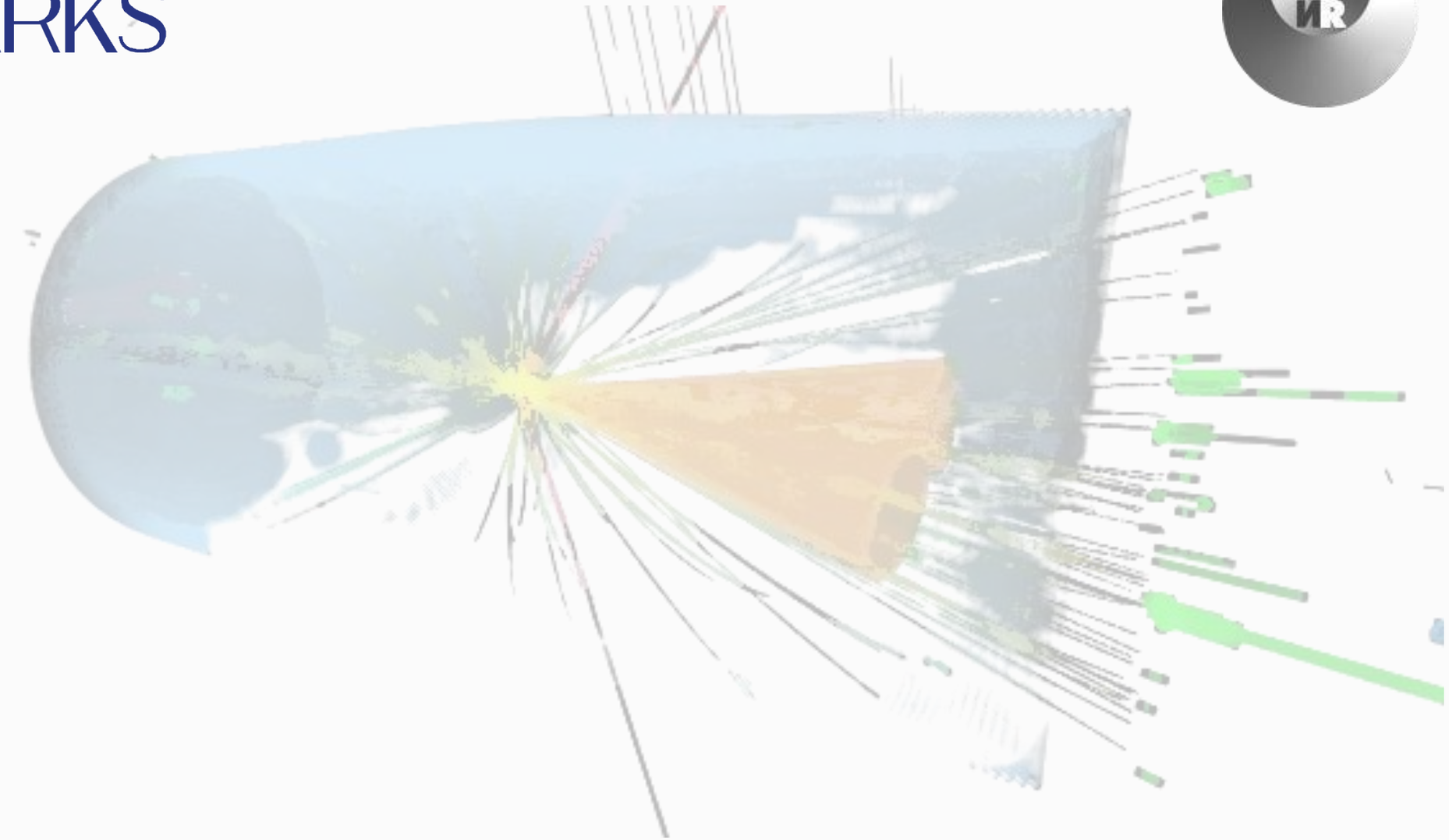
SGOLDSTINO AT FASER



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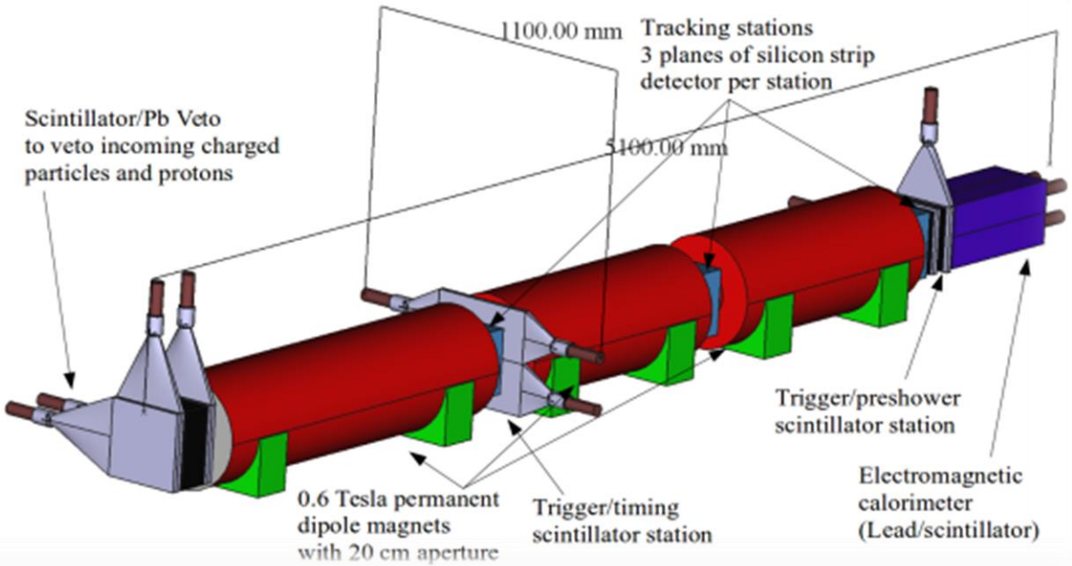
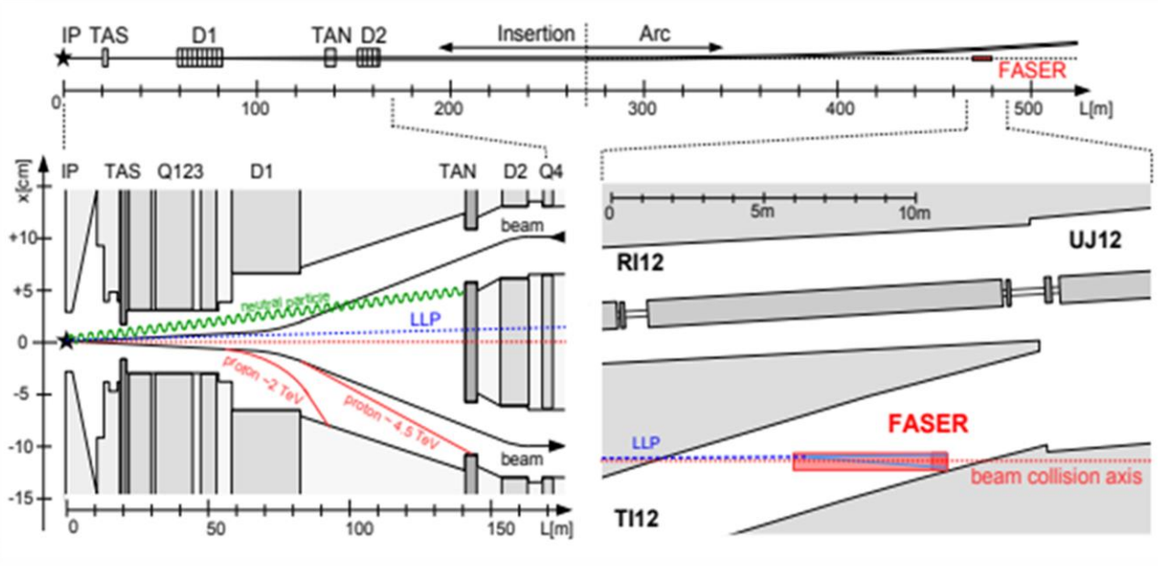
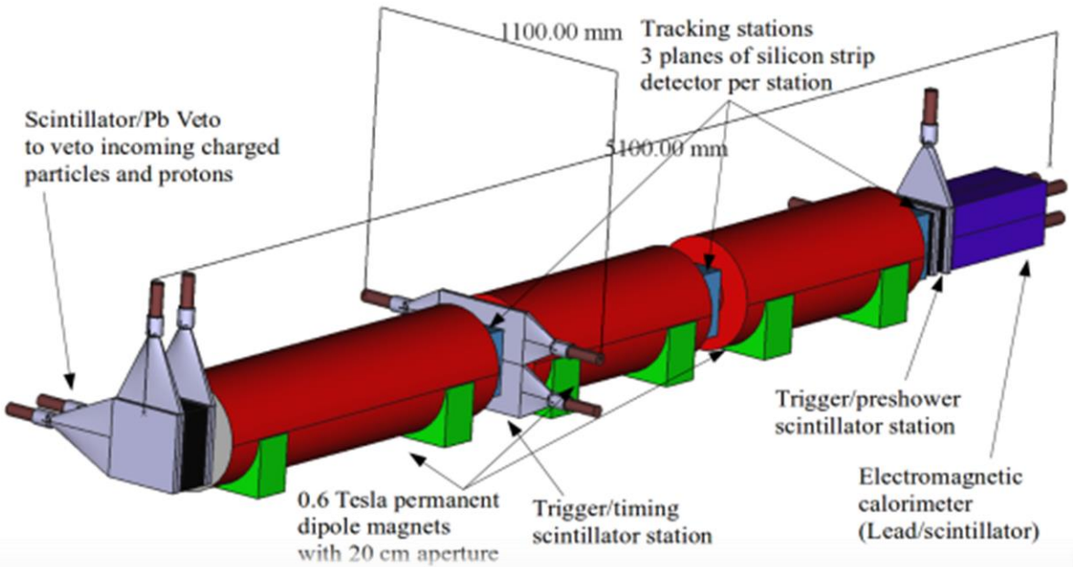
SGOLDSTINO AT FASER
Experimental setup





FASER detector layout

SGOLDSTINO AT FASER
Experimental setup



	FASER1	FASER2
$\sqrt{s}$, TeV	14	14
L, m	480	480
d, m	1.5	5.0
R, m	0.1	1.0
$\mathcal{L}, fb^{-1}$	150	3000

FASER experimental setup
2 stages: FASER1 and FASER2

SGOLDSTINO AT FASER
Models

$$\mathcal{S} = s + \sqrt{2}\theta\psi + \theta^2 F_s$$

$$s = \frac{1}{\sqrt{2}}(S + iP)$$

$$\mathcal{L} = \frac{1}{F} J^{\mu}_{SUSY} \partial_{\mu}\psi$$

$$\mathcal{L}_{S\gamma\gamma} = \frac{M_{\gamma\gamma}}{2\sqrt{2}F} S F_{\mu\nu} F^{\mu\nu}$$

$$J^{\mu}_{SUSY} \propto \Delta M$$

ΔM - mass split within the supermultiplets

$$\mathcal{L}_{S\bar{\psi}_i\psi_j} = S\frac{A_{ij}}{\sqrt{2}F}\bar{\psi}_i\psi_j$$

SGOLDSTINO AT FASER
Models

$$\mathcal{S} = s + \sqrt{2}\theta\psi + \theta^2 F_s$$

$$\mathcal{L} = \frac{1}{F} J^{\mu}_{SUSY} \partial_{\mu} \psi$$

$$\mathcal{L}_{S\gamma\gamma} = \frac{M_{\gamma\gamma}}{2\sqrt{2}F} S F_{\mu\nu} F^{\mu\nu}$$

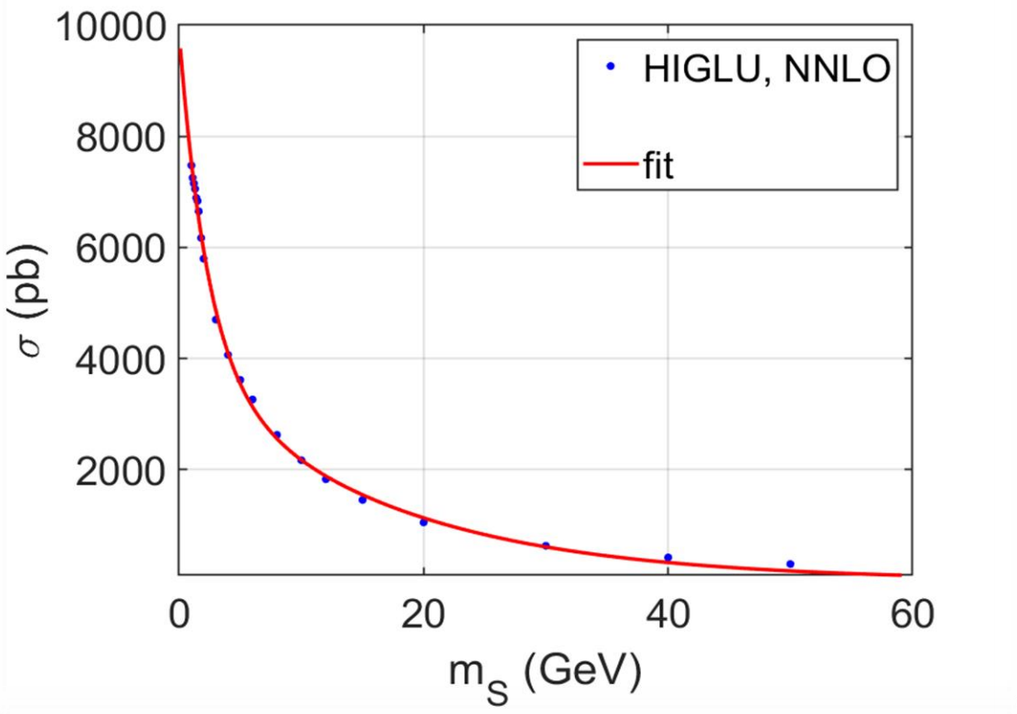
$$\mathcal{L}_{S\bar{\psi}_i\psi_j} = S \frac{A_{ij}}{\sqrt{2}F} \bar{\psi}_i \psi_j$$

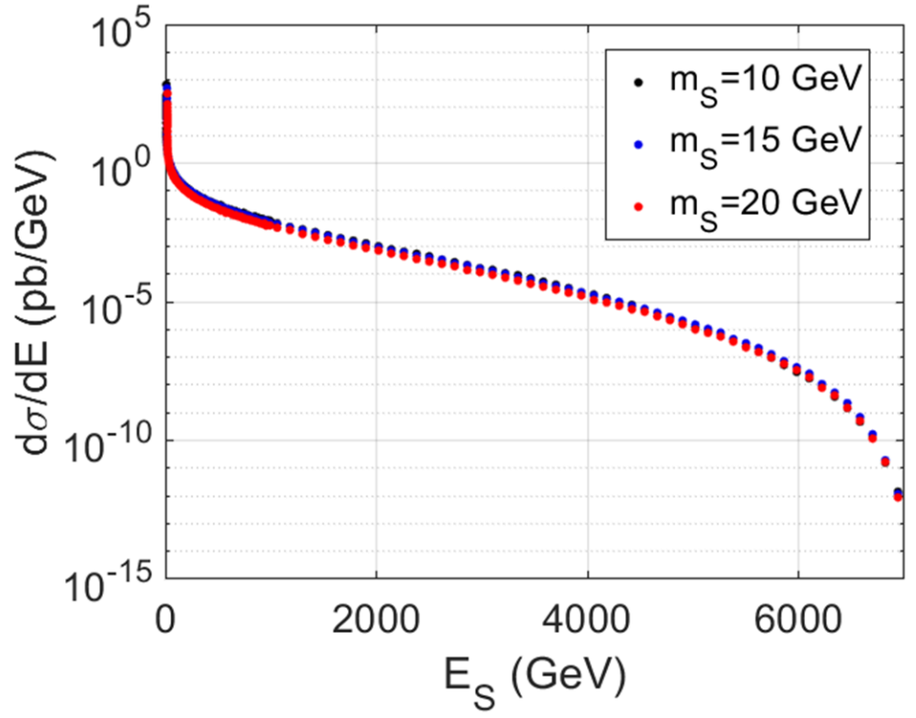
7 free parameters:
$m_{S/P}, F, M_{\gamma\gamma}, M_3, A_Q, A_l, m^{LR}$

Sources:
pp via gluon fission, meson decay

Decay modes:
$\gamma\gamma, l^+l^-$, meson decay

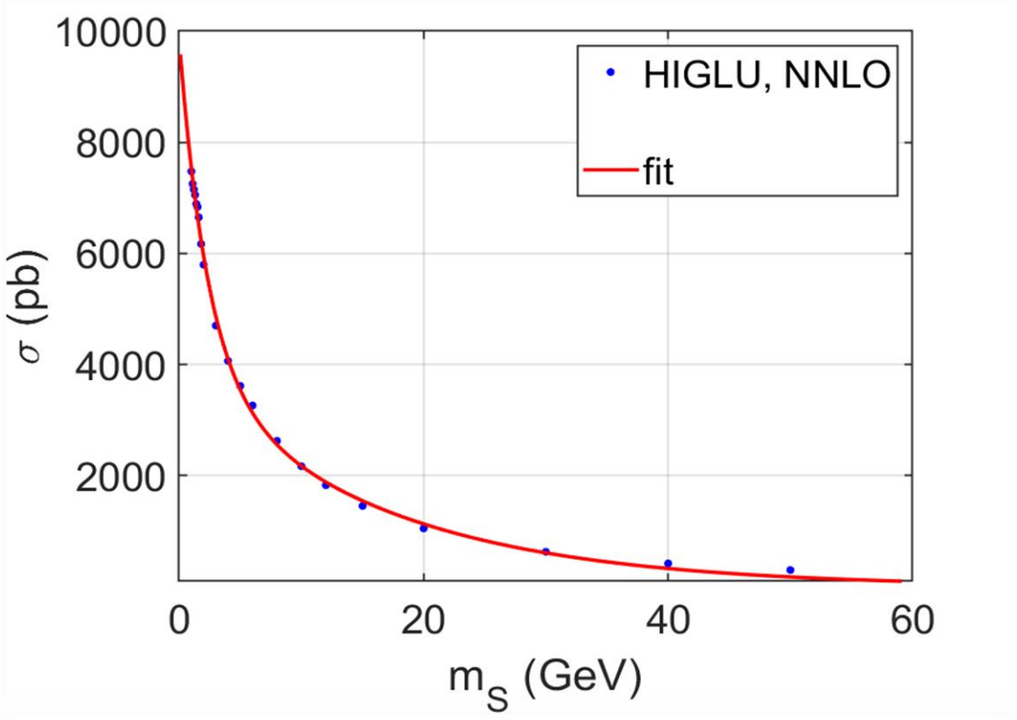
SGOLDSTINO AT FASER
Sources. Gluon fission

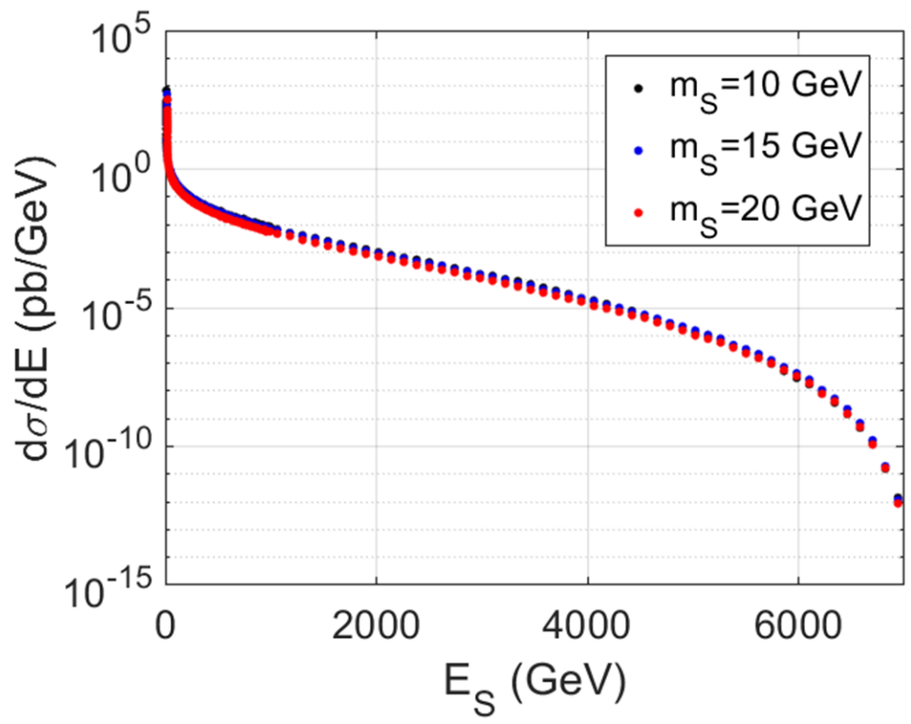




Sgoldstino production cross section in the gluon fusion

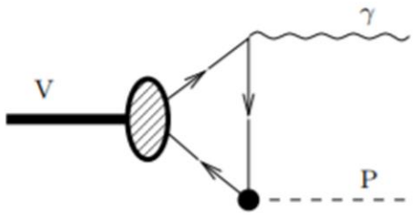
SGOLDSTINO AT FASER
Sources. Gluon fission

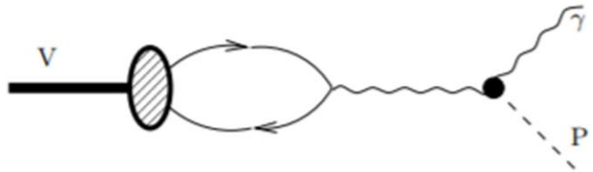




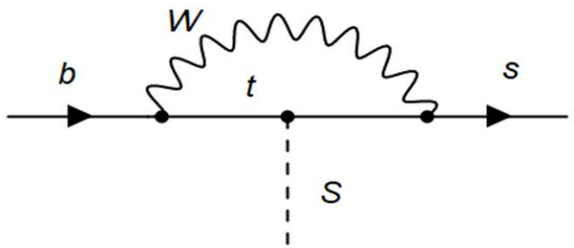
$$\sigma_0(m_S) = fit \longrightarrow {\sigma_0}^{-1}\frac{d\sigma_0}{dp} = fit \longrightarrow \frac{d\sigma(M_3,F)}{dp} \propto {\sigma_0}^{-1}\frac{d\sigma_0}{dp} \times \frac{M_3^2}{F^2}$$

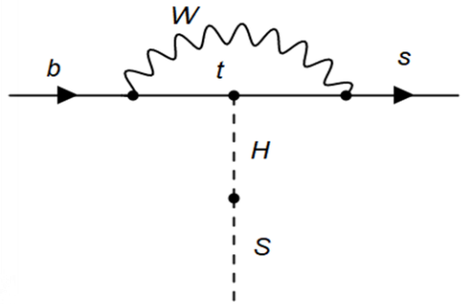
SGOLDSTINO AT FASER
Sources. Meson decays. Flavor conserving





$$\Gamma(V \to P(S)\gamma) \propto \frac{M_V^2 \left(A_Q \pm M_{\gamma\gamma} R^{\gamma}_{P(S)}\right)^2}{F^2}$$





$$\Gamma(M \to SM') \propto \left(\frac{A_Q v}{F} + \theta\right)^2$$

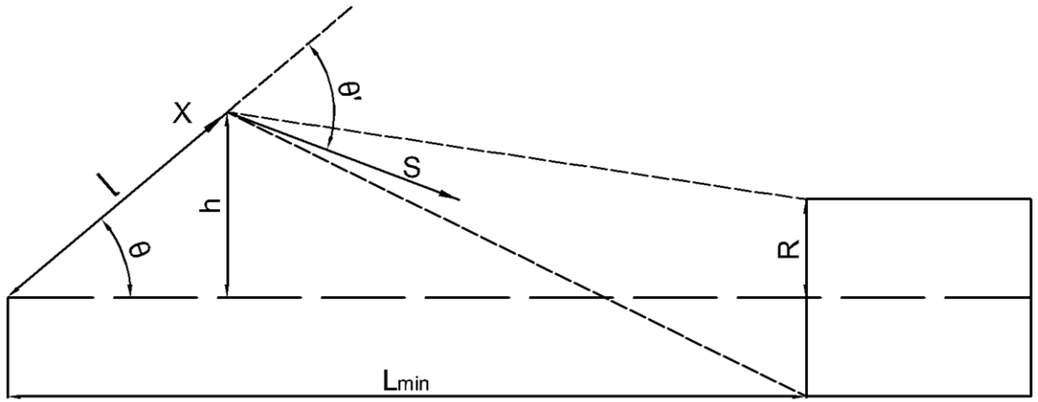
SGOLDSTINO AT FASER
Sources. Meson decays. Flavor violating

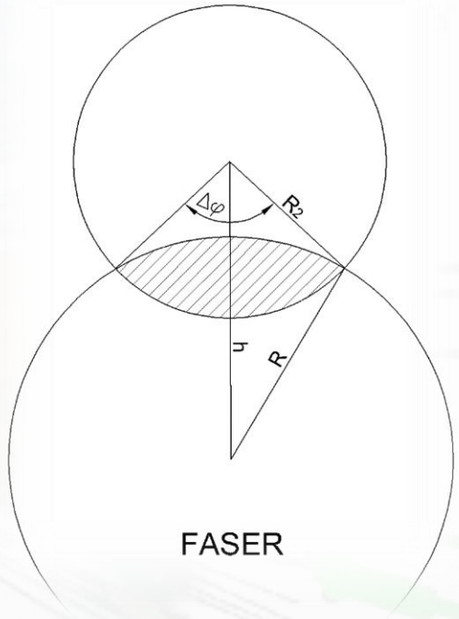
$$\Gamma(M \to M'S) \propto \frac{m_{q\,ij}^{LR\,4}}{F^2}$$

$$\Gamma(B \to K_s S) \propto \frac{m_{D\,23}^{LR\,4}}{F^2}$$

$$\Gamma(D_s \to K_s S) \propto \frac{m_{U\,12}^{LR\,4}}{F^2}$$

SGOLDSTINO AT FASER
Fiducial volume





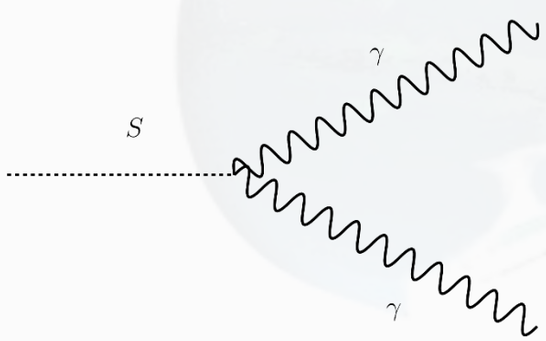
$$P_\tau = e^{-\frac{L_{min}-l}{\tau\gamma}} \times \frac{d}{\tau\gamma}$$

$$R_2 = L_{min} \times tg\theta' \qquad h = L_{min} \times tg\theta$$

$$\sin\frac{\Delta\varphi}{2} = \frac{2S}{h}$$

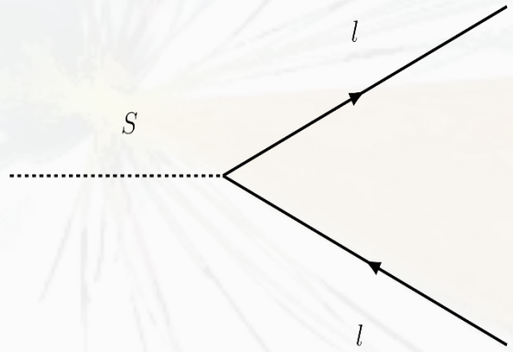
SGOLDSTINO AT FASER
Decays

Photon



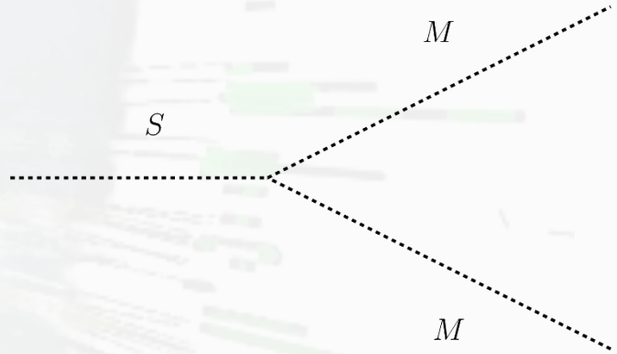
$$\Gamma \propto \frac{{M_{\gamma\gamma}}^2}{F^2}$$

Lepton



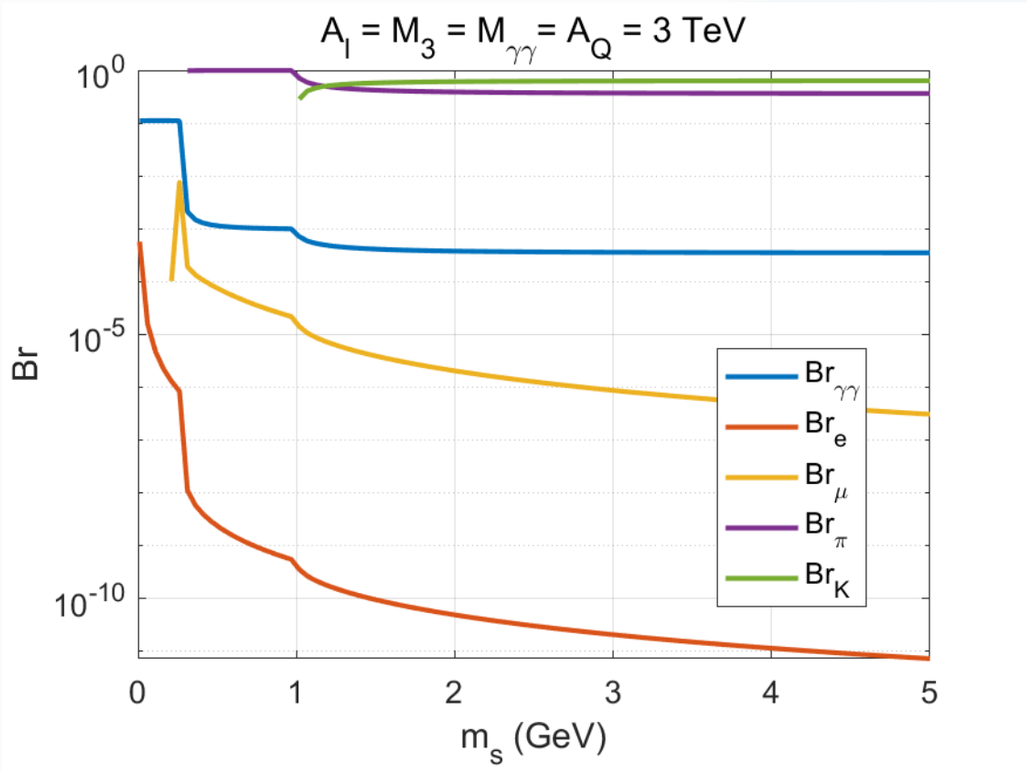
$$\Gamma \propto \frac{{A_l}^2}{F^2}$$

Meson (π, K)



$$\Gamma \propto \frac{{M_3}^2}{F^2}, \frac{{A_Q}^2}{F^2}$$

SGOLDSTINO AT FASER



It is convenient to consider 2 cases with sgoldstino mass:
1)$m_S < 2m_\pi$, 2) $m_S \geq 2m_\pi$

SGOLDSTINO AT FASER
Sensitivity

$$m_S < 2m_\pi$$

$$3\ TeV < \sqrt{F} < 7 \cdot 10^3\ TeV$$

$$100\ GeV < M_{\gamma\gamma} < \sqrt{F}$$

$$100\ GeV < A_Q < \sqrt{F}$$

$$3\ TeV < M_3 < \sqrt{F}$$

$$m_{F\ ij}^{LR} < 100\ GeV$$

$$2m_\pi < m_S < 4\ GeV$$

$$150\ TeV < \sqrt{F} < 7 \cdot 10^3\ TeV$$

$$150\ TeV < M_{\gamma\gamma} < \sqrt{F}$$

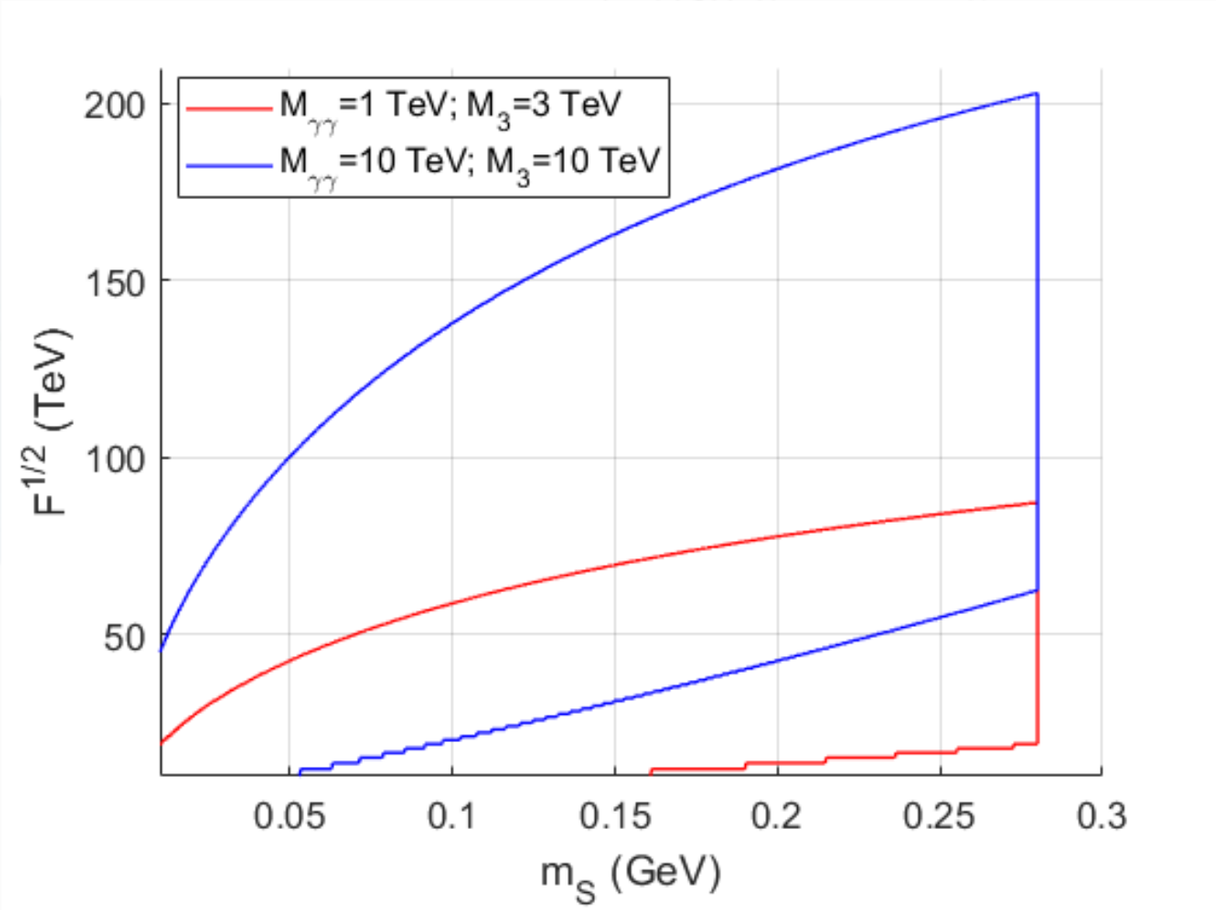
$$100\ GeV < A_Q < 10\ M_{\gamma\gamma}$$

$$3\ TeV < M_3 < 0.02\ M_{\gamma\gamma}$$

$$m_{F\ ij}^{LR} < 100\ GeV$$

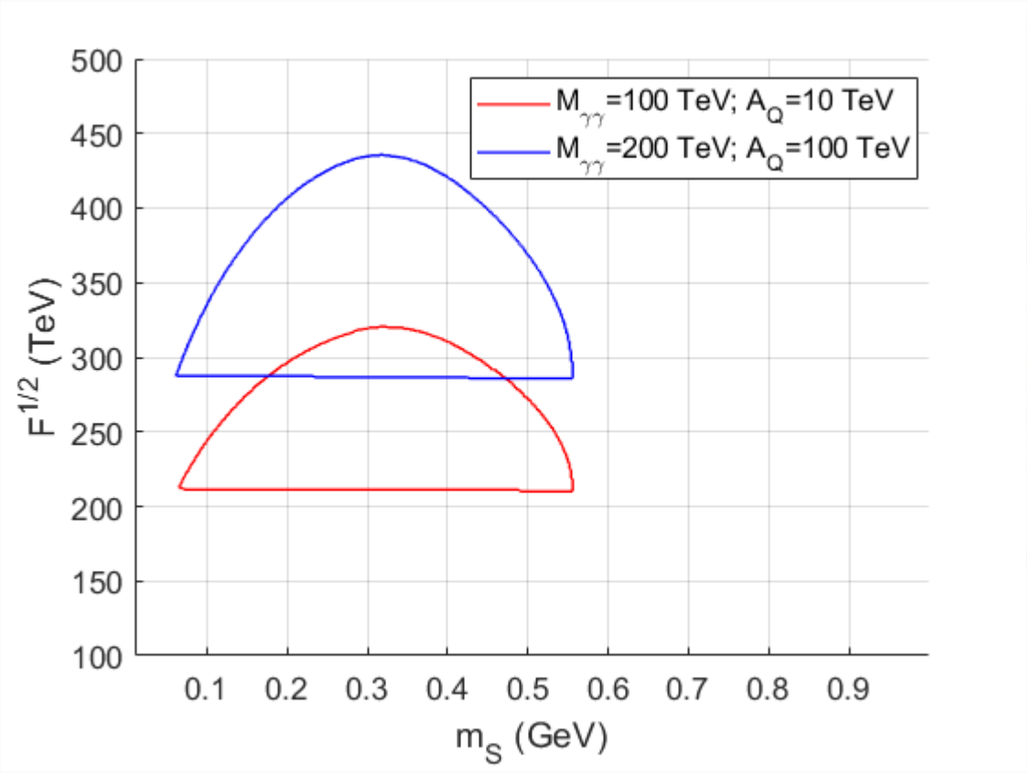
SGOLDSTINO AT FASER

Direct production Photon



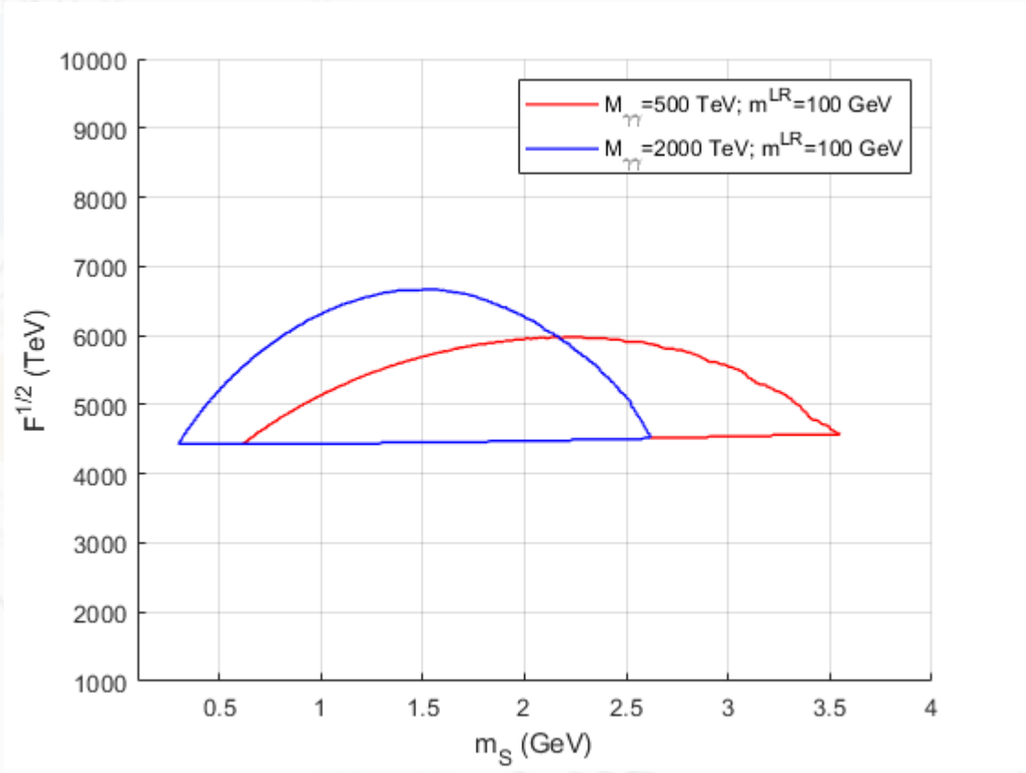
SGOLDSTINO AT FASER

B-meson decay



Flavor conserving meson decay

Photon



Flavor violating meson decay

FASER 1

Much smaller luminosity
Much smaller fiducial volume

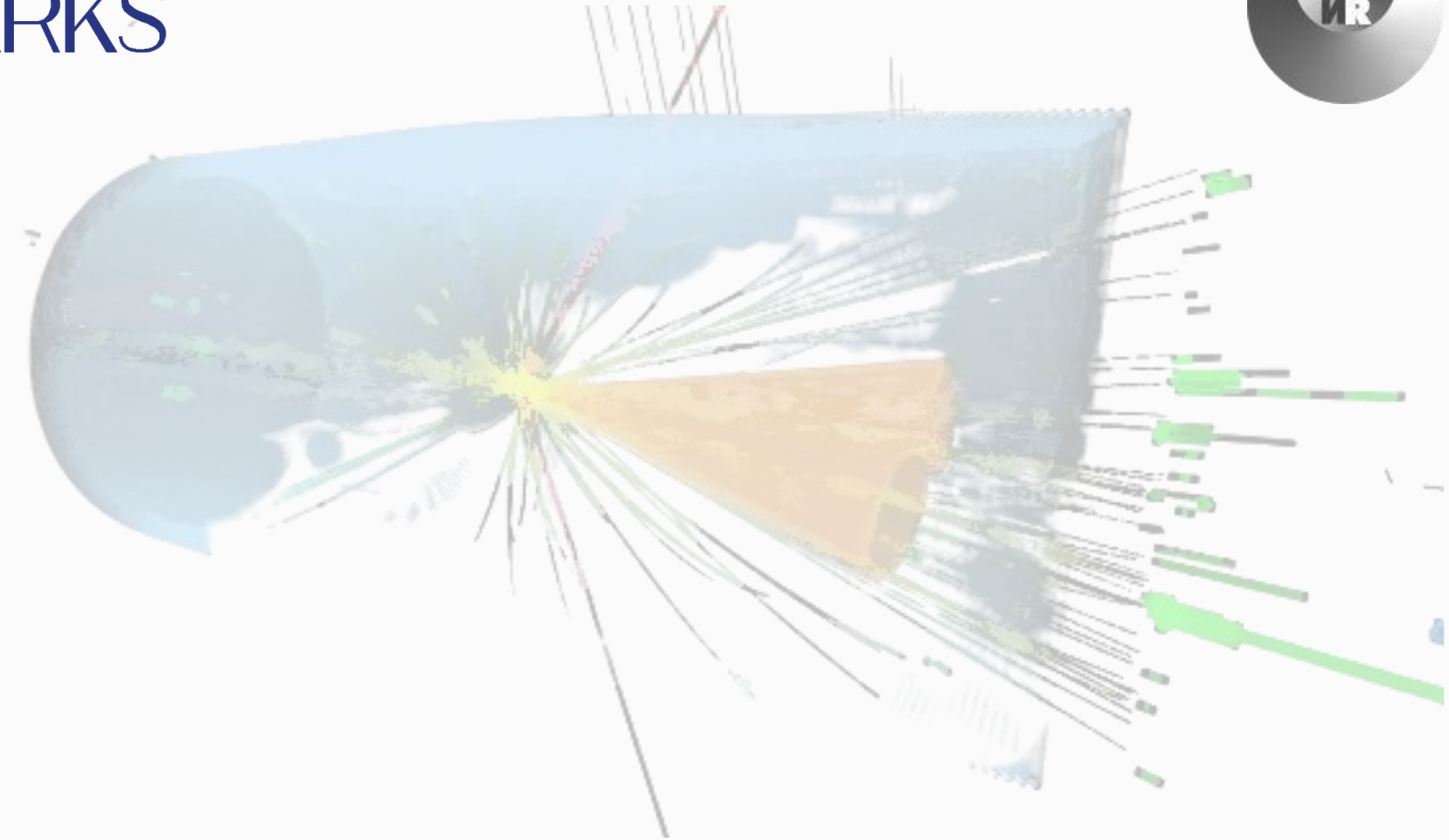
⇩

Less sgoldstino in the detector. Only light η-mesons and direct production contribute

⇩

$$m_S < 0.35\ GeV$$
$$\sqrt{F} < 500\ TeV$$

SGOLDSTINO AT FASER



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This work is supported by
RSF grant № 21-12-00379