IMPROVEMENTS TO E160 PHOTON SPECTRA

RPC Collaboration Meeting, May 18, 2001

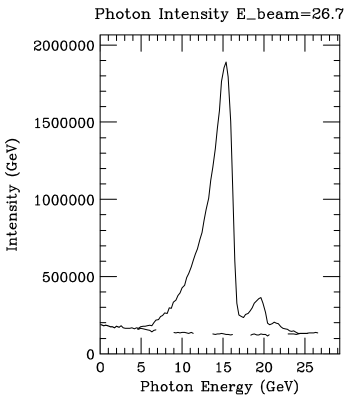
P. Bosted

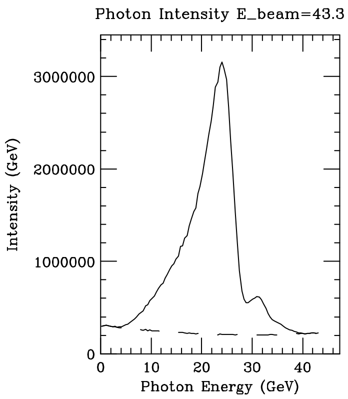
- Use higher endpoint energy
- Use thicker diamonds, bigger collimator
- Adjust angles to get extra, high k peaks
- Optimize to measure at about 15, 27, 40 GeV with only two settings.
- Bonus: get data at 20 GeV too
- A-line optics: can focus beam w/ Q27, Q28 only
- Beam size at diamond
- Future study: Use rectangular collimator.

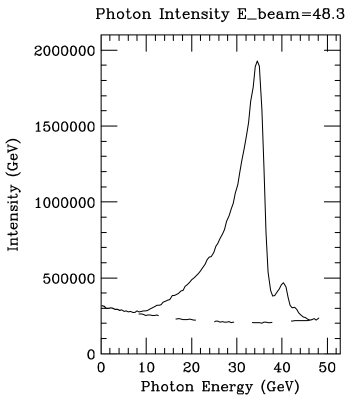
USE HIGHER ENDPOINT ENERGY

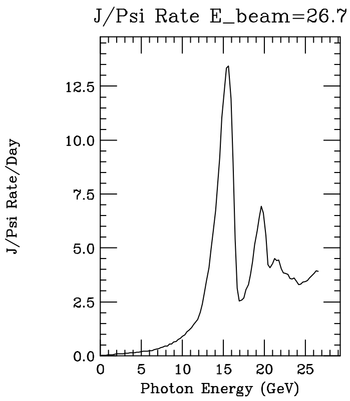
- Intensity limited by detector rates.
- Detector rates dominated by hadronic interactions (NI)
- Roughly constant NI cross section combined with $1/k$ bremsstrahlung flux means lots of rate from lower energy photons.
- So, want to maximize R=coherent/incoherent flux. This ratio scales roughly as E^3 for fixed k: better off with 45 GeV or so compared to 27 GeV for $k = 15$ GeV as in proposal.
- Angle between electrons and crystal gets smaller, but still $> 20\sigma$ if use y direction (small divergence of < 5 μrad) compared to x (divergence about 40 μrad!).

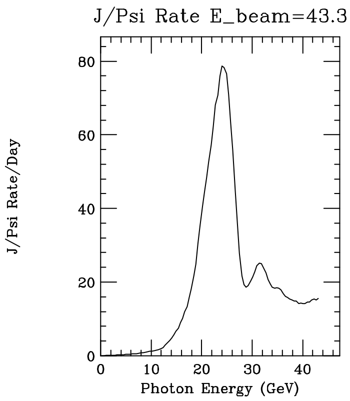
PROPOSAL OPTICS, RATES

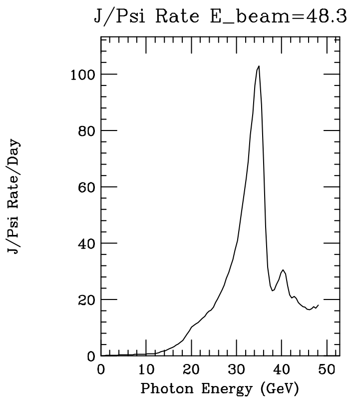






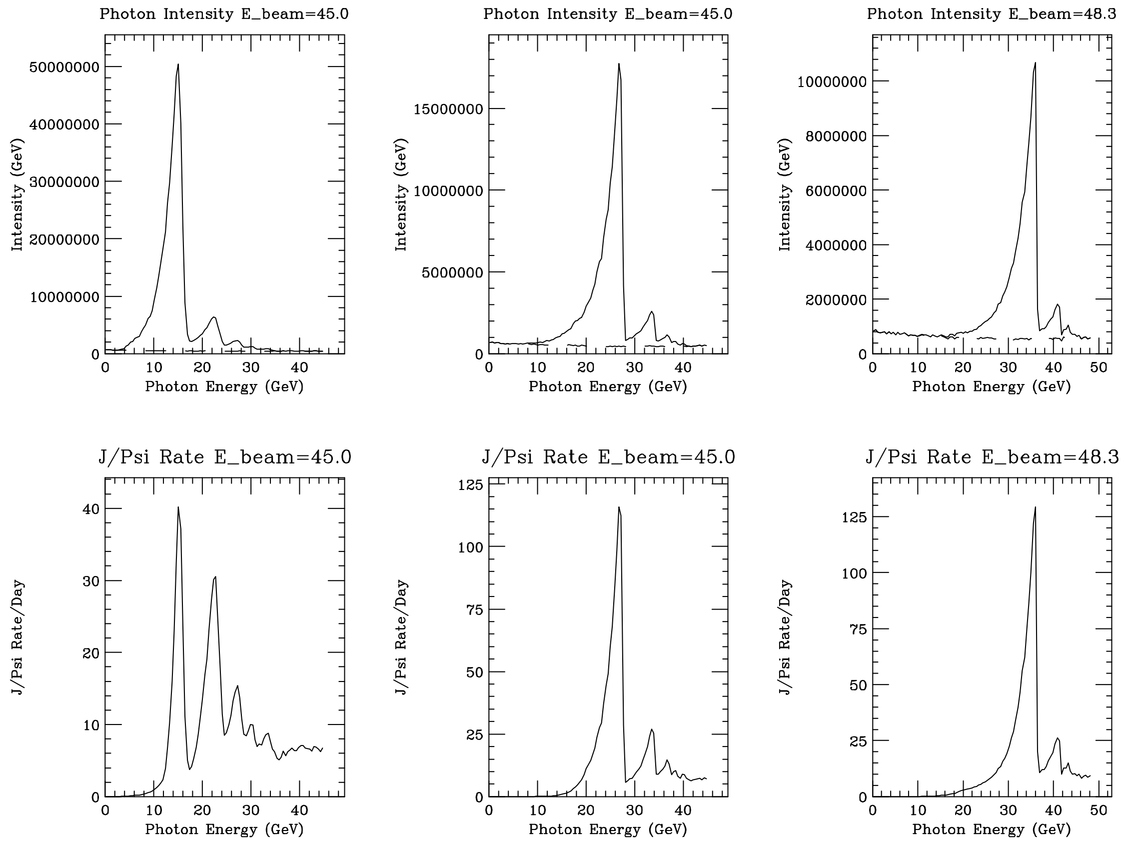






HIGHER ENDPOINT ENERGY (45 GEV)

Using 0.04 mm diamond, 0.5 mm radius collimator, 5E10 electrons/spill, endpoint energies 45, 45, 48.3.

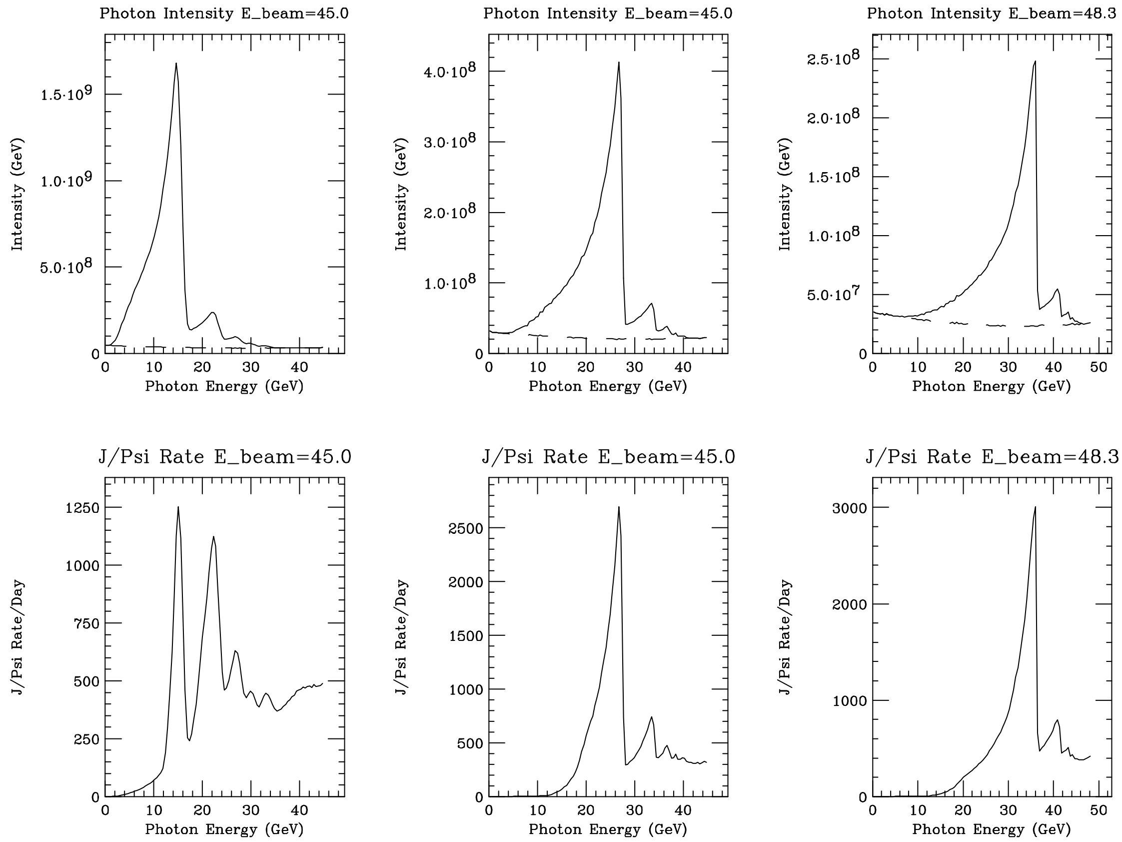


USE THICKER DIAMONDS, BIGGER COLLIMATOR

- Need more flux than in proposal to compensate for Bethe-Heitler background under $\psi(2S)$ peak.
- Electron current 5E10/spill already at maximum recommended (radiation damage, cracking).
- Compensate with slightly bigger collimator opening (1.5 mm at 78 m), thicker diamond (0.4 mm or so).
- Next plots show slight increase in peak widths, somewhat smaller R.
- But effects not dramatic: hard to see if don't look closely

USING THICKER DIAMOND

Using 0.4 mm diamond, 1.0/1.5 mm radius collimator, 5E10 electrons/spill, endpoint energies 45, 45, 48.3.

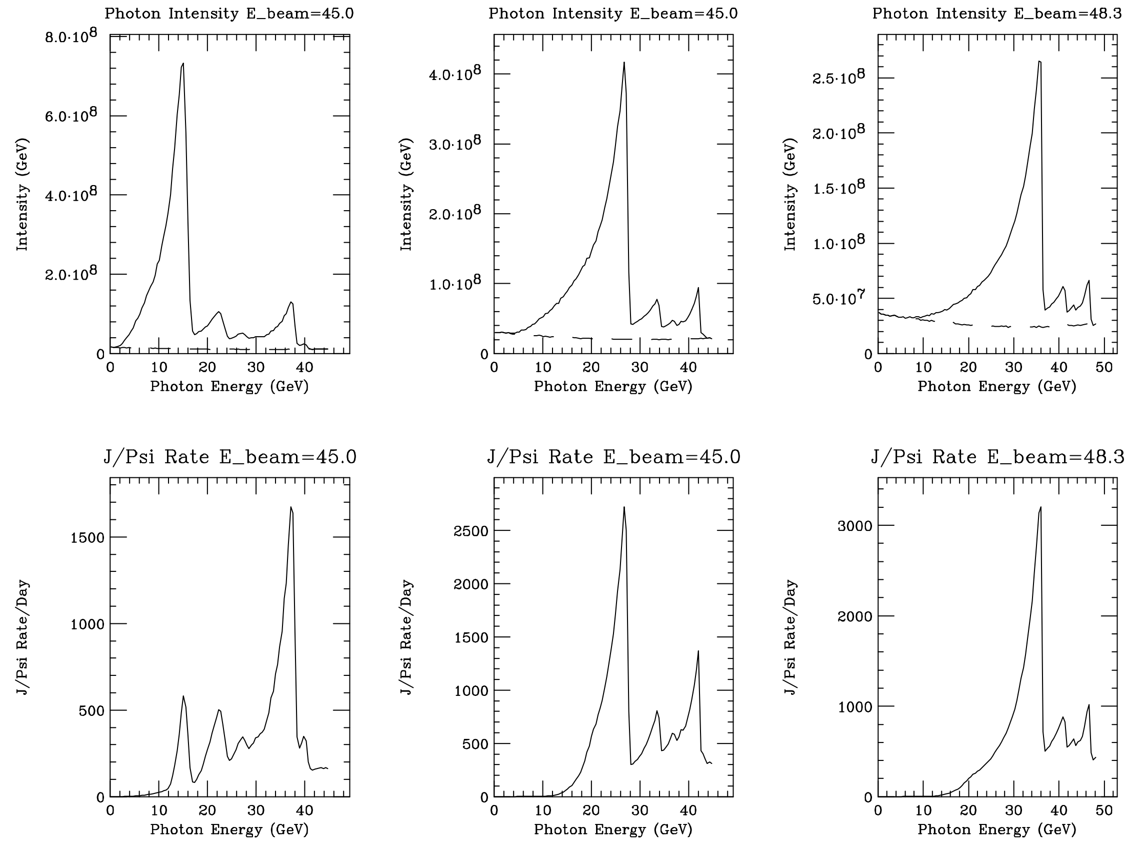


ADJUST ANGLES TO GET EXTRA, HIGH k PEAKS

- Previously using large ratio $r = \theta_x/\theta_y$. Only pick out (022) and (044) point with significant strength.
- To simultaneously measure near endpoint, can set r to about 10. This puts (0-2-2), (00-4), (02-2), and (400) peaks all near same k, and strength fairly large!
- Wrote code to optimize: loops over 1000's of lattice vectors.
- Found need to avoid "dangerous" ratios like r =2,2.5,3,4,5,7,9,11, 13, etc. otherwise get unwanted peaks near $k = 0$ (coming from smearing of θ_x, θ_y from multiple scattering, mosaic spread, and beam divergence.
- Using = 10 allows $33 < k < 45$ region to be measured at same time measuring 15 and 27 GeV regions.
- Bonus: (044) peak can be used for $k = 22$ GeV.

ADD HIGH ENERGY LATTICE POINTS

Spikes at high *k* come from (0,-2,-2), (0, 0, 4), etc.



A-LINE OPTICS

- Checked model against many E158 settings
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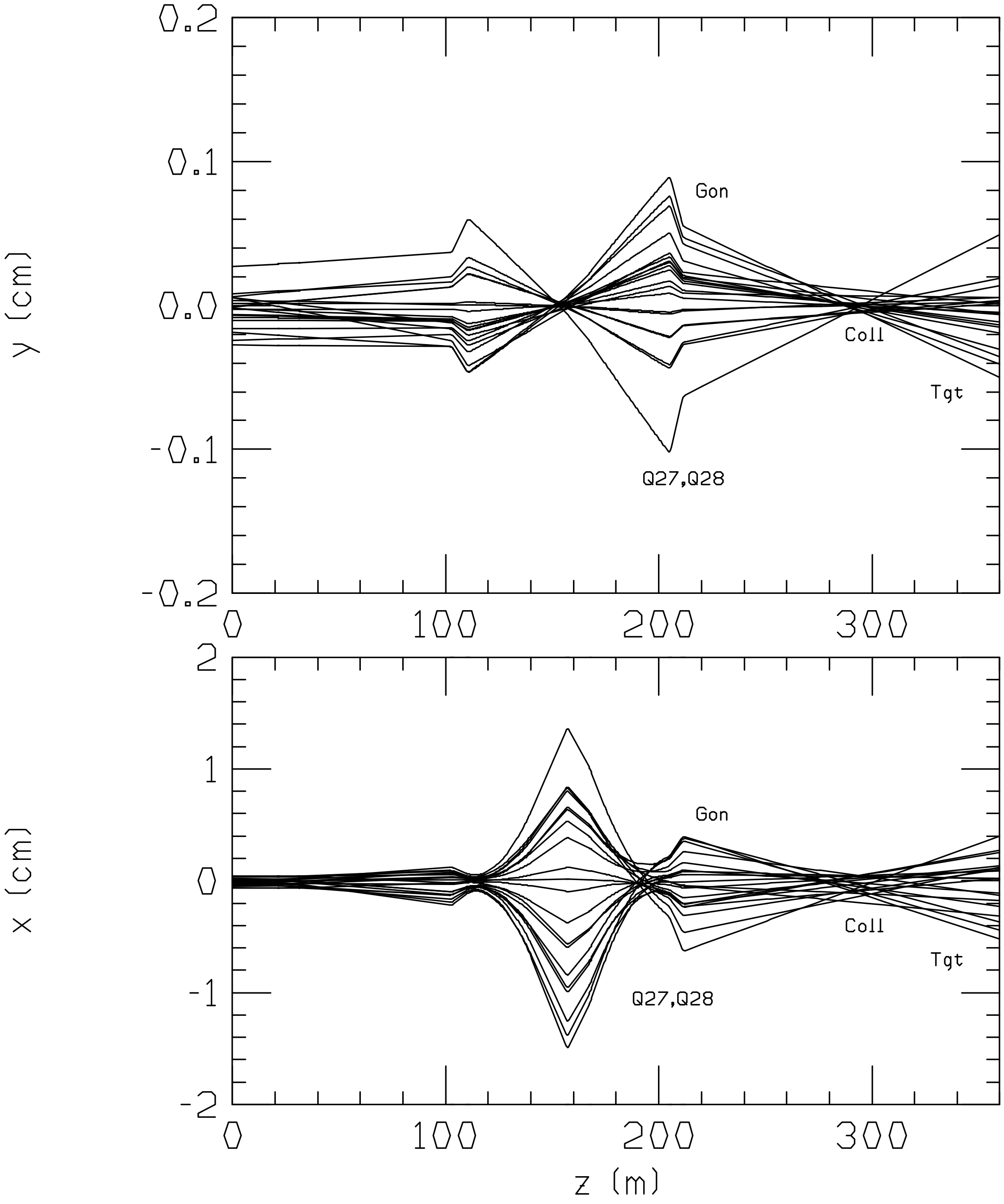
- Can focus beam with Q27, Q28 only.
- At 45 GeV, use Q27=-130, Q28=137.
- At collimator $\sigma_x = 1.02$ mm, $\sigma_y = 0.1$ mm.
- Beam size at diamond at 45 GeV $\sigma_x = 2.75$ mm, in x, $\sigma_y = 0.25$ mm.
- Beam fits o.k. on 8 mm wide diamond (10 mm better).
- Is spot area too small? May need to increase y emittance at source. In x, completely dominated by synchrotron radiation growth.

A-LINE OPTICS

Opritcs for 45 GeV with $dE/E = +/-0.2\%$, Q27=-130, Q28=137.5. Goniometer 8 m from Q28, Collimator 78 m from goniometer.



PHYSICAL LAYOUT

- Goniometer, Collimator positions fixed
- Work needed on Sweep Magnets (Lew)
- Work needed on Ion, SEQ location
- Compton Polarimeter needs design (Jeff, Yerevan)
- No more “soft bend”