- **Def. 3.17:** Edge FE = Nédélec FE
  The lowest order tetrahedral edge (Nédélec) FE is given by
  - a tetrahedron T
  - the local FE space $\mathcal{N}_0 := \{ v = a + b \times x : a, b \in \mathbb{R}^3 \}$
  - the functionals

$$\psi_{E_{\alpha\beta}} : v \longmapsto \int_{E_{\alpha\beta}} v \cdot t \, ds$$

  associated with the 6 edges $E_{\alpha\beta}$ of the tetrahedron T.

- **Properties 3.18:** of the edge FE-space
  1. As in 2D, the nodal basis function $\varphi_{\alpha\beta}$ associated with the edge $E_{\alpha\beta}$ is given by

(17) $$\varphi_{\alpha\beta} = \lambda_\alpha \nabla \lambda_\beta - \lambda_\beta \nabla \lambda_\alpha .$$

  2. The tangential trace of all $v \in \mathcal{N}_0$ onto a face F of ∂T exactly gives the 2D Nédélec triangle.
  3. $V_h := \{ v \in L_2(\Omega)^3 : v|_T \in \mathcal{N}_0 \wedge (\psi_{E_{\alpha\beta}} \equiv \psi_{\tilde{E}_{\tilde{\alpha}\tilde{\beta}}}$
     $\Rightarrow \psi_{E_{\alpha\beta}}(v|_T) = \psi_{\tilde{E}_{\tilde{\alpha}\tilde{\beta}}}(v|_{\tilde{T}})) \} \subset H(\mathrm{curl})$
  4. $\forall v_h \in V_h$: $\mathrm{curl}\, v_h$ is piecewise constant!
  5. $\mathrm{curl}\, V_h \subset H(\mathrm{div})$, i.e.
     $\forall v_h \in V_h$; the normal component of $\mathrm{curl}\, v_h$ is continuous across the faces!
  6. Interpolation error estimates:

(18) $$\| u - I_h^E u \|_{H(\mathrm{curl})} \le c h \left(|u|^2_{H^1} + |\mathrm{curl}\, u|^2_{H^1} \right)^{1/2} \le c h \, \| u \|_{H^1(\mathrm{curl})}$$

$$\| u - I_h^E u \|_{H(\mathrm{curl})} \le c h^s \, \| u \|_{H^s(\mathrm{curl})} , \quad s \in (0,1].$$