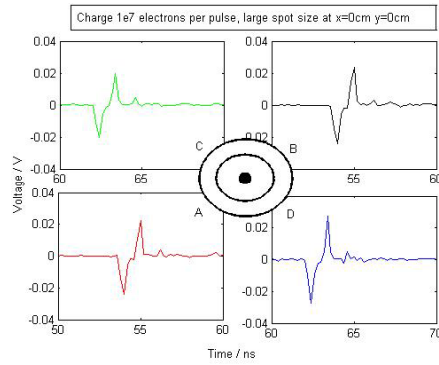
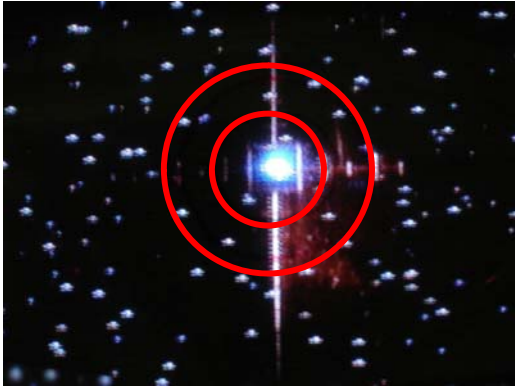
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- **Used 28.5 GeV SLAC beam to simulate ILC EM background environment:**
- **Mode 1:**
  - Large beam ~ 1mm diameter,  $10^{**6} < Q < 10^{**8}$**
  - Beam steered onto front of FONT module**
- **Mode 2:**
  - Beam passed through upstream thin radiator**
  - Main beam + halo that strikes module**

# Overview of T-488 Experiment

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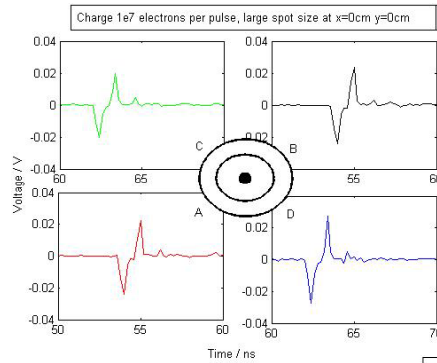
- **Used 28.5 GeV SLAC beam to simulate ILC EM background environment:**
  - **Mode 1:**
    - Lose primary beam signal in BPM**
    - Vary noise signal at BPM by varying Q**
  - **Mode 2:**
    - Still get primary beam signal in BPM**
    - Tune noise signal at BPM by varying X0**
- Studied impact on stripline BPM signals**



## Mode 1: beam scan across module: stripline BPM signals

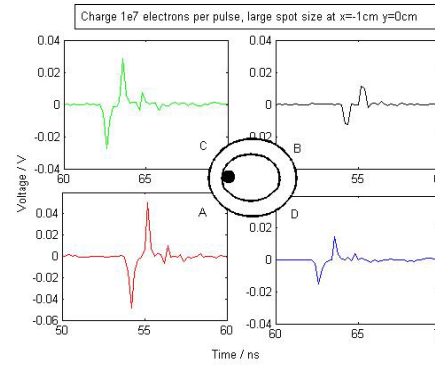
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**$10^{*}7$  beam**



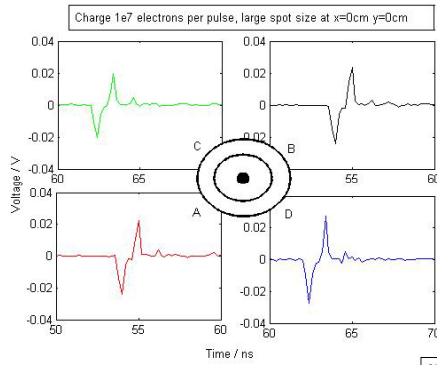
# Mode 1: beam scan across module: stripline BPM signals

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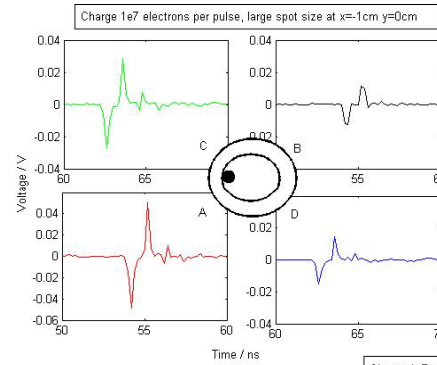


**$10^{*}7$  beam**

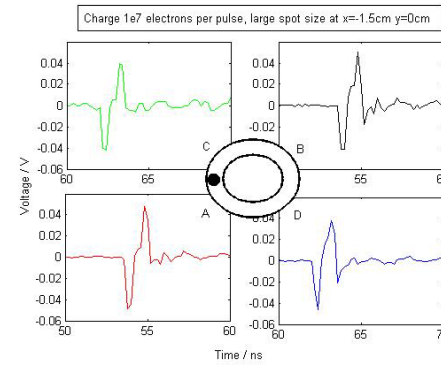




# Mode 1: beam scan across module: stripline BPM signals

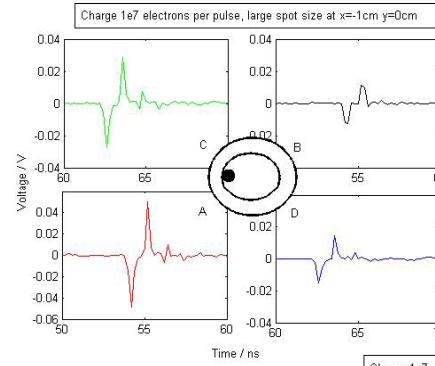
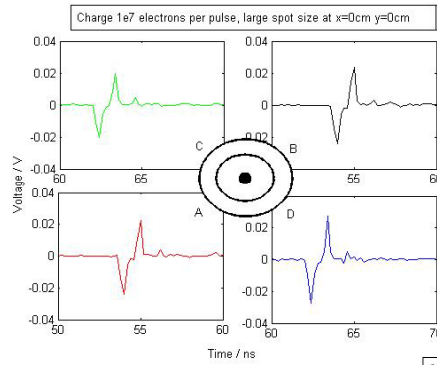


**$10^{*}7$  beam**

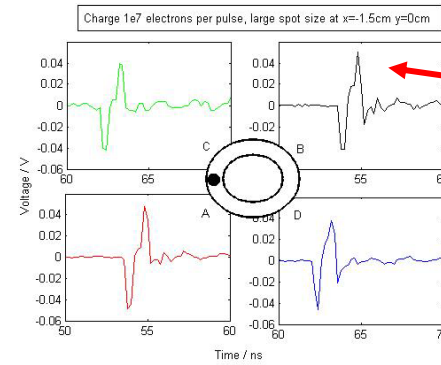




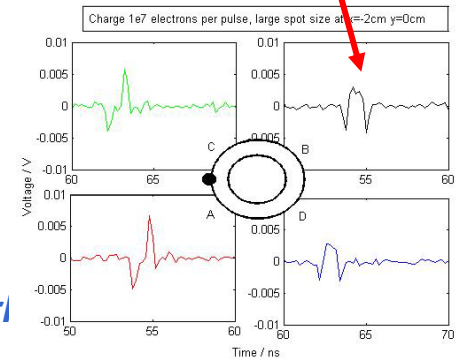
# Mode 1: beam scan across module: stripline BPM signals



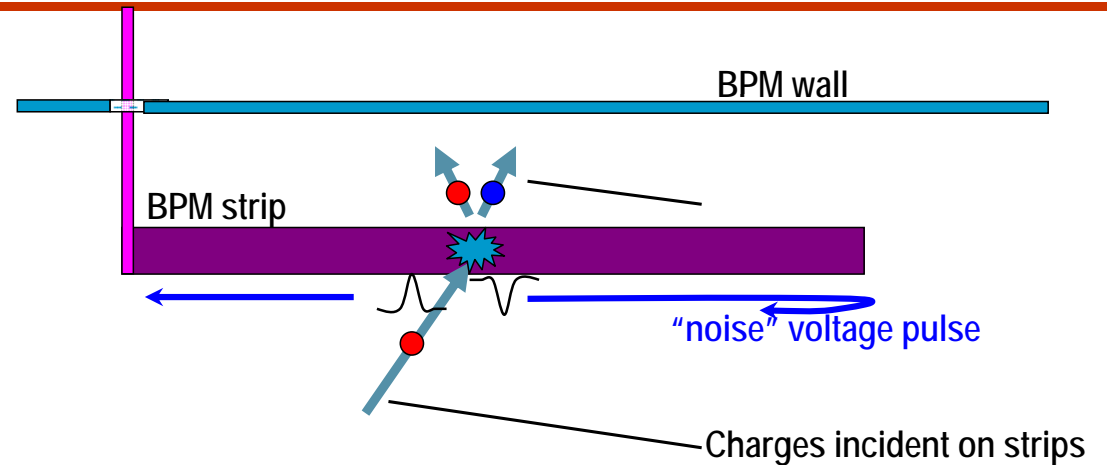
**10\*\*7 beam**



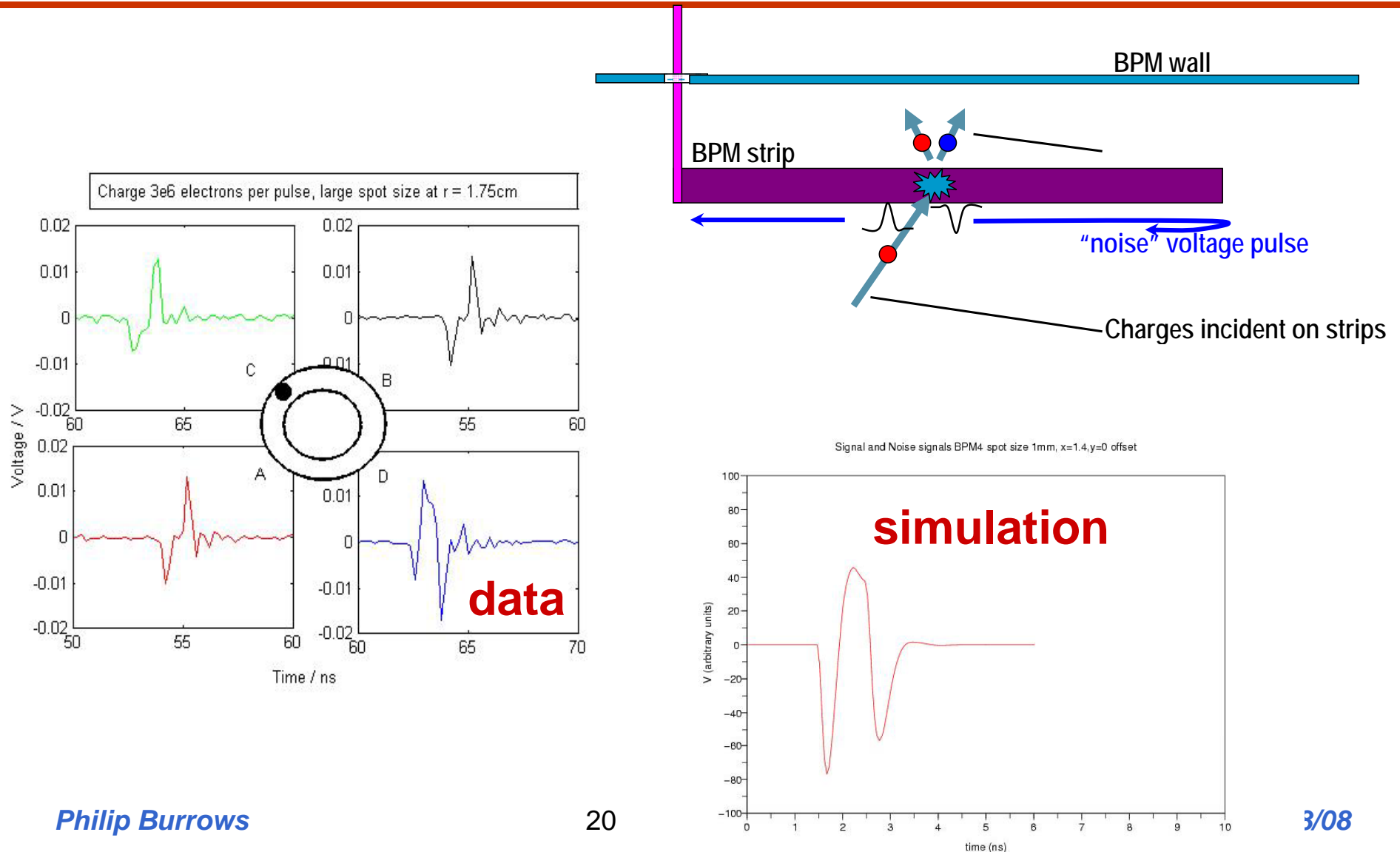
**Noticeable degradation of signals**



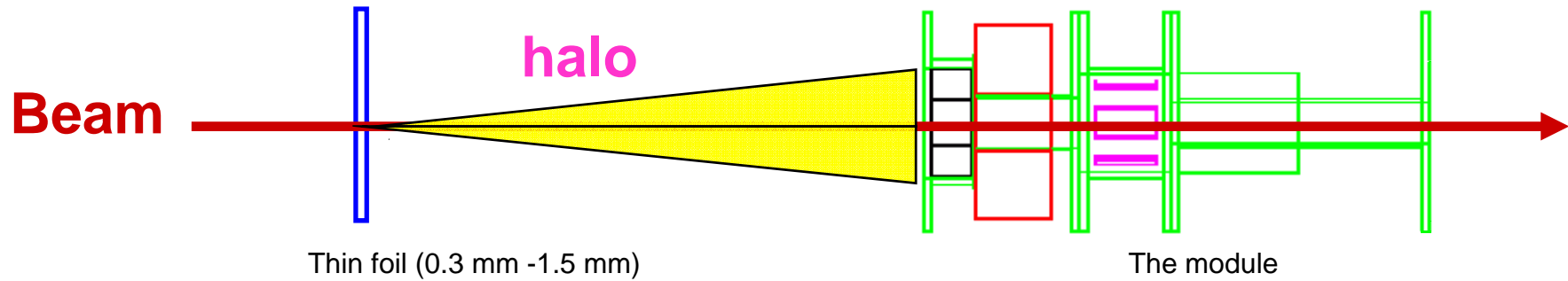
# Modelling of noise on BPM strips



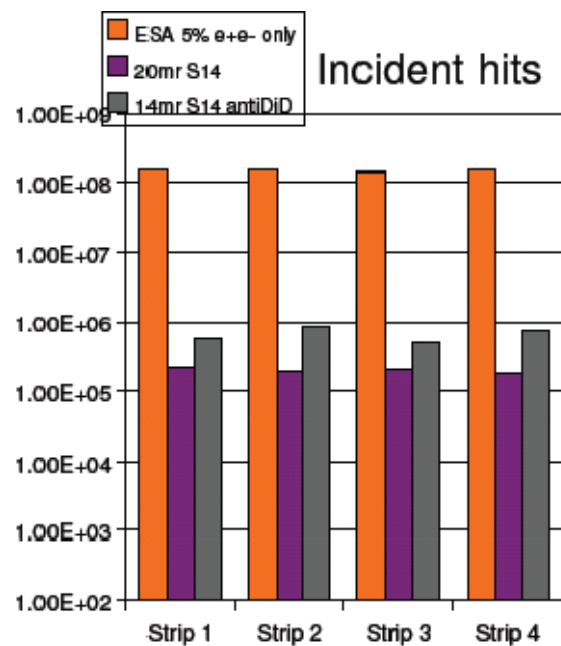
# Modelling of noise on BPM strips



# Mode 2: primary beam + halo

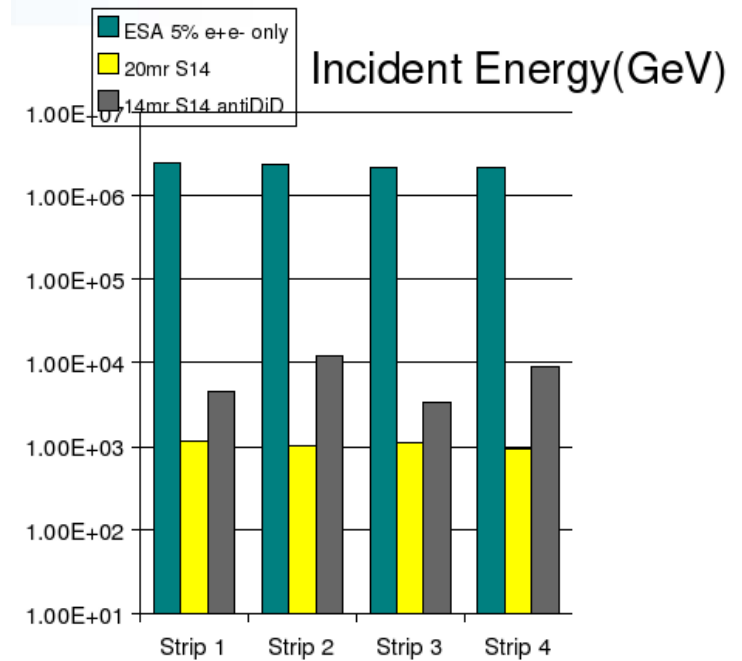


## Scaling from ESA to ILC:

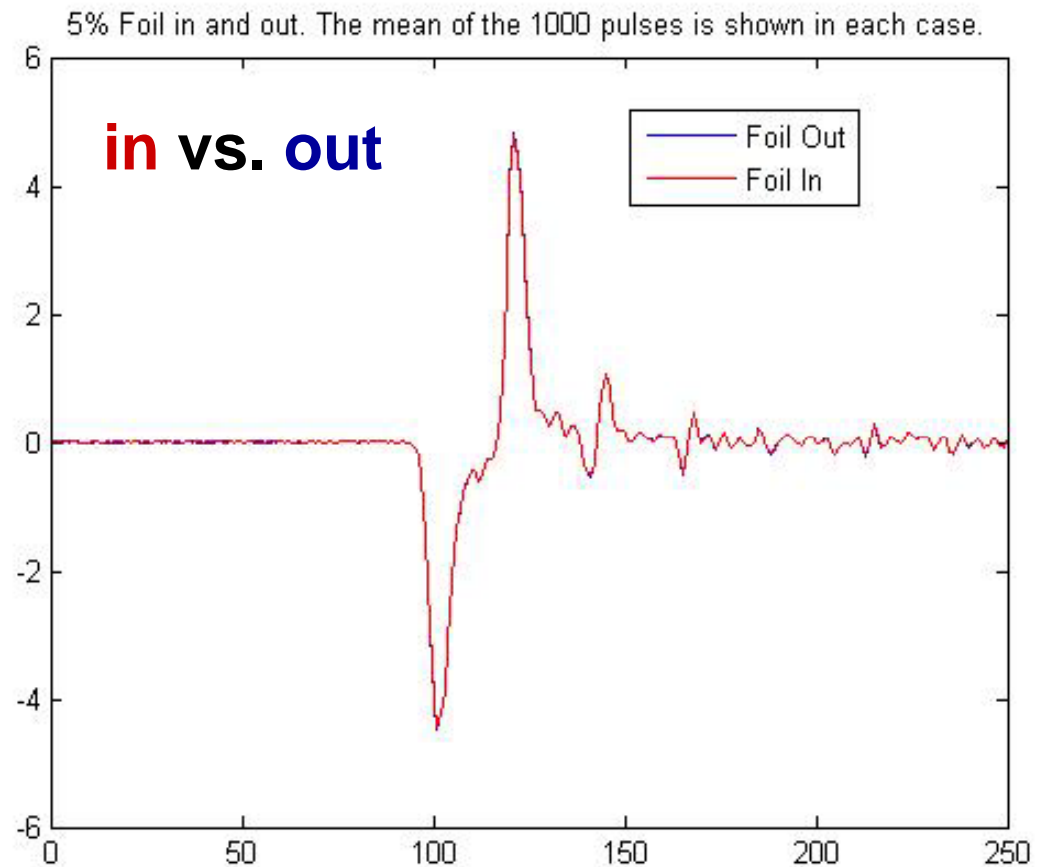
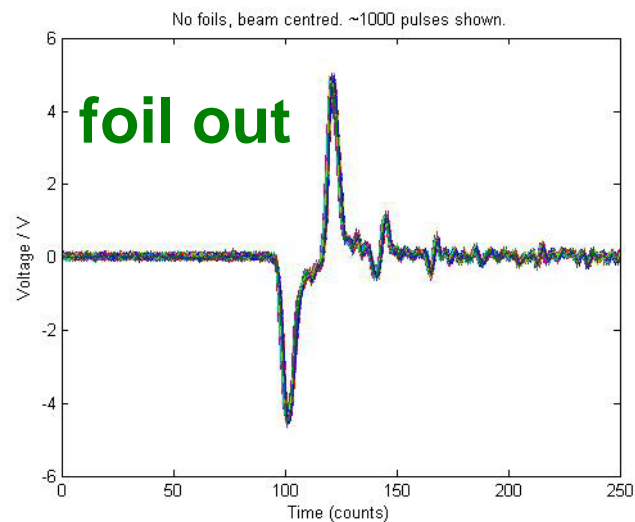
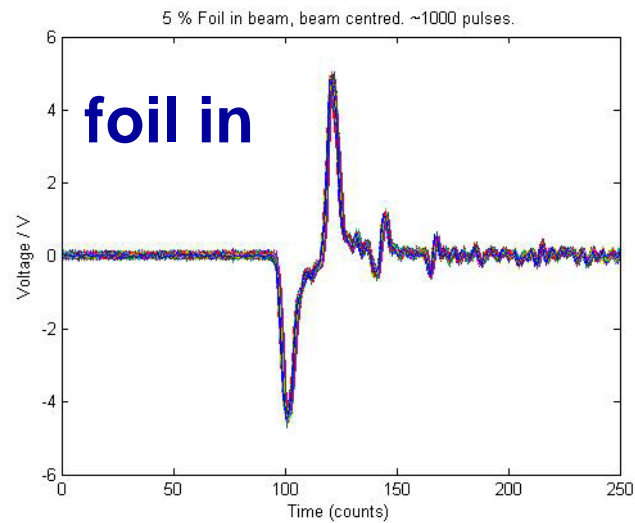


← ESA →

← ILC →



# Mode 2: results: worst case: 5% foil



# Peak voltages foil in vs foil out

Foil thickness	Foil IN		Foil OUT	
	Mean / V	std / V	Mean / V	std / V
5%	3.99	0.09	4.00	0.09
3%	4.00	0.08		
1%	3.99	0.09	4.01	0.09

**See no effect within statistics (1000 pulses)**

**< 10 micron effect in position at ESA**

**< 100 nm at ILC**

**c.f. FB BPM resolution needed ~ few microns**

# Summary + conclusions

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- EM backgrounds were source of concern for operation of a feedback BPM in ILC interaction region
- Built a material model of ILC extraction line
- Used SLAC/ESA 28.5 GeV beam to simulate ILC EM bgds
- Developed simple BPM noise model; reproduces data
- Under background conditions c. 1000 x worse than ILC we saw no degradation of BPM operation
  - < 100nm degradation in resolution at ILC
  - > current design of IP FB system looks robust