Hall D collaboration meeting
Bloomington, IN
April 6-8, 2000

Research and Development
Status + Plans
for
Photon Source and Beam Line

1. proposed R&D, Cassel review priorities
2. progress so far
3. what needs to be done for D.R. version 3?

2.1.2 Photon Beam

- The proposed tagger is essentially the same as that for Hall B and does not consitute a problem.

- Linear polarization from coherent bremsstrahlung is a well-understood phenomenon and the kind of beam proposed for Hall D has been used routinely in earlier experiments. However, achieving a beam of the quality desired for this experiment (i.e., the flux, the concentration into a narrow band of photon energies, and the collimation needed to adequately enhance the fraction of photons that are linearly polarized) will require ongoing R&D eforst in conjunction with JLab Hall B developments. The R&D efforts that will be required include:

either { or

  - growth of synthetic diamond crystals of suitable thickness,
  - thinning of natural diamond crystals to the relevant thickness (< 50 μm), and
  - a collimator feedback system to regulate photon beam targeting and polarization.

Jlab experts not worried

- Hall B tests indicate that the proposed Hall D incident flux will result in drift chamber occupancies well within the acceptable range.

We conclude that the proposed photon beam design is compatible with the goals of the experiment, contingent on a successful R&D outcome.

Should it prove impossible to achieve the proposed level of linear polarization, it will be necessary for the collaboration to make the appropriate modifications to the proposed physics program.

Priorities for R + D :

- one central issue identified: <u>crystals</u>
  - tied directly to physics goals of the experiment (Cassel review)
  - pushes the limits of what is known about diamond radiators
- two principal questions:
  - how can they be produced reliably for us?
  - can they be operated reliably at currents of $3 \mu A$ and beam spot size $1\,mm^2$?

2. Progress so far:

- C. Sinclair: from a colleague's visitor's friend ...

  News from behind the Diamond Curtain (Drukker / De Beers)

  > "they can get excellent thin crystals down to 1 micron" (!)

- Question: can we get ... ?

From the Hall B team:

- Jim Kellie: Glasgow, U.K.
  - they have obtained from Drukkers both natural and synthetic diamonds
  - just ordering diamond wafers is "a waste of time and money"
  - requires a friendly trusting contact "on the inside" to let you fish for the good wafers among the rough.
    - optical scan with polarized light
    - X-ray rocking curve measurements at a light source (Daresbury)

- it is possible to find good crystals, both natural and synthetic: $\delta\theta < 10\mu r$

- they are both produced thick ~300 μ... then DeBeers will mill them down t- the desired thickness for a fee.

News: J. Kellie is now trying to arrange for Drukker to polish a 4mm × 4mm synthetic diamond ($\delta\theta = 5.7\mu r$) down to **10 μm**, polishing expected to cost about 1000 £.

★ preferred growth axis for sythetic diamonds is (1,0,0) - the one we need

★ growing crystals up to 300 μm and then polishing them down is a waste, but at present we have to take what friendly insiders can provide

News: J. Kellie, K. Livingston (Glasgow group) are interested in working with us. We should try to attract them to join the callaboration.

3. What must be done to prepare for D. R. version 3?

- At present, question of natural vs. synthetic is moot: both are available, choice depends on cost.
- Milling down to desired thickness is necessary in either case at present, and is driving term in the cost:

$$\$\$ \sim \frac{1}{\text{thickness}}$$

We must eliminate the unknowns that might limit the use of thin radiators at high flux:

calculate 1) sublimation of the crystal

$$\underbrace{\dot{\rho}}_{\text{radiation cooling}} + \underbrace{\vec{\nabla} \cdot \vec{J}}_{\text{conduction cooling}} = \underbrace{h}_{\text{heat load}} , \quad \vec{\nabla} T = \frac{-1}{\nu t} \vec{J}$$

SLAC, Mainz experience 2) radiation damage $\mathcal{O}\left(10^6 s \cdot \frac{a\,(cm^2)}{I\,(\mu A)}\right)$

experience at light source 3) mechanical stresses under heat load