KHALATNIKOV 100

Landau Institute, October 17-20, 2019, Chernogolovka

Aerogels in superfluid 3He

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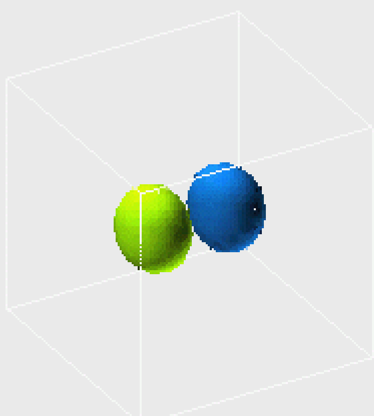
Superfluid ^{3}He *p-wave*, l=1,s=1 Cooper pairing

$$\Psi_\mu = \Sigma A_{\mu j} k_j$$

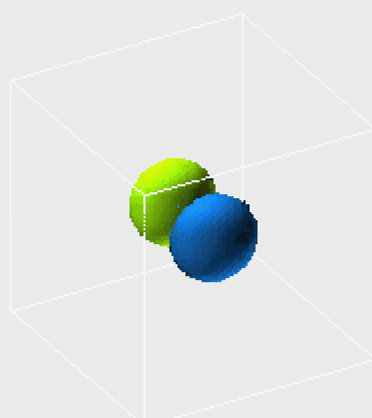
$$A_{\mu j}$$

orbital index j=1,2,3, enumerates px,py,pz- orbitals

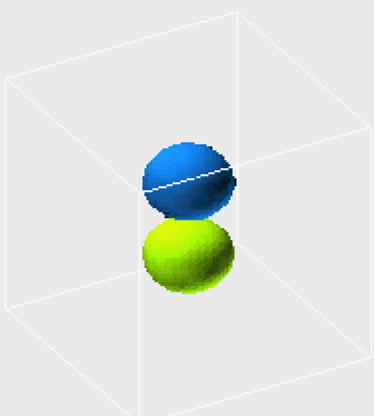
spin index μ = 1,2,3



px

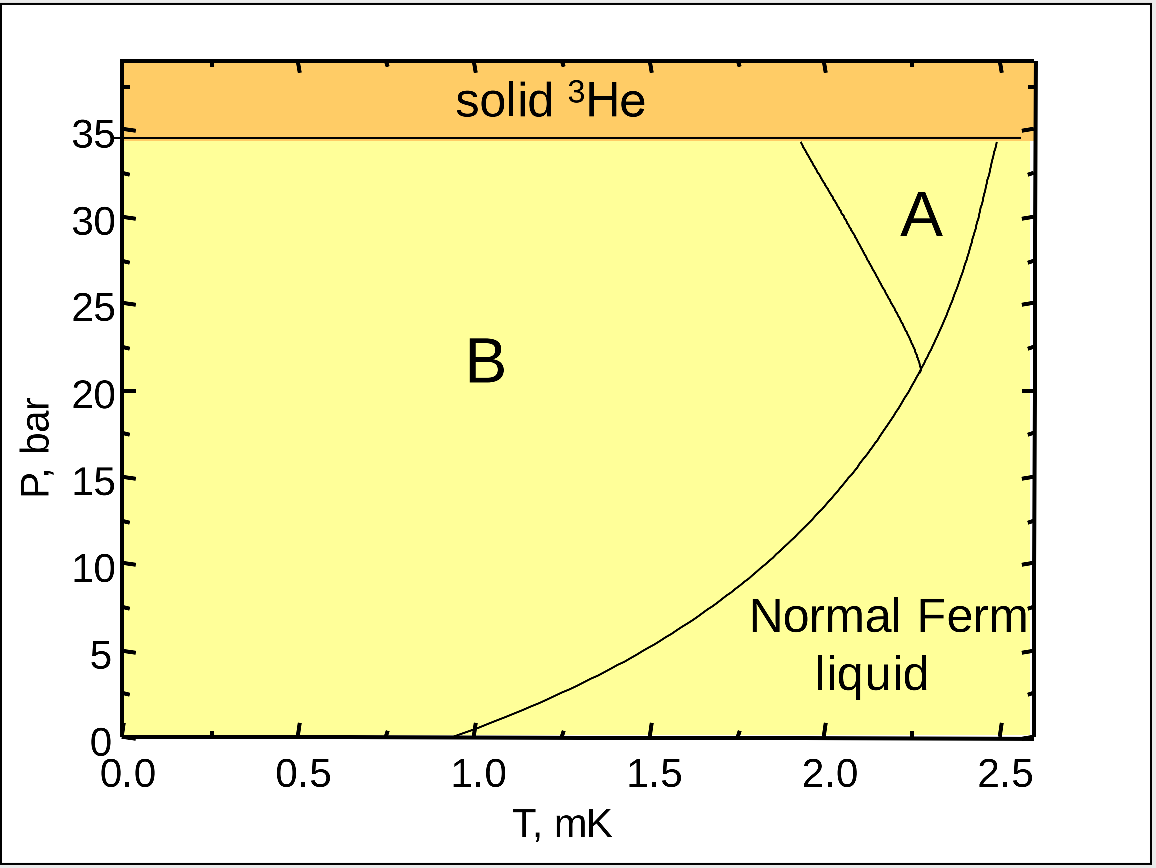


py

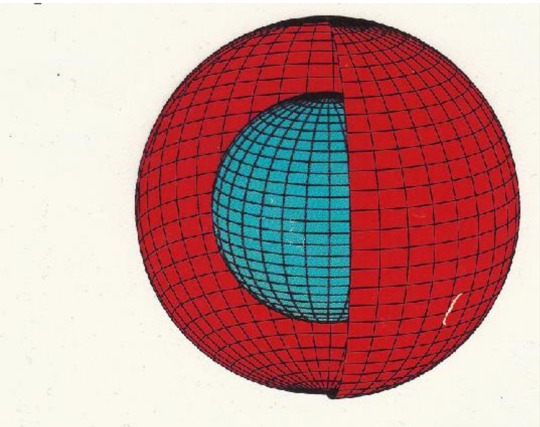


pz

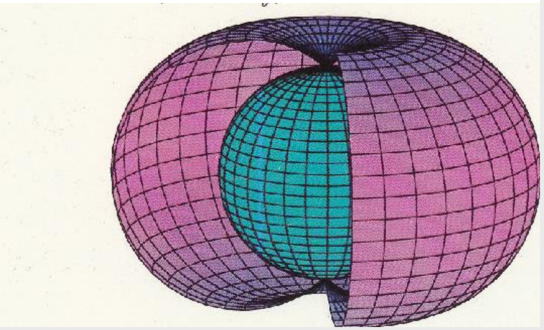
P-wave Cooper pairing (l=1 , s=1).



B-phase: isotropic state



A-phase: axial state



A-фаза: $A_{\mu i} = \Delta d_{\mu} \left(m_i + i n_i \right)$

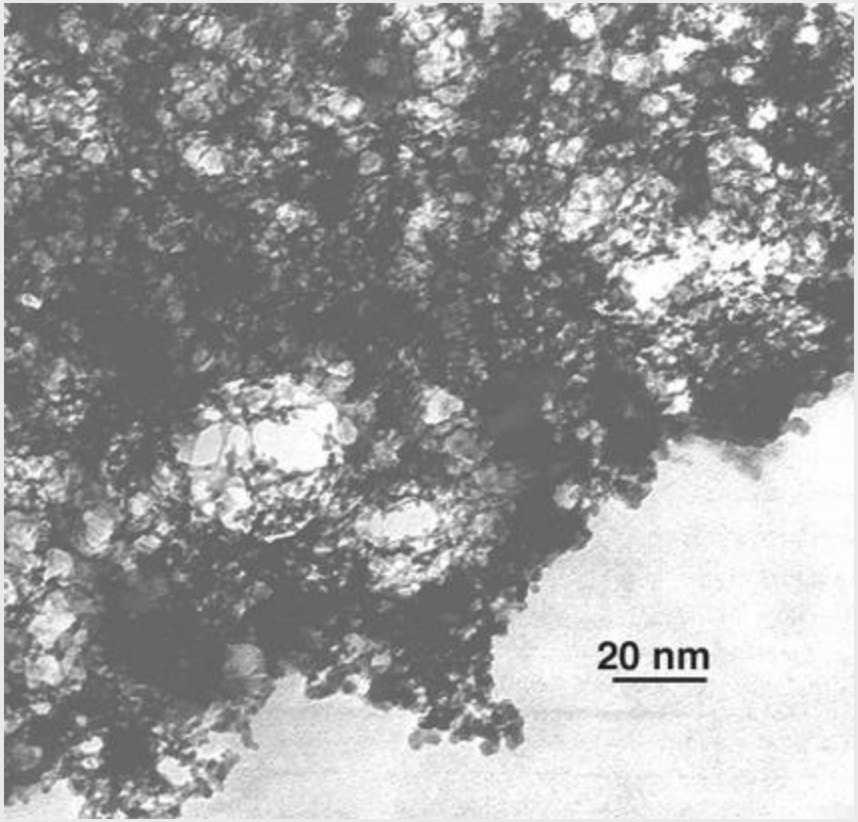
B-фаза: $A_{\mu i} = |\Delta| e^{i\varphi} \mathbf{R}(\hat{\mathbf{n}}, \theta)_{\mu i} \qquad \mu, i = 1,2,3$

Self-supporting structure – aerogel (SiO_2).

[1] J. V. Porto and J. M. Parpia, *Phys. Rev. Lett.*, **74**, 4667 (1995)

[2] D. T. Sprague, T. M. Haard, J. B. Kycia, V. R. Rand, Y. Lee, P. Hamot and W. P. Halperin, *Phys. Rev. Lett.*, **75**, 661 (1995)

Porosity P up to 99.5% .
Usually about 98%



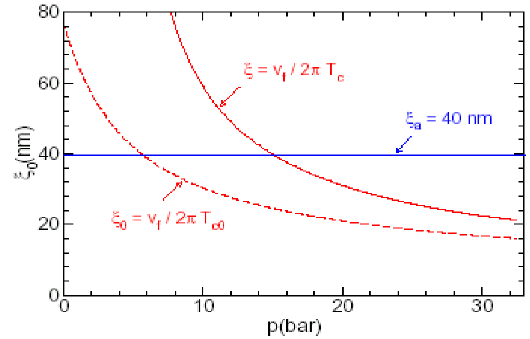
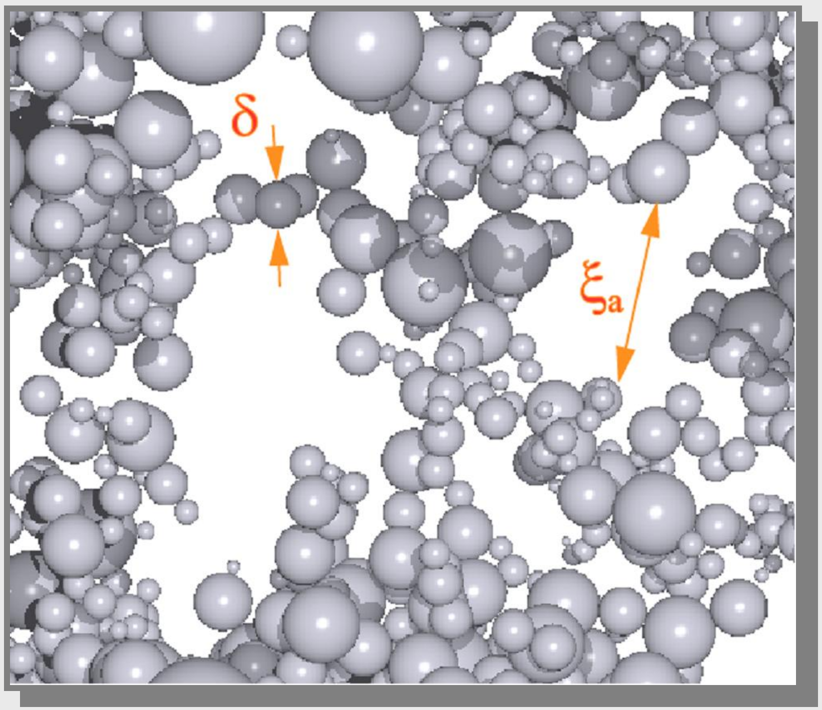


FIG. 2: The pair correlation length of superfluid ^{3}He in aerogel (solid curve) as a function of pressure is shown in comparison with an aerogel strand-strand correlation length, $\xi_a \simeq 40$ nm. A cross-over occurs near $p \approx 15$ bar. The bulk ^{3}He correlation length is also shown (dashed curve).



DLCA simulation of a silica aerogel depicting the length scales δ and ξ_a (courtesy of T.M. Lippman).

Impurity

- Silica ball size:

  $\delta \approx 3$ nm

- Correlation length:

  $\xi_a \sim 10 - 100$ nm

- Superfluid coherence length:

  $\xi \approx 20 - 80$ nm (P = 34 - 0 bar)

- Expect interesting physics when: $\xi \sim \xi_a$

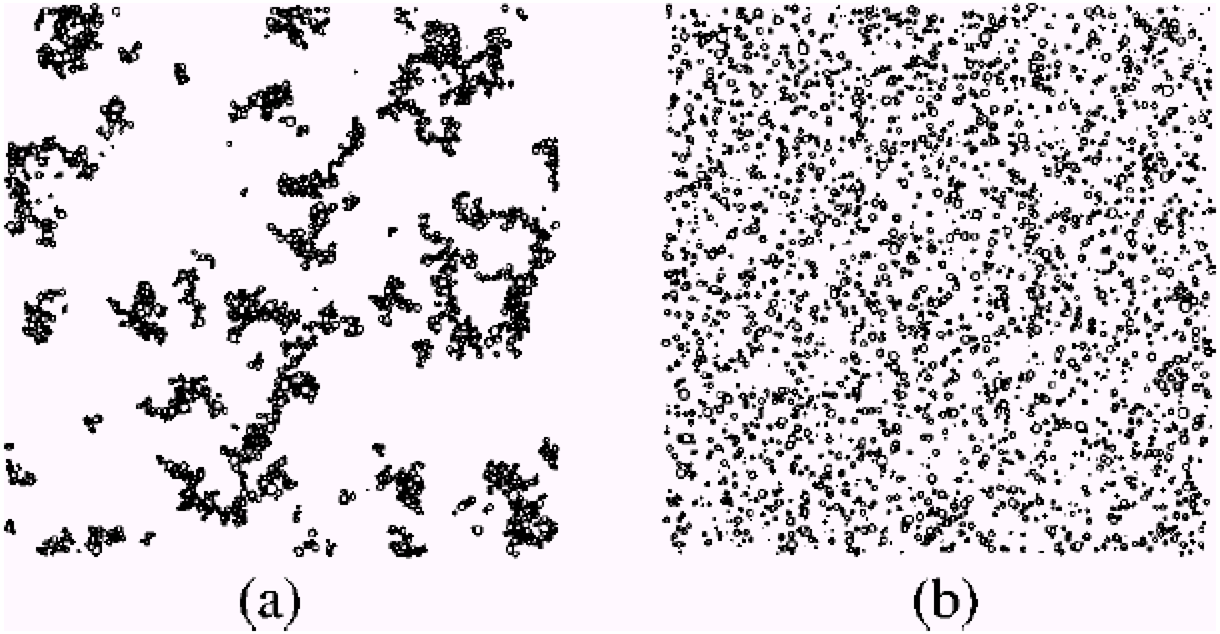


FIG. 3. Panel (a) shows a 300-Å-thick slice of the aerogel shown in Fig. 2(a). A similar slice of the random arrangement of spheres is shown in panel (b).

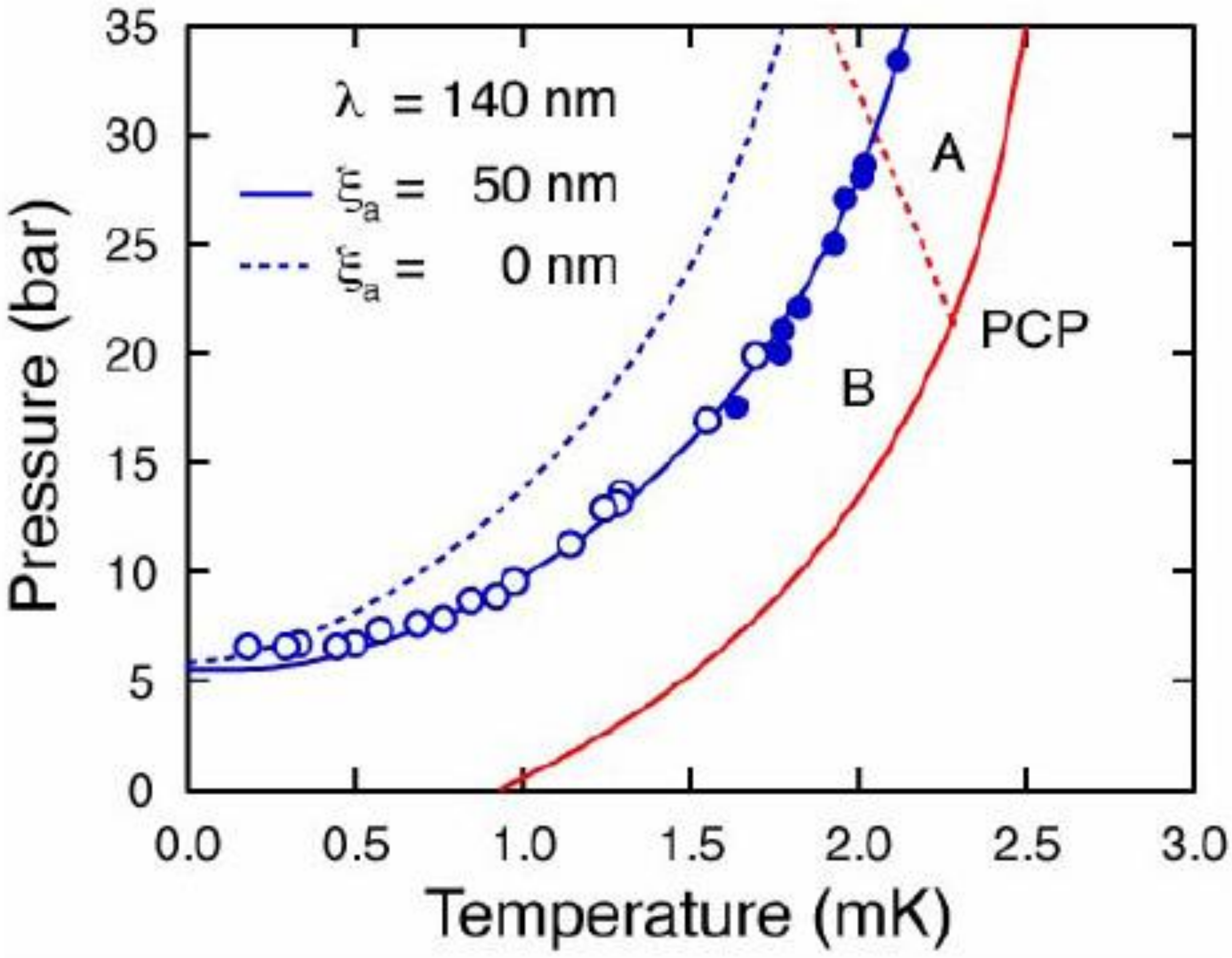
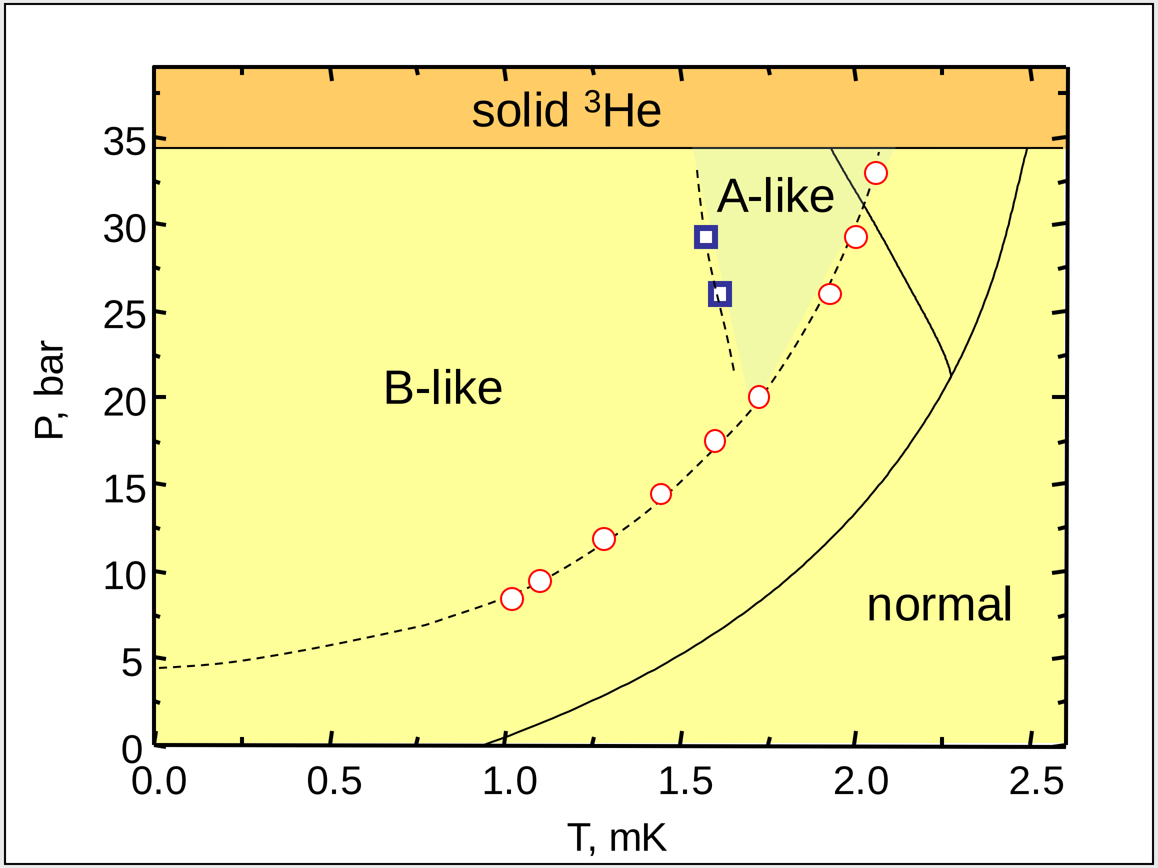


FIG. 1: Phase diagram for superfluid ^{3}He in two different samples of 98% aerogel. The known superfluid phases of

$$\frac{\xi_0}{l_{tr}}$$

98.2% aerogel:



solid ^{3}He
A-like
B-like
normal
P, bar
T, mK
0
5
10
15
20
25
30
35
0.0
0.5
1.0
1.5
2.0
2.5

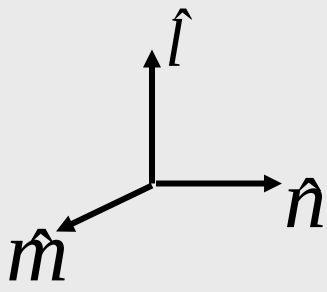
$$\Phi \to H_\mu H_\nu A_{\mu j} A^*_{\nu j}$$

$$\delta\Phi \propto \Delta^2 (H_\nu d_\nu)^2$$

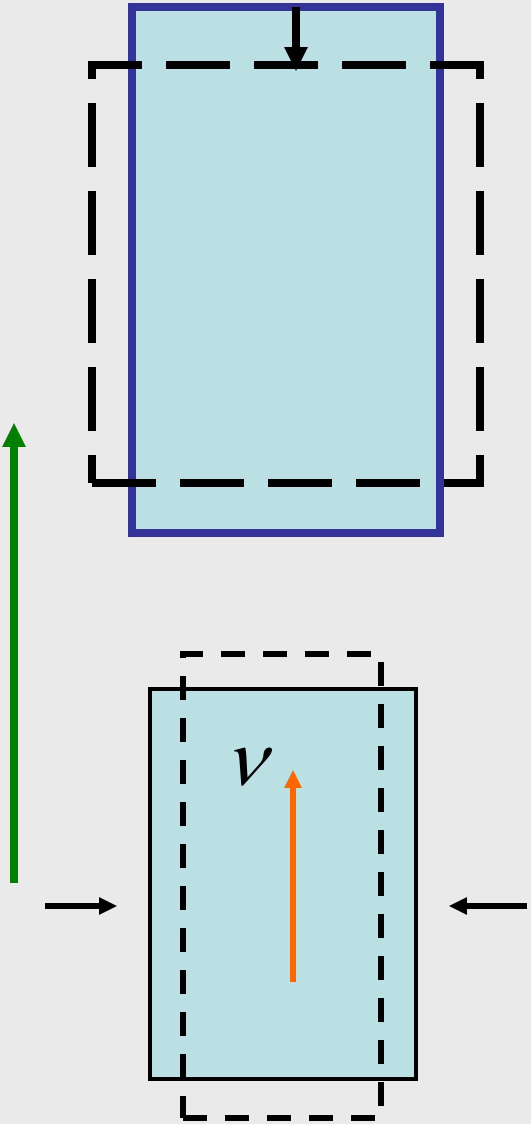
$$d \perp H$$

$$s_z = \pm 1$$

$$A_{\mu j} = \Delta \frac{1}{\sqrt{2}} \hat{d}_\mu (\hat{m}_j + i\hat{n}_j)$$ – ABM



Global orbital anisotropy



Lowering of symmetry: from spherical to axial.
Good quantum number is *m= -1,0,+1.*

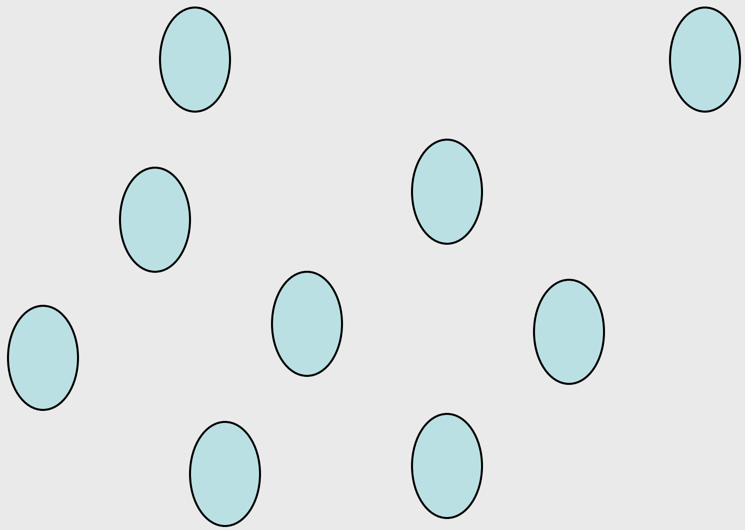
$$\delta F \propto a(\mathbf{l} \bullet \mathbf{z})^2$$

Squeezed aerogel $a < 0; m = \pm 1$

Is favored. Stretched - $a > 0,\ m = 0$

*T.Kunimatsu, T.Sato, K.Izumina, A.Matsubara, Y.Sasaki, M.Kubota, O.Ishikawa, T.Mizusaki and Yu.M.Bunkov. Письма в ЖЭТФ, **86**, 244 (2006)*

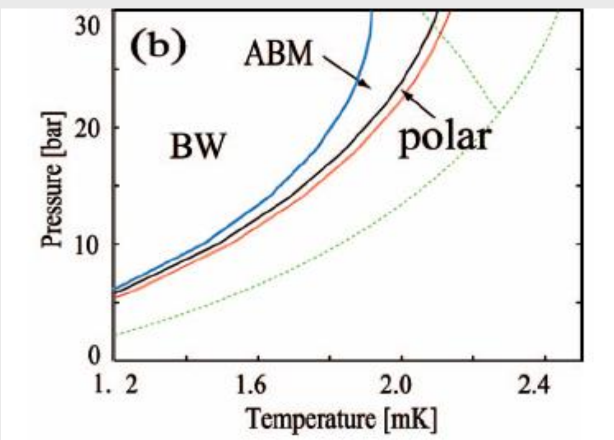
сжатие на ~4%



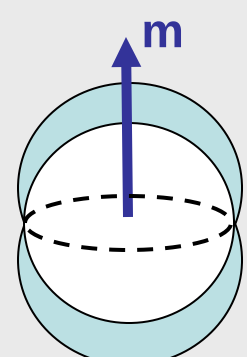
$$\overline{|u_{\mathbf{k}}|^2} = A[1 + \delta_u(\hat{\mathbf{k}} \cdot \hat{z})^2]$$

$$\delta_u = -0.07$$

Polar phase



$$A_{\mu\nu} = \Delta_0 d_\mu m_\nu$$



K. Aoyama and R. Ikeda, Phys. Rev. B **73**, 060504 (2006)

Quest for the polar phase

R.Sh. Askhadullin, V.V. Dmitriev, D.A. Krasnikhin, P.N.Martinov, A.A. Osipov, A.A. Senin, and A.N. Yudin, JETP Lett. 95, 326 (2012).

V.V. Dmitriev, A.A. Senin, A.A. Soldatov, and A.N. Yudin, Phys. Rev.Lett. 115, 165304 (2015).

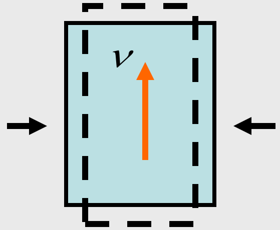
V.E. Asadchikov, R.Sh. Askhadullin, V.V. Volkov, V.V. Dmitriev, N.K. Kitaeva, P.N. Martynov, A.A. Osipov, A.A. Senin, A.A. Soldatov, D.I. Chekrygina, and A.N. Yudin, JETP Lett. 101, 556 (2015).

V.V. Dmitriev, L.A. Melnikovsky, A.A. Senin, A.A. Soldatov, and A.N. Yudin, JETP Lett. 101, 808 (2015).

S. Autti, V.V. Dmitriev, J.T. Maekinen, et al., Phys. Rev.Lett. 117, 255301 (2016).

V.V. Dmitriev, A.A. Soldatov, and A.N. Yudin, Phys. Rev.Lett. 120, 075301 (2018).

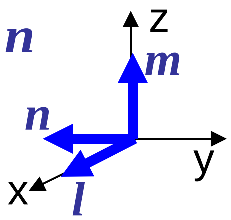
Squeezed aerogel



A phase: $\boldsymbol{l} = \boldsymbol{m} \times \boldsymbol{n}$

$$A_{\mu\nu} = \Delta_0 d_\mu (m_\nu + i n_\nu)$$

Gap vanishes at 2 points on Fermi sphere



Polar distorted A (PdA) phase:

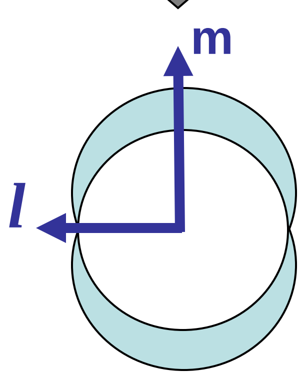
$$A_{\mu\nu} = \Delta_0 e^{i\varphi} d_\mu (a m_\nu + i b n_\nu)$$

$$(a^2 + b^2 = 1;\ \ a > b)$$

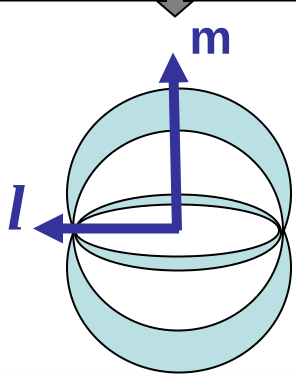
Polar:

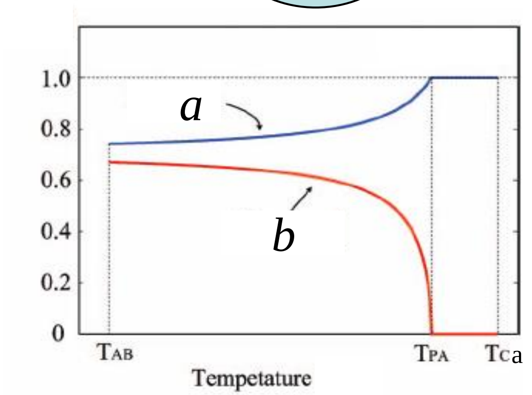
$$A_{\mu\nu} = \Delta_0 e^{i\varphi} d_\mu m_\nu$$

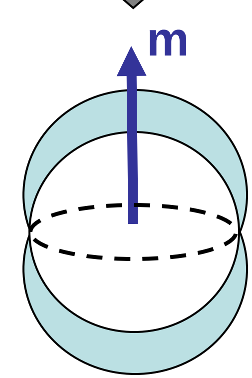
Gap is zero on the circle on Fermi sphere



$$\frac{\boldsymbol{b}^2}{\boldsymbol{a}^2} = 1$$







$$\frac{\boldsymbol{b}^2}{\boldsymbol{a}^2} = 0$$

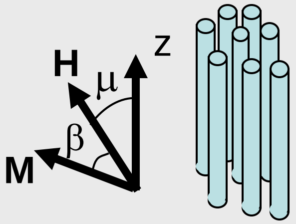
Spin dynamics in the LIM state can be obtained from Leggett equations

$$\dot{\mathbf{M}} = \gamma \mathbf{M} \times \mathbf{H} + \mathbf{R}_D$$
$$\dot{\mathbf{d}}(\hat{\mathbf{k}}) = \gamma \mathbf{d}(\hat{\mathbf{k}}) \times \left(\mathbf{H} - \frac{\mathbf{M}}{\chi} \right)$$

$$\omega(T) - \omega_L = \frac{\Omega_P^2(T)}{2\omega_L}$$

$$\Omega_P(T) \propto \Delta(T)$$

CW NMR frequency shift in A, PdA and polar phases:



CW NMR

μ=0: $2\omega\Delta\omega = K\Omega_A^2$

μ=π/2: $2\omega\Delta\omega = 0$

$A_{\mu\nu} = \hat{d}_\mu(\hat{m}_\nu + i\hat{n}_\nu)$	*A phase (2D LIM):*	$K = \frac{1}{2}$
$A_{\mu\nu} = \hat{d}_\mu(a\hat{m}_\nu + ib\hat{n}_\nu)$	*PdA phase (2D LIM):*	$K = \frac{4-6b^2}{3-4a^2b^2}$
$A_{\mu\nu} = \hat{d}_\mu \hat{m}_\nu$	*Polar phase:*	$K = \frac{4}{3}$

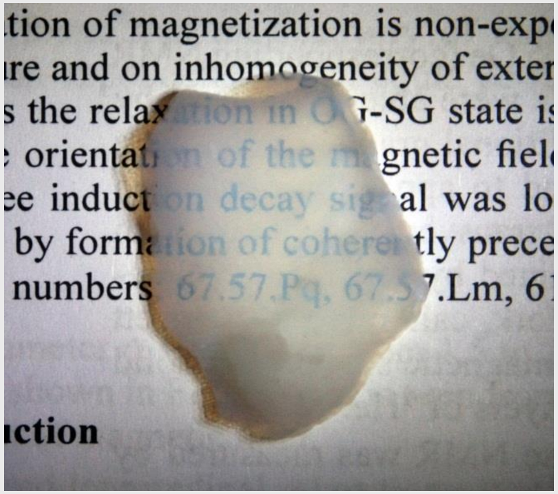
NOTE: Here K has been calculated in the weak coupling limit. Experiments show that K in the polar phase is decreasing (from 4/3 down to 1.15) with the increase of pressure from 0 to 29.3 bar.

“Obninsk aerogel”

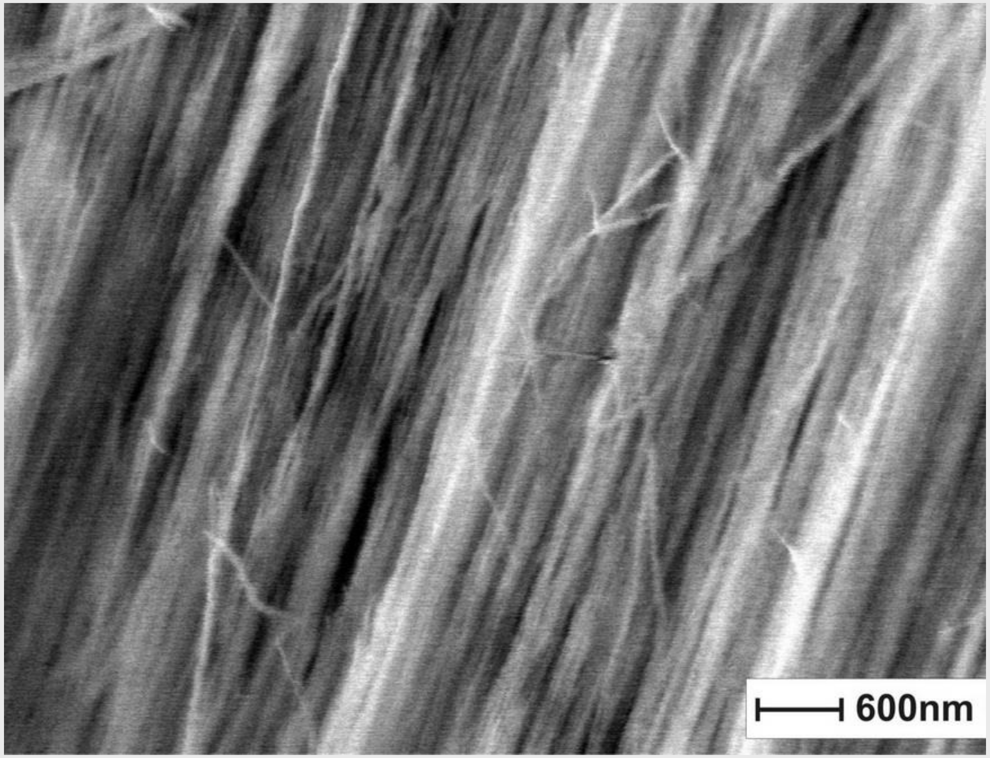
Al_2O_3 aerogel produced in Leypunskiy Institute of Power Engeneering (Obninsk, Moscow region)

R.Sh.Askhadullin et al., J. of Phys.: Conf. Ser., **98**, 072012 (2008)

Effective density: 8-40 mg/cm^3
Diameter of strands: 6-10 nm
Distance between strands: ~100 nm
For 30 mg/cm^3 sample mean free paths along and transverse to strands are 850 and 450 nm.

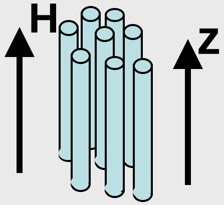


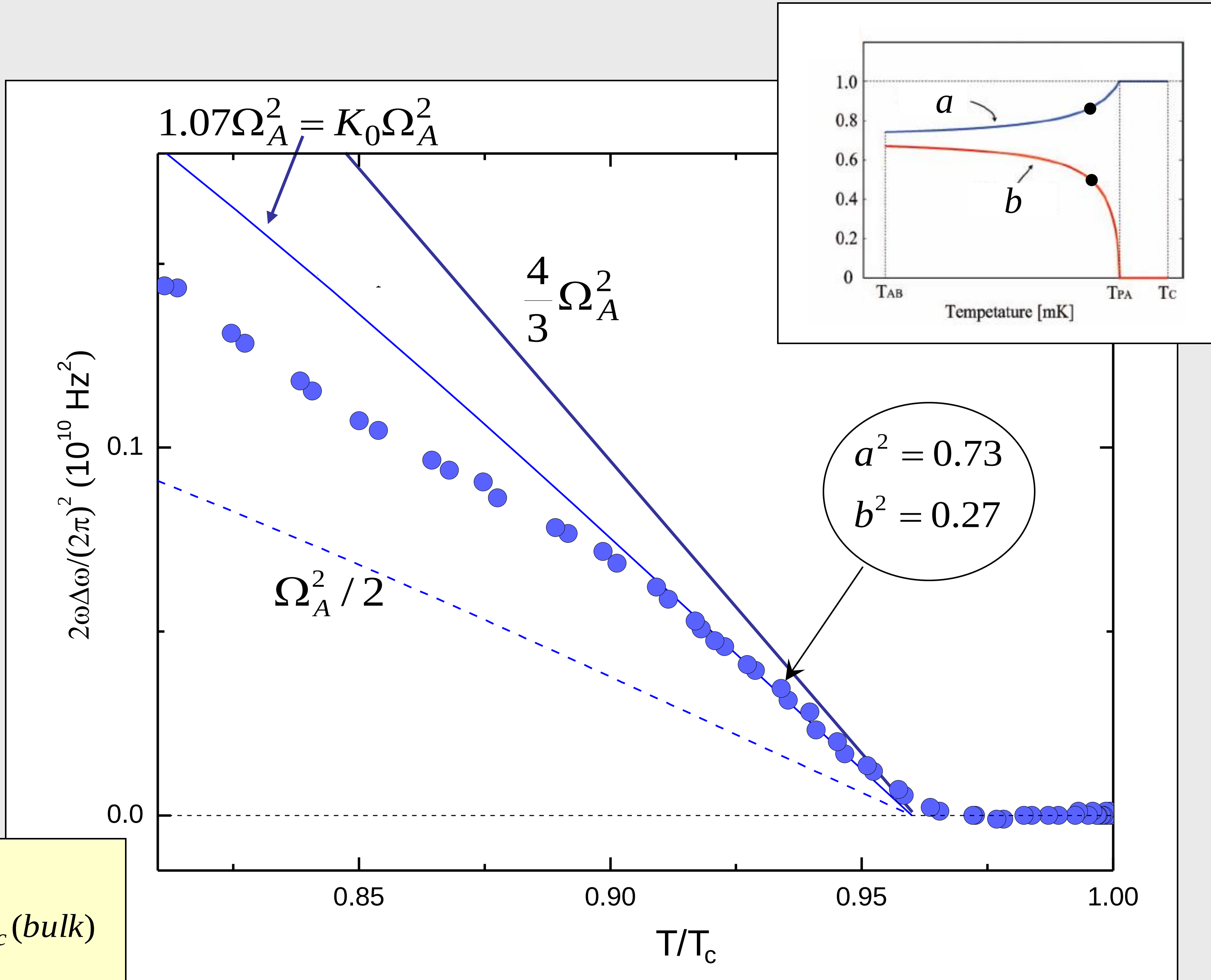
Samples have been supplied by R.Sh.Askhadullin, P.N.Martynov, A.A.Osipov (Leypunsky Institute, Obninsk, Russia)



SEM picture for 30 mg/cm^3 sample

Sample A. Normalized frequency shift on cooling (ESP phase)





$H = 346\,Oe$

$T_{ca} = 0.96\,T_c(bulk)$

$P = 6.5\,bar$

Pis'ma v ZhETF, vol. 95, iss. 6, pp. 355 – 360

Phase diagram of superfluid ^{3}He in "nematically ordered" aerogel

R. Sh. Askhadullin+, V. V. Dmitriev[1)], D. A. Krasnikhin, P. N. Martynov+, A. A. Osipov+, A. A. Senin, A. N. Yudin

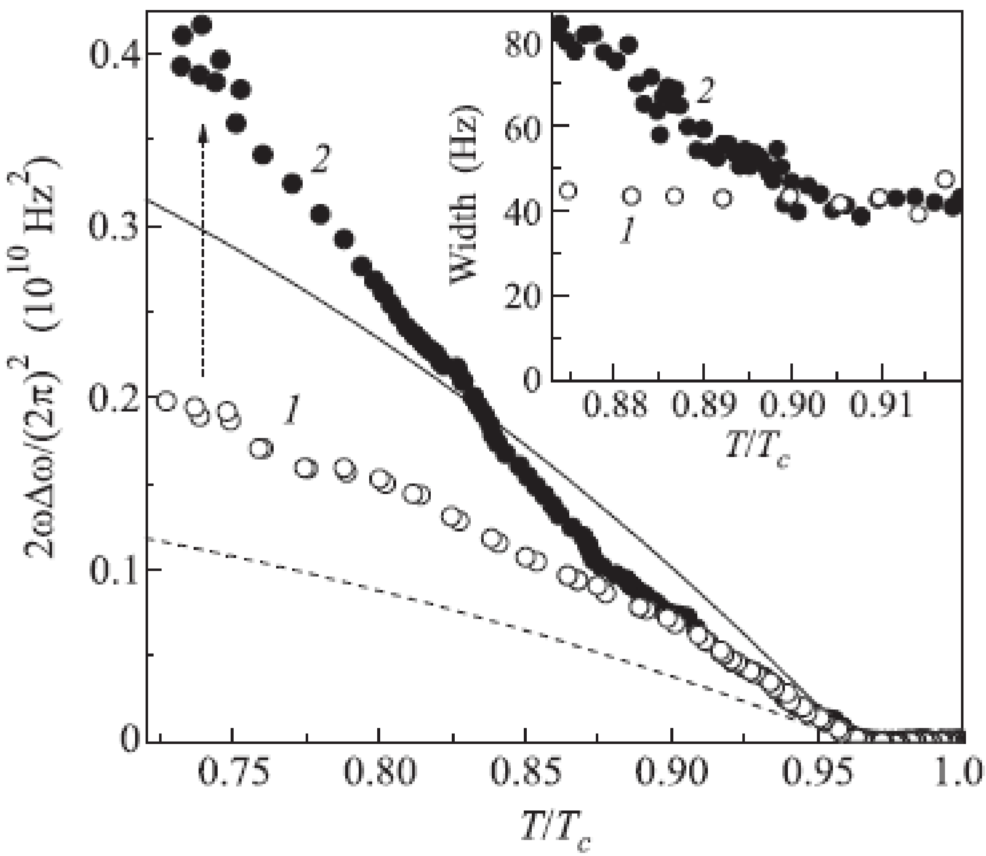
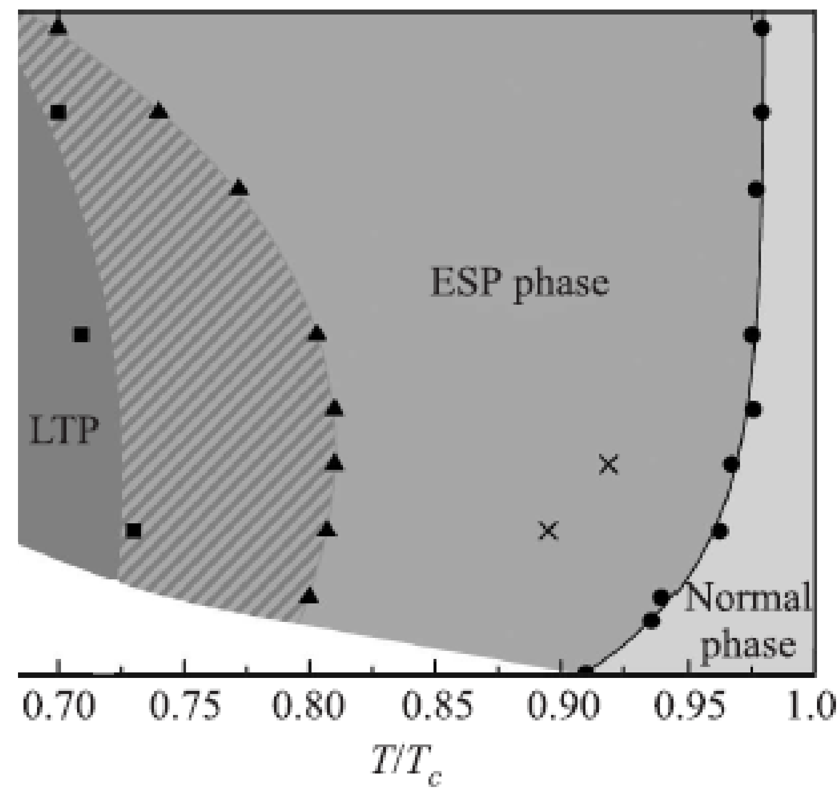


Fig. 6. The effective NMR-frequency shift versus temperature ($P = 6.5$ bar, $\mu = 0$, $T_{ca} = 0.962\,T_c$, and $H = 346$ Oe: *1* – the ESP1 phase; *2* – the LTP. Solid and dashed lines (see Section 5 for the explanation). Insert: corresponding

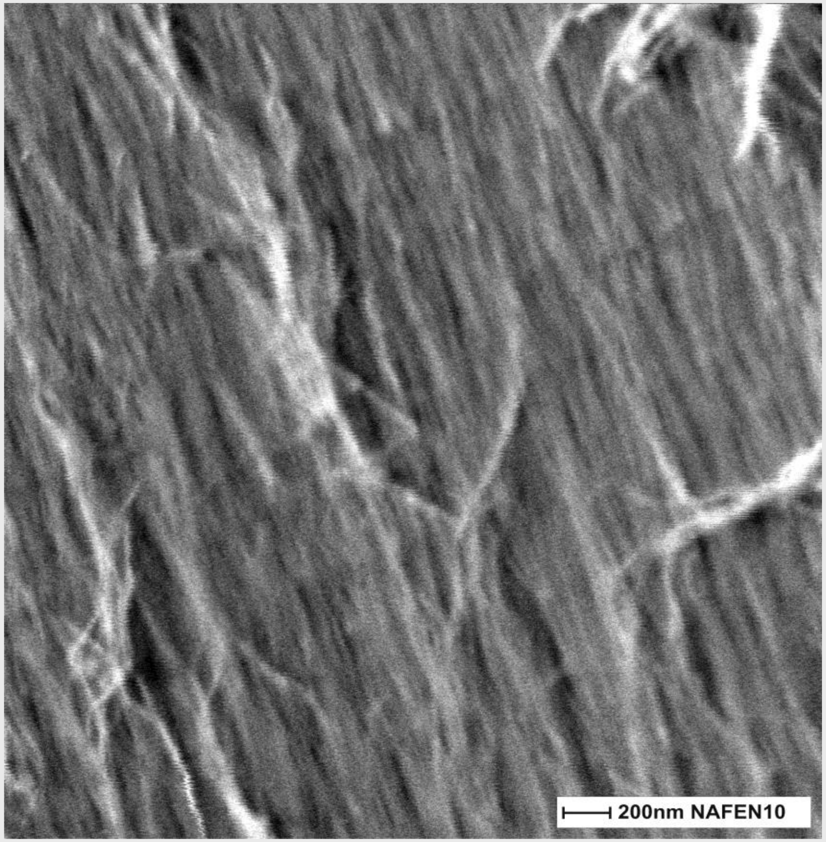


he phase diagram of liquid ^{3}He in "nematically or-
erogel obtained on cooling from the normal phase.
t the temperature is normalized to the superfluid
n temperature in bulk ^{3}He. See text for explana-

Al_2O_3 aerogel (“Nafen”) produced by ANF Technology Ltd (Tallinn, Estonia)

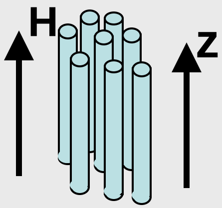
Effective density: 90 mg/cm^3 (97.8% open) or 243 mg/cm^3 (94% open)
Diameter of strands: ~10 nm
Distance between strands: ~40-70 nm
For 90 mg/cm^3 sample mean free paths along and transverse to strands are 950 and 250 nm, for 240 mg/cm^3 sample mean free paths along and transverse to strands are 560 and 60 nm.

Samples have been supplied by I.Grodnenskiy (ANF Technology Ltd, Tallinn, Estonia) – “Nafen”.

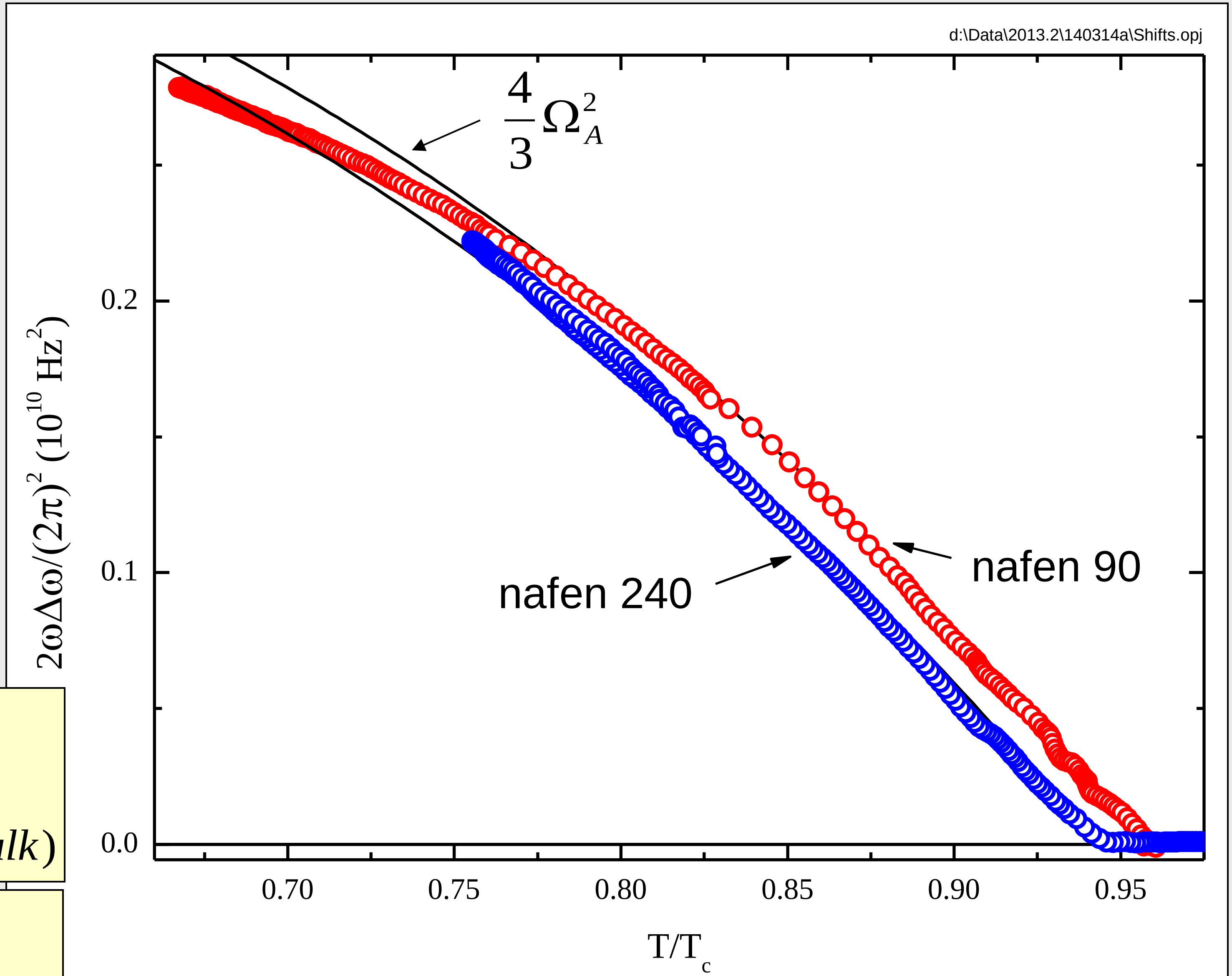


SEM picture for 90 mg/cm^3 sample

Normalized frequency shift in superfluid ESP phase of ^{3}He in Nafen-90 (red) and in Nafen-240 (blue).



$P = 5.4\, bar$



$Nafen90$

$H = 276\, Oe$

$T_{ca} = 0.96\, T_c(bulk)$

$Nafen240$

$H = 271\, Oe$

$T_{ca} = 0.94\, T_c(bulk)$

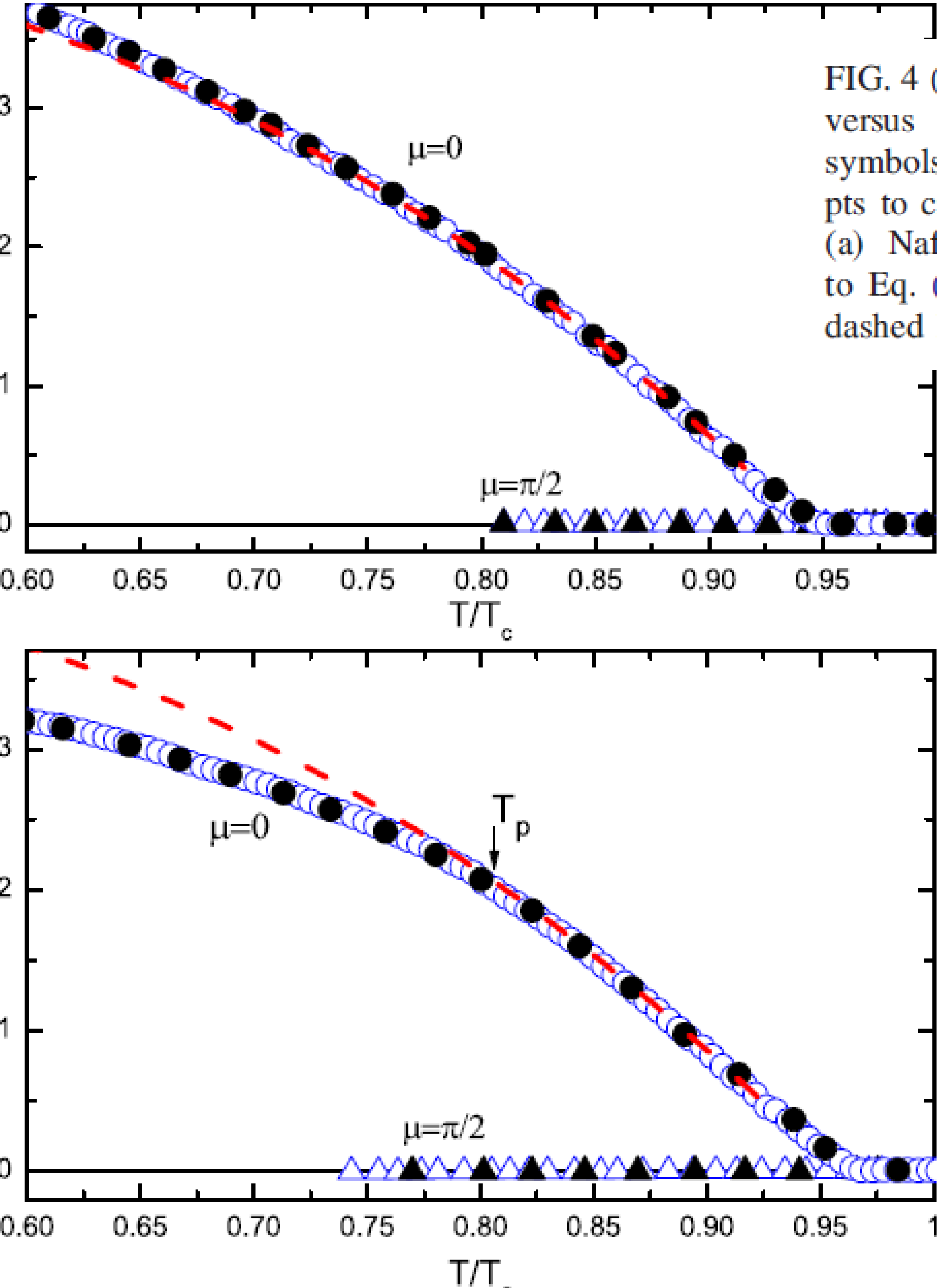


FIG. 4 (color online). Continuous wave NMR frequency shifts versus temperature in ^{3}He in nafen at $P = 7.1$ bar. Open symbols: the SN state; filled symbols: data obtained after attempts to create the SG state. $\mu = 0$ (circles), $\mu = \pi/2$ (triangles). (a) Nafen-243. $T_{ca} \approx 0.94 T_c$. The dashed line corresponds to Eq. (4) with $K = 1.245$. (b) Nafen-90. $T_{ca} \approx 0.955 T_c$. The dashed line corresponds to Eq. (4) with $K = 1.24$.

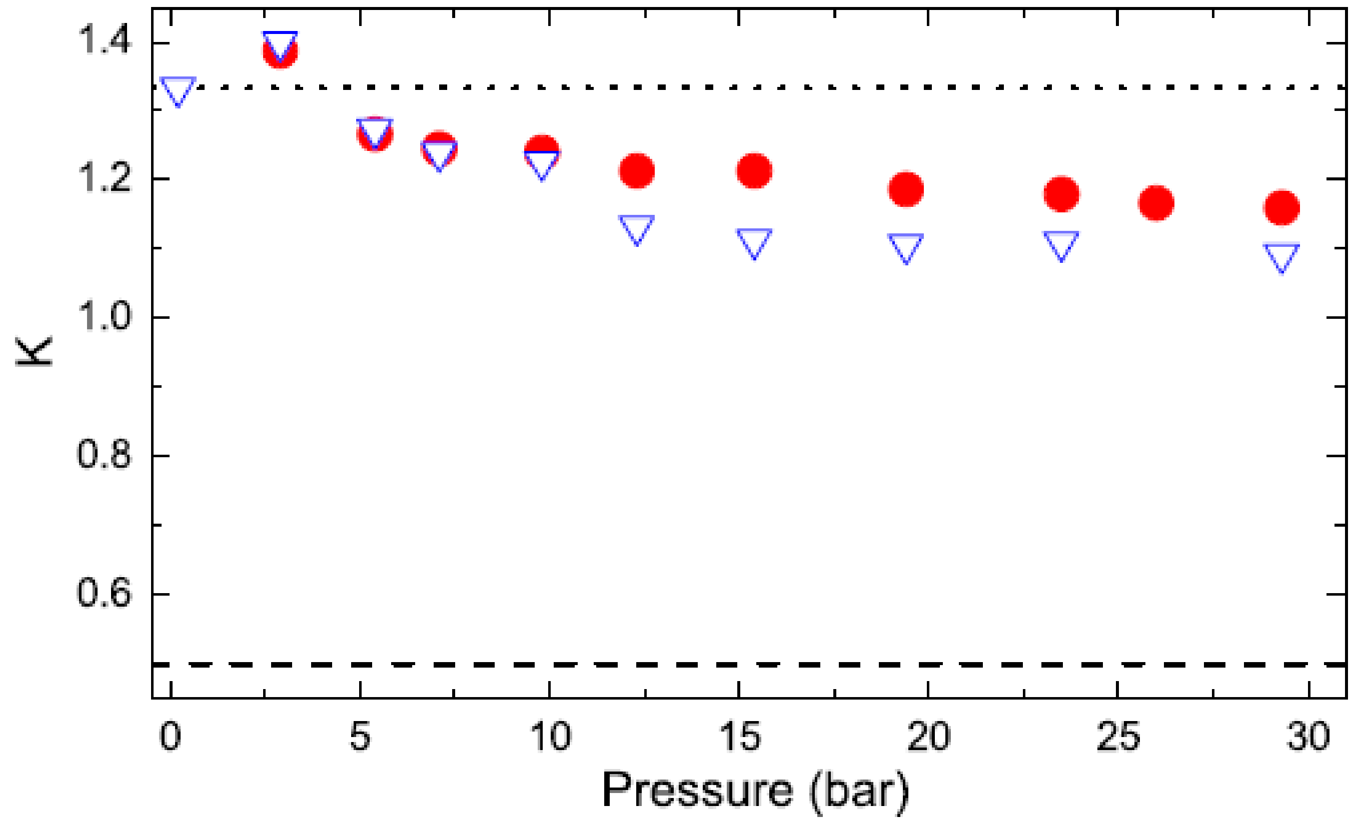


FIG. 5 (color online). K in the polar phase versus pressure. Open triangles—^{3}He in nafen-90, filled circles—^{3}He in nafen-243. Dotted and dashed lines correspond to K expected from Eq. (3) for polar and A phases, respectively. Depending on the temperature range used for determination of K, the obtained values vary by $\pm 2\%$ that limits the accuracy.

Polar Phase of Superfluid 3He in Anisotropic Aerogel

V. V. Dmitriev,1,* A. A. Senin,1 A. A. Soldatov,1,2 and A. N. Yudin1

PRL 115, 165304 (2015) PHYSICAL REVIEW LETTERS week ending 16 OCTOBER 2015

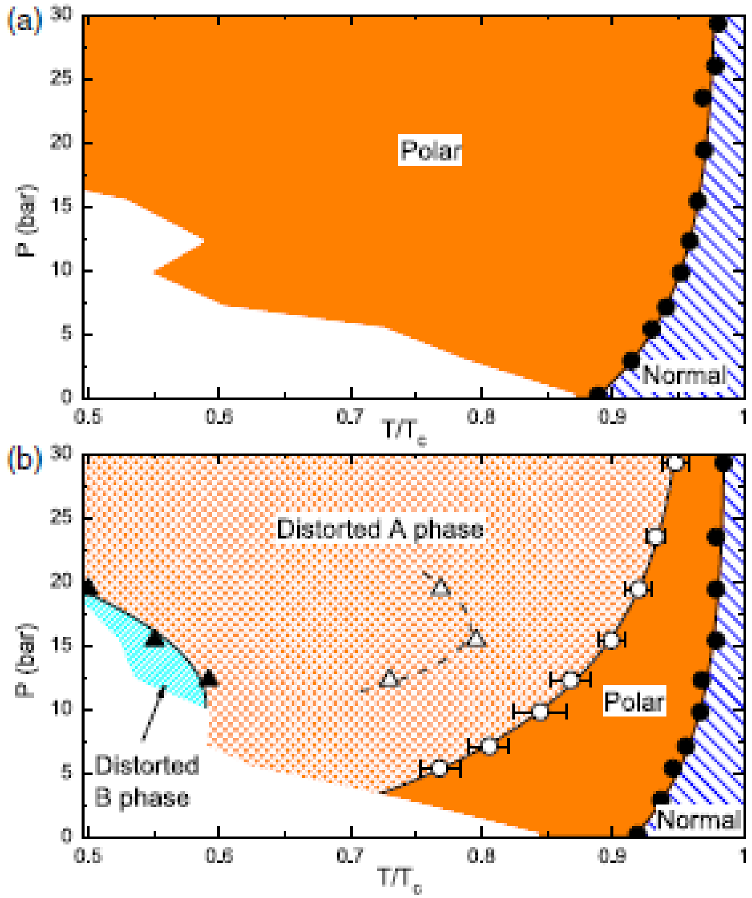


FIG. 2 (color online). Phase diagram of ^{3}He in nafen-243 (a) and in nafen-90 (b). Filled circles mark the superfluid transition of ^{3}He in nafen. Open circles mark the transition between polar and polar-distorted *A* phases. Filled triangles mark the beginning of the transition into the polar-distorted *B* phase on cooling. Open triangles mark the beginning of the transition into the distorted *A* phase on warming from the distorted *B* phase. The widths of the *A*-*B* and *B*-*A* transitions are ~$0.02T_{ca}$. The white area shows regions with no experimental data.

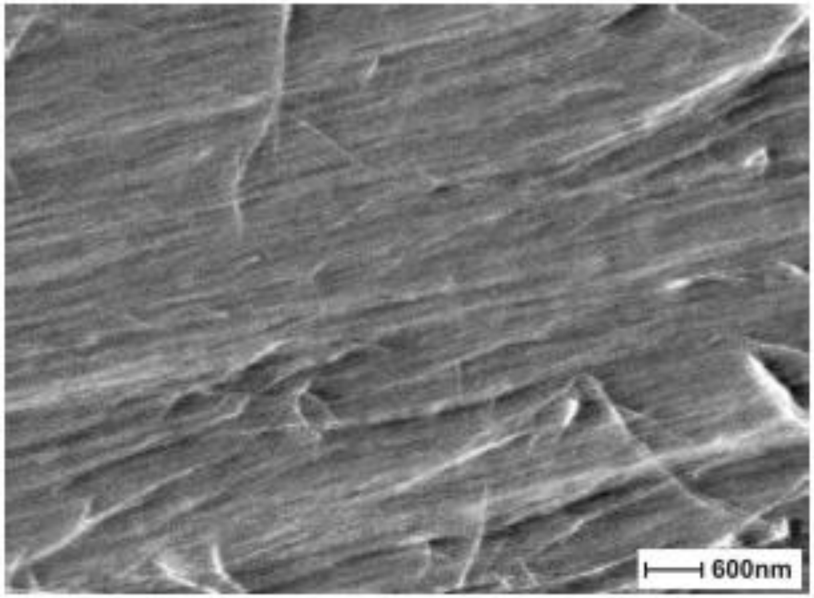


Figure 1: SEM image of the surface of nafen-90.

Topological nodal line in superfluid ^{3}He and the Anderson theorem

V.B. Eltsov,[1] T. Kamppinen,[1] J. Rysti,[1] and G.E. Volovik[1,2]

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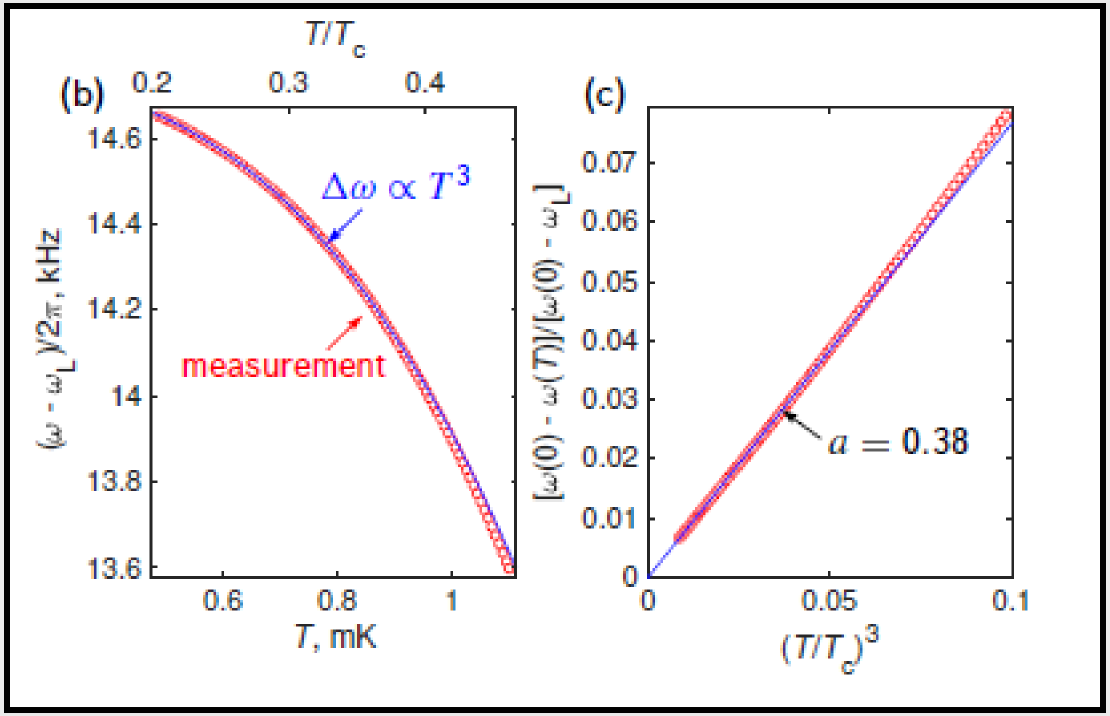
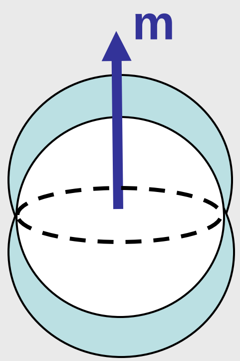
arXiv:1908.01645





$$\omega(T) - \omega_L = \frac{\Omega_P^2(T)}{2\omega_L}$$

$$\Omega_P(T) \propto \Delta(T)$$

$$\frac{\omega(0) - \omega(T)}{\omega(0) - \omega_L} = 1 - \frac{\Delta^2(T)}{\Delta^2(0)} = 2a\frac{T^3}{T_c^2} \ , \ T \ll T_c$$

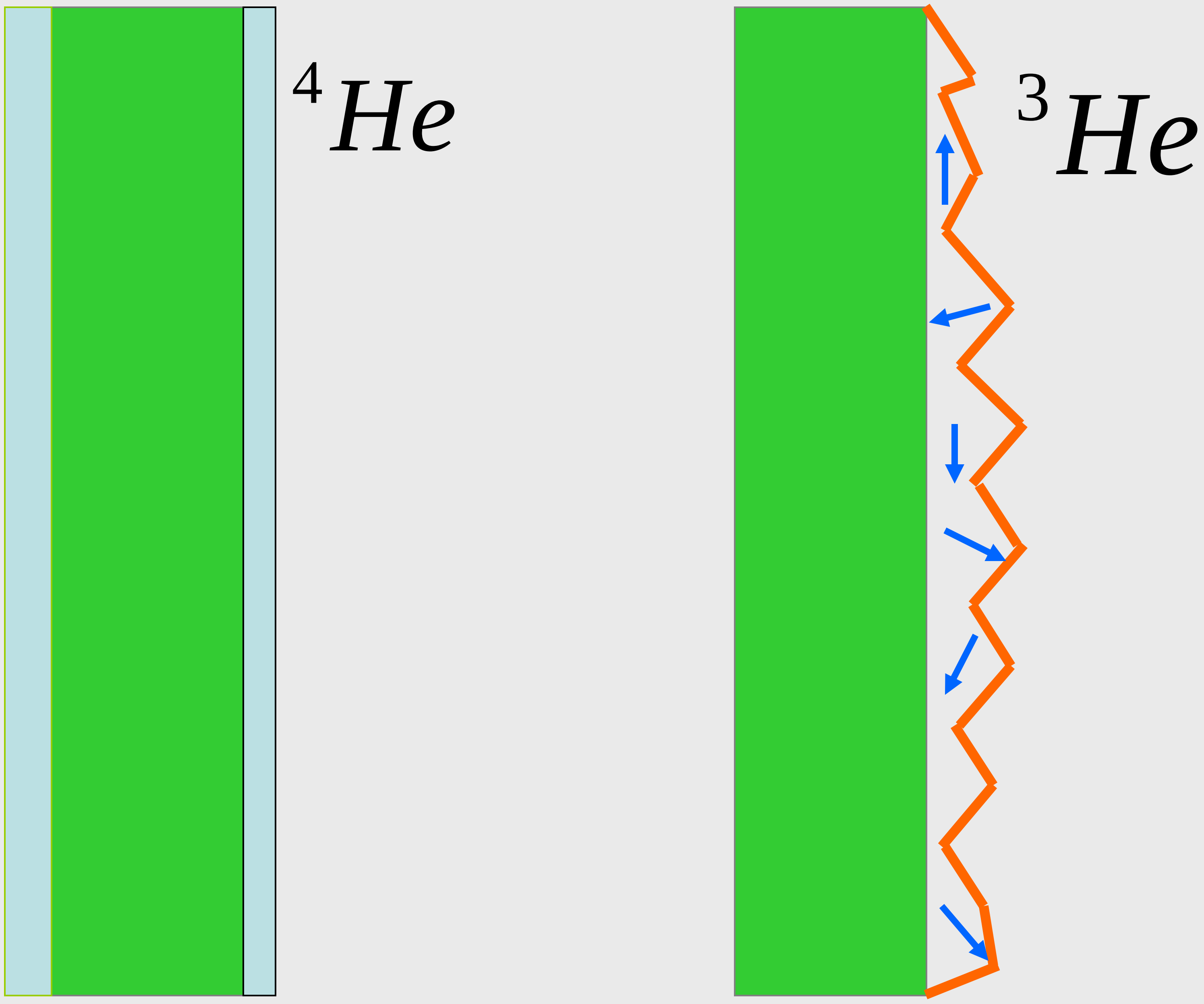
“Quest for the polar phase” is success. Now we know how to prepare the polar phase as well as a polar distorted A-phase. But some Important questions still have to be clarified:

1) What aerogel is ”good”, or which property of e.g. nafen Is crucial for stabilization of the polar phase.

2) Why the global anisotropy induced by Obninsk aerogel is not sufficient for stabilization of the polar phase in spite of theoretical predictions.

3) Why nafen-243 having porosity smaller than 94% does not suppress superfluidity of 3He completely.

There is important input from the experiment.



^4He
^3He

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Effect of Magnetic Boundary Conditions on Superfluid ^{3}He in Nematic Aerogel

V. V. Dmitriev,[1,*] A. A. Soldatov,[1,2] and A. N. Yudin[1]
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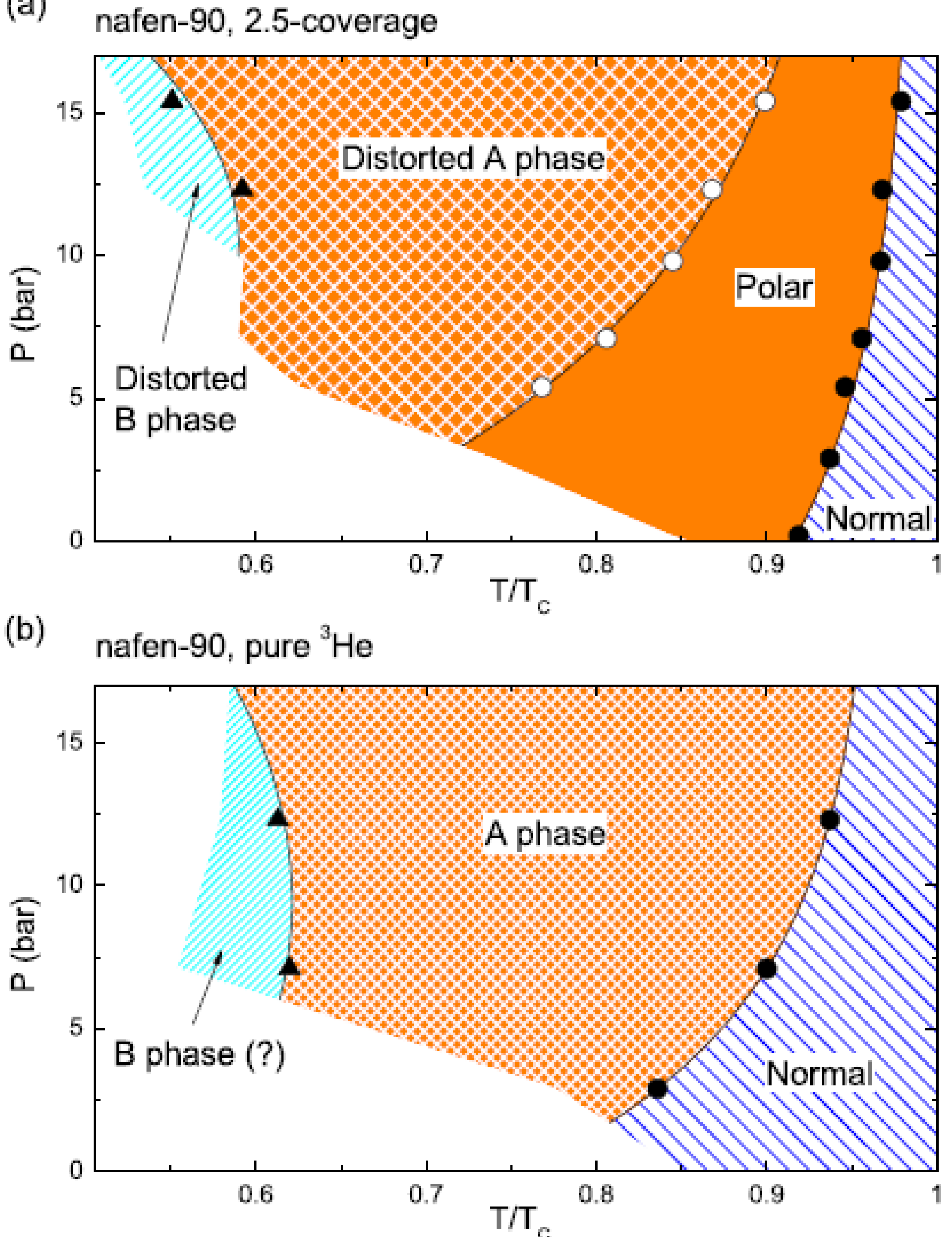
(Received 27 September 2017; revised manuscript received 19 December 2017; published 13 February 2018)

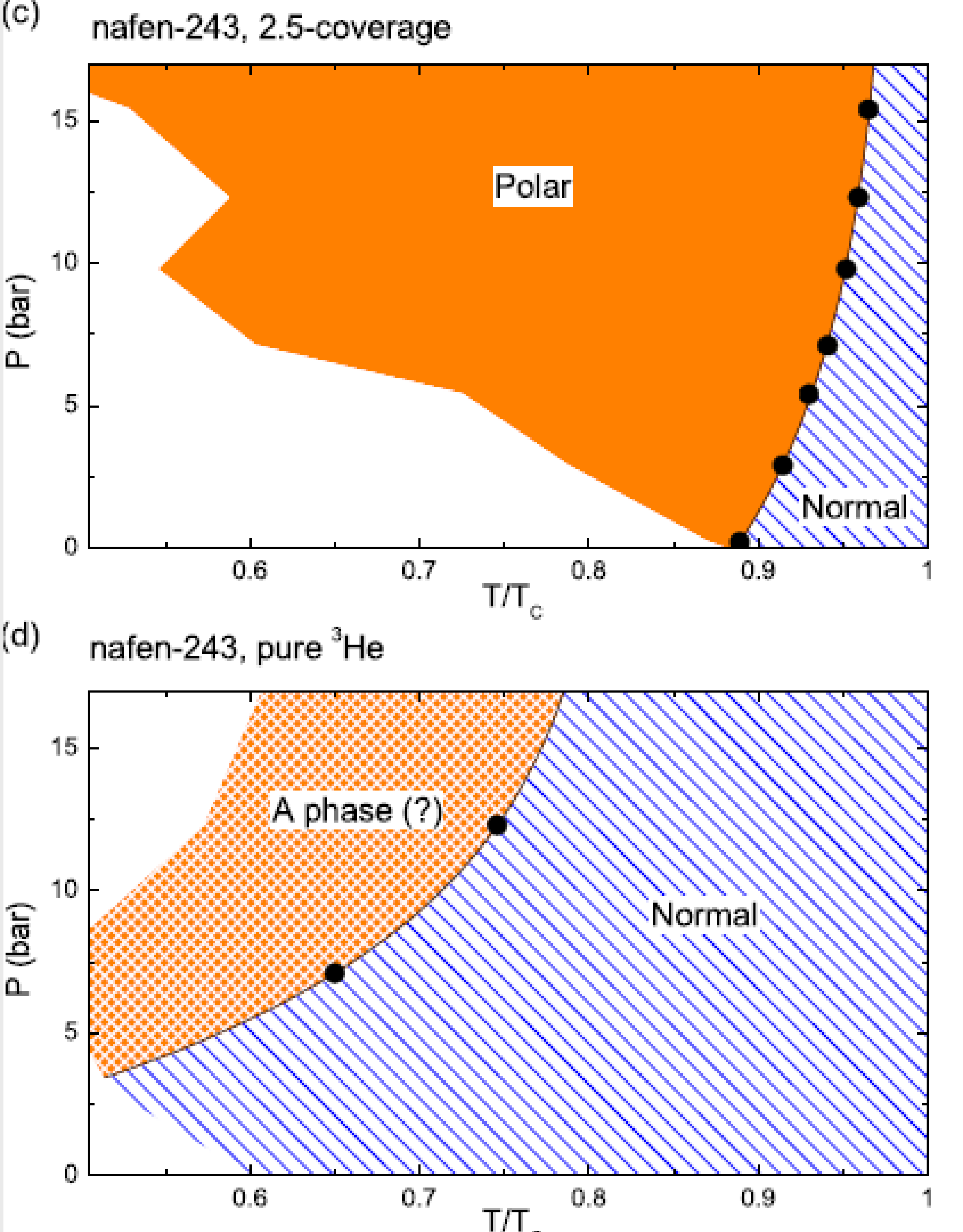
PHYSICAL REVIEW LETTERS **120,** 075301 (2018)

TABLE I. Characteristics of the samples: ρ is the overall density, d is the mean distance between axes of adjacent strands.

Sample	ρ (mg/cm^3)	Porosity (%)	d (nm)	$l_{\parallel}$ (nm)	$l_{\perp}$ (nm)
nafen-72	72	98.2	64	···	···
nafen-90	90	97.8	58	960	290
nafen-243	243	93.9	35	570	70
nafen-910[a]	910	78	18	···	···

[a]Prepared from nafen with density 72 mg/cm^3 (see Ref. [38]).

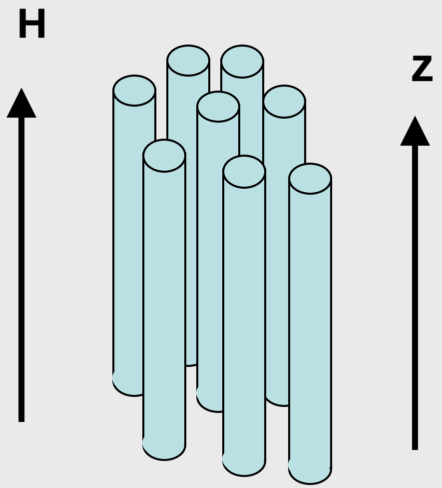

(a)
nafen-90, 2.5-coverage
Distorted A phase
Polar
Distorted
B phase
Normal
P (bar)
T/T$_c$
(b)
nafen-90, pure ^{3}He
A phase
B phase (?)
Normal
P (bar)
T/T$_c$



(c)
nafen-243, 2.5-coverage
Polar
Normal
P (bar)
T/T_c
0
5
10
15
0.6
0.7
0.8
0.9
1
(d)
nafen-243, pure ³He
A phase (?)
Normal
P (bar)
T/T_c
0
5
10
15
0.6
0.7
0.8
0.9
1

A. A. Abrikosov and L. P. Gorkov, Zh. Eksp. Teor. Fiz. **35**, 1558 (1958).

A. A. Abrikosov and L. P. Gorkov, Zh. Eksp. Teor. Fiz. **36**, 319 (1959).



$U(\mathbf{r}) = \sum_a u(\rho - \rho_a)$. Здесь $\rho = (x, y)$

specular reflection

$$U(\mathbf{k}) = 2\pi\delta(k_z)u(\kappa)\sum_a e^{-i\kappa\rho_a}$$

$$V(\mathbf{k}, \mathbf{k}') = 3g(\mathbf{k} \cdot \mathbf{k}')$$

*I.A.Fomin, JETP **127**, 933 (2018):*

$$(i\omega - \xi - \overline{G_\omega})G(k) + (\Delta + \overline{F_\omega^\dagger})F^\dagger(k) = 1$$

$$(i\omega + \xi - \overline{G_\omega})F^\dagger(k) + (\Delta + \overline{F_\omega^\dagger})G(k) = 0$$

$$\overline{G_\omega} = \frac{n}{(2\pi)^3}\int |u(k-k')|^2 \frac{i\tilde{\omega} + \xi}{\xi^2 + \tilde{\omega}^2 + \tilde{\Delta}^2} d^3k'$$

$$\overline{F_\omega^\dagger} = \frac{n}{(2\pi)^3}\int |u(k-k')|^2 \frac{\tilde{\Delta}}{\xi^2 + \tilde{\omega}^2 + \tilde{\Delta}^2} d^3k'$$

$$i\tilde{\omega} = i\omega - \overline{G_\omega}$$

$$\tilde{\Delta} = \Delta + \overline{F_\omega^\dagger}$$

$$U(\mathbf{k}) = 2\pi\delta(k_z)u(\kappa)\sum_a e^{-i\kappa\rho_a},$$

$$\Delta \sim k_z$$

$$\frac{1}{\tau} = n_2 m^* \overline{|u|^2},$$

$$-\frac{\overline{G_\omega}}{i\omega} = \frac{\overline{F^\dagger_\omega}}{\Delta}$$

$$i\tilde{\omega} = i\omega\eta \qquad \tilde{\Delta} = \Delta\eta$$

$$\eta = 1 + \frac{1}{2\tau\sqrt{\omega^2 + \Delta^2}}$$

$$\{\omega, \Delta\} \to \{\omega\eta, \Delta\eta\}$$

η (and τ) drop out of the equation for $\Delta(T)$

$\Delta(T,\tau) = \Delta(T, \tau \to \infty)$

$$T_c = T_c(\tau \to \infty)$$

Anderson theorem

Apparent conflict with the well known statement for unconventional Cooper paring: detrimental effect of potential impurities (A.I. Larkin, JETP Letters **2**, 130, (1965))

Рассмотрим сначала влияние примесей на векторное спаривание. Усреднение уравнений для функций Грина производится так же, как и при скалярном спаривании [4], и приводит к появлению собственно энергетических частей $\bar{G}$ и $\bar{F}$

$$(i\omega_n + i\bar{G} - \xi)G + (\Delta + \bar{F})F^+ = 1,$$

$$(i\omega_n + i\bar{G} + \xi)F^+ + (\Delta^+ + \bar{F}^+)G = 0, \qquad (I)$$

где $\bar{G} = in\int |u(\vec{p} - \vec{p}')|^2 G(\vec{p}')\frac{d\vec{p}'}{(2\pi)^3}; \; \bar{F} = n\int |u(\vec{p} - \vec{p}')|^2 F(\vec{p}')\frac{d\vec{p}'}{(2\pi)^3}$ (2)

n – концентрация примесей, $u(q)$ – фурье-компонента потенциала взаимодействия электрона с атомом примеси.

Будем считать, что во взаимодействии между электронами преобладает притяжение в p – состоянии (симметричное по спиновым индексам):

$$\hat{V} = g(\vec{n}\vec{n}')(\sigma^y\sigma^i)_{\alpha\beta}(\sigma^y\sigma^i)_{\gamma\delta}, \quad \vec{n} = \vec{p}/p_0. \qquad (3)$$

Уравнение для критической температуры получается из (5) при $\Delta \to 0$.

$$1 = g\rho\sum_{\omega_n}\frac{1}{|\omega_n| + \frac{1}{2\tau_{tr}}}, \quad \ln\frac{T_{c0}}{T_c} = \psi\left(\frac{1}{2} + \frac{1}{4\pi\tau_{tr}T}\right) - \psi\left(\frac{1}{2}\right). \qquad (6)$$

$$\overline{F_{\omega}^{\dagger}} = \frac{n}{(2\pi)^3} \int |u(k-k')|^2 \frac{\tilde{\Delta}}{\xi^2 + \tilde{\omega}^2 + \tilde{\Delta}^2} d^3k' = 0$$

Magnetic scattering

A. A. Abrikosov and L. P. Gorkov, Zh. Eksp. Teor. Fiz. **39**, 1781 (1960).

$$H_{int} = \sum_a J\psi^\dagger(\mathbf{r_a})\hat{\sigma}^k \hat{S}_a^k \psi^\dagger(\mathbf{r_a}),$$

$$\ln\frac{T_{c0}}{T_{cs}} = \psi\left(\frac{1}{2} + \frac{1}{2\pi\tau_s T_{cs}}\right) - \psi\left(\frac{1}{2}\right)$$

$$T_{c0} - T_{cs} = \frac{\pi}{4\tau_s}.$$

$$\frac{1}{\tau_s} = \frac{\pi N_0 n_s J^2}{4}.$$

$$\frac{T_{c0} - T_{cs}}{T_{c0} - T_{c1}} \sim (N_0 J)^2.$$

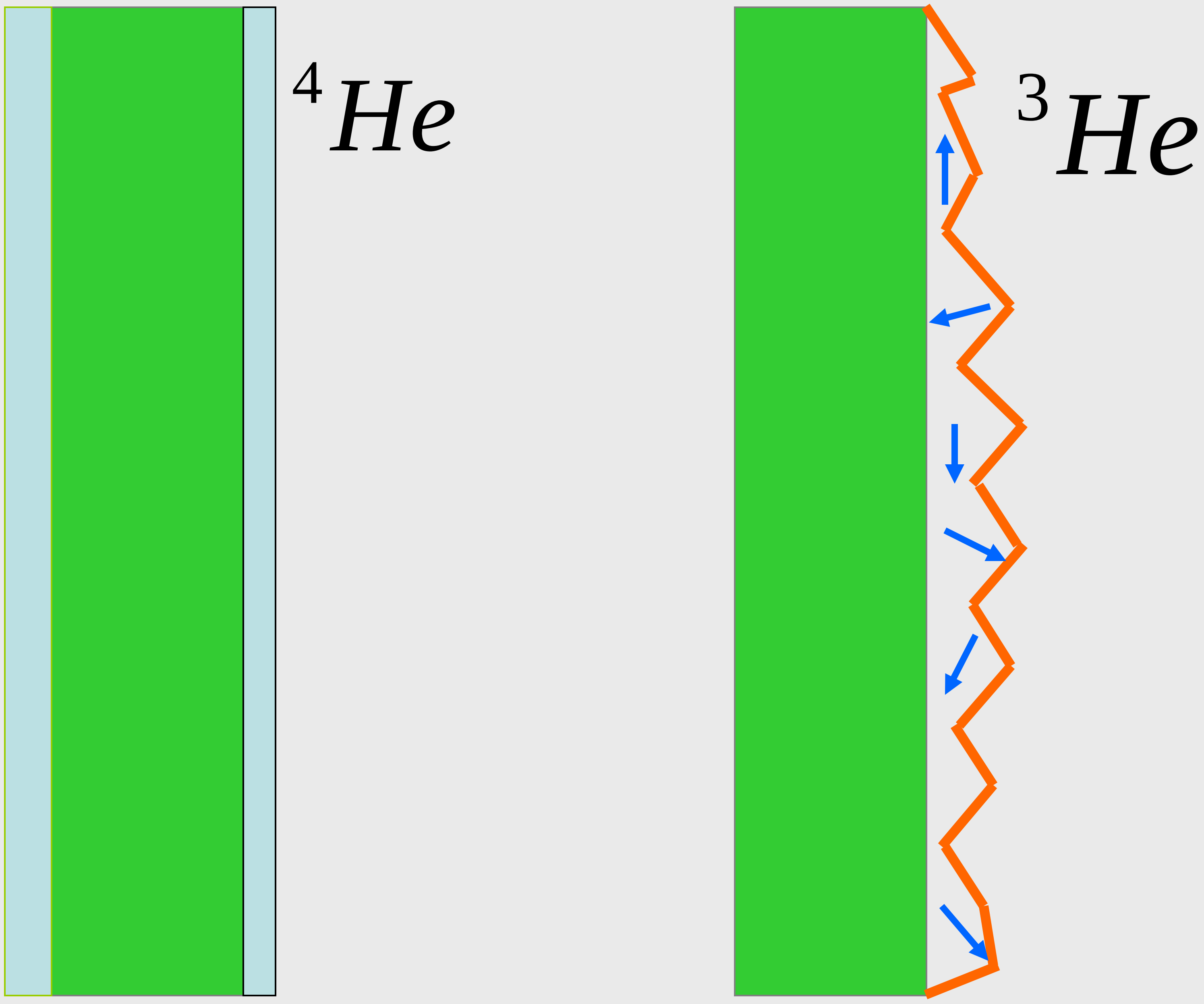
$$J \approx 100 \ \text{mK}$$

$$(N_0 J)^2 \approx 1/10 \div 1/20.$$

*I.A.Fomin, JETP **127**, 933 (2018): Magnetic scattering seems to be too small*

*V.P.Mineev, Phys.Rev.**B 98**, 014501 (2018): Magnetic scattering can decrease effective anisotropy*

Magnetic scattering lowers the transition temperature, but does not “spoil” the order parameter of the polar phase.



⁴He
³He

Specular reflection versus diffuse

Specular reflection – pure *m=0* state (polar phase) – Anderson theorem.
Diffuse reflection – admixture of other components – Larkin situation

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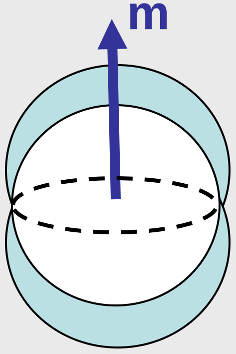
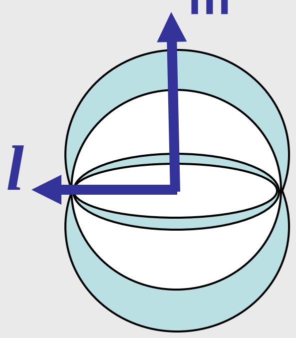
m=0



Admixture of two other projections *m=-1, m=+1* *makes the phase "unconventional"*



A test for unconventional Cooper pairing in metallic superconductors and new materials (cuprates, Fe-based, ruthenates etc.).
Concept of *superconducting fitness* for multi-orbital superconductors.

A. Ramires and M. Sigrist, Phys. Rev. **B 94**, 104501 (2016)

$$[H_0(\mathbf{k}), \hat{\Delta}(\mathbf{k})]^* = F(\mathbf{k})(i\sigma_2),$$

F(**k**) = 0 condition of the "compatibility of arbitrary pairing states with a given normal state Hamiltonian".

Generalized Anderson`s theorem for superconductors derived from topological insulators., L. Andersen, A. Ramires, Z Wang, T. Lorenz, and Y. Ando, arXiv: 1908.08766 (23 Aug 2019)

1) What aerogel is ”good”, or which property of e.g. nafen Is crucial for stabilization of the polar phase.

1a) Long straight strands with specular reflection.

2) Why the global anisotropy induced by Obninsk aerogel is not sufficient for stabilization of the polar phase in spite of theoretical predictions.

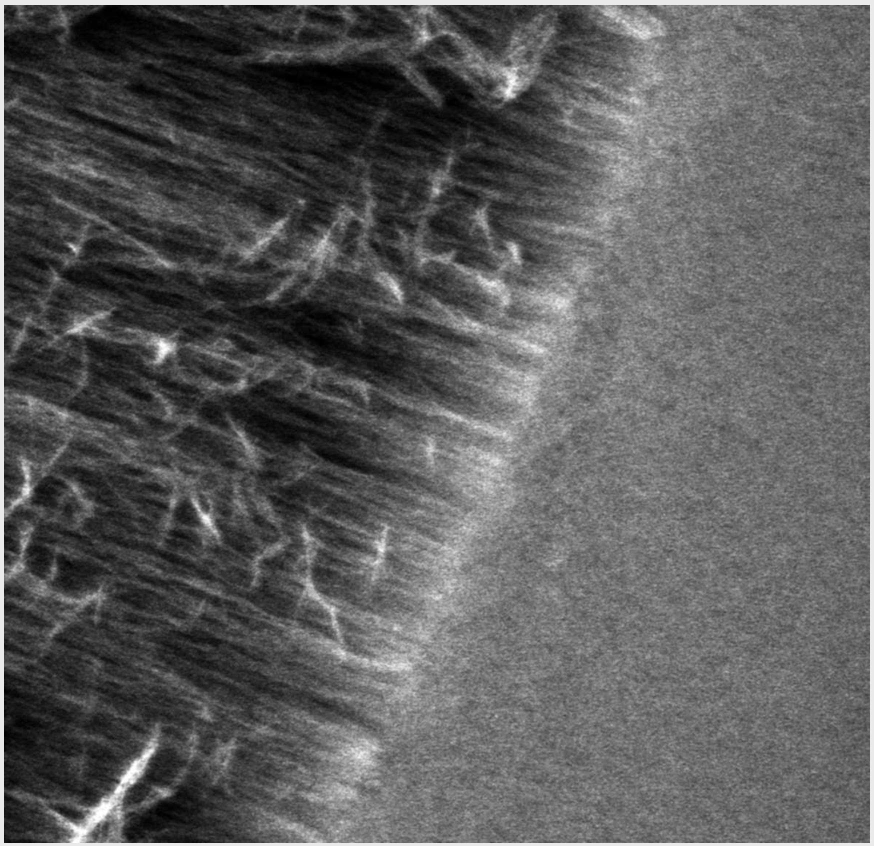
2a) Because of admixture of $m=1$ and $m=-1$ components due to diffuse part of scattering amplitude.

3) Why nafen-243 having porosity smaller than 94% does not suppress superfluidity of 3He completely.

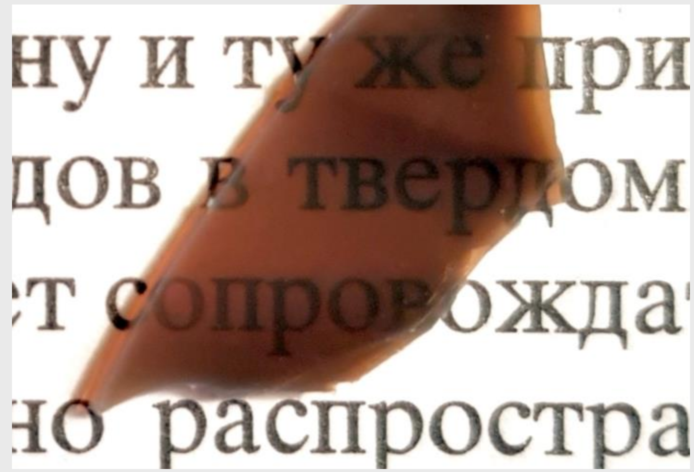
3a) Because of Anderson theorem.

Three samples were cut from the same piece of mullite nematic aerogel) with porosity ~96%. One sample was used in experiments with vibrating wire (poster P2.9). One of 2 remaining samples was squeezed by 30% in the direction transverse to the strands (“squeezed sample”) and was used in NMR experiments together with unsqueezed sample (“original sample”). All samples have a characteristic sizes ~ 2.5 - 4 mm.

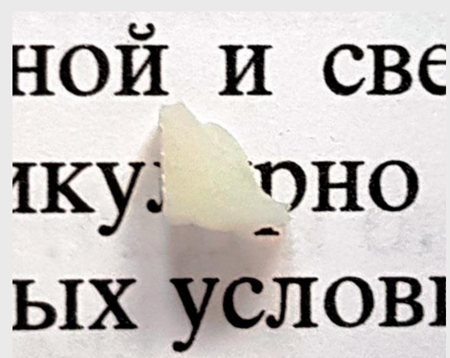
SEM picture of the mullite sample



5 μm



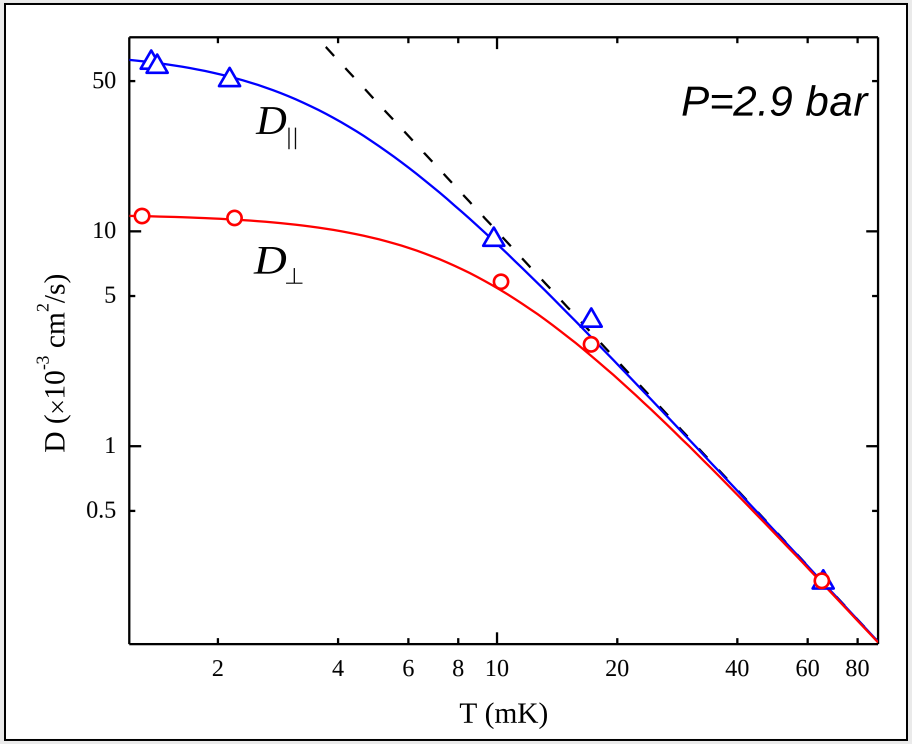
mullite sample



nafen-90

Spin diffusion

Spin diffusion in the original sample (along and transverse to the strands)



In the limit T=0 the diffusion is limited by the aerogel strands.

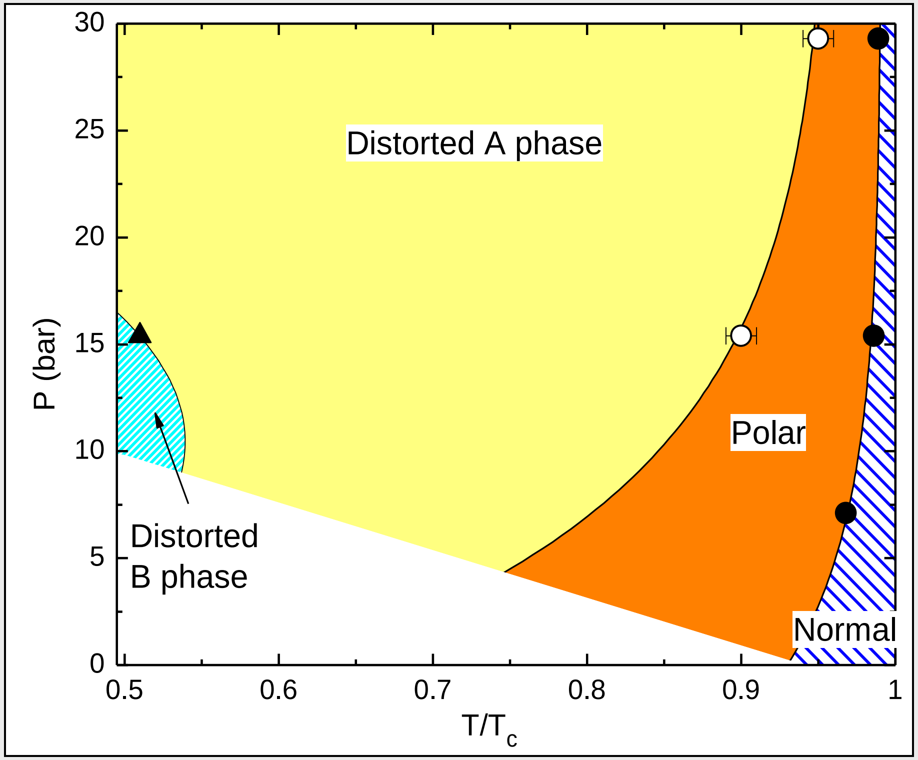
We may introduce the effective mean free paths of ^{3}He qusiparticles which are determined only by aerogel. In case of specular scattering in ideal nematic aerogel we expect that at T → 0

$$\lambda_{||} \to \infty$$

Sample	**Porosity (%)**	**T_{ca} at 7.1 bar**	**$\lambda_{\perp}, \lambda_{||}$ (nm)**
nafen-90	97.8	0.955	290 960
original mullite	96	0.968	235 1350
squeezed mullite	94.3	0.957	130 550

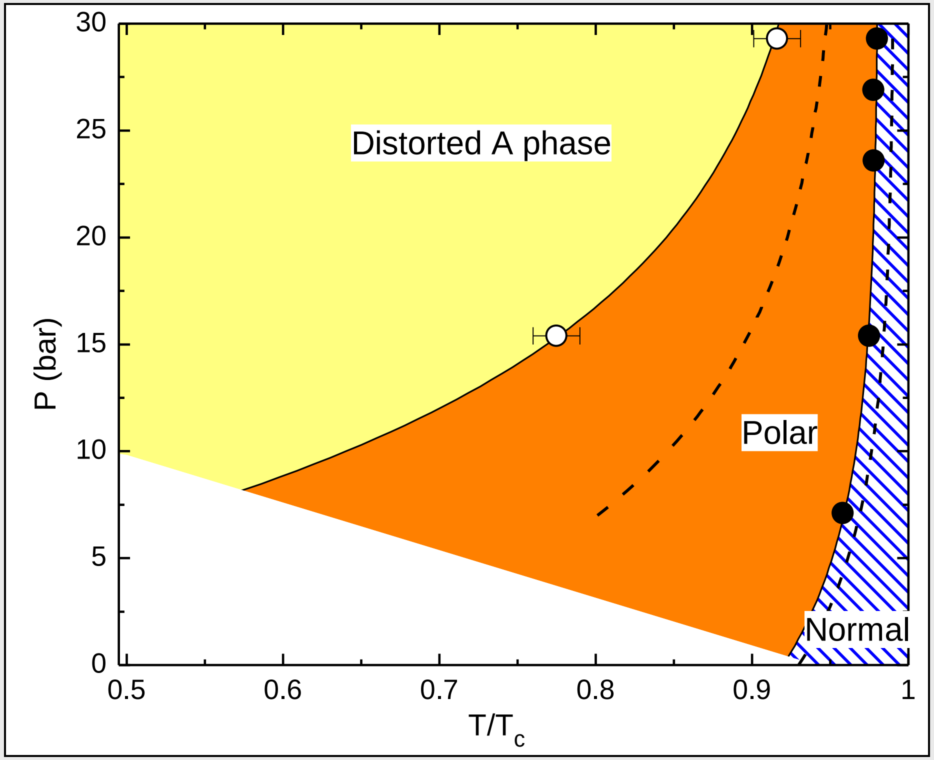
Phase diagrams of ^3He in mullite samples (the strands are covered by ^4He)

original sample



$$\lambda_\perp = 235\, nm$$

squeezed sample



$$\lambda_\perp = 130\, nm$$

V.V. Dmitriev, QFS 2019

1. In ^3He in ideal nematic aerogel ($\lambda_\perp \to \infty$ at T=0) $T_{ca}=T_c$

2. Region of existence of the polar phase is proportional to $\xi_0 / \lambda_\perp$