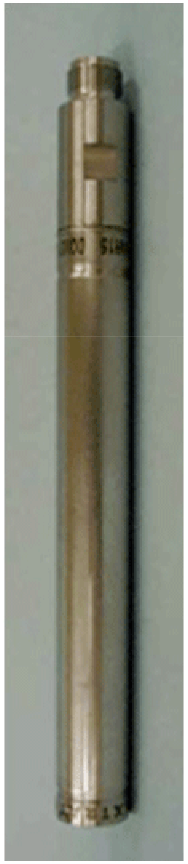
Studies on VESPA detectors

- **Proposed by N. Rhodes & D. Raspino (on 10th-5-'17):**

Cylindrical ^{3}He tubes;
L=203.2 mm, long *(i.e.* 8"*)*;
W=7.938 mm, internal diameter *(i.e.* 5/16"*)*;
^{3}He pressure up to *p*≤20 atm.

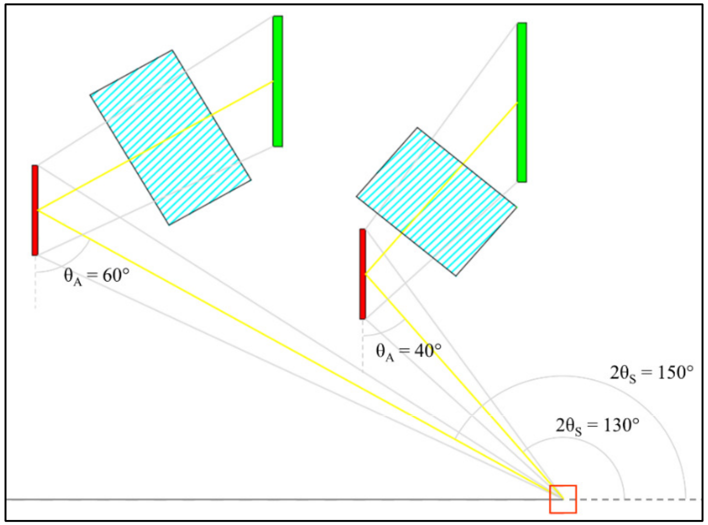


- **Proposed by M. Zoppi (in 2015):**

"Squashed" ^{3}He tubes;
L=203.2 mm, long *(i.e.* 8"*)*;
2a=12.065 mm *(i.e.* 19/4"*)*, *2b*≈2.54 mm *(i.e.* 1/10"*)*;
^{3}He pressure *p*=20 atm.

- **How to arrange them in the VESPA modules?**

1. **Backscattering** (θ_m=130°): 176.16 mm illuminated. **20 tubes** can be accommodated, if a 8.8 mm gap per tube is enough. Solid angle: 0.0612 sr. **Problems**: the last 3 tubes would have **λ_f<3.97 Å** (Be cut-off). **17 tubes** left !



2. **Extreme Backscattering** (θ_m=150°): 144.64 mm illuminated. **17 tubes** can be accommodated, if a 8.5 mm gap per tube is enough. Solid angle: 0.0212 sr.

istituto dei sistemi complessi

Science & Technology Facilities Council ISIS

- **What about the VESPA "elastic line"?**

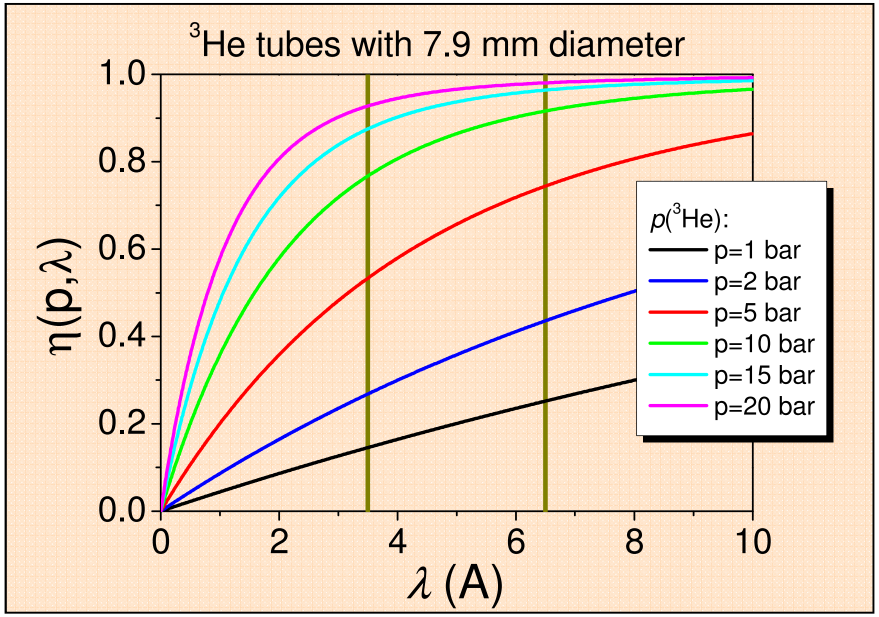
– we don't have neutrons with $\lambda_0 > 4.7$ Å ! –

1. **Backscattering** ($\theta_m = 130^o$):
   Out of **17 tubes** (4.00 Å $< \lambda_f < 4.83$ Å) **14** exhibit the "elastic line" *(i.e.* from **4**[th] to **17**[th]*).*

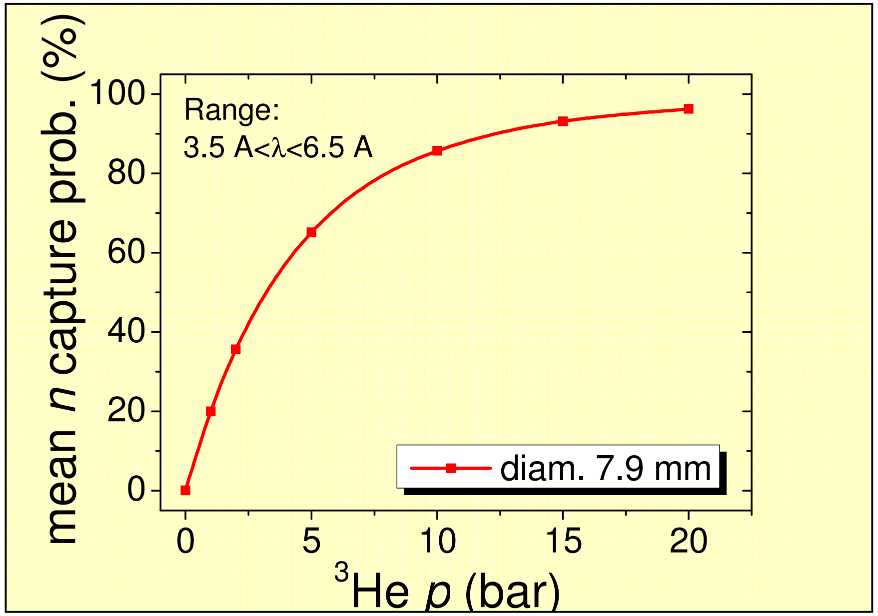
2. **Extreme Backscattering** ($\theta_m = 150^o$):
   Out of **17 tubes** (5.59 Å $< \lambda_f < 6.02$ Å) **none** exhibits the "elastic line".

EUROPEAN SPALLATION SOURCE

- **Detector capture efficiency in the 3.5 Å<λ_f<6.5 Å range**



⇒

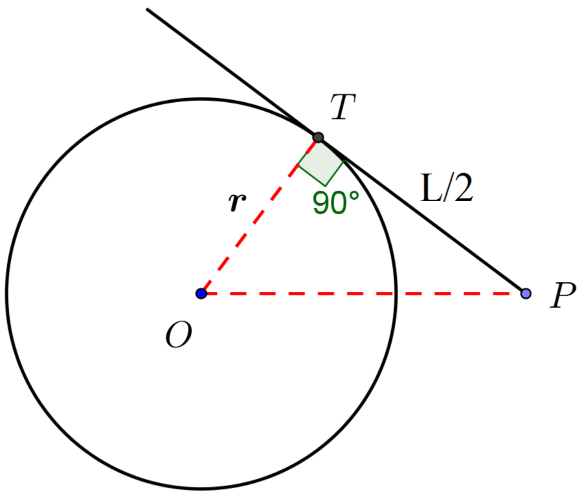


p(^{3}He) = 11 bar is surely enough!

- **What is the effect of the detector width on the energy resolution?**

There are three detector-ΔE components:

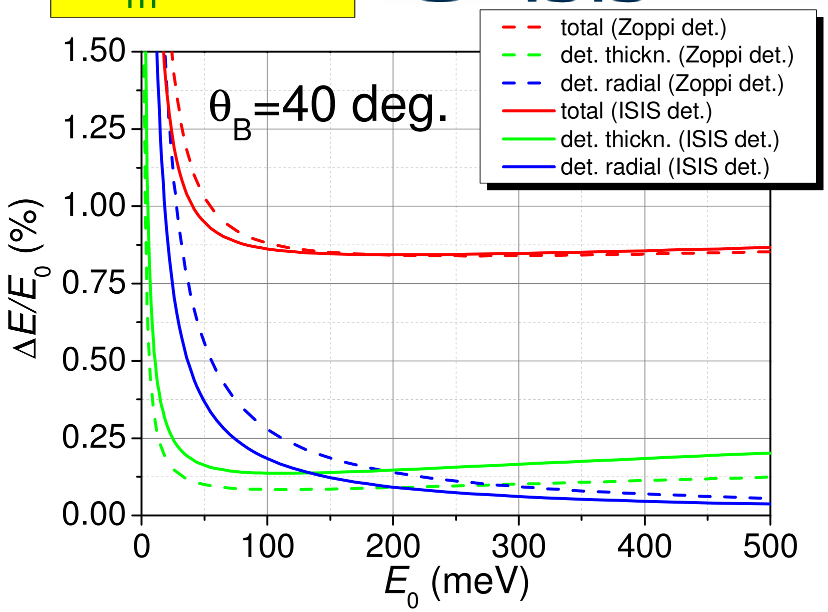
- **Radial** $\propto$ W
- **Thickness** (a) $\propto$ s. d. of the n. free path: $\sigma_{fp}=\sigma_{fp}(\lambda,p)$
- **Thickness** (b) $\propto$ s. d. of curvature "error" $\sigma_c \approx (1/\sqrt{720})\ L^2/r$



istituto
dei sistemi
complessi

θ_m=130º

Science & Technology Facilities Council ISIS

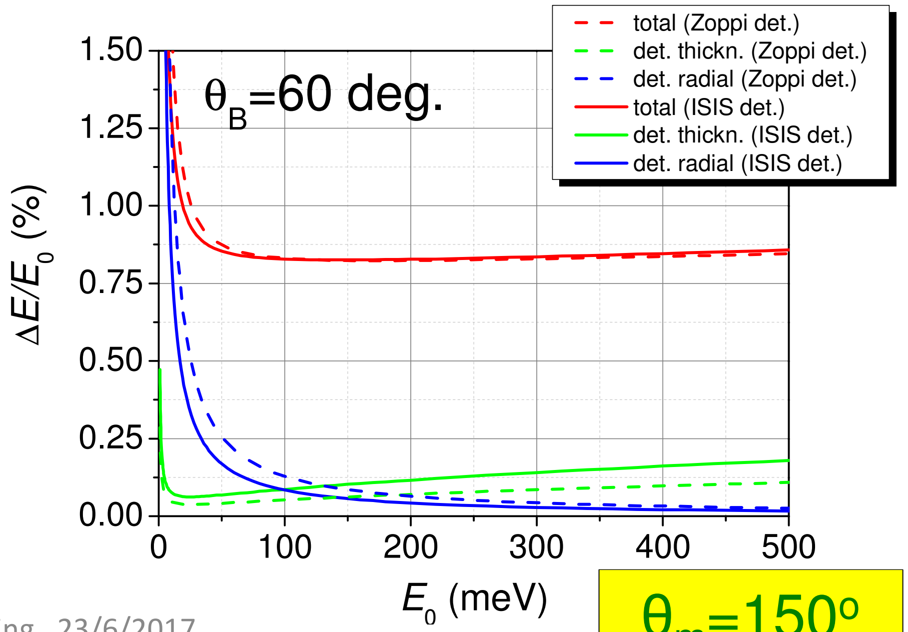


Proposed by **MZ**

- *W*=12 mm, *s*=2.5 mm (elliptical)
- **thickness** $(a^2+b^2)^{0.5}$ (at *p*=20 bar)
- σ_{fp}= 1.104÷0.932 mm (3.5 Å<λ_f< 6.5 Å)
- σ_c= 3.182 mm (150 deg.); 3.348 mm (130 deg.)

Proposed by **ISIS**

- *W*=7.9 mm, *s*=7.9 mm (circular)
- **thickness** $(a^2+b^2)^{0.5}$ (at *p*=11 bar)
- σ_{fp}= 1.786÷1.545 mm (3.5 Å<λ_f< 6.5 Å)
- σ_c= 3.182 mm (150 deg.); 3.348 mm (130 deg.)



EUROPEAN SPALLATION SOURCE

θ_m=150º

First estimates of the peak neutron counts on the EL

Fictitious McSample sample: purely incoherent elastic scatterer with σ_t**(H)**, scattering power ~5% for 3.7 meV<E_0<5.4 meV. Low-resolution mode @ 5 MW with the straight tapered guide.

Backscattering ($\theta \approx 130^o$): **14 ideal McStas detectors** (8 mm × 20 mm) [4.00 Å<λ_f<4.66 Å].

Example: tube **no. 17** (the most intense), λ_f=4.00 Å → E_f=5.112 meV

⇒ Peak rate, I= 4.65×10^4 n/s;

⇒ Mean rate, I= 2.78×10^4 n/s.

Upper limit for ^{3}He tube **count rate**: ≈ 40-50 kHz peak rate per tube.

Just about for the *elastic line*, so *inelastic part* is surely all right!

Why? Let us take a standard calibration sample: **HMT** @ T=20 K
The maximum of the elastic line is **46.8** times larger that of the inelastic part (ω=5.15 meV) in a raw ToF spectrum ***I(θ,t)*** (with θ=130^o & E_f=5 meV)!