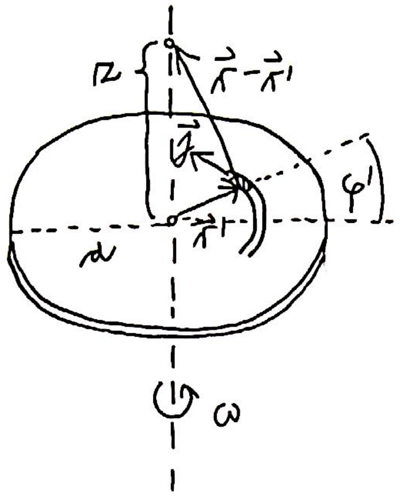
3 MAGNETNO POLJE NABITE VRTEČE SE OKROGLE PLOŠČE

$$\vec{B}(\vec{r}) = \frac{\mu_0}{4\pi} \int \frac{\vec{j}(\vec{r}\,') \times (\vec{r} - \vec{r}\,')}{|\vec{r} - \vec{r}\,'|^3}\, d^3\vec{r}\,'$$



[rešimo nalogo na bolj FORMALEN način, kakor smo rešili tudi nalogo s krožno tokovno zanko

$$\vec{j}(\vec{r}\,') = j \begin{bmatrix} -\sin\varphi' \\ \cos\varphi' \\ 0 \end{bmatrix}$$

$$|\vec{r} - \vec{r}\,'| = \sqrt{r'^2 + z^2} \quad \Leftarrow \quad \vec{r} = \begin{bmatrix} 0 \\ 0 \\ z \end{bmatrix}, \quad \vec{r}\,' = \begin{bmatrix} r'\cos\varphi' \\ r'\sin\varphi' \\ 0 \end{bmatrix} \Rightarrow \vec{r} - \vec{r}\,' = \begin{bmatrix} -r'\cos\varphi' \\ -r'\sin\varphi' \\ z \end{bmatrix}$$

$$\vec{j}(\vec{r}\,') \times (\vec{r} - \vec{r}\,') = j \begin{bmatrix} -\sin\varphi' \\ \cos\varphi' \\ 0 \end{bmatrix} \times \begin{bmatrix} -r'\cos\varphi' \\ -r'\sin\varphi' \\ z \end{bmatrix} = j \begin{bmatrix} z\cos\varphi' \\ z\sin\varphi' \\ r'\underbrace{(\sin^2\varphi' + \cos^2\varphi')}_{1} \end{bmatrix}$$

$$\vec{B}(\vec{r}) = \frac{\mu_0}{4\pi} \int \frac{1}{(r'^2 + z^2)^{\frac{3}{2}}} \begin{bmatrix} z\cos\varphi' \\ z\sin\varphi' \\ r' \end{bmatrix} \underbrace{j\, d^3\vec{r}\,'}$$

$$\underbrace{j\, dS'}_{dI}\, dl' = \underbrace{dI}_{\sigma\omega r' dr'} \cdot r' d\varphi' = \sigma\omega r'^2 dr' d\varphi'$$

$$\vec{B}(\vec{r}) = \frac{\mu_0 \sigma\omega}{4\pi} \int \frac{r'^2}{(r'^2 + z^2)^{\frac{3}{2}}} \begin{bmatrix} z\cos\varphi' \\ z\sin\varphi' \\ r' \end{bmatrix} d\varphi'\, dr'$$

→ prvi dve komponenti integrala dasta NIČ, pri zadnji je $\int_0^{2\pi} d\varphi' = 2\pi$

$$B_z(\vec{r}) = \frac{\mu_0 \sigma\omega}{4\pi} \int \frac{r'^2}{(r'^2 + z^2)^{\frac{3}{2}}}\, r' \quad 2\pi \quad dr'$$

$$B_z(\vec{r}) = \frac{\mu_0 \sigma\omega}{2} \int \frac{r'^3\, dr'}{(r'^2 + z^2)^{\frac{3}{2}}}$$

→ enak integral, kot smo ga dobili na bolj geometrijski način!